FURUNO

OPERATOR'S MANUAL

MARINE RADAR

MODEL FR-2100 Series

FR-2110/2120
FR-2120W/2150W
FR-2130SW/2160SW
FR-2130S
FR-2150
FR-2160DS

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·Your Local Agent/Dealer

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FR-2100 SERIES

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IMPORTANT SAFETY INFORMATION

Danger!—Electrical Shock Hazard

This equipment contains high voltages which can endanger human life at several internal circuits including a cathode ray tube (CRT) which uses several thousands volts. These voltages are sufficient to kill anyone coming in direct contact with them.

While the equipment has been designed with utmost safety considerations, precautions must always be exercised when reaching inside the equipment for the purpose of maintenance or service. For this reason, any internal adjustment, servicing and repair shall only be performed by qualified service personnel totally familiar with electrical circuits and servicing of the equipment. A residual charge remains in capacitors and other devices several minutes after turning off the power. It is therefore essential to wait at least 3 minutes to allow residual charge to subside before beginning any maintenance or service work.

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 W/m^2 and 10 W/m^2 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 nearest 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-2110 (X-band, 10 kW)	XN2 (4')	Worst case 0.25 m *	Worst case 2.3 m *	11.0 W/m^2
	XN3 (6.5')			9.6 W/m^2
	XN3A (6.5')			9.6 W/m^2
	XN4A(8')			6.7 W/m^2
FR-2120/2120W (X-band, 25 kW)	XN2* (4')	Worst case 3.25 m *	Worst case 0.6 m *	29.0 W/m^2
	XN3* (6.5')			23.8 W/m^2
	XN3A (6.5')			23.8 W/m^2
	XN4A(8')			20.6 W/m^2
FR-2150/2150W (X-band, 50 kW)	XN3A (6.5')			
	XN4A(8')			
	XN5A** (10')			
FR-2130S/2130SW (S-band, 30 kW)	SN5AF (9')	Nil	1.06 m	20 W/m^2
	SN7AF(12)	Nil	0.5 m	16 W/m^2
FR-2160SW (S-band, 60 kW)	SN5AF (9')		1 m	40 W/m^2
	SN7AF(12)		0.9 m	32 W/m^2
FR-2160DS (S-band, 60 kW)	SN4A	Nil	1.2 m	46.8 W/m^2
	SN5A(10)	Nil	1 m	40 W/m^2

*UK DRA measured with narda 8616. Other values by FURUNO.
**XN2 and XN3 not applicable to FR-2120W; XN5A not applicable to FR-2150W.

IMPORTANT SAFETY INFORMATION

Danger!—Before Turning On the Radar

Before turning on the radar, make sure that there is no person in close proximity to the antenna unit. Serious injury or even death may result if a rotating antenna strikes any person standing nearby.

Danger!—When Working on the Antenna Unit

Wear a safety belt and a hard hat when working on the antenna unit. Always make sure that the radar is POWERED OFF and the Antenna Switch in the display unit is OFF before working on the antenna unit. Also take all steps to ensure that the radar will not be accidentally operated by someone else to prevent the potential risk of being struck by the rotating antenna and exposure to RF radiation hazards.

Caution!—X-Radiation

No part of the equipment generates X-radiation in excess of 0.5 millirem/h at a distance of 5 cm.

Safety Notice to Navigator

When properly used, the radar will provide valuable information for safe navigation. However, no single navigational aid should ever be relied upon exclusively for the safety of crew members and vessel. The navigator is responsible for checking all aids available to confirm his position and surrounding situations to avoid potential dangers. Electronic aids, including the radar equipment, are not a substitute for basic navigational principles and common sense. The navigator is also responsible for the compliance with statutory requirements for the operation of vessels whether or not a radar is in use.

SART (Search and Rescue Radar Transponder)

General

The 1974 SOLAS as amended in 1988 (GMDSS) requires at least one set of Search and Rescue Radar Transponder (SART) to be provided on vessels of 300 GT and above but less than 500 GT, two sets on vessels of 500 GT and upwards. SART performance standard is specified in IMO Resolution A.697 (XVII).

SART Activating Conditions

The SART should operate correctly when interrogated at a distance of 5 nm by an X-band navigational radar complying with IMO Resolutions A.477(XII) and A.422(VII), with an antenna height of 15 m. It should also operate correctly when interrogated at a distance of up to 30 nm by an airborne radar with at least 10 kW peak output power at a height of 3,000 feet.

How SART Works?

Upon receiving a radar signal from a rescue party, the SART automatically transmits a series of pulses at frequencies between 9200 MHz (+0/-60 MHz) and 9500 MHz (-0/+60 MHz). The radar will display 12 SART marks during one sweep cycle on the screen as shown in the figure below.

Length of SART Marks

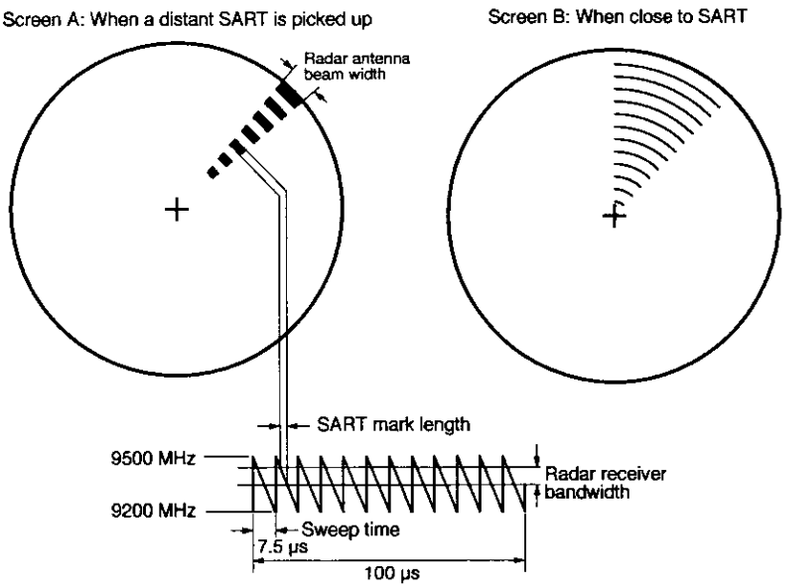
The radial length of each SART mark depends on the radar receiver bandwidth and sensitivity. For a bandwidth of 12 MHz, the length is approximately 45 m and for a bandwidth of 3 MHz (usually on 6 nm or larger range scale), approximately 12 m.

Showing SART Marks on the Radar Display

To show SART marks only on the radar display, detune the radar receiver by turning the TUNE control out of its best tuning point. This erases or weakens all normal radar echoes, but the SART marks are not erased because the SART response signal is swept over all frequencies in the 9 GHz band. When the radar approaches a SART in operation, the SART marks will become large arcs, blurring a large part of the screen. Reduce the sensitivity and adjust the sea clutter control of the radar.

For Sure Detection of SART Responses

- Select the 6 or 12 nm range scale to properly distinguish SART responses. This is because the spacing between SART marks is about 0.6 nm (1125 m).
- Turn off the automatic clutter suppression facility.
- Turn off the Interference Rejector.
- Turn off the Echo Average feature.



SART (Search and Rescue Radar Transponder)

General Remarks on Receiving SART Responses

1 Radar Range Scale

When looking for a SART, it is preferable to use a range scale between **6 and 12 nautical miles**. This is because the spacing between the SART responses is about 0.6 nautical miles (1125 m) and it is necessary to see a number of responses to distinguish the SART from other responses.

2 SART Range Errors

There are inherent delays in the SART responses as the SART has a trigger delay and may also have to sweep through the whole radar band before reaching the frequency of the search radar. At medium ranges of about 6 nautical miles the range delay may be between about 150 meters and 0.6 nautical mile beyond the SART position.

As the SART is approached the radar will normally detect the initial fast sweep of the SART so that the double dots will appear. The range delay of the first dot should be no more than 150 meters beyond the SART position.

3 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. The Radar Operating Manual should be consulted about the particular radar parameters and bandwidth selection.

4 Radar Side Lobes

As the SART is approached, side lobes 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 side lobes as these will confirm that the SART is near to the ship.

5 Detuning the Radar

To increase the visibility of the SART in clutter conditions, the radar may be detuned to reduce the clutter without reducing the SART response. Radar with automatic frequency control may not permit manual detune of the equipment. Care should be taken in operating the radar detuned as other wanted navigational and anti-collision information may be removed. The tuning should be returned to normal operation as soon as possible.

6 Gain

For maximum range SART detection the normal maximum gain should be used.

7 Anti-clutter Sea Control

For optimum range SART detection, this control should be set to the minimum. Care should be exercised as target in sea clutter may be obscured.

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

8 Anti-clutter Rain Control

This should not be used when trying to detect SARTs as the SART responses may be removed by this control.

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

Note: The information on this page was produced by CIRM, reviewed at NAV 39 and circulated as ANNEX 8 NAV 39/WP.2/Add.1.

TABLE OF CONTENTS

INTRODUCTION

A Word to the Owner of FURUNO Radar

Thank you for purchasing the 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 over 40 years, Furuno Electric Company has gained an enviable reputation as a world leader in the industry. This is the result of our technical excellence as well as our worldwide distribution and service network.

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

The FR-2100 Series

The FURUNO FR-2100 Series of radars has been designed to meet the exacting requirements of international and national standards and regulations including:

- IMO Resolution A.477 (XII): Performance Standards for Radar Equipment
- IEC 936: Shipborne Radar Operational and Performance Requirements
- IEC 945: Marine Navigational Equipment General Requirements

There is a choice of several models as shown below in the FR-2100 Series to suite your particular navigational needs and different types of vessels.

Model	Basic Spec.
FR-2110	X-band, 10 kW, TR-up
FR-2120	X-band, 25 kW, TR-up
FR-2120W	X-band, 25 kW, TR-down
FR-2150	X-band, 50 kW, TR-up
FR-2150W	X-band, 50 kW, TR-down
FR-2130S	S-band, 30 kW, TR-up
FR-2130SW	S-band, 30 kW, TR-down
FR-2160SW	S-band, 60 kW, TR-down
FR-2160DS	S-band, 60 kW, TR-up

Besides the choice of the above models, the FR-2100 Series is available in the following three types: **Regular type** (abbreviated to R-type), **N-type** and **German type** (abbreviated to G-type). This is because different national authorities have slightly different operational requirements on marine radars. The G-type is a German-approved version for installation as a primary radar on vessels below 10,000 GT and as a secondary radar for vessels of 10,000 GT and upwards. The N-type is suited for the same classes of vessels registered in the Netherlands, the United Kingdom and most other European countries. The R-type can be installed on vessels of all other flags (except for Japanese flag vessels which require a Japanese version). A comparison of operational features of the different types of radars is given on the next page.

Notes: *1) Refer to the Specifications section for detailed information on the differences among the above models.*
2) If you are not certain which type of the FR-2100 Series should be installed on your ship, or if you need to convert the type of your radar due to transfer of the ship's flag, for example, consult your nearest FURUNO representative or dealer.

About This Manual

This manual is designed to provide information on operation and maintenance of the FR-2100 series of radars as well as fault diagnosis and troubleshooting procedures that may be performed by suitably qualified personnel on board.

In producing this manual, we tried to provide as "user-friendly" an operation guide as possible to the many functions of this sophisticated equipment. We would appreciate feedback from you about this manual. Your comments and suggestions would be valuable inputs for future improvement.

Categories of FR-2100 Series Radars: R-type, N-type and G-type

	R-type	N-type	G-type	Ref. Paragraph
Range Scales (all models)	0.125, 0.25, 0.5, 0.75, 1.5, 3, 6, 12, 16, 24, 32, 48, 96 nm (13 steps)	0.125, 0.25, 0.5, 0.75, 1.5, 3, 6, 12, 24, 48, 96 nm (11 steps)		1.8
Guard Alarm Zone	Inward or outward guard alarm selectable. Outer and inner limits can be set at any distance from own ship.	Inward guard alarm only. Outer and inner limits can be set at any distance from own ship.	Inward guard alarm only. Radial width fixed to 0.5 nm with both outer and inner limits settable between 3 and 6 nm.	1.18
Off-centering	Up to 100% of range in use in any direction	75% of range in use to any direction		1.19
Anchor Watch	Available in either standby or transmit status	Available in standby status only		1.25
Own Ship Mark	Displayed when Anchor Watch is activated. (Entry of ship data required)	Unavailable		1.25
x2 Zoom	Available	Unavailable	Unavailable	1.27
Stern Marker	Available	Unavailable	Unavailable	1.28
Navigation Data Display	Own ship position, cursor position, waypoint data, wind data, water current data, depth data, water temperature, rudder angle, rate of turn and navigation lane (with optional Video Plotter RP-23) provided that appropriate inputs are available	Own ship position, cursor position and waypoint data provided that appropriate inputs are available.		1.33
Auto Plotter History Mark (ARP-23)	Past positions of tracked targets are marked by dots or line segments, whichever is selected on AUTO PLOT 2 menu. Up to 200 past position as selected.	Up to 200 positions as selected.	5 or 10 positions as selected.	2.1.10

SPECIFICATIONS

ANTENNA RADIATOR

1. Type: Slotted waveguide array
2. Length: 4 ft (XN2), 6.5 ft (XN3, XN3A), 8 ft (XN4A), 10 ft (XN5A), 9 ft (SN5AF), 12 ft (SN7AF)
3. Beamwidth: 1.8x25° (XN2), 1.23x20° (XN3, XN3A), 0.95x20° (XN4A), 0.75x20° (XN5A), 2.3x25° (SN5AF), 1.9x25° (SN7AF)
4. Rotation speed
   X-band: 24 rpm, 36 rpm(optional)
   S-band: 21 (50 Hz) or 25 (60 Hz)
5. Wind load: 100 knots relative wind

RF TRANSCEIVER

1. Frequency
   X-band: 9410 ± 30 MHz
   S-band: 3050 ± 30 MHz (S-band)
2. Output power
   FR-2110: 10 kW
   FR-2120/2120W: 25 kW
   FR-2150/2150W: 50 kW
   FR-2130S/2130SW: 30 kW
   FR-2160SW: 60 kW
   FR-2160DS: 60 kW
3. Pulselength and PRF
   X-band:

Range (nm)	PL (μs)	PRR (Hz)
0.125, 0.25	0.08	2200
0.5, 0.75	0.08/0.2	2200
1.5	Two from 0.08, 0.2, 0.4	2200/1000
3	Two from 0.2, 0.4, 0.7	2200/1000
6	Two from 0.4, 0.7, 1.2	1000/600
12, 24	0.7, 1.2	1000/600
48, 96	1.2	600 (500)

   S-band:

Range (nm)	PL (μs)	PRR (Hz)
0.125, 0.25, 0.5	0.08	2200
0.75, 1.5	0.08/0.3	2200
3	Two from 0.08, 0.3, 0.6	2200/1000
6	Two from 0.3, 0.6, 1.2	2200/1000
12, 24	0.6, 1.2	1000/600
48, 96	1.2	600 (500)*

   0.2 for 2150W/2150/2160SW/2160DS
   *( ) for 2160DS
4. Mixer and local oscillator:
   Microwave integrated circuit
5. I/F amplifier
   Logarithmic amplifier, IF 60 MHz
   Bandwidth: 27 MHz (0.08 μs), 4.5 MHz (0.2 μs)
   3 MHz (0.4/0.7/1.2 μs)
6. Duplexer: Ferrite circulator with limiter diode
7. Noise figure: 6 dB nominal

DISPLAY UNIT

1. Picture tube: 20" color CRT (rasterscan), 800 (H) x 1024 (V) pixels
2. Color
   R-type: Monochrome yellow or green with 16-level gradation or 3 colors depending on echo strengths
   N-type, G-type: Monochrome yellow or green with 16-level gradation
3. Presentation modes: Head-up, Head-up/True bearing*, Course-up*, North-up*, True motion**
   (*Gyro input required. **Log and gyro inputs required.)
4. Range scales and fixed range ring intervals (nm)
   0.125, 0.25, 0.5, 0.75, 1.5, 3, 6, 12, 24, 48, 96
   0.025, 0.05, 0.1, 0.25, 0.25, 0.5, 1, 2, 4, 8, 16
   (16 and 32 nm ranges are additionally available on the R-type.)
5. Minimum Range: 25 meters on 0.25 nm range
6. Range discrimination: Better than 25 meters on 0.75 nm range
7. Accuracy
   Range: 1% of range in use or 15 m, whichever is greater
   Bearing: Better than 1°
8. E-plot: 10 targets with ID symbols
   Target data: range/bearing from own ship, speed/course, CPA/TCPA
9. Echo trail interval: 30 sec, 1, 3, 6, 15 or 30 min, or continuous
10. Guard alarm: Targets entering guard zone trigger visual and audible alarms. (3-6 nm on G-type. Anywhere on R- and N-types)

ENVIRONMENTAL CONDITIONS

1. Ambient temperature (Complies with IEC 945)
   Display unit: -15 to +55°C
   Antenna unit: -25 to +70°C

COMPASS SAFE DISTANCE

	Standard	Steering
Display unit RDP-106 w/Control Unit:	1.5 m	0.8 m
Antenna unit C2P7N2N (X-band, 10kW):	1.5 m	0.8 m
Antenna unit C2P7N2N (X-band, 25kW):	4.1 m	2.5 m
Antenna unit RSB-0026 (S-band, 30kW):	4.3 m	2.6 m
Transformer RU-1803:	2.1 m	1.5 m
Rectifier RU-1746B:	2.1 m	1.5 m
Interswitch RJ-5:	1.3 m	0.8 m
Performance monitor PM-30 (X-band):	0.4 m	0.3 m
Performance monitor PM-50 (S-band):	1.3 m	0.8 m

POWER SUPPLY

1. FR-2110/2120
   - DC set: 24 to 32 VDC, 220 W (FR-2110), 250 W (FR-2120)
   - AC set: 115/230 VAC, 1ø, 250 VA
2. FR-2120W/2150/2150W
   - Display unit: 115 VAC, 1ø, 320 VA (FR-2120W), 400 VA (FR-2150/2150W)
   - Antenna unit: 115/230 VAC, 1ø, 150 VA
230 VAC, 3ø, 120 VA
380/440 VAC, 3ø, 120 VA (FR-2120W/2150W)
24 VDC, 30 W (FR-2150)
3. FR-2130S/2130SW
   - Display unit: 115/230 VAC, 1ø, 320 VA or 24 VDC, 200 W
   - Antenna unit: 230 VAC, 3ø, 50-60 Hz, 440 VA
380/440 VAC, 3ø, 50-60 Hz, 440 VA
4. FR-2160SW
   - Display unit: 115 VAC, 1ø, 400 VA
   - Antenna unit: 230 VAC, 3ø, 50-60 Hz, 440 VA
380/440 VAC, 3ø, 50-60 Hz, 440 VA
5. FR-2160DS
   - Display unit: 115 VAC, 1ø, 400 VA
   - Antenna unit: 24 VDC, 40W

EQUIPMENT LIST

Standard Supplies

1. Display unit
2. Antenna unit with 30 m antenna cable
3. Standard spare parts and installation materials

Optional Supplies

1. Display pedestal
2. Gyro interface GC-8 (built-in type)
3. Stepdown transformer for 440 VAC
4. Interswitch box RJ-8, 7 or 5
5. Performance monitor PM-30 (X-band)
6. Performance monitor PM-50 (S-band)
7. Auto plotter ARP-23
8. Video plotter RP-23
9. 36 rpm scanner motor

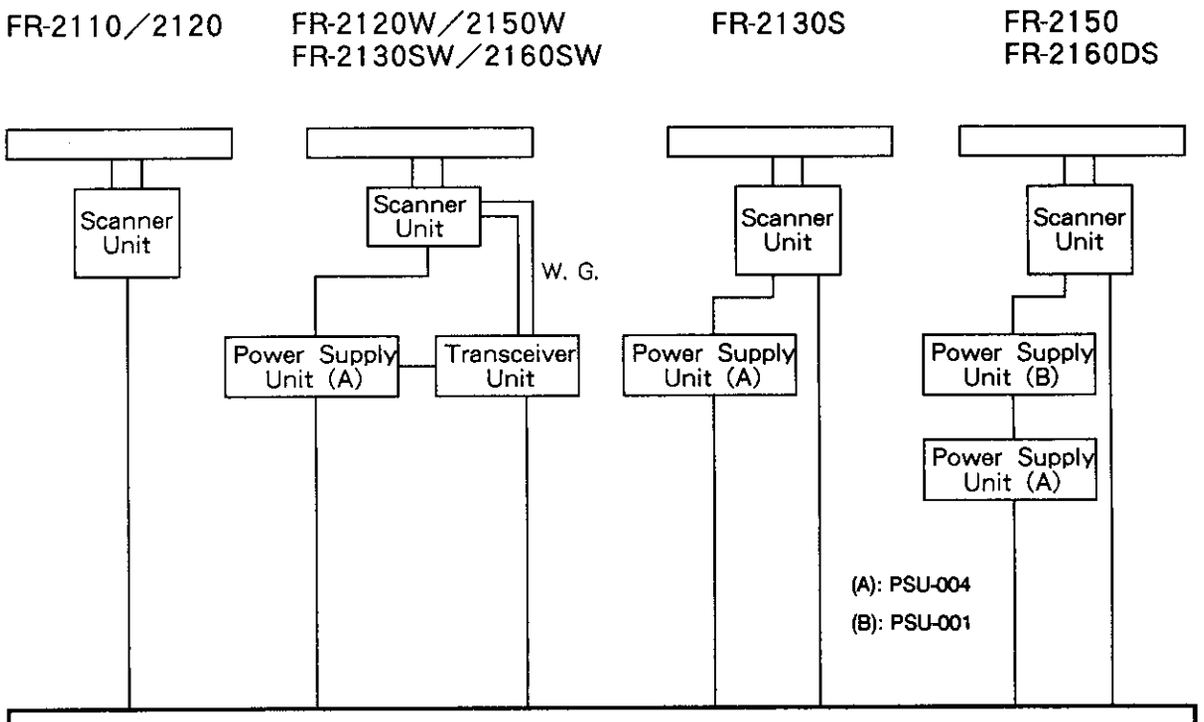
SPECIFICATIONS OF AUTO PLOTTER ARP-23

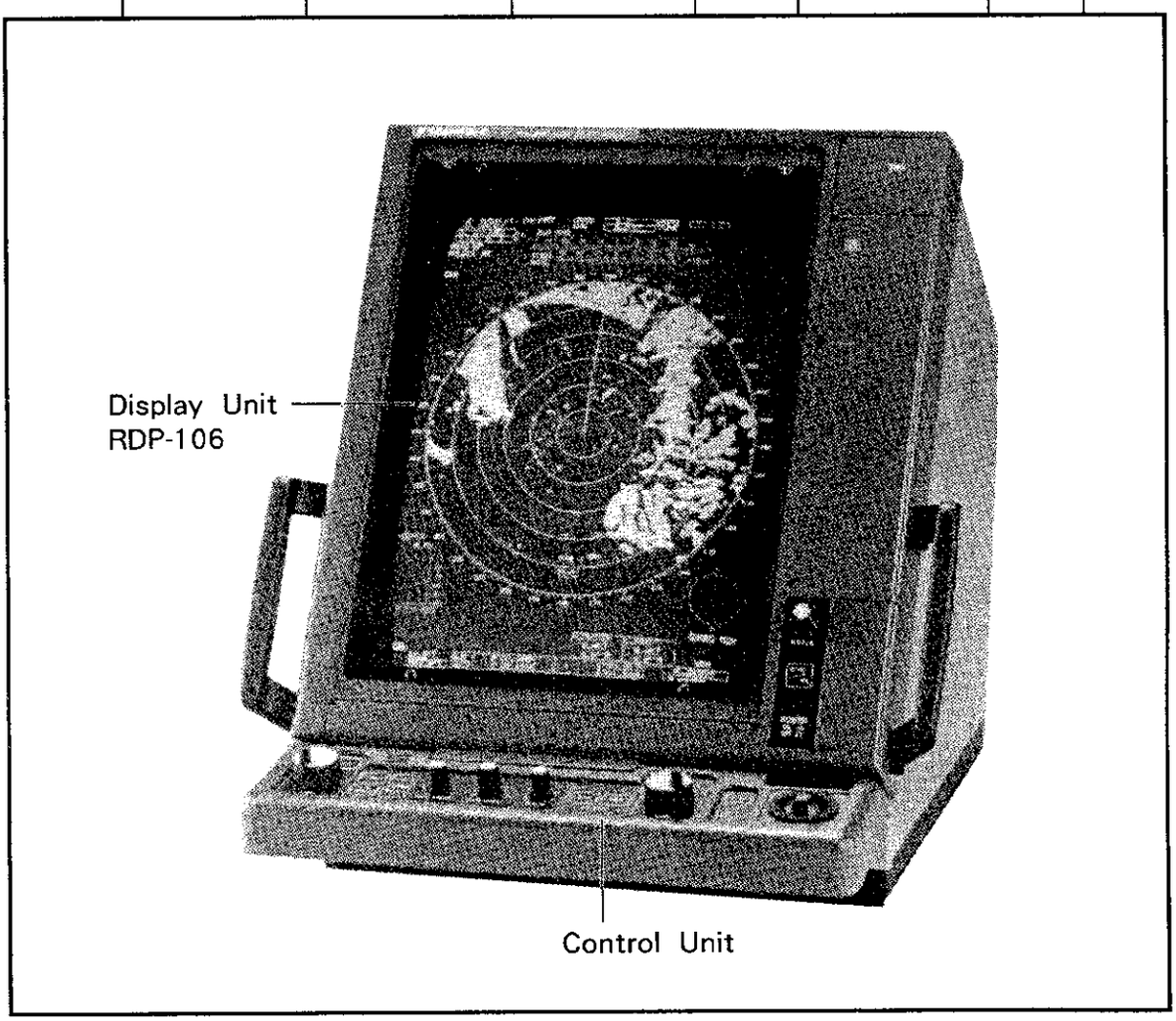
1. Target acquisition: Automatic acquisition of up to 20 targets plus manual acquisition of 10 additional targets or manual only acquisition of up to 30 targets.
2. Vector mode: True or relative vector of 30 sec, 1, 2, 3, 6, 12, 15 or 30 min. long
3. Past positions: Multiple past positions at intervals of 30 sec, 1, 2, 3 or 6 min.
4. Own ship speed: Automatic from speed log, manual key input or referenced to a fixed target (target-based speed)
5. Digital output: Trackball position in accordance with NMEA 0183

SPECIFICATIONS OF VIDEO PLOTTER RP-23

1. Plot: Combination of course plot and radar, or course plot only
2. Map area: 0.125 to 96 nm
3. Latitude limits: Between 85°N and 85°S
4. Plot interval: 10, 30 sec, 1, 5, 10, 30 or 60 min.
5. Built-in memory: 10,000 points for courseline and marks
6. IEC 1162 (NMEA 0183): $★★GLL, $★★WPL, $★★GTD, $★★MTW, $★★DBT (★★: any talker)

Configurations





CHAPTER 1 OPERATION

Danger!

Before turning on the radar, make sure that there is no person in close proximity to the antenna unit. Serious injury or even death may result if a rotating antenna strikes any person standing nearby.

1.1 Turning On the Power

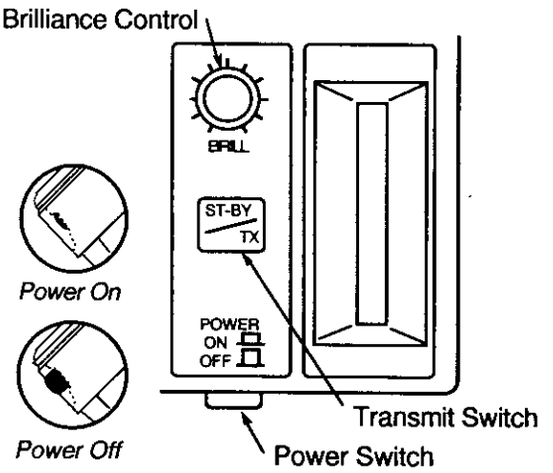
The POWER switch is located at the lower-right edge of the display. Push it to switch on the radar set. To turn off the radar, push it again; the switch will extend. The screen shows the bearing scale and digital timer approximately 15 seconds after power-on. The timer counts down 3 minutes of warm-up time. During this period the magnetron, or the transmitting tube, is warmed up for readiness for transmission. When the timer has reached 0:00, the legend STBY (standby) appears indicating that the radar is now ready to transmit.

In warm-up and standby conditions, you will see the message BRG SIG MISSING. This is normal because the bearing signal is not generated when the antenna is not rotating. ON TIME and TX TIME values shown at the screen bottom are time counts in hours and tenths of hour when the radar has been in POWER-ON and TRANSMIT status, respectively.

Quick Start

Provided that the magnetron was once in operation and is still warm, you can turn the radar into TRANSMIT status without waiting for the 3-minute warm-up time. If the Power Switch has been turned off by mistake and you wish to restart the radar promptly, follow the steps shown below to do so:

- Turn on the Power Switch not later than 5 seconds after power-off.
- Push the ST-BY Switch in the tuning compartment (inside the hinged cover at the upper-right corner of the display unit).
- Push the Transmit Switch labeled ST-BY/TX for TRANSMIT status.



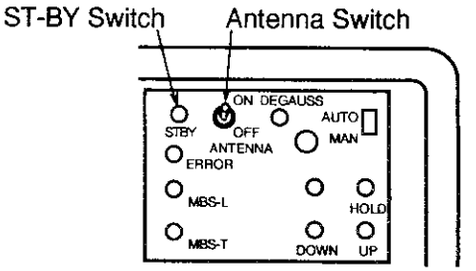
1.2 Transmitter ON

When the STANDBY status is displayed on the screen, press the Transmit Switch labeled ST-BY/TX at the lower-right corner of the display unit.

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

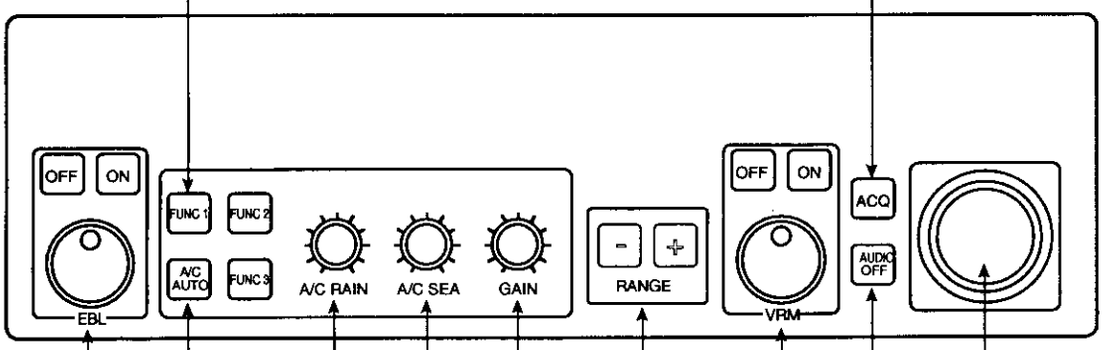
The Transmit Switch toggles the radar between STANDBY and TRANSMIT status in a moment. The antenna stops in STANDBY status and rotates in TRANSMIT status.

Notes: 1) If the antenna does not rotate in TRANSMIT status, check whether the Antenna Switch in the tuning compartment is in the OFF position.
2) 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.



Tuning Compartment

Operating Controls



Function Keys
#1 key: Setup 1
#2 key: Setup 2
#3 key: Setup 3

ACQuire Key
Press this key after selecting a target with Trackball. The target will be acquired in 30s.

A/C AUTO Key
Automatically reduces sea and rain clutter. Permits manual override by A/C SEA and A/C RAIN controls.

RANGE Keys
Select range scales.

TRACKBALL
Moves around cursor on radar screen.

GAIN Control
Adjusts receiver sensitivity.

AUDIO OFF
Silences audible alarm (except for guard alarm) and ARP-23 (optional) generated alarm.

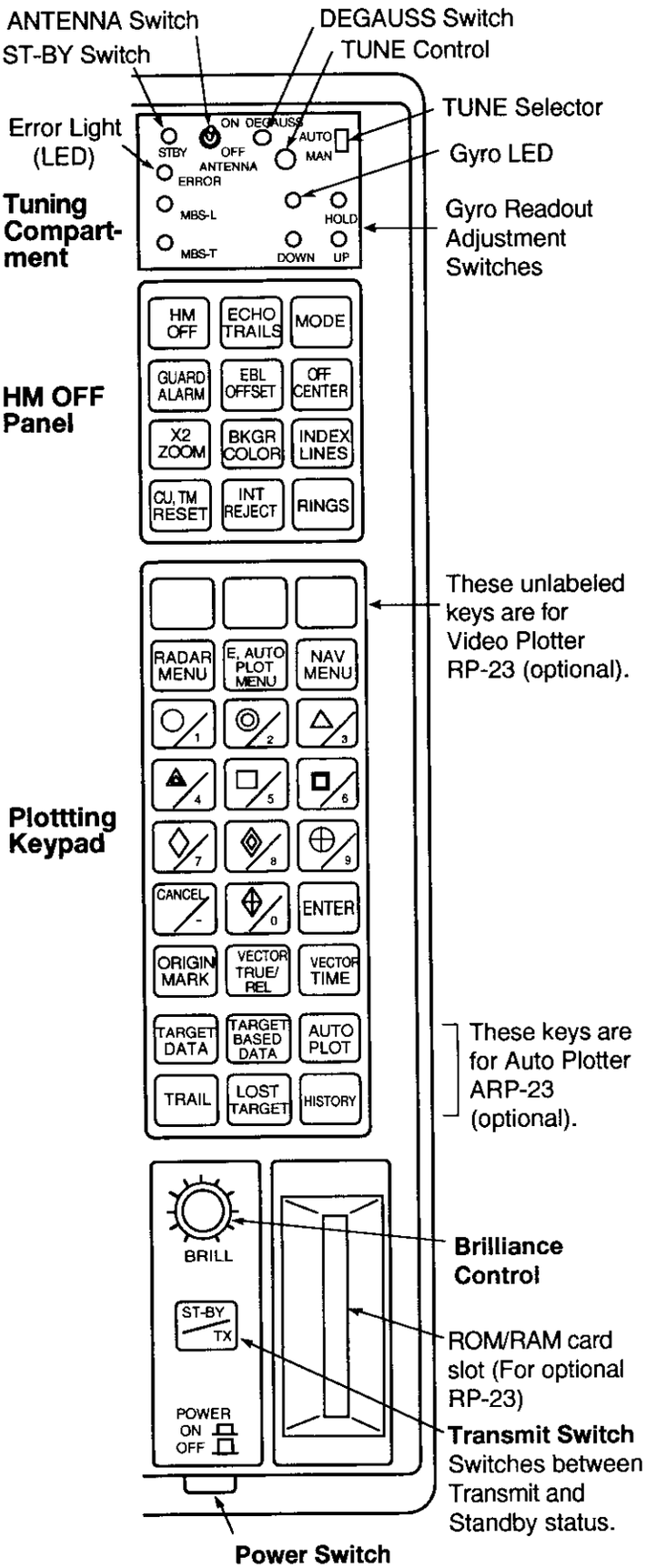
A/C SEA Control
Reduces sea clutter.

A/C RAIN Control
Reduces clutter from rain, snow and clouds.

VRM ON/OFF Keys and Rotary Control
Press ON key to activate Variable Range Marker (VRM). Turn rotary control clockwise to increase VRM diameter, counterclockwise to decrease it. Read range at lower-right corner of screen. There are two VRMs which are toggled by each press of ON key. Press OFF key to deactivate each VRM.

EBL ON/OFF Keys and Rotary Control
Press ON key to activate Electronic Bearing Line (EBL) and turn rotary control until EBL passes through a target of interest. Bearing is read at lower-left corner of screen. There are two EBLs which are toggled by each press of ON key. Press OFF key to deactivate each EBL.

Display Controls *(Hinged covers opened)*



Tuning Compartment

ANTENNA Switch: Turns on and off the antenna gearbox. Set to ON normally. Used for servicing only to stop antenna rotation.

TUNE Control: Tunes the receiver for maximum sensitivity with the Tune Selector set to the MAN (manual) position.

TUNE Selector: Selects automatic or manual tuning. Normally set this at AUTO position.

Gyro Readout Adjustment Switches: Used to align heading readout with the gyrocompass. See paragraph 1.6 for details.

DEGAUSS Switch: Press this switch to eliminate color contamination caused by magnetism.

ST-BY Switch: Enables Quick Start of the radar within 5 seconds of accidental power-off.

HM OFF Panel

HM OFF: Temporarily erases the heading marker.

ECHO TRAILS: Shows trails of target echoes in the form of simulated afterglow.

MODE: Selects presentation modes—Head-up, Head-up/TB, North-up, Course-up and True Motion.

GUARD ALARM: Used for setting a guard alarm.

EBL OFFSET: Displaces the EBL origin.

OFF CENTER: Activates and deactivates off-centering of the sweep origin.

BKGR COLOR: Selects a background color.

INDEX LINES: Alternately shows and erases parallel index lines.

×2 ZOOM: Enlarges a user-selected portion of picture twice as larger than normal. (R-type only)

CU, TM RESET: Resets the heading marker to 000° in Course-up mode; moves own ship position to 50% radius in stern direction in True Motion mode.

INT REJECT: Reduces mutual radar interference.

RINGS: Adjusts the brightness of range rings.

Plotting Keypad

RADAR MENU: Opens and closes RADAR menus.

E-PLOT, AUTO PLOT MENU: Opens and closes E-Plot and Auto Plot (optional) menus.

NAV MENU: Opens and closes NAV menu.

Keys 0-9: Selects plot symbols. Also used for entering numeric data.

CANCEL: Terminates plotting of a specified target or all tracked targets.

ENTER: Used to save settings on menu screens.

ORIGIN MARK: Shows and erases the origin mark (a reference point for range/bearing measurement).

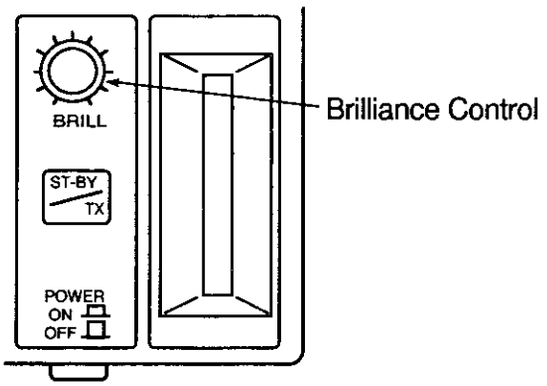
VECTOR TRUE/REL: Selects true or relative vectors.

VECTOR TIME: Sets vector length in time.

***Note:** For users frequently using the controls on the HM OFF panel and the plotting keypad, it is recommended to detach their hinged covers.*

1.3 CRT Brilliance

Operate the BRILL control at lower right corner of the display unit to adjust 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 menu to be explained later.

1.4 Tuning the Receiver

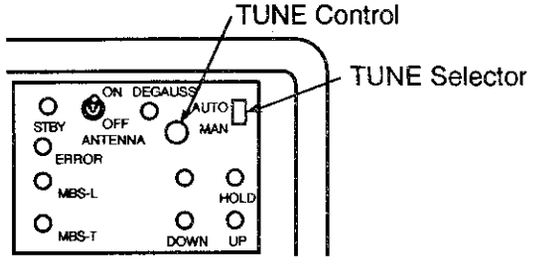
Auto Tune

The radar receiver is tuned automatically each time the power is turned on, thus there is no front panel control for tuning purpose. The tuning indicator and the label AUTO TUNE at the top of the screen show that the tuning circuit is working. If the label AUTO TUNE is not displayed, check that the Tune Selector in the tuning compartment to the AUTO position.

Manual Tune

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

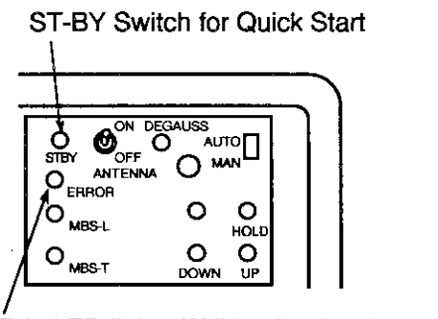
1. Set the Tune Selector in the tuning compartment to MAN for manual tuning.



Video Lockup Recovery

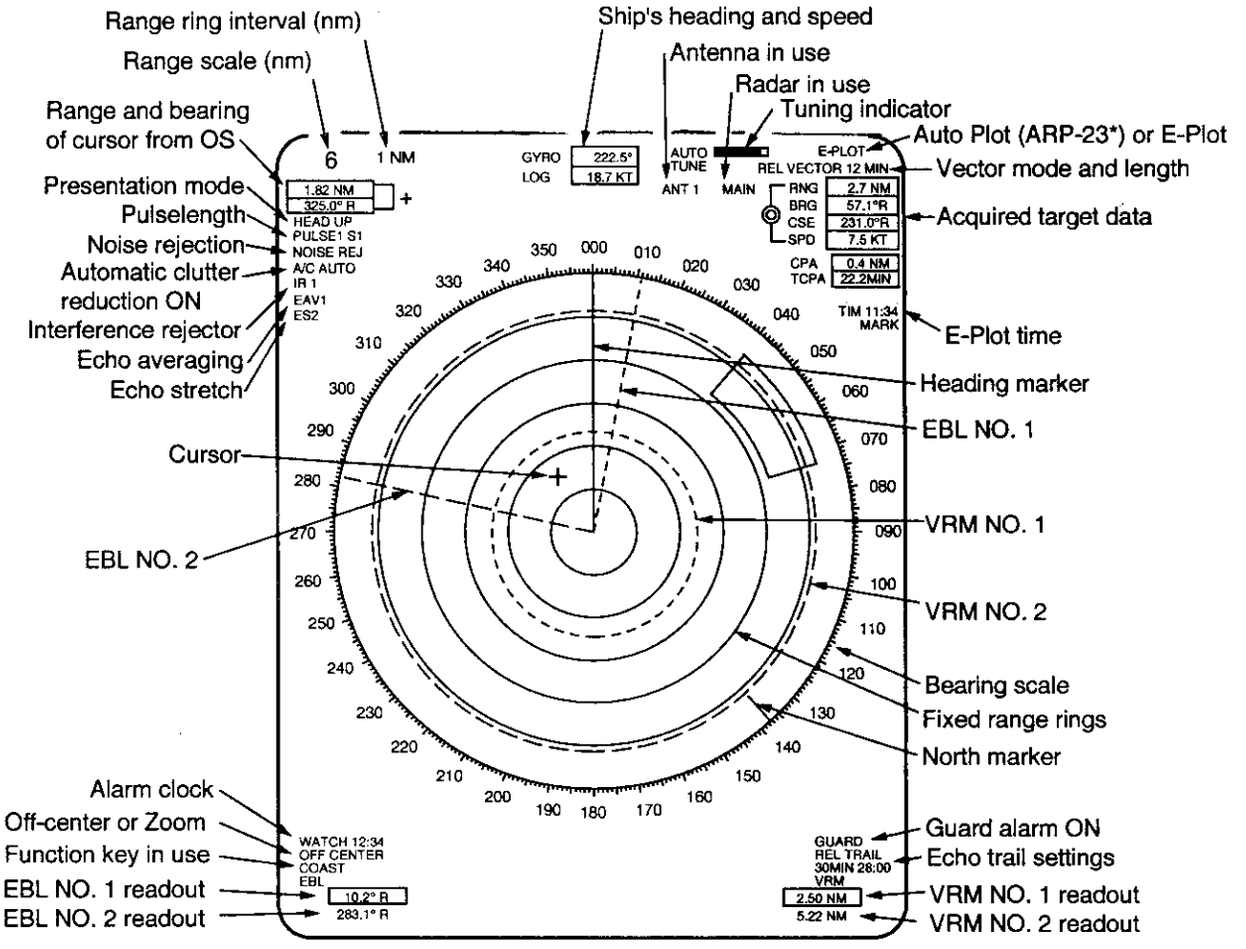
Video lockup, or picture freeze, can occur unexpectedly on digital rasterscan radars. This is mainly caused by heavy spike noise in the power line and can be noticed by carefully watching the nearly invisible sweep line. If you suspect that the picture is not updated every scan of the antenna or no key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

- Turn off the Power Switch and turn it on again within 5 seconds.
- Push the ST-BY Switch in the tuning compartment (inside the hinged cover at the upper-right corner of the display unit).
- Push the Transmit Switch labeled ST-BY/TX for TRANSMIT status.



2. Push the Tune Control so that it will pops up.
3. While observing the picture on the 48 mile scale, slowly adjust the Tune Control and find the best tuning point.
4. Set the Tune Selector to AUTO and wait for about 10 seconds or four scanner rotations.
5. 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.
6. Push the Tune Control into the retracted position.

On-Screen Legend and Markers

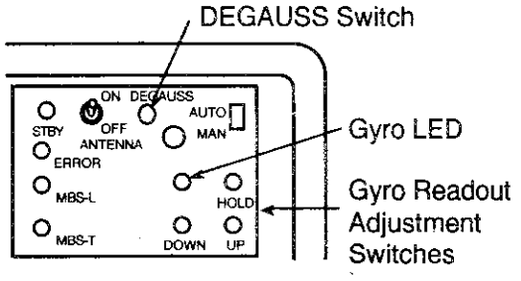


**Optional Auto Plotter ARP-23 is required for automatic target acquisition and tracking.*

1.5 Degaussing the CRT Screen

Each time the radar is turned on, a 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. When degaussed, the screen may be disturbed momentarily with vertical lines. If you wish to degauss by manual operation, open the tuning compartment at the upper-right section of the display unit and press the Degauss Switch.



1.6 Initializing the Gyro Readout

Provided that your radar is interfaced with a gyrocompass, ship's heading is displayed at the top of the screen. Upon turning on the radar, align the on-screen GYRO 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 GYRO readout goes wrong for some reason, repeat the procedure to correct it.

1. Open the tuning compartment and press the HOLD button. The Gyro LED lights.

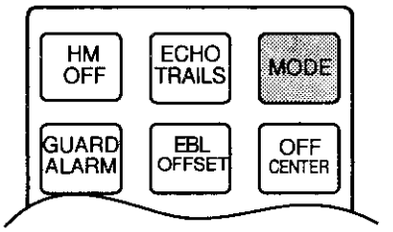
2. Press UP or DOWN button to duplicate the gyrocompass reading at the on-screen GYRO readout. Each press of these buttons changes the readout in 0.1-degree steps. To change the readout quickly, hold the UP or DOWN button down for over two seconds.

3. Press the HOLD button when the on-screen GYRO readout has matched the gyrocompass reading. The Gyro LED goes out.

Note: *The HOLD button is used to disengage the built-in gyro interface from the gyrocompass input in the event that you have difficulty in fine-adjusting the GYRO readout due to ship's yawing, for example. When initializing the GYRO readout at a berth (where the gyro-compass reading is usually stable), you may omit steps 1 and 3 above.*

Selecting Presentation Mode

Press the MODE key on the HM OFF panel at the right side of the display unit. Each time the MODE key is pressed, the presentation mode and mode indication at the upper-left corner of the screen change cyclically.



Note: *International Radar Performance Standards IMO 477(XII) require at least Head-up and TM presentation modes.*

1.7 Presentation Modes

This radar has the following presentation modes:

Relative Motion (RM)

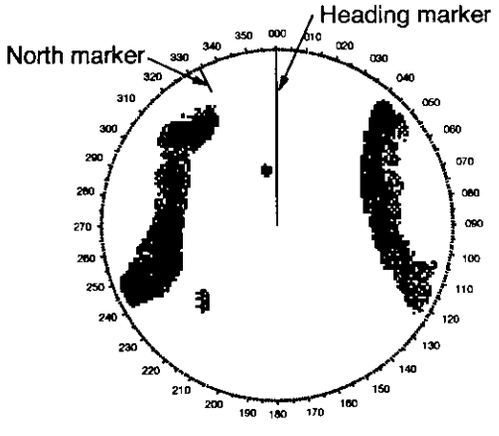
Head-up:	Unstabilized
Head-up/TB:	Head-up with compass-stabilized bearing scale (True Bearing)
Course-up:	Compass-stabilized relative to ship's intended course
North-up:	Compass-stabilized with reference to north

True Motion (TM)

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

LOSS OF GYRO SIGNAL

When the gyro signal is lost, the presentation mode automatically becomes Head-up and the GYRO readout at the screen top shows asterisks (***.*) and the message SET HEADING appears at the lower-left corner of the screen. The asterisks do not disappear even when the gyro signal is restored to warn the operator that the readout may be unreliable. When the gyro signal has been restored, press the MODE key to select another presentation mode (the asterisks are erased at this point). Then, align the GYRO readout with the gyrocompass reading and press the CANCEL key to erase the message SET HEADING.

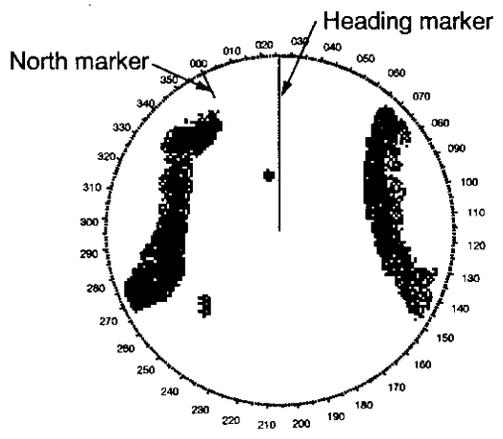


Head-up Mode

A display without azimuth stabilization in which the line connecting the center with the top of the display indicates own ship's heading.

Target pips are painted at their measured distances and in directions relative to own ship's heading.

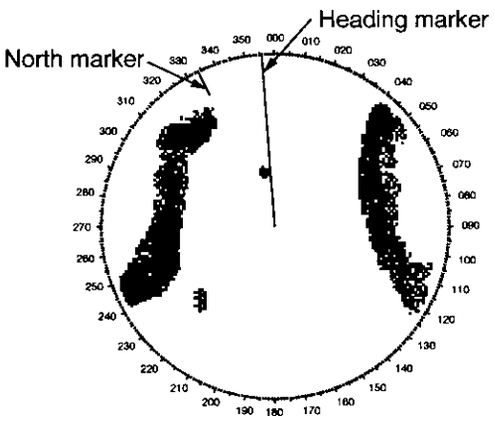
A short line on the bearing scale is the north marker indicating compass north. A failure of the gyro input will cause the north marker to disappear and the GYRO readout to show asterisks (***.*) and the message SET HEADING appears at the lower-left corner of the screen.



Head-up TB (True Bearing) Mode

Radar echoes are shown in the same way as in Head-up mode. The difference from normal Head-up presentation lies in the orientation of the bearing scale. The bearing scale is compass stabilized, that is, it rotates in accordance with the compass signal enabling you to know own ship's heading at a glance.

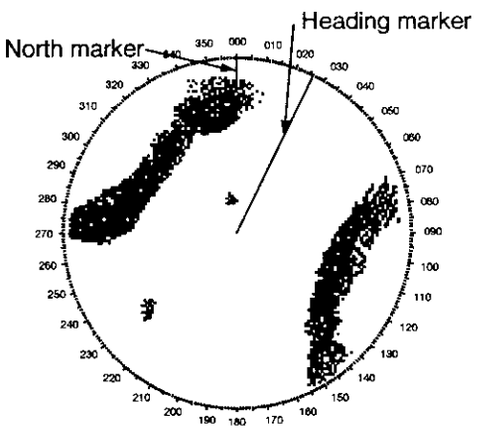
This mode is available only when the radar is interfaced with a gyrocompass.



Course-up Mode

An azimuth stabilized display in which the line connecting the center with the top of the display indicates own ship's *intended course* (i.e., own ship's previous heading just before this mode has been selected). 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 marker moves in accordance with the ship's yawing and course changes. This mode is useful to avoid smearing of picture during course changes. 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.

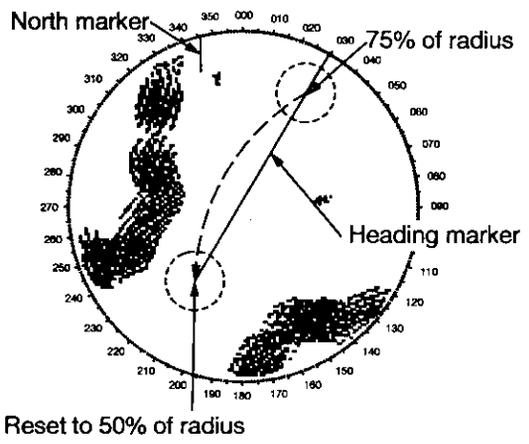
If the gyrocompass fails, the presentation mode changes to Head-up mode and the north marker disappears. Also, the GYRO readout at the screen top shows asterisks (***.*) and the message SET HEADING appears at the lower-left corner of the screen.

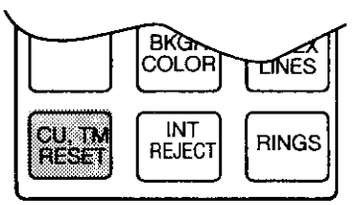


North-up Mode

In North-up mode, target pips are painted at their measured distances and in their true (compass) directions with reference to own ship, north being maintained at the top of the screen. The heading marker changes its direction according to the ship's heading.

If the gyrocompass fails, the presentation mode changes to Head-up mode and the north marker disappears. Also, the GYRO readout at the screen top shows asterisks (***.*) and the message SET HEADING appears at the lower-left corner of the screen.





True Motion Mode

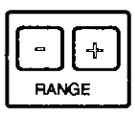
A display in which own ship and other moving objects move in accordance with their true courses and speeds. All fixed targets such as a landmass appear as stationary echoes.

When own ship reaches a point corresponding to 75% of the radius of the radar display, the sweep origin is automatically flipped (reset) to a point of 50% radius opposite to the extension of the heading marker passing through the display center.

Sweep origin resetting can be made at any moment before the ship reaches the point of 75% radius by pressing the [CU, TM RESET] key. Automatic resetting is preceded by a beep sound.

If the gyrocompass fails, the presentation mode changes to Head-up mode and the north marker disappears. Also, the GYRO readout at the screen top shows asterisks (***.*) and the message SET HEADING appears at the lower-left corner of the screen.

1.8 Selecting the Range Scale



The display range scale is changed in 13 steps on the R-type (11 steps on the N-type and G-type) by pressing the [+] and [-] keys. The selected range scale and range ring interval are shown at the upper-left corner of the screen.

The display range can be extended up to 100% (75% on the G-type) in any direction by using the off-centering feature.

1.9 Selecting the Pulsewidth

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

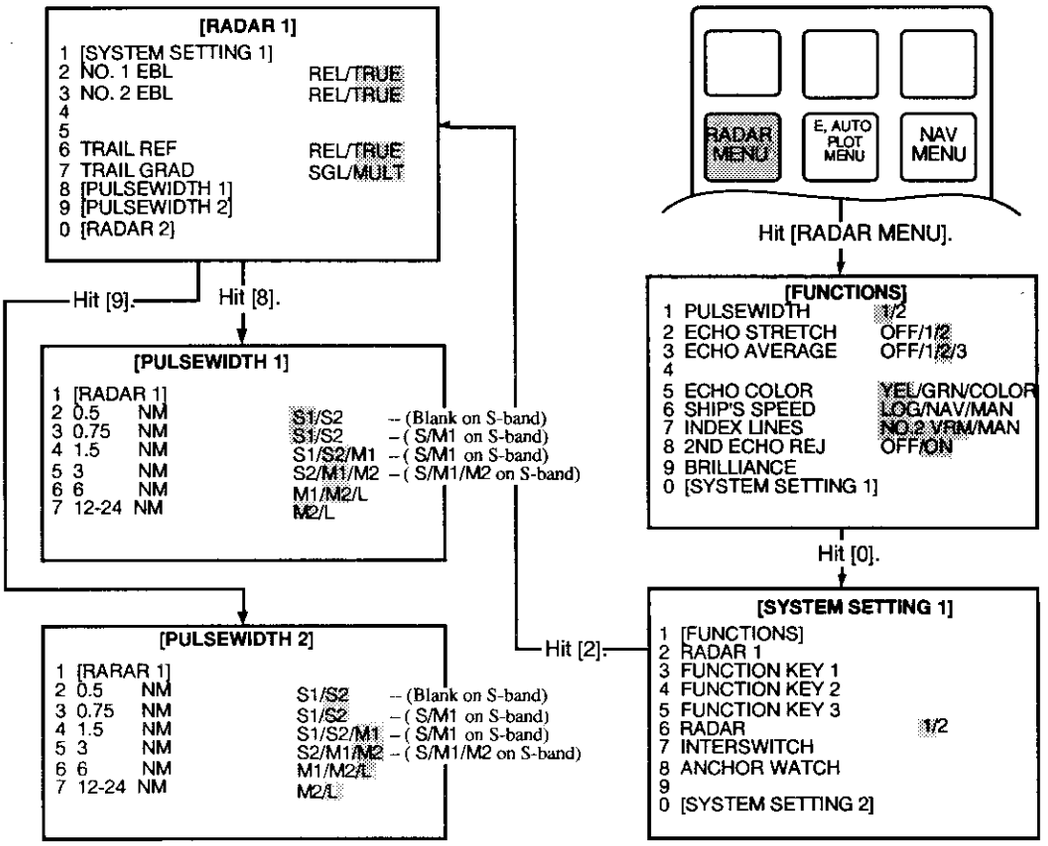
Appropriate pulsewidths are preset to the individual range scales and Function Keys. Therefore, you are not usually required to select them. If you are not satisfied with the current pulsewidth settings, however, it is possible to change them by Radar menu operation shown in the following.

You can choose Pulsewidth 1 or 2 on the 0.5 to 24 nm ranges on X-band models (0.75 to 24 nm ranges on S-band models).

Selecting Pulsewidth 1 or 2

1. Press the RADAR MENU key on the plotting keypad to show the FUNCTIONS menu.
2. Press numeric key [1] to select menu item 1 PULSELENGTH.
3. Press numeric key [1] to select (or highlight) PULSELENGTH 1 or 2 as appropriate.
4. Press the ENTER key to confirm your selection followed by the RADAR MENU key to close the FUNCTIONS menu.

Legend	Pulsewidth	
	X-band	S-band
S (Short pulse)	–	0.08 μs
S1 (Short pulse 1)	0.08 μs	–
S2 (Short pulse 2)	0.2 μs	–
M1 (Medium pulse 1)	0.4 μs	0.3 μs
M2 (Medium pulse 2)	0.7 μs	0.6 μs
L (Long pulse)	1.2 μs	1.2 μs



Example: To select S1 (0.08 μs) as short pulse 1 for the 0.5 nm range, call out the PULSEWIDTH 1 menu following the steps shown above and hit numeric key [2] to choose "2 0.5 NM". Further hit the [2] key until the menu option "S1" is highlighted to the right of "2 0.5 NM".

Note: *The above menus are for the R-type. Refer to paragraph 1.30 for the menus on the N-type and G-type.*

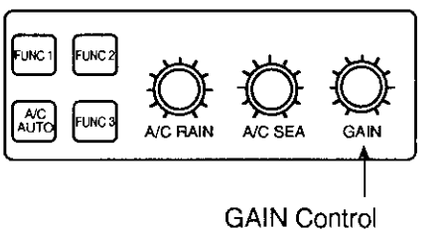
PULSEWIDTH 1 menu and M1 at 3 NM on the PULSEWIDTH 2 menu.

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

1.10 Adjusting the Sensitivity

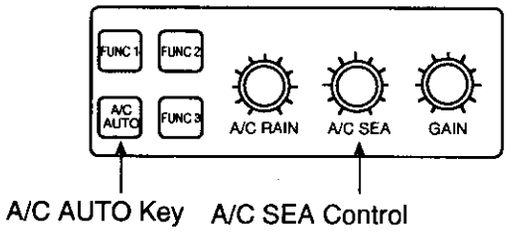
The GAIN control is used to adjust the sensitivity of the receiver, and thus the intensity of echoes as they appear on the screen. It should be adjusted so that speckled background noise is just visible on the screen.

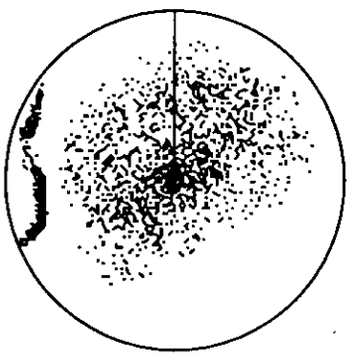
To become acquainted with the way the GAIN control works, try rotating it between fully counterclockwise and clockwise positions while observing the radar picture. You will notice that clockwise rotation increases the echo intensity level. A low gain setting results in a loss of weak echoes and a reduced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



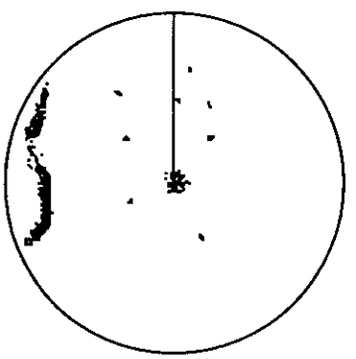
1.11 Suppressing Sea Clutter

In rough weather conditions returns from the sea surface are received over several miles around own ship and mask nearby targets. This situation can be improved by properly using the automatic anti-clutter function and/or A/C SEA (Anti-Clutter Sea) control.





(a) A/C SEA control OFF



(b) A/C SEA control properly adjusted

Automatic Anti-Clutter Control

The easiest way to suppress the surface clutter is to use the automatic anti-clutter function. Press the A/C AUTO key next to the EBL rotary control at the left corner of the operator control panel. Use of a Function key is also a good method for reducing sea clutter. For this purpose, presetting is required (ask for a service technician).

Manual Anti-Clutter Control

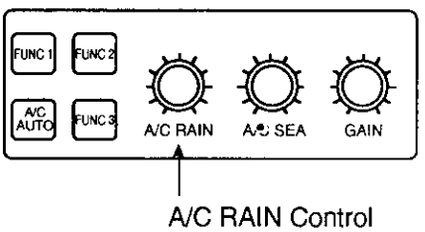
From the fully counterclockwise position, slowly turn the A/C SEA control clockwise. For optimum target detection, you should leave speckles of the surface return slightly visible.

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

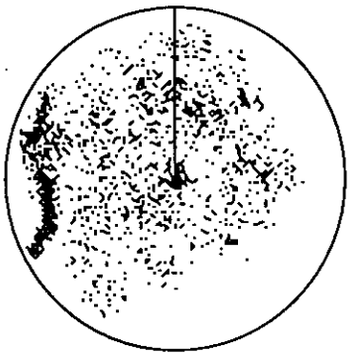
A common mistake is to over-adjust the A/C SEA control so that the surface clutter is completely removed. By rotating the control fully clockwise, you will see how dangerous this can be; a dark zone will be created near the center of the screen, causing a loss of close-in targets. This dark zone is even 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 a very calm water), set the control at the fully counterclockwise position.

1.12 Suppressing Precipitation Clutter

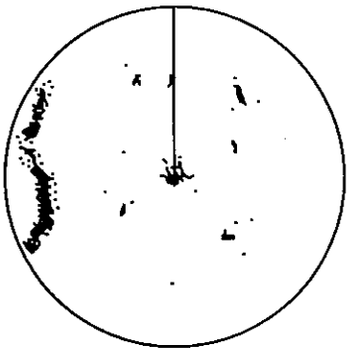
In adverse weather conditions, clouds, rain or snow produces a lot of spray-like spurious echoes and impairs target detection over a long distance. This situation can be improved by using a Function key provided that it is so programmed. If the Function key fails to effectively suppress rain clutter, use the A/C RAIN control on the operator control panel.



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.



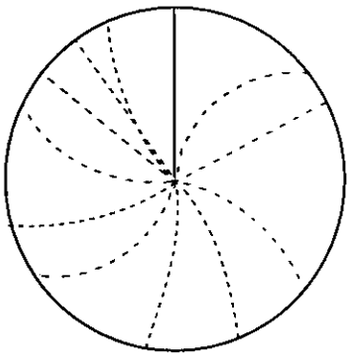
(a) A/C RAIN control OFF



(b) A/C RAIN control properly adjusted

1.13 Interference Rejector

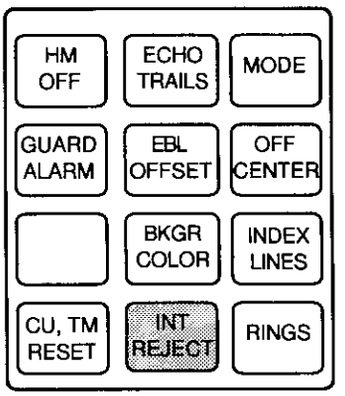
Mutual radar interference may occur in the vicinity of another shipborne radar operating in the same frequency band (9 GHz for X-band, 3 GHz for S-band). It is seen on the screen as a number of bright spikes either in irregular patterns or in the form of usually curved spoke-like dotted lines extending from the center to the edge of the picture. This type of interference can be reduced by activating the Interference Rejector circuit.



Mutual Radar Interference

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 position of the screen.

Press the [INT REJECT] key to activate the Interference Rejector circuit. 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.



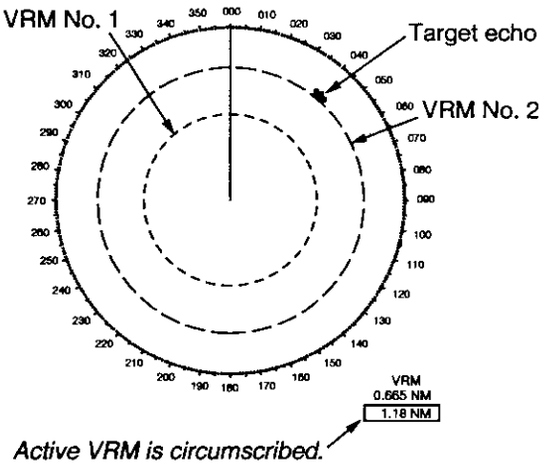
Note: *For stable reception of certain types of radar beacons (racons) or SART (Search and Rescue Transponder) as required by SOLAS 1974, it may be needed to turn off the Radar Interference Rejector.*

1.14 Measuring the Range

Use the fixed range rings to obtain a rough estimate of the range to a target. They are concentric solid circles around 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. Press the RINGS key on the HM OFF panel to show the fixed range rings if they are not displayed. Successive presses of the RINGS key gradually increase their brightness in 4 steps and a fifth press erases the range rings.

Use 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.

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 circumscribed by a rectangle.

Align the active VRM 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.

Press the VRM OFF key to erase each VRM.

1.15 Measuring the Bearing

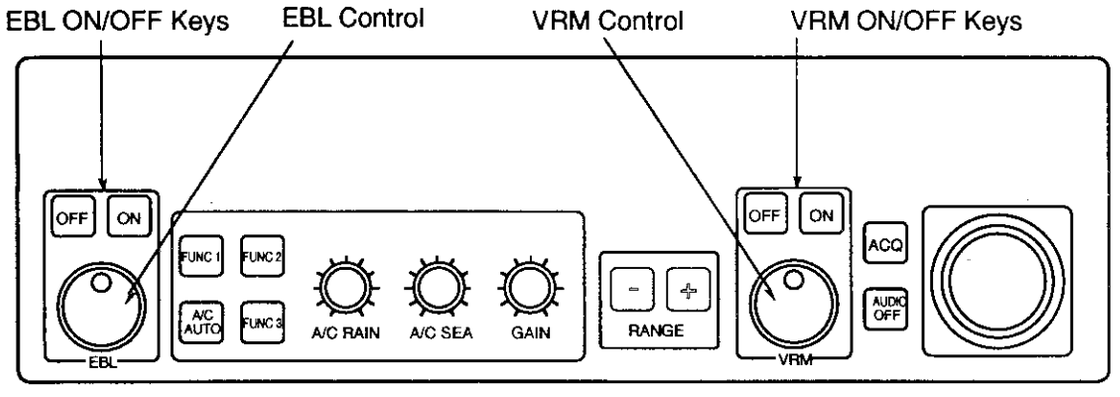
Use Electronic Bearing Lines (EBLs) to take bearings of a target. There are two EBLs, NO. 1 and NO. 2, which are toggled by successive presses of the EBL ON key. Each EBL is a straight dashed line extending out from the own ship position up to the circumference of the radar picture. The fine dashed line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

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 circumscribed by a rectangle.

Rotate the EBL rotary control clockwise or counterclockwise until the active EBL bisects the center of the target of interest, and read its bearing at the lower-left corner of the screen.

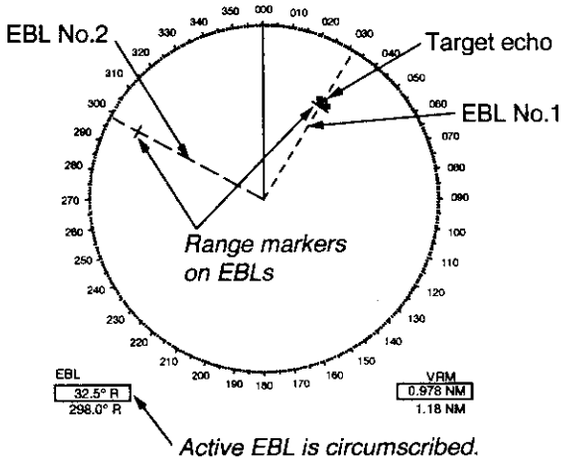
The EBL readout is affixed by "R" (relative) if it is relative to own ship's heading, "T" (true) if it



is referenced to the north, as determined by RADAR 1 menu settings.

Each EBL carries a range marker, or a short line crossing the EBL at right angles and 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.

Press the EBL OFF key to erase each EBL.



1.16 Collision Assessment Using Offset EBL

The origin of the EBL can be placed anywhere with the trackball to enable measurement of range and bearing between any targets. This function is also useful for assessment of the potential risk of collision. Proceed as follows to do this:

1. Press the EBL ON key to display or activate an EBL (NO. 1 or 2).

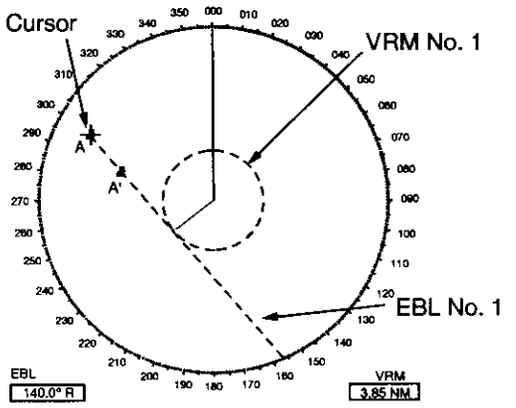
2. Place the cursor (+) on a target of interest (A in the illustrated example) by operating the trackball.

3. Press the EBL OFFSET key on the HM OFF panel, and the origin of the active EBL shifts to the cursor position. Press the EBL OFFSET key again to anchor the EBL origin.

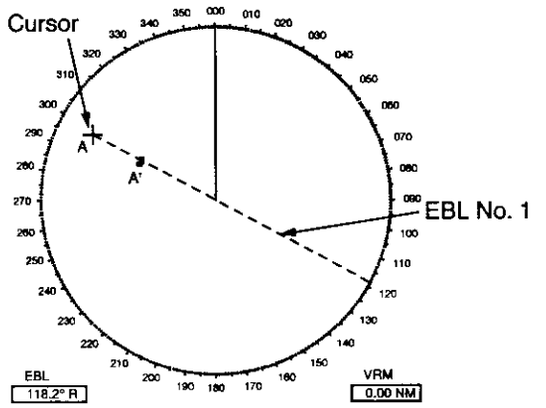
4. After waiting for a few minutes (at least 3 minutes), operate the EBL control until the EBL bisects the target at the new position (A'). The EBL readout shows the target ship's course, which may be true or relative depending on the settings on the RADAR 1 menu.

   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.



(a) Evaluating target ship's course and CPA in Relative Motion Mode



(b) Target ship on collision course

1.17 Measuring the Range and Bearing between Two Targets

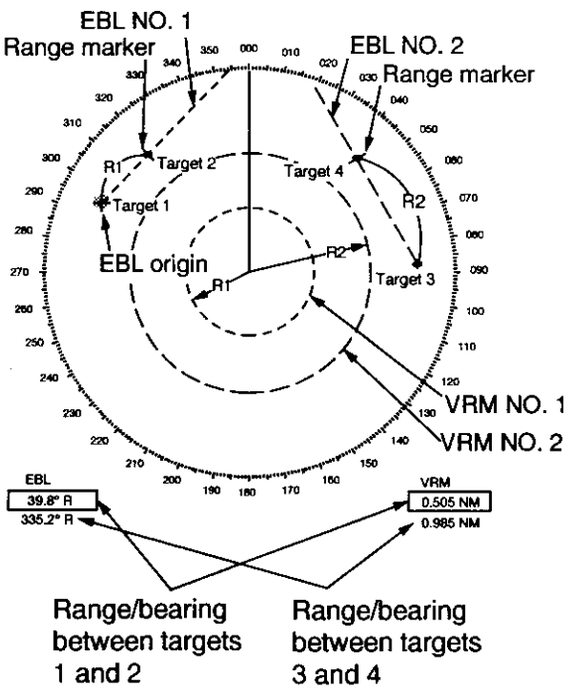
Press the EBL OFFSET key, and place the origin of EBL NO.1, for example, on a target of interest (target 1 in the illustrated example) by operating the trackball.

Turn the EBL control until the EBL passes through another target of interest (target 2).

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 forth targets (targets 3 and 4) by using EBL NO. 2 and VRM NO. 2.

Bearing is shown relative to own ship with suffix "R" or as a true bearing with suffix "T" depending on EBL relative/true settings on the RADAR 1 menu. To return the EBL origin to the own ship position, press the EBL OFFSET key again.



1.18 Setting a Guard Alarm Zone

Warning!—Guard Zone

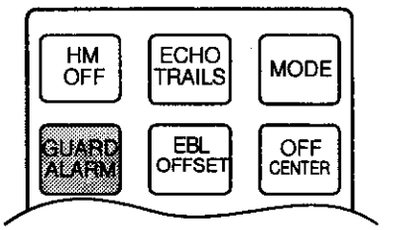
The Guard Alarm Zone feature should never be relied upon as a sole means for detecting the risk of potential collision. The operator of a ship is not relieved of the responsibility to keep visual lookout for avoiding collisions, whether or not the radar is in use.

A guard zone may be set to alert the navigator to targets (ships, landmasses, etc.) entering a certain area with visual and audible alarms.

On the G-type, the guard zone has a fixed width of 0.5 nm in the radial direction and is adjustable only within 3.0 to 6.0 nm from own ship. On the R-type and N-type, the outer and inner boundaries can be set at any distance. On any radar type, the guard zone can be set to any sector angle between 0 and 360 degrees in any direction.

Supposing that you are going to set a guard alarm zone as shown in the illustration (hatched area), proceed as follows:

1. Place the cursor (+) at point "A" using the trackball and press the GUARD ALARM key on the HM OFF panel. The message SET GUARD appears at the bottom-right corner of the screen.



2. Move the cursor (+) to point "B" and press the GUARD ALARM key. Then, a guard alarm zone as illustrated is created and the label GUARD replaces SET GUARD at the lower-right corner of the screen.

   Note: *If you wish to create a guard 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 GUARD ALARM key.*

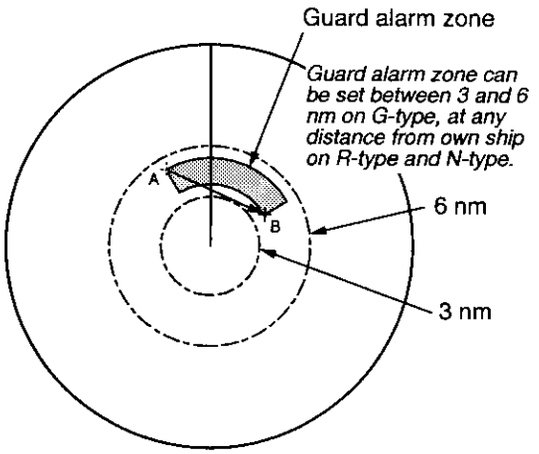
3. A target entering the guard alarm zone produces both visual (flashing) and audible

(beeping) alarms. To silence the audible alarm, press the GUARD ALARM key, and the label GUARD ACK replaces GUARD on the display.

This will deactivate the audible alarm but will not stop the flashing of the target in the guard alarm zone. To reactivate the audible alarm, press the GUARD ALARM key again.

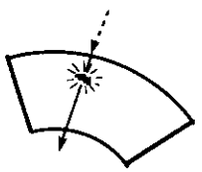
4. To disable the guard alarm feature, hold the GUARD ALARM key depressed for at least 3 seconds.

Note: *The guard 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 guard alarm against false target detection.*

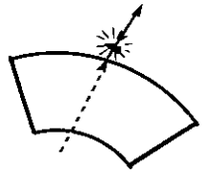


Inward and Outward Guard Alarms

On the R-type, an inward or outward guard alarm can be selected on RADAR 2 menu. On the N-type and G-type, only the inward guard alarm is available. The inward guard alarm generates visual and audible warnings when an approaching target enters the guard zone from outside. The outward guard alarm is produced when a receding target leaves the guard zone.



(a) Inward guard alarm available on R-, N- and G-types



(b) Outward guard alarm available on R-type only

1.19 Shifting the Display (Off-Centering)

Own ship position, or the sweep origin, can be displaced to expand the view field without switching to a larger range scale. On the R-type and N-type, the sweep origin can be off-centered to a point specified by the cursor, up to 100% of the range in use in any direction. On the G-type, 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 the 75% of the range scale, the sweep origin will be off-centered to the point of 75% limit.

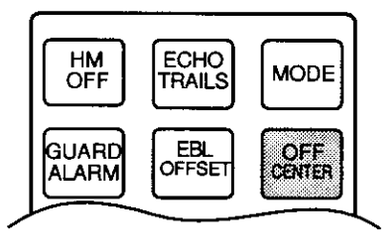
This feature is not available on the longest range scale. The number of range rings increases keeping the original range intervals unchanged.

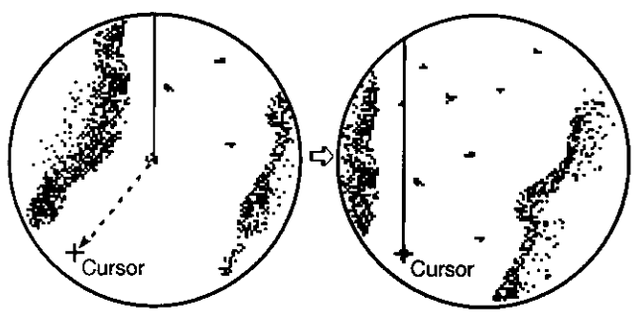
Follow the steps shown below to off-center the radar picture:

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.





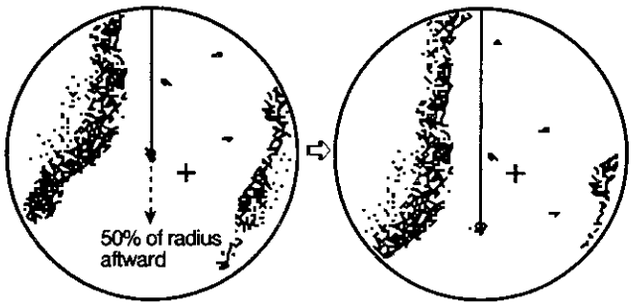
Off-centered to cursor position — Max. offset 100% of range in use on R-type and N-type, 75% of range in use on G-type

Note: *Off-centering can not be performed in True Motion mode.*

G-type

1. Press the OFF CENTER key. Then, the sweep origin is off-centered by 75% of the radius to the stern side, extending the forward view by the same amount.

2. To cancel off-centering, press the OFF CENTER key again.



(b) G-type — Off-centered 50% of range in use for extended forward view

Note: Off-centering can not be performed in True Motion mode.

1.20 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 nm range scales, the same sized targets get smaller on screen as they approach own ship. These are due to the inherent property of the radiation pattern produced by the antenna. To enhance target video, use the Echo Stretch feature. There are two types of Echo Stretch, i.e., ECHO STRETCH 1 for long range detection and ECHO STRETCH 2 for 1.5-6 nm ranges. Proceed as follows to activate or deactivate the Echo Stretch feature:

1. Press the RADAR MENU key on the plotting keypad to show the FUNCTIONS menu.

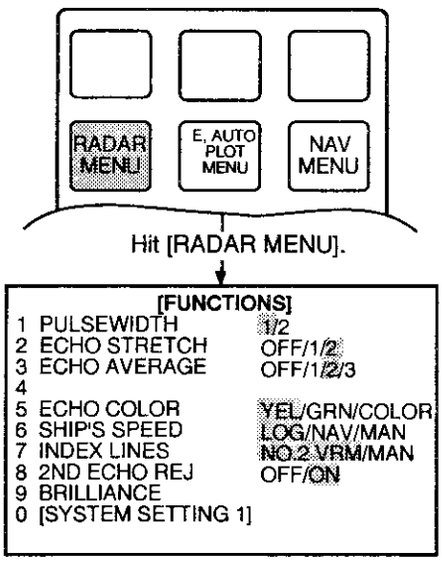
2. Press numeric key [2] to select menu item 2 ECHO STRETCH.

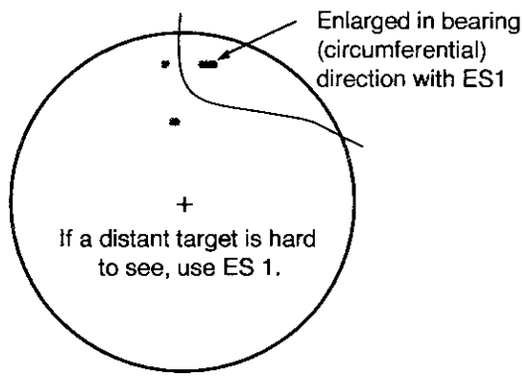
NOTE

Echo Stretch magnifies not only small target pips but also returns from sea surface, rain and radar interference. For this reason, make sure that these types of interference have been sufficiently suppressed before activating the Echo Stretch feature.

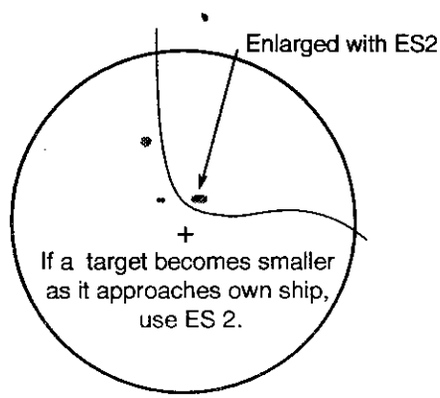
3. Press [2] until Echo Stretch option 1, 2 or OFF as desired is highlighted.

4. Press the ENTER key to confirm your selection followed by the RADAR MENU key to close the FUNCTIONS menu.





(a) Echo Stretch 1 for 24 nm range and above



(b) Echo Stretch 2 for 1.5-6 nm ranges

Note: If the 1.5 nm range is preset for pulsewidth S1 (0.08 μs) or S2 (0.2 μs), and the 3 nm scale for S2 (0.2 μs), the Echo Stretch feature is not available on these range scales.

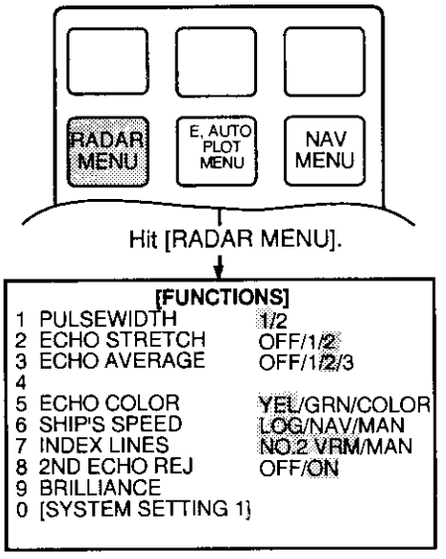
1.21 Echo Averaging

The Echo Average feature effectively suppresses sea clutter and other random noise. Echoes received from stable targets such as ships (if not moving at high speeds) 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 shown in its normal intensity. Sea clutter is averaged over successive scans and reduced in brightness. This makes it easier to discriminate real targets from sea clutter.

To properly use the echo average feature, it is recommended to first suppress sea clutter with the A/C SEA control and proceed as follows:

1. Press the RADAR MENU key on the plotting keypad to show the FUNCTIONS menu.

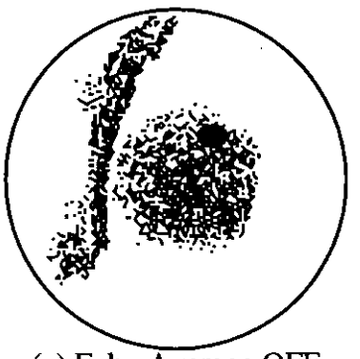


2. Press numeric key [3] to select menu item 3 ECHO AVERAGE.

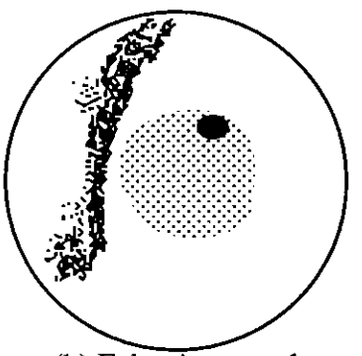
3. There are three echo averaging levels, corresponding to the number of picture frames to be correlated, and the selected echo averaging level is shown at the upper-left position of the screen. Successive presses of numeric key [3] changes the echo average setting to 1, 2, 3 and OFF in this order.

   OFF: No echo averaging
   1: Distinguishes targets from sea clutter and suppresses brilliance of unstable echoes.
   2: Distinguishes small stationary targets such as navigation buoys.
   3: Displays distant targets as stable echoes.

4. Press the ENTER key to confirm your selection followed by the RADAR MENU key to close the FUNCTIONS menu.



(a) Echo Average OFF



(b) Echo Average 1

Warning!—Echo Average

Do not use the Echo Average feature under heavy pitching or rolling. Otherwise, loss of true targets may result.

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.

The Echo Average feature is inoperable when a gyrocompass signal is not available. If you wish to use this feature without a gyrocompass signal, system initialization is required. (Consult your nearest FURUNO representative or dealer.)

Echo averaging also requires ship's speed information from a log or manual entry.

Manual speed entry is done at menu item 6 SHIP'S SPEED on the FUNCTIONS menu which is accessed by pressing the RADAR MENU key.

1.22 Electronic Plotting (E-Plot)

A maximum of 10 operator-selected targets can be plotted electronically by manual operation to assess their motion trends. Five past positions can be marked for each of the plotted targets. If you enter a 6th plot for a certain target, its oldest plot is erased to allow the newest plot to be displayed.

A vector appears as you enter a second plot for a target and is updated each time a new plot is entered for the target. The vector shows the target motion trend based on its latest two plots.

Alphanumeric readouts at the upper-right corner of the screen show range, bearing, course, speed, CPA, and TCPA of the last-plotted target.

It should be noted that the vector and alphanumeric target data are not updated in real time, but only when you enter a new plot.

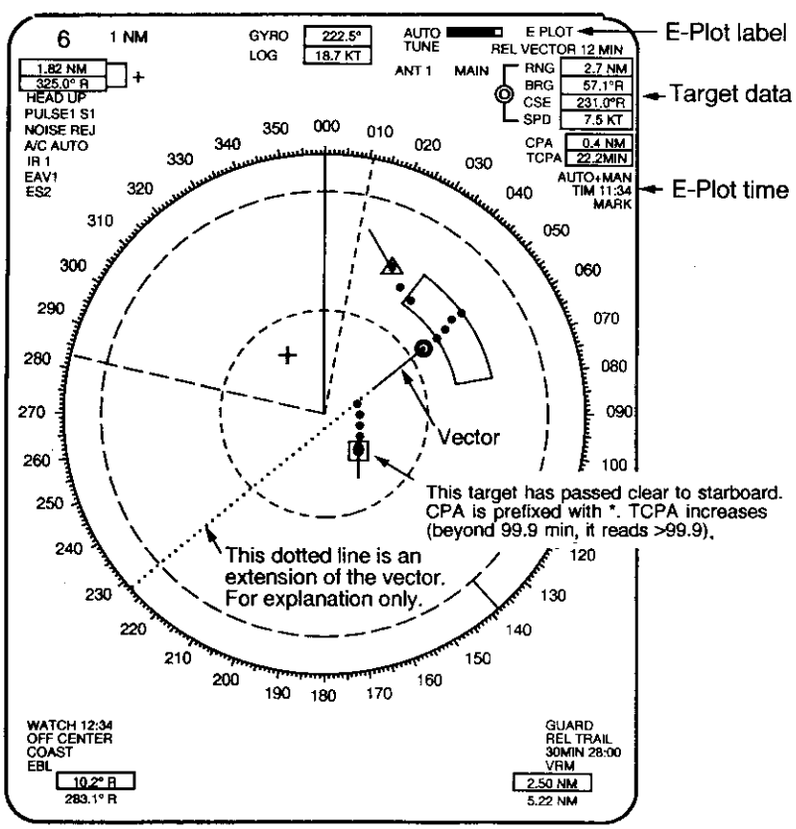
NOTE

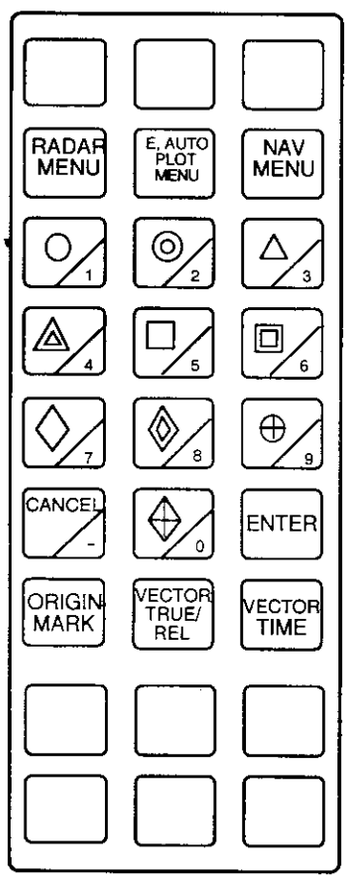
E-plot requires own ship's speed input (automatic or manual) and a compass signal.

Plotting a Target

To perform electronic plotting, do as below:

1. Place the cursor (+) on a target of interest by operating the trackball.
2. Select a desired plot symbol (e.g., ○,□, △) by pressing one of the plot symbol keys on the plotting keypad. To change the symbol size, refer to 1.32.
3. Press the ACQ key on the operator control panel, and the selected plot symbol is marked at the cursor position.
4. Watching the E-plot time (TIM xx:xx) shown at the upper right of the screen, wait for at





least 30 seconds. Place the cursor (+) on the target at its new location, select the same plot symbol for the target and press the ACQ key. The plot symbol moves to the new target position and the previous position is marked by a small dot.

5. To acquire and plot other targets, repeat the above steps using different plot symbols.

Note: If a certain target once plotted is not plotted again within 12 minutes, the warning "UPDATE PLOT" will appear on the upper right of the screen and the plot symbol of the target flashes. If you want to continue plotting this target, reacquire it within one minute. 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 3 or 6 minutes as far as possible.

When a target has been plotted more than once, the radar calculates its motion trend and automatically displays a vector on the target.

True or Relative Vector

Target vectors can be displayed relative to own ship's heading (Relative) or with reference to the north (True). Press the VECTOR TRUE/REL key to select the proper indication. This feature is available in all presentation modes (Gyrocompass must be working correctly). The current vector mode is indicated at the upper-right corner of the screen.

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 upper-right corner of the screen. Press the VECTOR TIME key until the desired vector time is reached. 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.

Target Data

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

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

Reading the Target Data
Press the corresponding plot symbol key, and the following target data is displayed.

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

CSE/SPD (Course/Speed): Course and speed are displayed for the last-plotted 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 a target ship has passed clear of own ship, CPA value is prefixed with an asterisk (*); TCPA>99.9 MIN beyond 99.9 minutes.

Terminating Target Plotting

With E-plot 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 corresponding plot symbol key. Then press the CANCEL key.

With Trackball: Place the cursor (+) on a target which you do not want to be tracked any longer by operating the trackball and press the CANCEL key.

All Targets: To terminate plotting of all targets at once, press and hold the CANCEL key until all plot symbols and marks disappear in about 3 seconds.

Entering Own Ship Speed

E-Plot requires an own ship speed input and compass signal. The speed can be entered from a speed log, navigator or through the plotting keypad (manual).

Log or Navigator Input

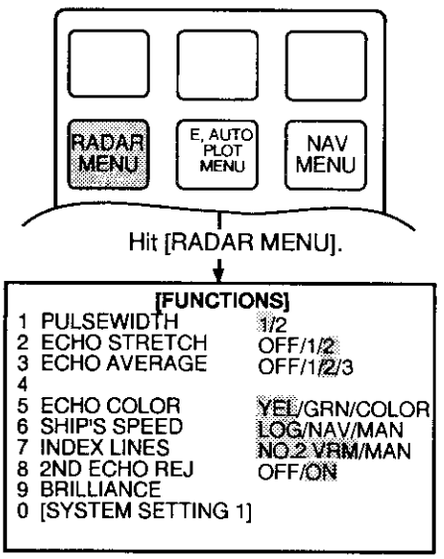
1. Press the RADAR MENU key on the plotting keypad to show the FUNCTIONS menu.

2. Press numeric key [6] to select menu item 6 SHIP'S SPEED.

3. Press numeric key [6] to select (or highlight) LOG (or NAV).

4. Press the ENTER key to confirm your selection followed by the RADAR MENU key to close the FUNCTIONS menu. The ship speed readout at the screen top shows own ship speed fed from the speed log preceded by the label "LOG" (or NAV).

Notes: 1) IMO Resolution A.422(XI) for ARPA recommends that a speed log to be interfaced with an ARPA should be capable of providing through-the-water speed data rather than over-the-ground 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 screen top will be blank.



Manual Speed Input

If the radar is not interfaced with a speed log, or the speed log does not feed correct speed data, enter the ship's speed as follows:

1. Press the RADAR MENU key on the plotting keypad to show the FUNCTIONS menu.

2. Press numeric key [6] to select menu item 6 SHIP'S SPEED.

3. Press numeric key [6] to select (or highlight) MAN option.

4. Press the ENTER key to confirm your selection. At this point, "MAN = XX.XX KT" appears at the bottom of the FUNCTIONS menu.

5 Enter the ship speed by hitting corresponding numeric keys without omitting leading zeros, if any. As an example, if the ship speed is 8 knots, press [0][8].

6. Press the RADAR MENU key to close the FUNCTIONS menu. The ship speed readout at the screen top shows own ship speed you entered preceded by the label "MANU".

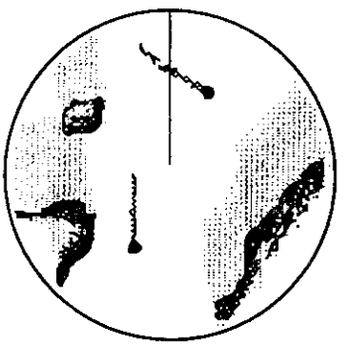
1.23 Echo Trail

Echo trails are simulated afterglow of target echoes that represent their movements relative to own ship or true movements with respect to land in a single tone or gradual shading depending on the settings on the RADAR 1 menu.

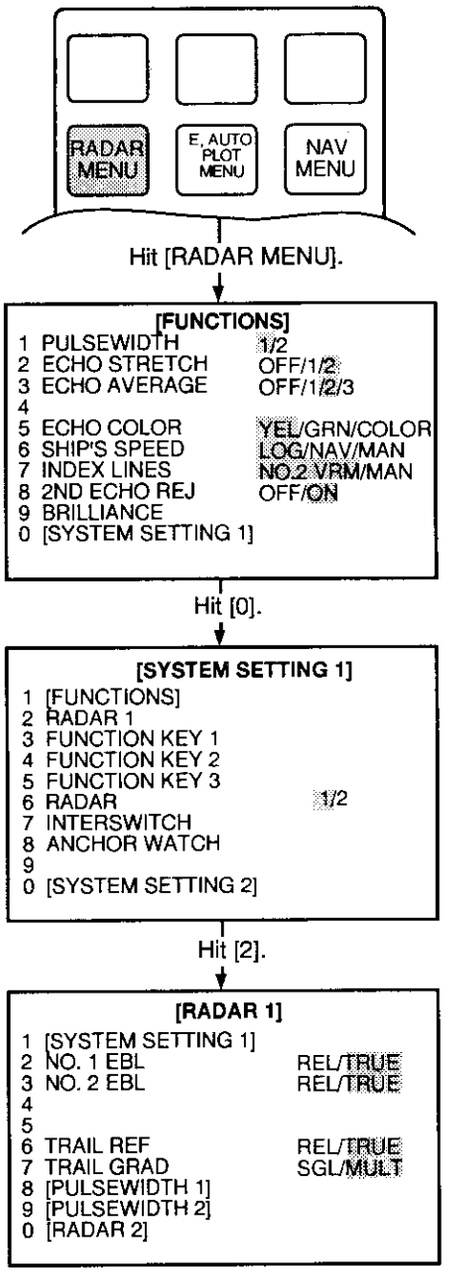
True or Relative Trails

You may display echo trails in true or relative motion. Relative trails show relative movements between targets and own ship. True motion trails require a gyrocompass signal and own ship speed input to cancel out own ship's movement and present true target movements in accordance with their over-the-ground speeds and courses. Refer to the automatic and manual speed input procedures for entering own ship's speed information.

(a) True echo trails without smearing of stationary targets



(b) Relative echo trails painted on all targets moving relative to own ship



Proceed as follows to select true or relative echo trail presentation:

1. Press the RADAR MENU key on the plotting keypad to show the FUNCTIONS menu.
2. Press numeric key [0] to show the SYSTEM SETTING 1 menu.
3. Press numeric key [2] to show the RADAR 1 menu.
4. Press numeric key [6] to select menu item 6 TRAIL REF.
5. Press numeric key [6] to select (or highlight) REL (relative) or TRUE option.
6. Press the ENTER key to confirm your selection followed by the RADAR MENU key to close the menu.

True or relative trail setting is displayed at the lower-right corner of the screen.

Trail Graduation

Echo 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.

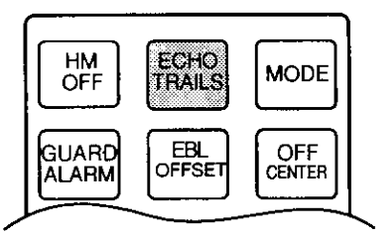
Monotone (Single) Gradual shading (Multi)

Selection of monochrome or gradual shading requires almost the same operation as for True or Relative Trails setup procedure described above except that you should:

- Press numeric key [7] to select menu item 7 TRAIL GRAD (graduation) in step 4, and
- Press numeric key [7] to select (or highlight) SGL (single tone) or MULT (multiple shading) option in step 5.

Displaying and Erasing Echo Trails

Press the ECHO TRAILS key to activate or deactivate the echo trailing feature.



Each press of the ECHO TRAILS key within 5 seconds cyclically changes echo trail length (time) to 30 seconds, 1, 3, 6, 15 and 30 minutes, continuous echo trailing and OFF. The current echo trail setting is displayed at the lower-right corner of the screen.

OFF → 30 sec → 1 min → 3 min → 6 min

↳ Continuous ← 30 min ← 15 min ↵

Suppose that "3 MIN" has just been selected. If the ECHO TRAILS key is hit more than 5 seconds later, echo trails are removed from the display (memory still alive with echo trail timer count going on). Next hitting the key calls out

the echo trails on the screen. To proceed to longer plot intervals, successively push the ECHO TRAILS key with a hit-and-release action. The larger the echo trail length, the larger the echo trail plot interval.

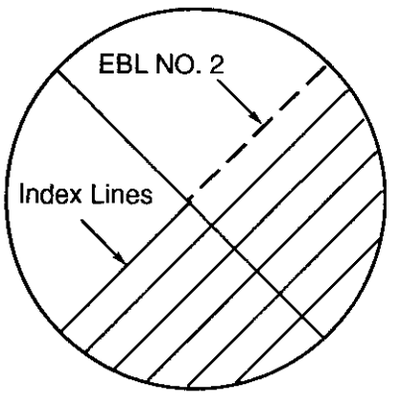
Note: *Holding the ECHO TRAILS key depressed for about 3 seconds will cause a total loss of echo trail data so far stored in an internal memory.*

Resetting Echo Trails

To reset (or clear) the echo trail memory, hold the ECHO TRAILS key depressed for about 3 seconds. Echo trails are cleared and the echo trailing process restarts from time count zero at current echo trail plot intervals. When the memory assigned to echo trailing becomes full, the echo trail timer at the lower-right corner of the screen freezes and the oldest trails are erased to show the latest trails.

1.24 Index Lines

Parallel index lines are useful for keeping a constant distance between own ship and a coastline or a partner ship when navigating. The index lines are drawn in parallel with EBL NO. 2 (EBL NO. 2 must be active). The orientation of the index lines is controlled with the EBL rotary control and the intervals between the lines are adjusted with the VRM rotary control (provided that VRM NO. 2 is active) or through a menu setting.

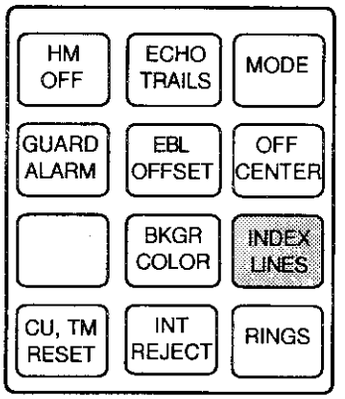


Displaying and Erasing the Index Lines

1. Press the INDEX LINES key if the index lines are not already shown.

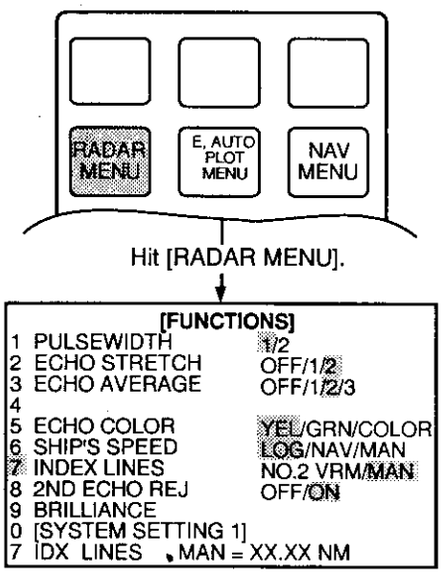
2. Make sure that EBL NO. 2 is active and orient the index lines in a desired direction with the EBL rotary control.

3. To erase the index lines, press the INDEX LINES key again.



Adjusting Index Line Intervals

1. Press the RADAR MENU key on the plotting keypad to show the FUNCTIONS menu.



2. Press numeric key [7] to select menu item 7 INDEX LINES.

3. Press numeric key [7] to select (or highlight) NO. 2 VRM or MAN (manual) option.

4. Press the ENTER key to confirm your selection.

5. If you have selected MAN for manual input of the index line interval through numeric keys in step 3 above, "MAN = XX.XX NM" appears at the bottom of the FUNCTIONS menu. Enter a desired line interval by hitting numeric keys without omitting leading zeros, if any.

6. If you have selected NO. 2 VRM in step 3 above, make sure that NO. 2 VRM is active (NO. 2 VRM readout circumscribed by a rectangle) and adjust the spacing between the index lines by operating the VRM control.

7. Press the RADAR MENU key to close the FUNCTIONS menu.

There are 6 index lines but the number of lines visible on the screen may be less than six depending on the line interval setting.

1.25 Anchor Watch

The Anchor Watch feature helps you monitor whether own ship is dragged by wind and/or tide while at anchor. This feature requires ship position data from a suitable radio navigational aid. Provided that own ship's physical data has been entered, an own ship mark can be displayed when the Anchor Watch feature is activated.

Notes: 1) The own ship mark is available on the R-type radar only; unavailable on the N-type and G-type.
2) The own ship mark is created with data on ship's length, width, radar antenna location, etc. To display an own ship mark, ask your nearest FURUNO representative or dealer.

A general operation flow for setting up Anchor Watch is shown at right. Proceed as follows to set up the Anchor Watch feature:

Activating Anchor Watch

On the ANCHOR WATCH menu, press numeric key [2] to select menu item 2 ANCHOR WATCH OFF/ON. Further press numeric key [2] to select (or highlight) ON, followed by the ENTER key to confirm your selection. The label WATCH appears at the lower-left corner of the screen.

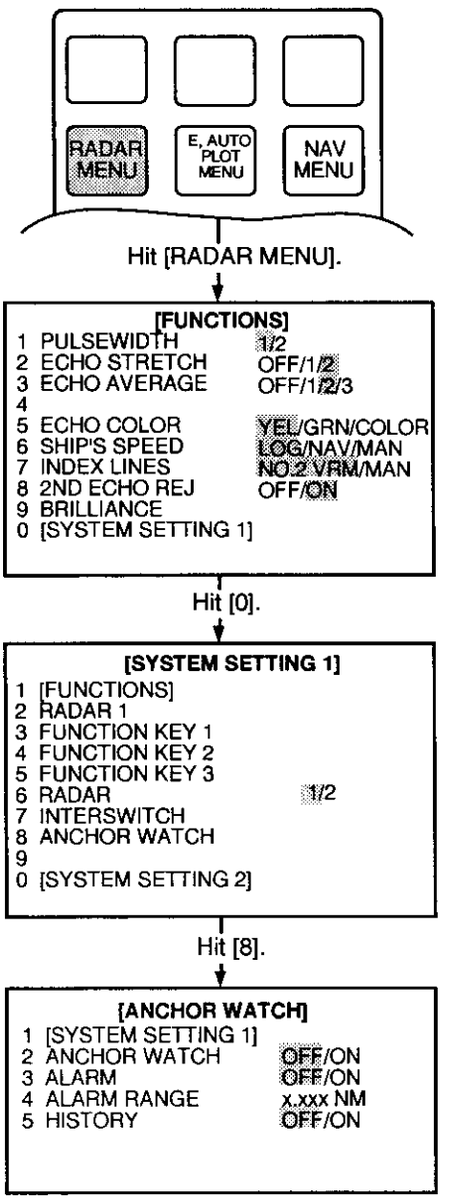
Press numeric key [3] to select menu item 3 ALARM OFF/ON. Further press numeric key [3] to select (or highlight) ON or OFF, followed by the ENTER key to confirm your selection. (This operation determines whether to activate the Anchor Watch audible alarm.)

Alarm Range Setting

Press numeric key [4] to select menu item 4 ALARM RANGE on the ANCHOR WATCH menu. Enter a desired alarm range between 0.1 and 9.999 nm with numeric keys and press the ENTER key to confirm your key input.

An anchor watch alarm circle thus established shows up as a red circle on the screen. When own ship is dragged out of this alarm circle, an audible alarm is generated and the on-screen label ANCHOR WATCH turns red.

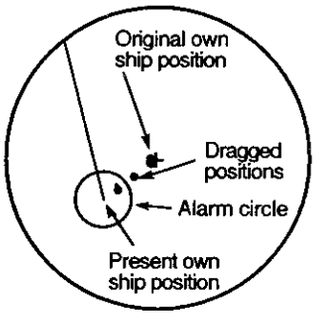
To silence the audible alarm, press the AUDIO OFF key on the operator control panel.



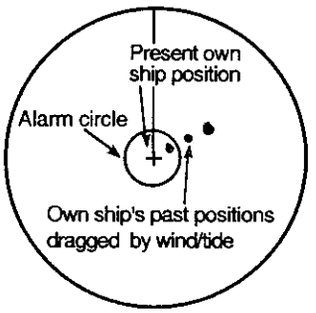
Showing Drag Line

Press numeric key [5] to select menu item 5 HISTORY on the ANCHOR WATCH menu. Further press numeric key [5] to select (or highlight) ON, followed by the ENTER key to confirm your selection.

A drag line, or a series of dots along which own ship was carried by wind and water current, appears as illustrated below. During the first 50-minute period, dots or own ship's past positions are plotted every minute. When 50 dots have been plotted in 50 minutes, the plot interval becomes 2 minutes and up to 25 dots are plotted during the succeeding 50-minute period. Next, the dot interval becomes 4 minutes and the maximum number of dots will be 12.



(a) Anchor Watch in True Motion Mode



(b) Anchor Watch in Head-up Mode

Anchor Watch in Standby or Transmit Status

▌R-type

On the R-type the Anchor Watch feature is available in either STANDBY or TRANSMIT status.

▌N-type and G-type

On the N-type and G-type the Anchor Watch feature is available only in STANDBY status.

1.26 Origin Mark

You can mark any dangerous point, prominent target or a particular reference point using the Origin Mark feature. This mark is geographically fixed. Proceed as follows to use the Origin Mark:

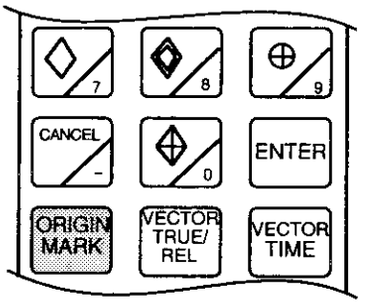
1. Place the cursor (+) at a point where you want to place a reference mark by operating the trackball.

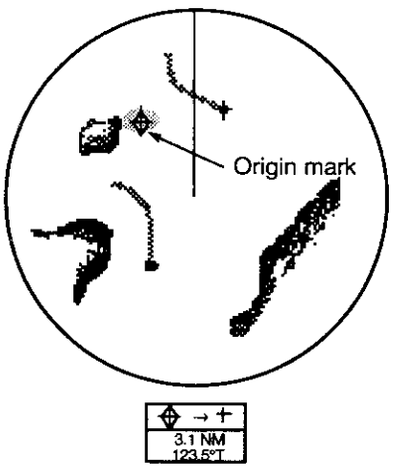
2. Press the ORIGIN MARK key on the plotting keypad. The Origin Mark appears at the cursor position of which range and bearing are indicated at the upper-left section of the screen.

3. To measure the range and bearing to a target of interest from the Origin Mark, press the ORIGIN MARK key again to anchor the mark at the selected position.

4. Move the cursor to the target of interest. Then, the range and bearing from the Origin Mark to the target are shown at the bottom center on the screen.

5. To erase the Origin Mark, press the ORIGIN MARK key once again.





1.27 Zoom

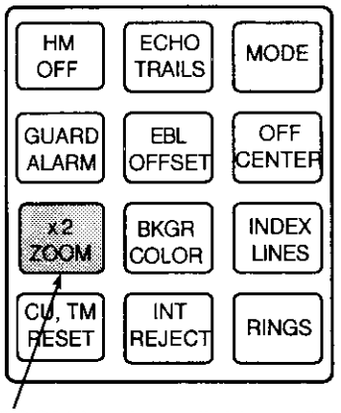
The Zoom function is available on the R-type radar only to enlarge an area of interest.

1. Place the cursor (+) close to the point of interest by operating the trackball.

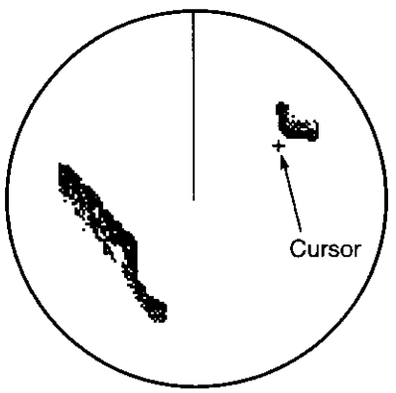
2. Press the X2 ZOOM key. The area around the cursor and own ship is enlarged twice as large as the original size and the label ZOOM appears at the lower-left corner of the screen.

3. To cancel Zoom, press the X2 ZOOM key again.

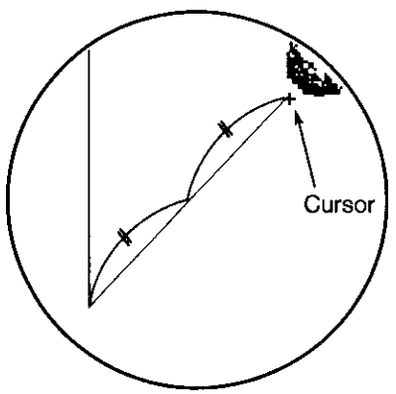
Note: The Zoom feature is inoperative on an off-centered display.



ZOOM key is available on R-type only.
Blank keytop on N-type and G-type.



(a) Cursor placed at point of interest



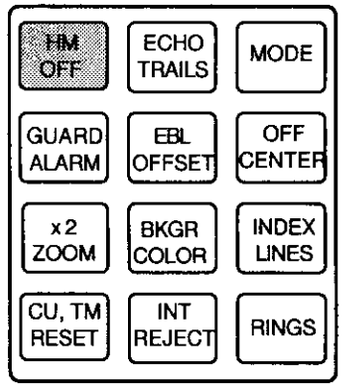
(b) Zoom in (R-type only)

1.28 Heading Marker

The heading marker indicates the ship's heading in all presentation modes. It appears at zero degrees on the bearing scale in Head-up mode, in any direction depending on the ship orientation in North-up and True Motion modes.

Temporarily Erasing Heading Marker

To temporarily extinguish the heading marker to look at targets existing dead ahead of own ship, press the HM OFF key on the HM OFF panel to the right of the screen. The heading marker reappears when the key is released.



North Marker

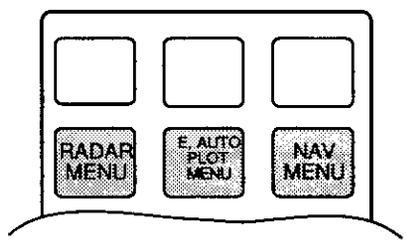
The north marker appears as a short dashed line. In Head-up mode, the north marker moves around the bearing scale in accordance with the compass signal.

Stern Marker

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

1.29 Menu Keys

Three menu keys are provided on the plotting keypad: RADAR MENU, E-AUTO PLOT MENU and NAV MENU keys.



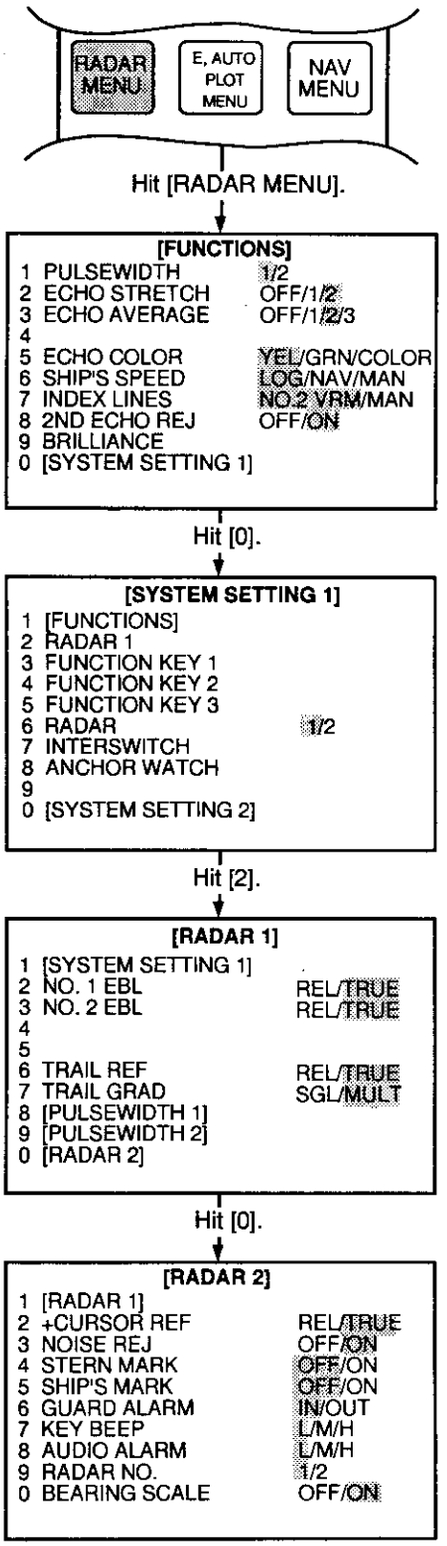
RADAR MENU: Permits setting of basic radar parameters.

E, AUTO PLOT MENU: Provides a choice of standard or large size of plotting symbols for E-plot (electronic plotting) and the optional Auto Plotter ARP-23.

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

1.30 RADAR 1 and 2 Menu Settings

R-type Radar



[FUNCTIONS] menu

5 ECHO COLOR: Targets are painted in monochrome Yellow, Green or Full Colors (red, yellow and green depending on echo strengths).

[SYSTEM SETTING 1] menu

6 RADAR: Select 1 for single radar installation or for connecting to antenna unit No. 1 on a dual radar installation, 2 for connecting to antenna unit No. 2 on a dual radar installation.

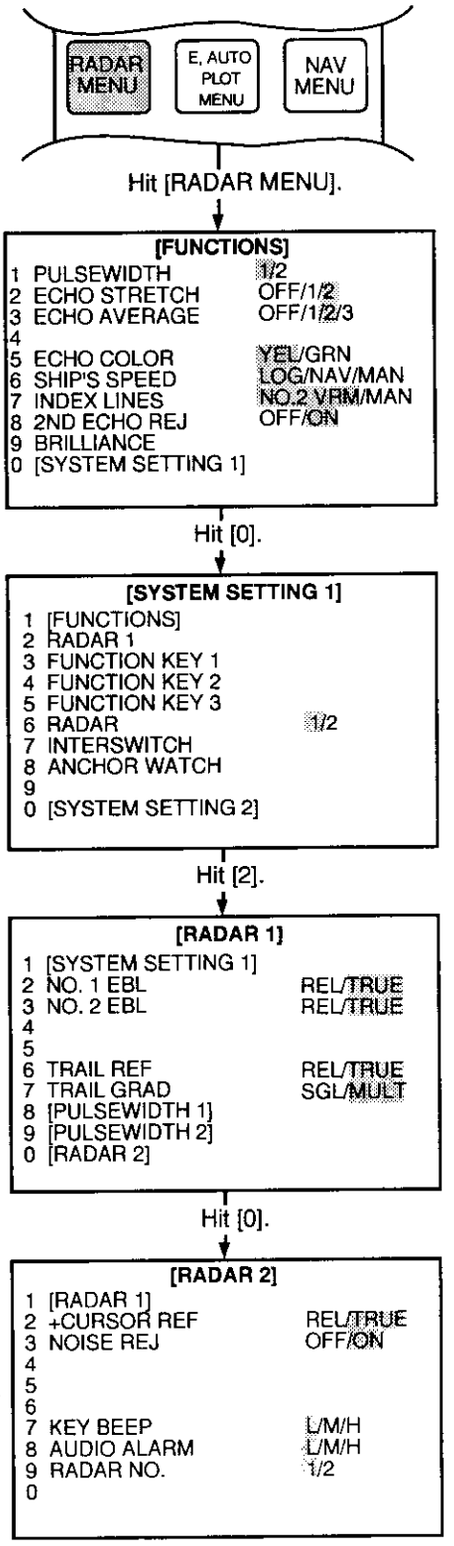
[RADAR 1] menu

2 NO. 1 EBL: Select REL to show relative bearing at EBL readout, TRUE to show true bearing at EBL readout.
3 NO. 2 EBL: Select REL to show relative bearing at EBL readout, TRUE to show true bearing at EBL readout.
6 TRAIL REF: Select REL to show relative echo trails, TRUE to show true echo trails.
7 TRAIL GRAD: Select SGL to show echo trails in single tone, MULT to show them in multiple shading.

[RADAR 2] menu

2 +CURSOR REF: Select REL to read relative bearing of the cursor, TRUE to read true bearing.
3 NOISE REJ: Select ON to activate noise rejector, OFF to deactivate it.
4 STERN MARK: Select ON to show stern marker, OFF to hide it.
5 SHIP'S MARK: Select ON to show own ship mark, OFF to hide it.
6 GUARD ALARM: Select IN for inward guard zone alarm, OUT for outward guard zone alarm.
7 KEY BEEP: Select sound level of key beep from L (low), M (medium) and H (high).
8 AUDIO ALARM: Select sound level of audible alarms from L (low), M (medium) and H (high).
9 RADAR NO.: Designate Radar No. 1 or 2 on a dual radar installation. Select 1 on a single radar installation. *(**Note:** Do not change the original setting. Consult your nearest FURUNO representative or dealer for details.)*
0 BEARING SCALE: Select ON to show bearing scale, OFF to hide it.

N-type and G-type Radars



[FUNCTIONS] menu

5 ECHO COLOR: Targets are painted in monochrome Yellow or Green as selected.

[SYSTEM SETTING 1] menu

6 RADAR: Select 1 for single radar installation or for connecting to antenna unit No. 1 on a dual radar installation, 2 for connecting to antenna unit No. 2 on a dual radar installation. *(**Note:** This item is blank on the G-type radar.)*

[RADAR 1] menu

2 NO. 1 EBL: Select REL to show relative bearing at EBL readout, TRUE to show true bearing at EBL readout.
3 NO. 2 EBL: Select REL to show relative bearing at EBL readout, TRUE to show true bearing at EBL readout.
6 TRAIL REF: Select REL to show relative echo trails, TRUE to show true echo trails.
7 TRAIL GRAD: Select SGL to show echo trails in single tone, MULT to show them in multiple shading.

[RADAR 2] menu

2 +CURSOR REF: Select REL to read relative bearing of the cursor, TRUE to read true bearing.
3 NOISE REJ: Select ON to activate noise rejector, OFF to deactivate it.

7 KEY BEEP: Select sound level of key beep from L (low), M (medium) and H (high).
8 AUDIO ALARM: Select sound level of audible alarms from L (low), M (medium) and H (high).
9 RADAR NO.: Designate Radar No. 1 or 2 on a dual radar installation. Select 1 on a single radar installation. *(**Note:** Do not change the original setting. Consult your nearest FURUNO representative or dealer for details. This item is blank on the G-type radar.)*

1.31 Function Keys

The three function keys (#1-3) on the operator control panel work like the auto-dialing feature of a telephone, instantly calling out desired settings to perform specially assigned functions. 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 a your specific navigating purpose, and an adhesive label (such as BUOY, HARBOR, COAST or the like) is usually attached to the keytop 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 key #1: Picture Setup
Function key # 2: Picture Setup or Specific Operation
Function key # 3: Picture Setup or Watch Alarm

1.31.1 Picture Setup

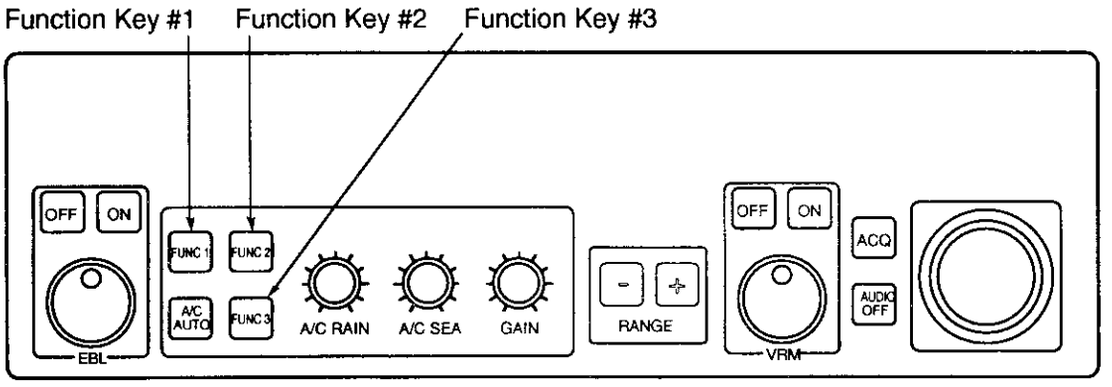
Suppose that you have been navigating along a coast for hours and now you are approaching a harbor, your final destination. You will have to adjust your radar to change from the settings for coastal navigation to those for harbor approach. Every time your navigating environment or task changes, you must 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 keytop. 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 lower left of the screen. If you re-press the same key, the radar returns to the previous settings.

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

Picture Setup Options for Function Keys

Label	Feature
RIVER	Optimum setting for navigation in a river
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 NM or less on calm seas
LONG	Optimum setting for long range detection using a range scale of 6 nm or larger
CRUISING	For cruising using a range scale of 1.5 nm or larger
HARBOR	Optimum setting for short range navigation in a harbor area using a range scale of 1.5 nm or less
COAST	For coastal navigation using a range scale of 12 nm or less
OCEAN	Transoceanic voyage using a range scale of 12 nm or larger
ROUGH SEA	Optimum setting for rough weather or heavy rain



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.*

1.31.2 Specific Operation

Most often used controls are placed on the operator control panel while less often used controls are provided inside the covered compartments on the right side of the display unit. To avoid opening the covers or menus to set up the radar for a particular situation, Function Key #2 may be assigned a combination of the following settings at the time of installation.

- Head-up, Course-up, North-up or True Motion (See paragraph 1.7.)
- Echo trails (See paragraph 1.23.)
- Course-up and True Motion reset function (See paragraph 1.7.)
- Off-centering (See paragraph 1.19.)
- Echo stretch 1 or 2 (See paragraph 1.20.)
- Pulsewidth 1 or 2 (See paragraph 1.9.)
- Echo averaging 1, 2 or 3 (See paragraph 1.21.)
- Echo color (See paragraph 1.30.)
- Echo trail graduation (See paragraph 1.23.)
- Panel illumination
- Label brilliance
- Noise rejection

Provided that Function Key #3 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 Function Key #3, the radar returns to the previous settings.

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.*

1.31.3 Watch Alarm

The Watch Alarm sounds a buzzer at selected time intervals to help you keep regular watch of the radar picture for navigating safety or other purposes. This feature can be assigned to Function Key #3 with a choice of alarm time intervals of 6, 10, 12, 15 and 20 minutes. (See the flowchart in paragraph 1.31.6 for the keystroke sequence.)

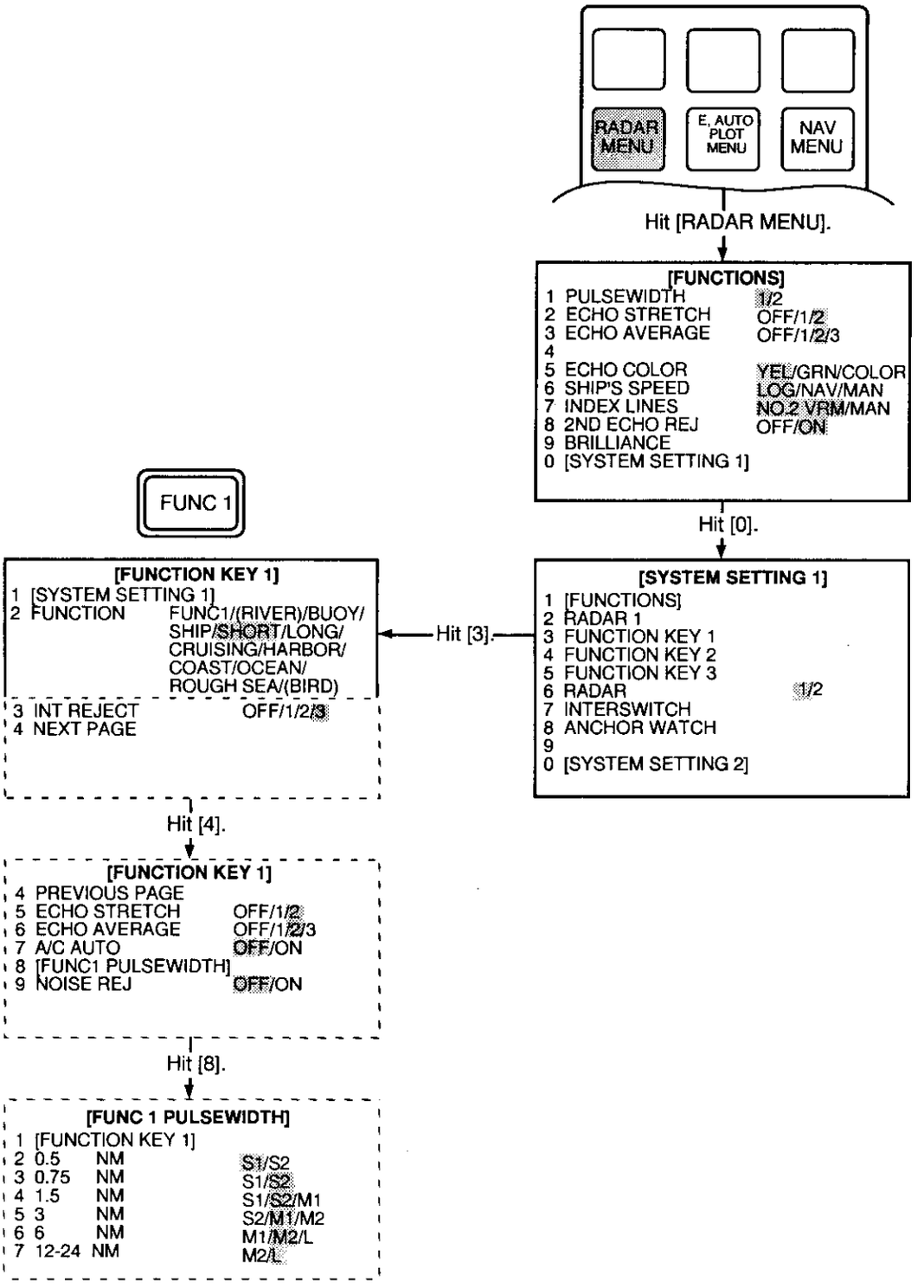
Provided that Function Key #3 is assigned the Watch Alarm feature, just press Function Key #3 to activate the feature. The label WATCH appears at the lower-left corner of the screen associated with a watch alarm timer counting down from the initial value (e.g., "12:00").

When an audible watch alarm is released after the preset time interval has elapsed, the on-screen 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.

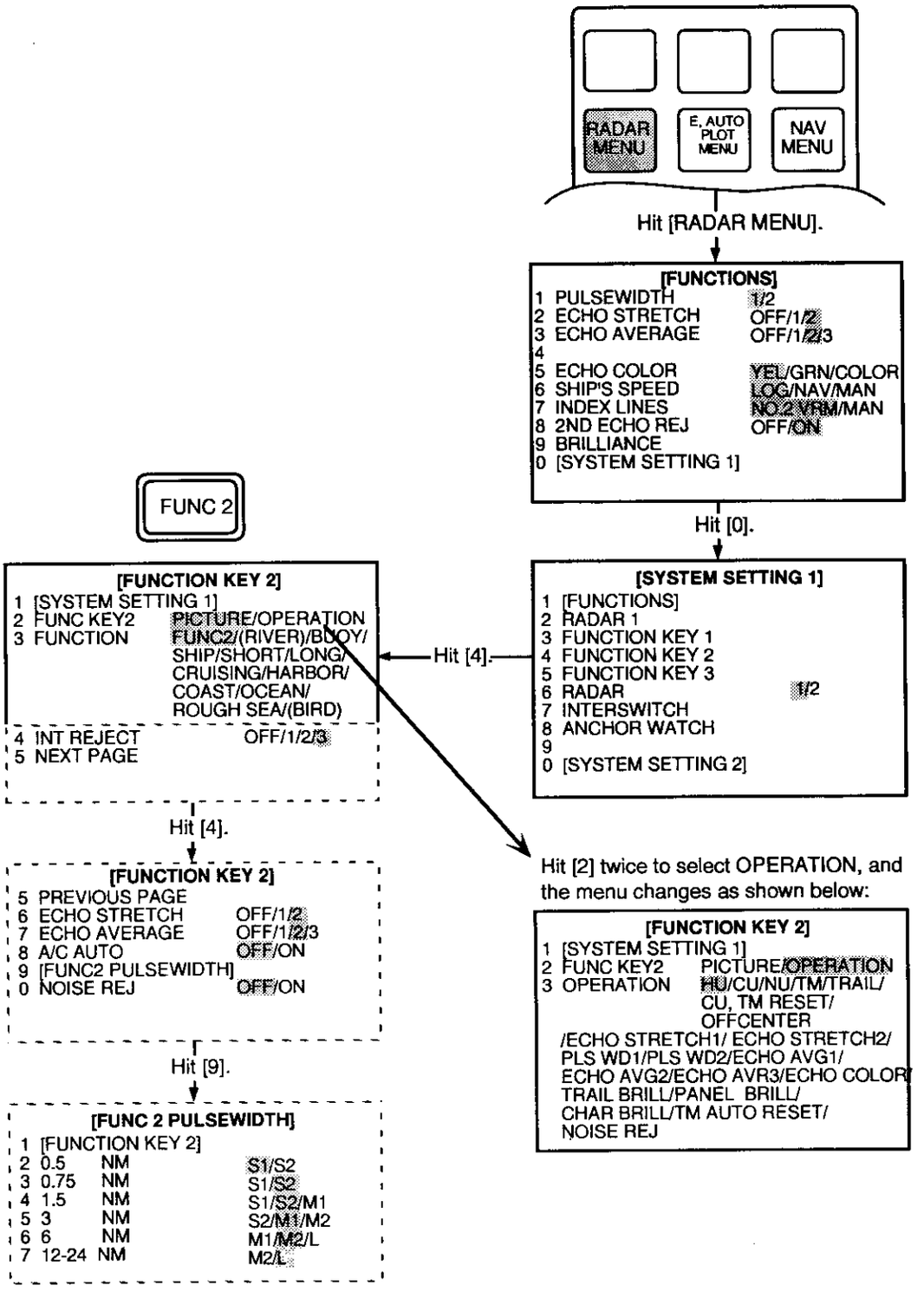
If you press the AUDIO OFF key before the selected time interval is reached, the watch alarm timer is reset to the initial value and starts the count-down sequence again.

1.31.4 Setting for Function Key #1



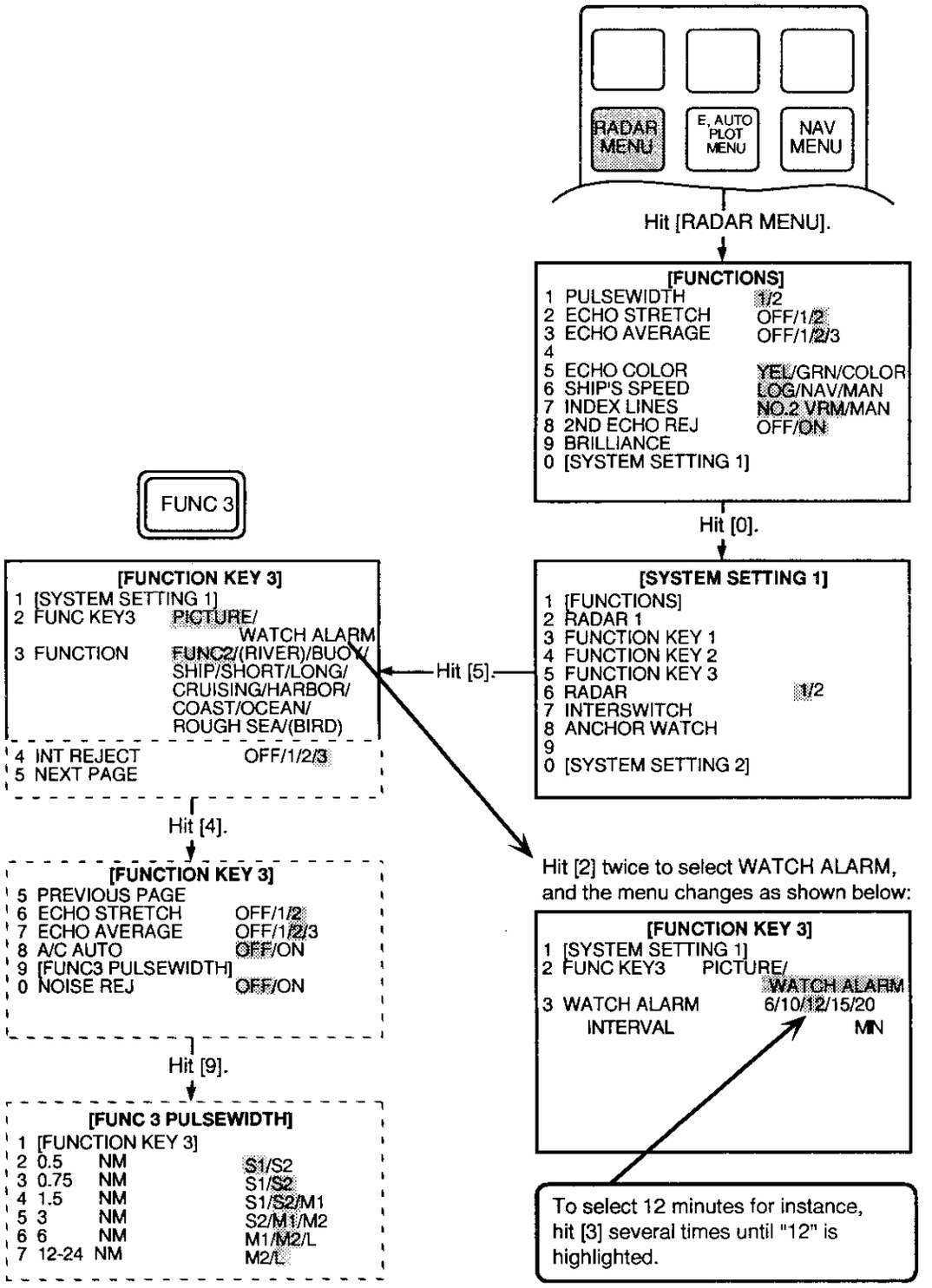
Notes: *1) The above menus are for the R-type. Menu options in parentheses are not shown on the N-type and G-type. Menu item 6 RADAR 1/2 on the SYSTEM SETTING 1 menu is not shown on the G-type.*
2) Items enclosed by dashed lines should be left to the original settings. For further information, contact your nearest FURUNO representative or dealer.

1.31.5 Setting for Function Key #2



Notes: 1) The above menus are for the R-type. Menu options in parentheses are not shown on the N-type and G-type. Menu item 6 RADAR 1/2 on the SYSTEM SETTING 1 menu is not shown on the G-type.
2) Items enclosed by dashed lines should be left to the original settings. For further information, contact your nearest FURUNO representative or dealer.

1.31.6 Setting for Function Key #3



Notes: *1) The above menus are for the R-type. Menu options in parentheses are not shown on the N-type and G-type. Menu item 6 RADAR 1/2 on the SYSTEM SETTING 1 menu is not shown on the G-type.*
2) Items enclosed by dashed lines should be left to the original settings. For further information, contact your nearest FURUNO representative or dealer.

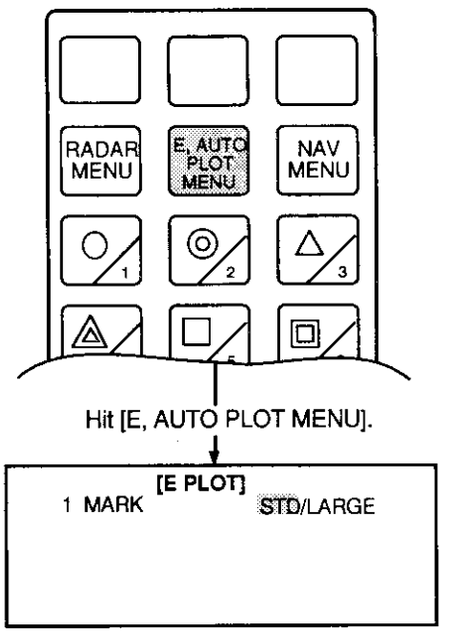
1.32 E PLOT Menu

You can change the size of the plotting symbols by the procedure shown below:

1. Press the E, AUTO PLOT MENU key on the plotting keypad to show the E PLOT menu.

2. Press numeric key [1] two or three times until plot symbol size option STD (standard) or LARGE is highlighted.

3. Press the ENTER key to confirm your selection followed by the E, AUTO PLOT MENU key to close the E PLOT menu.



1.33 NAV INFORMATION Menu and Navigation Data Display

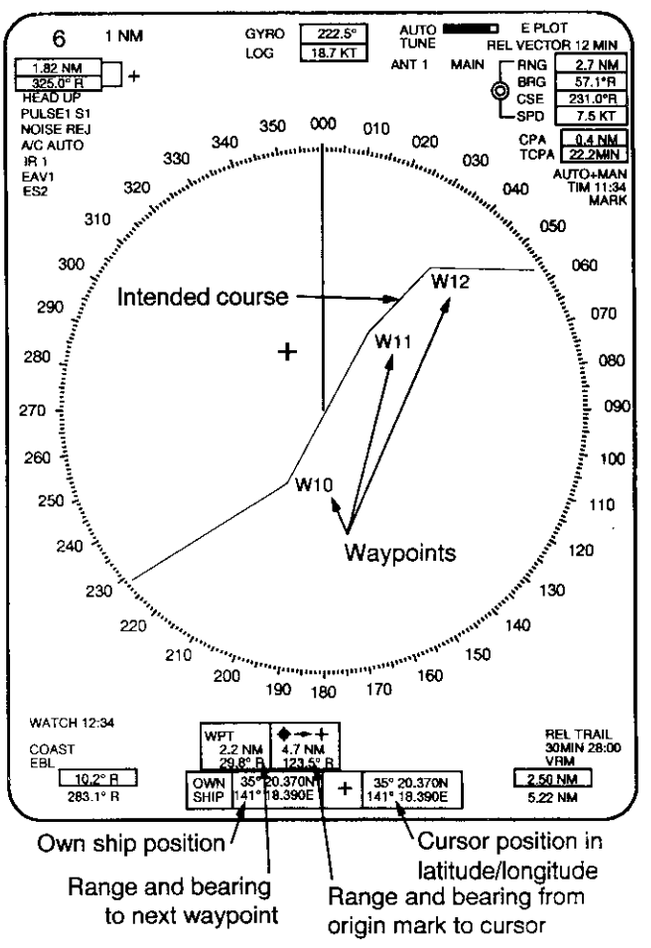
Various navigation data can be displayed on the radar screen. The data includes, depending on whether appropriate information is fed into the radar, own ship position, cursor position, waypoint data, wind data, water current data, depth data, water temperature, rudder angle, rate of turn and navigation lane (with optional Video Plotter RP-23). Note that data not directly related with the radar presentation is not available on N-type and G-type radars. Shown below is a typical navigational data display.

1. Press the NAV MENU key on the plotting keypad to show the NAV INFORMATION menu.

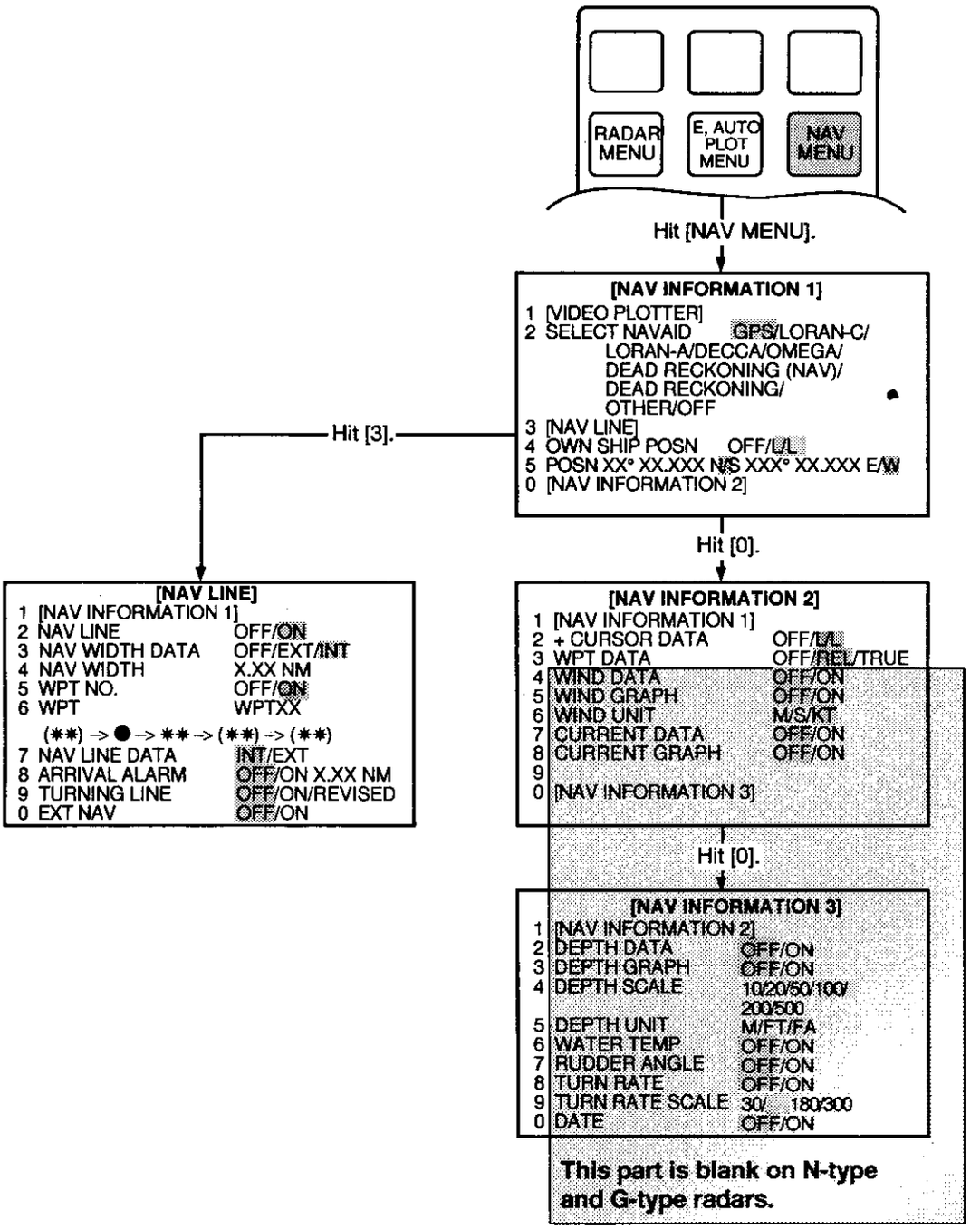
2. Select navigation data input device and press the ENTER key to confirm your selection.

3. Also, set other nav data parameters as appropriate referring to the operation flow shown on the next page.

4. Press the NAV MENU key to close the NAV INFORMATION menu.



Notes: 1) Own ship position display requires an input from radionavigational equipment such as a GPS receiver or a Loran-C receiver. Such a navigator should be of the type which provides output data in accordance with the data format as defined by NMEA 0183 version 2.0 on G-type radars.
2) Wind data, water current data, depth data, water temperature, rudder angle, rate of turn and navigation lane are not displayed on N-type and G -type radars.



NAV MENU Operation Flow

How to Display External Waypoint

A waypoint fed from navigational equipment can be displayed on the radar screen along with its data (range and bearing from own ship to waypoint). The waypoint symbol is a dashed circle enclosing "WP". The radar can display only one waypoint and does not provide for storage of the waypoint or its data; the waypoint and its data are cleared when the radar is turned off. Position accuracy increases with range and there is about 0.5° error on the 72 nm range.

The procedure for displaying external waypoint is as follows.

Without RP-23

1. Press the NAV MENU key to show the NAV INFORMATION 1 menu.
2. Press 3 (NAV LINE).
3. Select ON on the EXT. WPT line to display external waypoint on the radar screen.
4. Press 1 to return to the NAV INFORMATION1 menu and then press 0 to display the NAV INFORMATION2 menu.
5. Set 3. WPT DATA to relative or true (waypoint bearing reference).

With RP-23

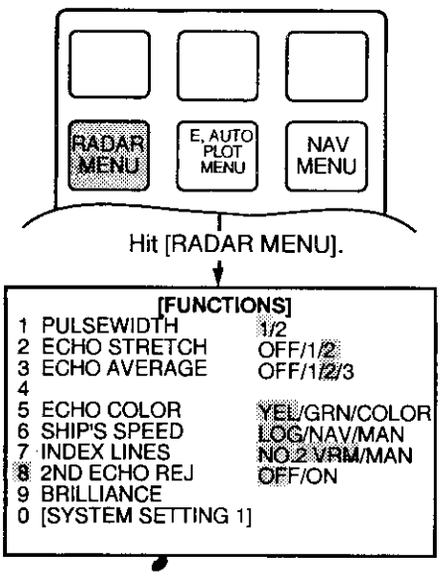
1. Press the NAV MENU key to show the NAV INFORMATION 1 menu.
2. Press 1 (VIDEO PLOTTER).
3. Press 3 to select NAV LINE.
4. Set 7. NAV LINE DATA for EXT.
5. Return to the VIDEO PLOTTER 1 menu.
6. Set 3. SELECT WP, NAVLINE to WP.
7. Set 2. WP to ON.
8. Return to the NAV INFORMATION1 menu and then select the NAV INFORMATION2 menu.
9. Set 3. WPT DATA to relative or true (waypoint bearing reference).

1.34 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, i.e., after a next radar pulse has been transmitted.

Proceed as follows to activate or deactivate the second-trace echo rejector:

1. Press the RADAR MENU key on the plotting keypad to show the FUNCTIONS menu.



2. Press numeric key [8] to select menu item 8 2ND ECHO REJ.

3. Further press numeric key [8] to activate (ON) or deactivate (OFF) the second-trace echo rejector.

4. Press the ENTER key to confirm your selection followed by the RADAR MENU key to close the FUNCTIONS menu.

1.35 Adjusting Relative Brilliance Levels of Screen Data

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

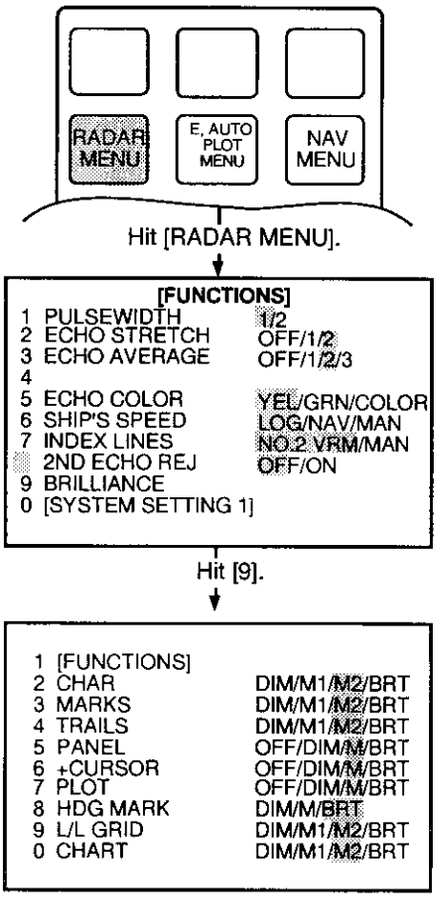
1. Press the RADAR MENU key on the plotting keypad to show the FUNCTIONS menu.

2. Press numeric key [9] to show the BRILLIANCE menu.

3. Select a desired menu item by pressing the corresponding numeric key. As an example, press [4] if you want to change the brilliance of echo trails.

4. Further press the same numeric key as you pressed in step 3 above to select or highlight a desired brilliance level: DIM for dimmed light, M for medium level, BRT for brightest, etc.

5. Press the ENTER key to confirm your selection followed by the RADAR MENU key to close the FUNCTIONS menu.



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

Menu item	Of which brilliance is adjusted?
CHAR	Alphanumeric readouts
MARKS	Bearing scale, EBLs and VRMs
TRAILS	Echo trails
PANEL	Operator control panel
+CURSOR	Trackball cursor (+)
PLOT	Plot symbols and marks for E-plot and optional Auto Plotter ARP-23
HDG MARK	Heading marker and stern marker (Stern marker is displayed on the R-type only.)
L/L GRID	Lat/lon grid lines generated by optional Video Plotter RP-23
CHART	Chart generated by optional Video Plotter RP-23

Note: *You should adjust the entire CRT brilliance by operating the BRILLIANCE rotary control before adjusting relative brilliance levels on the BRILLIANCE menu.*

1.36 Alarms

This radar produces visual and audible alarms to alert you to certain events or system failures to provide enhanced safety and convenience. The table below summarizes these alarms.

Problem	Audible alarm	Visual alarm	To quit alarm status
Gyro failure	2 beeps	"****.*" in GYRO readout. SET HEADING is displayed at the bottom left corner of the screen. "SYSTEM FAILURE" GYRO in red Presentation mode becomes Head-up automatically.	Change the presentation mode when the gyro input has been restored. Align the on-screen GYRO readout if necessary. Press CANCEL key to erase SET HEADING indication.
Guard alarm	Beeps	Target flashes.	Press the GUARD ALARM key to silence the alarm.
Watch alarm	Beeps	WATCH 0:00 (Label "WATCH" turns red and time count freezes at "0:00".)	Press the AUDIO OFF key to silence the alarm. The label WATCH turns to normal video and the timer is reset.
Anchor watch	Beeps	Label "ANCHOR WATCH" turns red.	Press the AUDIO OFF key to silence the alarm.
Own ship lat/lon Cursor lat/lon	No	"*****" if status V in GLL sentence for more than 90s.	Status A will restore the normal reading. Make sure that own ship position data is fed from external radionav equipment.
System failure	No	"BRG SIGNAL MISSING" at the bottom. No radar echoes. "SYSTEM FAIL" T. in red at the lower left of the display during Track Test	Make sure that the Antenna Switch in the tuning compartment is ON.
Incorrect keystroke	Double beep tone	No	Perform correct key operation. Correct keystroke is responded by a single beep tone provided that KEY BEEP ON is selected in initial settings.
Log failure	2 beeps	"SYSTEM FAIL LOG" with the readout **.* appears if no log signal is input for 30s while the current ship speed has been above 5.0kt. At a speed under 5.0kt, the readout is displayed with a certain delay due to filteration.	

CHAPTER 2 OPERATION OF OPTIONAL DEVICES

2.1 Performance Monitor

A performance monitor is required for a radar installed on vessels of 500 GT and upward (300 GT and upward in the GMDSS) engaged in international voyages. For X-band radars, the FURUNO PM-3 or PM-30 satisfies the requirement covering 9410 ± 50 MHz. For S-band radars, the PM-50 is available covering 3050 ± 30 MHz. The following describes how to use these performance monitors.

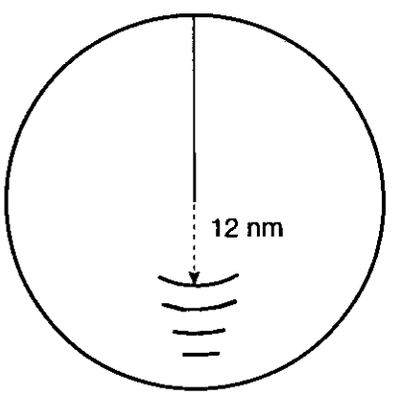
The performance monitor is basically an independent unit, i.e., it is not interconnected with any unit of the radar system except for the 100 VAC power cable. In some radars the power cable is not routed via the power switch or other control of the radar and the monitor is operated as completely a separate device.

Operating the Performance Monitor

Set the radar to the 24 nm range scale and select a long pulse. The radar screen will show several arcs, opposite to the heading marker (provided that the performance monitor is installed behind the radar antenna as is normally the case). If the radar transmitter and receiver are in good working conditions inasmuch as the original state when the monitor was tuned up, the innermost arc should appear at 12 nm and there should be a total of 4 arcs.

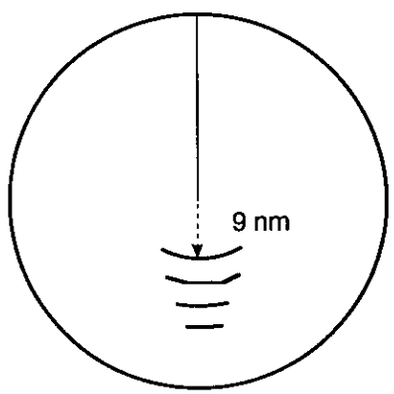
The range of the innermost arc reduces 3 nm with every 3 dB loss of transmitted power. The receiver sensitivity can be evaluated from the number of visible arcs; one arc is lost every 3 dB deterioration of the sensitivity.

Transmitter performance		Receiver performance	
Range to innermost arc	Loss	No. of arcs	Loss
12 nm	0 dB	4	0 dB
9 nm	3 dB	3	3 dB
6 nm	6 dB	2	6 dB
3 nm or less or none	≥10 dB	1	≥9 dB
		0	≥12 dB



(a)

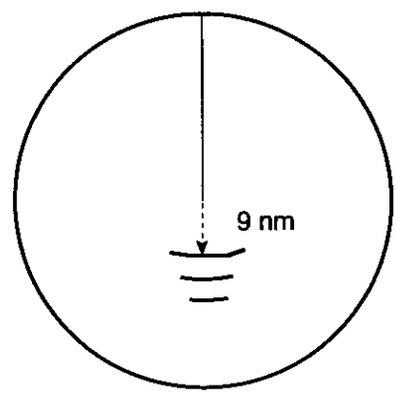
Transmitter: Normal
Receiver: Normal



(b)

Transmitter: 3 dB loss (Transmitter system has lost half of the initial power. Suspect magnetron and feeder system.)

Receiver: Normal



(c)

Transmitter: 3 dB loss (Transmitter system has lost half of the initial power. Suspect magnetron and feeder system)

Receiver: 3 dB loss (Note the number of arcs is reduced. Receiver has lost half of the normal sensitivity. Suspect receiver front end such as MIC element, water ingress into feeder system, etc.)

2.2 Auto Plotter ARP-23

2.2.1 General

The Auto Plotter ARP-23 is an optional circuit board which is accommodated in the display unit of the radar.

The Auto Plotter can acquire radar targets automatically or manually and tracks them. An internal microprocessor calculates target data such as speeds and courses and displays the results in alphanumerics and by vectors. To ensure the reliability of the displayed target data, the radar must be properly adjusted for minimum sea returns and noise.

Principal Specifications

Acquisition and Tracking:

- Automatic acquisition of all acquired targets between 0.1 and 24 nm
- Automatic tracking of up to 20 all acquired targets between 0.1 and 24 nm

Vectors:

Vector length:	30 sec., 1, 2, 3, 6, 12, 15, 30 min.
Orientation:	True velocity or relative velocity
Motion trend:	Displayed within 1 min., full accuracy within 3 min. after acquisition
Past positions:	Choice of 5 or 10 past positions at plot intervals of 30 sec., 1, 2, 3 or 6 min. (G-type) 200 max. (R- and N-type)
Alarms:	Visual and audible alarms against targets violating CPA/TCPA limits, lost targets, targets crossing guard ring, system failure and target full status
Trial maneuver:	Predicted situation appears in 1 min. after a selected delay
Compatible Radar:	FR-2100 Series, X- or S-band
Target discrimination:	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.

Note: The Auto Plotter ARP-23 is not intended to cover all the ARPA functions as specified in IMO A.422(XI) and IEC 872. Target acquisition suppression area can not be set, for instance.

2.2.2 Keys Used for Auto Plotter

The Auto Plotter utilizes the touchpad keys on the plotting keypad on the right side of the radar screen and two keys on the operator control panel. Given below is a brief description of these keys.

E, AUTO PLOT MENU: Shows and erases AUTO PLOT menus when the Auto Plotter is active.

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

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 TRUE/REL: Selects true or relative presentation of target vectors.

VECTOR TIME: Selects a vector length of 30 seconds, 1 , 2 , 3 , 6 , 12 , 15 or 30 minutes.

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

TARGET BASED SPEED: Own ship's speed is measured relative to a fixed target.

AUTO PLOT: Activates and deactivates the Auto Plotter.

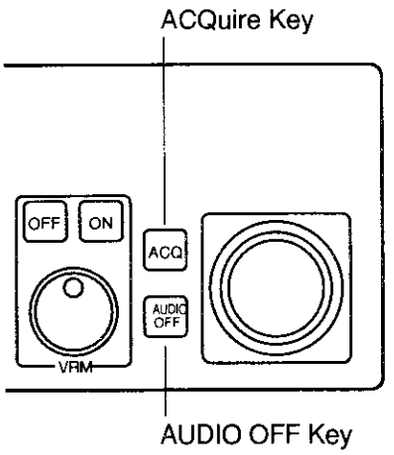
TRIAL: Initiates a trial maneuver.

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

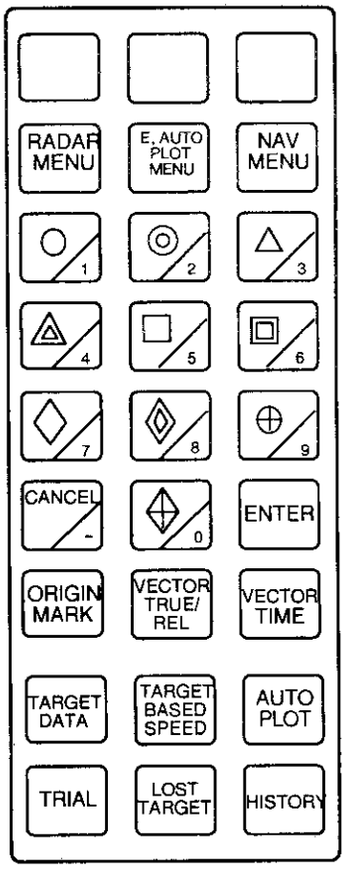
HISTORY: Shows and erases past positions of tracked targets.

ACQ (on operator control panel): Used to manually acquire a target.

AUDIO OFF (on operator control panel): Silences audible alarm.



Operator Control Panel



Plotting Keypad

2.2.3 Auto Plot Menu Operation

Various parameters for the Auto Plotter are set on the AUTO PLOT 1 to 3 menus. To do this, follow the steps shown below:

1. Press the AUTO PLOT key if the Auto Plotter is not yet activated. Note that the label AUTO PLOT appears at the upper-right corner on the screen.

2. Press the E, AUTO PLOT MENU key to show the AUTO PLOT 1 menu.

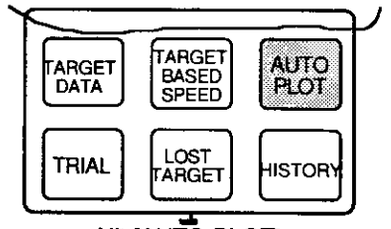
3. Press numeric key [0] once or twice if you wish to go to the AUTO PLOT 2 or 3 menu.

4. Select a desired menu item by pressing the corresponding numeric key.

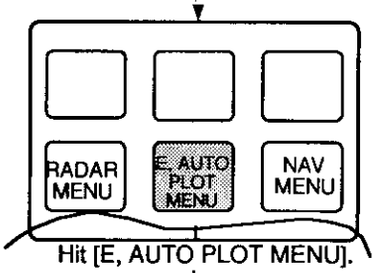
5. Select a menu option by pressing the same numeric key as pressed in step 3 above. If there is more than one option on the current menu item, you may need to press the numeric key several times. Press it until the desired option is highlighted. (Note that certain menu items will prompt you to enter numeric data or to define points on the radar screen with the trackball.)

6. Press the ENTER key to register your new settings.

7. Press the E, AUTO PLOT MENU key to close the menu.



Hit [AUTO PLOT].



Hit [E, AUTO PLOT MENU].

[AUTO PLOT1]

1	AUTO ACQ	OFF/ON
2	AUTO ACQ AREA	6 NM/SET
3	GUARD RING	OFF/ON
4	GUARD RING SET	
5	GUARD RING, AUTO ACQ SELECT	0/1 GUARD RING 1 AUTO ACQ 1
6	CPA, TCPA SET	CPA x.xNM TCPA xx.xMIN
0	[AUTO PLOT 2]	

Hit [0].

[AUTO PLOT 2]

1	[AUTO PLOT 1]	
2	HISTORY POINTS	5/10/20/30 100/150/200*
3	HISTORY INTERVAL	30S/1/2/3/6MIN
4	HISTORY MARK	DOT/LINE
5	SET, DRIFT	OFF/MAN SET xxx.x° DRIFT xx.xKT
0	[AUTO PLOT 3]	

*: 5/10 only on G-type

Hit [0].

[AUTO PLOT 3]

1	[AUTO PLOT 2]	
2	TRIAL MANEUVER	STATIC/DYNAMIC
3	MARK SIZE	STANDARD/LARGE
4	CPA, TCPA DISPLAY	OFF/ON NORTH/CRT
5		
6	GUARD RING, ACQ LINE STABILIZE	
7		
8	INPUT SIG CHECK	
9	ARP TRACK TEST	
0		

2.2.4 Start-up Procedure

Activating the Auto Plotter

To activate the Auto Plotter, follow the steps shown below:

1. Select a range scale between 3 and 24 nm.
2. Adjust the A/C RAIN, A/C SEA and GAIN controls for proper radar picture.
3. Press the AUTO PLOT key. The label AUTO PLOT appears at the upper-right corner on the screen.

Note: When the Auto Plotter is activated, E-plot symbols and target data disappears. Beware that each press of the AUTO PLOT key alternately selects the Auto Plotter and E-plot.

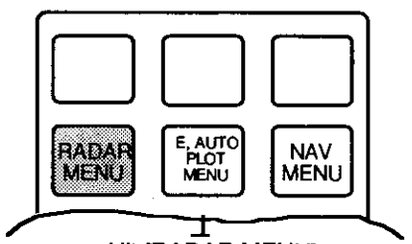
Entering Own Ship Speed

The Auto Plotter requires own ship's speed and heading data. Of these, the speed data can be entered automatically from a speed log or navigator, manually through the numeric keys, or based on a selected reference target (such as a buoy or other prominent stationary target).

Log or Nav Speed Input

To use the speed log or nav input, do the following:

1. Press the RADAR MENU key on the plotting keypad to show the FUNCTIONS menu.
2. Press numeric key [6] to select menu item 6 SHIP'S SPEED.



Hit [RADAR MENU].

[FUNCTIONS]

1	PULSEWIDTH	1/2
2	ECHO STRETCH	OFF/1/2
3	ECHO AVERAGE	OFF/1/2/3
4		
5	ECHO COLOR	YEL/GRN/COLOR
6	SHIP'S SPEED	LOG/NAV/MAN
7	INDEX LINES	NO.2 VRM/MAN
8	2ND ECHO REJ	OFF/ON
9	BRILLIANCE	
0	[SYSTEM SETTING 1]	

*COLOR: R-type only

3. Press numeric key [6] to select (or highlight) LOG (or NAV).
4. Press the ENTER key to confirm your selection followed by the RADAR MENU key to close the FUNCTIONS menu. The ship speed readout at the screen top shows own ship speed fed from the speed log preceded by the label "LOG" (or NAV).

Notes: 1) IMO Resolution A.422(XI) for ARPA recommends that a speed log to be interfaced with an ARPA should be capable of providing through-the-water speed data rather than over-the-ground 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 screen top will be blank.
3) In the event of a log error, you can continue plotting by entering a manual speed.
If the log signal interval becomes more than 30S with the ship's speed 5 kt or more, the radar regards the speed log is in a trouble and LOG FAIL appears, reading **.*KT.

Manual Speed Input

To manually enter the ship's speed via the numeric keys, proceed as follows:

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

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.) though leeward movement can not be disregarded.

If you select target-based speed, the Auto Plotter calculates own ship's speed relative to a fixed reference target.

Note: When the target-based speed is adopted, automatically or manually entered ship's speed is disregarded.

Establishing Target-based Speed

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 TARGET BASED SPEED key.

   The reference target mark (see below) appears at the cursor position and the own ship data label changes from "LOG", "NAV" or "MANU" to "REF". Note that it takes one minute before a new speed is displayed.


Reference target mark

Notes: 1) When the reference target is lost or goes out of the acquisition range (0.1-24nm), the reference target mark blinks and the speed reads "**.*". Select a different reference target.
2) When all targets are deleted, the reference target mark is also deleted and the target-based speed becomes invalid.
3) The speed is indicated in KTBT where BT means Bottom Track (speed over ground).

Canceling Target-based Speed

To cancel the target-based speed, just press the TARGET BASED SPEED key.

Deactivating the Auto Plotter

To deactivate the Auto Plotter, just press the AUTO PLOT key. Target plotting symbols and the on-screen label AUTO PLOT will disappear.

Note: Even when the Auto Plotter is turned off, target tracking still continues until the radar is turned off.

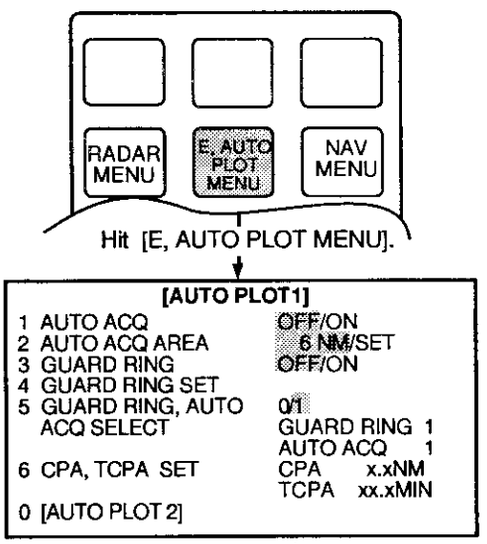
2.2.5 Automatic Acquisition

The Auto Plotter can acquire up to 30 targets (20 automatically and 10 manually). A target just acquired automatically is marked with a broken square ([ ]) and a vector appears about one minute after acquisition indicating the target's motion trend. Three minutes after acquisition, 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 (○).

Enabling and Disabling Auto Acquisition

1. Press the AUTO PLOT key if the Auto Plotter is not yet activated. Note that the label AUTO PLOT appears at the upper-right corner on the screen.

2. Press the E, AUTO PLOT MENU key to show the AUTO PLOT 1 menu.



3. Press numeric key [1] to select menu item 1 AUTO ACQ.

4. Further press numeric key [1] to select (or highlight) ON (enable auto acquisition) or OFF (disable auto acquisition) as appropriate.

5. Press the ENTER key to confirm your selection followed by the E, AUTO PLOT MENU key to close the AUTO PLOT 1 menu. Note that the label AUTO+MAN is displayed just beneath the target data field when auto acquisition is enabled; MAN when auto acquisition is disabled.

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

One or Two Auto Acquisition Areas

You can establish one or two auto acquisition areas depending on the setting of menu item 5 GUARD RING, AUTO ACQ SELECT on the AUTO PLOT 1 menu.

Provided that the Auto Plotter is already activated and auto acquisition is enabled, follow the steps shown below to determine whether to use one or two auto acquisition areas:

1. Press the E, AUTO PLOT MENU key to show the AUTO PLOT 1 menu.

2. Press numeric key [5] to select menu item 5 GUARD RING, AUTO ACQ SELECT.

3. Further press numeric key [5] to select (or highlight) "0" or "1" as appropriate.

   "0": Two auto acquisition areas
   "1": One auto acquisition area and one guard ring (Guard ring will be explained later.)

4. Press the ENTER key to confirm your selection followed by the E, AUTO PLOT MENU key to close the AUTO PLOT 1 menu.

Setting Auto Acquisition Areas

If you have selected to use two auto acquisition areas (option "0" at item 5 on the AUTO PLOT 1 menu), menu item 2 AUTO ACQ AREA offers options "3, 6NM/SET". If you have selected to use one auto acquisition area (option "1" at item 5 on the AUTO PLOT 1 menu), menu item 2 AUTO ACQ AREA offers options "6NM/SET". These options permit you to establish the following auto acquisition areas:

3, 6NM: Two predefined auto acquisition areas; one between 3.0 and 3.5 nm and the other between 5.5 and 6.0 nm

6NM: One predefined auto acquisition area between 5.5 and 6.0 nm

SET: One or two sector-shaped or full-circle auto acquisition areas (depending on menu item 5 setting) set by using the trackball

To Set 3 & 6 NM (or 6 NM) Auto Acquisition Areas

Follow the steps shown below to activate one or two predefined auto acquisition areas:

1. Press the E, AUTO PLOT MENU key to show the AUTO PLOT 1 menu.

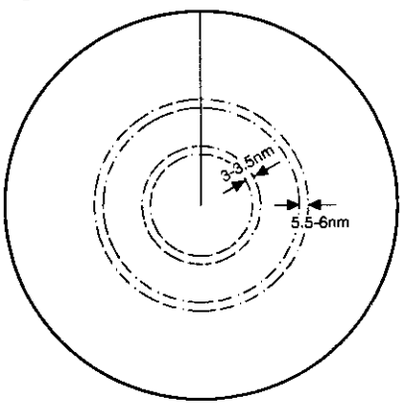
2. Press numeric key [2] to select menu item 2 AUTO ACQ AREA.

3. Further press numeric key [2] to select (or highlight) menu option 3, 6NM (or 6NM).

4. Press the ENTER key to confirm your selection followed by the E, AUTO PLOT MENU key to close the AUTO PLOT 1 menu.

The figure below shows how the auto acquisition areas (two areas in this example) are displayed on the screen. Up to 20* targets within the auto acquisition areas are acquired automatically. If option "1" is selected at item 5 on the AUTO PLOT 1 menu, only the outer auto acquisition area between 5.5 and 6 nm is displayed.

*: If 20 targets have already been acquired manually in the MAN ACQ mode (AUTO OFF on AUTO PLOT menu), only 10 more targets can be accquired automatically.



Predefined Auto Acquisition Areas

To Set Auto Acquisition Areas with Trackball

Follow the steps shown below to set one or two auto acquisition areas by using the trackball:

1. Press the E, AUTO PLOT MENU key to show the AUTO PLOT 1 menu.

2. Press numeric key [2] to select menu item 2 AUTO ACQ AREA.

3. Further press numeric key [2] to select (or highlight) SET option.

4. Press the ENTER key to confirm your selection. At this point the AUTO ACQ SETTING menu is displayed at the screen bottom.

```
[AUTO ACQ SETTING]
1 [AUTO PLOT 1]
2 1/2
```

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

```
[AUTO ACQ SETTING]
1 [AUTO PLOT 1]
2 1/2
  SET LEFT/RIGHT BOUNDARY
  CANCEL PREVIOUS AREA : CANCEL KEY
```

6. Place the cursor at the outer counterclockwise corner of the area (point A) and press the ENTER key.

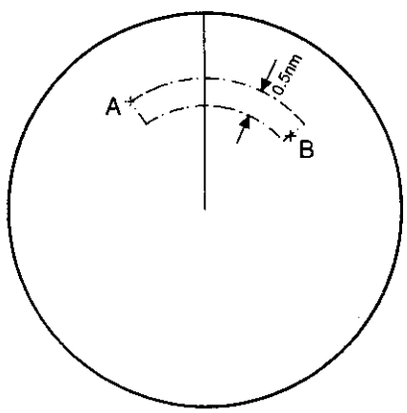
7. Place the cursor at the clockwise edge of the area (point B) and press the ENTER key.

   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. ±3°) 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 numeric key [1] followed by the E, AUTO PLOT MENU key to close the AUTO PLOT 1 menu.

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



Automatic Acquisition Area Set by Trackball

Note that the auto acquisition areas are preserved

in an internal memory of the Auto Plotter even when auto acquisition is disabled or the radar is turned off.

Terminating Tracking of Targets

When the Auto Plotter has acquired 20 targets automatically, the message AUTO TARGET FULL is displayed at the screen bottom 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.

Individual Targets

Place the cursor (+) on a target which you do not want to be tracked any longer by operating the trackball and press the CANCEL key.

All Targets

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

Discrimination between Landmass and True Targets

A target is recognized as a landmass and thus not acquired if it is 800 m or more in range or bearing direction.

2.2.6 Manual Acquisition

When auto acquisition is enabled (AUTO ACQ ON), up to 10 targets can be manually acquired. When auto acquisition is disabled (AUTO ACQ OFF), up to 30 targets can be manually acquired and automatically tracked.

Provided that the Auto Plotter is already activated, follow the steps shown below to manually acquire a target:

1. Place the cursor (+) on a target of interest by operating the trackball.

2. Select a desired plot symbol (e.g.,□, o, Δ) by pressing one of the plot symbol keys on the plotting keypad.

3. Press the ACQ key on the operator control panel, and 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 and disappears shortly.

(a) Immediately after acquisition—Plot symbol shown in broken lines

(b) One minute after acquisition—Vector appears to show a trend of motion

(c) 3 minutes after acquisition—Plot symbol shown in solid lines indicating stable tracking

Notes: 1) The target to be acquired should be within 0.1 to 24 nm from own ship and not obscured by sea or rain clutter for successful acquisition.
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 "Terminating Tracking of Acquired Targets")

Warning—Target Swap

When a tracked target nears another tracked target, 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 targets have separated.

2.2.7 Changing Plot Symbol Size

Press a desired plot symbol key, and the symbol is enlarged for about 7 seconds.

Also, you can choose a large or standard size for all plot symbols. Proceed as follows to do this:

1. Press the E, AUTO PLOT MENU key on the plotting keypad followed by numeric keys [0][0] to show the AUTO PLOT 3 menu.

2. Press numeric key [3] to select 3 MARK SIZE.

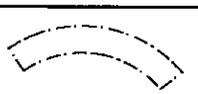
3. Further press numeric key [3] to select (or highlight) STANDARD or LARGE as appropriate.
4. Press the ENTER key to confirm your selection followed by the E, AUTO PLOT MENU key to close the AUTO PLOT 1 menu.

Auto Plotter Symbols

The Auto Plotter ARP-23 is not an ARPA as defined by IMO A.422(XI) and IEC 872. However, the symbols used in this equipment are designed to comply with Annex E (ARPA Video Symbols) to IEC 872, Operational Requirements for ARPA.

Item	Symbol	Status	Description
Automatically acquired targets		Initial stage	Broken square for approx. 1 min. after acquisition
			Between 1 and 3 min after acquisition (Vector still unreliable)
		Stready tracking	Solid circle with vector indicating steady state tracking (3 min. after acquisition)
		CPA Alarm	Plot symbol changes to a triangle flashing together with vector if the target is assessed to come into the preset CPA area.
		CPA Alarm acknowledged	Flashing stops when CPA/TCPA alarm is acknowledged.
		Guard ring alarm	
		Lost target	Lost target is indicated by a flashing diamond symbol.
Manually acquired targets		Initial stage	Plot symbol selected for manual acquisition is shown in a bold broken square for approx. 1 min. after acquisition
			Between 1 and 3 min after acquisition
		Steady tracking	Manual plot symbol in a bold solid circle with vector indicating steady state tracking (3 min. after acquisition)
		CPA Alarm	Plot symbol changes to a triangle flashing together with vector if the target is assessed to come into the preset CPA area.
			Flashing stops when CPA/TCPA alarm is acknowledged.
		Guard ring alarm	
			Lost target is indicated by a flashing diamond symbol.

Auto Plotter Symbols (continued)

Item	Symbol	Location	Description
Manually acquired targets (cont.)	○ △ □ ◫ ◇ ◈ ⊕ ◈	On acquired target	These plot symbols can also be used for manual acquisition in addition to the double-circle symbol (◎) shown on the preceding page.
Guard ring alarm		On target passing through operator-set guard ring	Plot symbol changes to an inverted triangle flashing together with vector if target transits guard ring (0.5 nm wide).
Automatic acquisition area		5.5-6.0 nm, 3-3.5 nm or anywhere as set by trackball	
Target selected for data readout	□1	On selected target	Target data (range, bearing, course, speed, CPA and TCPA) is displayed at the upper-right corner of the screen.
Reference target		On reference target	Used for calculating own ship's over-the-ground speed (target-based speed) with reference to land or other fixed target selected by trackball.
Trial maneuver	T	Bottom center	Appears during execution of a trial maneuver.
Auto Plotter performance test	TEST	Bottom center	Appears during execution of a performance test (Track Test).

2.2.8 Adjusting Brilliance of Plot Marks

1. Press the RADAR MENU key on the plotting keypad to show the FUNCTIONS menu.
2. Press numeric key [9] to show the BRILLIANCE menu.
3. Press numeric key [7] to select 7 PLOT BRILL.
4. Further press numeric key [7] 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 FUNCTIONS menu.

Note: Refer to paragraph 1.35 for the BRILLIANCE menu screen.

2.2.9 Displaying Target Data

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

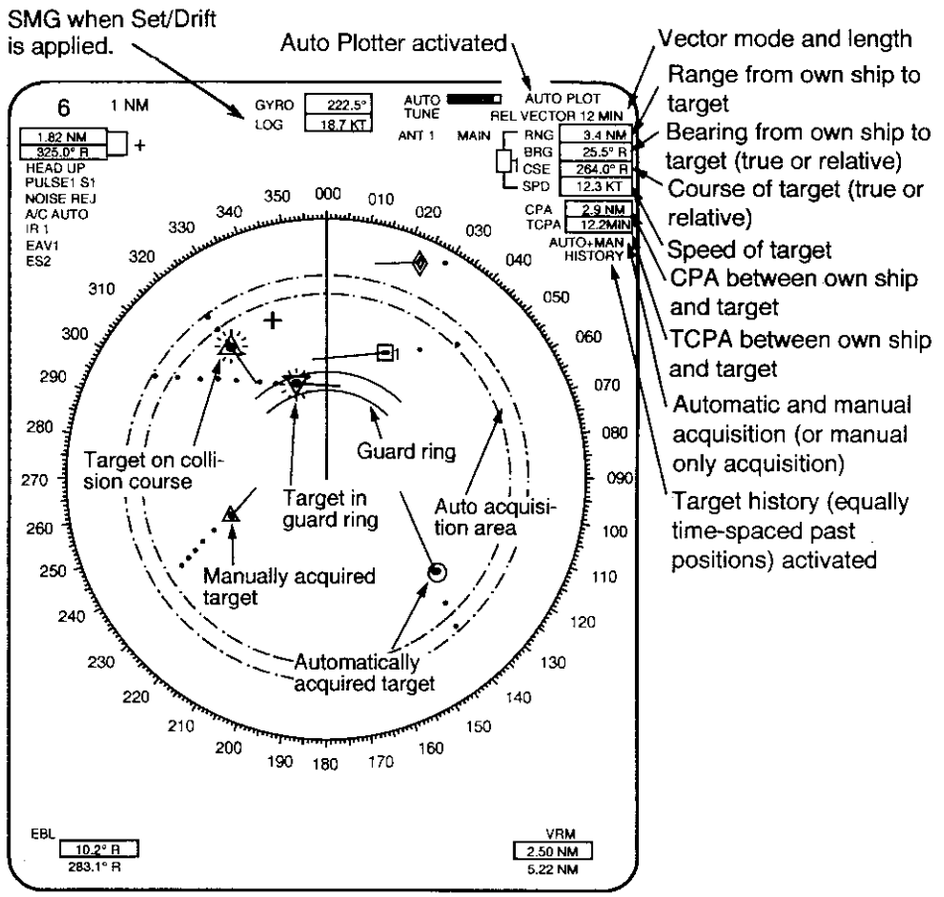
In Head-up and Head-up True Bearing modes, target bearing, course and speed shown in the upper-right target data field become true (suffix "T") or relative (suffix "R") to own ship in accordance with the true/relative vector setting. In North-up, Course-up and True Motion modes, the target data field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

Place the cursor on a desired target and press the TARGET DATA key on the plotting keypad. Data on the selected target is displayed at the upper-right corner of the screen. A typical target data display is shown in the figure below.

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

CSE/SPD (Course/Speed): Course and speed are displayed for the last-plotted 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 a target ship has passed clear of own ship, CPA is prefixed with an asterisk such as *1.5NM. TCPA is counted to 99.9 min and beyond this, it is indicated as >*99.9 MIN.



2.2.10 Mode and Length of Vectors

True or Relative Vector

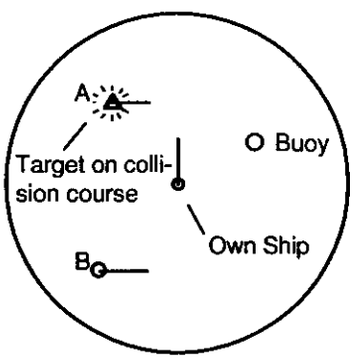
Target vectors can be displayed relative to own ship's heading (Relative) or with reference to the north (True).

Press the VECTOR TRUE/REL key to select true or relative vectors. This feature is available in all presentation modes (Gyrocompass must be working correctly). The current vector mode is indicated at the upper-right corner of the screen.

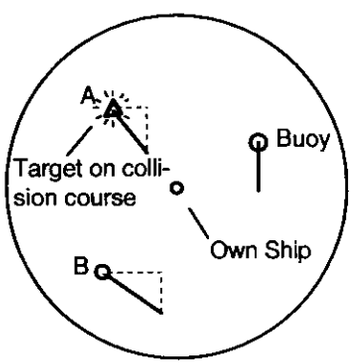
True Vector

With true vectors the radar display will look like the one shown below in Head-up mode.

All fixed targets such as land, navigational marks and ships at anchor are stationary on the radar screen with vector length zero. But in the presence of wind and/or current, true vectors appear on fixed targets representing the reciprocal of set and drift affecting own ship unless set and drift values are properly entered (see paragraph 2.2.12).



(a) True Vectors in Head-up Mode

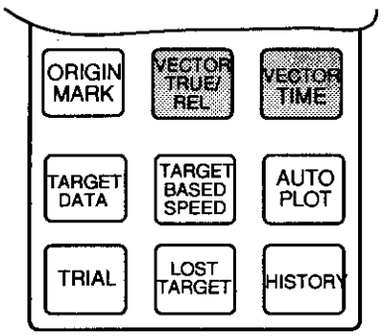


(b) Relative Vectors in Head-up Mode

Relative Vector

With relative vectors the radar display will look like (b).

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. (Dotted lines in the figure are for explanation only.)



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 upper-right corner of the screen.

Press the VECTOR TIME key until the desired vector time is reached. 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.

2.2.11 Past Position Display

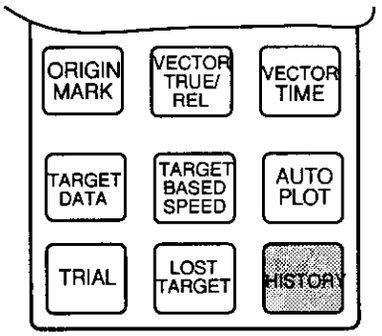
The Auto Plotter displays equally time-spaced dots marking the past positions of any targets being tracked.

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

Displaying and Erasing Past Positions

1. Press the HISTORY key to display past positions of targets being tracked. The label HISTORY appears at the upper-right corner of the screen.

2. To erase the past positions, press the HISTORY key.



Selecting the Number of Dots, Past Position Plot Intervals and Plot Marks

1. Press the E, AUTO PLOT MENU key on the plotting keypad to show the AUTO PLOT 1 menu.

2. Press numeric key [0] to show the AUTO PLOT 2 menu.

3. Press numeric key [2] to select menu item 2 HISTORY POINTS.

4. Further press numeric key [2] to select a desired number of past positions (5, 10, 20, 30, 100, 150 or 200). G-type has the selection of only 5 or 10.

5. Press the ENTER key to confirm your selection.

6. Press numeric key [3] to select menu item 3 HISTORY INTERVAL.

7. Further press numeric key [3] to select a desired past position plot interval (30 seconds, 1, 2, 3 or 6 minutes).

8. Press the ENTER key to confirm your selection.

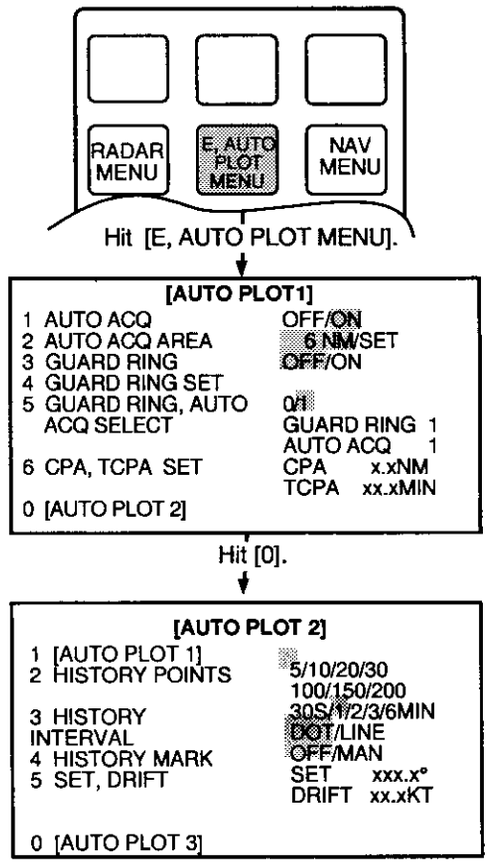
9. Press numeric key [4] to select menu item 4 HISTORY MARK. (R-type only)

10. Further press numeric key [4] to select DOT or LINE option. Note that if you select "DOT," past positions of each target will be marked by dots. If you select "LINE," past positions will be connected by line segments. (R-type only)

11. Press the ENTER key to confirm your selection.

12. Press the E, AUTO PLOT MENU key to close the menu.

Notes: 1) Steps 9 and 10 are applicable to the R-type only.
2) The Auto Plotter can store a maximum of 1000 past positions. If the total number of past positions stored in the memory reaches 1000, the oldest plots will be erased on the first-in-first-out basis.



Notes: 1) Menu item 2 HISTORY POINTS has options of only 5 and 10 points on the G-type.
2))Menu item 4 HISTORY MARK DOT/LINE is available on the R-type. This item is blank on the N - and G-types.

2.2.12 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 Head-up mode with true vectors, watching landmasses, or other stationary targets. If they have vectors, set and drift values should be adjusted until they lose vectors.

Proceed as follows to enter set and drift (rate):

1. Press the E, AUTO PLOT MENU key on the plotting keypad to show the AUTO PLOT 1 menu.

2. Press numeric key [0] to show the AUTO PLOT 2 menu.

3. Press numeric key [5] to select menu item 5 SET, DRIFT.

4. Further press numeric key [5] to select OFF or MAN option.

   OFF: No correction against set and drift.
   MAN: Manual entry of set and drift data.

5. If OFF is selected, press the ENTER key.

6. If you have selected MAN in step 4 above, the highlight cursor will advance one line down requesting you to enter SET xxx.x°. Enter the value of set in degrees by hitting numeric keys without omitting leading zeros, if any, and press the ENTER key.

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

7. Press the E, AUTO PLOT MENU key to close the menu.

   The label LOG on the top of the display changes to SMG xx.x KTBT, where SMG stands for Speed Made Good and BT, Bottom Track.

2.2.13 Setting CPA/TCPA Alarm Ranges

The Auto Plotter ARP-23 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 a preset CPA alarm range and its predicted TCPA less than a preset TCPA alarm limit, the ARP-23 releases an audible alarm and displays a warning label COLLISION on the radar screen. In addition, the target plot 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 and the Auto Plotter is set up so that it can acquire and track targets effectively.

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

Warning!–CPA/TCPA Alarm

The CPA/TCPA alarm feature should never be relied upon as a 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.

Follow the steps shown below to set the CPA/TCPA alarm ranges:

1. Press the E, AUTO PLOT MENU key on the plotting keypad to show the AUTO PLOT 1 menu.

2. Press numeric key [6] to select menu item 6 CPA, TCPA SET. At this point, a highlight cursor appears at the "CPA x.xNM" field.

3. Enter the CPA alarm range in nautical miles (max. 99.9 nm) without omitting leading zeros, if any, and press the ENTER key. The highlight cursor now moves to the "TCPA xx.xMIN" field.

4. Enter the TCPA alarm limit in minutes (max. 99.9 min) without omitting leading zeros, if any, and press the ENTER key.

5. Press the E, AUTO PLOT MENU key to close the menu.

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

the screen until the dangerous situation is gone or you intentionally terminate tracking of the target by using the CANCEL key.

2.2.14 Setting a Guard Ring

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

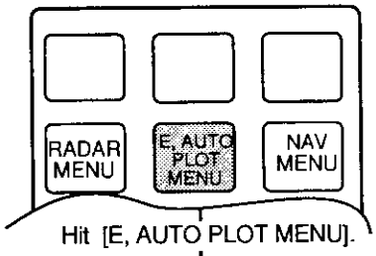
Warning–Guard Ring

The Guard Ring should never be relied upon as a 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.

Activating the Guard Ring

Follow the steps shown below to set and activate the guard ring:

1. Press the E, AUTO PLOT MENU key on the plotting keypad to show the AUTO PLOT 1 menu.



[AUTO PLOT1]

1 AUTO ACQ	OFF/ON
2 AUTO ACQ AREA	6 NM/SET
3 GUARD RING	OFF/ON
4 GUARD RING SET	
5 GUARD RING, AUTO ACQ SELECT	0/1 GUARD RING 1 AUTO ACQ 1
6 CPA, TCPA SET	CPA x.xNM TCPA xx.xMIN

0 [AUTO PLOT 2]

2. Check that "1" is selected at menu item 5 GUARD RING, AUTO ACQ SELECT on the AUTO PLOT 1 menu.

   If not, press numeric key [5] to select menu item 5 GUARD RING, AUTO ACQ SELECT. Further press numeric key [5] to select (or highlight) "1" followed by the ENTER key to enable the guard ring feature.

3. Press numeric key [3] to select menu item 3 GUARD RING.

4. Further press numeric key [3] to select (or highlight) ON to activate the guard ring.

5. Press the ENTER key to confirm your selection.

6. Press numeric key [4] to select menu item 4 GUARD RING SET. At this point the GUARD SETTING menu is displayed at the screen bottom.

[GUARD SETTING]
1 [AUTO PLOT 1]
SET LEFT/RIGHT BOUNDARY
CANCEL PREVIOUS AREA : CANCEL KEY

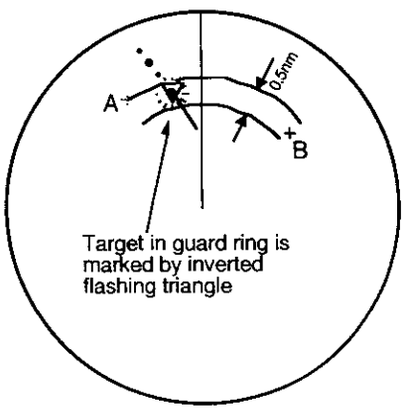
7. Place the cursor at the outer left corner of the area (point A) and press the ENTER key.

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 ring having a 360-degree coverage around own ship, set point B in almost the same direction (approx. ±3°) as point A and press the ENTER key.*

9. Press numeric key [1] followed by the E, AUTO PLOT MENU key to close the AUTO PLOT 1 menu.

The guard ring like an example shown below appears on the display. Note that the guard ring has a fixed radial extension (width) of 0.5 nm.



Deactivating the Guard Ring

1. Press the E, AUTO PLOT MENU key on the plotting keypad to show the AUTO PLOT 1 menu.

2. Press numeric key [3] to select menu item 3 GUARD RING.

3. Further press numeric key [3] to select (or highlight) OFF to deactivate the guard ring.

4. Press the ENTER key to confirm your selection followed by the E, AUTO PLOT MENU key to close the AUTO PLOT 1 menu.

Silencing the Guard Ring Audible Alarm

Press the AUDIO OFF key to acknowledge and silence the guard ring audible alarm.

2.2.15 Operational Warnings

There are six main situations which cause the Auto Plotter to trigger visual and audible alarms.

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

CPA/TCPA Alarm

Visual and audible 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 audible alarm. *(Refer to paragraph 2.2.13 Setting CPA/TCPA Alarm Ranges for further information.)*

Guard Ring Alarm

Visual and audible alarms are generated when a target transits the operator-set guard ring. Press the AUDIO OFF key to acknowledge and silence the guard ring audible alarm. *(Refer to paragraph 2.2.14 Setting a Guard Ring for further information.)*

Lost Target Alarm

When the system detects a loss of a tracked target, the target symbol begins flashing and the indication "LOST" appears at the screen bottom. At the same time, an audible alarm is produced for one second. The plot symbol changes to a diamond (two triangles with the bases merged together).

Press the LOST TARGET key To acknowledge and silence the guard ring audible alarm. The lost target mark disappears and the visual and audible alarms go off.

Target Full Alarm

When the memory reaches full capacity, the memory full status is indicated and the relevant indication appears on the screen associated with a short beep.

Manually Acquired Targets

The indication "MAN TARGET FULL" appears at the screen bottom associated with a short beep tone when the number of manually acquired targets reaches 10 or 30 depending on whether auto acquisition is activated.

Automatically Acquired Targets

The indication "AUTO TARGET FULL" appears at the screen bottom associated with a short beep tone when the number of automatically acquired targets reaches 20.

System Failure Alarm

When the ARP-23 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 audible alarm. The missing signals are denoted as shown below:

Missing Signal	Indication
Speed log signal	LOG
Gyrocompass	GYRO
Trigger signal from radar	T
Video from radar	V
Bearing signal from radar antenna	B
Heading pulses from radar antenna	H

2.2.16 Trial Maneuver

Trial Maneuver in the Auto Plotter ARP-23 simulates the effect on all tracked targets of an own ship maneuver without interrupting the updating of target information.

There are two types of Trial Maneuvers; Dynamic and Static Trial Maneuvers.

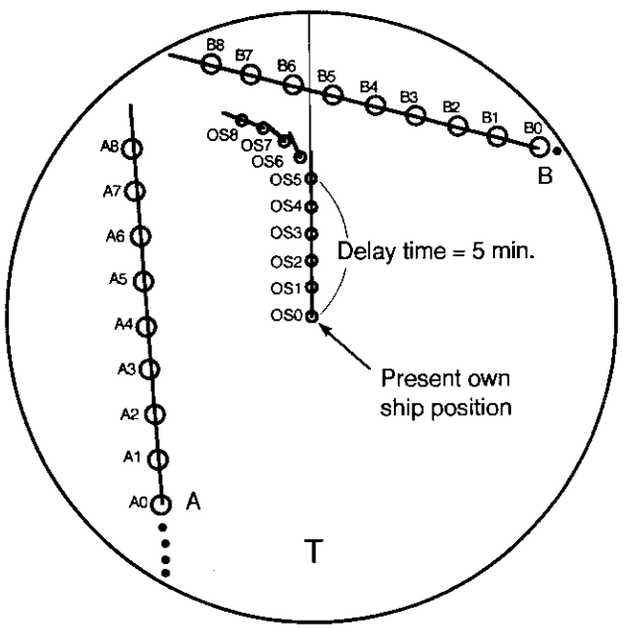
Note: Only Static Trial Maneuver is available on the G-type.

Dynamic Trial Maneuver

A Dynamic Trial Maneuver displays predicted positions of the tracked targets and own ship. You enter own ships' 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 below.

The delay time does not imply "when you will make a maneuver." It represents the time lag up to a point where own ship will 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 in addition to the maneuver time delay when entering the delay time. This is particularly important on large vessels.

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



Dynamic Trial Maneuver — Ship numbers are for explanation only.

It is to be noted 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.

Static Trial Maneuver

A Static Trial Maneuver displays only the final situation. If you enter the same trial speed, course and delay time 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.

Caution–Trial Maneuver

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 initial settings at the time of installation.

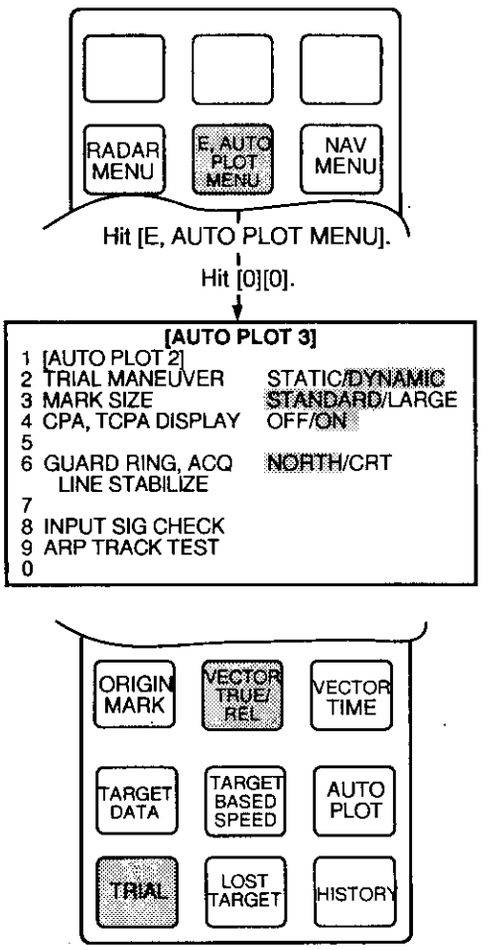
To perform a trial maneuver, follow the steps shown below:

Note: Take steps 6 and 7 for the G-type.

1. Press the E, AUTO PLOT MENU key on the plotting keypad followed by numeric keys [0][0] to show the AUTO PLOT 3 menu.
2. Press numeric key [2] to select 2 TRIAL MANEUVER.
3. Further press numeric key [2] to select (or highlight) STATIC or DYNAMIC trial maneuver option as appropriate.
4. Press the ENTER key to confirm your selection followed by the E, AUTO PLOT MENU key to close the AUTO PLOT 3 menu.
5. Press the VECTOR TRUE/REL key to select true or relative vector.

6. Press the TRIAL key. The indication "TRIAL DATA SETTING" appears at the screen bottom associated with the current own ship's speed and course readouts. 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 numeral 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 the own ship loading and others.



7. Press the TRIAL key again to start a trial maneuver.

Trial maneuver takes place in one minute with the letter "**T**" displayed at the bottom of the radar picture. 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 (Δ) 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 one minute later.

Terminating Trial Maneuver

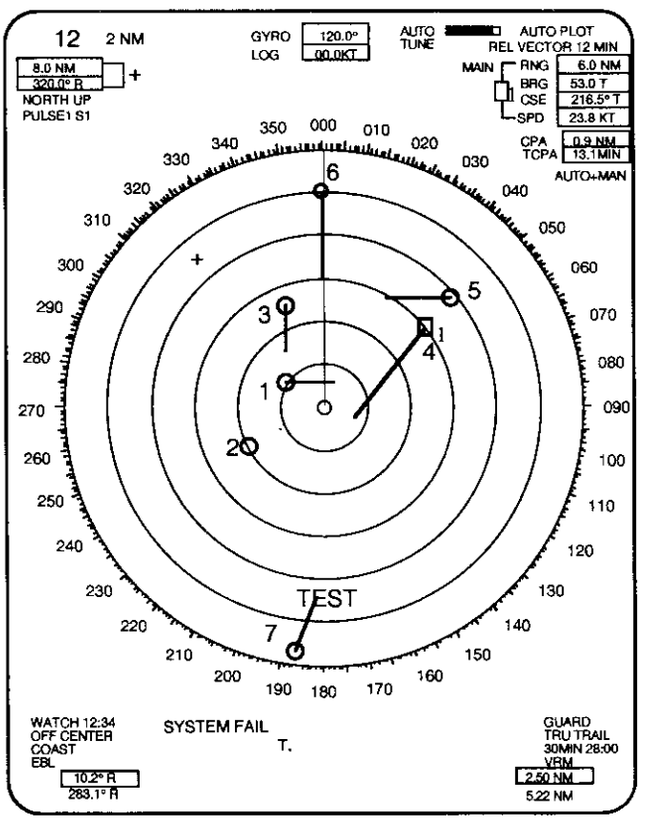
Press the TRIAL key again at any time without waiting for the automatic termination of one minute.

2.2.17 ARP Track Test

A test program called the ARP Track Test is provided for assessing the overall performance of the Auto Plotter. **Note that normal operation is interrupted** and the label "TEST" is displayed at the bottom of the screen during this test.

Proceed as follows to execute the test:

1. Select North-up mode and relative vector presentation on the 12 nm range.
2. **Enter manual speed of 0 knots.**



***Note:** Target numbers are for reference only.*

3. Press the E, AUTO PLOT MENU key on the plotting keypad followed by numeric keys [0][0] to show the AUTO PLOT 3 menu.

4. Press numeric key [9] to select 9 ARP TRACK TEST. A Track Test picture is displayed on the screen.

5. Press the ENTER key to proceed the test.

6. It takes approximately three minutes for all vectors to be displayed. The Track Test display does not need echo signal, gyro or speed log input. Seven targets having various speeds and courses, as shown in the table below, are simulated automatically.

7. The Track Test continues for 5 minutes and then repeats. To terminate the Track Test, turn off the Power Switch. Turn on the Antenna Switch. Perform Quick Start (see page 1.1) if you wish to restore normal radar operation immediately.

CPA and TCPA are initial values.

* invalid value

Target	Course	Speed (knots)	CPA (nm)	TCPA (min.)
Target 1	90.0°T	10.0	1.0	10.4
Target 2	0.0°T	0.0	4.0	*
Target 3	180.0°T	10.0	1.7	28.2
Target 4	216.5°T	23.8	0.9	15.0
Target 5	273.5°T	14.2	6.0	22.5
Target 6	180.0°T	20.0	0.0	30.0
Target 7	24.6°T	15.6	4.0	43.6

To Terminate the Track Test;
Press the ST-BY/TX key and the ST-BY display will appear.

2.3 Video Plotter RP-23

The Video Plotter RP-23 is an optional circuit board which is accommodated in the display unit of the radar.

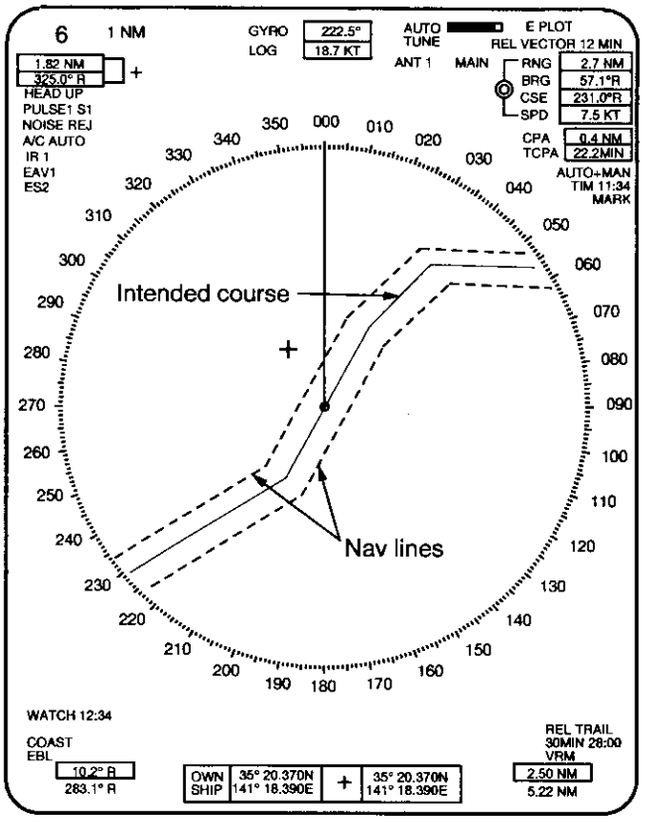
With the RP-23, you can enter navigation lines or reference lines with as many segments and vertexes as required (maximum 25 lines and 30 vertexes per line).

An optional memory card will enable you to display a digital chart on the radar screen, either alone or superimposed on the radar picture.

For additional features and operating details of the RP-23, refer to the separate manual.

NOTE

Some Administrations may not permit a digital chart or map to be drawn on the basic radar presentation, either alone or superimposed on the radar picture, on SOLAS Convention ships. They would require that such information be shown on a separate display.



Nav Lines Produced by Optional Video Plotter RP-23

CHAPTER 3 MAINTENANCE

Danger!—Electrical Shock Hazard

This equipment contains high voltages which can endanger human life at several internal circuits including a cathode ray tube (CRT) which uses several thousands volts. Any internal adjustment, servicing and repair shall only be performed by qualified service personnel totally familiar with electrical circuits and servicing of the equipment. A residual charge remains in capacitors and other devices several minutes after turning off the power. It is therefore essential to wait at least 3 minutes to allow residual charge to subside before accessing the inside of the equipment. Special care must be taken when approaching the following parts:

- Power supply circuit (Display unit and separate power supply units)
- CRT circuit (Display unit)
- Modulator circuit and magnetron (Antenna unit or separate transceiver unit)
- Motor drive circuit (Antenna unit)

When Working on the Antenna Unit

Wear a safety belt and a hard hat when working on the antenna unit. Always make sure that the radar is POWERED OFF and the Antenna Switch in the display unit is OFF before working on the antenna unit. Also take all steps to ensure that the radar will not be accidentally operated by someone else to prevent the potential risk of being struck by the rotating antenna and exposure to RF radiation hazards.

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.

3.1 Periodic Maintenance Schedule

Interval	Check point	Check and Measures	Remarks
Weekly	Display unit	Periodically clean the exterior of display unit using dry soft cloth. Use of commercially available CRT cleaner (spray) having anti-static effect is recommended.	CRT screen produces static charge which would attract dust. DO NOT use strong solvent like paint thinner or abrasive cleaners for cleaning. Dust and dirt on CRT creates symptoms similar to poor sensitivity.

(Cont...)

Interval	Check point	Check and Measures	Remarks
3 to 6 months	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.
	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	CRT and surrounding components 	High voltage at CRT and surrounding components attract dust in environment which will cause poor insulation. **Ask your nearest FURUNO representative or dealer to clean internal high-voltage components.**	If CRT anode rubber cap or wire sheath is cracked, ask your dealer to replace it. **Wait for 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

Part	Type	Life expectancy	Remarks
Antenna motor	RM-8123 (X-band) RM-8124 (X-band) RM-8247 (X-band) RM-7398 (S-band) RM-7435 (S-band)	Gears more than 10,000 hours	Wind load 100 knots
Magnetron	9M752/M5187F (X-band, 25 kW) 9M31/M4505E (X-band, 50 kW) MG5223F (S-band, 30 kW) MG5240 (S-band, 60 kW)	2,000-3,000 hours	

CHAPTER 4 TROUBLESHOOTING

Danger!—Electrical Shock Hazard

This equipment contains high voltages which can endanger human life at several internal circuits including a cathode ray tube (CRT) which uses several thousands volts. Any internal adjustment, servicing and repair shall only be performed by qualified service personnel totally familiar with electrical circuits and servicing of the equipment. A residual charge remains in capacitors and other devices several minutes after turning off the power. It is therefore essential to wait at least 3 minutes to allow residual charge to subside before accessing the inside of the equipment. Special care must be taken when approaching the following parts:

- Power supply circuit (Display unit and separate power supply units)
- CRT circuit (Display unit)
- Modulator circuit and magnetron (Antenna unit or separate transceiver unit)
- Motor drive circuit (Antenna unit)

When Working on the Antenna Unit

Wear a safety belt and a hard hat when working on the antenna unit. Always make sure that the radar is POWERED OFF and the Antenna Switch in the display unit is OFF before working on the antenna unit. Also take all steps to ensure that the radar will not be accidentally operated by someone else to prevent the potential risk of being struck by the rotating antenna and exposure to RF radiation hazards.

Whenever you suspect the radar is not working properly, turn it off and check plug connections at terminal strips and circuit boards. If plug connections are good, proceed to advanced-level troubleshooting beginning on the next page.

If a circuit board is found to be faulty, consult your nearest FURUNO representative or dealer. Do not attempt further component check or repair any circuit board. Careless handling may cause a permanent damage.

4.1 Easy Troubleshooting

This paragraph describes how to cure operational problems, which can be made by observing the radar picture and using operator controls and touchpad keys without opening the display unit, antenna unit or other equipment units.

The table below shows user-level troubleshooting procedures.

Problem	Remedy
Key beep inaudible	Adjust key beep level on RADAR 2 menu referring to paragraph 1.30.
No own ship mark at anchor watch	On the R-type, check that SHIP'S MARK ON is selected at menu item 5 of the RADAR 2 menu referring to paragraph 1.30. Also, own ship information (length, width, etc.) should have been entered in initial settings. Consult your nearest FURUNO representative or dealer for details. On the N-type and G-type, the own ship mark is not available.

4.2 Advanced-level Troubleshooting

This paragraph describes how to cure hardware and software troubles which should be carried out by qualified service personnel.

Notice
This radar equipment contains complex modules in which fault diagnosis and repair down to component level are not practicable by users.

Serviceman Qualification

All adjustments of radio transmitter during or coinciding with the installation, servicing, or maintenance which may affect the proper operation must be performed by or under the immediate supervision and responsibility of a person holding an operator certificate containing a ship radar endorsement.

This is what the U.S. Codes of Federal Regulations part 80.169 implies (not exact extract).

As such, every administration sets forth its own rule; service personnel must be aware of this kind of competency requirements.

Problem	Check point and probable cause	Remedy
Power turned on but radar does not operate all. Control panel is not illuminated either.	1. Blown fuse F1 or F2.	1. Replace blown fuse.
	2. Mains voltage/polarity	2. Correct wirings and input voltage.
	3. Power Supply Board	3. Replace Power Supply Board.
	4. Illumination lamps	4. Replace defective lamps.
CRT brilliance adjusted but no picture	1. RADAR 1/2 menu settings	1. In case of single display installation (without radar interswitching), make sure RADAR 1 is selected on SYSTEM SETTING 1 menu.
	2. CRT voltage	2. Check high voltage supply with utmost care.
	3. RCPU Board	3. Replace RCPU Board.
Antenna not rotating	1. Antenna drive mechanism (Note that the message "BRG SIG MISSING" is displayed in Standby status.)	1. Make sure that there is no short circuit across #1 and #2 of J435 on DTB-8425 Board.
	2. Defective antenna drive motor relay (thermal relay K2 200/220/380, 440/100 VAC)	2. Press relay reset button.
	3. DTB-8425	3. Check that Antenna Switch is on.
Alphanumeric data and marks are not displayed in Transmit status.	1. AD Board	1. Replace AD Board.
	2. RCPU Board	2. Replace RCPU Board.

(Cont...)

Problem	Check point and probable cause	Remedy
Adjust GAIN control with A/C SEA control set at minimum. Marks and legends appear but no noise or echo.	1. IF amplifier	1. Replace IF amplifier.
	2. Multiconductor cable between antenna and display	2. Check continuity and isolation of coaxial cable. *(Note: Disconnect the plug and lugs at both ends of coaxial cable before checking it by ohmmeter.)*
	3. Video Amplifier Board	3. Check video coax line for secure connection. If connection is good, replace Video Amplifier Board.
Marks, legends and noise appear but no echo. (Transmission leak, representing own ship position, is absent.)	1. TX fuse F801 (Transceiver module)	1. If fuse is blown replace it. If it blows again the magnetron or modulator circuit may be defective.
	2. Magnetron	2. Check magnetron current with the check meter in the sub panel. Replace magnetron.
	3. Modulator Board	3. Replace Modulator Board.
	4. Modulator SCR	4. Replace SCR. **DANGER! – High voltage.**
	5. AD Board	5. Replace AD Board.
Picture not updated	1. Bearing Signal Generator Board (Scanner Unit)	1. Check the connection of multiconductor cable.
	2. AD Board	2. Replace AD Board.
	3. Video lockup	3. Turn off and on radar using Quick Start procedure (see page 1.1).
Incorrect orientation of picture	1. AD Board	1. The message "HD SIG MISSING" appears on the screen when heading pulse is not received during ST-BY.
	2. RCPU Board	2. Replace RCPU Board.
	3. Gyro Interface	3. Replace gyro interface.

(Cont...)

Problem	Check point and probable cause	Remedy
TUNE control adjusted but poor sensitivity	1. Deteriorated magnetron	1. With radar transmitting on 48 mm range, check magnetron current with check meter. If current is below normal value, magnetron may be defective. Replace magnetron.
	2. Detuned MIC	2. Check MIC detecting current with check meter. If it is below normal value, MIC may have become detuned. MIC must be tuned.
	3. Dirt on radiator face	3. Clean radiator surface.
	4. Water ingress to the waveguide or other finder line.	4. Remove water from the feeder line.
	5. Second-trace rejection is ON.	5. Disable the second-trace rejector referring to paragraph 1.34.
Range changed but no radar picture change	1. Defective RANGE key	1. Try to hit [+] and [-] Range keys several times. If unsuccessful, replacement of keypad may be required.
	2. AD Board	2. Replace AD Board.
	3. RCPU Board	3. Replace RCPU Board.
	4. Mother Board	4. Replace Mother Board.
	5. Video lockup	5. Turn off and on radar using Quick Start procedure (see page 1.1).
Interference rejector inoperable (interference rejection level not displayed)	1. Bad contact of key	1. Repair contact of key.
	2. AD Board	2. Replace AD Board.
	3. Mother Board	3. Replace mother board.
Echo Stretch ineffective (Neither "ES1" nor "ES2" is displayed.)	1. Bad contact of key	1. Replace keypad.
	2. AD Board	2. Replace AD Board.
Only 2 parallel index lines (6 lines wanted)	1. Incorrect setting index line interval	1. Set index line interval referring to paragraph 1.24.
Range rings are not displayed.	1. Press [RING] key to see intensity is increased.	1. Replace associated circuit board if unsuccessful.
	2. Bad contact of key	2. Replace keypad.
	3. RCPU Board	3. Replace RCPU Board.
Key beep inaudible	1. Improper setting on RADAR 2 menu	1. Adjust key beep level on RADAR 2 menu referring to paragraph 1.30.

(Cont...)

Problem	Check point and probable cause	Remedy
Poor discrimination at range	1. Sea clutter control not functioning properly	1. Improper setting of A/C Sea control. If A/C Sea effect is seen only at very close range, suspect inaccurate frequency of crystal oscillator.
True Motion presentation not working correctly	1. Poor contact of MODE key.	1. Try to press MODE key a little harder.
	2. Selection is not accessed	2. Press MODE key until "TM" appears at upper-left corner on screen.
	3. Speed entry is incorrect.	3. Enter correct own ship speed referring to paragraph 1.22.
	4. TM display inaccurate	4. Make sure that speed and compass inputs are accurate.
Target not tracked correctly	1. Poor definition of targets in sea clutter	1. Adjust A/C Sea and A/C Rain controls referring to paragraphs 1.11 and 1.12.

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 on the plotting keypad to show the FUNCTIONS menu.

2. Press numeric key [0][0] to show the SYSTEM SETTING 2 menu.

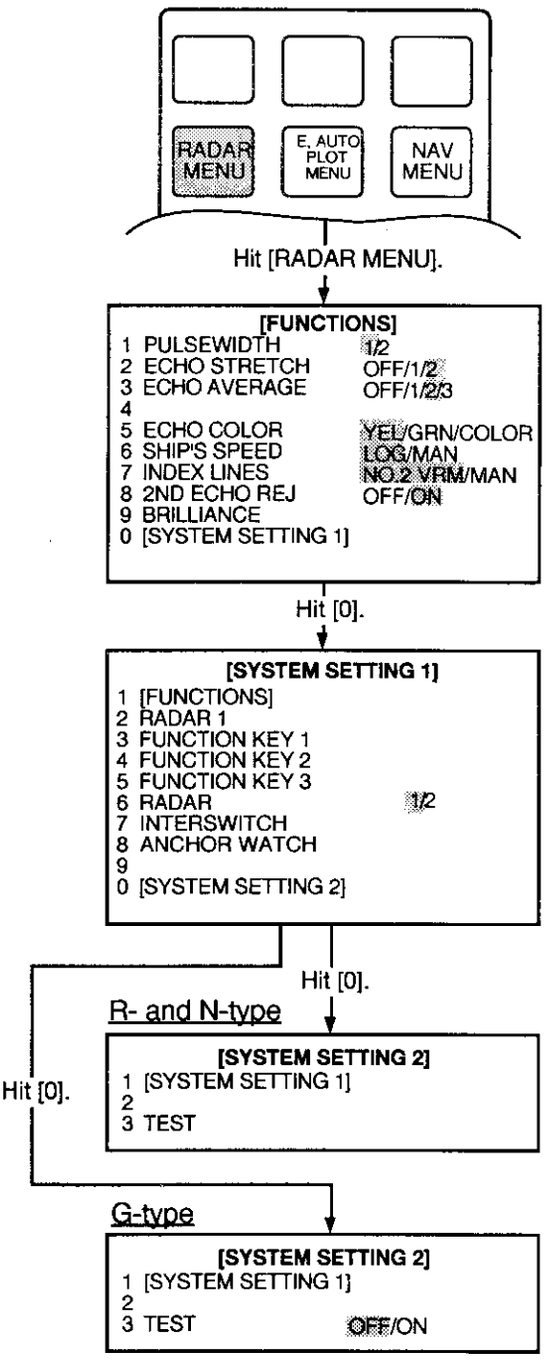
3. On the R-type and N-type, press numeric key [3] to select menu item 3 TEST. Then, press the ENTER key.

   On the G-type, press numeric key [3] to select menu item 3 TEST. Then, press numeric key [3] again to highlight select TEST ON, followed by the ENTER key.

   Now, the diagnostic test is executed and the screen shows test results as shown on the next page.

4. To terminate the diagnostic test, turn off the Power Switch. Perform Quick Start (see page 1.1) if you wish to restore normal radar operation immediately.

Small squares displayed at the right and bottom of the test result screen are for testing the switches and touchpad keys in the hinged compartments of the display unit and on the operator control panel. As you operate these switches and touchpad keys, corresponding squares are highlighted, indicating that your switch/key operations are properly recognized.



```
FR-2100 TEST
      PROGRAM NO ROM RAM  CRAM  DIPSW
MAIN XXXXXXXXXXX  OK  OK    OK  1111
SUB   XXXXXXXXXX  OK  OK

ARP   XXXXXXXXXX  OK  OK    OK  0000
DSP   XXXXXXXXXX  OK  OK    OK

RP    XXXXXXXXXX  OK  OK    OK  1000
     DRAM
     RP BOARD BAT OK
     RP CARD1     OK  CARD2      OK
VRAM  1 2 3 4 5 6 7 8
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(These squares are for ST-BY, DEGAUSS and AUTO/MAN TUNE switches from left.)

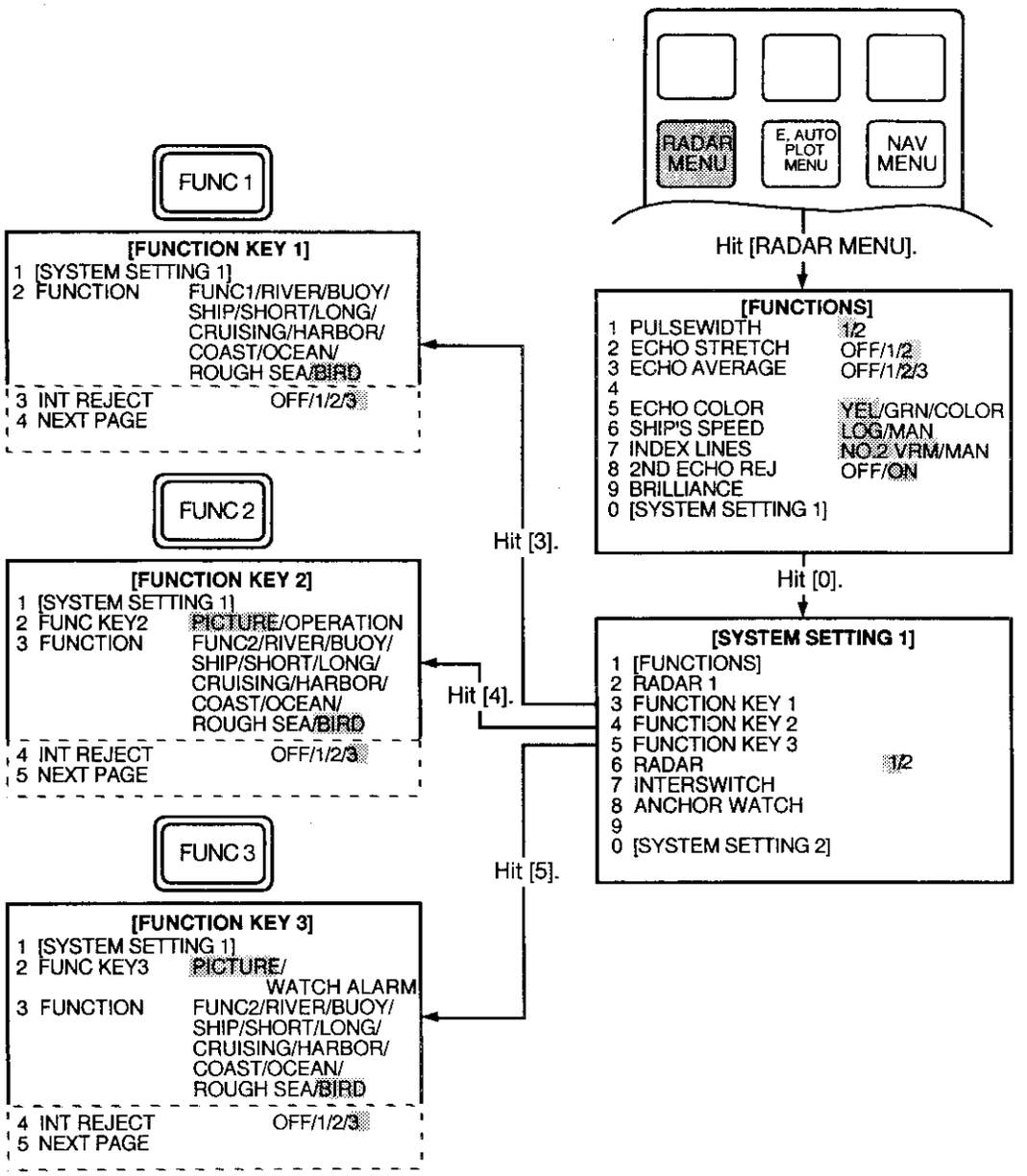
(Squares are highlighted as corresponding keys are pressed.)

(Two lines at the bottom are for operator control panel.)

APPENDIX I SPECIAL FEATURES FOR FISHING VESSELS

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

If the BIRD option is menu-selected at the time of installation, the corresponding Function Key is labeled "BIRD". Press the Function Key "BIRD" and the radar will be set 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.



***Note:** Items enclosed by dashed lines should be left to the original settings. For further information, contact your nearest FURUNO representative or dealer.*

APPENDIX II MENU TREE

Main menu

FUNCTION
- 1. PULSE WIDTH (1,2)
- 2. ECHO STRETCH (OFF, 1, 2)
- 3. ECHO AVERAGE (OFF, 1,2, 3)
- 5. ECHO COLOR (YER, GRN, COLOR)
- 6. SHIP'S SPEED (LOG, NAV, MAN)
- 7. INDEX LINES (NO.2 VRM, MAN)
- 8. 2ND ECHO REJ (OFF, ON)
- 9. BRILLIANCE
  - 1. [FUNCTIONS]
  - 2. CHAR BRILL (DIM, M1, M2, BRT)
  - 3. MARKS BRILL (DIM, M1, M2, BRT)
  - 4. TRAILS BRILL (DIM, M1, M2, BRT)
  - 5. PANEL DIMMER (OFF, DIM, M, BRT)
  - 6. +CURSOR BRILL (OFF, DIM, M, BRT)
  - 7. PLOT BRILL (OFF, DIM, M, BRT)
  - 8. HDG MARK BRILL (DIM, M, BRT)
  - 9. L/L GRID BRILL (DIM, M1, M2, BRT)
  - 0. CHART BRILL (DIM, M1, M2, BRT)
- 0. [SYSTEM SETTING 1]

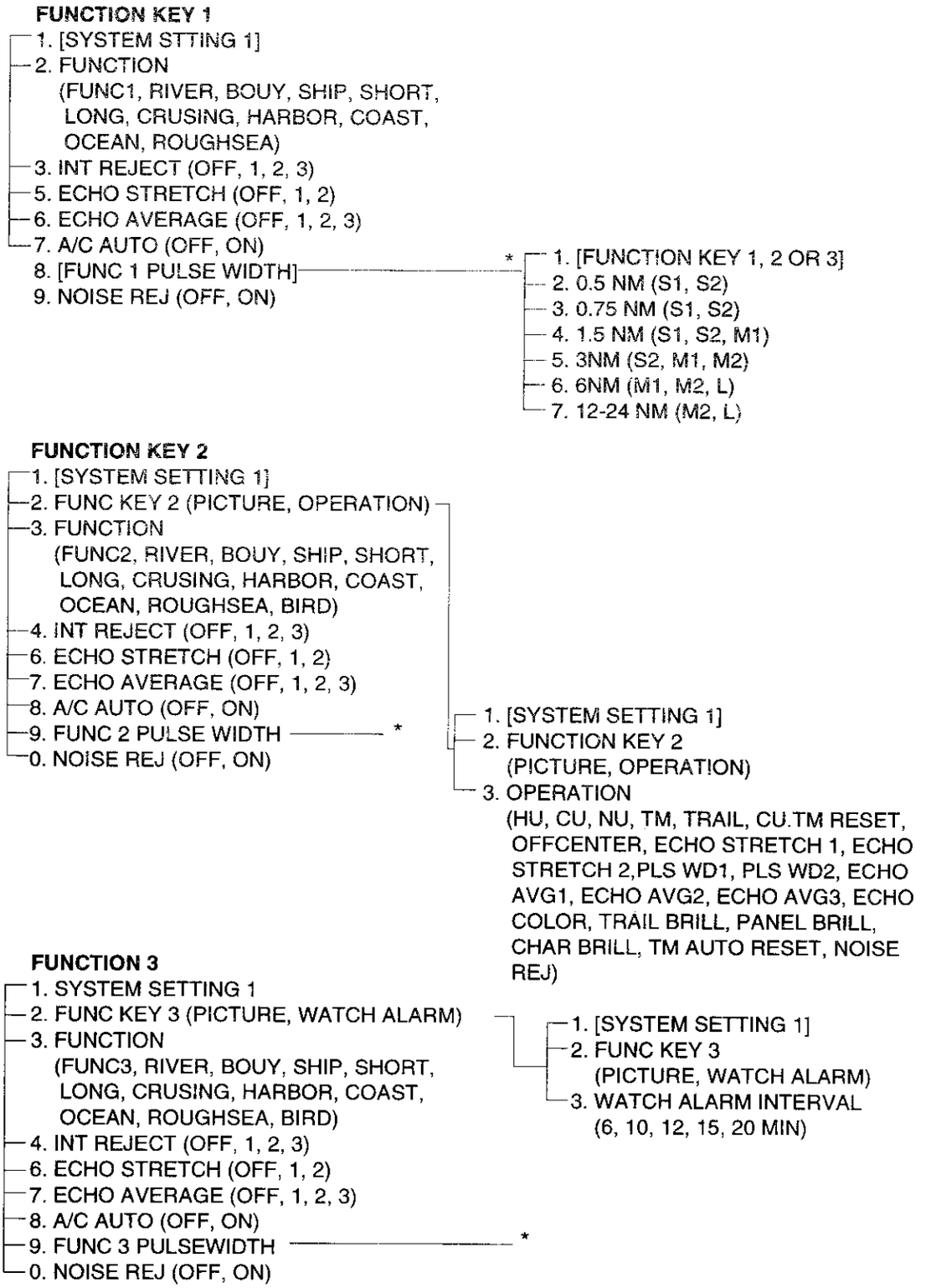
SYSTEM SETTING 1
- 1. [FUNCTIONS]
- 2. RADAR 1
- 3. FUNCTION KEY 1
- 4. FUNCTION KEY 2
- 5. FUNCTION KEY 3
- 6. RADAR (1, 2)
- 7. INTER SWITCH *(On connecting with RJ-5, 7 or 8)*
- 8. ANCHOR WATCH
  - 1. [SYSTEM SETTING 1]
  - 2. ANCHOR WATCH (OFF, ON)
  - 3. ALARM (OFF, ON)
  - 4. ALARM RANGE (x.xxx NM)
  - 5. HISTORY (OFF, ON)
- 0. [SYSTEM SETTING 2]

SYSTEM SETTING 2
- 1. [SYSTEM SETTING 1]
- 2. INITIAL SETTING *(See the Installation Manual.)*
- 3. TEST

RADAR 1
- 1. [SYSTEM SETTING 1]
- 2. NO. 1 EBL (REL, TRUE)
- 3. NO. 2 EBL (REL, TRUE)
- 6. TRAIL REF (REL, TRUE)
- 7. TRAIL GRAD (SGL, MULT)
- 8. [PULSE WIDTH 1]
- 9. [PULSE WIDTH 2]
  - 1. [RADAR 1]
  - 2. 0.5 NM (S1, S2)
  - 3. 0.75 NM (S1, S2)
  - 4. 1.5 NM (S1, S2, M1)
  - 5. 3 NM (S2, M1, M2)
  - 6. 6 NM (M1, M2, L)
  - 7. 12-24 NM (M2, L)
- 0. [RADAR 2]

RADAR 2
- 1. [RADAR 1]
- 2. +CURSOR REF (REL, TRUE)
- 3. NOISE REJ (OFF, ON)
- 4. STERN MARK (OFF, ON)
- 5. SHIP'S MARK (OFF, ON)
- 6. GUARD ALARM (IN, OUT)
- 7. KEY BEEP (L, M, H)
- 8. AUDIO ALARM (L, M, H)
- 9. RADAR NO. (1, 2)
- 0. BEARING SCALE (OFF, ON)

Function key



PLOT and NAV menu

PLOT

AUTO PLOT 1

- 1. AUTO ACQ (OFF, ON)
- 2. AUTO ACQ AREA (6 NM, SET) ——— 1. AUTO PLOT 1
- 3. GUARD RING (OFF, ON)
- 4. GUARD RING SET (YER, GRN, COLOR) ——— 1. AUTO PLOT 1
- 5. GUARD RING, AUTO (0, 1)
  ACQ SELECT (GUARD RING1/AUTO ACQ1, GUARD RING 0 /AUTO ACQ 2)
- 6. CPA, TCPA SET (CPA x.xNM, TCPA xx.x min)
- 0. [AUTO PLOT 2]

E-PLOT

- 1. MARK (STD, LARGE)

AUTO PLOT 2

- 1. [AUTO PLOT 1]
- 2. HISTORY POINTS
  (5, 10, 20, 30, 100, 150, 200)
- 3. HISTORY INTERVAL
  (30S, 1, 2, 3, 6 MIN))
- 4. HISTORY MARK (DOT, LINE)
- 5. SET, DRIFT (OFF, MAN)
  (SET xxx.x°, DRIFT xx.xKT)
- 0. AUTO PLOT 3

AUTO PLOT 3

- 1. [AUTO PLOT 2]
- 2. TRIAL MANEUVER
  (STATIC, DYNAMIC)
- 3. MARK SIZE (STANDARD, LARGE)
- 4. CPA, TCPA DISPLAY (OFF, ON)
- 6. GUARD RING, ACQ LINE STABILIZED
  (NORTH, CRT)
- 8. INPUT SIG CHECK
- 9. ARP TRACK TEST

NAV

NAV INFORMATION 1

- 2. SELECT NAVAID
  (GPS, LORAN-C, LORAN-A, DECCA, OMEGA, DEAD RECKONING (NAV), DEAD RECKONING, ALL, OFF)
- 3. NAV LINE
- 4. OWN SHIP POSN (OFF, L/L)
- 5. POSN (xx°xx.xxx N/S, xxx°xx.xxx E/W)
- 0. [NAV INFORMATION 2]

NAV LINE

- 1. [NAV INFORMATION 1]
- 2. NAV LINE (OFF, ON)
- 3. NAV WIDTH DATA (OFF, EXT, INT)
- 4. NAV WIDTH (x.xx NM)
- 5. WPT.NO. (OFF, ON)
- 6. WPT (WPT xx)
  xx -> • -> xx -> (xx) -> (xx)
- 7. NAV LINE DATA (INT, EXT)
- 8. ARRIVAL ALARM (OFF, ON x.xx NM)
- 9. TURNING LINE (OFF, ON, REVISED)

NAV INFORMATION 2

- 1. [NAV INFORMATION 1]
- 2. +CURSOR DATA (OFF, L/L)
- 3. WPT DATA (OFF, REL, TRUE)
- 4. WIND DATA (OFF, ON)
- 5. WIND GRAPH (OFF, ON)
- 6. WIND UNIT (M, S, KT)
- 7. CURRENT DATA (OFF, ON)
- 8. CURRENT GRAPH (OFF, ON)
- 0. [NAV INFORMATION 3]

NAV INFORMATION 3

- 1. [NAV INFORMATION 2]
- 2. DEPTH DATA (OFF, ON)
- 3. DEPTH GRAPH (OFF, ON)
- 4. DEPTH SCALE (10, 20, 50, 100, 200, 500)
- 5. DEPTH UNIT (M, FT, FA)
- 6. WATER TEMP (OFF, ON)
- 7. RUDDER ANGLE (OFF, ON)
- 8. TURN RATE (OFF, ON)
- 9. TURN RATE SCALE (30, 90, 180, 300)
- 0. DATE (OFF, UTC, LOCAL)