

FURUNO

OPERATOR'S MANUAL

MARINE RADAR

MODEL FAR/FR-2805 Series

Radar

- FR-2815
- FR-2825
- FR-2855
- FR-2825W
- FR-2855W
- FR-2835S
- FR-2835SW
- FR-2865SW

ARPA

- FAR-2815
- FAR-2825
- FAR-2855
- FAR-2825W
- FAR-2855W
- FAR-2835S
- FAR-2835SW
- FAR-2865SW
- FA-2805

Basic Spec.

- X-band, 10 kW, TR up
- X-band, 25 kW, TR up
- X-band, 50 kW, TR up
- X-band, 25 kW, TR down
- X-band, 50 kW, TR down
- S-band, 30 kW, TR up
- S-band, 30 kW, TR down
- S-band, 60 kW, TR down
- Add-on ARPA

Your model is ticked in the box above.



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NISHINOMIYA, JAPAN

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(YOSH)

PUB. No. OME-34040
FAR/FR-2805 SERIES

•Your Local Agent/Dealer

FIRST EDITION : AUG 1995
U : NOV. 8, 1999





SAFETY INSTRUCTIONS

WARNING

Radio Frequency Radiation Hazard

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

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

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

Model	Radiator type	Distance to 100 W point	Distance to 10 W point	RF power density on antenna aperture
FR-2815- (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-2825/2825W (X-band, 25 kW)	XN2 (4')	Worst case 0.6 m*	Worst case 3.25 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-2835S/2835SW (S-band, 30 kW)	SN5AF (9')	Nil	1.06 m	20.0 W/m ²
	SN7AF (12')	Nil	0.5 m	16.0 W/m ²
FR-2855/2855W X-band,50KW	XN3A (6.5')	Nil	2.0m	76.0 W/m ²
	XN4A (8')	Nil	1.9m	64.0W/m ²
	XN5A (10')	Nil	1.8m	50.0W/m ²
FR-2865SW (S-band, 60kW)	SN5AF (9')	Nil	1.2 m	46.0 W/m ²
	SN7AF (12)	Nil	1.0 m	40.0 W/m ²

*UK DRA measured on FR-2810/2820 with NARDA 8616. Other values by FURUNO.



WARNING



ELECTRICAL SHOCK HAZARD Do not open the equipment.

Only qualified personnel should work inside the equipment.



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

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



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

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

Do not disassemble or modify the equipment.

Fire, electrical shock or serious injury can result.

Turn off the power immediately if water leaks into the equipment or the equipment is emitting smoke or fire.

Continued use of the equipment can cause fire or electrical shock.



WARNING

Use the proper fuse.

Fuse rating is shown on the equipment. Use of a wrong fuse can result in equipment damage.

Keep heater away from equipment.

Heat can alter equipment shape and melt the power cord, which can cause fire or electrical shock.

Do not place liquid-filled containers on the top of the equipment.

Fire or electrical shock can result if a liquid spills into the equipment.

Do not operate the equipment with wet hands.

Electrical shock can result.

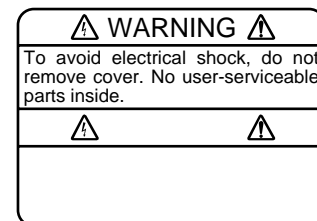
Keep heater away from equipment.

Heat can alter equipment shape and melt the power cord, which can cause fire or electrical shock.



CAUTION

A warning label is attached to the equipment. Do not remove the label. If the label is missing or illegible, contact a FURUNO agent or dealer.



Name: Warning Label (1)
Type: 86-003-1011-0
Code No.: 100-236-230

TABLE OF CONTENTS

INTRODUCTION

A Word to the Owner of FURUNO Radar	v
About This Manual	vi
Features	vii
Specifications	ix
SYSTEM CONFIGURATION	xii

1. OPERATION

1.1 Turning on the Power	1-1
1.2 Transmitter ON	1-1
1.3 Controls	1-2
1.4 CRT Brilliance	1-6
1.5 Tuning the Receiver	1-6
1.6 On-screen Legends and Markers	1-7
1.7 Degaussing the CRT Screen	1-8
1.8 Initializing the Gyro Readout	1-9
1.9 Presentation Modes	1-9
1.10 Selecting the Range Scale	1-12
1.11 Selecting the Pulswidth	1-12
1.12 Adjusting the Sensitivity	1-14
1.13 Suppressing Sea Clutter	1-14
1.14 Suppressing Precipitation Clutter	1-15
1.15 Interference Rejector	1-15
1.16 Measuring the Range	1-16
1.17 Measuring the Bearing	1-16
1.18 Collision Assessment by Offset EBL	1-17
1.19 Measuring Range and Bearing Between Two Targets	1-18
1.20 Setting a Guard Zone (Guard Alarm)	1-18
1.21 Off-Centering	1-19
1.22 Echo Stretch	1-20
1.23 Echo Averaging	1-21
1.24 Electronic Plotting (EPA)	1-22
1.25 Target Trails (Echo Trails)	1-24
1.26 Parallel Index Lines	1-26
1.27 Anchor Watch	1-28
1.28 Origin Mark	1-29
1.29 Zoom	1-30
1.30 Markers	1-30
1.31 Menu Keys	1-31
1.32 RADAR 1 and 2 Menu Settings	1-32
1.33 Function Keys	1-34
1.34 EPA Menu	1-40
1.35 NAV INFORMATION Menu and Navigation Data Display	1-41
1.36 Radar Map	1-42

1.37 Suppressing Second-trace Echoes	1-43
1.38 Adjusting Relative Brilliance Levels of Screen Data	1-44
1.39 Set and Drift (Set and Rate)	1-45
1.40 Display of Ancillary Information	1-45
1.41 Alarms	1-47

2. OPERATION OF ARPA

2.1 General	2-1
2.2 Keys Used for ARPA	2-1
2.3 ARPA Menu Operation	2-2
2.4 Start-up Procedure	2-3
2.5 Automatic Acquisition	2-4
2.6 Manual Acquisition	2-7
2.7 Changing Plot Symbol Size	2-7
2.8 Adjusting Brilliance of Plot Marks	2-10
2.9 Displaying Target Data	2-10
2.10 Mode and Length of Vectors	2-11
2.11 Past Position Display	2-11
2.12 Setting CPA/TCPA Alarm Ranges	2-12
2.13 Setting a Guard Zone	2-13
2.14 Operational Warnings	2-14
2.15 Trial Maneuver	2-15
2.16 ARPA Track Test	2-17
2.17 Criteria for Selecting Targets for Tracking	2-18
2.18 Factors Affecting ARPA Functions	2-19

3. RADAR OBSERVATION

3.1 General	3-1
3.2 False Echoes	3-2
3.3 SART (Search and Rescue Transponder)	3-3
3.4 RACON (Radar Beacon)	3-4

4. MAINTENANCE

4.1 Periodic Maintenance Schedule	4-1
4.2 Life Expectancy of Major Parts	4-2

5. TROUBLESHOOTING

5.1 Easy Troubleshooting	5-1
5.2 Advanced-level Troubleshooting	5-2
5.3 Diagnostic Test	5-5

APPENDIX

A.1 Performance Monitor	A-1
A.2 For Fishing Vessel	A-2
A.3 Navigation Data (IEC-1162-1)	A-3
A.4 Sentence Description	A-7

MENU TREE MN-1

Declaration of conformity to type

INTRODUCTION

A Word to the Owner of FURUNO Radar

Thank you for purchasing this FURUNO radar and/or ARPA. 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 50 years, FURUNO Electric Company has gained an unrivaled reputation as a world leader in the industry. This is the result of our technical excellence as well as our worldwide distribution and service network.

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

FR-2805 Series

The FR-2805 Series are available in the following two types:

Regular type and IMO type

The Regular type is for fishing boats and pleasure boats where some more functions are provided in addition to the functions of IMO type.

Note: You can easily recognize which type your radar/ARPA is by looking at the range scale provided.

The FURUNO FR-2805 Series of radars are designed to meet the exacting requirements of international and national standards and regulations including:

- IMO MSC-64 (67) Annex 4: Performance Standards for Radar Equipment
- IMO A.477 (XII): Performance Standards for Radar Equipment
- A. 694 (17): General requirements for shipborne radio equipment forming part of the global maritime distress and safety system (GMDSS) and for electronic navigation aids
- IEC 60936-1: Shipborne Radar Operational and Performance Requirements
- IEC 60936-2: Radar for HSC (X-band 42 rpm type)
- IEC 60945: Marine Navigational Equipment General Requirements

FAR-2805 Series ARPA

There are also Regular type and IMO type as in the FR-2805-I series radars. The IMO type ARPA complies with the following (Regular type also complies with but includes more additional functions convenient for practical uses in fishing):

- IMO Resolution A.823 (19): Performance standards for Automatic Radar Plotting Aids
- A. 694 (17): General requirements for shipborne radio equipment forming part of the global maritime distress and safety system (GMDSS) and for electronic navigation aids
- Results of NAV 40/WP.3/Add. I which is to be met for new building on or after January 1, 1997
- IEC 60945:1996-11: Marine Navigational Equipment General Requirements
- US Navigation safety regulations, Labeling requirement in § 164.38(d)(1) of CFR33

"This device was designed and manufactured to comply with the International Maritime Organization (IMO) Performance Standards for Automatic Radar Plotting Aids (ARPA)."



If your ship is 10,000 or more gross tons and scheduled to operate in the navigable waters of the United States, make sure the above label is attached on the ARPA. Otherwise please make one yourself by typing and gluing overleaf with the transparent seal.

About This Manual

This manual is designed to provide information on operation and maintenance of the FR-2805-I series radars as well as fault diagnosis and troubleshooting procedures which 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.

Categorization by specification

See the table on the next page.

Item	IMO-type	R-type
Range Scales	0.125, 0.25, 0.5, 0.75, 1.5, 3, 6, 12, 16, 24, 48, 96 nm	FR-2805 and FAR-2805 0.125, 0.25, 0.5, 0.75, 1.5, 3, 6, 12, 24, 48, 72nm Other models: 0.125, 0.25, 0.5, 0.75, 1.5, 3, 6, 12, 16, 24, 32, 48, (72) 120 nm
Guard Zone	IRange depth fixed to 0.5 nm with both outer and inner limits settable between 3 and 6 nm.	Inward (CZ) or outward (Anchor) guard alarm selectable. Outer and inner limits can be set at any distance from own ship. ARPA guard ring: Outer limit: 0.7-32 nm Width of ring: 0.5 nm Sector angle: 1-360°
Off-centering	Up to 75% of range in use in any direction	Up to 100% of range in use in any direction
Anchor Watch	Available in stand-by only	Available in either stand-by or transmit status
Own Ship Mark	Standard mark	Displayed when Anchor Watch is activated. (Entry of ship data required.)
x2 Zoom	No	Yes
Stern Marker	No	Yes

Features

The new FR-2805 series of radar and the FAR-2805 series of ARPAs are the results of combination of the FURUNO's many years of experience in the marine field and the advanced computer technology. The FR-2805 series and FAR-2805 series are designed to fully meet the exacting rules of the International Maritime Organization (IMO) for installations on all classes of vessels.

The display unit employs a 28" diagonal high-resolution green-phosphor CRT. It provides an effective radar picture of 360 mm diameter leaving sufficient space for on-screen alphanumeric data.

Target detection is enhanced by the sophisticated signal processing technique such as multi-level quantization (MLQ), echo stretch, echo average, and a built-in radar interference rejector. Audible and visual guard zone alarms are provided as standard. Other ship's movement is assessed by trails of target echoes or by electronic plotting. The FAR-2805 series ARPA further provides target assessment by historical plots, vectors and target data table.

On-screen data readouts include CPA, TCPA, range, bearing, speed/course of own ship and up to 3 targets. The ARPA functions include automatic acquisition of up to 20 targets, or manual acquisition of 40 targets. In addition, the ARPA features display of a traffic lane, buoys, dangerous points, and other important reference points.

General features

- Daylight-bright high-resolution display
- 28" diagonal CRT presents radar picture of 360 mm effective diameter with alphanumeric data area around it
- User friendly operation by combination of tactile backlit touchpads, a trackball and rotary controls
- Audio-visual alert for targets in guard zone
- Echo trail to assess targets' speed and course by simulated afterglow
- Electronic plotting of up to 10 targets in different symbols (This function is disabled when ARPA is activated.)
- Electronic parallel index lines
- Interswitch (optional) built in radar or ARPA display unit
- Enhanced visual target detection by Echo Average, Echo Stretch, Interference Rejector, and multi-level quantization
- Stylish display
- Choice of 10, 25 or 50 kW output for X-band; 30 kW output for S-band, either in the transceiver aloft (gearbox) or RF down (transceiver in bridge)
- Exclusive FURUNO MIC low noise receiver

ARPA features

- Acquires up to 20 targets automatically plus up to 20 targets manually, or all 40 targets manually
- Movement of tracked targets shown by true or relative vectors. (Vector length 1 to 99 min. selected in 1 min. steps.)
- Setting of nav lines, buoy marks and other symbols to enhance navigation safety
- On-screen digital readouts of range, bearing, course, speed, CPA (Closest Point of Approach), TCPA (Time to CPA), BCR (Bow Crossing Range) and BCT (Bow Crossing Time) of 2 targets out of all tracked targets.
- Audible and visual alarms against threatening targets coming into operator-selected CPA/TCPA limits, lost targets, targets, two guard rings, visual alarm against system failure and target full situation

Specifications

ANTENNA RADIATORS

1. Type

Slotted waveguide array

2. Beamwidth and sidelobe attenuation

Band	X-band				S-band
	Radiator type	XN3	XN3A	XN4A	XN5A
Beamwidth (Hor.)	1.23°	1.23°	0.95°	0.75°	1.9°
Beamwidth (Ver.)	25°	20°	20°	20°	25°
Sidelobe att within ±10°	24 dB	28 dB	28 dB	26 dB	25 dB
Sidelobe att outside ±10°	30 dB	32 dB	32 dB	30 dB	30 dB

* 9 ft radiator SN5AF available for NON-solas ships.
(Beamwidth 2.3°H, 25°V, Sidelobe attenuation 20 dB)

3. Polarization

Horizontal

4. Rotation

26 rpm (60 Hz), 21 rpm (50 Hz)

RF TRANSCEIVER

1. Frequency

X-band: 9410 MHz ±30 MHz
9415 MHz ±30 MHz(50kW)
S-band: 3050 MHz ±30 MHz

2. Output power

FR/FAR-2815: 10 kW
FR/FAR-2825/2825W: 25 kW
FR/FAR-2855-I/2855W: 50 kW
FR/FAR-2835S-I/2835SW: 30 kW
FR/FAR-2865SW: 60 kW

3. Pulselength/PRF

FR/FAR-2815/2825

Range(nm)	Pulselength (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	1.2	600
96	1.2	500

Other models:

Range (nm)	Pulselength (µs)	PRR (Hz)
.125, .25, .5	0.08	2200
0.75, 1.5	0.08/0.3*	2200
3	Two from 0.08, 0.3, 0.6	2200/1100
6	Two from 0.3, 0.6, 1.2	2200/1100
12, 24	0.6, 1.2	1000/600
48	1.2	600
96	1.2	500

*: 0.2 for 2855/2855W/2865SW

4. I.F.

60 MHz, Logarithmic
S1: 28 MHz
S2: 4.5 MHz (FR/FAR-2815/2825)
Middle/long pulse: 3 MHz

5. Duplexer

Ferrite circulator with diode limiter for FR/FAR-2825/2835S/2835SW
Ferrite circulator with TR limiter for FR-2825W/2855W/2865SW

6. Noise figure

FR/FAR-2815/2825/2825W/2855/2855W/
2835S: 6 dB
FR/FAR-2835SW: 4 dB
FR/FAR-2865SW: 4.5 dB

RADAR DISPLAY

1. Picture tube

28" color CRT, Effective radar dia. 360 nm
IMO type: Yellow or green echoes in 16 levels
R-type: Yellow or green echoes in 16 levels or
3 colors depending on echo strengths
Different color for VRM, range rings, alarms,
etc.
Raster scan at scanning frequency 32.25 kHz
horizontal, 60 Hz vertical. Number of scanning lines 1024, interlaced.

2. Minimum range and discription

35 m

3. Range scales (nm)

IMO type:
0.125, 0.25, 0.5, 0.75, 1.5, 3, 6, 12, 24, 48, 96
R-type:
0.125, 0.25, 0.5, 0.75, 1.5, 3, 6, 12, 16, 24, 32
48, 72, 120

4. Range accuracy

1% of range in use or 15 m whichever is the greater

5. Range discrimination

35 m on 0.25 nm range

6. Bearing accuracy

±1°

7. Bearing discrimination

Better than 2.5° except S-band 9 ft radiators

8. Presentation modes

Head-up, Head-up TB, North-up, Course-up,
True motion north-up
(Automatically set to HU in case of compass failure)

9. Variable Range Markers

Two Variable Range Markers, switched

10. Electronic Bearing Lines

Two Electronic Bearing Lines, switched
Range marker on EBL

11. Offcenter

IMO type: Sweep origin can be offcentered
by 75% of range in use in any direction.
Regular type: Any direction up to 100%

12. Target alarm zone

2 TAZ at 3 and 6 nm in width of 0.5 nm, any
sector, in ARPA mode.

13. Electronic plotting (E-plot)

10 targets manual plotting. Not operative in
ARPA mode.

14. Parallel index lines

2, 3 and 6 lines (selectable on menu)

15. Navigation lines (option)

Two lines to define a navigation channel
(with RP-25)

ARPA FUNCTIONS

1. Acquisition

Instant selection of auto or manual acquisition
in 0.2 to 32 nm, relative speed 100 kt. Auto
20 targets plus manual 20 targets, or Manual
40 targets

2. Tracking

Automatic tracking of all acquired targets on
the display for 5 out of 10 consecutive scans
in 0.1 to 32 nm

3. Prediction of target motion

True or relative vectors, time scaled. Length:
1 to 99 min

4. Past positions

5 or 10 past positions of tracked targets at
intervals of 2 min

5. Collision warning

CPA limit: 0.2 to 10 nm
TCPA limit: 0 to 99 min

6. Guard zone (Guard ring)

2 guard zones (guard rings) of operator-
defined width in 0.7 to 32 nm, Sector 1 to
360° any direction

7. Trial maneuver

Simulates the effect on all tracked targets of
own ship maneuver with course, speed and
delay time.

INTERFACING

1. IEC 61162-1

OSD, RSD, TTM, etc. (Listener 2 mA at 2V,
Talker 60 mA max)

2. Analog

RGB video, H/V sync for VDR with optional
board)

3. Gyrocompass

Built-in interface accepts synchro signal (20-
50 V, 50-400 Hz) or stepper signal (20-50
VDC, any polarity).

4. Speed log (IEC 61192-1 interface)

IEC 61192-1 interface contact closure or DC
signal at 200, 400 or 500 pulses/nm.

POWER SUPPLY

1. FR/FAR-2815/2825

115/230 VAC, 1 ϕ , 470 VA(2815), 500
VA(2825-I), DC set not available

2. FR/FAR-2825W/2855/2855W

Display unit: 115/230 VAC, 1 ϕ , 500 VA
(2825W), 115 VAC, 1 ϕ , 550 VA (2855/
2855W)
Antenna unit: 115/230 VAC, 1 ϕ , 150 VA
(2825W/2855W), 230 VAC, 3 ϕ , 120 VA, 380/
440 VAC, 3 ϕ , 120 VA (2825W/2855W), 24 V,
30 W (2855)

3. FR/FAR-2835S/2835SW

Display unit: 115/230 VAC, 1 ϕ , 500 W
Antenna unit: 230 VAC, 50-60 Hz, 3 ϕ , 440
VA, 380/440 VAC, 50-60 Hz, 3 ϕ , 440 VA

4. FR/FAR-2865SW

Display unit: 115/230 VAC, 1 ϕ , 550 VA
Antenna unit: 230 VAC, 3 ϕ , 50-60 Hz, 440
VA, 380/440 VAC, 3 ϕ , 50-60 Hz, 440 VA

PROGRAM NUMBER

SPU Board

MAIN: 0359096131
SUB: 0359057134

ARP Board

ARP: 1859038106
SUB: 18590399101

RP Board

0359094111

EQUIPMENT LIST

Standard Supplies

1. Display unit
Radar: RDP-115 (w/RP-25)
ARPA: RDP-115A (w/ARP-25, RP-25)
2. Antenna unit with 30 m antenna cable
3. RF transceiver unit for RF-down system
4. PSU-004 for FR/FAR-2825W/2855W/
2835S/2835SW/2865SW
5. PSU-001 for FR/FAR-2855
6. Standard spare parts and installation materials

Optional Supplies

1. Waveguide for RF-down system
(Coax cable for S-band)
2. Gyro interface GC-8
3. Interswitch box RJ-7 or 8
4. Performance monitor PM-30* (X-band),
PM-50* (S-band)
5. 42 rpm scanner motor
(FR/FAR-2815/2825 only)
6. Video plotter RP-25**
7. ARPA Board ARP-25
8. Hand grip
9. Display pedestal

* Necessary in IMO-type Radar and ARPA

** RP-25 (Radar Video Picture) necessary for all class of SOLAS ships for radar maps and navlines

*** ARP-25 (Auto Radar Plotter) may not be necessary on ships below 1,000 GT. Check with the Administrations.

Category of Equipment Units

Equipment for Protected Area

- Display unit
- Power supply unit
- RF transceiver unit
- Interswitch unit

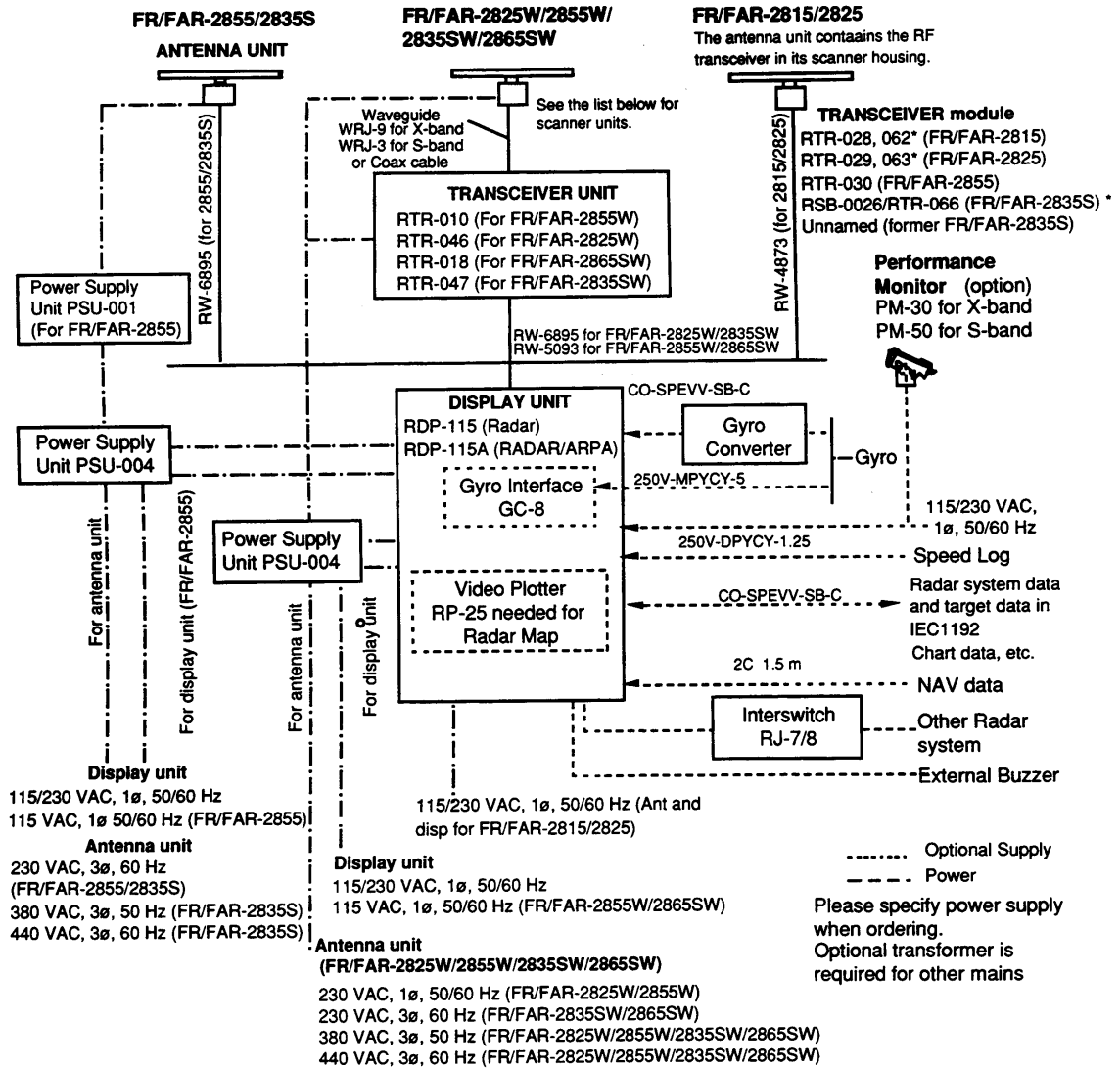
Equipment for Exposed

- Antenna unit
- Performance monitor

Compass safe distance

See each corresponded Installation Manual.

SYSTEM CONFIGURATION



SCANNER UNIT (Turning unit or Gearbox)

FR/FAR-2815	C2P7N2N (24 rpm, 24 V) RSB-0074 (24 rpm, 24 V) * RSB-0068 (42 rpm, 24 V) RSB-0075 (42 rpm, 24 V) *	FR/FAR-2825W	RSB-0041 (24 rpm, 220 VAC, 3ø) obsolete RSB-0042 (24 rpm, 380/440 VAC, 3ø) obsolete RSB-0046 (24 rpm, 220 VAC, 1ø) obsolete RSB-0076 (24 rpm, 220 VAC, 3ø) * RSB-0077 (24 rpm, 380/440 VAC, 3ø) * RSB-0079 (24 rpm, 220 VAC, 1ø) *
FR/FAR-2825	RSB-0014 (24 rpm, 24 V) RSB-0074 (24 rpm, 24 V) * RSB-0069 (42 rpm, 24 V) RSB-0075 (42 rpm, 24 V) *	FR/FAR-2835S	RSB-0026/RTR-066 (24 rpm, 220 VAC, 3ø) RSB-0031/RTR-066 (24 rpm, 380/440 VAC, 3ø)
FR/FAR-2855	RSB-0049 (24 rpm, 220 VAC, 3ø) RSB-0050 (24 rpm, 24 V)	FR/FAR-2835SW	RSB-0027 (24 rpm, 220 VAC, 3ø) RSB-0032 (24 rpm, 380/440 VAC, 3ø)

RADIATORS (X-band)

4 ft	Type XN -3, 3A, XN12AF *	8 ft	Type XN-5, XN24AF *
6.5 ft	Type XN-4A, XN20AF *	NOTE Radiators marked* for RSB-0074/0075	

NOTE: The gearboxes marked* work with new radiators (such as XN12AF*). The new radiator has different physical dimensions at the rotary joint and only fits on the new gearbox. The slotted waveguide array radiators are the same as the current ones. The gearing and motors are the same as those in the former counterpart. Assembled antennas are compatible to each other within the same RF output.

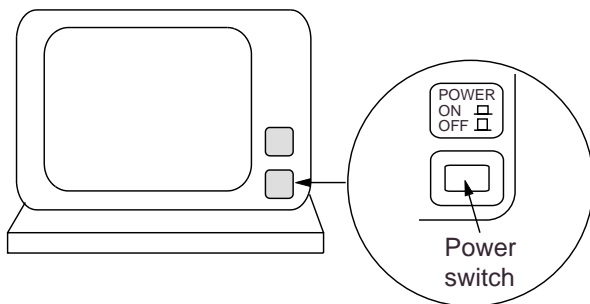
1. OPERATION

WARNING

Before turning on the radar, make sure that there is no one near the antenna unit. Serious injury or even death may result if a rotating antenna strikes someone standing nearby.

1.1 Turning on the Power

The POWER switch is located at the lower right corner 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 three minutes of warm-up time. During this period the magnetron, or the transmitter tube, is warmed for transmission. When the timer has reached 0:00, the legend STBY appears indicating that the radar is now ready to transmit pulses.



Location of power switch

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

1.2 Transmitter ON

When the STANDBY status is displayed on the screen, press the Transmit switch labeled ST-BY/TX on the control panel of the display unit.

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

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

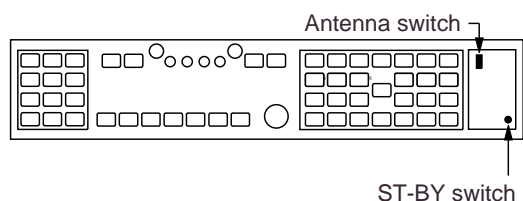
Notes:

- 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.

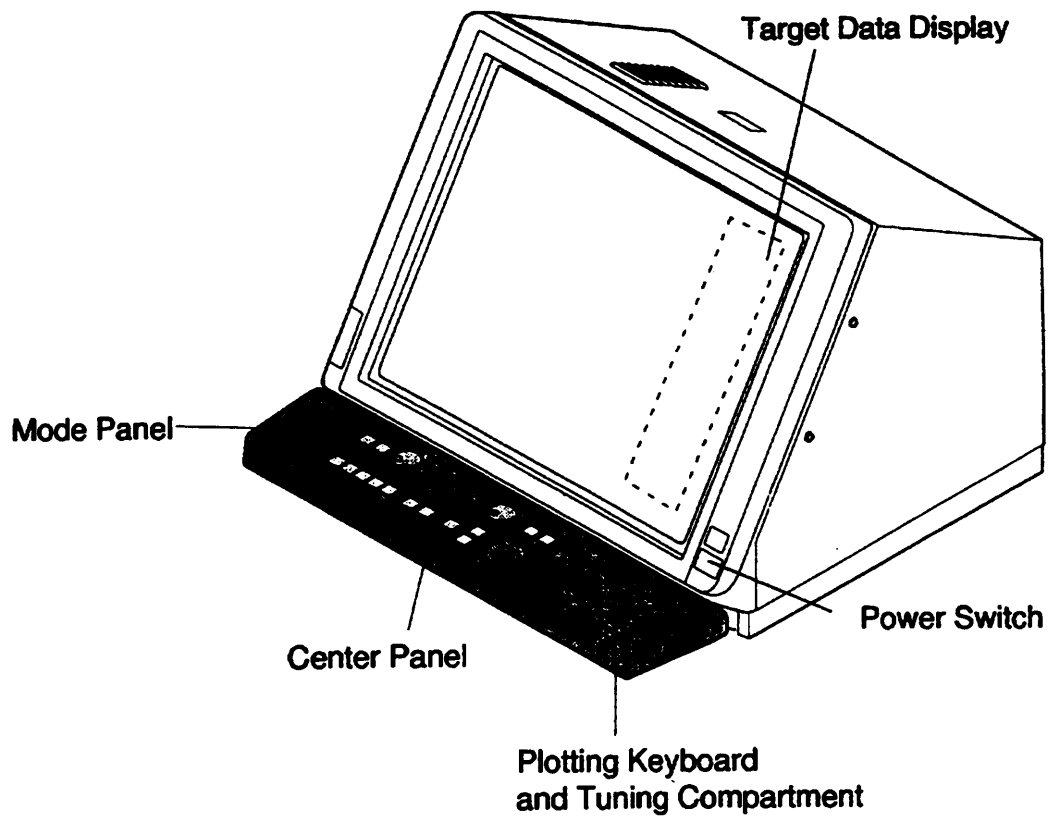
Quick Start

Provided that the radar was once in use with the transmitter tube (magnetron) still warm, you can turn the radar into TRANSMIT condition without 3-minutes standby. If the Power Switch has been turned off by mistake or the like and you wish to restart the radar promptly, follow the steps below:

- Turn on the Power Switch not later than 5 sec after power-off.
- Press the ST-BY switch in the tuning compartment.
- Press the Transmit Switch STBY/TX.

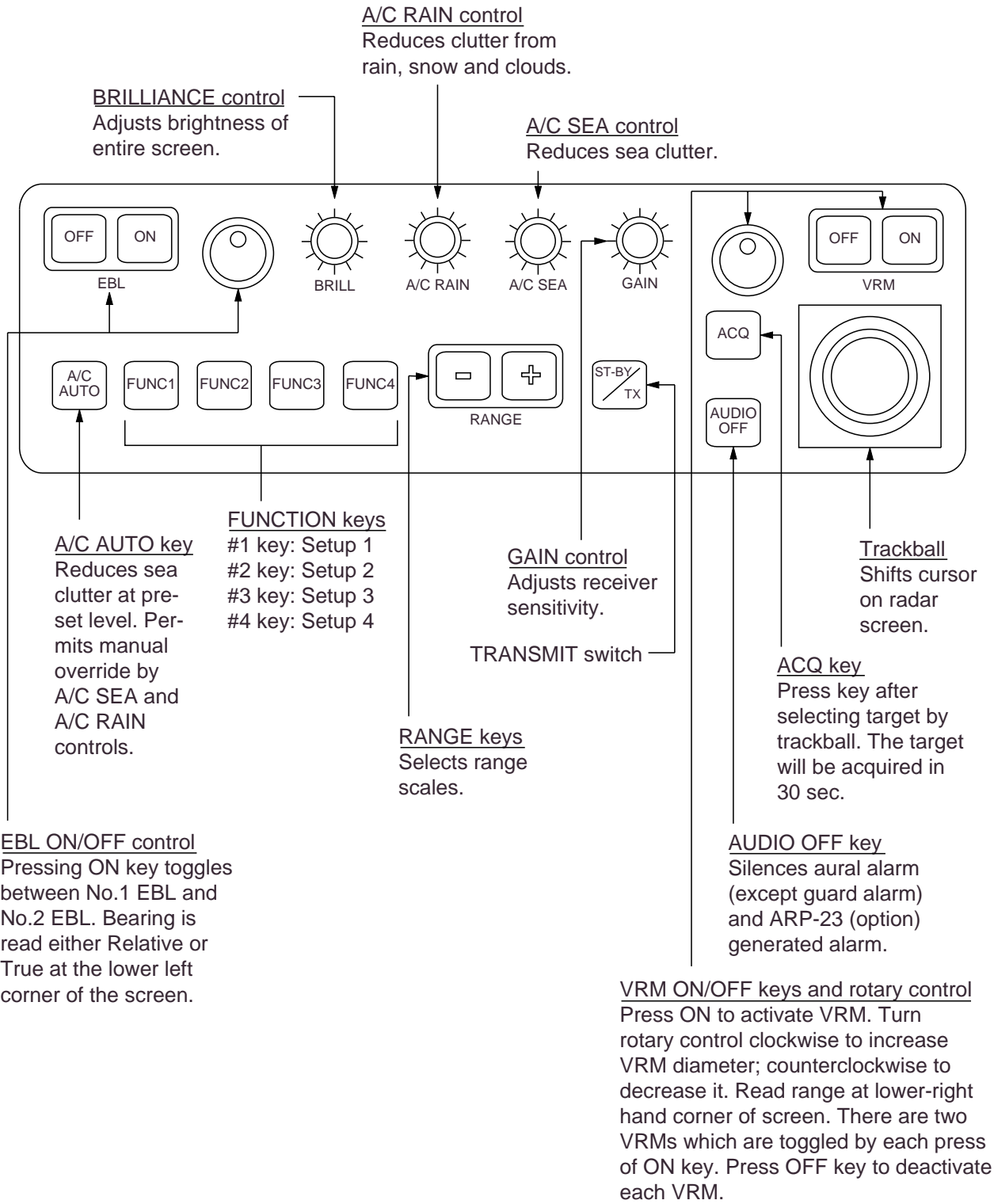


1.3 Controls



FR-2805 Series Radar Display Unit Overview

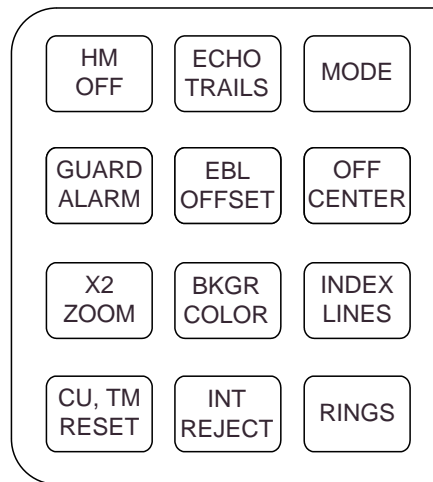
Main control panel



GAIN, A/C RAIN, A/C SEA and BRILL controls are of push-and-rotate type. Push in wanted switch lightly, and it will pop up. Rotate it to the wanted setting and push it in. The retracted position of the controls provides a better protection for water splash.

Display controls

Mode 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 the guard alarm.

EBL OFFSET

Activates and deactivates off-centering of the sweep origin.

BKGR COLOR

Selects the background color.

INDEX LINES

Alternately shows and erases parallel index lines.

X2 ZOOM

Enlarges a user-selected portion of picture twice as large as 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 the true motion mode.

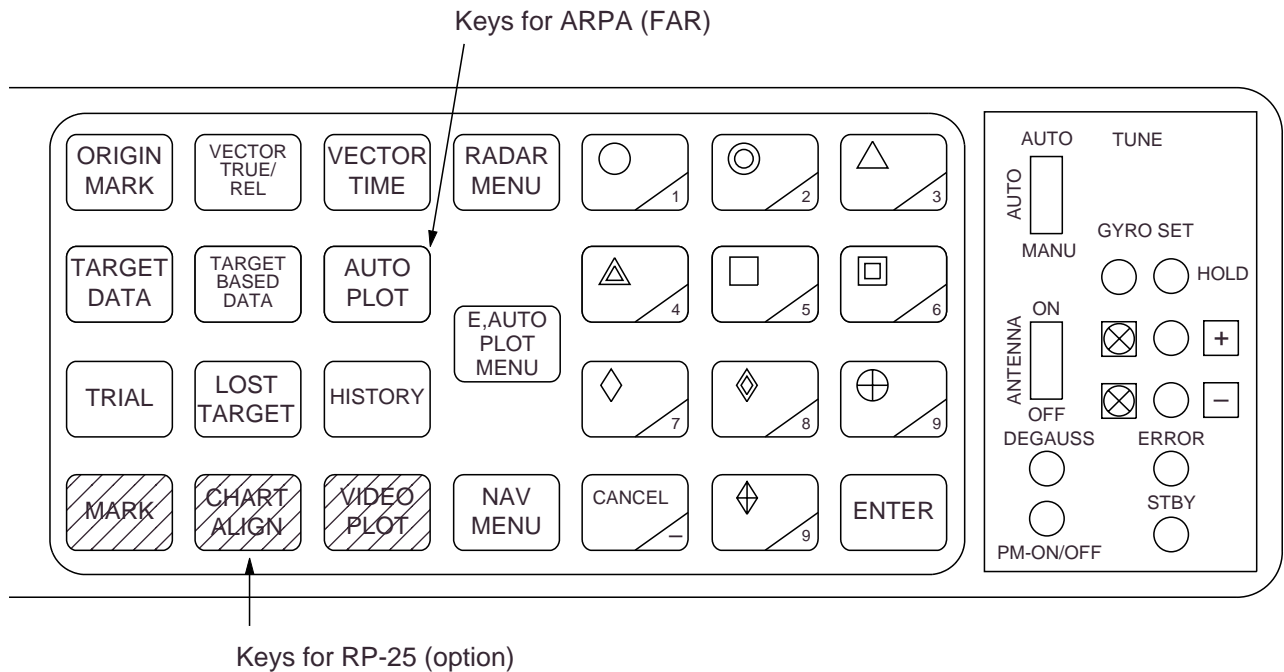
INT REJECT

Reduces mutual radar interference.

RINGS

Adjusts the brightness of range rings.

Plotting keypad and tuning compartment



ORIGIN MARK

Show and erases the origin mark (a reference point for range/bearing measurement).

VECTOR TRUE/REL

Selects true or relative vector.

VECTOR TIME

Sets vector length in time.

RADAR MENU

Opens and closes RADAR menus.

E-PLOT, AUTO PLOT MENU

Opens and closes E-Plot and optional AUTO PLOT menus.

NAV MENU

Opens and closes NAV menu.

Keys 0-9

Select 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 screen.

Keys for ARPA (optional in R-type)

TARGET DATA

Displays the acquired target data.

TARGET BASED DATA

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.

Keys for Video Plotter (optional)

MARK Enter/erase marks

CHART ALIGN

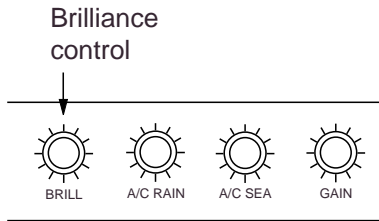
Used to align chart data.

VIDEO PLOT

Turns the video plotter on/off.

1.4 CRT Brilliance

Operate the BRILL control on the control panel 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.

1.5 Tuning the Receiver

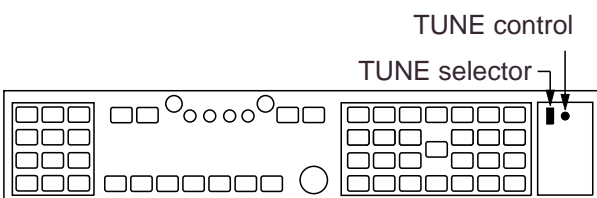
Auto tune

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 right corner of the display unit show the tuning circuit is working. If the label AUTO TUNE is not displayed, check that the TUNE selector in tuning compartment is in 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.



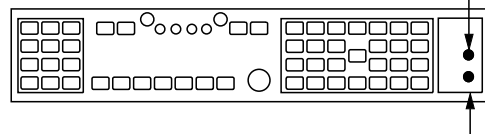
2. Push the tune control so that it pops up.
3. While observing the picture on the 48 mile scale, slowly adjust TUNE control and find the best tuning point.
4. So the TUNE selector to AUTO and wait for about 10 seconds or four scanner rotations.
5. Make sure that the radar has been set to the best tuning 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.

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:

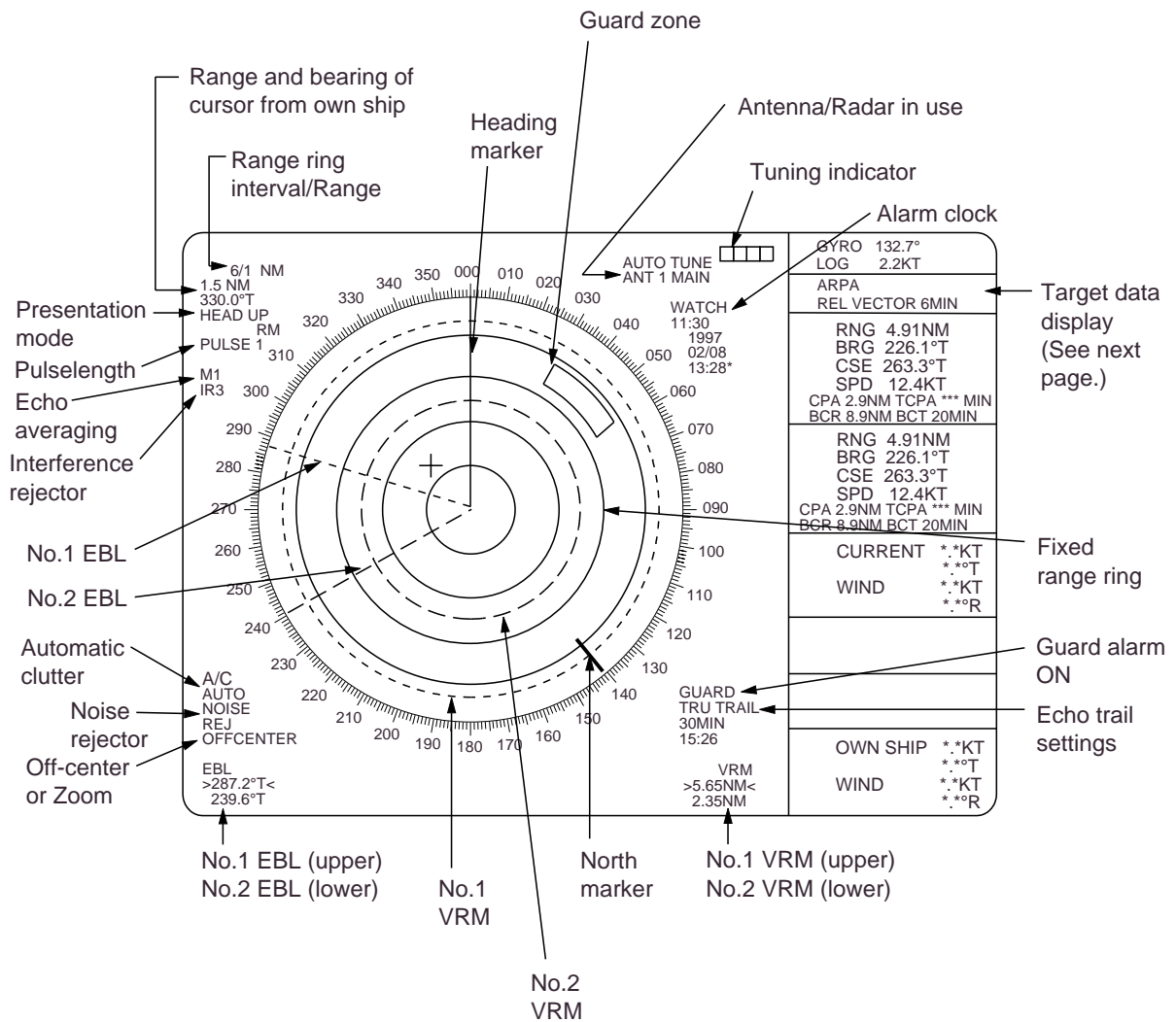
1. Turn of the power switch and turn it on again within five seconds.
2. Push the ST-BY switch in the tuning compartment.
3. Push the Transmit switch labeled ST-BY/TX for Transmit status.

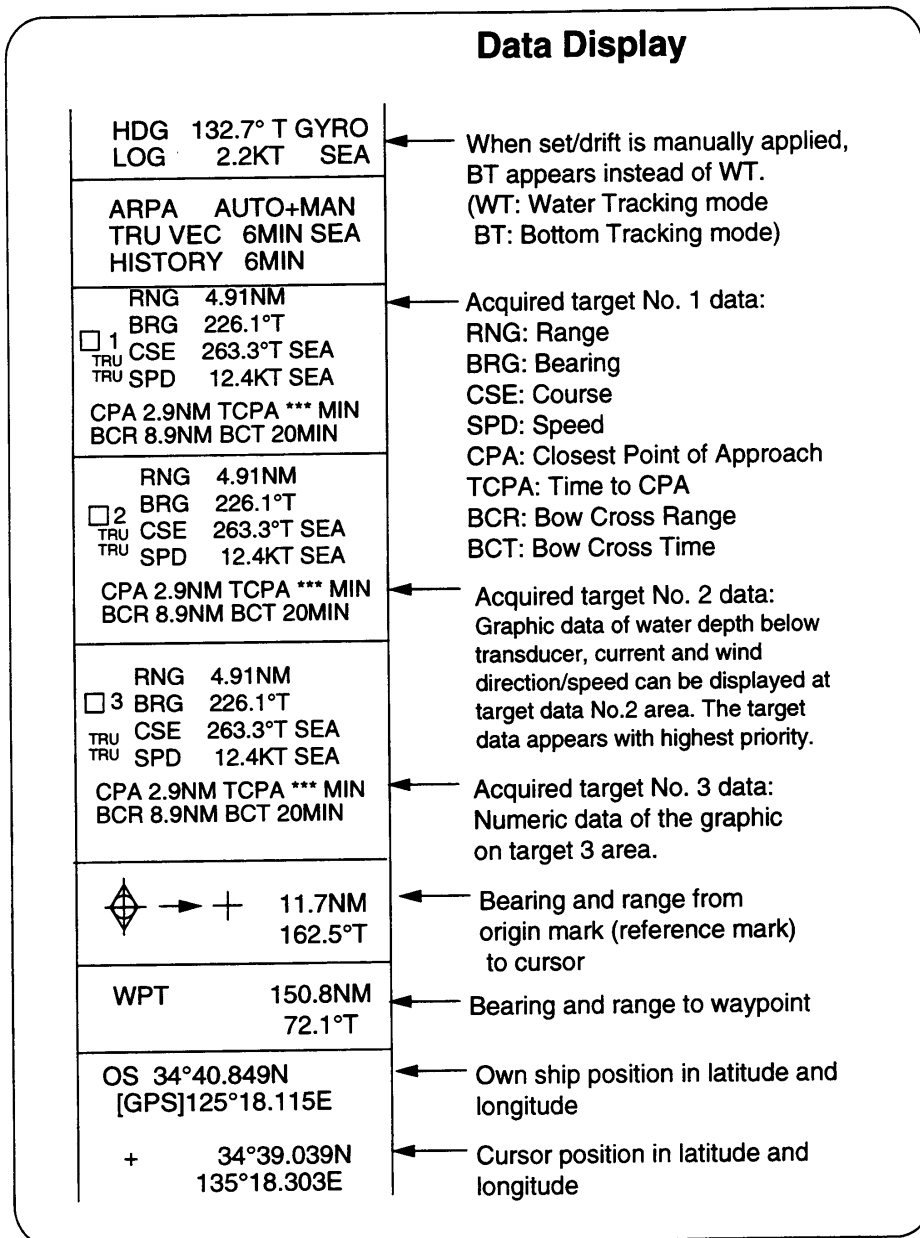
This LED lights if video lockup is associated with fundamental malfunction of CPU.



ST-BY switch for quick start

1.6 On-screen Legends and Markers



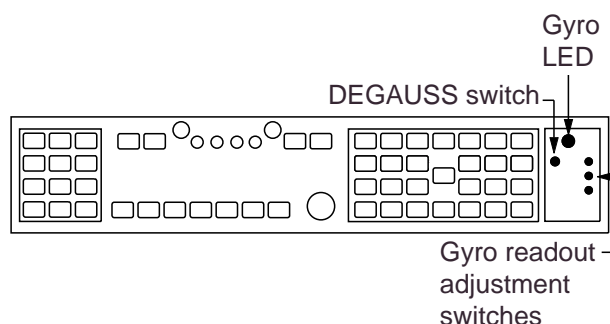


1.7 Degaussing the CRT Screen

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

The screen is also degaussed automatically when own ship has made a significant course change. While being

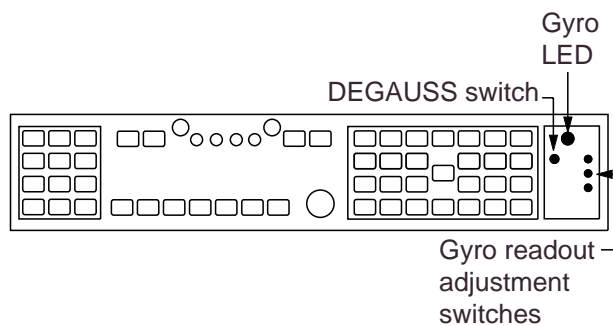
degaussed, the screen may be disturbed momentarily with vertical lines. If you wish to degauss by manual operation at an arbitrary time, open and press the "DEGAUSS" switch.



1.8 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 the UP or DOWN button to duplicate the gyrocompass reading at the on-screen GYRO readout. Each press of these buttons changes the readout by 0.1-degree steps. To change the readout quickly, hold the UP or DOWN button for over two seconds.
3. Press the HOLD switch 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 gyrocompass reading is usually stable), you may omit steps 1 and 3 above.

1.9 Presentation Modes

This radar has the following presentation modes:

Relative Motion (RM)

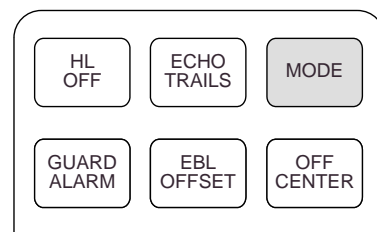
- Head-up: Unstabilised
- Head-up TB: Head-up with compass-stabilized bearing scale (True Bearing)
- Course-up: Compass-stabilized relative to ship's intended course
- North-up: Compass-stabilized with reference to north

True Motion (TM)

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

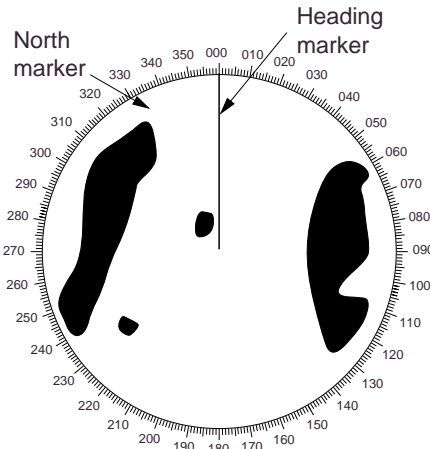
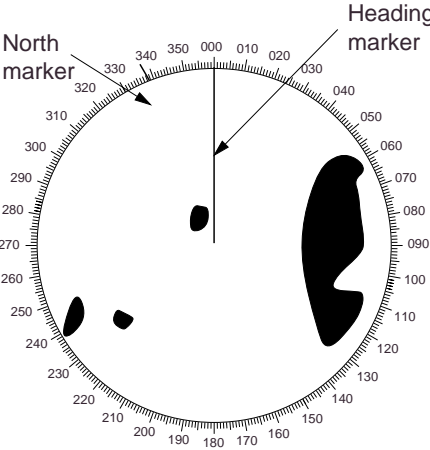
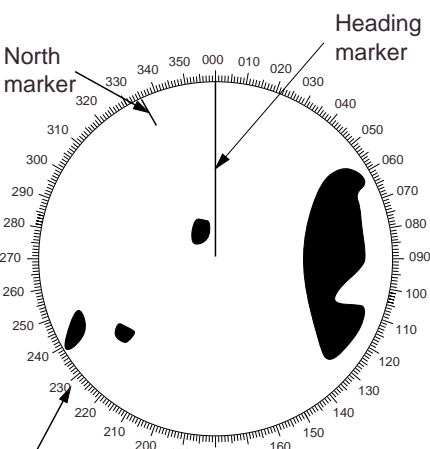
Selecting presentation mode

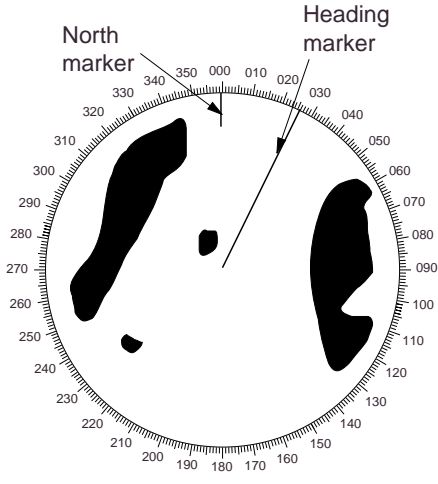
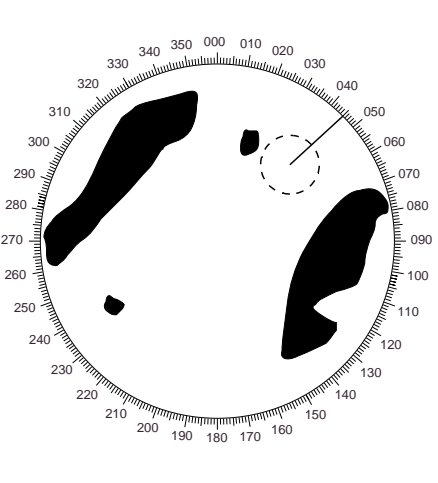
Press the MODE key on the mode panel. Each time the MODE key is pressed, the presentation mode and mode indication at the upper-left corner of the screen change cyclically.

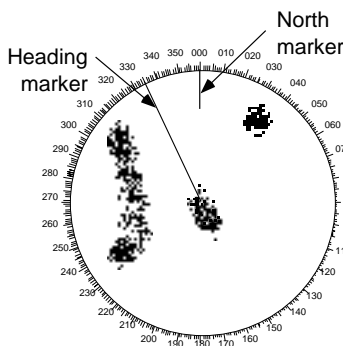


Loss of Gyro Signal

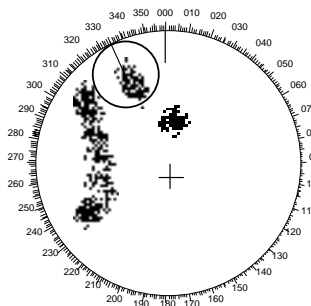
When the gyro signal is lost, the presentation mode automatically becomes head-up and the GYRO readout at the screen top shows asterisks (**.*) . The message SET HEADING appears at the lower-left corner of the screen. This warning stays on when the gyro signal is restored, to warn the operator that the readout may be unreliable. 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.

Presentation mode, representative display	Description
	<p>Head-up Mode</p> <p>A display without azimuth stabilization in which the line connecting the center with the top of the display indicates own ship's heading.</p> <p>The target pips are painted at their measured distances and in their directions relative to own ship's heading.</p> <p>A short line on the bearing scale is the north marker indicating 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 HDG appears on the screen.</p>
	<p>Course-up Mode</p> <p>An azimuth stabilized display in which a line connecting the center with the top of the display indicates own ship's intended course (namely, own ship's previous heading just before this mode has been selected). 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 ship's yawing and course changes. This mode is useful to avoid smearing of picture during course change. After a course change, press the [CU, TM RESET] key to reset the picture orientation if you wish to continue using the course-up mode.</p>
	<p>Head-up TB (True Bearing) Mode</p> <p>Radar echoes are shown in the same way as in the head-up mode. The difference from normal head-up presentation lies in the orientation of the bearing scale. The bearing scale is compass stabilized, that is, it rotates in accordance with the compass signal, enabling you to know own ship's heading at a glance.</p> <p>This mode is available only when the radar is interfaced with a gyrocompass.</p>

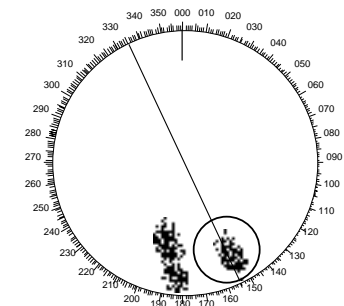
Presentation mode, representative display	Description
	<p>North-up Mode</p> <p>In the north-up mode, target pips are painted at their measured distances and in their true (compass) directions from own ship, north being maintained UP of the screen. The heading marker changes its direction according to the ship's heading.</p> <p>If the gyrocompass fails, the presentation mode changes to head-up and the north maker disappears. Also, the GYRO readout shows asterisks (***.*) and the message SET HEADING appears at the lower-left corner of the screen.</p>
	<p>True Motion Mode</p> <p>Own ship and other moving objects move in accordance with their true courses and speeds. All fixed targets, such as landmasses, appear as stationary echoes.</p> <p>When own ship reaches a point corresponding to 75% of the radius of the display, the own ship is automatically reset to a point of 50% radius opposite to the extension of the heading marker passing through the display center. Resetting can be made at any moment before the ship reaches the limit by pressing the [CU, TM RESET] key. Automatic resetting is preceded by a beep sound.</p> <p>If the gyrocompass fails, the presentation mode is changed to the head-up mode and the north marker disappears. The GYRO readout at the top of the screen shows asterisks (***.*) and the message SET HEADING appears at the lower-left corner of the screen.</p>



(a) True motion is selected



(b) Own ship has reached a point 75% of display radius



(c) Own ship is automatically reset to 50% of radius

Automatic resetting of sweep center in true motion mode

1.10 Selecting the Range Scale

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

The display range can be expanded by 75% (100% in R-type) in any direction by using the off-centering control.

1.11 Selecting the Pulsewidth

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

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

You can choose the pulsewidth 1 or 2 on the scales 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 the [1] key to select menu item 1 PULSEWIDTH.
3. Press the [1] key to select (or highlight) PULSEWIDTH 1 OR 2 as appropriate.
4. Press the ENTER key to conclude your selection followed by the RADAR MENU key to close the FUNCTION menu.

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

Presetting pulsewidths 1 and 2

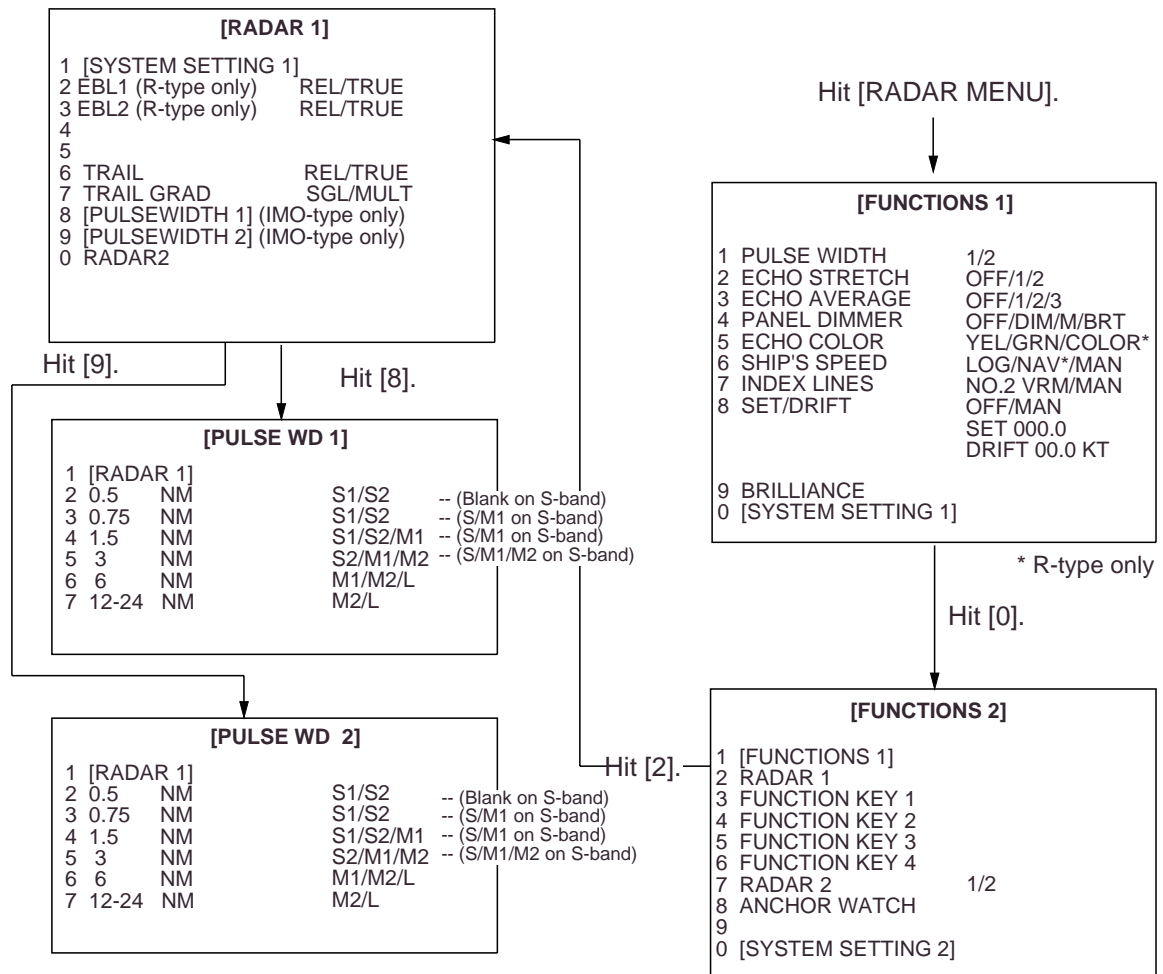
Pulsewidth 1 and 2 can be preset on the Pulsewidth 1 and 2 menus. Shown below are examples of the pulsewidth setup procedure:

1. To enable selection of S1 (0.08 μ s) and S2 (0.2 μ s) pulsewidth on the 0.5 nm range on an X-band model, select S1 at 0.5 nm on the PULSEWIDTH 1 menu and S2 at 0.5 nm on the PULSEWIDTH 2 menu.
2. To enable selection of S2 (0.2 μ s) and M1 (0.4 μ s) pulsewidth on the 3 nm range on an X-band model, select S2 at 3 nm in the PULSEWIDTH 1 menu and M1 at 3 nm in 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.

Example: To select S1 (0.08 μ s) as Pulsewidth 1 for the 0.5 nm range, display the PULSEWIDTH 1 menu following the steps shown above and hit the [2] key 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."

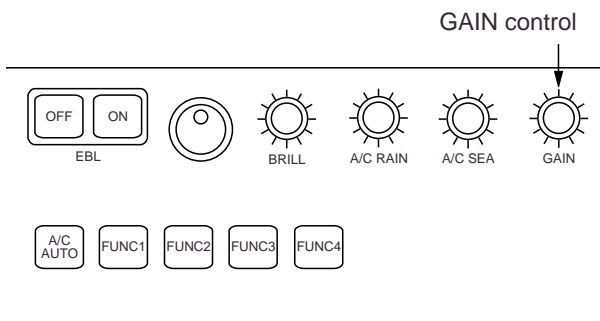
Note: The menus on the next page are for the R-type. Refer to paragraph 1.32 or the menus on the IMO type.



1.12 Adjusting the Sensitivity

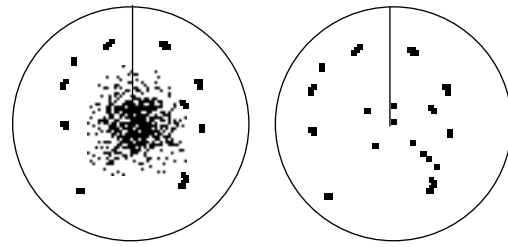
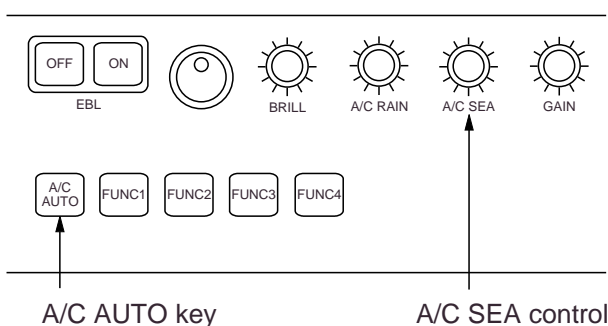
The GAIN control is used to adjust the sensitivity of the receiver, and thus the intensity of echoes as they appear on the screen. It should be adjusted so that speckled background noise is just visible on the screen.

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 the loss of weak echoes and a reduced detection range. If you turn the GAIN control too far clockwise for an excessive gain setting, desired echoes will be masked in the strong background noise.



1.13 Suppressing Sea Clutter

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



A/C SEA control off

A/C SEA control adjusted

Automatic anti-clutter control

The easiest way to suppress the surface clutter is to use the automatic control. Press the A/C AUTO key next to the EBL rotary control at the left corner on the control panel. Use of a function key is also a good method for reducing sea clutter. For this purpose, presetting is required. Consult a FURUNO representative.

CAUTION

The auto A/C function can erase weak targets.

Manual anti-clutter control

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

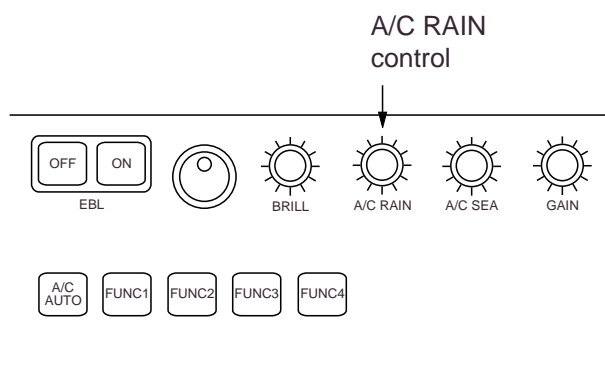
The anti-clutter sea control is often referred to as STC (Sensitivity Time Control) which decreases the amplification of the receiver immediately after a radar pulse is transmitted, and progressively increases the sensitivity as the range increases.

A common mistake is to over-adjust the A/C SEA control so that the surface clutter is completely removed. By rotating the control fully clockwise, you will see how dangerous this can be; a dark zone is created near the center of the screen and close-in targets can be lost. This dark zone is even more dangerous if the gain

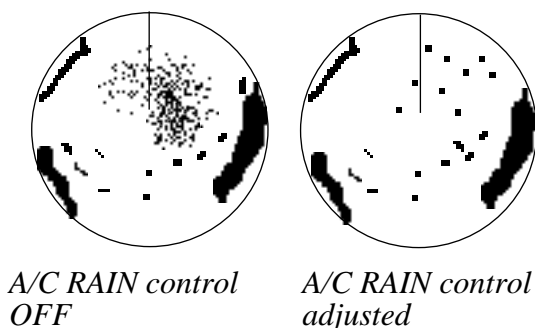
has not been properly adjusted. Always leave a little surface clutter visible on the screen. If no surface clutter is observed (on a very calm water), set the control at the fully counterclockwise position.

1.14 Suppressing Precipitation Clutter

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



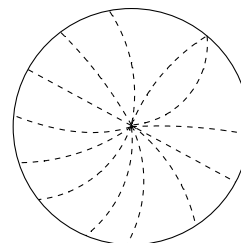
The A/C RAIN control adjusts the receiver sensitivity as the A/C SEA control does but rather in a longer time period (longer range). Clockwise rotation of this control increases the anti-clutter effect.



1.15 Interference Rejector

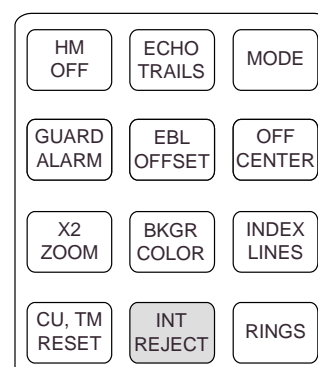
Mutual radar interference may occur in the vicinity of another shipborne radar operating in the same frequency band (9 GHz for X-band, 3 GHz for S-band). It is seen on the screen as a number of bright spikes either in irregular patterns or in the form of usually curved spoke-like dotted lines extending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

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.



Mutual radar interference

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.



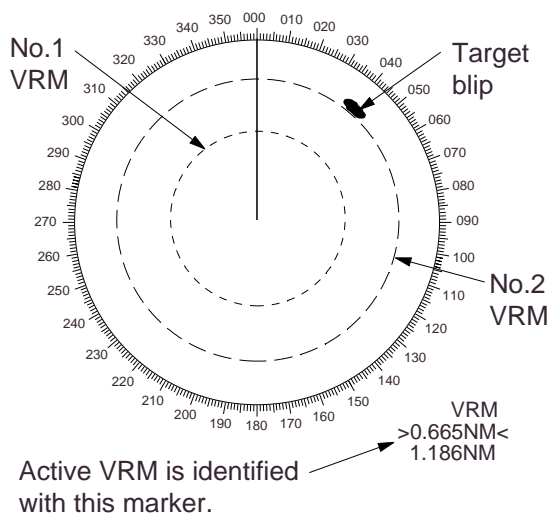
Inside mode panel

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

1.16 Measuring the Range

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

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



Measuring the range

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 >.....<.

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 key to erase each VRM.

1.17 Measuring the Bearing

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

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 >... <.

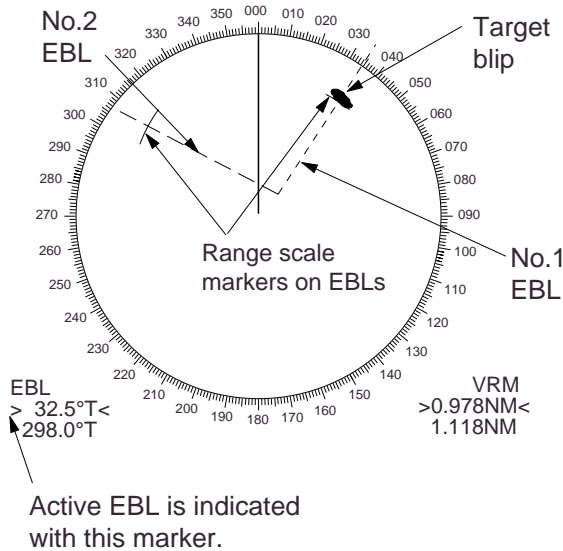
Rotate the EBL rotary control clockwise or counterclockwise until the active EBL bisects the target of interest, and read its bearing at the lower-left corner of the screen.

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 2 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.



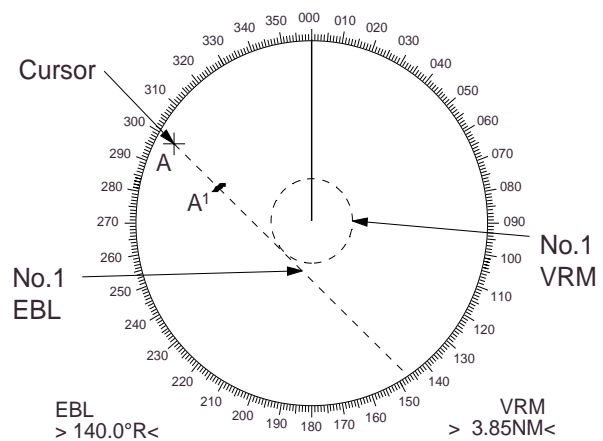
1.18 Collision Assessment by Offset EBL

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

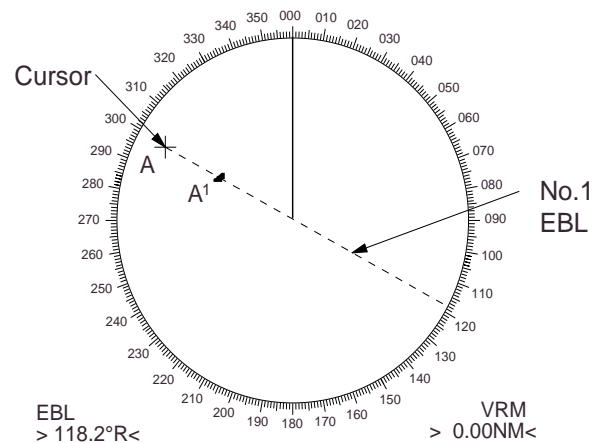
1. Press the EBL ON key to display or activate an EBL (No.1 or 2).
2. Place the cursor (+) on a target of interest (A in the illustrated example) by operating the trackball.
3. Press the EBL OFFSET key on the mode panel, and the origin of the active EBL shifts to the cursor position. Press the EBL OFFSET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

1.19 Measuring Range and Bearing Between Two Targets

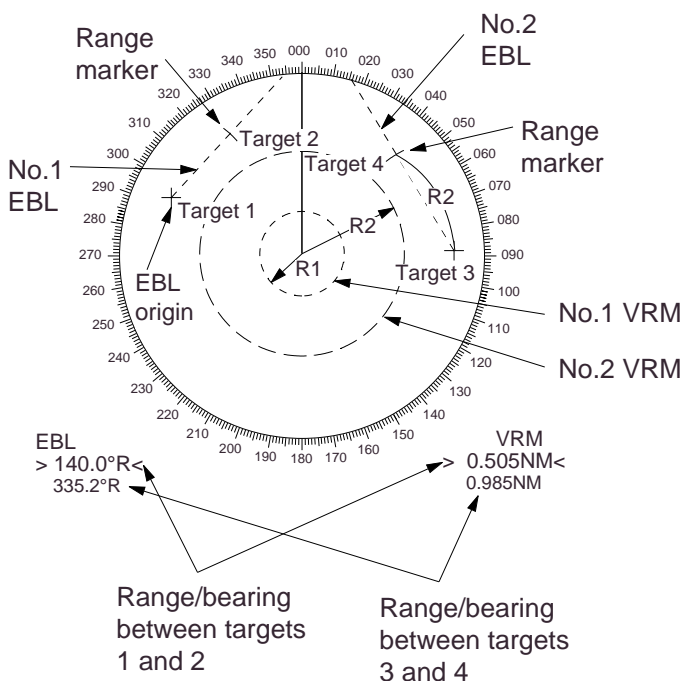
Press the EBL OFFSET key, and place the origin of No.1 EBL, for example, on a target of interest (target 1 in the illustrated example) by operating the trackball.

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 fourth targets (targets 3 and 4) by using No.2 EBL and No.2 VRM.

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 2 menu. To return the EBL origin to the own ship position, press the EBL OFFSET key again.



1.20 Setting a Guard Zone (Guard Alarm)

CAUTION

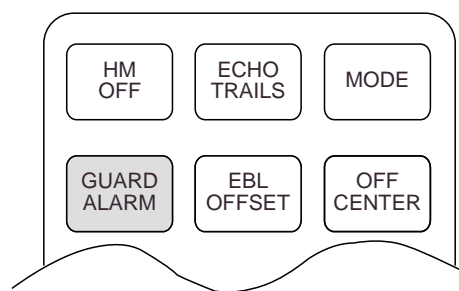
The guard zone (guard alarm) feature should never be relied upon as the sole means for detecting the risk of potential collision. The operator of a ship is not relieved of the responsibility to keep visual lookout for avoiding collisions, whether or not the radar is in use.

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

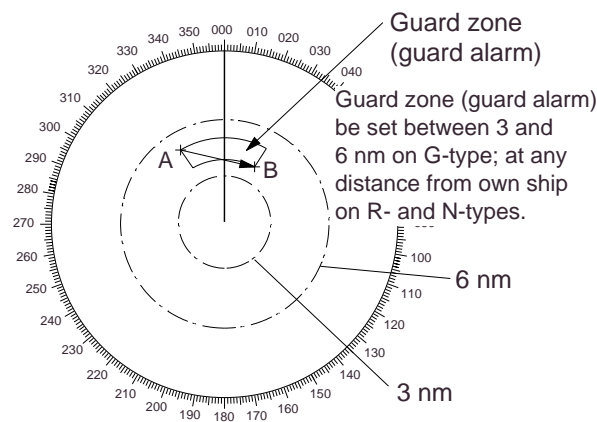
The guard zone (guard alarm) has a fixed width of 0.5 nm in the radial direction and is adjustable only within 3.0 to 6.0 nm from own ship. The guard zone (guard alarm) can be set to any sector angle between 0 and 360 degrees in any direction.

To set a guard zone (guard alarm):

1. Place the cursor (+) at point "A" (see figure at the top of the next page) using the trackball and press the GUARD ALARM key on the mode panel (left key group). The message SET GUARD appears at the bottom-right corner of the screen.



Inside mode panel



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

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

Silencing audible alarm, reactivating guard alarm

A target entering the guard zone (guard alarm) 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 zone (guard alarm). To reactivate the audible alarm, press the GUARD ALARM key again.

Disabling guard zone (guard alarm)

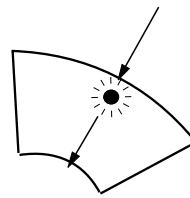
Hold the GUARD ALARM key depressed for at least 3 seconds.

Note: The guard alarm is given to targets having a certain level of echo strength. This level does not always imply a land-mass, reef, ships or other surface objects but can mean returns from the sea surface or precipitation. Properly adjust the

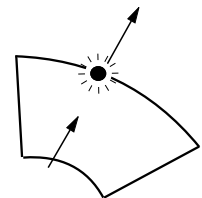
GAIN, A/C SEA, and A/C RAIN controls to reduce noise to avoid generation of guard alarm against false target detection.

Inward and outward guard alarms

On the R-type, an inward or outward guard alarm can be selected on the RA-DAR 2 menu. On the IMO 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 (guard alarm) from any direction. The outward guard alarm is produced when a target leaves the guard zone.



(a) Inward guard alarm available on IMO and R-types



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

1.21 Off-Centering

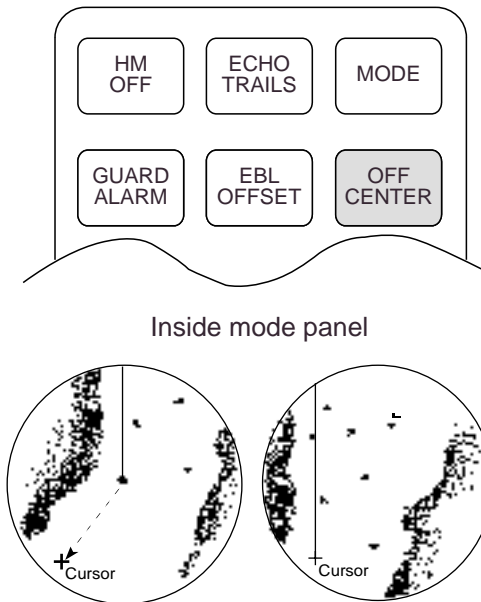
Own ship position, or sweep origin, can be displaced to expand the view field without switching to a larger range scale. On the R-type, the sweep origin can be off-centered to a point specified by the cursor, up to 100% of the range in use in any direction. On the IMO-type, the sweep origin can be off-centered to the cursor position, but not more than 75% of the range in use; if the cursor is set beyond 75% of the range scale, the sweep origin will be off-centered to the point of 75% of the limit.

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

To off center the radar picture:

1. Place the cursor at a position where you wish to move the sweep origin by operating the trackball.

2. Press the OFF CENTER key. Then, the sweep origin is off-centered to the cursor position.
3. To cancel off-centering, press the OFF CENTER key again.



Off-centered to cursor position – Max. offset

100% of range in use on R-type
75% of range in use on IMO-type

The picture cannot be off centered in the true motion mode.

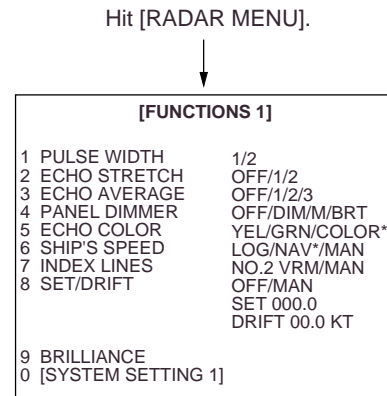
1.22 Echo Stretch

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 scales, the same size targets get smaller on screen as they approach the 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 function. There are two types: echo stretch 1 for long range detection and echo stretch 2 on 1.5-6 nm scales.

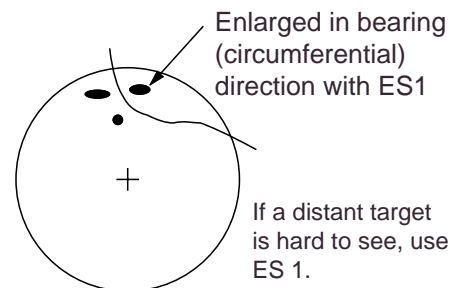
To activate the echo stretch:

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

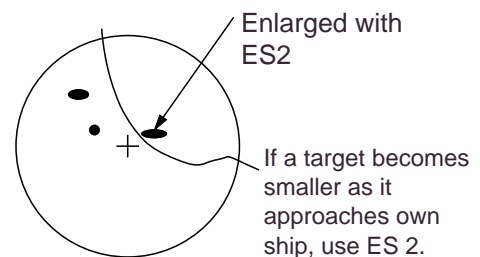
2. Press the [2] key to select 2 ECHO STRETCH.
3. Press [2] until Echo Stretch option 1, 2 or OFF as desired is highlighted.
4. Press the ENTER key to conclude your selection followed by the RADAR MENU key to close the FUNCTIONS menu.



* R-type only



(a) Echo stretch 1 for 12 nm range and above



(b) Echo stretch 2 for 1.5–6 nm ranges

Notes:

- 1) If the 1.5 nm range is preset for pulsewidth of S1 (0.08 μ s) or S2 (0.2 μ s), and the 3 nm scale for S2 (0.2 μ s), the echo stretch function is not available on these range scales.

2) The echo stretch function magnifies not only small target pips but also returns from sea surface, rain and radar interference. For this reason make sure these types of interference have been sufficiently suppressed before activating this function.

1.23 Echo Averaging

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

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

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

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

Hit [RADAR MENU].

[FUNCTIONS 1]	
1 PULSE WIDTH	1/2
2 ECHO STRETCH	OFF/1/2
3 ECHO AVERAGE	OFF/1/2/3
4 PANEL DIMMER	OFF/DIM/M/BRT
5 ECHO COLOR	YEL/GRN/COLOR*
6 SHIP'S SPEED	LOG/NAV*/MAN
7 INDEX LINES	NO.2 VRM/MAN
8 SET/DRIFT	OFF/MAN SET 000.0 DRIFT 00.0 KT
9 BRILLIANCE	
0 [SYSTEM SETTING 1]	

* R-type only

2. Press the [3] key to select 3 ECHO STRETCH.

3. Press [3] until echo average option 1,

2 or OFF as desired is highlighted.

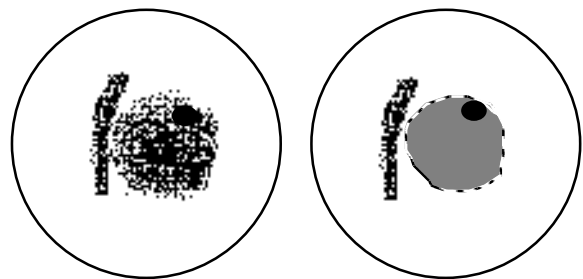
OFF: No averaging effect

1: Helps distinguish targets from sea clutter and suppresses brilliance of unstable echoes

2: Distinguishes small stationary targets such as navigation buoys.

3: Stably displays distant targets.

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



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

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

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

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.

CAUTION

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

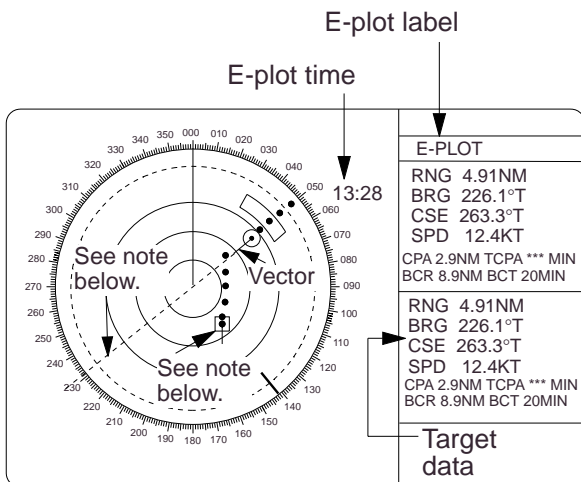
1.24 Electronic Plotting Aid (EPA)

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

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

Alphanumeric readouts at the upper right-hand 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 data are not updated in real time, but only when you enter a new plot.



Note:

- This target has passed clear to starboard.
- CPA remaining is prefixed with *.*
- TCPA is counted up to 99.9 min and beyond this it is indicated as TCPA >*99.9 MIN.
- Dotted line is an extension of the vector.
For explanation only.

Note: EPA requires own speed input (automatic or manual) and a compass signal. The vector and data are updated on real time between plot a new position over a long period of time. Otherwise, the accuracy will be reduced. Note that the plots will be lost when the compass fails; start the plotting exercise again.

Plotting a target

To perform electronic plotting:

1. Place the cursor(+) on a target of interest by operating the trackball.
 2. Select a desired plot symbol 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.
 4. Watching the EPA time (TIM xx:xx) shown at the upper right margin 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 previous position is marked by a small dot.
5. To acquire other targets, repeat the above steps selecting different plot symbols.

Note: If a target once plotted is not plotted again within 10 minutes, the warning "UPDATE PLOT No" will appear on the upper right margin of the screen and the plot symbol of the target flashes. If you want to continue plotting this target, reacquire it within five 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

True 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 sec, 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 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 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.

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 last-plotted target with suffix "T" (True) or "R" (Relative) plot symbol.

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

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

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

Terminating target plotting

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

By Symbol: To terminate plotting of a certain target, press the 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.

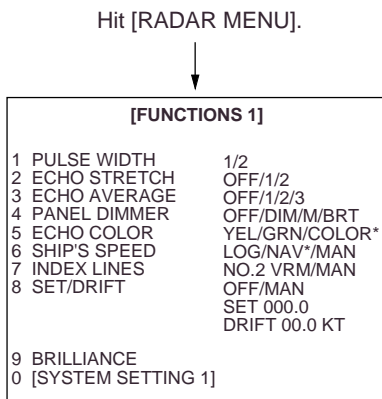
All Targets: To terminate plotting of all targets at once, press and hold the CANCEL key until all plot symbols and marks disappear in about 3 seconds.

Entering own ship's speed

EPA requires an own ship speed input and compass signal. The speed can be entered from a speed log (automatic) or through the plotting keypad (manual).

Automatic speed input

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



* R-type only

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

Notes:

- 1) IMO Resolution A.823(19) for ARPA recommends that a speed log to be interfaced with an ARPA should be capable of providing through-the-water speed data.
- 2) Be sure not to select LOG when a speed log is not connected. If the log signal is not provided, the ship's speed readout at the 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 enter the ship's speed as follows:

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

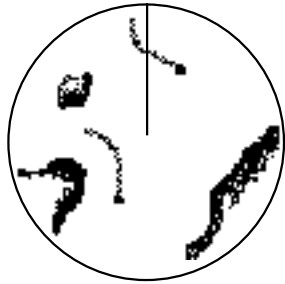
2. Press the [6] key to select menu 6 SHIP'S SPEED.
3. Press the [6] key to select (or highlight) MAN option.
4. Press the ENTER key to confirm selection. At this point, "MAN = XX. KT" appears at the bottom of FUNCTIONS menu.
5. Enter the ship speed by hitting corresponding numeric keys followed by the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

1.25 Target Trails (Echo Trails)

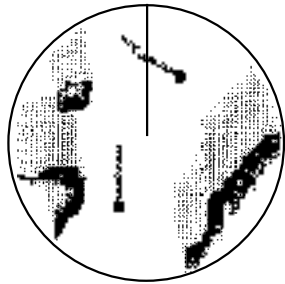
Echo trails are simulated afterglow of target echoes that represent their movements relative to own ship or true movements with respect to land in a single tone or gradual shading depending on the settings on the RADAR 1 menu.

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.

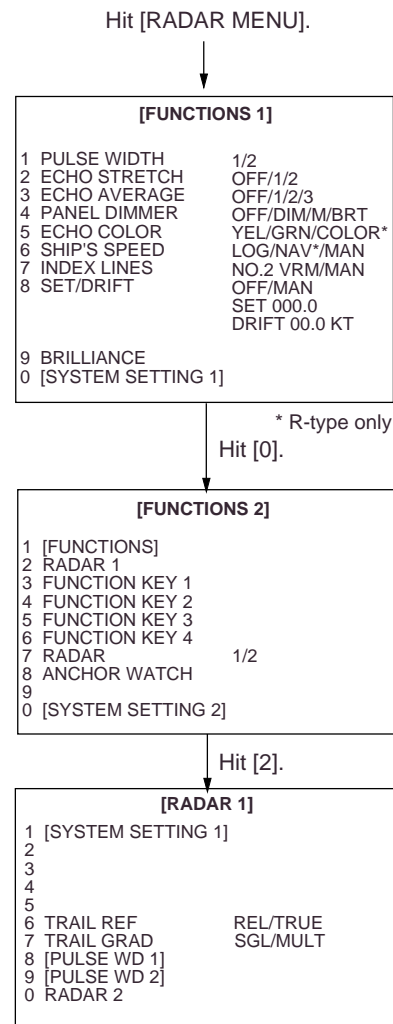


(a) True echo trails without smearing of stationary targets



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

Note: When true trail is selected on the RM mode, the legend TRUE TRAIL appears in red. No true-relative selection on TM, it is only TRUE TRAIL on TM mode.



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 the [0] key to show the SYSTEM SETTING 1 menu.
3. Press the [2] key to show the RADAR 1 menu.
4. Press the [6] key to select menu item 6 TRAIL REF.
5. Press the [6] key 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.

Trail gradation

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)*



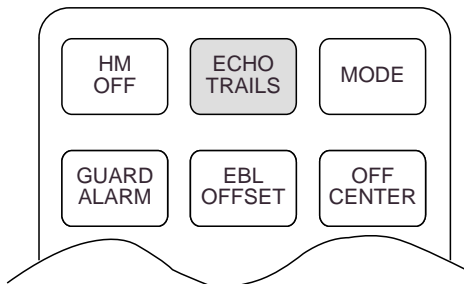
*Gradual shading
(Multi)*

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 the [7] key to select menu item 7 TRAIL GRAD (graduation) in step 4.
- Press the [7] key 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 trails 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 of 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 loss of echo trail data so far stored in an in memory.

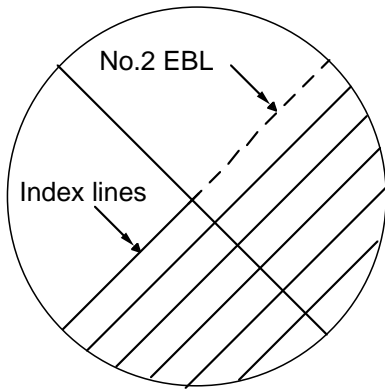
Resetting echo trails

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

1.26 Parallel Index Lines

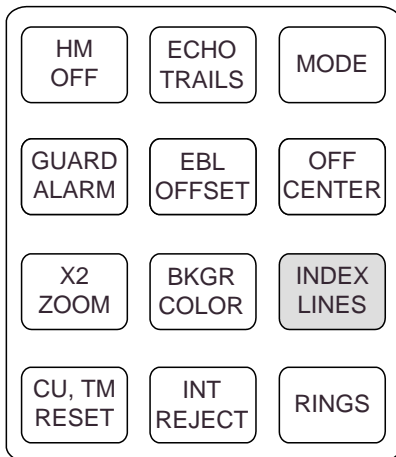
Parallel index lines are useful for keeping a constant distance between own ship and a coastline or a partner ship when navigating. Index lines are drawn in parallel with the No.2 EBL (No.2 EBL must be active). The orientation of the index lines is controlled with the EBL control and the intervals between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

Maximum number of the index line can be set the Initial Setting menu: 2, 3 or 6.



Displaying and erasing the index lines

1. Press the INDEX LINES key if the index lines are not already shown.
2. Make sure that the No.2 EBL 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.



Inside mode panel

Adjusting index line intervals

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

Hit [RADAR MENU].

[FUNCTIONS 1]	
1 PULSE WIDTH	1/2
2 ECHO STRETCH	OFF/1/2
3 ECHO AVERAGE	OFF/1/2/3
4 PANEL DIMMER	OFF/DIM/M/BRT
5 ECHO COLOR	YEL/GRN/COLOR*
6 SHIP'S SPEED	LOG/NAV*/MAN
7 INDEX LINES	NO.2 VRM/MAN
8 SET/DRIFT	OFF/MAN
	SET 000.0
	DRIFT 00.0 KT
9 BRILLIANCE	
0 [SYSTEM SETTING 1]	

* R-type only

2. Press the [7] key to select menu item 7 INDEX LINES.
3. Press the [7] key to select (or highlight) No.2 VRM or MAN (manual) option.
4. Press the ENTER key to conclude your selection.
5. If you have selected MAN 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 followed by the ENTER key without omitting leading zeroes, if any. There are six index lines but the number of lines visible on the screen may be less than six depending on the line setting interval.
6. If you have selected NO.2 VRM in step 3 above, make sure that the No.2 VRM is active and adjust the spacing between the index lines by operating the VRM control.
7. Press the RADAR MENU key to close the FUNCTIONS menu.

1.27 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. The message "ANCHOR WATCH ERR" appears in red when position data is not inputted.

Notes:

- 1) The own ship mark is available on the R-type radar only; unavailable on the IMO 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.

Activating anchor watch

To set up the anchor watch feature:

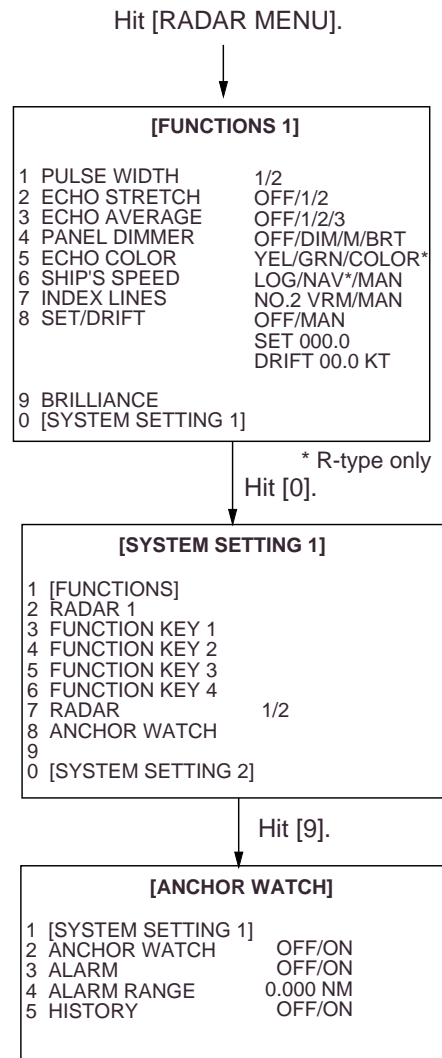
1. On the ANCHOR WATCH menu, press the [2] key to select menu item 2 ANCHOR WATCH OFF/ON.
2. Further press the [2] key to select (or highlight) ON, followed by the ENTER key to conclude your selection. The label WATCH appears at the lower-left corner of the screen.
3. Press the [3] key to select menu item 3 ALARM OFF/ON. Further press the [3] key to select (or highlight) ON or OFF, followed by the ENTER key to conclude your selection. (This operation determines whether to activate the anchor watch audible alarm.)

Alarm range setting

Press the [4] key 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 conclude 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 control panel.

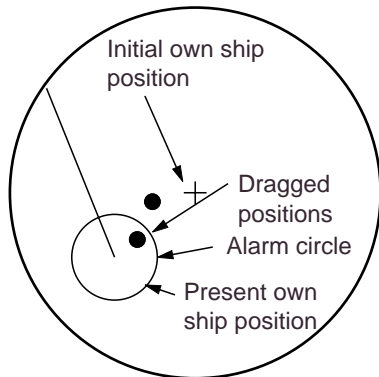


Showing drag line

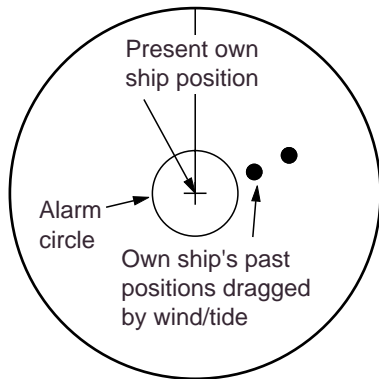
Press the [5] key to select menu item 5 HISTORY on the ANCHOR WATCH menu. Further press the [5] key to select (or highlight) ON, followed by the ENTER key to conclude your selection.

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 plot-

ted 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.

IMO-type

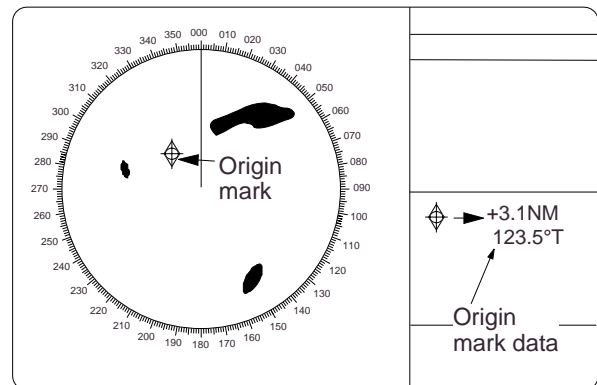
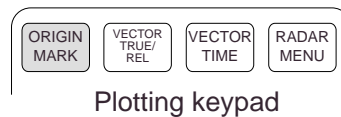
On the IMO type the anchor watch feature is available only in STANDBY status.

1.28 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.

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 lower-left section of the screen.
3. To measure the range and bearing to a target of interest from the origin mark, move the cursor to the target of interest. Then, the range and bearing from the origin mark to the target are shown at the target data display.
4. To erase the origin mark, press the ORIGIN MARK key once again.

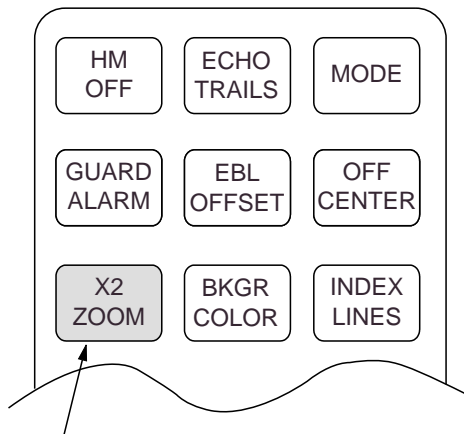


1.29 Zoom

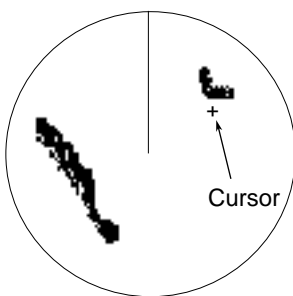
The zoom function is available on the R-type radar only to enlarge an area of interest.

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.

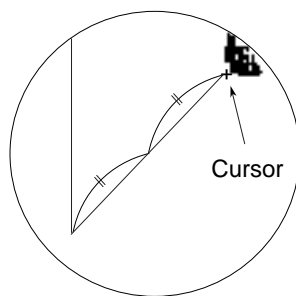
Note: The zoom feature is inoperative when the display is off centered.



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



(a) *Cursor placed at point of interest*



(b) *Zoom in (R-type only)*

1.30 Markers

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 mode panel. The heading marker reappears when the key is released.

North marker

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

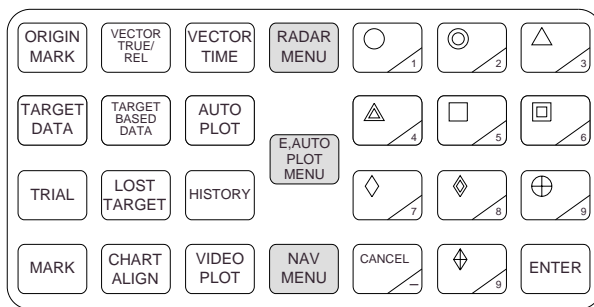
1.31 Menu Keys

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.

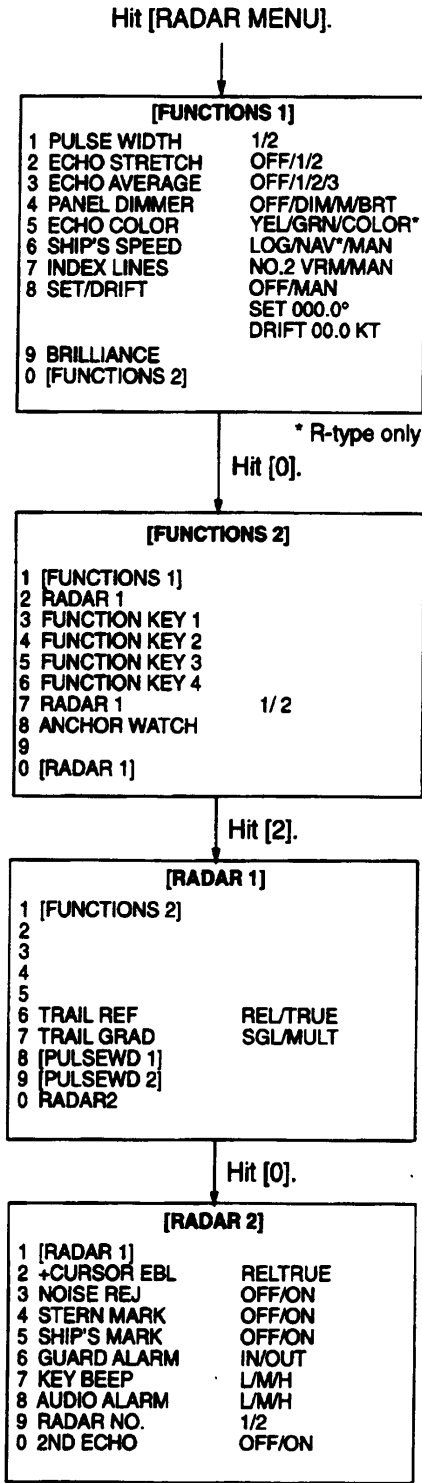
E, AUTO PLOT MENU: Provides a choice of standard or large size of plotting symbols for plot.

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



1.32 RADAR 1 and 2 Menu Settings

R-type



[FUNCTIONS 1] menu

5 ECHO COLOR: Targets are painted in monochrome yellow, green or full colors (red, yellow and green according to echo strengths).

[FUNCTIONS 2] 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

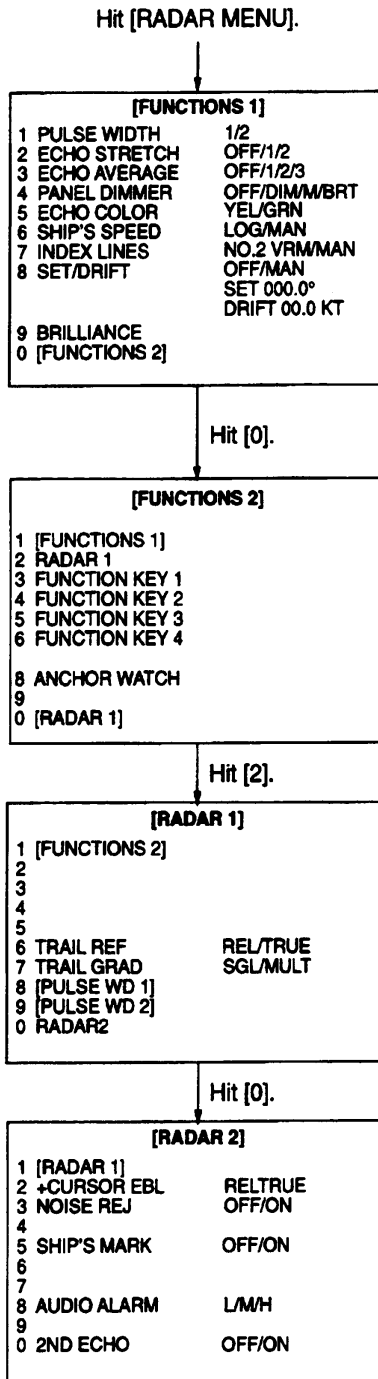
6 TRAIL REF: Select REL to show relative trails; TRUE to show true echo trails.
7 TRAIL GRAD: Select SGL to show echo trails in single tone; MULT to show them in multiple shading.

[RADAR 2] menu

2 CURSOR EBL: Select REL to read relative bearing of the cursor and EBL; TRUE to read true bearing of them.
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's marker; 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 key beep 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 a FURUNO representative or dealer for details.)

IMO-type radar

IMO-type radar



[FUNCTIONS 1] menu

5 ECHO COLOR: Targets are painted in monochrome yellow or green as selected.

[RADAR 1] menu

6 TRAIL REF: Select REL to show relative 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 EBL: Select REL to read relative bearing of the cursor and EBL; TRUE to read true bearing of them.

3 NOISE REJ: Select ON to activate noise rejector; OFF to deactivate it.

5 SHIP'S MARK: Select ON to show own ship's marker OFF to hide it.

8 AUDIO ALARM: Select sound level of key beep from L (low), M (medium), and H (high).

1.33 Function Keys

The four function keys (#1-4) on the 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 your specific navigating purpose, and an adhesive label (such as BUOY, HARBOR, COAST or the like) is usually attached to the key top for easy identification of the assigned purpose.

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

Function key #1: Picture setup

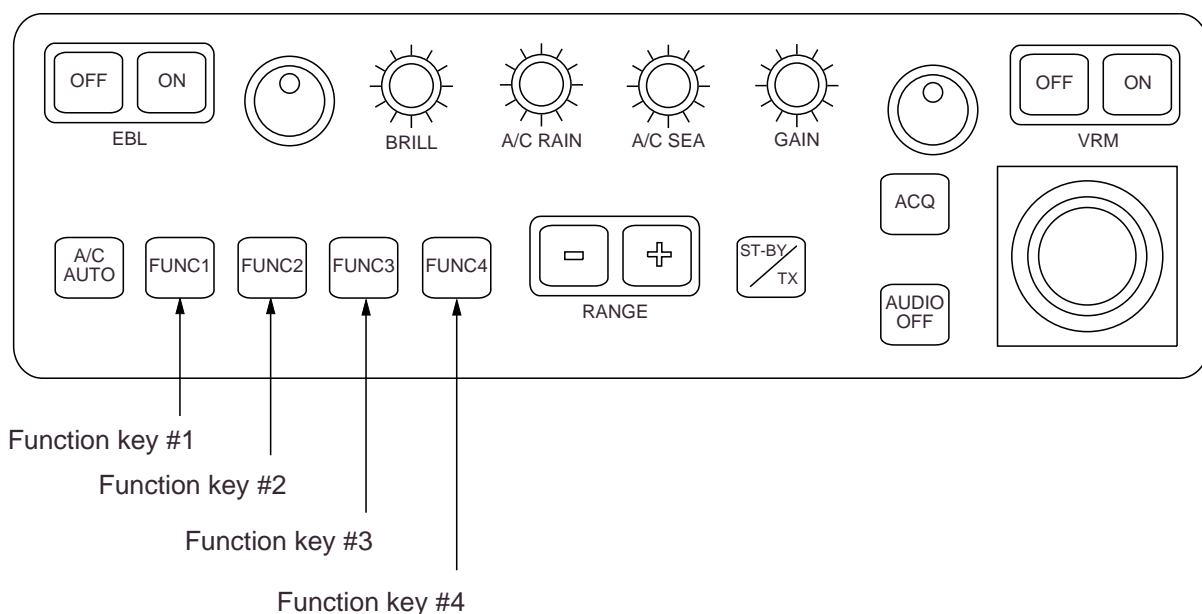
Function keys #2 and #3: Picture setup and specific operation

Function key #4: Specific operation or watch alarm

Picture setup

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

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

Specific operation

Most often used controls are placed on the center panel while less often used controls are provided inside the covered compartments on the right and left sides. To avoid opening the covers or menus to set up the radar for a particular situation, function keys #2, #3 and #4 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 1.9.)
- Echo trails (See paragraph 1.25.)
- Course-up and True Motion reset function (See paragraph 1.9.)
- Off-centering (See paragraph 1. 21.)
- Echo stretch 1 or 2 (See paragraph 1.22.)
- Pulsewidth 1 or 2 (See paragraph 1.11.)
- Echo averaging 1, 2 or 3 (See paragraph 1 .23.)
- Echo color (See paragraph 1.32.)
- Echo trail graduation (See paragraph 1.23.)
- Panel illumination
- Label brilliance
- Noise rejection

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

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.

Watch alarm

The watch alarm sounds an external buzzer selected time intervals to help you keep regular watch of the radar picture for safety or other purposes. This feature can be assigned to function key #4 with a choice of alarm intervals of 3, 6, 10, 12, 15 and 20 minutes. (See the flowchart on page 1-39 for keystroke sequence.)

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

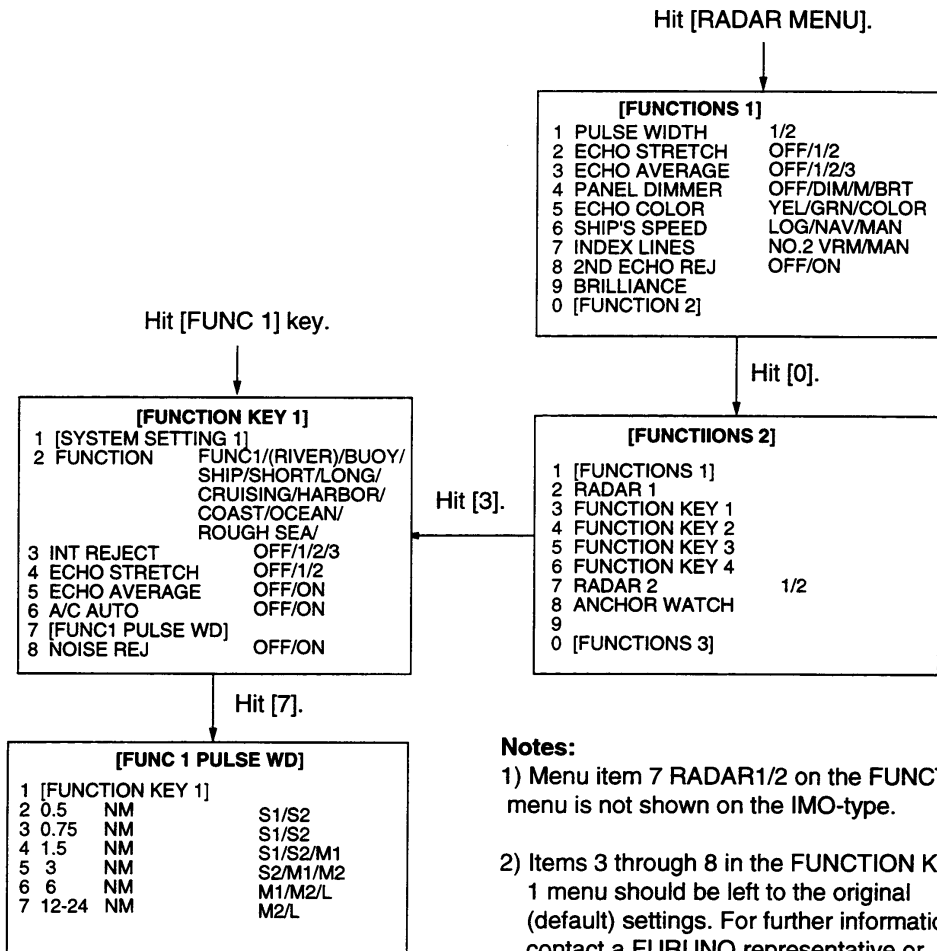
When an audible watch alarm is released the preset time interval has elapsed, the screen label WATCH turns red and the watch alarm timer freezes at "0:00."

To silence the alarm, press the AUDIO 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.

Setting for function key #1

Setting for function key #1



Notes:

- 1) Menu item 7 RADAR1/2 on the FUNCTIONS 2 menu is not shown on the IMO-type.
- 2) Items 3 through 8 in the FUNCTION KEY 1 menu should be left to the original (default) settings. For further information contact a FURUNO representative or dealer.

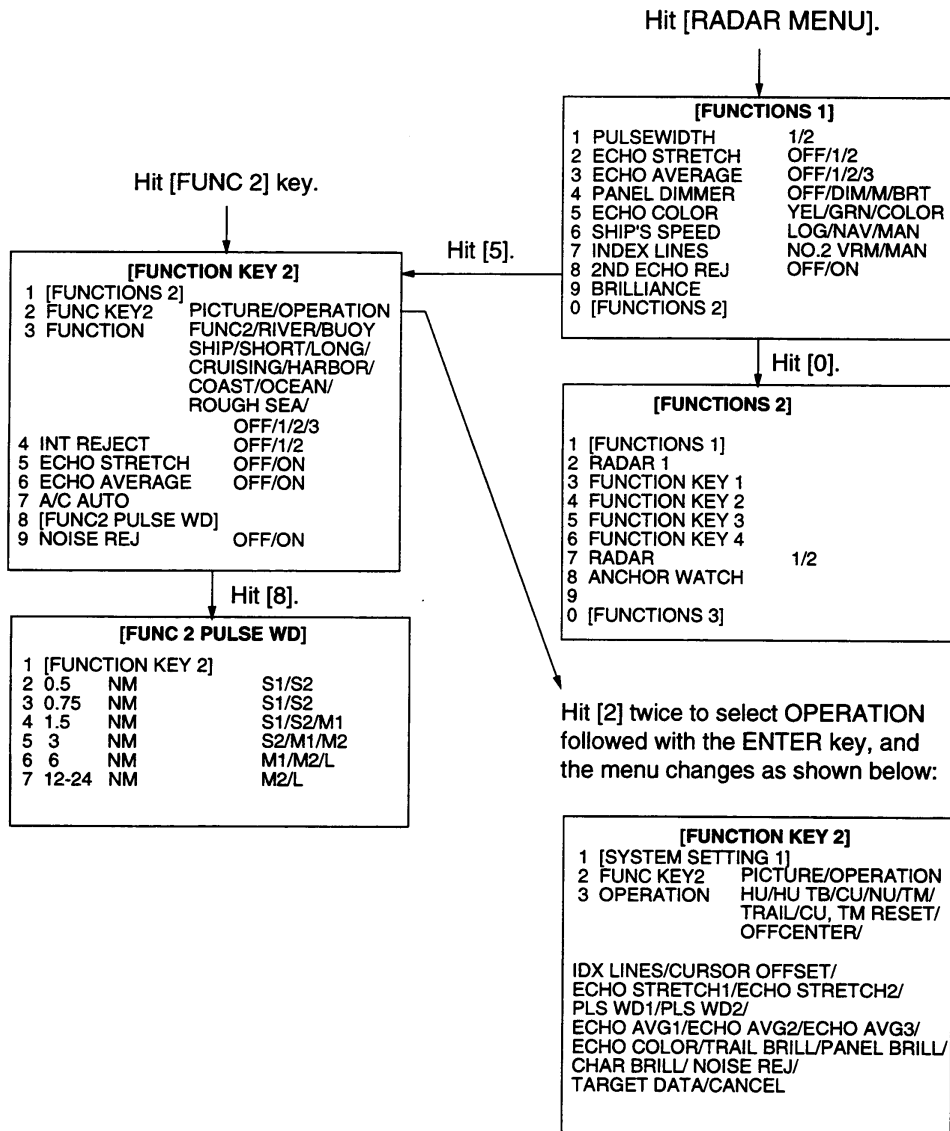
Picture Setup Default for Function Keys 1, 2 and 3

To restore default settings, select appropriate function again and close the menu.

	3. INT REJ	4. E. S.	5. E. A.	6. A/C AUTO	8. NOISE REJ	0.5NM	0.75NM	1.5NM	3 NM	6NM	12-24NM
RIVER	2	1	OFF	OFF	OFF	S	S1	S1	S2	M1	M2
BUOY	3	2	3	OFF	ON	S1	S2	S2	M1	M2	L
SHIP	3	2	3	OFF	ON	S1	S2	S2	M1	M2	L
SHORT	2	OFF	OFF	OFF	OFF	S1	S1	S1	S2	M1	M2
LONG	3	2	3	OFF	ON	S1	S1	S1	S2	M1	M2
CRUISING	3	3	3	OFF	ON	S2	S2	S2	M2	L	L
HARBOR	3	OFF	OFF	OFF	OFF	S1	S1	S1	S2	M1	M2
COAST	2	OFF	OFF	OFF	OFF	S1	S1	S2	M1	L	L
OCEAN	2	OFF	3	OFF	OFF	S1	S2	S2	M1	M2	L
ROUGH SEA	2	OFF	2	ON	OFF	S1	S1	S2	M1	M2	L

Setting for function key #2

Setting for function key #2

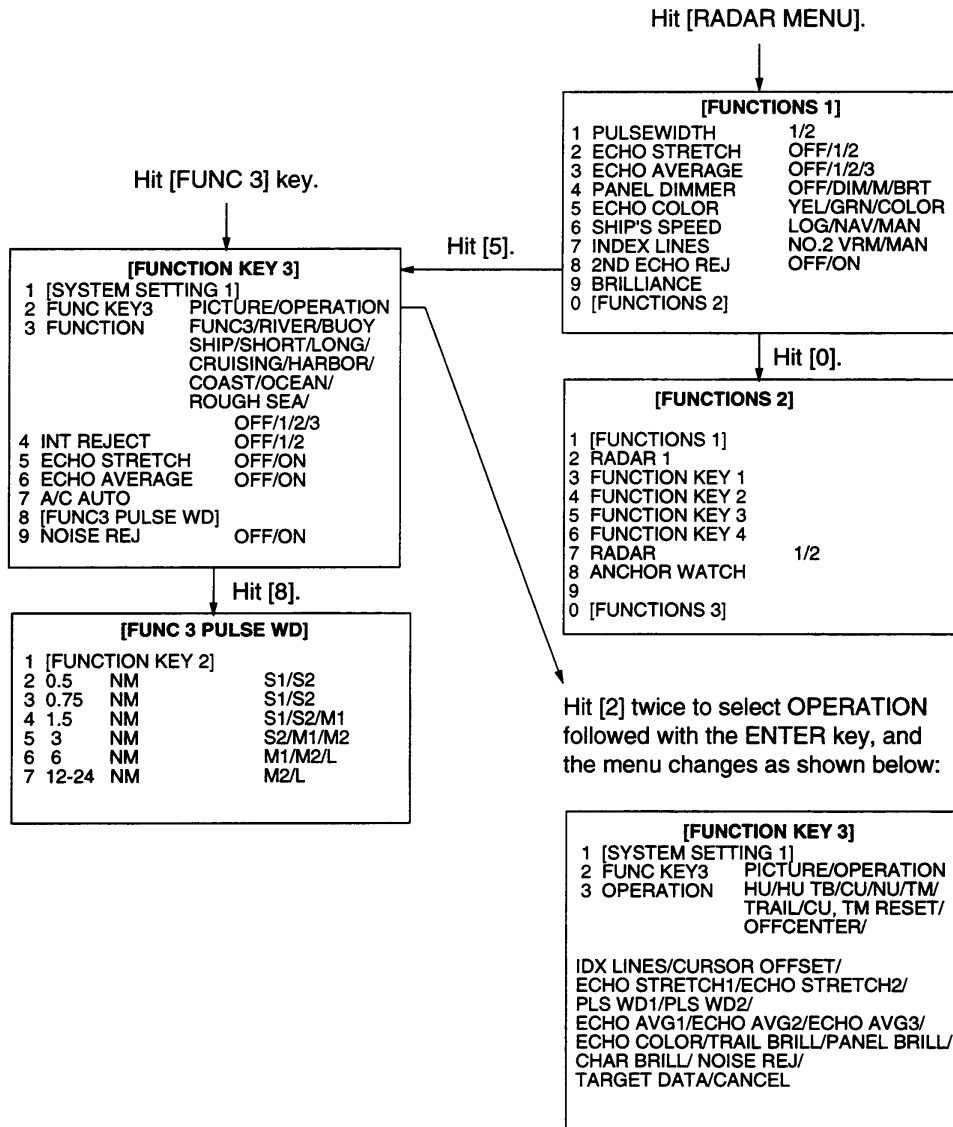


Notes:

- 1) Menu item 7 RADAR 1/2 on the FUNCTIONS 2 menu is not shown on the IMO-type.
- 2) Items 4 through 9 on FUNCTION KEY 2 menu should be left in the default setting.
For further information contact a FURUNO representative or dealer.

Setting for function key #3

Setting for function key #3

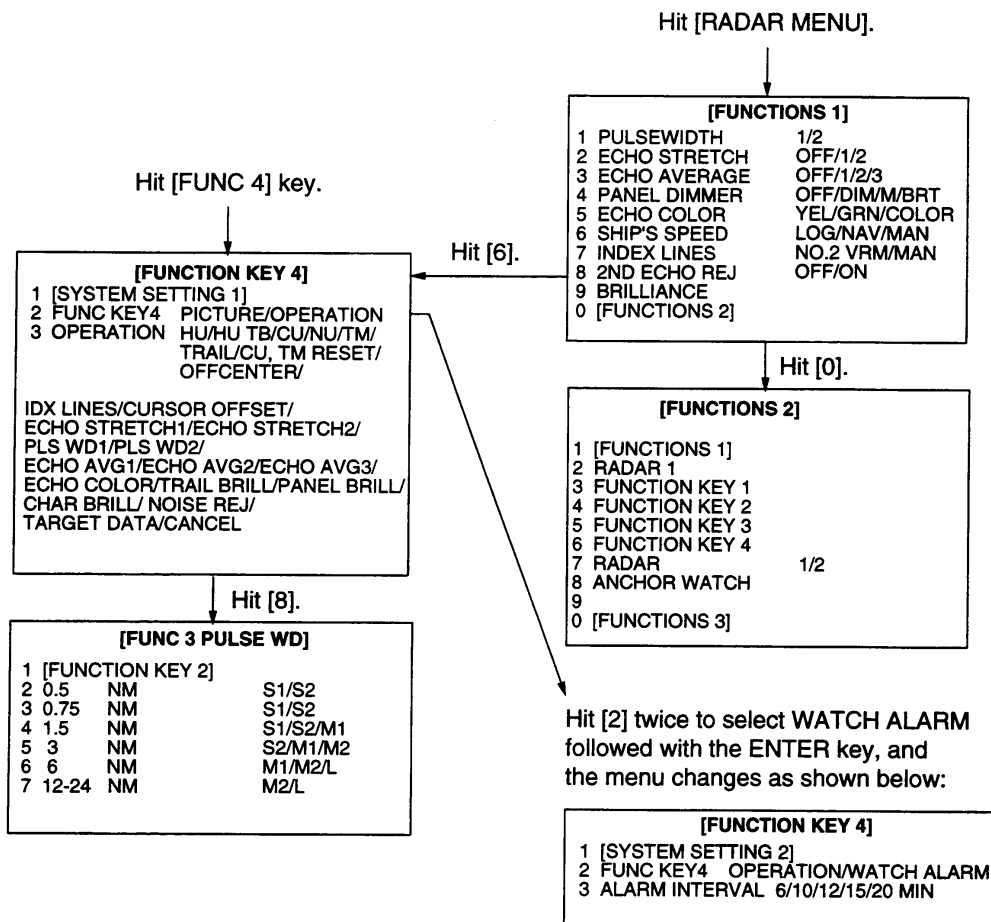


Notes:

- 1) Menu item 7 RADAR 1/2 on the FUNCTIONS 2 menu is not shown on the IMO-type.
- 2) Items 4 through 9 on FUNCTION KEY 3 menu should be left in the default setting.
 For further information contact a FURUNO representative or dealer.

Setting for function key #4

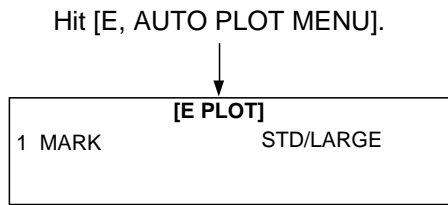
Setting for function key #4



1.34 EPA Menu

EPA menu appears by pressing the E, AUTO PLOT MENU key. You can set the following items.

1. COLLISION ALARM: You can set CPA and TCPA for the tracked target. Refer to 2.12 Setting CPA/TCPA Alarm range. Note that TCPA setting is available over one-minute.
2. MARK SIZE: Change the size of the plotting.
3. PLOT No.: Displays or hides plot number inside of the plot symbol (circle and square).
4. TARGET DATA: Selects target vector mode between TRUE or REL. Selection of REL provides the target mode in REL on HU TB.

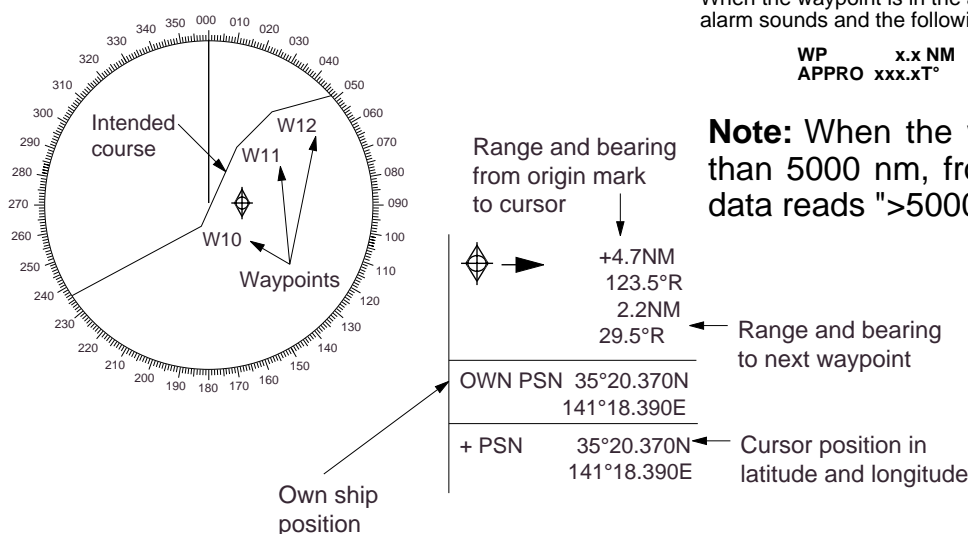


1.35 NAV INFORMATION Menu and Navigation Data Display

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.

Note that data not directly related with the radar presentation is not available. 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 an EPFS (elest rouis position-fixing system) such as a GPS receiver or a Loran-C receiver. Such an EPFS should be of the type which provides output data in accordance with IEC 1162.
- 2) When the sensor in use changes (ex. from GPS or DGPS), the name of sensor in the own ship call turns red, and EPFS label appears. To erase, press the CANCEL key.

Displaying External Waypoint

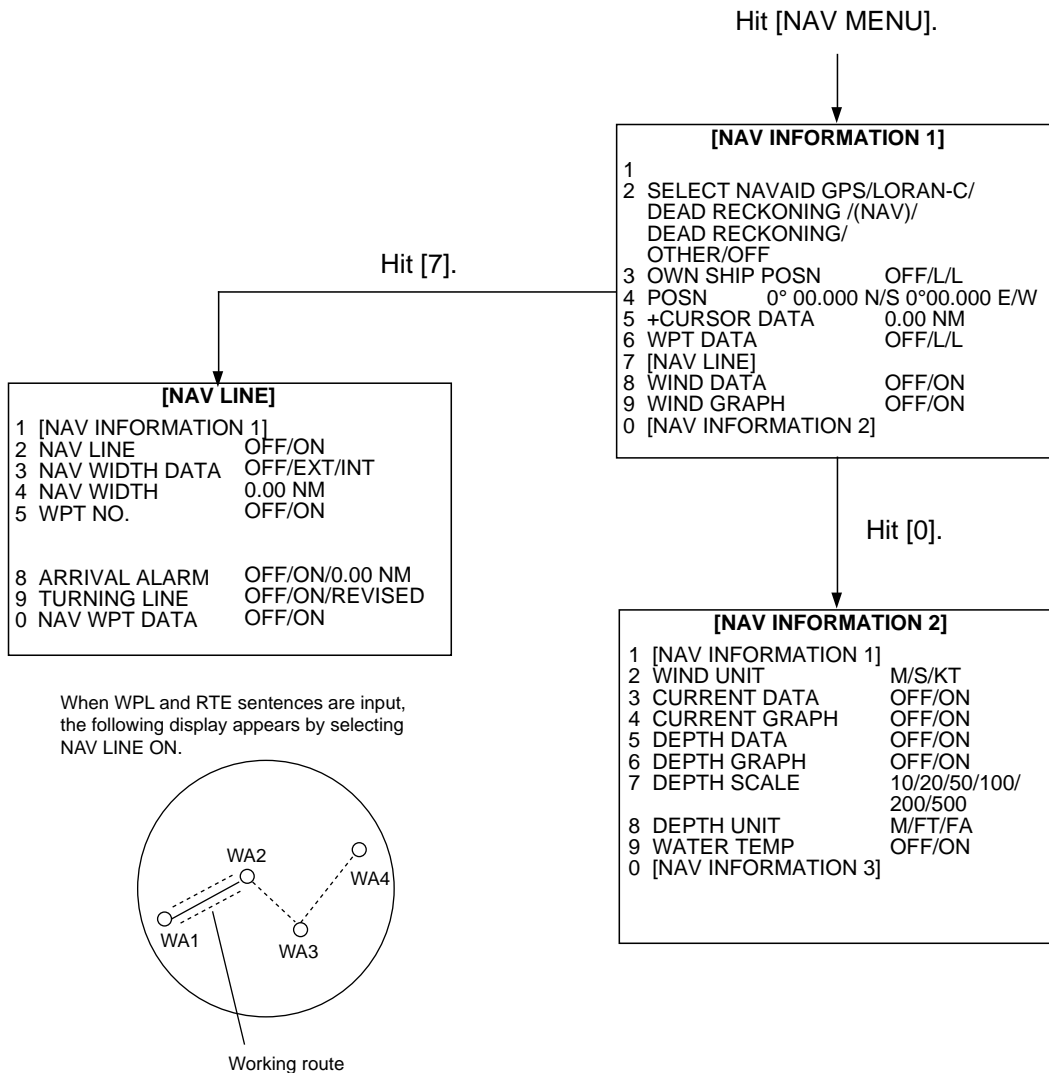
The mark and data of external waypoint from an EPFS can be displayed by setting NAV LINE menu as follows. To display the menu, press [NAV MENU] [7] in order.

[NAV LINE]	
1	[NAV INFORMATION 1]
2	NAV LINE OFF/ON
3	NAV WIDTH DATA OFF/EXT/INT
4	NAV WIDTH 0.00 NM
5	WPT NO. OFF/ON
8	ARRIVAL ALARM* OFF/ON/0.00 NM
9	TURNING LINE OFF/ON/REVISED
0	NAV WPT DATA OFF/ON

*ARRIVAL ALARM may be turned OFF or ON. When the waypoint is in the area set, alarm sounds and the following message appears.

WP x.x NM
APPRO xxx.xT°

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



1.36 Radar Map

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

Marking radar map

Select mark entry mode as follows.

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

3. Press [2] key to twice to select ON, and then press the ENTER key. MAP indication appears at the right-hand of the screen.
4. Press [5] key several times to select the entry mode, cursor, L/L or own ship position.
5. Press the ENTER key followed by the NAV MENU key.

A radar map contain 1500 points of mark and line data.

Mark a radar map as follows.

By Cursor position;

1. Press the MARK key to display the ENTER MARK menu.
2. Enter mark number to select desired mark, followed by the ENTER key.

3. Place + cursor an appropriate point.
4. Press the ENTER key.
5. Repeat steps 2 to 4 above. To enter the same mark selected at step 2, simply repeat step 3 and 4.
6. To escape the mark entry mode, press the MARK key.

By L/L position entry mode

1. Press the MARK key to display the ENTER MARK menu. On L/L entry mode, the latitude and longitude are appears.
2. Key in the latitude. If necessary, press the following key.
[5] key; N, [6] key; S
3. Key in the longitude. If necessary, press the following key.
[7] key; E, [8] key; W
4. Select mark.
5. Press the ENTER key.

By own ship position entry mode

1. Press the VIDEO PLOT key.
2. Press the MARK key.
3. Enter mark number.
4. Press the ENTER key.

Note: Waypoints used to make NAV lines, as described on page 1-40, can be erased on the NAV LINE menu.

Chart alignment

You can align the chart data and radar image, by using the ALIGN key.

1. Press the ALIGN key.
2. Operate the trackball to align the chart on the radar.
3. Press the ALIGN key to fix.

Other items

3. NAV DATA POSN:

Reset the chart alignment.

4. ALIGN + CURSOR

Select ON, plus the alignment rate to the cursor data which is appeared at the lower of the display.

6. ERASE MARK

AREA; Erase all marks on the current appearing display.

ALL; Erase all marks in the CPU.

1.37 Suppressing Second-trace Echoes

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

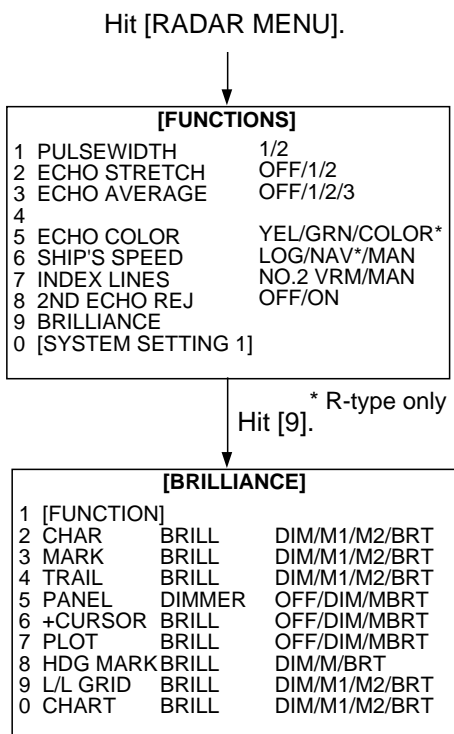
To activate or deactivate the second-trace echo rejector:

1. Press the RADAR MENU key on the plotting keypad to show the FUNCTIONS menu.
2. Press the [8] key to select menu item 8 2ND ECHO REJ.
3. Further press the [8] key to activate (ON) or deactivate (OFF) the second-trace echo rejector.
4. Press the ENTER key to conclude selection followed by the RADAR MENU key to close the FUNCTIONS menu.

1.38 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 the [9] key 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.
5. Press the ENTER key to conclude 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-25
HDG MARK	Heading line and stern marker (Stern marker displayed on R-type only.)
L/L GRID	Lat/long grid lines generated by optional Auto Plotter ARP-25
CHART	Chart generated by optional Auto Plotter ARP-25

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

1.39 Set and Drift (Set and Rate)

Set the direction in which a water current flows, can be manually entered in 0.1 - degree steps. Drift, in another word Rate, the speed of tide, can also be entered manually in 0.1 knot steps.

Set and drift corrections are beneficial for increasing the accuracy of vectors and target data. The correction is best made in the head-up mode with true vector, watching landmasses, or other stationary targets. If they have vectors, set and drift values should be adjusted until they lose vectors.

Note: Set and drift correction is available on selecting the water tracking mode only.

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

1. Press the RADAR MENU key on the plotting keyboard to show the FUNCTIONS 1 menu.
2. Press the [8] key to select menu item 8; SET, DRIFT.
3. Further press the [8] key to select OFF or MAN option.
OFF: No correction against set and drift.
MAN: Manual entry of set and drift data.
4. If OFF is selected, press the ENTER key.

5. If you have selected MAN in step 3 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 zeroes, if any, and press the ENTER key.

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

6. Press the RADAR MENU key to close the menu.

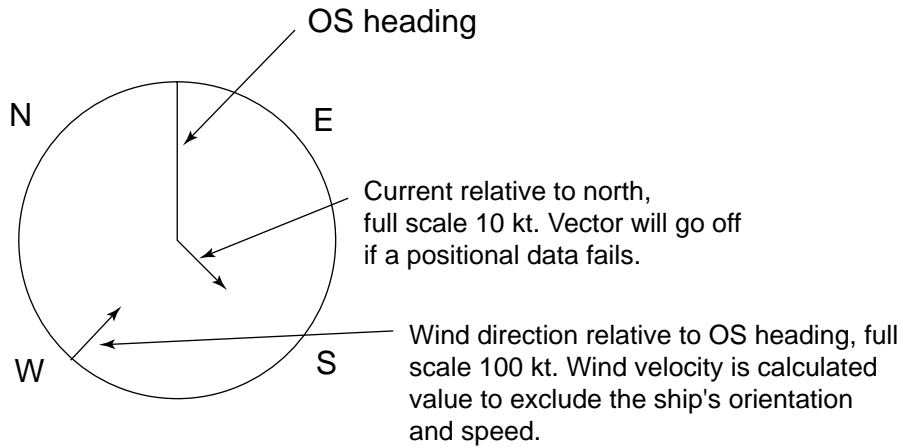
1.40 Display of Ancillary Information

Wind and tide data and depth sounding data can be displayed in the text cell which is normally used to indicate third target ship data. Do as follow:

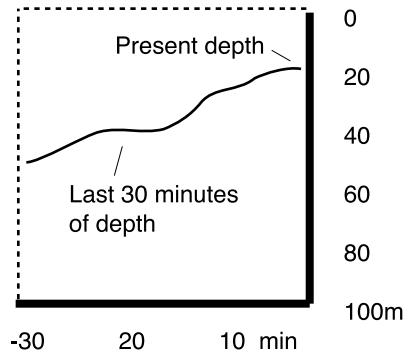
1. Press the NAV MENU key to show the NAV INFORMATION 1 menu.
2. Press [8] key twice to set WIND DATA ON and press the ENTER key.
3. Press [9] key twice to set WIND GRAPH ON and press the ENTER key.
4. Do the same to indicate ocean current graph and echo-sounding chart. Depth scales can be selected among 10, 20, 50, 100, 200 and 500 m on the NAV INFORMATION 2 menu.
5. Press [0] key twice to show the NAV INFORMATION 3 menu.
6. Press [2] key twice and press ENTER key to select UTC.

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

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



Example of Head-up mode



Example of Depth graph

1.41 Alarms

This radar generates visual and audible alarms to alert you to certain events or systems 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	HDG label reads ***.* and GYRO in red appears at the lower-right corner of the screen. Display is automatically switched to head-up mode within 1 min.	Change the presentation mode when the gyro input has been restored. Align the on-screen GYRO readout, if necessary. Then, press the CANCEL key to erase the message SET HEADING.
Target alarm (TAZ)	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.
Own ship lat/lon, Cursor lat/lon	None	***.* in own ship position field ***.* in own cursor position field	Make sure that own ship position data is fed from external EPFS.
System failure	None	Message BRG SIGNAL MISSING shows at screen bottom. No radar echoes. SYSTEM FAILURE in red at the lower left of the display during Track Test.	Make sure the Antenna switch in the turning compartment is ON.
Incorrect Keystroke	Double beep tone (Key beep not available on IMO-type.)	None	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	LOG *.* and the label LOG turns red, if no log signal is input for 30 sec while the ship speed has been more than 5.0 kt.	If the SDME has field, use the Manual Speed mode or other appropriate sensor.
AZIMUTH HDG TRIG VIDEO	1 beeps 1 beeps 1 beeps 1 beeps	AZIMUTH in red HDG in red TRIG in red VIDEO in red	When input signal corners in.

2. OPERATION OF ARPA

2.1 General

The FAR-2805 series with ARP-25 board provide the full ARPA (Automatic Radar Plotting Aid) functions complying with IMO A. 823 as well as complying with the radar performance in MSC.64 (67) Annex 4.

This chapter describes the operation of the ARPA. For operation of normal radar, refer to Chapter 1.

Principal specifications

Acquisition and tracking

- Automatic acquisition of up to 20 targets plus manual acquisition of 20 targets, or fully manual acquisition of 40 targets between 0.1 and 32 nm (0.1 and 24 nm depending on initial setting)
- Automatic tracking of all acquired targets between 0.1 and 32 nm (0.1 and 24 nm depending on initial setting)

Vectors

Vector length: 30 sec, 1, 2, 3, 6, 12, 15, 30 min.

Orientation: True velocity or relative velocity

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

Past positions: Choice of 5 or 10 past positions at intervals of 30 sec, 1, 2, 3 or 6 min.

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

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

2.2 Keys Used for ARPA

The Auto Plotter uses the keys on the plotting keypad on the right side of the radar screen and two keys on the control panel. Below is a brief description of these keys.

E-plot is inoperable in ARPA mode. For E-plot refer to section 1.24 and 1.34.

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 sec, 1, 2, 3, 6, 12, 15 or 30 min.

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 ARPA functions.

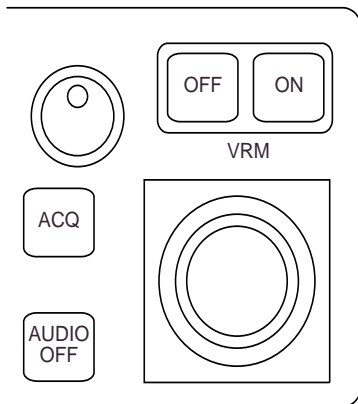
TRIAL: Shows consequences of own ship's speed and course against all tracked targets.

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

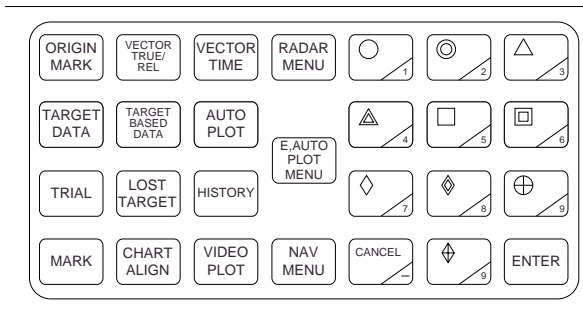
HISTORY: Shows and erases past positions of tracked targets.

ACQ (on control panel): Manually acquires a target.

AUDIO OFF (on control panel): Silences aural alarm.



Control panel



Plotting keypad

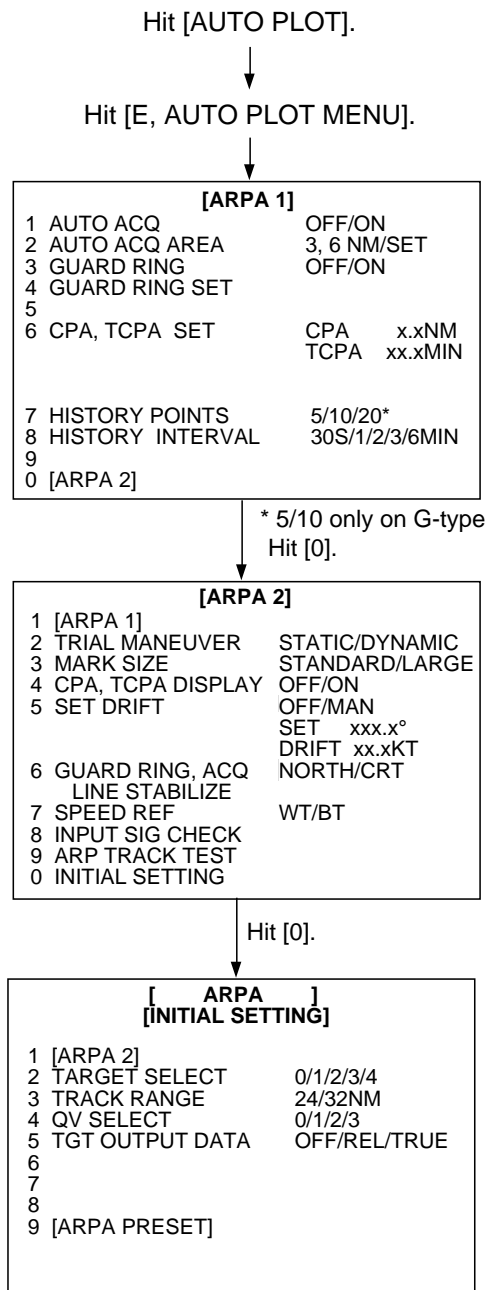
CRITERIA OF TRACKING
 A target measuring 800 m or more in the radial or circumferential direction is regarded as a landmass and not acquired or tracked. Echoes smaller than 800 m are regarded as targets to be tracked.

2.3 ARPA Menu Operation

Various parameters for the Auto Plotter are set on the ARPA 1 and ARPA 2 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 ARPA appears in the upper-right box on the screen.
2. Press the E, AUTO PLOT MENU key to show the ARPA 1 menu.
3. Press the [0] key once if you wish to go to the ARPA 2 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 settings.
7. Press the E, AUTO PLOT MENU key to close the menu.



2.4 Start-up Procedure

Activating the ARPA

To activate the ARPA:

1. Adjust the A/C RAIN, A/C SEA and GAIN controls for proper radar picture.
2. Press the AUTO PLOT key. The label ARPA appears in the box at the upper-right on the screen.

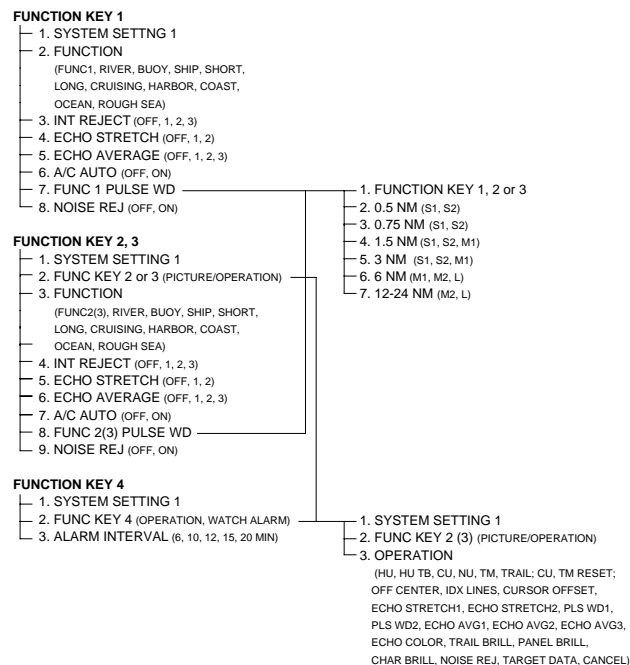
Entering own ship's speed

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

Automatic speed input

For speed log input:

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



2. Press the [6] key to select menu item 6SHIP'S SPEED.
3. Press the [6] key to select (or highlight) LOG option.

4. Press the ENTER key to conclude your selection followed by the RADAR MENU key to close the FUNCTIONS menu. The ship's speed readout at the top of the screen shows own ship's speed fed from the speed log preceded by the label "LOG."
5. When the speed log is used, select speed reference to either of SEA or GND(ground) on the ARPA 2 menu.

Notes:

- 1) IMO Resolution A.823:1995 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 top of the screen will be blank. In the event of a log error, you can continue plotting by entering a manual speed.
- 3) If a log signal interval becomes more than 30 seconds with the ship's speed 5KT or more, the radar regards the speed log is in a trouble and LOG FAIL appears, reading xx-x KT. For R-type, if no speed input is present for 3 minutes at below 0.1KT, the radar regards the log is in failure.

Manual speed input

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

1. Press the RADAR MENU key on the plotting keypad to show the FUNCTIONS menu.
2. Press the key [6] to select menu item 6SHIP'S SPEED.
3. Press the key [6] to select (or highlight) MAN option.
4. Press the ENTER key to conclude your selection. At this point, "MAN = xx.x KT" appears at the bottom of the FUNCTIONS menu.

5. Enter the ship speed by hitting corresponding numeric keys followed by the ENTER key without omitting leading zeroes, if any. As an example, if the ship speed is 8 knots, press [0] [8] [ENTER]. For 4.5 knots, [0] [4] [5] [ENTER].
6. Press the RADAR MENU key to close the FUNCTIONS menu. The ship speed readout at the screen top shows own ship's 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.

To establish 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, the reference target mark blinks and the speed reads "xx.x." Select a different reference target in this case.
- 2) When all targets are deleted, the reference target mark is also deleted and the target-based speed becomes invalid. The speed is indicated in KTBT where BT means Bottom Track (speed over ground).
- 3) The vector of the reference target can be displayed by menu operation (Auto Plot 1 menu).

Canceling target-based speed

To cancel the target-based speed, just press the TARGET BASED SPEED key. The speed is shown by LOG, NAV* or MANUAL as selected previously. (NAV only on R-type)

Deactivating the ARPA

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

Note: Even when the ARPA is turned off, target tracking still goes on until the radar is turned off. (For G-type, target tracking goes off at STBY.)

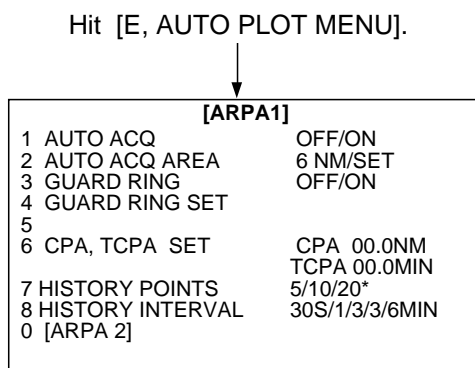
2.5 Automatic Acquisition

The ARPA can acquire up to 40 targets (20 automatically and 20 manually or all 40 manually. If AUTO ACQ is selected after more than 20 targets have been manually acquired, only the remaining capacity of targets can be automatically acquired. For example, when 30 targets have been acquired manually, then the ARPA is switched to AUTO ACQ. Only 10 targets can be acquired automatically. A target just acquired automatically is marked with a broken square and a vector appears 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. (Targets automatically acquired are distinguished from those acquired manually, displayed by bold symbol.)

Enabling and disabling auto acquisition

1. Press the E, AUTO PLOT key if the ARPA is not yet activated. Note that the label ARPA appears in the box at the upper-right on the screen.



*5/10 only on IMO-type

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

Note: When the ARPA has acquired 20 targets automatically, the message AUTO TARGET FULL is displayed in the box at the right-hand side of screen.

Setting auto acquisition areas

Instead of limit lines, auto acquisition areas are provided in the system. There are two setting methods:

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.

SET: Two sector-shaped or full-circle auto acquisition areas set by using the trackball.

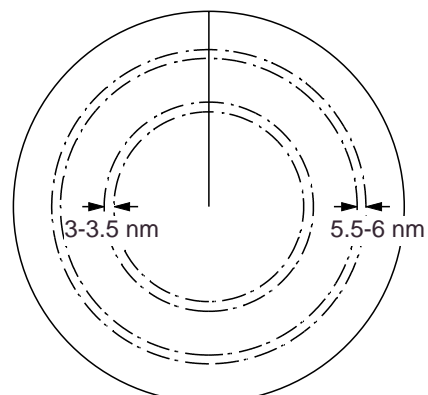
To set 3 & 6 NM auto acquisition areas

To activate two predefined auto acquisition areas:

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

The illustration below shows how the auto acquisition areas are displayed on the screen. Up to 20* targets within the auto acquisition areas are acquired automatically.

*If 30 targets have already been acquired manually in the MAN ACQ mode (AUTO OFF on ARPA 1 menu), only 10 more targets can be acquired automatically.



Predefined auto acquisition areas

To set auto acquisition areas with trackball

To set auto acquisition areas with trackball:

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

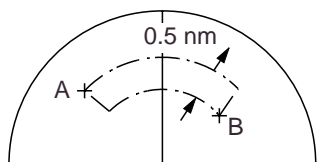
```
[AUTO ACQ SETTING]
1 [AUTO PLOT 1]
2 1/2
```

5. Press the [2] key to select menu item 21/2 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 counter-clockwise 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.



Automatic acquisition area set by trackball

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

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

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

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

Terminating tracking of targets

When the ARPA has acquired 20 targets automatically, the message AUTO TARGET FULL is displayed in the box at right-hand side of the screen 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 to cancel tracking by operating the trackball. 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.




2.6 Manual Acquisition

In auto acquisition mode (AUTO ACQ ON), up to 20 targets can be manually acquired in addition to 20 auto acquired targets. When auto acquisition is disabled (AUTO ACQ OFF), up to 40 targets can be manually acquired and automatically tracked.

To manually acquire a target:

1. Place the cursor (+) on a target of interest by operating the trackball.
2. Press the ACQ key on the control panel. 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) 20 scans after acquisition—
Vector appears to show a trend of movement.
-  (c) 60 scans after acquisition—
Plot symbol shown in solid lines indicating stable tracking.

Notes:

- 1) For successful acquisition, the target to be acquired should be within 0.1 to 32 nm from own ship and not obscured by sea or rain clutter.
- 2) When you have acquired 40 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" on page 2-6.)

CAUTION

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.

2.7 Changing Plot Symbol Size


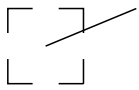
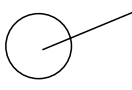
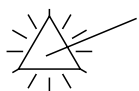
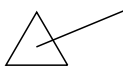


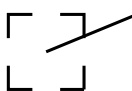
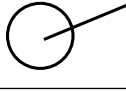



Press a desired plot symbol key, and the symbol is enlarged for about 7 seconds.

You may also choose plot symbol size. To choose a large or standard size for all plot symbols:






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

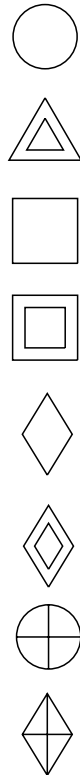
ARPA symbols

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	Remarks
Automatically acquired targets		Initial stage EPVS symbol NO. 3	Broken square around an echo to indicate the target under acquisition and initial stage of tracking, before steady-state tracking.
		EPVS symbol NO. 3	Between 20 and 60 scans of antenna after acquisition (vector still unreliable)
		Steady tracking EPVS symbol NO. 4a	Solid circle with vector indicating steady state tracking (60 scans after acquisition)
	 (flashing)	CPA alarm EPVS symbol NO. 8	Plot symbol changes to an equilateral triangle flashing to indicate the target is predicted to come into CPA or TCPA.
		CPA alarm acknowledge EPVS symbol NO. 8	Flashing stops after CPA/TCPA alarm is acknowledged.
	 (flashing)	Lost target EPVS symbol NO. 9	Lost target is indicated by flashing diamond symbol. The diamond is formed from two equal triangles.
Manually acquired targets		Initial stage EPVS symbol NO. 3	Plot symbol selected for a target acquired manually is shown in bold broken lines.
		EPVS symbol NO. 3	Bold broken square for 20 - 60 scans of antenna after acquisition.
		Steady tracking EPVS symbol NO. 4a	Manual plot symbol in a bold solid circle (60 scans after acquisition)
	 (flashing)	CPA alarm (collision course) EPVS symbol NO. 8	Plot symbol changes to an equilateral triangle flashing if a target is predicted to come into the preset CPA or TCPA.
		EPVS symbol NO. 8	Flashing stops after CPA/TCPA alarm is acknowledged.
	 (flashing)	Lost target EPVS symbol NO. 9	Lost target is indicated by flashing diamond symbol. The diamond is formed from two equal triangles (one apex up and the other apex down).

ARPA symbols (continued)

Item	Symbol	Status	Remarks
Guard zone	 (flashing)	On target passing through operator-set guard zone EPVS symbol NO. 7	Plot symbol changes to an equilateral triangle apex down, flashing together with vector if target entering guard zone (guard ring).
Automatic acquisition area		5.5-6.0 nm, 3-3.5 nm or anywhere EPVS symbol NO. 2	Sector or full circle as selected by the operator.
Target selected for data readout	 1	On selected target EPVS symbol NO. 12	Target data (range, bearing, course, speed, CPA and TCPA).
Reference target	 R (In 60 scans, change to  R)	On reference target	Used to calculate own ship's over-the-ground speed (target-based speed) for ground stabilization.
Trial maneuver	T (flashing)	Bottom center EPVS symbol NO. 10	Appears during execution of a trial maneuver.
Auto Plotter performance test	XX (flashing)	Bottom center EPVS symbol NO. 11A	Appears during execution of a performance test (Track Test).

Item	Symbol	Status	Remarks
Non-ARPA symbols			These are non-ARPA symbols but only for E-prot. Not available in the ARPA mode.

2.8 Adjusting Brilliance of Plot Marks

1. Press the RADAR MENU key on the plotting keypad to show the FUNCTIONS menu.
2. Press the [9] key to show the BRILLIANCE menu.
3. Press the [7] key to select 7 PLOT BRILL.
4. Further press the [7] key to select (or highlight) a desired brilliance level.
5. Press the ENTER key to confirm your selection followed by the RADAR MENU key to close the FUNCTION menu.

Note: Refer to paragraph 1.37 for the BRILLIANCE menu screen.

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.

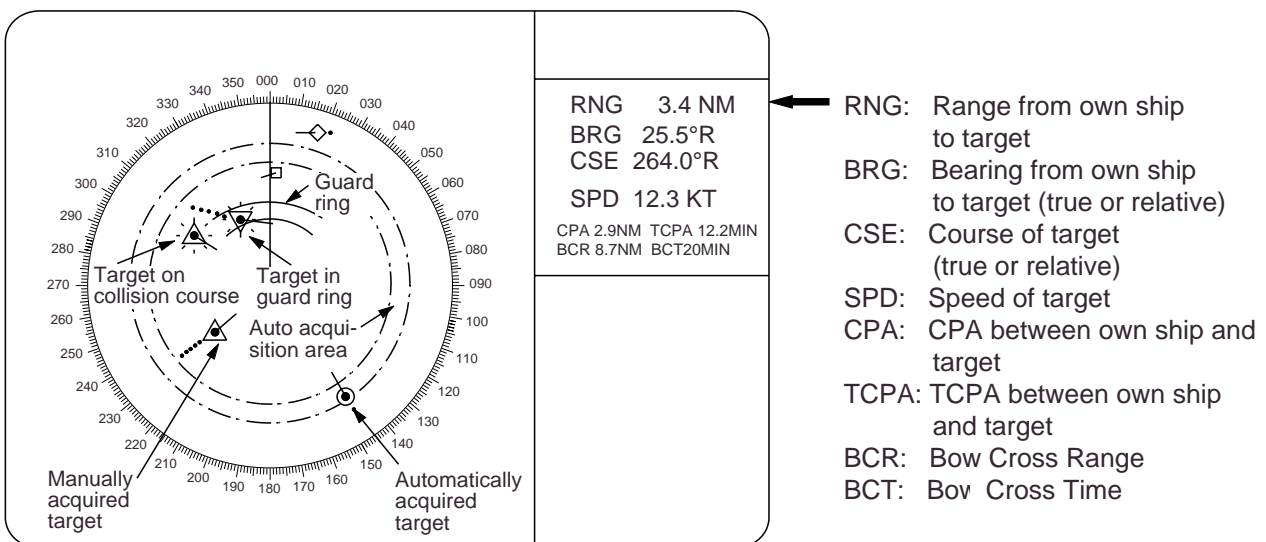
Place the cursor on a desired target and press the TARGET DATA key on the plotting keypad. Data on the selected target is displayed at the upper-right corner of the screen. A typical target data display is shown in the illustration below.

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

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

CPA/TCPA: CPA(Closest Point of Approach) is the closest range a target will approach to own ship. TCPA is the time to CPA. Both CPA and TCPA are automatically calculated. When a target ship has passed clear of own ship, CPA is prefixed with an asterisk such as, CPA*1.5NM. TCPA is counted to 99.9 min and beyond this, it is indicate as TCPA>*99.9MIN.

BCR/BCT: Bow crossing range is a range of a target which will pass dead ahead of own ship at a calculated distance. BCT is the time when BCR occurs.



2.10 Mode and Length of Vectors

True or relative vector

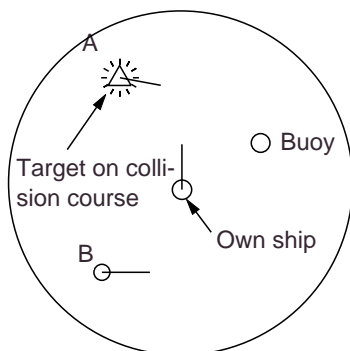
Target vectors can be displayed relative to own ship's heading (relative) or with reference to the north (true).

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.

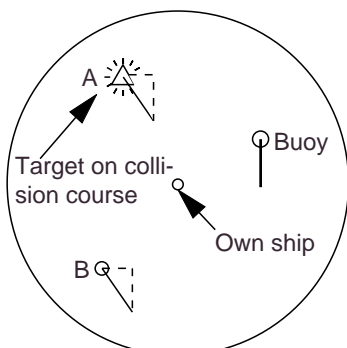
True vector

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

In the true motion mode, all fixed targets such as land, navigational marks and ships at anchor remain stationary on the radar screen with vector length zero. But in the presence of wind and/or current, 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 2.12).



(a) True vectors in head-up mode

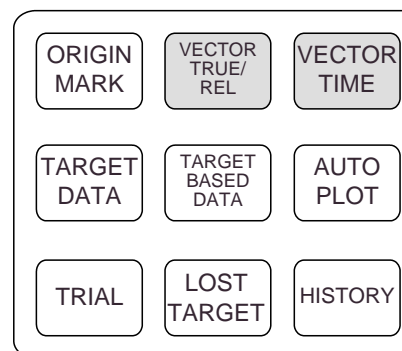


(b) Relative vectors in head-up mode

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 to select desired vector time. 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.

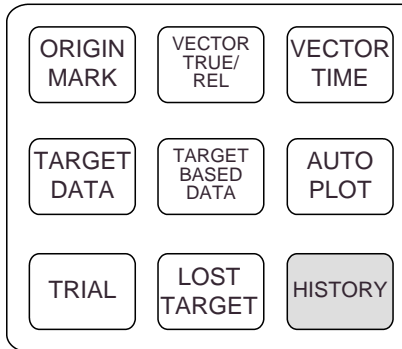
2.11 Past Position Display

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

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

Displaying and erasing past positions

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



To erase past positions, press the HISTORY key again.

Selecting the number of dots and past position plot intervals

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

Hit [E, AUTO PLOT MENU].

[ARPA1]	
1	AUTO ACQ OFF/ON
2	AUTO ACQ AREA 6 NM/SET
3	GUARD RING OFF/ON
4	GUARD RING SET
5	
6	CPA, TCPA SET CPA 00.0NM TCPA 00.0MIN
7	HISTORY POINTS 5/10/20*
8	HISTORY INTERVAL 30S/1/3/3/6MIN
0	[ARPA 2]

*5/10 only on IMO-type

2. Press the [7] key to select menu item 7HISTORY POINTS.
3. Further press the [7] key to select a desired number of past positions (5, 10, 20, 30, 100, 150 or 200). The IMO-type has the selection of only 5 or 10.
4. Press the ENTER key to confirm your selection.
5. Press the [8] key to select menu item 8HISTORY INTERVAL.

6. Further press the [8] key to select a desired past position plot interval (30 seconds, 1, 2, 3 or 6 minutes).
7. Press the ENTER key to conclude your selection.
8. Press the E, AUTO PLOT MENU key to close the menu.

2.12 Setting CPA/TCPA Alarm Ranges

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

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

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

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

CAUTION

CPA/TCPA Alarm

The CPA/TCPA alarm feature should never be relied upon as the sole means for detecting the risk of collision.

The navigator is not relieved of the responsibility to keep visual lookout for avoiding collisions, whether or not the radar or other plotting aid is in use.

To set the CPA/TCPA alarm ranges:

1. Press the E, AUTO PLOT MENU key on the plotting keypad to show the ARPA 1 menu.
2. Press the [6] key to select menu item 6CP A, 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 9.9 min) without omitting leading zeroes, 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. 99.0 min) without omitting leading zeroes, if any, and press the ENTER key.
5. Press the E, AUTO PLOT MENU key to close the menu.


Silencing CPA/TCPA aural alarm

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

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

2.13 Setting a Guard Zone

When a target transits the operator-set guard zone, 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.

 CAUTION
Guard Zone
The Guard Zone (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 a visual lookout for avoiding collisions, whether or not the radar or other plotting aid is in use.

Activating the guard zone

No.1 Guard Zone is available between 3 and 6 nm with a fixed range depth of 0.5 nm. No.2 GZ may be set anywhere when No.1 GZ is valid.

To set and activate the guard zone:

1. Press the E, AUTO PLOT MENU key on the plotting keyboard to show the ARPA 1 menu.
2. Press the [3] key to select menu item 3GUARD RING.
3. Further press the [3] key to select (or highlight) ON to activate the guard zone.
4. Press the ENTER key to conclude your selection.
5. Press the [4] key to select menu item 4GUARD RING SET. At this point the GUARD SETTING menu is displayed at the screen bottom.

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

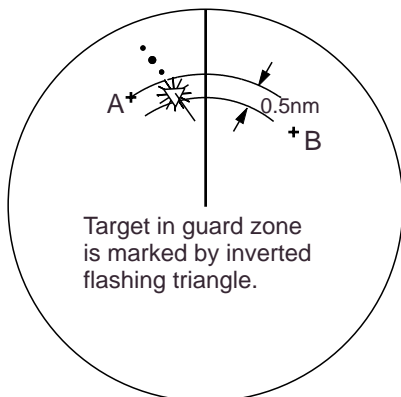
6. Press the [2] key and ENTER key. ([2] [2] [ENTER] when setting the no.2 ring.)

7. Referring to figure below, place the cursor at the outer left corner of the area (point A) and press the ENTER key.
8. Place the cursor at the right edge of the area (point B) and press the ENTER key.

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

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

The guard zone as an example shown below appears on the display. Note that the guard zone has a fixed radial extension (width) of 0.5 nm. The label GZ is displayed in the box at the upper-right on the screen when guard zone is enabled.



Deactivating the guard zone (guard ring)

1. Press the E, AUTO PLOT MENU key on the plotting keyboard to show the ARPA 1 menu.
2. Press the [3] key to select menu item 3GUARD RING.
3. Further press the [3] key to select (or highlight) OFF to deactivate the guard zone.
4. Press the ENTER key to conclude your selection followed by the E, AUTO PLOT MENU key to close the ARPA 1 menu.

Silencing the guard zone (guard ring) audible alarm

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

2.14 Operational Warnings

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

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

The audible alarm can be set to OFF through the AUTO PLOT 2 menu.

CPA/TCPA alarm

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

Guard zone (guard ring) alarm

Visual and audible alarms are generated when a target transits the operator-set guard zone. Press the AUDIO OFF key to acknowledge and silence the guard zone audible alarm. (Refer to paragraph 2.14 Setting a Guard Zone for further information.)

Lost target alarm

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

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

Target full alarm

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

Manually acquired targets

The indication "MAN TARGET FULL" appears at the screen bottom and a short beep tone sounds when the number of manually acquired targets reaches 20 or 40 depending on whether auto acquisition is activated or not.

Automatically acquired targets

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

System failure alarm

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

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

*The alarm is available with or without ARPA.

2.15 Trial Maneuver

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

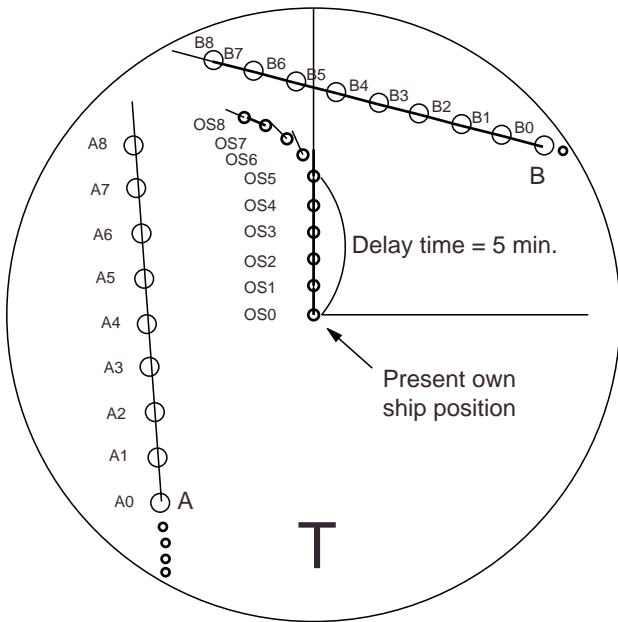
There are two types of trial maneuvers: static and dynamic.

Dynamic trial maneuver

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

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

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

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

Static trial maneuver

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

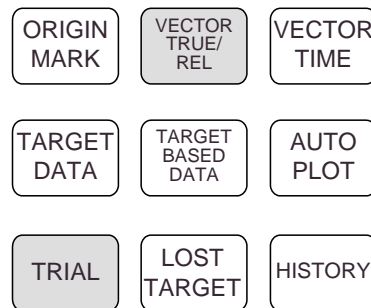
Note: For accurate simulation of ship movements in a trial maneuver, own ship's characteristics such as acceleration and turning performance should be properly set in initial settings at the time of installation.

To perform a trial maneuver:

1. Press the E, AUTO PLOT MENU key on the plotting keypad followed by the [0] key to show the ARPA 2 menu.

[ARPA 2]	
1	[ARPA 1]
2	TRIAL MANEUVER STATIC/DYNAMIC
3	MARK SIZE STANDARD/LARGE
4	CPA, TCPA DISPLAY OFF/ON
5	SET DRIFT OFF/MAN
	SET xxx.x°
	DRIFT xx.xKT
6	GUARD RING, ACQ NORTH/CRT
	LINE STABILIZE
7	SPEED REF WT/BT
8	INPUT SIG CHECK
9	ARP TRACK TEST
0	INITIAL SETTING

2. Press the [2] key to select 2TRIAL MODE.
3. Further press the [2] key to select (or highlight) STATIC or DYNAMIC trial maneuver option as appropriate.
4. Press the ENTER key to conclude your selection followed by the E, AUTO PLOT MENU key to close the ARPA 2 menu.
5. Press the VECTOR TRUE/REL key to select true or relative vector.



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

TRIAL DATA SETTING [DYNAMIC MODE]:	
SPEED (VRM)	15.0KT
COURSE (EBL)	53.6°
DELAY TIME	xx.x MIN

Note: The second line reads [STATIC MODE] in the event of a static trial maneuver.

7. 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 own ship loading condition, etc.

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

Trial maneuver takes place in three minutes with the letter "T" displayed at the bottom of the screen. If any tracked target is predicted to be on a collision course with own ship (that is, the target ship comes within preset CPA/TCPA limits), the target plot symbol changes to a triangle (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 three minutes later.

Terminating trial maneuver

Press the TRIAL key again at any time.

2.16 ARPA Track Test

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

To execute the ARPA track test:

1. Select north-up mode presentation on the 12 nm range.
2. Enter manual speed of 0 knots.
3. Press the E, AUTO PLOT MENU key on the plotting keypad followed by the [0] key to show the ARPA 2 menu.
4. Press the [9] key to select 9 ARP TRACK TEST. A track test picture appears on the screen.
5. Press the ENTER key.

6. It takes approximately three minutes for all vectors to be displayed. The track test display does not need echo signal, gyro nor speed log input. Seven targets having various speeds and courses, as shown in the table on the next page, are simulated automatically.

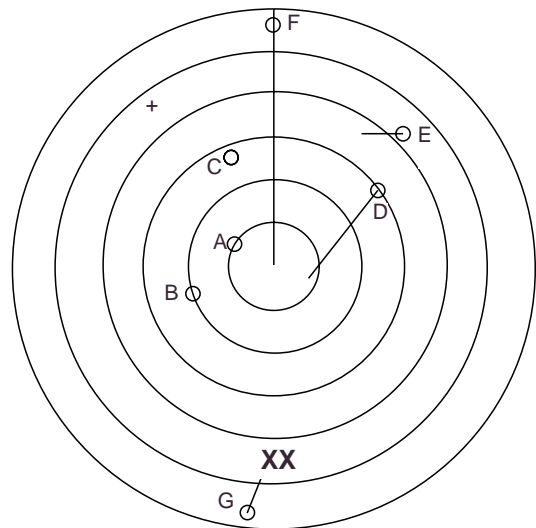
7. The track test continues for 5 minutes and then repeats.

To terminate the track test, press the ST-BY/TX key twice and the ST-BY display will appear.

CPA and TCPA shown below are initial values.

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

* Invalid value



Note: Alphabets mark targets in the above table and figure; on the actual display figures mark targets. Note that target numbering varies.

2.17 Criteria for Selecting Targets for Tracking

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

When a target is first displayed, it is shown as having zero true speed but develops a course vector as more information is collected. In accordance with the International Marine Organization Automatic Radar Plotting Aid (IMO ARPA) requirements, an indication of the motion trend should be available in 1 minute and full vector accuracy in 3 minutes of plotting. The FURUNO ARPAs comply with these requirements.

Acquisition and tracking

A target which is hit by 5 consecutive radar pulses is detected as a radar echo. Manual acquisition is done by designating a detected echo with the trackball. Automatic acquisition is done in the acquisition areas when a target is detected 5-7 times continuously depending upon the congestion. Tracking is achieved when the target is clearly distinguishable on the display for 5 out of 10 consecutive scans whether acquired automatically or manually.

Targets not detected in 5 consecutive scans become "lost targets."

Quantization

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

The digital radar signal is then analyzed by a ship-sized echo discriminator. As the antenna scans, if there are 5 consecutive radar pulses with I's indicating an echo presence at the exact same range, a target "start" is initiated. Since receiver noise is random, it is not three bang correlated, and it is filtered out and not classified as an echo.

The same is true of radar interference. Electronic circuits track both the closest and most distant edges of the echo. At the end of the scanning of the echo, the discriminator indicates the measured maximum range extent and total angular extent subtended by the echo. If the echo is larger than a ship-sized echo in range extent and/or angular width, adjusted as a function of range, it is declared to be a coastline and the closest edge is put into memory as a map of the area. This land outline is used to inhibit further acquisition and tracking of ship sized echoes beyond the closest coast outline. 5 consecutive scans of coastal outline are retained in memory to allow for signal variation. All smaller echoes are declared to be ship sized and the middle of the leading edge is used to provide precise range and bearing coordinates of each echo on every scan. This range/bearing data is matched to previous data and analyzed from scan-to-scan for consistency. When it is determined to be as consistent as a real target, automatic acquisition occurs and tracking is initiated. Continued tracking and subsequent calculation develop the relative course and speed of the target just as a man would do when plotting the relative course and speed of the target on the scope with a grease pencil.

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

Automatic acquisition areas and suppression lines

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

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

Qualitative description of tracking error

The FURUNO ARPA accuracies comply with or exceed IMO standards.

Own ship maneuvers

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

Other ship maneuvers

Target ship courses, lag 15 to 30 seconds at high relative speed, or 3 to 6 seconds at low (near 0) relative speed. It is less accurate during a turn due to lag, but accuracy recovers quickly.

2.18 Factors Affecting ARPA Functions

Sea returns

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

Rain and snow

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

Low clouds

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

Non-synchronous emissions

No effect.

Low gain

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

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

Manual acquisition is done if a target is positively displayed more than once. Automatic acquisition is done when the target is detected 5-7 times continuously. Tracking is achieved when the target is detected 5 times (not necessarily continuously) out of 10 scans. If not detected 6 times out of 10 scans, the target will become a "lost target." The ARPA will acquire a radar echo that is present once in every six antenna scans and continue tracking if 1 in 10.

Second trace echoes

When the radar beam is super refracted, strong echoes may be received at such long ranges that they appear on a different timebase sweep than the transmitted

pulse. This gives an incorrect range indication. Second and third trace echoes can be tracked if they are consistent enough to meet acquisition and tracking criteria but target course and speed data will be in error.

To receive radar beacon or SART signals, turn off the radar interference rejection and echo average which operate on the correlation technique.

Blind and shadow sectors

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

Indirect echoes

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

Radar interference

If interference is extreme due to another radar operating at close range, spiral "dotting" and/or false targets may appear momentarily. The interference rejector can clear the display.

3. RADAR OBSERVATION

3.1 General

Minimum and maximum ranges

Minimum range

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

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

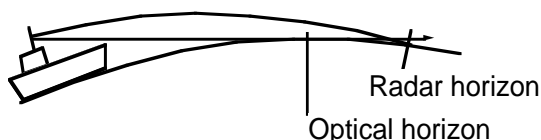
Maximum range

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

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

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

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



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

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

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

X-band and S-band

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

Radar resolution

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

Bearing resolution

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

Range resolution

Range resolution is the ability to display as separate pips the echoes received from two targets which are on the same bearing and close to each other. This is deter-

mined by pulselength only. Practically, a 0.08 microsecond pulse offers the discrimination better than 25 m as do so with all FURUNO radars.

Test targets for determining the range and bearing resolution are radar reflectors having an echoing area of 10 m².

Bearing accuracy

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

Range measurement

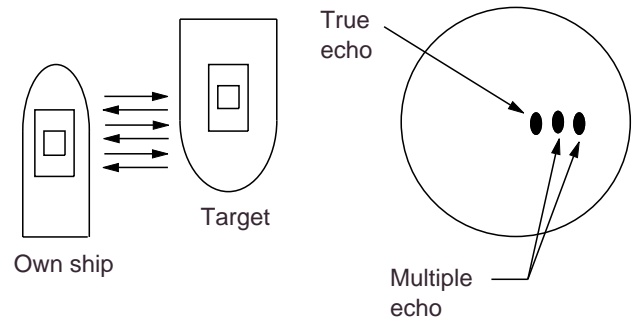
Measurement of the range to a target is also a very important function of the radar. Generally, there are two means of measuring range: the fixed range rings and the variable range marker (VRM). The fixed range rings appear on the screen with a predetermined interval and provide a rough estimate of the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

3.2 False Echoes

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

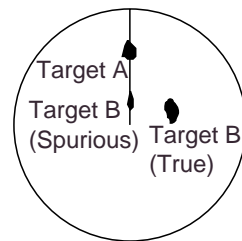
Multiple echoes

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



Sidelobe echoes

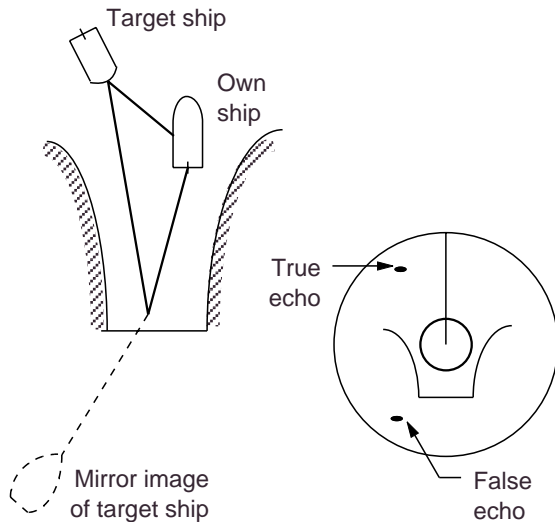
Every time the radar pulse is transmitted, some radiation escapes on each side of the beam, called "sidelobes." If a target exists where it can be detected by the side lobes as well as the main lobe, the side echoes may be represented on both sides of the true echo at the same range. Side lobes show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



Virtual image

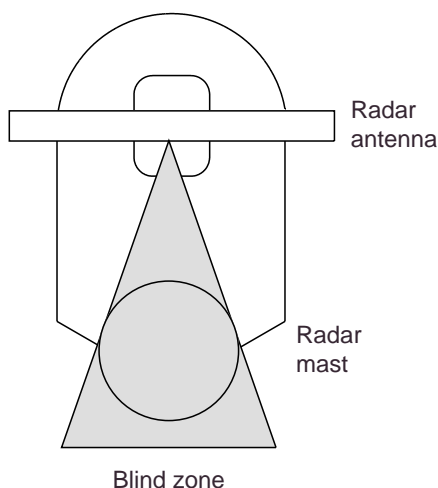
A relatively large target close to your ship may be represented at two positions on the screen. One of them is the true echo directly reflected by the target and the other

is a false echo which is caused by the mirror effect of a large object on or close to your ship as shown in the figure below. If your ship comes close to a large metal bridge, for example, such a false echo may temporarily be seen on the screen.



Shadow sectors

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



3.3 SART (Search and Rescue Transponder)

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

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

General procedure for detecting SART response

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

General remarks on receiving SART

SART range errors

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

Radar bandwidth

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

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

Radar side lobes

As the SART is approached, 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 they may be easier to detect in clutter conditions and also they will confirm that the SART is near to the ship.

Gain

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

A/C SEA control

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

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

A/C RAIN control

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

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


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


3.4 RACON (Radar Beacon)

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

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

4. MAINTENANCE



DANGER




DANGER: Electrical Shock Hazard

This equipment contains high voltages which can cause death at several internal circuits including a cathode ray tube (CRT) which uses several thousand 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)


WARNING



WARNING: 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.

4.1 Periodic Maintenance Schedule

Interval	Check point	Check and measures	Remarks
Weekly	Display unit	Periodically clean the exterior of display unit using dry soft clean. Use of commercially available CRT cleaner (spray) having antistatic 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.

(Continued on next page)

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.	

4.2 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	MG5241 (X-band 10 kW) 9M752/M5187F (X-band, 25 kW) MG5223F (S-band, 30 kW) MG5240 (S-band, 60 kW)	2,000-3,000 hours	

5. TROUBLESHOOTING

DANGER



DANGER: Electrical Shock Hazard

This equipment contains high voltages which can cause death at several internal circuits including a cathode ray tube (CRT) which uses several thousand 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)

WARNING



WARNING: 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.

5.1 Easy Troubleshooting

This paragraph describes how to cure operational problems, which can be made by observing the radar picture and using operator controls and 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 1.32.
No own ship mark	On the R-type radar, check that SHIP'S MARK ON is selected at the RADAR 2 menu, referring to paragraph 1.32. Also, own ship information (length, width, etc.) should have been entered in initial settings. Consult a FURUNO representative or dealer for details. On the IMO type, the own ship mark is not available.

5.2 Advanced-level Troubleshooting

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

Note: 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.

Service call

When making a service call to your service agent, check S/N and symptom beforehand.

Problem	Check point and probable cause	Remedy
Power turned on but radar does not operate at all. Control panel is not illuminated either.	<ol style="list-style-type: none"> 1. Blown fuse F1 or F2 2. Mains voltage/polarity 3. Power Supply Board 4. Illumination lamps 	<ol style="list-style-type: none"> 1. Replace blown fuse. 2. Correct wirings and input voltage. 3. Replace Power Supply Board. 4. Replace defective lamps.
CRT brilliance adjusted but no picture	<ol style="list-style-type: none"> 1. RADAR 1/2 menu settings 2. CRT voltage 3. SPU Board 	<ol style="list-style-type: none"> 1. In case of single display installation without radar inter-switching), make sure RADAR 1 is selected on SYSTEM SETTING menu. 2. Check high voltage supply with utmost care. 3. Replace SPU Board.
Antenna not rotating	<ol style="list-style-type: none"> 1. Antenna drive mechanism (Note that the message BRG SIG MISSING appears in stand-by.) 2. Defective antenna drive motor relay (thermal relay K2, 200/220/380, 440/100VAC) 3. INT-9170 Board 	<ol style="list-style-type: none"> 1. Make sure that there is no short circuit across #1 and #2 of J461 on IN-9170 Board. 2. Press relay reset button. 3. Check that antenna switch is on.
Alphanumeric data and marks are not displayed in Transmit status.	<ol style="list-style-type: none"> 1. SPU Board 	<ol style="list-style-type: none"> 1. Replace SPU Board.

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.	<ol style="list-style-type: none"> 1. IF amplifier 2. Signal cable between antenna and display 3. Video Amplifier Board 	<ol style="list-style-type: none"> 1. Replace IF amplifier. 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. Check video coax line for secure connection. If connection is good, replace SPU Board.
Marks, legends and noise appear but no echo. (Transmission leak, representing own ship position, is absent.)	<ol style="list-style-type: none"> 1. Tx fuse F801 (Trans. Unit) 2. Magnetron 3. Modulator Board 4. SPU Board 	<ol style="list-style-type: none"> 1. If fuse is blown, replace it. If it blows again, the modulator or modulator circuit may be defective. 2. Check magnetron current with the check meter in the sub panel. Replace magnetron. 3. Replace Modulator Board. 3. Replace SCR. DANGER: HIGH VOLTAGE. 4. Replace SPU Board.
Picture not updated	<ol style="list-style-type: none"> 1. Bearing Signal Generator Board (antenna unit) 2. SPU Board 3. Video lockup 	<ol style="list-style-type: none"> 1. Check the connection of signal cable. 2. Replace SPU Board. 3. Turn off and on radar.
Incorrect orientation of picture	<ol style="list-style-type: none"> 1. SPU Board 2. Gyro Interface 	<ol style="list-style-type: none"> 1. The message "HD SIG MISSING" appears when the heading pulse is not received during stand-by. 2. Replace gyro interface.
TUNE control adjusted but poor sensitivity	<ol style="list-style-type: none"> 1. Deteriorated magnetron 2. Detuned MIC 3. Dirt on radiator face 4. Water ingress to the wave-guide or other feeder line 5. Second trace rejection is ON. 	<ol style="list-style-type: none"> 1. With radar transmitting on 48 mm range, check magnetron current. If current is below normal value, magnetron may be defective. Replace magnetron. 2. Check MIC detecting current. If it is below normal value, MIC may have become detuned. MIC must be tuned. 3. Clean radiator surface. 4. Remove water from the feeder line. 5. Disable the second-trace rejector referring to paragraph 1.36.
Range changed but radar picture does not change	<ol style="list-style-type: none"> 1. Defective RANGE key 2. SPU Board 3. Mother Board 4. Video lockup 	<ol style="list-style-type: none"> 1. Try to hit [+] and [-] RANGE keys several times. If unsuccessful, replacement of keypad may be required. 2. Replace SPU Board. 3. Replace Mother Board. 4. Turn off and on radar.

Problem	Check point and probable cause	Remedy
Interference rejector inoperable (interference rejection level not displayed)	1. Bad contact of key 2. SPU Board 3. Mother Board	1. Repair contact of key. 2. Replace SPU Board. 3. Replace Mother Board.
Echo stretch ineffective (Neither "ES1" nor "ES2" is displayed.)	1. Bad contact of key 2. SPU Board	1. Repair contact of key. 2. Replace SPU Board.
Only 2 parallel index lines (6 lines wanted)	1. Incorrect setting of index line interval	1. Set index line interval referring to paragraph 1.26.
Range rings are not displayed.	1. Press RINGS key to see if intensity is increased. control to see if intensity is increased. 2. Bad contact of key 3. SPU Board	1. Replace associated circuit board if unsuccessful. 2. Replace keypad. 3. Replace SPU Board.
Key beep inaudible	1. Improper setting on RADAR 2 menu	1. Adjust key beep level on RADAR 2 menu referring to paragraph 1.32.
Poor discrimination at range	1. Sea clutter control not functioning properly.	1. Improper setting of A/C SEA control. If A/C SEA 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. 2. Selection is not accessed. 3. Speed entry is incorrect. 4. TM display inaccurate	1. Try to press MODE key a little harder. 2. Press MODE key until "TM" appears. 3. Enter correct own ship speed referring to paragraph 1.24. 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 1.13 and 1.14.

5.3 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:

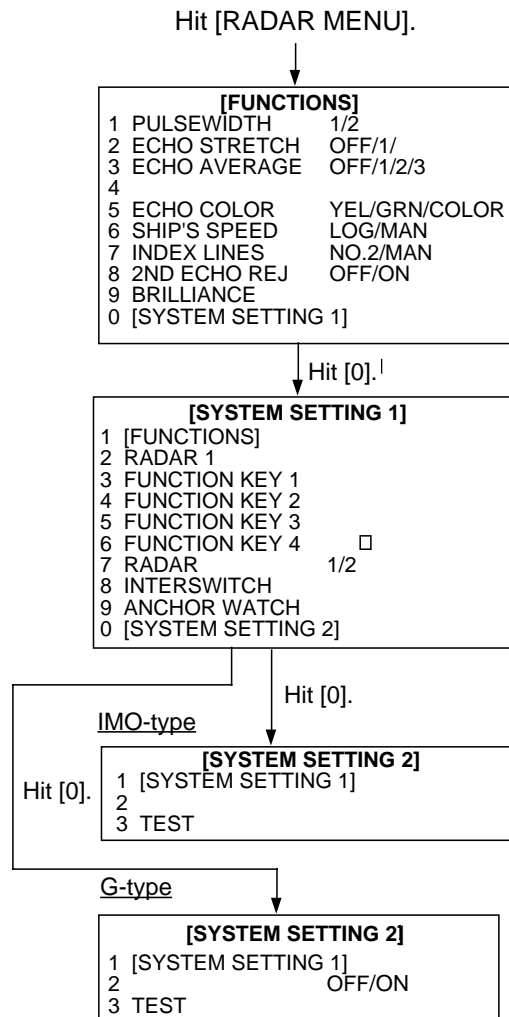
1. Press the RADAR MENU key on the plotting keypad to show the FUNCTIONS menu.
2. Press numeric key [0][0] to show the SYSTEM SETTING 2 menu.
3. **On the R-type**, press the key [3] to select menu item 3TEST . Then, press the ENTER key.

On the IMO-type, press the key [3] to select menu item 3TEST . 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.

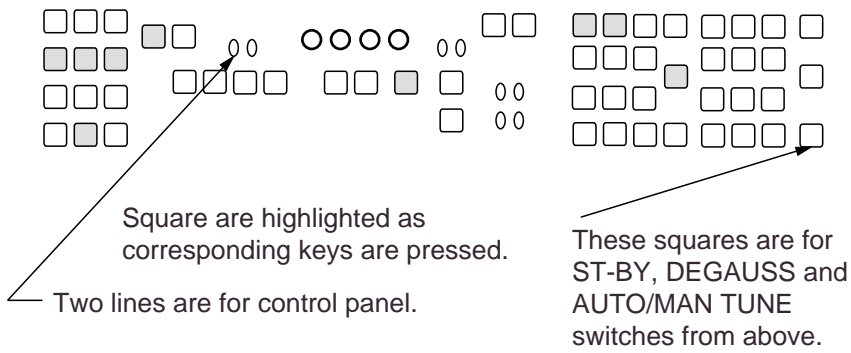
Small squares displayed at the right and bottom of the test result screen are for testing the switches and keys in the hinged compartments of the display unit and on the operator control panel. As you operate these switches and keys, corresponding squares are highlighted, indicating that your switch/key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



FR-2005 TEST

```

PROGRAM NO      ROM RAMCRAM DIPSW
MAIN XXXXXXXXXXXX OK  OK  OK  1111
SUB  XXXXXXXXXXXX OK  OK
ARP  XXXXXXXXXXXX OK  OK  OK  0000
DSP  XXXXXXXXXXXX OK  OK  OK
RP   XXXXXXXXXXXX OK  OK  OK  1000
    DRAM
    RP BOARD BAT OK
    RP CARD1 OK  CARD2  OK
VRAM  1 2 3 4 5 6 7 8
    
```



A.1 Performance Monitor

For X-band radars, the FURUNO PM-30 satisfies the requirement covering 9410 ± 50 MHz. For S-band radars, the PM-50 is available covering 3050 ± 30 MHz.

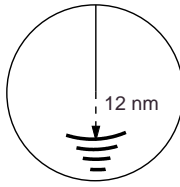
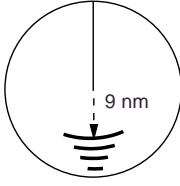
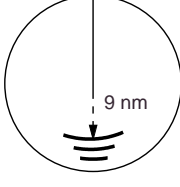
The performance monitor is an independent unit, namely, it is not interconnected with any unit of the radar system except for the 100 VAC power cable. In some radars the power cable is not routed via the power switch or other control of the radar and the monitor is operated as completely a separate device.

Operating the performance monitor

When Radar Interswitch RJ-7 is connected, set it to the "straight" mode. Press the PM ON/OFF button at the lower left corner in the Turning Compartment, and the range scale is automatically set to 24 nm range scale, producing the monitor display. 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 in as much as the original state when the monitor was turned 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.

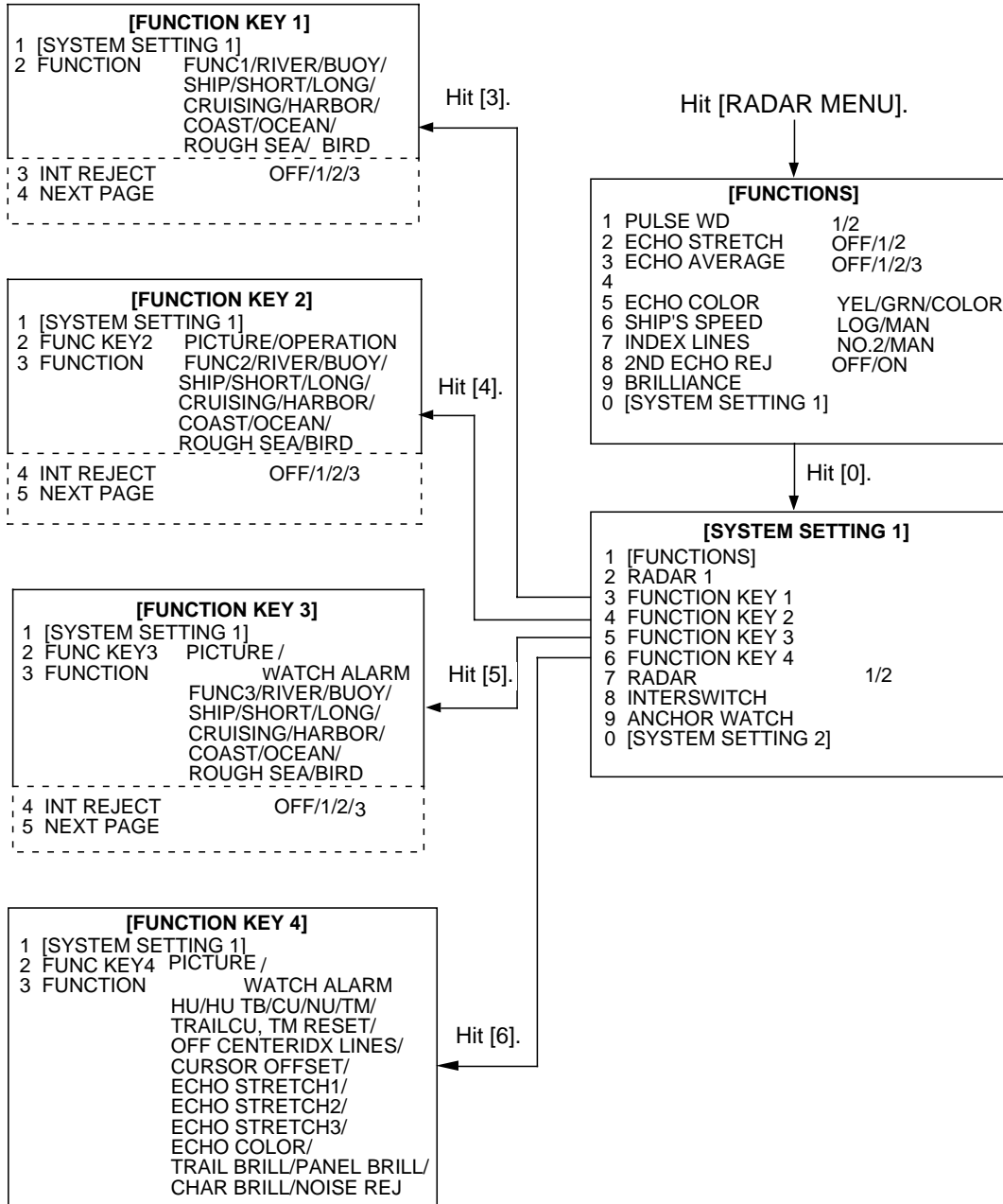
Transmitter performance		Receiver performance	
Range to innermost arc	Loss	No. of arcs	Loss
12 nm	0 dB	4	0 dB
9 nm	3 dB	3	3 dB
6 nm	6 dB	2	6 dB
3 nm or less or none	10 dB	1	9 dB
		0	12 dB

Display	Meaning
	TRANSMITTER: normal RECEIVER: normal
	TRANSMITTER: 3 db loss (Transmitter system has lost half of initial power. Suspect magnetron and feeder system.) RECEIVER: normal
	TRANSMITTER: 3 db loss (Transmitter system has lost half of initial power. Suspect magnetron and feeder system.) RECEIVER: 3 db loss (Receiver has lost half of normal sensitivity. Suspect receiver front end, water leakage in feeder system, etc.)

A.2 For Fishing Vessel

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, 3 or 4 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 in the default settings. For further information, contact a FURUNO representative.

A.3 Navigation Data (IEC-1162-1)

1. I/O Sentences for Channel 1

Input

BWC, BWR, DBT, DPT, GGA, GLL, MTW, MWV, RMA, RMB, RMC, VDR, VTG(*), ZDA * : not recommended in IMO-type

Note: Channel 1 serial port may be connected with a multiplexer interface box IF-2300 to feed Own Ship data, and Wind/Depth/Others data..

2. I/O Sentences of Channel 2

Input

VBW, VHW, HDT

Output

RAOSD, RARSD (An interval of three seconds)

3. I/O Sentences of Channel 3

Output

RATTM (Every five seconds when acquiring 10 targets)

4. Sentence Description

See pages which follow.

Note: Sentences without checksum will not be accepted as a proper data.

5. Priority

Nav data sentences below are read left to right, and in case of timeout the sentence right of last read sentence is read. In case of multiple high priority sentences the sentences having the highest priority is read. ** is read regardless of talker. Timeout is 30 seconds unless specified otherwise. Difficult time-outs for data sentences are required by German authorities.

Position data

GP GGA>GPRMC>GP GLL>LCRMA>LC GLL>** GLL

Timeout: 30 seconds

Data, time data

GPZDA

Timeout: 10 seconds

Course heading, speed over ground

(In the case of log)

VDVBW>**VBVBW

(In the case of navigator)

GPVTG>GPRMC (Not recommended in IMO-type)

Course heading, speed over water

VDVBW>**VBW>VD VHW

Water depth data

SDDPT>SDDBT>**DBT>**DBS

Water temperature data

**MTW

Waypoint range and bearing data

GPBWR>GPBWC>GPRBM

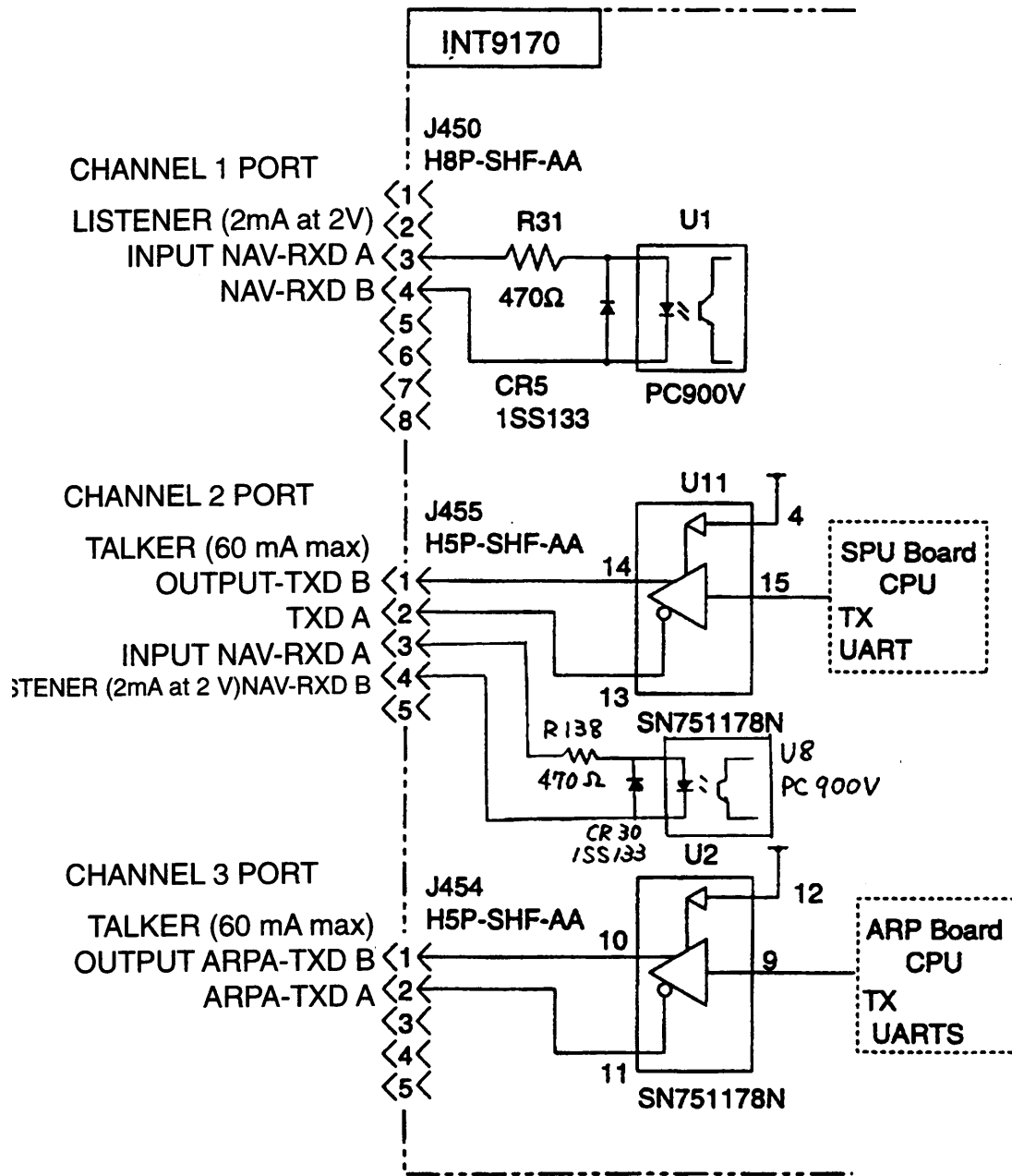
Route data (WPL, RTE)

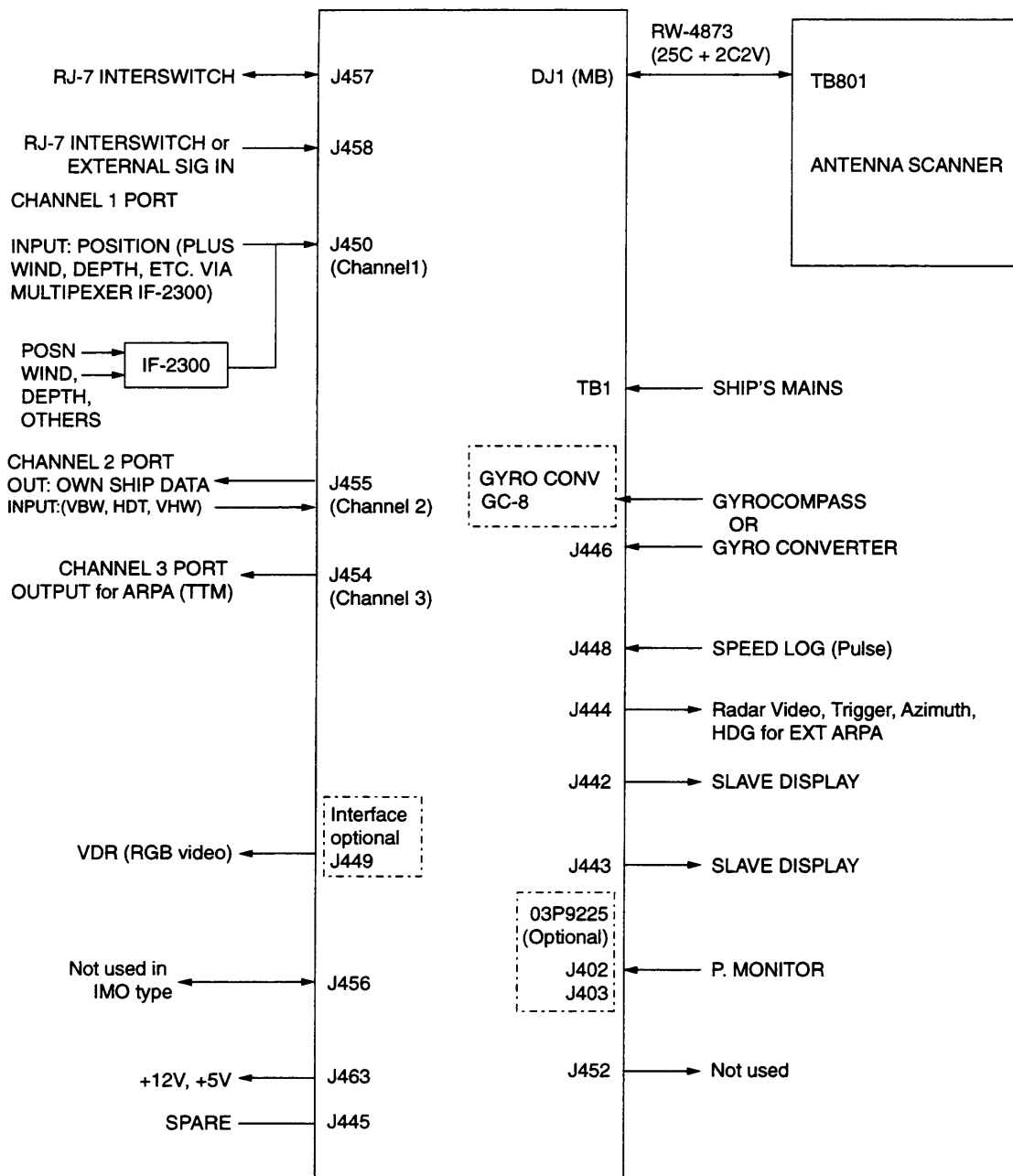
*WPL

*RTE

Ship's heading

**HDT

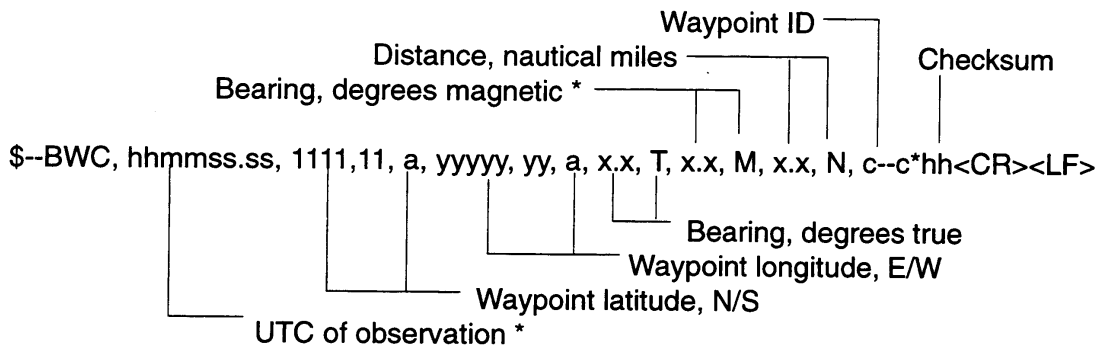




A.4 Sentence Description

Channel 1 Input

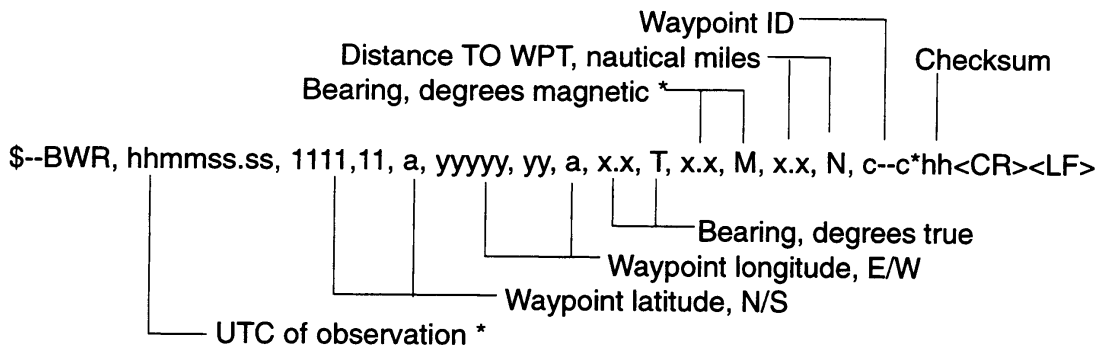
BWC - Bearing and distance to waypoint - great circle



* Not used

BWR - Bearing and distance to waypoint - rhumb line

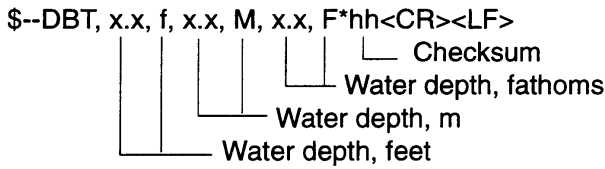
Time (UTC) and distance and bearing to, location of, a specified waypoint from present position. \$--BWR data is calculated along the rhumb line from present position rather than along the great circle path



* Not used

DBT - Depth below transducer

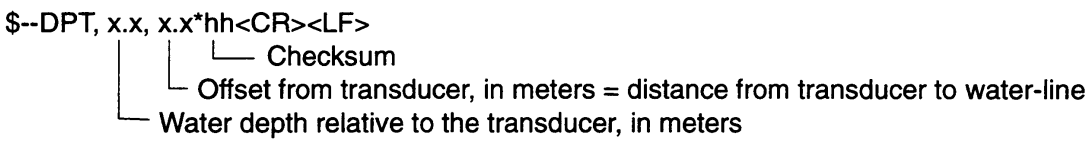
Water depth referenced to the transducer.



Priority: f > M > F

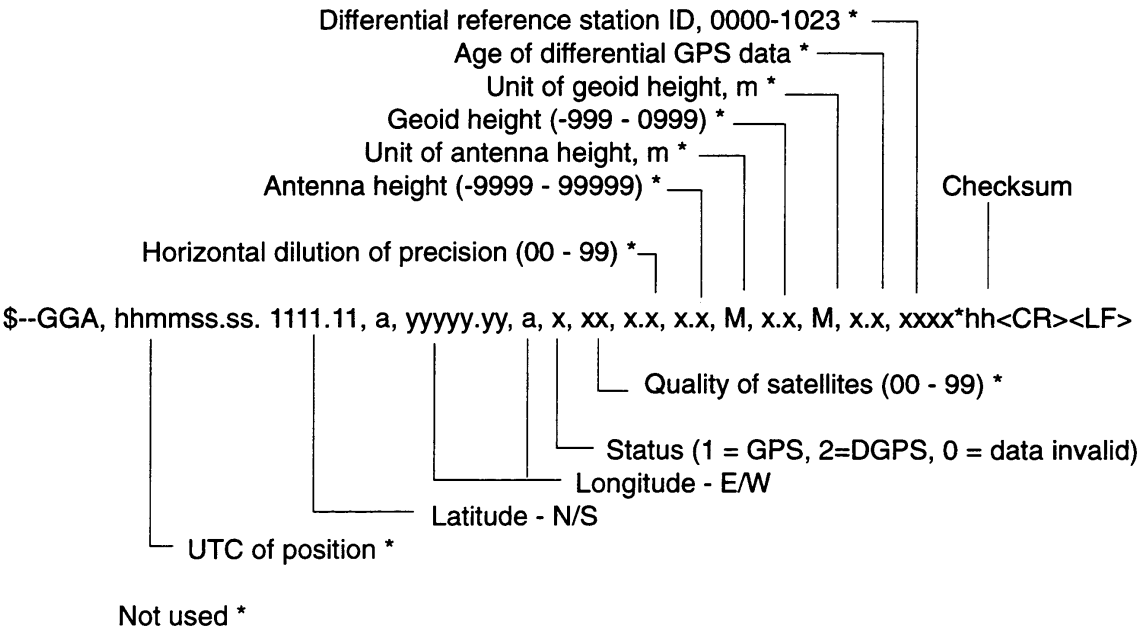
DPT - Depth

IMO Resolution A.224 (VII). Water depth relative to the transducer and offset of the measuring transducer. Positive offset numbers provide the distance from the transducer to the waterline. Negative offset numbers provide the distance from the transducer to the part of the keel of interest.



GGA - Global positioning system (GPS) fix data

Time, position and fix related data for a GPS receiver.



GLL - Geographic position - latitude/longitude

Latitude and longitude of present vessel position, time of position fix and status.

\$--GLL, 1111.11, a, yyyy.yy, a, hhmmss.ss, A*hh<CR><LF>

Checksum
Status (A = data valid V = data invalid)
UTC of position *
Longitude, E/W
Latitude, N/S

Not used *

MTW - Water temperature

\$--MTW, x.x, C*hh<CR><LF>

Checksum
Temperature, degrees C (99.9 to - 99.9 °C)
Display range: 99.9 to - 99.9 °C

MWV - Wind speed and angle

When the reference field is set to relative, data is provided giving the wind angle in relation to the vessel s heading and wind speed, both relative to the moving vessel.

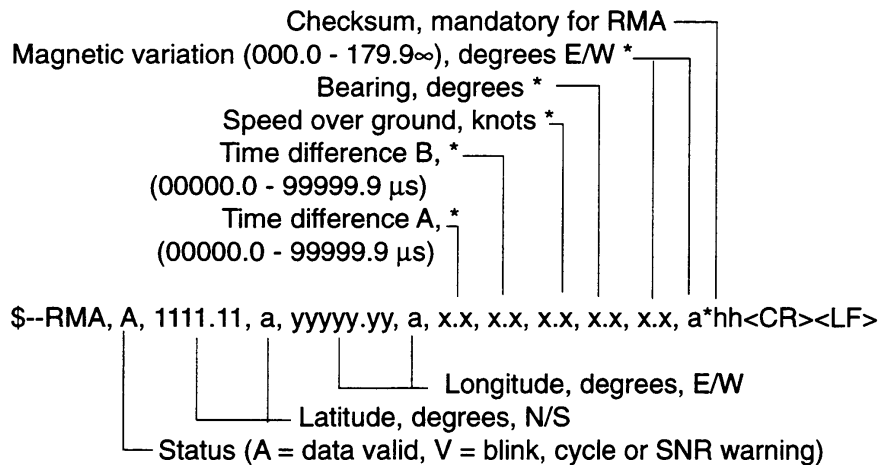
When the reference field is set to true, data is provided giving the wind angle relative to the vessel s heading and wind speed, both with reference to the moving water. True wind is the vector sum of the relative apparent wind vector and the vessel s velocity vector along the heading line of the vessel. It represents the wind at the vessel if it were stationary relative to the water and heading in the same direction.

\$--MWV, x.x, a, x.x, a, A*hh<CR><LF>

Checksum
Status (A = data valid V = data invalid)
Wind speed unit (K/M/N)
Wind speed
Reference, R = relative
T = true
Wind angle (0 to 359.9 degrees)

RMA - Recommended minimum specific LORAN-C data

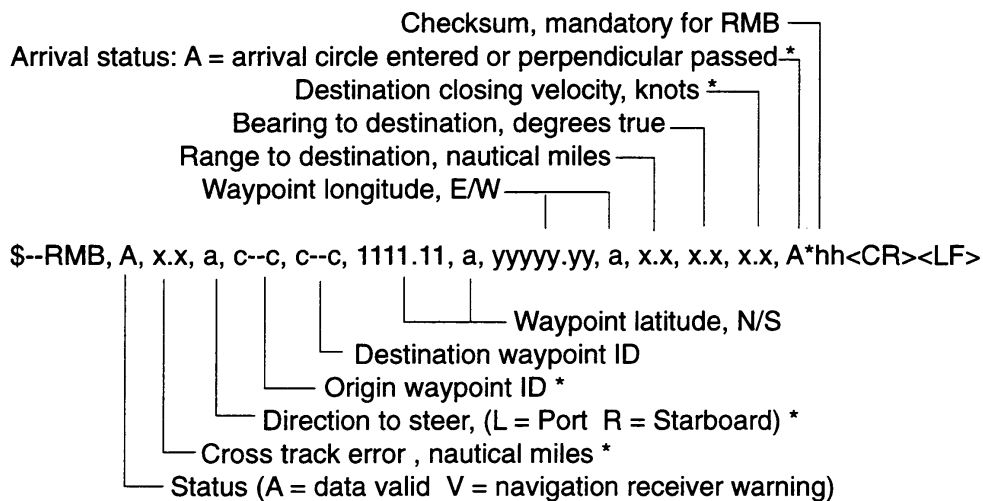
Position, course and speed data provided by a LORAN-C receiver. Time differences A and B are those used in computing latitude/longitude. Checksum is mandatory in this sentence. This sentence is transmitted at intervals not exceeding 2 s and is always accompanied by RMB when a destination waypoint is active. RMA and RMB are the recommended minimum data to be provided by a LORAN-C receiver. All data fields must be provided, null fields used only when data is temporarily unavailable.



Not used *

RMB - Recommended minimum navigation information

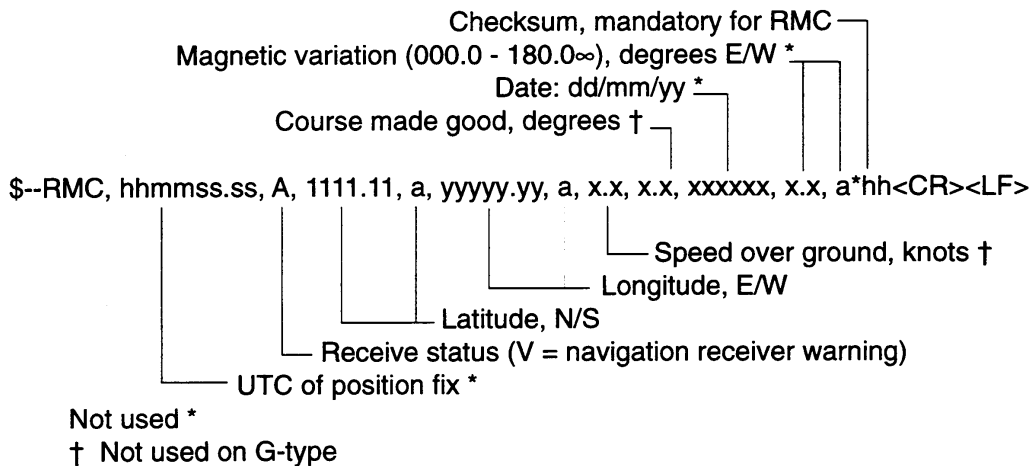
Navigation data from present position to a destination waypoint provided by a LORAN-C, TRANSIT, OMEGA, GPS, DECCA, navigation computer or other integrated navigation system. Checksum is mandatory in this sentence. This sentence always accompanies RMA or RMC sentences when a destination is active when provided by a LORAN-C, TRANSIT or GPS receiver, other systems may transmit \$--RMB without \$--RMA or \$--RMC.



Not used *

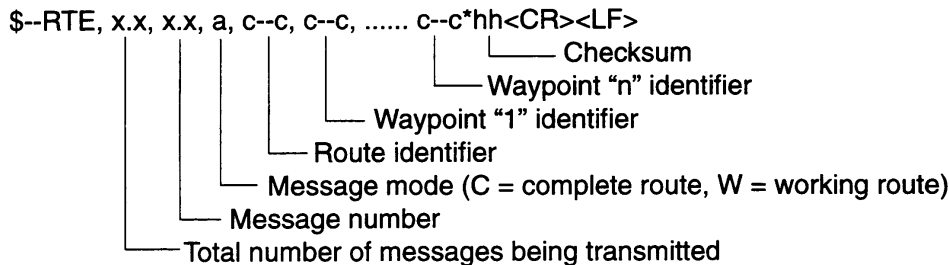
RMC - Recommended specific GPS/TRANSIT data

Time, date, position, course and speed data provided by a GPS or TRANSIT navigation receiver. Checksum is mandatory in this sentence. This sentence is transmitted at intervals not exceeding 2 s and is always accompanied by RMB when a destination waypoint is active. RMC and RMB are the recommended minimum data to be provided by a GPS or TRANSIT receiver. All data fields must be provided, null fields used only when data is temporarily unavailable.



RTE - Routes

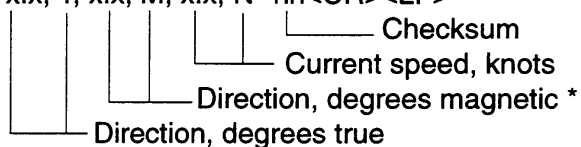
Waypoint identifiers, listed in order with starting waypoint first, for the identified route. Two modes of transmission are provided: "c" indicates that the complete list of waypoints in the route is being transmitted; "w" indicates a working route where the first listed waypoint is always the last waypoint that had been reached (FROM), while the second listed waypoint is always the waypoint that the vessel is currently heading for (TO), the remaining list of waypoints represents the remainder of the route.



VDR - Set and drift

The direction towards which a current flows (set) and speed (drift) of current.

\$--VDR, x.x, T, x.x, M, x.x, N *hh<CR><LF>

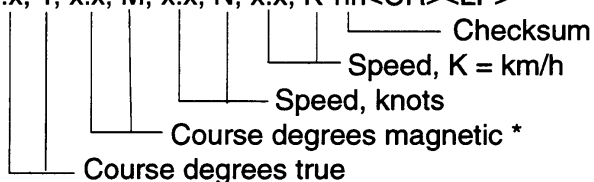


*: Not used

VTG - Course over ground and ground speed (R-TYPE ONLY)

The actual course and speed relative to the ground.

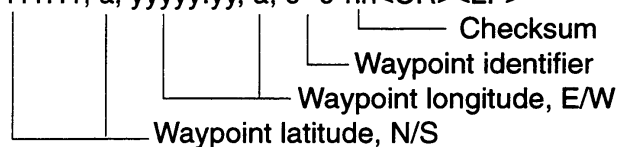
\$--VTG, x.x, T, x.x, M, x.x, N, x.x, K*hh<CR><LF>



WPL - Waypoint location

Latitude and longitude of specified waypoint

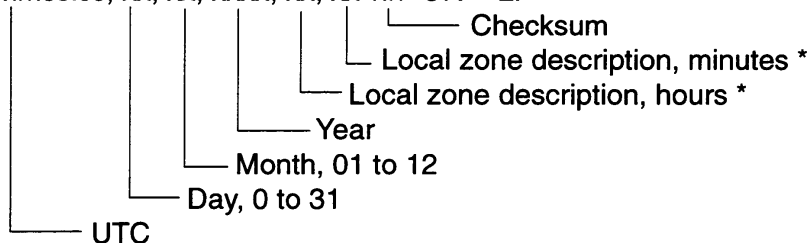
\$--WPL, 1111.11, a, yyyyy.yy, a, c--c*hh<CR><LF>



ZDA - Time and date

UTC, day, month, year and local time zone.

\$--ZDA. hhmmss.ss, xx, xx, xxxx, xx, xx*hh<CR><LF>



Not used *

Channel 2 input

VBW - Dual ground/water speed

\$--VBW,x.x,x.x,A,x.x,x.x,A*hh<CR><LF>

Checksum
 Speed status (A = data valid, V = data invalid)
 Transverse ground speed (knots)
 Longitudinal ground speed (knots)
 Status (A = data valid, V = data invalid)
 Transverse water speed (knots)
 Longitudinal water speed (knots)

VHW - Water speed and heading

The compass heading to which the vessel points and the speed of the vessel relative to the water.

\$--VHW, x.x, T, x.x, M, x.x, N, x.x, K *hh<CR><LF> Priority ; N > km

Checksum
 Water speed, K = km/h
 Water speed, knots
 Heading (M = magnetic bearing) *
 Heading (T = true bearing) *

HDT - Heading - true

\$--HDT, x.x, T *hh<CR><LF>

Checksum
 Heading (M = magnetic bearing) *

Channel 2 output

OSD - own ship data

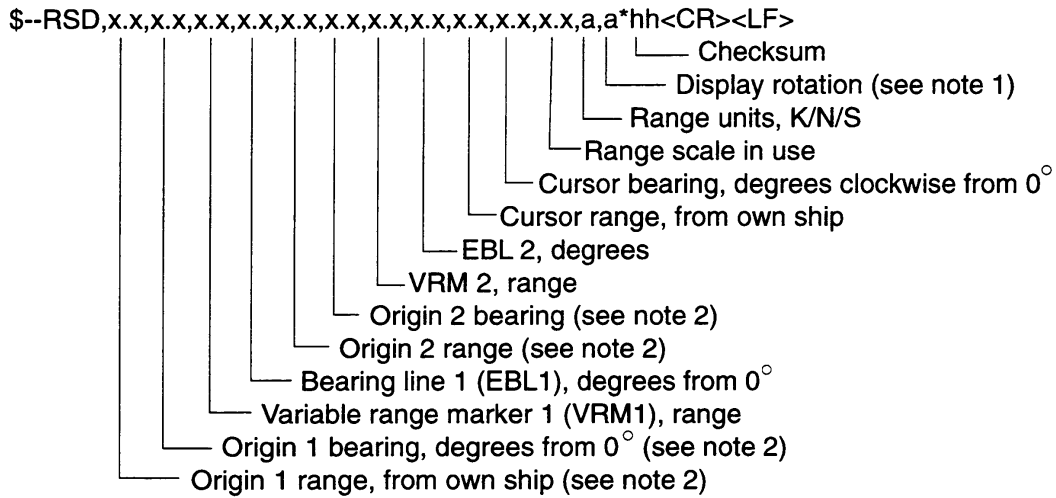
\$OSD,x.x,A,x.x,a,x.x,a,x.x,x.x,a*hh<CR><LF>

Checksum
 Speed units, K/N/S
 Vessel drift (speed)
 Vessel set, degrees true
 Speed reference (see note)
 Vessel speed
 Course reference (see note)
 Vessel course, degrees true
 Heading status: A = data valid
 Heading, degrees true

Note - Reference systems (speed/course)

- B = bottom tracking log
- M = manually entered
- W = water referenced
- R = radar tracking (of fixed target)
- P = positioning system ground reference

RSD -Radar system data



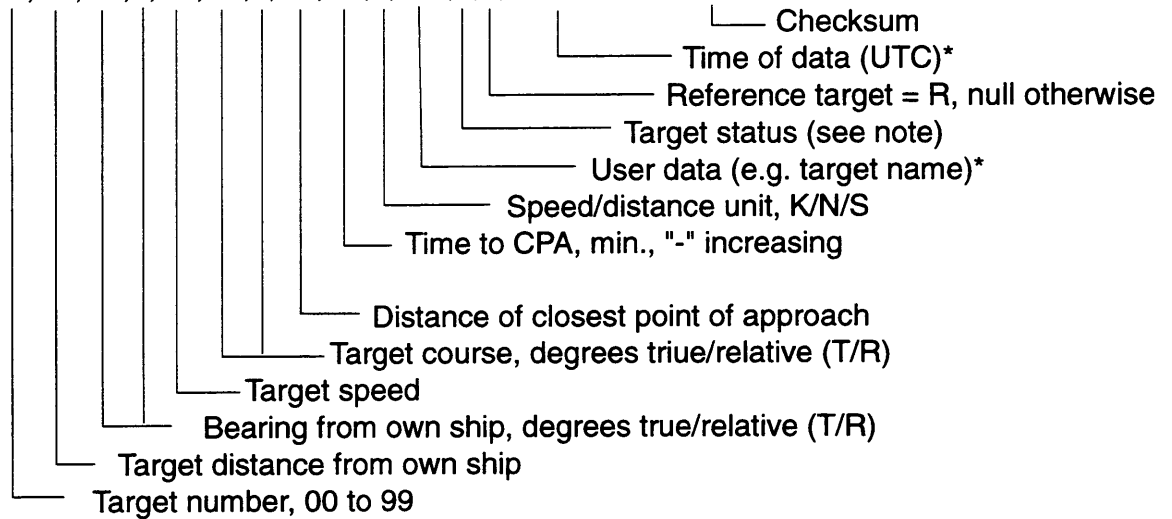
Notes

- 1 Display rotation:
 C = course-up, course-over-ground up, degree true
 H = head-up, ship's heading (centre-line) 0 up
 N = north-up, true north is 0 up
- 2 Origin 1 and origin 2 are located at the stated range and bearing from own ship and provide for two independent sets of variable range markers (VRM) and electronic bearing lines (EBL) originating away from own ship position.

Channel 3 output

TTM - Tracked target message

\$--TTM,xx,x.x,x.x,a,x.x,x.x,a,x.x,x.x,a,c--c,a,a,hhmmss.ss,a*hh<CR><LF>



Note Target status:

- L = lost, tracked target has been lost
- Q = query, target in the process of acquisition
- T = tracking

MENU TREE

MAIN MENU

FUNCTIONS 1

- 1. PULSE WIDTH (1, 2)
- 2. ECHO STRETCH (OFF, 1, 2)
- 3. ECHO AVERAGE (OFF, 1, 2, 3)
- 4. PANEL DIMMER (OFF, DIM, M, BRT)
- 5. ECHO COLOR (YEL, GRN, COLOR*)
- 6. SHIP SPEED (LOG, NAV*, MAN)
- 7. INDEX LINES (No.2 VRM, MAN)
- 8. SET/DRIFT (OFF, MAN)
- 9. BRILLIANCE
- 0. FUNCTIONS 2

*: R-type only

- 1. FUNCTIONS 1
- 2. CHAR BRILL (DIM, M1, M2, BRT)
- 3. MARKS BRILL (DIM, M1, M2, BRT)
- 4. TRAIL BRILL (DIM, M1, M2, BRT)
- 5. +CURSOR BRILL (DIM, M, BRT)
- 6. PLOT BRILL (OFF, DIM, M, BRT)
- 7. HDG MARK BRILL (DIM, M, BRT)
- 9. SYMBOL GRID BRILL (DIM, M1, M2, BRT)
- 0. CHART BRILL (DIM, M1, M2, BRT)

FUNCTIONS 2

- 1. FUNCTIONS 1
- 2. RADAR 1
- 3. FUNCTION KEY 1
- 4. FUNCTION KEY 2
- 5. FUNCTION KEY 3
- 6. FUNCTION KEY 4
- 7. RADAR (1, 2)*
- 8. ANCHOR WATCH
- 9. INTER SWITCH (Requires RJ-7 or 8)
- 0. FUNCTIONS 3

- 1. FUNCTIONS 2
- 2. ANCHOR WATCH (OFF, ON)
- 3. ALARM (OFF, ON)
- 4. ALARM RANGE (x.xxx NM)
- 5. HISTORY (OFF, ON)

FUNCTIONS 3

- 1. FUNCTIONS 2
- 2. INITIAL SETTING (Avalable by special operation)
- 3. TEST

RADAR 1

- 1. FUNCTIONS 2
- 2. EBL1 (REL, TRUE)*
- 3. EBL2 (REL, TRUE)*
- 6. TRAIL (REL, TRUE)
- 7. TRAIL GRAD (SGL, MULT)
- 8. [PULSE WD 1]
- 9. [PULSE WD 2]
- 0. RADAR 2

RADAR 2

- 1. RADAR 1
- 2. CURSOR, EBL (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)

FUNCTION KEY MENU

FUNCTION KEY 1

- 1. FUNCTIONS 2
- 2. FUNCTION (FUNC1, RIVER, BUOY, SHIP, SHORT, LONG, CRUISING, HARBOR, COAST, OCEAN, ROUGH SEA)
- 3. INT REJECT (OFF, 1, 2, 3)
- 4. ECHO STRETCH (OFF, 1, 2)
- 5. ECHO AVERAGE (OFF, 1, 2, 3)
- 6. A/C AUTO (OFF, ON)
- 7. FUNC 1 PULSE WD
- 8. NOISE REJ (OFF, ON)

- 1. FUNCTION KEY 1, 2 or 3
- 2. 0.5 NM (S1, S2)
- 3. 0.75 NM (S1, S2)
- 4. 1.5 NM (S1, S2, M1)
- 5. 3 NM (S1, S2, M1)
- 6. 6 NM (M1, M2, L)
- 7. 12-24 NM (M2, L)

FUNCTION KEY 2, 3

- 1. FUNCTIONS 2
- 2. FUNC KEY 2 or 3 (PICTURE/OPERATION)
- 3. FUNCTION (FUNC2/3, RIVER, BUOY, SHIP, SHORT, LONG, CRUISING, HARBOR, COAST, OCEAN, ROUGH SEA)
- 4. INT REJECT (OFF, 1, 2, 3)
- 5. ECHO STRETCH (OFF, 1, 2)
- 6. ECHO AVERAGE (OFF, 1, 2, 3)
- 7. A/C AUTO (OFF, ON)
- 8. FUNC 2/3 PULSE WD
- 9. NOISE REJ (OFF, ON)

FUNCTION KEY 4

- 1. FUNCTIONS 2
- 2. FUNC KEY 4 (OPERATION, WATCH ALARM)
- 3. ALARM INTERVAL (6, 10, 12, 15, 20 MIN)

- 1. FUNCTION2
- 2. FUNC KEY 2/3 (PICTURE/OPERATION)
- 3. OPERATION (HU, HU TB, CU, NU, TM, TRAIL; CU, TM RESET; OFF CENTER, IDX LINES, CURSOR OFFSET, ECHO STRETCH1, ECHO STRETRCH2, PLS WD1, PLS WD2, ECHO AVG1, ECHO AVG2, ECHO AVG3, ECHO COLOR, TRAIL BRILL, PANEL BRILL, CHAR BRILL, NOISE REJ, TARGET DATA, CANCEL)

PLOT MENU

ARPA 1

- 1. AUTO ACQ (OFF, ON)
- 2. AUTO ACQ AREA (3, 6 NM, SET)
- 3. GUARD ZONE (OFF, ON)
- 4. GUARD ZONE SET
- 5. REF TARGET VECT (OFF, ON)
- 6. CPA/TCPA WARNING (OFF, ON)
- 7. HISTORY DOTS (5, 10, 20)
- 8. HISTORY INTERVAL (30S, 1, 2, 3, 6 MIN)
- 9. AUDIO ALARM (ON, OFF)
- 0. ARPA 2

EPA

- 1. COLLISION ALARM (OFF, ON)
- 2. MARK SIZE (STD, LARGE)
- 3. PLOT NO. (OFF, ON)
- 4. TARGET DATA (REL, TRUE)]

- 1. ARPA 1
- 2. TRAIL MODE (STATIC, DYNAMIC)
- 3. MARK SIZE (STANDARD, LARGE)
- 4. DISPLAY BCR/BCT (OFF, ON)
- 5. ZET VECT TGT DATA (REL, TRUE)
- 6. GZ/AZ STABILIZED (NORTH, CRT)
- 7. SPEED REF (WT, BT)*
- 8. INPUT SIG CHECK
- 9. ARP TRACK TEST
- 0. ARP INITIAL SETTING

NAV

NAV INFORMATION 1

- 1. RADAR MAP
- 2. SELECT NAV AID (GPS+LC, DEAD RECKONING)
- 3. OWN SHIP POSN (OFF, L/L)
- 4. POSN
- 5. +CURSOR DATA (OFF, L/L)
- 6. WPT DATA (OFF, REL*, TRUE*)
- 7. WAY POINT
- 8. NAV LINE
- 9. WIND DATA (OFF, ON)
- 0. NAV INFORMATION 2

- 1. NAV INFORMATION 1
- 2. WPT (OFF, ON)
- 4. WPT LINE (OFF, ON)
- 5. WPT NO. (OFF, ON)
- 8. ARRIVAL ALARM (OFF, ON)

- 1. NAV INFORMATION 1
- 2. NAV LINE (OFF, ON)
- 4. NAV WIDTH (OFF, ON)
- 5. WPT NO. (OFF, ON)
- 9. TURNING LINE (OFF, ON, REVISED)

NAV INFORMATION 2

- 1. NAV INFORMATION 1
- 2. WIND GRAPH (OFF, ON)
- 3. WIND UNIT (M, S, KT)
- 4. CURRENT DATA (OFF, ON)
- 5. CURRENT GRAPH (OFF, ON)
- 6. DEPTH DATA (OFF, ON)
- 7. DEPTH GRAPH (OFF, ON)
- 8. DEPTH SCALE (10, 20, 50, 100, 200, 500)
- 9. DEPTH UNIT (M, FT, FA)
- 0. NAV INFORMATION 3

NAV INFORMATION 3

- 1. NAV INFORMATION 2
- 2. WATER TEMP (OF, ON)
- 3. DATE (OFF, UTC, LOCAL)

INITIAL SETTING MENU

INITIAL SETTING 1

- 1. FUNCTIONS 2
 - 2. HD ALIGN
 - 3. TIMING ADJ
 - 4. ANT HEIGHT (6, 8, 10, 15, 20, 25, 35M, MORE)
 - 5. LOG PULSE (200P, NM)
 - 6. OWN SHIP INFORMATION
 - 7. UNIT (NM, SM, KM)*
 - 8. ON TIME
 - 9. TX TIME
 - 0. INITIAL SETTING 2
- 1. INITIAL SETTING 1
 - 2. SHIP'S LENGTH
 - 3. SHIP'S WIDTH
 - 4. RADAR POSN
 - 6. TURN RATE
 - 7. SPEED RATE

INITIAL SETTING 2

- 1. INITIAL SETTING 1
- 2. LOG GYRO INPUT (LOG, GYRO)
- 3. TYPE (R, N, G, D)
- 4. KEY BEEP (OFF, ON)*
- 5. SCANNER STOPPED (ST-BY, TX)
- 6. VIDEO SIGNAL (ANLG, DGTL)
- 7. ALARM LEVEL (4, 5, 6, 7)
- 8. DISPLAY (MAIN, SUB)
- 9. SECTOR BLKG (OFF, ON)
- 0. INITIAL SETTING 3

INITIAL SETTING 3

- 1. INITIAL SETTING 2
- 2. TRAIL RESTART (OFF, ON)
- 3. ECHO AVG W/O GYRO (OFF, ON)
- 4. HEAD UP TB SCALE (OFF, ON)
- 5. CTR ECHO STRETCH (ST-BY, TX)
- 6. VIDEO CONTRAST (1, 2, 3, 4)
- 7. MAXIMUM RANGE (72, 96, 120)*
- 8. ECHO FULL COLOR (OFF, ON)*
- 9. INDEX LINES (S, 3, 6)
- 0. INITIAL SETTING 4

INITIAL SETTING 4

- 1. INITIAL SETTING 3
- 2. MODEL (FR-2815/2825, OTHER X-BAND, S-BAND)
- 4. SHIPS TYPE (DEEP SEA, OTHERS)
- 5. RJ-7 (OFF, ON)
- 6. RJ-8 (OFF, ON)
- 9. CABLE L. (500, 5000M)
- 0. FACTORY DEFAULT