FURUNO

OPERATOR'S MANUAL

MARINE RADAR/ARPA

FAR-28x7 Series

MODEL **FAR-21x7(-BB) Series**

FURUNO ELECTRIC CO., LTD.
NISHINOMIYA, JAPAN

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Your Local Agent/Dealer

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SAFETY INSTRUCTIONS

⚠ WARNING

Radio Frequency Radiation Hazard

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

Distances at which RF radiation levels of 100 and 10 W/m^2 exist are given in the table below.

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

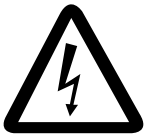
Model[3]	TR unit	Magnetron	Antenna[1]	Distance to 100 W/m^2 point	Distance to 10 W/m^2 point
FAR-2827/2127	RTR-079	MG5436	XN12AF	0.80 m	11.20 m
FAR-2827/2127	RTR-079	MG5436	XN20AF	0.40 m	8.60 m
FAR-2827/2127	RTR-079	MG5436	XN24AF	0.20 m	5.80 m
FAR-2817/2117	RTR-078	MG4010[2]	XN12AF	0.30 m	4.20 m
FAR-2817/2117	RTR-078	MG4010[2]	XN20AF	0.10 m	3.00 m
FAR-2817/2117	RTR-078	MG4010[2]	XN24AF	--	2.40 m
FAR-2137S	RTR-080	MG5223F	SN30AF		
FAR-2137S	RTR-080	MG5223F	SN36AF		
FAR-2827W	RTR-081	MG5436	XN20AF		
FAR-2827W	RTR-081	MG5436	XN24AF		
FAR-2837S	RTR-080	MG5223F	SN30AF		
FAR-2837S	RTR-080	MG5223F	SN36AF		
FAR-2837SW	RTR-082	MG5223F	SN30AF		
FAR-2837SW	RTR-082	MG5223F	SN36AF		

1 XN12AF: 4 ft XN20AF: 6.5 ft XN24AF: 8 ft
SN30AF: 10 ft SN36AF: 12 ft

2 Or MAF1425B

3 FAR-2117/2127/2137S available in blackbox configuration.

⚠ 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.

Immediately turn off the power at the ship's mains switchboard if water leaks into the equipment or the equipment is emitting smoke or fire.

Continued use can cause fatal damage to the equipment.

⚠ WARNING

Use the proper fuse.

Use of a wrong fuse can result in damage to the equipment or cause fire.

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 near 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.

Before servicing the radar, turn off the appropriate external breaker.

Power is not removed from the radar simply by turning off its power switch.

⚠ WARNING

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

- This ARP automatically tracks automatically or manually acquired radar targets and calculates their courses and speeds, indicating them by vectors. Since the data generated by the auto plotter are based on what radar targets are selected, the radar must always be optimally tuned for use with the auto plotter, to ensure required targets will not be lost or unwanted targets such as sea returns and noise will not be acquired and tracked.

- A target does not always mean a land-mass, reef, ships or other surface vessels but can imply returns from sea surface and clutter. As the level of clutter changes with environment, the operator should properly adjust the A/C SEA, A/C RAIN and GAIN controls to be sure target echoes are not eliminated from the radar screen.

⚠ CAUTION

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

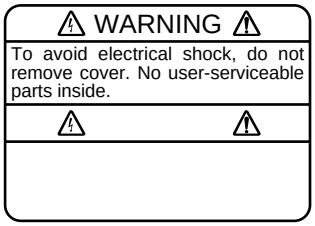
- Tracking accuracy is affected by course change. One to two minutes is required to restore vectors to full accuracy after an abrupt course change. (The actual amount depends on gyrocompass specifications.)
- The amount of tracking delay is inversely proportional to the relative speed of the target.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

The data generated by ARP, AIS and video plotter are intended for reference only.

Refer to official nautical charts for detailed and up-to-date information.

WARNING LABEL

Warning labels are attached to the equipment. Do not remove any label. If a label is missing or damaged, contact a FURUNO agent or dealer about replacement.



DISPLAY UNIT, PROCESSOR UNIT

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



ANTENNA UNIT

Name: Radiation Warning Label
Type: 03-142-3201-0
Code No.: 100-266-890

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Declaration of conformity

FOREWORD

A Word to the Owner of the FAR-28x7/FAR-21x7(-BB)

Congratulations on your choice of the FURUNO FAR-28x7/FAR-21x7(-BB) Series Radar. We are confident you will see why FURUNO has become synonymous with quality and reliability.

For over 50 years FURUNO Electric Company has enjoyed an enviable reputation for innovative and dependable marine electronics equipment. This dedication to excellence is furthered by our extensive global network of agents and dealers.

Your radar is designed and constructed to meet the rigorous demands of the marine environment. However, no machine can perform its intended function unless installed, operated and maintained properly. Please carefully read and follow the recommended procedures for operation and maintenance.

We would appreciate hearing from you, the end-user, about whether we are achieving our purposes.

Thank you for considering and purchasing FURUNO equipment.

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

Features

- High-resolution 20.1-inch LCD (FR-21x7) or 23.1-inch LCD (FR-28x7).
- This series of radar and ARP (automatic radar plotter, includes ARPA or ATA) are available in the models shown in the table below. " BB" means blackbox configuration (monitor to be supplied locally) is available.

X-band			**S-band**		
Model	Output	TR config.	Model	Output	TR config.
FAR-2117(-BB)	12 kW	UP	FAR-2137S(-BB)	30 kW	UP
FAR-2127(-BB)	25 kW	UP	FAR-2837S	30 kW	UP
FAR-2817	12 kW	UP	FAR-2837SW	30 kW	DOWN
FAR-2827	25 kW	UP			
FAR-2827W	25 kW	DOWN			

- Two types of trackball-equipped control units are available: RCU-014 (full keyboard) and the RCU-015 (palm control). The trackball is easy to use thanks to the ergonomically designed palm rest.
- Simplified operation with point-and-click menu operation.
- All functions are accessible by using the trackball alone.
- Applicable to HSC (High Speed Craft)
- ARPA (Automatic Radar Plotting Aid) or ATA (Automatic Tracking Aid) + AIS, Radar Plotter and Interswitch supplied as standard. (ARPA or ATA selectable on installation menu.)
- Meets the following requirements:

  IMO MSC.64(67) Annex 4: Performance standards for Radar equipment

  IEC 60936-1 (1999): Shipborne radar-Performance requirements

  IEC 60936-1 Am. 1 (2002-06): Unwanted emissions of radar systems

  IMO A.823 (19): Performance standards for ARPAs

  IEC 60872-1 (1998): ARPA – Performance requirements

  IMO A.820(19): Performance standards for navigational radar equipment for high speed craft

  IEC 60936-2 (1998): Radar for high speed craft – Performance requirements

  IMO A. 694(17): General requirements for electronic navigational aids (including ATA)

  IEC 60945 (2002-08): Maritime Navigational Equipment General Requirements

  IEC 61162-1 and 2: Maritime navigation equipment-digital interface

  IEC 60936-5: Guidelines for the use and display of AIS information on Radar

  IEC 60872-2: ATA performance requirements
- Guard alarm watches for targets entering or exiting the guard zone
- TCPA/CPA alarms
- Electronic parallel index lines
- 42 rpm antenna for high speed craft

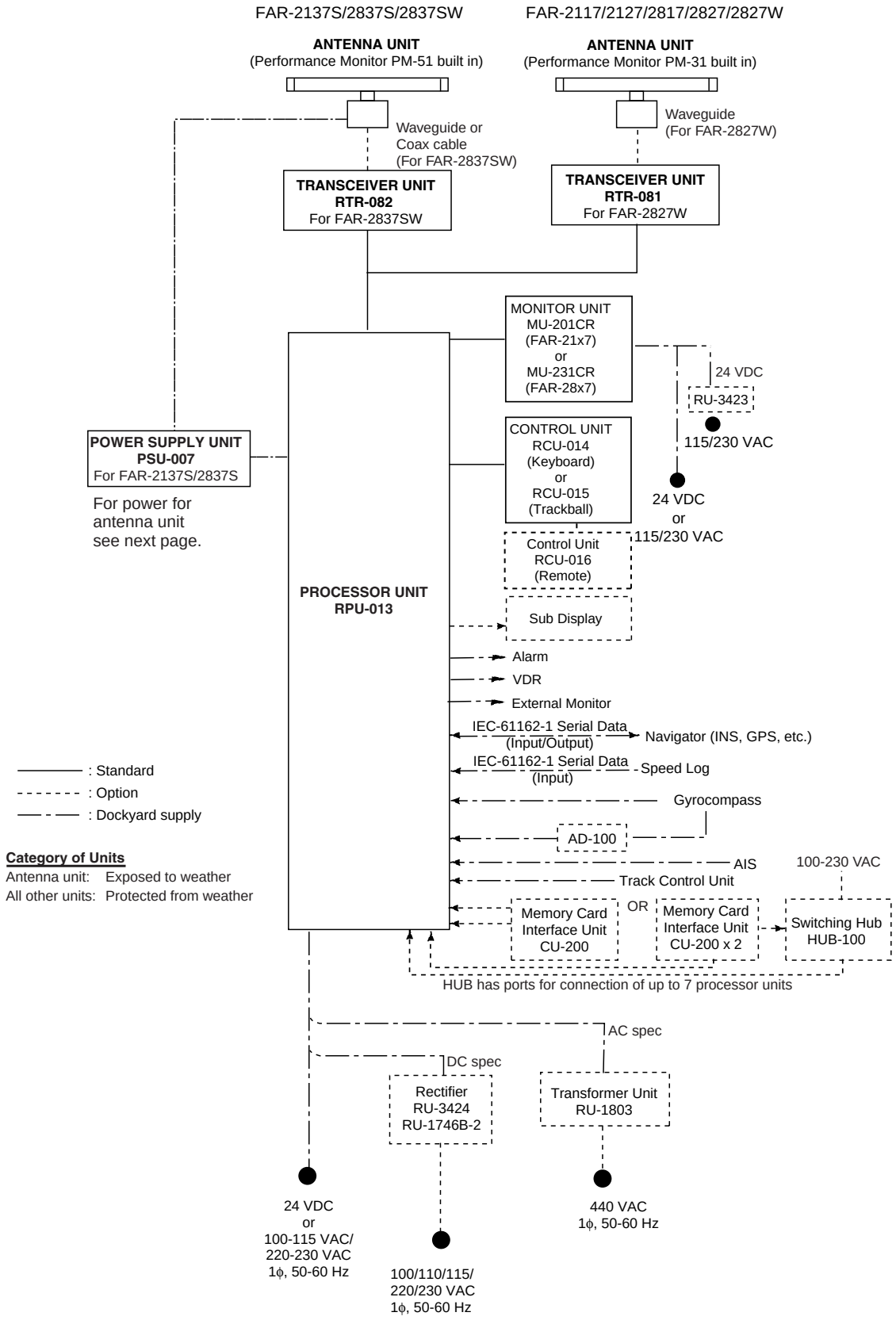
PROGRAM NUMBER

PC Board	Program No.	Version No.	Date of Modification
SPU	035-9204	01.**	
RFC	035-9202	01.**	
KEY(REMOTE)	035-9203	01.**	
CARD	035-9209	01.**	

** Program Version No.

SYSTEM CONFIGURATION

With FURUNO-supplied monitor



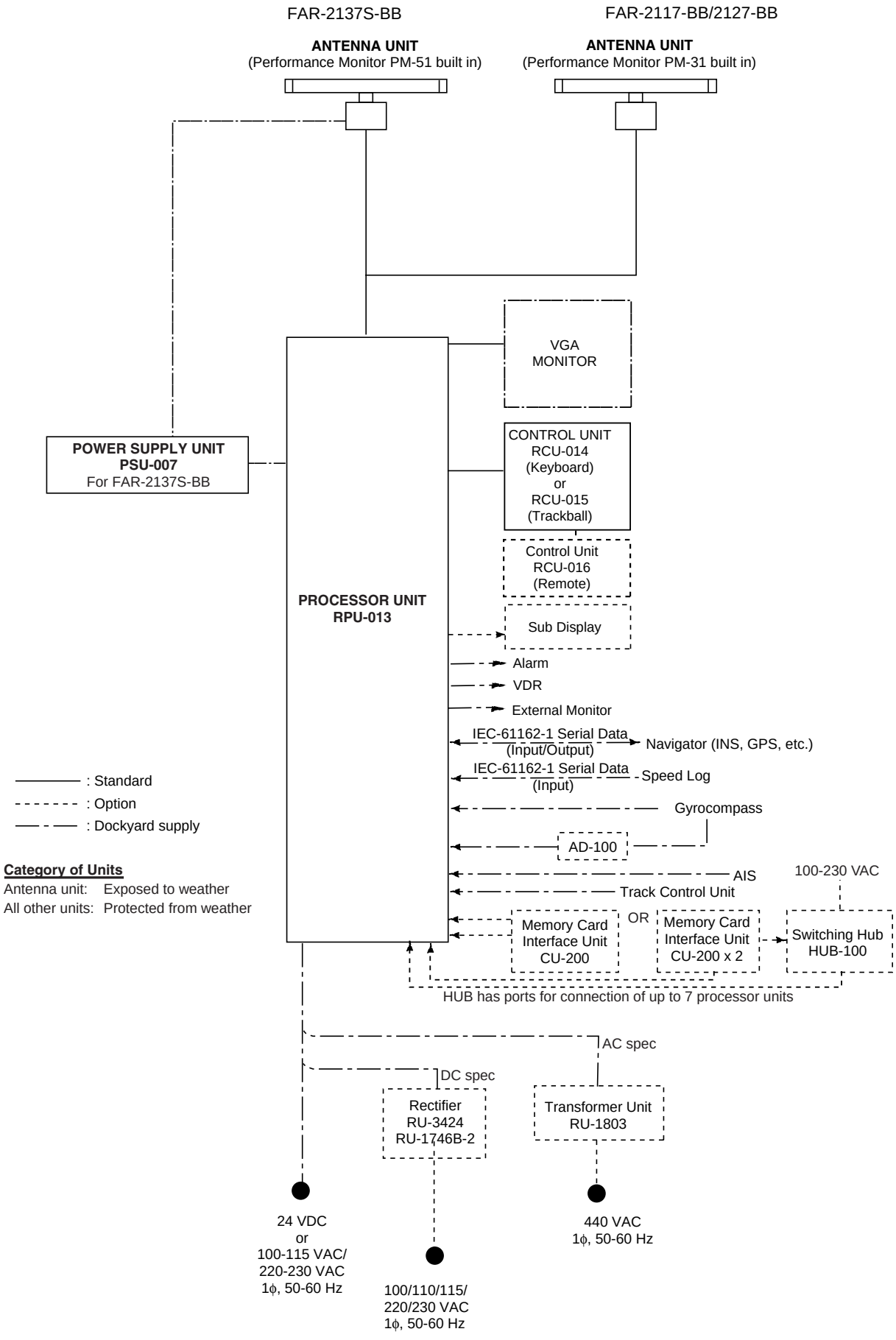
Antenna unit

FAR-2117, FAR-2117-BB FAR-2127, FAR-2127-BB, FAR-2827,	RSB-096 (24 rpm) RSB-097 (42 rpm)
FAR-2137S, FAR-2137S-BB	RSB-098/099 (21/26 rpm, 200 VAC, 3ø, 50 Hz; 220 VAC, 3ø, 60 Hz; 380 VAC, 3ø, 50 Hz, 440 VAC, 3ø, 60 Hz) RSB-100/101/102 (45 rpm, 220 VAC, 3ø, 50/60 Hz(HSC); 440 VAC, 3ø, /60 Hz(HSC))
FAR-2827W	RSB-103 (24 rpm, powered by processor unit)
FAR-2837S	Same as FAR-2137S
FAR-2837SW	RSB-104/105 (21/26 rpm, 200 VAC, 3ø, 50 Hz; 220 VAC, 3ø, 60 Hz; 380 VAC, 3ø, 50 Hz, 440 VAC, 3ø, 60 Hz)

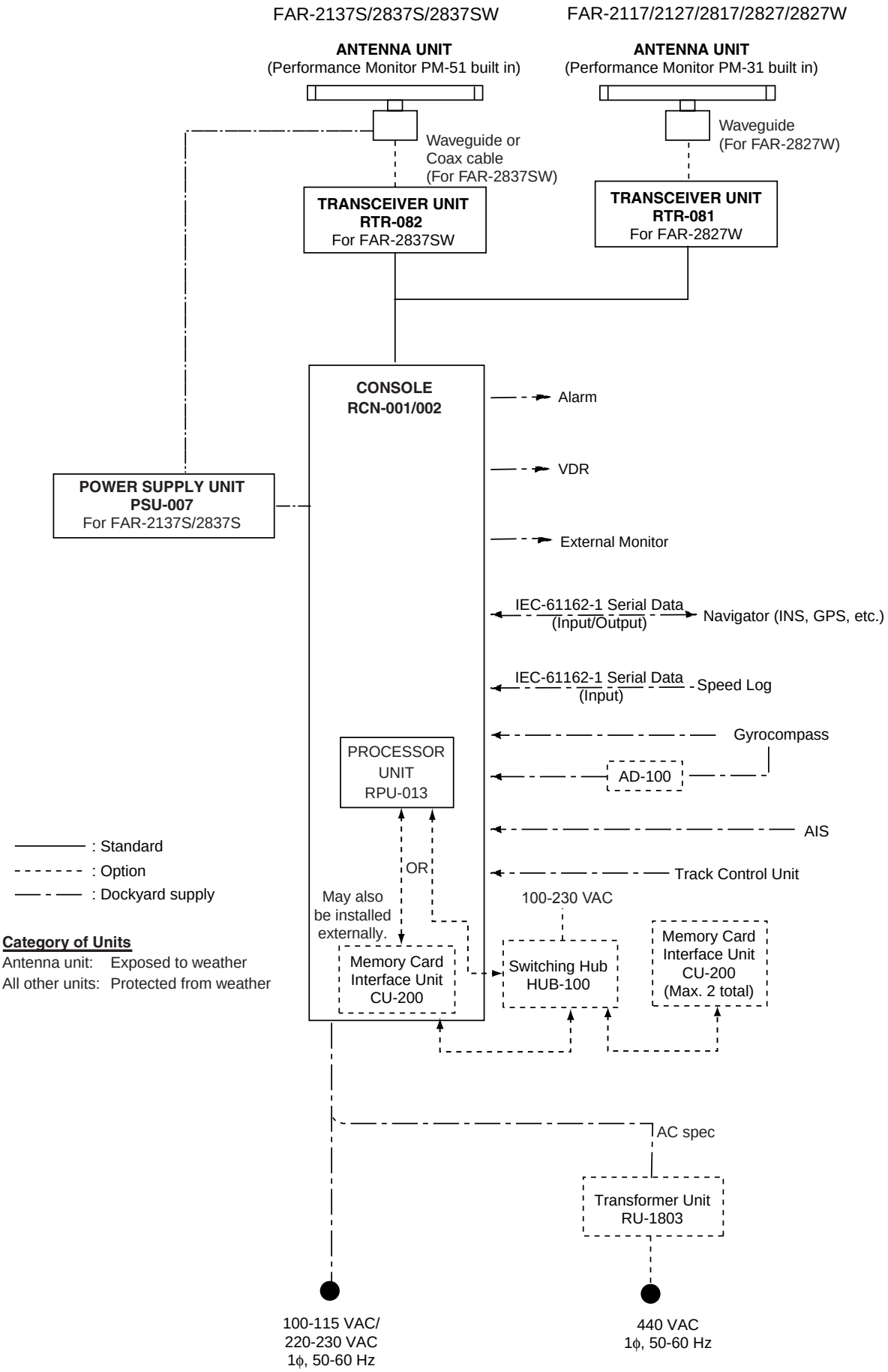
Radiator

FAR-2117, FAR-2117-BB FAR-2127, FAR-2127-BB, FAR-2827	XN12AF (4 ft), XN20AF (6.5 ft), XN24AF (8 ft)
FAR-2137S, FAR-2137S-BB	SN30AF (10 ft), SN36AF (12 ft)
FAR-2827W	XN20AF (6.5 ft), XN24AF (8 ft)
FAR-2837S	SN30AF (10 ft), SN36AF (12 ft)
FAR-2837SW	SN30AF (10 ft), SN36AF (12 ft)

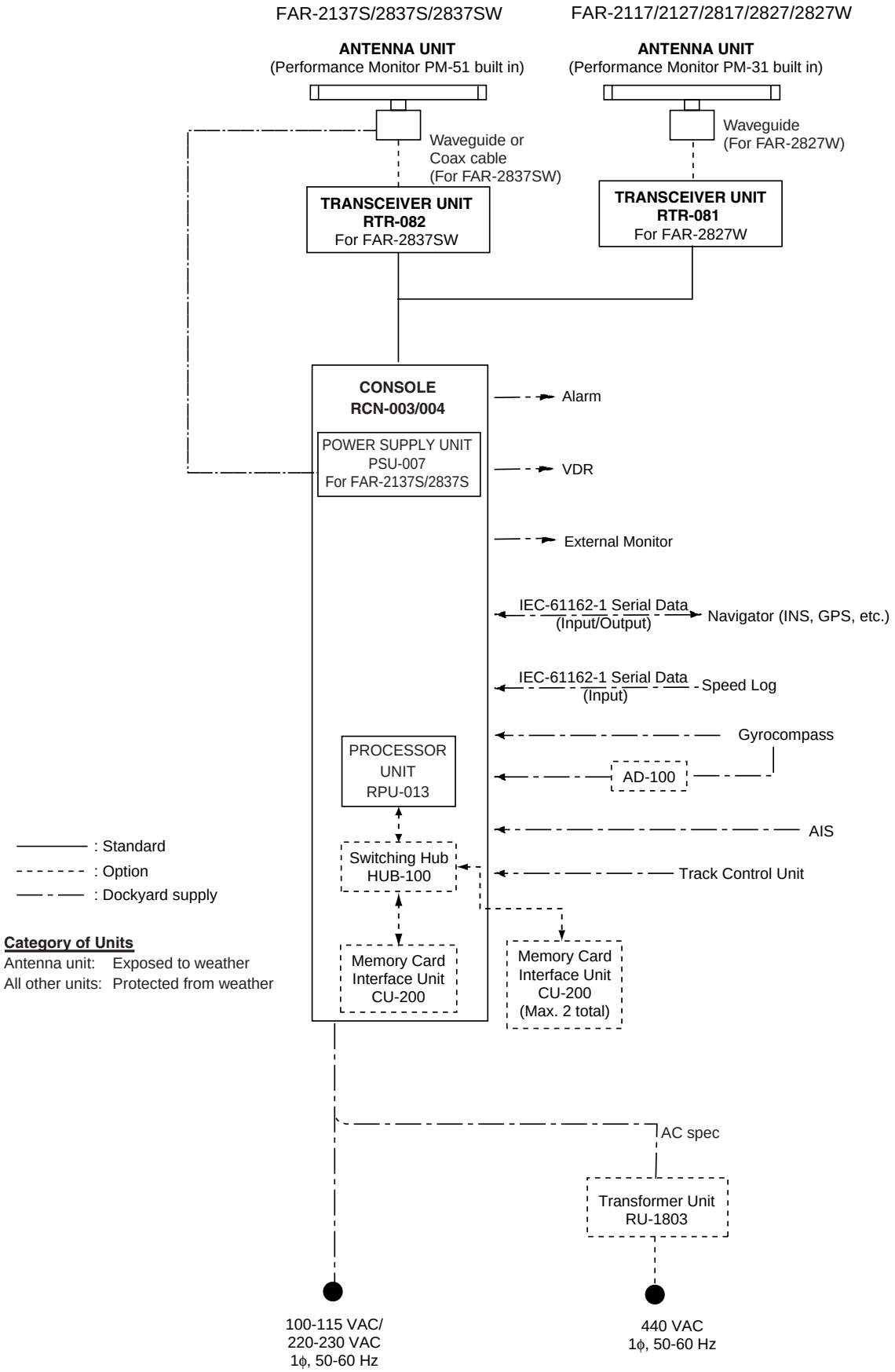
Blackbox type



Console type RCN-001/RCN-002



Console type RCN-003/RCN-004



SPECIFICATIONS OF MARINE RADAR/ARPA
FAR-21x7(-BB)/28x7 SERIES

1. ANTENNA RADIATORS

1. Type: Slotted waveguide array
2. Beam width and sidelobe attenuation

Radiator type	X-band			S-band	
	XN12AF	XN20AF	XN24AF	SN30AF	SN36AF
Length	4 ft	6.5 ft	8 ft	10 ft	12 ft
Beam width(H)	1.8°	1.23°	0.95°	2.3°	1.8°
Beam width(V)	20°	20°	20°	25°	25°
Sidelobe within ±10°	-24 db	-28db	-28 db	-24 db	-24 db
Sidelobe outside ±10°	-30 db	-32 db	-32 db	-30 db	-30 db

3. Polarization: Horizontal
4. Rotation: FAR-2117/2127/2827: 24 rpm or 42 rpm
   FAR-2137S/2837S: 21/26 rpm or 45 rpm
   FAR-2827W: 24 rpm
   FAR-2837SW: 21/26 rpm

2. RF TRANSCEIVER

1. Frequency: X-band: 9410 MHz ±30 MHz, S-band: 3050 MHz ±30 MHz
2. Output power: FAR-2117/2817: 12 kW FAR-2127/2827/2827W: 25 kW
   FAR-2137S/2837S/2837SW: 30 kW
   Unwanted emissions comply with ITU-R RR.
3. Pulselength, PL, PRF and range

Pulselength	S1	S2	M1	M2	M3	L
PL (µs)	0.07	0.15	0.3	0.5	0.7	1.2
PRF (Hz)	3000*	3000*	1500	1000	1000	600**
Range scale (nm)	0.125, 0.25, 0.5, 0.75, 1.5	0.5, 0.75, 1.5, 3	0.75, 1.5, 3, 6	3, 6, 12, 24	3, 6, 12, 24	6, 12, 24, 48, 96, 120#

*: 2200 Hz with ARPA on, 32 nm range **: 450 Hz on 96 and 120 nm ranges #: Non-IMO type only

4. IF: 60 MHz
5. Noise figure: 6 dB (typical)
6. Duplexer: Ferrite circulator with diode limiter for
   FAR-2117/2127/2137S/2817/2827/2837S
   Ferrite circulator with TR limiter for FAR-2827W/2837SW

3. DISPLAY UNIT

1. Screen: Yellow or green echoes in 32 levels. Rasterscan non-interlace at 48.3kHz horizontal, 60 Hz vertical. Non-IMO type has yellow or green monochrome plus 3-color display according to echo strengths.

	FAR-21x7 series	FAR-28x7 series
Size, model	20.1-inch color LCD, MU-201CR	23.1-inch color LCD, MU-231CR
Display area (mm)	399.36 x 319.49	470.4 x 352.8
Resolution	1280 x 1024 pixels	1280 x 1024 pixels
Effective radar diameter	308 mm	340 mm

2. Minimum range and range discrimination: 35 m

3. Range scales (nm), ring interval	0.125 (.025), 0.25 (0.05), 0.5 (0.1), 0.75 (0.25), 1 (0.25)*, 1.5 (0.25), 3 (0.5), 4 (1)*, 6 (1), 8 (2)*, 12 (2), 16 (4)*, 24 (4), 32 (8)*, 48 (8), 96 (16), 120 (20)* *: Non-IMO type only
4. Range accuracy	1% of the maximum range of the scale in use or 30 m, whichever is the greater
5. Bearing discrimination	Better than 2.5°
6. Bearing accuracy	±1°
7. Presentation mode	Head-up, Head-up TB, North-up, Course-up, True Motion sea or ground stabilization
8. Plotting facilities (ARPA or ATA)	Auto or Manual acquisition: 100 targets in 0.1-32 nm Auto tracking on all acquired targets
9. Radar map	Nav lines, coastlines, buoys, etc. produced by operator. 3000 pts in radar mode, 6000 pts on IC card in chart mode
10. Guard zone	Two GZ anywhere
11. Parallel index line	Choice of 2, 4 or 6 lines
12. AIS	IMO SN Circ.217, IEC 60936-5
13. Chart cards	FURUNO and NAVIONICS

4. INTERFACE

1. IEC 61162-1 Ed. 2	RSD, TTM, AIS related data, etc.
2. Compass	Built-in interface (option) for sync signal (20-135 V, 50-400 Hz), or stepper signal (20-135 VDC), any polarity, for gyrocompass, GPS compass SC-60/120 by IEC 61162-2
3. Speed log	NMEA format data
4. Others	Echo sounder, GPS navigator, water temperature, etc.

5. POWER SUPPLY

1. Display unit	24 VDC or 115/230 VAC, 1ø, 50/60 Hz FAR-21x7: 24 VDC, 2.3 A; 100-230 VAC, 0.7A (100 V) FAR-28x7: 24 VDC, 3.2 A; 100-230 VAC, 0.9 A (100 V) 440 VAC, 1 ø, 50/60 Hz with optional transformer RU-1803
2. Processor unit	FAR-2117/2817/2117-BB: 24VDC: 7.6A[1]/8.5A[2], 100-115 VAC: 2.6A[1]/3.0A[2], 220-230 VAC: 1.6A[1]/1.7A[2] FAR-2127/2827/2127-BB: 24 VDC: 8.8A[1]/9.7A[2], 100-115 VAC: 3.0A[1]/3.4A[2], 220-230 VAC: 1.8A[1]/1.9A[2] [1:] 24 rpm, [2:] 42 rpm
3. Antenna unit (S-band)	200/220/380/440 VAC 115/230 VAC, 1ø, 50 or 60 Hz

	Antenna voltage input (100 kt)				
	200 VAC, ø3, 50 Hz, 220 VAC, ø3, 60 Hz	380 VAC, ø3, 50 Hz, 380 VAC, ø3, 60 Hz	220 VAC, ø3, 50 Hz, (HSC)	220 VAC, ø3, 60 Hz (HSC)	220 VAC, ø3, 60 Hz (HSC)
FAR-2137S	3.0 A	1.5 A	3.5 A	3.5 A	1.7 A
FAR-2837S	3.0 A	1.5 A	3.5 A	3.5 A	1.7 A
FAR-2837SW	3.0 A	1.5 A	-	-	-
FAR-2137SW	3.0 A	1.5 A	3.5 A	3.5 A	1.7A

4. Console	115/230 VAC, 1ø, 50/60 Hz, 440 VAC, 1ø, 50/60 Hz with optional transformer RU-1803

6. ENVIRONMENTAL CONDITIONS

1. Ambient temperature (Complies with IEC 60945)	
Indoor units	-15°C to +55°C
Antenna unit	-25°C to +55°C (storage +70°C)
2. Relative humidity	95% at 40°C
3. Waterproofing	Antenna unit: IPX6 (IEC 60529) Indoor units: IPX0 (IEC 60529)
4. EMC	Full compliance with IEC 60945 Ed. 4 (to 2 GHz cabinet radiation)

7. OPTIONAL EQUIPMENT

SWITCHING HUB HUB-100

1. Access Format	CSMA/CD
2. Switching Format	Store and Forward
3. Transmission Speed	Half-duplex: 10Mbps/100Mbps Full-duplex: 20Mbps/200Mbps
4. Necessary Cabling	10BASE-T: Category 3 or higher STP cable 100 BASE-TX: Category 5 or higher STP cable
5. Max. Cable Length	100 m
6. Ports	8 ports - All ports auto-MDIX compliant (straight or cross cable, automatic recognition) - All ports EMC compliant (STP cable port) - All ports equipped with 3 LED injectors (Link/Act, Full-duplex/Collision, 100Mbps/10Mbps)
7. Buffer Memory	SRAM buffer
8. MAC Address Table	1024
9. Dimensions and Mass	
Dimensions	47(H)x270(W)x1458(D) (mm) includes fixing screws
Mass	Less than 1.6 kg
10. Environmental Conditions	
Ambient Temperature	-15 to +55°C
Relative Humidity	95% (at 40°C)
EMC	IEC 60945
Waterproofing	IPX0 (IEC 60529)
11.Power and Power Consumption	
Power	100-230 VAC
Power Consumption	100mA/100 VAC
12. Coating and Color	N3.0

Precautions for high speed targets

Assume your ship is making 40 kt and a target ship is approaching at 49 kt right toward you. Then the relative speed is 80 kt. With the antenna rotating at 42 rpm, the target blip appears jumping to a new location 59 m nearer. This jump corresponds to 19 mm on the display using the 0.25 nm range scale. On such a short range you may lose the track of a target in the midst of sea clutter, random noise or other targets. Use one step larger range scale.

ARPA can fail to track a target when the relative speed exceeds 100 kt.

1 RADAR OPERATION

1.1 Turning on the Power

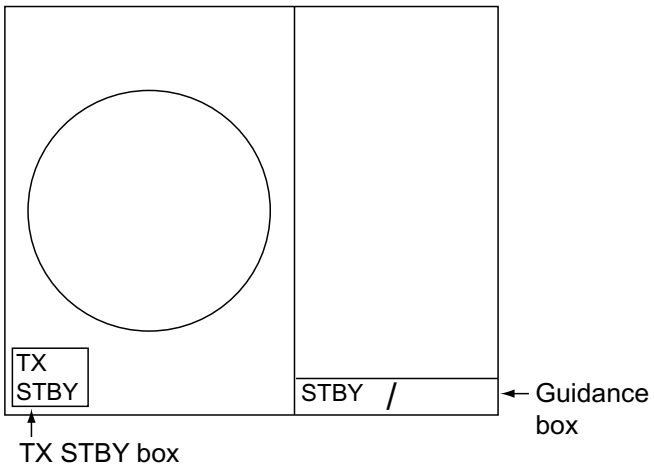
The [POWER] switch is located at the left corner of the control unit. Open the power switch cover and press the switch to turn on the radar system. To turn off the radar, press the switch again. The screen shows the bearing scale and digital timer approximately 30 seconds after power-on. The timer counts down three minutes of warm-up time. During this period the magnetron (transmitter tube) is warmed for transmission. When the timer has reached 0:00, the indication “ST-BY” appears at the screen center, meaning the radar is now ready to transmit pulses.

In the stand-by condition, markers, rings, map, charts, etc. are not shown. Further, ARP is cancelled and the AIS display is erased.

In warm-up and stand-by condition, ON TIME and TX TIME counts in hours and tenths of hour appear at the screen center.

1.2 Transmitter ON

After the power is turned on and the magnetron has warmed up, ST-BY appears at the screen center, meaning the radar is ready to transmit radar pulses. You may transmit by pressing the [STBY/TX] key on the full keyboard or roll the trackball to choose the TX STBY box at the bottom left corner of the display and then push the left button (above the trackball). The label at the left-hand side of the guidance box at the bottom right corner of the screen changes from TX to STBY.



Radar display

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

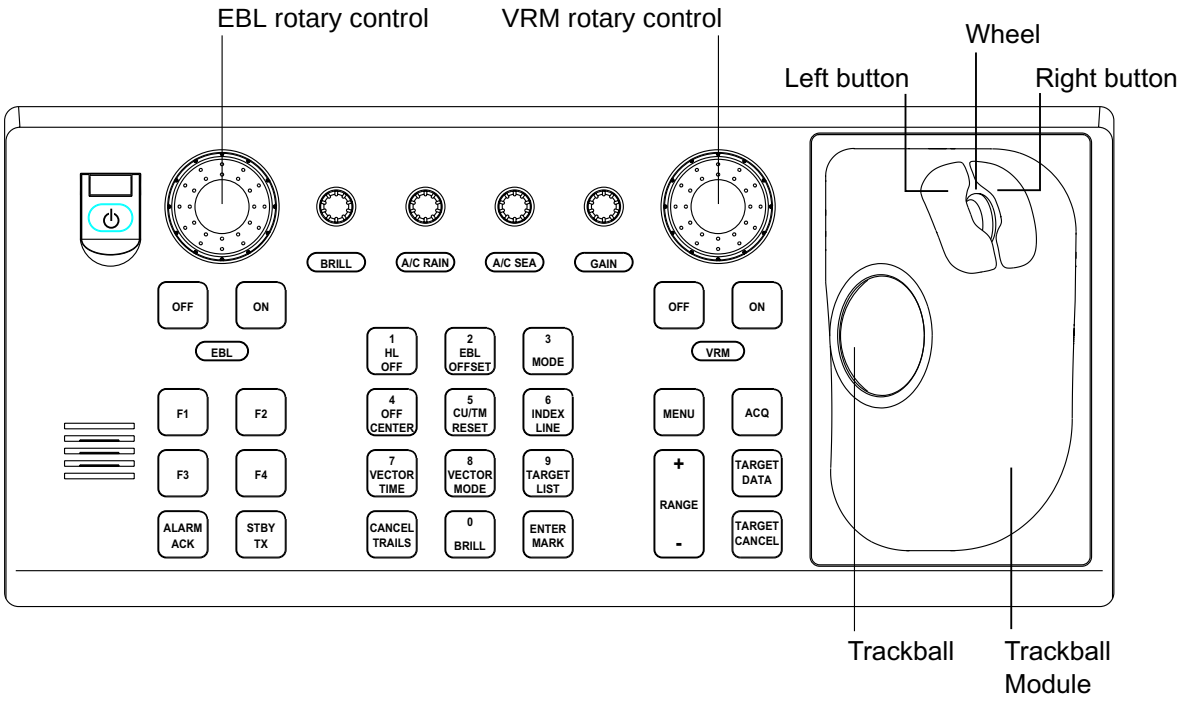
The [STBY/TX] key (or TX STBY box) toggles the radar between STBY and TRANSMIT status. The antenna stops in stand-by and rotates in transmit. The magnetron ages with time resulting in a reduction of output power. Therefore, it is highly recommended that the radar be set to stand-by when not used for an extended period of time.

Quick start

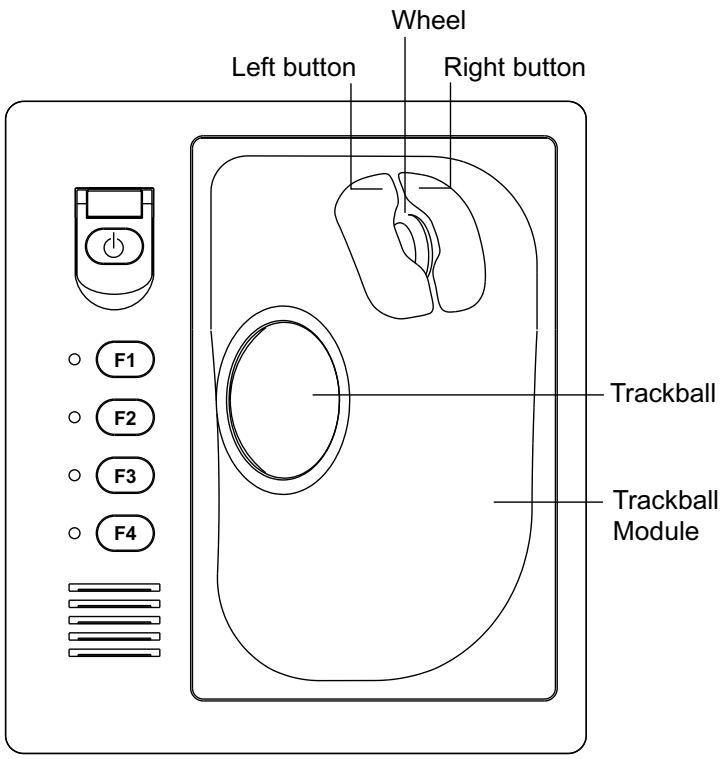
Provided that the radar was once in use with the transmitter tube (magnetron) still warm, you can turn the radar into TRANSMIT condition without three minutes of warm-up. If the [POWER] switch has been turned off by mistake or the like and you wish to restart the radar promptly, turn on the [POWER] switch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

1.3 Control Unit

Two types of control units are available: Control Unit RCU-014 (full keyboard) and Control Unit RCU-105 (palm control).



Control Unit RCU-014 (full keyboard)



Control Unit RCU-015 (palm control)

Control description

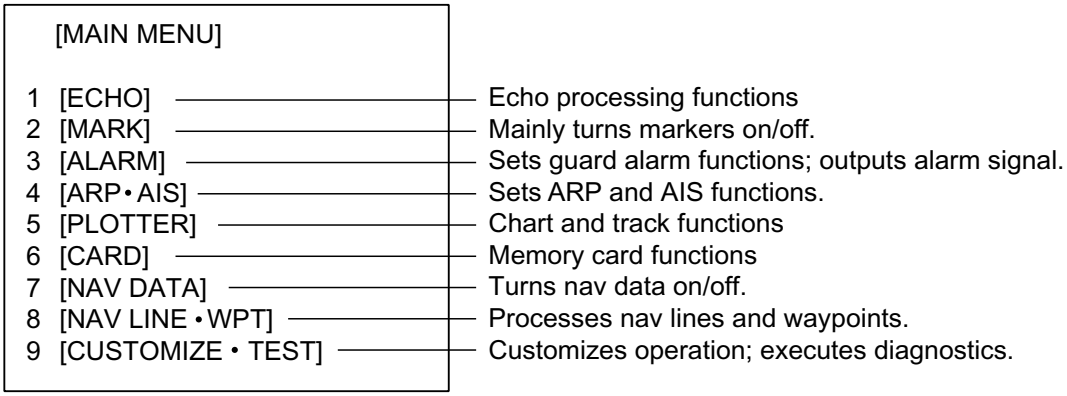
Control	**Description**
Control Unit RCU-014 (full keyboard)	
POWER	Turns the system on and off.
EBL and VRM rotary controls	Adjust EBL and VRM, respectively.
EBL ON, EBL OFF	Turns the EBLs on and off, respectively.
F1-F4	Execute menu short cut assigned.
ALARM ACK	Silences audible alarm.
STBY TX	Toggles between stand-by and transmit.
BRILL	Adjusts display brilliance.
A/C RAIN	Suppresses rain clutter.
A/C SEA	Suppresses sea clutter.
GAIN	Adjusts sensitivity of the radar receiver.
HL OFF	Temporarily erases the heading line while pressed.
EBL OFFSET	Enables, disables the EBL offset. In menu operation, switches polarity from North to South and East to West and vice versa.
MODE	Chooses presentation mode.
OFF CENTER	Shifts own ship position.
CU/TM RESET	• Moves own ship position in 75% radius in stern direction. • Resets the heading line to 0° in course-up and true motion modes.
INDEX LINE	Turns index lines on and off.
VECTOR TIME	Chooses vector time (length).
VECTOR MODE	Chooses vector mode, relative or true.
TARGET LIST	Displays ARP target list.
CANCEL TRAILS	Cancels all target trails. In menu operation it clears line of data.
ENTER MARK	Enters marks; terminates keyboard input.
VRM ON, VRM OFF	Turns the VRMs on and off, respectively
MENU	Opens and closes the MAIN menu; closes other menus.
ACQ	• Acquires a target for ARP after choosing it with the trackball. • Changes a sleeping AIS target to an activated one after choosing it with the trackball.
RANGE	Chooses radar range.
TARGET DATA	Displays target data for ARP or AIS target chosen with the trackball.
TARGET CANCEL	Cancels tracking on ARP, AIS or reference target chosen with the trackball.
Control Unit RCU-015 (palm control)	
POWER	Turns the system on and off.
F1-F4	Execute menu short cut assigned.

1.4 Main Menu

You may access the MAIN menu from the full keyboard or by using the trackball. In later sections only the procedure for menu operation by trackball is given.

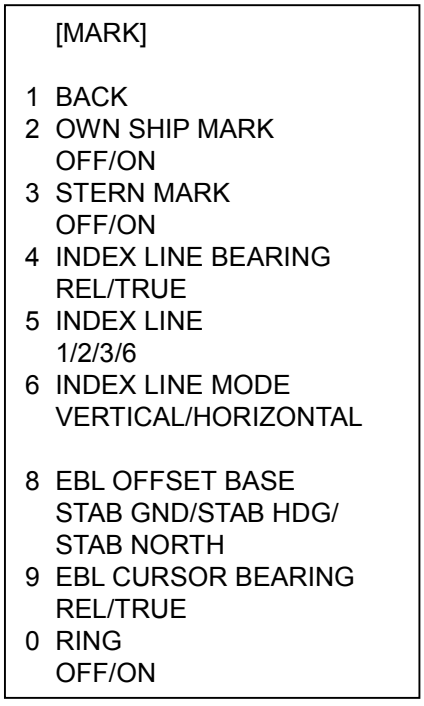
Main menu operation by keyboard

1. Press the [MENU] key. The MAIN menu appears in the text area at the right side of the screen.



MAIN menu

2. Press the numeral key corresponding to the menu you wish to open. For example, press the [2] key to open MARK menu.



MARK menu

3. Press the numeral key corresponding to the item you wish to set.
4. Consecutively press the same numeral key pressed at step 3 to choose appropriate option and then press the [ENTER MARK] key to register your selection.
5. Press the [MENU] key to close the menu.

Useful keys in menu operation

- To clear a line of numeric data: Use the [CANCEL TRAILS] key.
- Switch between plus and minus, North and South or East and West: Use the [2] key.

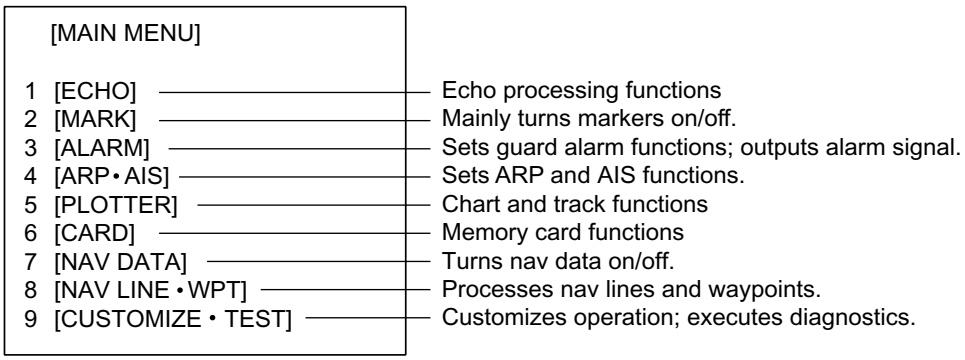
Main menu operation by trackball

1. Roll the trackball to choose the MENU box at the right side of the screen. The guidance box at the bottom right corner (see the illustration at the bottom of the next page for location) now reads “DISP MAIN MENU.”



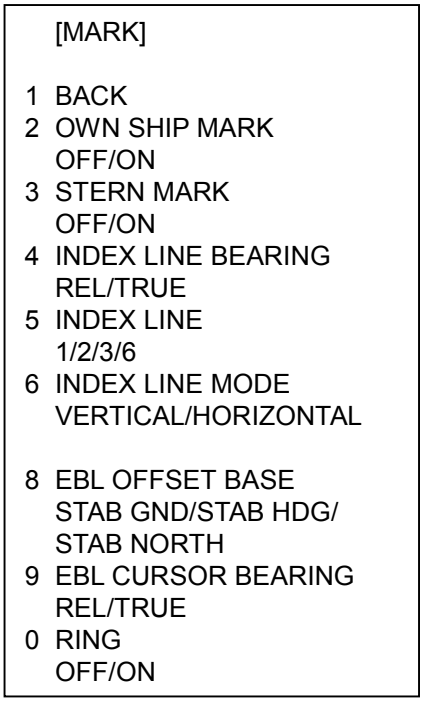
Menu box

2. Push the left button to display the MAIN menu.



MAIN menu

3. Roll the wheel to choose the menu you wish to open and then push the wheel or the left button. For example, choose the 2 [MARK] menu and then push the wheel or the left button.



MARK menu

4. Roll the wheel to choose item desired and then push the wheel or the left button.
5. Roll the wheel to choose option desired and then push the wheel or the left button to register your selection.
6. Push the right button to close the menu. (Several pushes may be necessary depending on the menu used.)

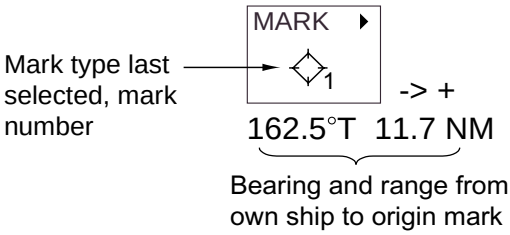
1.5 Operation Using the On-Screen Boxes

All radar functions can be accessed by using the trackball alone. This is done by choosing the appropriate on-screen box with the trackball and operating the trackball module to choose item and option. (See paragraph 1.9 for location of all on-screen boxes.) On-screen boxes come in two varieties: Function selection and function selection w/pop-up menu. On-screen boxes of the latter type have "►" at the right side of their boxes, as in the MARK box shown below.

To operate the radar using on-screen boxes, do the following:

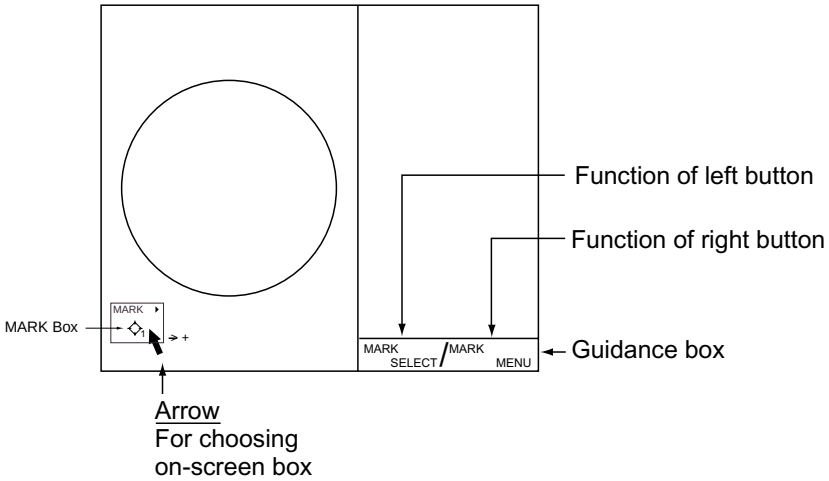
1. Roll the trackball to place the trackball marker inside the box desired.
   Note: The trackball marker changes its configuration according to its location. It is an arrow when placed outside the effective display and a cursor (+) when inside the effective display. See the illustration on the next page for further details.

   For example, choose the MARK box, which is at the bottom left corner.



MARK box

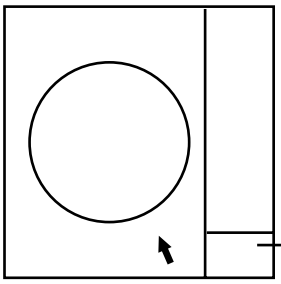
   When a box is correctly selected, its color changes from green to yellow (default colors) and the guidance box at the bottom right corner shows operational guidance. The operational guidance shows the function of the left and right buttons, with a diagonal line separating the information. For the MARK box, for example, the operational guidance is "MARK SELECT / MARK MENU." In this case you would push the left button to choose a mark or push the right button to open the MARK menu.



Guidance box (Example: guidance for MARK box)

Trackball marker location and guidance box indication

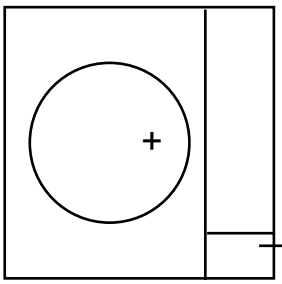
The trackball marker is either a cursor (+) or an arrow (↖) depending on whether it is within or outside the display area, respectively. Further, the indication in the guidance box changes according to trackball marker location.



Trackball marker is out of effective display area (incl. text area) and not selecting a box: The trackball marker is an arrow

Guidance box reads
"JUMP CURSOR / DISP MENU."
Push the left button to choose the on-screen box closest to the arrow or push the right button to display the MAIN menu.

To choose boxes successively, push the wheel when the guidance box reads as above. Then, the nearest box is selected and marked with the double-ended arrow (⇳) and the guidance box reads
"JUMP FORWARD / JUMP BACKWARD."
Hit the left button to go to the box below or adjacent to the currently selected box or hit the right button to go to the box above or adjacent to the currently selected box. Continue pushing a button to choose boxes successively. This is convenient for operation under heavy pitching and rolling. To cancel this feature, push the wheel when the guidance box reads as above.



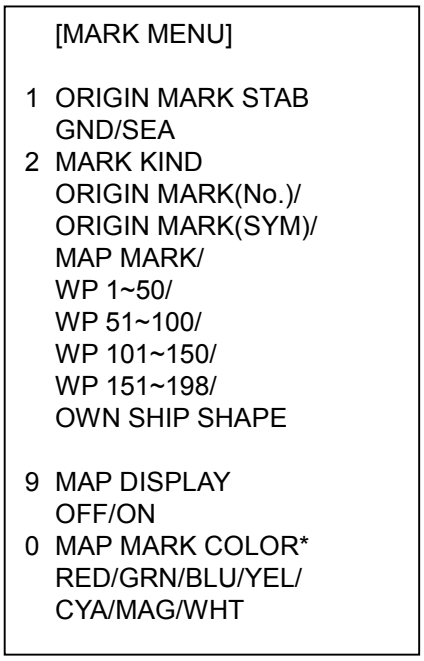
Trackball marker is within effective display area: The trackball marker is a cursor

Guidance box reads
"TARGET DATA & ACQ / CURSOR MENU."
In this condition you may access cursor-operated functions, by hitting the left button for direct selection of function or the right button to choose desired functions from the CURSOR menu. For further details about the CURSOR menu, see paragraph 1.6.

2. Push the left button (or roll the wheel depending on the box) until the desired option is displayed in the box.

Note: When you chose an on-screen box's option by rolling the wheel, the box and its contents turn red. This simply indicates that the chosen setting is different from the currently active setting. To change the setting, push the wheel or the left button. If neither the wheel nor the left button is pushed within about 30 seconds after operating the wheel, the previous setting is automatically restored.

3. The pop-up menu attached to the MARK box is the MARK menu. To open the menu, push the right button. The menu opens in the text area at the right side of the screen.



MARK menu

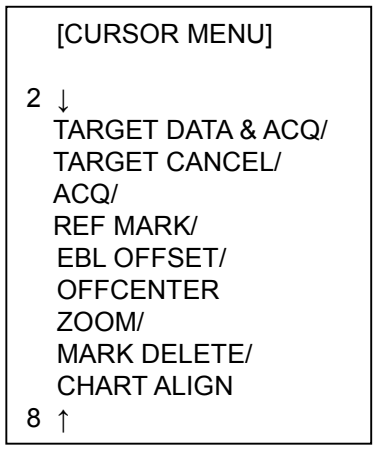
Note: Any menu may be operated from the full keyboard or the trackball, or a combination of the two in case of Control Unit RCU-014. ***Note that in later sections only the procedure for menu operation by the trackball is given.***

4. Roll the wheel to choose item desired and then push the wheel or the left button. Selected item is initially shown in reverse video and changes to normal video and circumscribed when the wheel or the left button is pushed.
5. Roll the wheel to choose option desired and then push the wheel or the left button. Selected option is initially shown in reverse video and changes to normal video and circumscribed when the wheel or the left button is pushed.
6. Push the right button to close the menu. (On some menus several presses of the right button are required to close the menu.)

1.6 Cursor Menu

Functions which require the use of the cursor, such as EBL offset and zoom, may be activated directly from the guidance box or from the CURSOR menu, either method with the cursor inside the effective display area. Below is the procedure for choosing a cursor-related function from the CURSOR menu. In later sections only the procedure for selection from the guidance box is given.

1. Roll the trackball to place the cursor inside the effective display area.
2. Roll the wheel to show “TARGET DATA & ACQ / CURSOR MENU” in the guidance box.
3. Push the right button to show the CURSOR menu.



CURSOR menu

4. Roll the wheel to choose “2” and then push the wheel or the left button.
5. Roll the wheel to choose function desired and then push the wheel or the left button.

Note: For operation from the keyboard, you may press the [2] key to choose a function in top-to-bottom order or the [8] key to choose in reverse order.

Cursor Menu item	Description
TARGET DATA & ACQ	ARP: Acquires ARP target; displays data for chosen ARP target. AIS: Activates sleeping AIS target; display data for chosen AIS target.
TARGET CANCEL	ARP: Cancels tracking on chosen ARP target. AIS: Sleeps chosen AIS target.
ACQ	ARP: Acquires chosen echo. AIS: Activates chosen AIS target.
REF MARK	Inscribes reference mark, for target-based speed input.
EBL OFFSET	Offsets EBL, to measure range and bearing between two targets.
OFF CENTER	Shifts screen center to chosen location.
ZOOM	Zooms chosen location.
MARK DELETE	Deletes chosen mark (plotter mark, origin mark or waypoint mark).
CHART ALIGN	Aligns chart with radar picture.

6. The guidance box shows “XX / EXIT.” (XX = function chosen). Roll the trackball to place the cursor where desired.
7. Push the left button to execute the function selected at step 5.
8. To quit the function selected, push the right button when the guidance box shows “XX / EXIT.” (XX = function chosen at step 5)

1.7 Monitor Brilliance

The brilliance of the entire screen should be adjusted according to lighting conditions. Monitor brilliance should be adjusted before adjusting relative brilliance levels on the BRILL menu to be explained later.

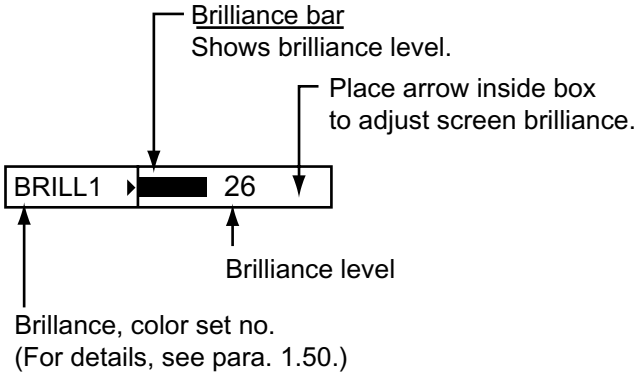
Note: The brilliance of a commercial monitor cannot be adjusted from the radar. See the owner’s manual of the commercial monitor for how to adjust its brilliance.

By keyboard

Operate the [BRILL] control on the control unit to adjust brilliance. Turn it clockwise to increase brilliance; counterclockwise to decrease brilliance. Watch the BRILL box (see illustration below) to know current brilliance level.

By trackball

1. Roll the trackball to place the arrow on the brilliance level indicator in the brilliance level indication box at the bottom left corner of the screen.



Brilliance level indicator

2. Roll the wheel downward to increase brilliance or roll it upward to decrease brilliance. The length of the brilliance bar increases or decreases with operation of the wheel.

Note: If nothing appears on the screen at power-up when using Control Unit RCU-015 (palm control) or when the radar is in stand-by, press and hold down any key except the power switch for four seconds to automatically set up for medium display brilliance.

1.8 Choosing the Display Mode

This radar has two display modes: Radar and Radar + Plotter. Choose a display mode as below. Note that a display mode cannot be chosen when the menu is open.

1. Roll the trackball to place the arrow in the DISPLAY MODE box at the top of the screen.



* XX = display mode
(RADAR, +PLOTTER)

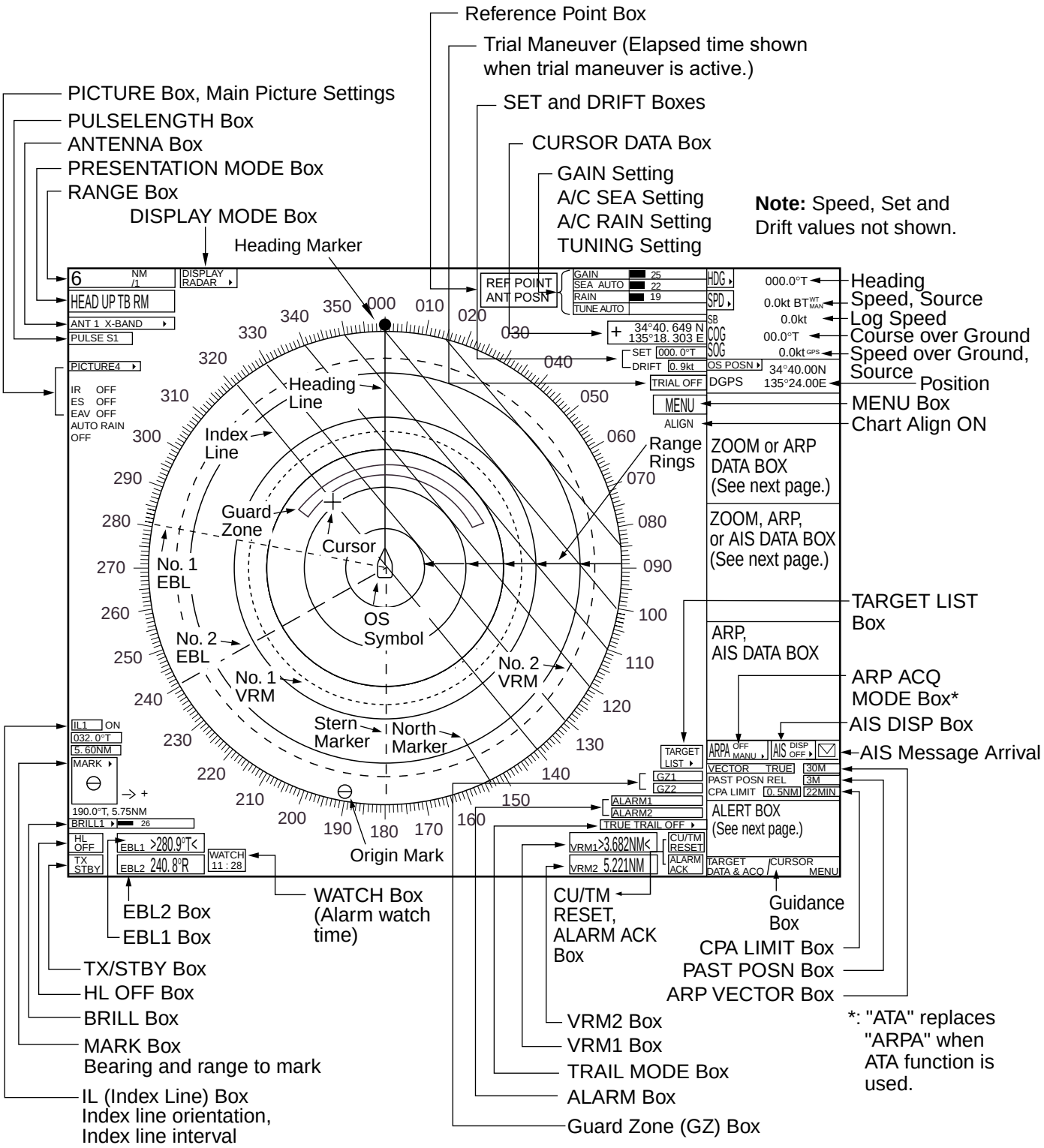
DISPLAY MODE box

2. Push the left button to choose appropriate mode:

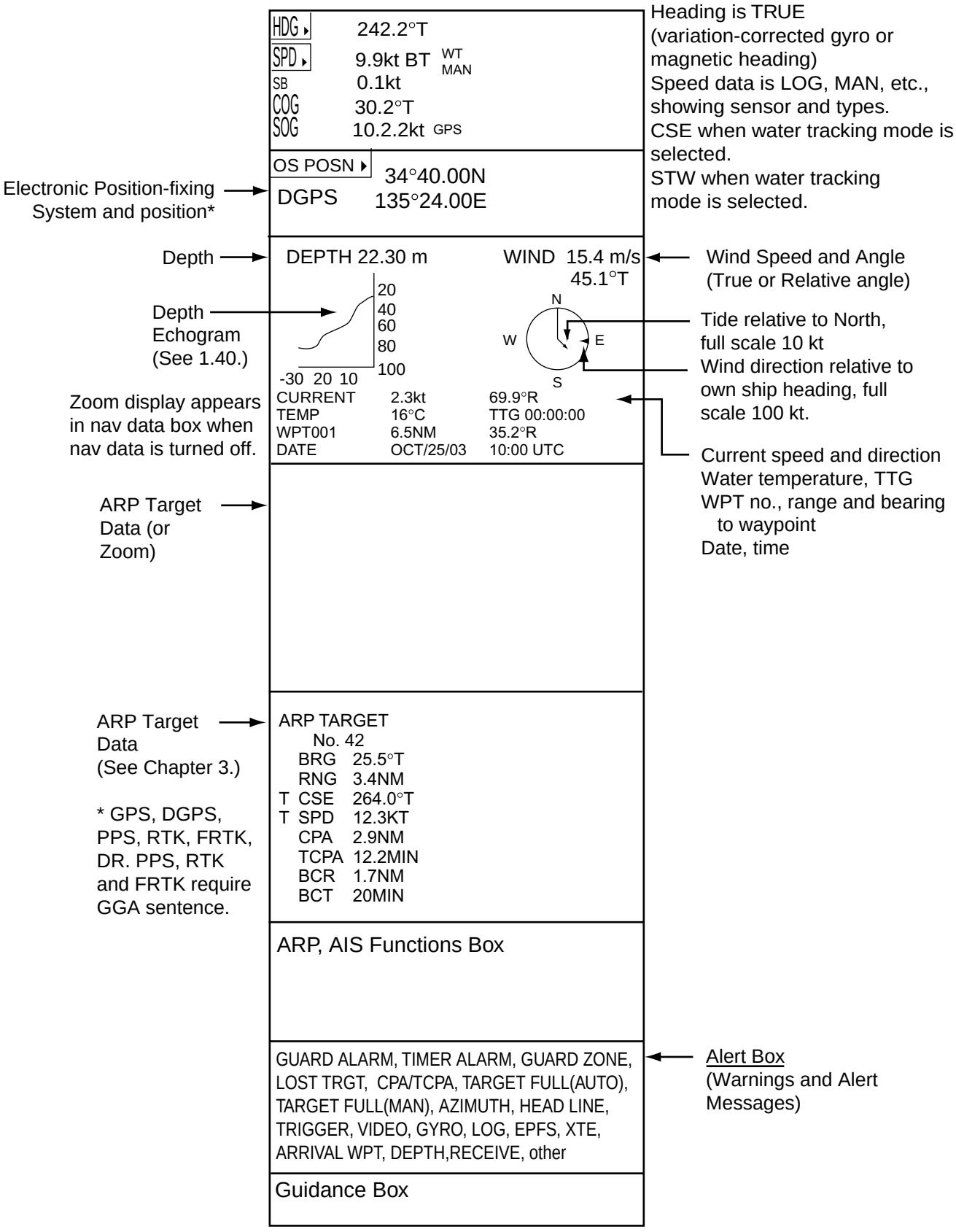
   RADAR: Radar picture

   +PLOTTER: Radar picture + plotter picture (incl. chart)

1.9 On-Screen Boxes and Markers



Display screen


HDG 242.2°T
SPD 9.9kt BT WT MAN
SB 0.1kt
COG 30.2°T
SOG 10.2.2kt GPS
OS POSN
34°40.00N
DGPS 135°24.00E
DEPTH 22.30 m
WIND 15.4 m/s
45.1°T
20
40
60
80
100
-30 20 10
N
W
E
S
CURRENT 2.3kt 69.9°R
TEMP 16°C TTG 00:00:00
WPT001 6.5NM 35.2°R
DATE OCT/25/03 10:00 UTC
ARP TARGET
No. 42
BRG 25.5°T
RNG 3.4NM
T CSE 264.0°T
T SPD 12.3KT
CPA 2.9NM
TCPA 12.2MIN
BCR 1.7NM
BCT 20MIN
ARP, AIS Functions Box
GUARD ALARM, TIMER ALARM, GUARD ZONE, LOST TRGT, CPA/TCPA, TARGET FULL(AUTO), TARGET FULL(MAN), AZIMUTH, HEAD LINE, TRIGGER, VIDEO, GYRO, LOG, EPFS, XTE, ARRIVAL WPT, DEPTH,RECEIVE, other
Guidance Box
Heading is TRUE (variation-corrected gyro or magnetic heading)
Speed data is LOG, MAN, etc., showing sensor and types.
CSE when water tracking mode is selected.
STW when water tracking mode is selected.
Electronic Position-fixing System and position*
Depth
Depth Echogram (See 1.40.)
Zoom display appears in nav data box when nav data is turned off.
ARP Target Data (or Zoom)
Wind Speed and Angle (True or Relative angle)
Tide relative to North, full scale 10 kt
Wind direction relative to own ship heading, full scale 100 kt.
Current speed and direction
Water temperature, TTG
WPT no., range and bearing to waypoint
Date, time
ARP Target Data (See Chapter 3.)
* GPS, DGPS, PPS, RTK, FRTK, DR. PPS, RTK and FRTK require GGA sentence.
Alert Box (Warnings and Alert Messages)

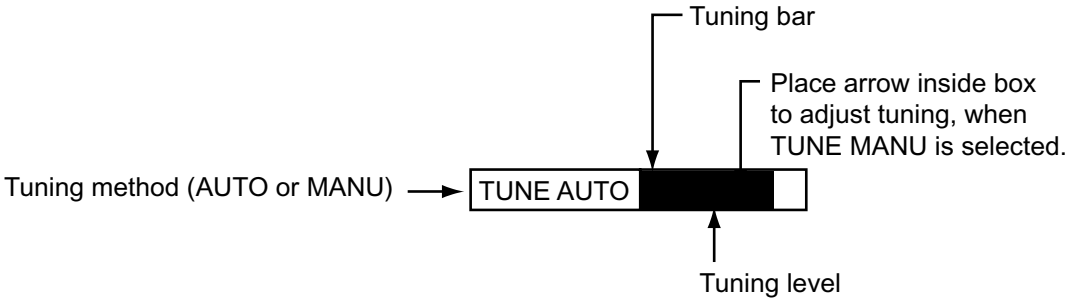
Data fields

1.10 Tuning the Receiver

1.10.1 Choosing the tuning method

The tuning method can be selected with the TUNE box at the top of the screen.

1. Roll the trackball to choose the TUNE box (TUNE AUTO or TUNE MAN) at the top of the screen.



TUNE box

2. Push the left button or roll the wheel to display TUNE AUTO or TUNE MAN as appropriate.
3. If you used the wheel to choose tuning method, push the wheel or the left button to change setting.

1.10.2 Initializing tuning

Automatic tuning is initialized during the installation. However, if you feel that automatic tuning is not working properly try re-initializing it as follows:

1. Roll the trackball to choose the MENU box at the right side of the screen and then push the wheel or the left button.
2. Roll the wheel to choose 1 ECHO and then push the wheel or the left button.

[ECHO]

1 BACK
2 2ND ECHO REJ
OFF/ON
3 TUNE INITIALIZE
4 PM
OFF/ON
5 SART
OFF/ON
6 WIPER
OFF/1/2

ECHO menu

3. Roll the wheel to choose 3 TUNE INITIALIZE.
4. Push the wheel or the left button to initialize automatic tuning. (For operation from the keyboard, press the [ENTER MARK] key.) "WORK IN PROGRESS – TUNE INITIALIZE appears in the Alert Box during the initialization.
5. Push the right button twice to close the menu.

1.10.3 Automatic tuning

Choose automatic tuning following paragraph 1.10.1. The TUNE box shows TUNE AUTO.

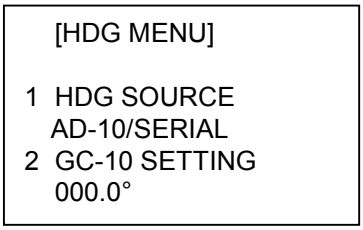
1.10.4 Manual tuning

1. Roll the trackball to choose the RANGE box at top left corner and then push the left or right button as appropriate to choose the 48-mile range. Push the left button to lower the range; the right button to raise the range.
2. Choose manual tuning following the procedure in paragraph 1.10.1.
3. Roll the trackball to place the arrow on the tuning bar area in the TUNE box.
4. Roll the wheel to adjust tuning. The best tuning point is where the bar graph swings maximum. The arrow below the bar graph shows tuning control position; not the tuning condition.

1.11 Aligning Heading with Gyrocompass

With connection of a gyrocompass, ship's heading is displayed at the right side of the screen. Upon turning on the radar, align the on-screen GYRO readout with the gyrocompass reading by following the procedure shown below. Once you have set the initial heading correctly, resetting is not usually required. However, if the GYRO readout looks wrong or the gyro alarm sounds, follow the procedure below. Note that the FURUNO SC-60/120 does not require alignment on the radar.

1. Roll the trackball to place the arrow in the HDG box at the top right corner of the screen.
2. Push the right button to open the HDG menu.



HDG menu

3. Roll the wheel downward to choose GC-10 SETTING and then push the wheel or the left button.

   Note: If heading source selected is not suitable change it at 1 HDG SOURCE to match your heading source.
4. Roll the wheel to set the heading. (For entry through the keyboard use the numeric keys.)
5. Push the wheel to finish.
6. Push the right button to close the menu.

1.12 Presentation Modes

This radar has the following presentation modes:

Relative Motion (RM)

Head-up: Unstabilized
Head-up TB: Head-up with compass-stabilized bearing scale (True Bearing) where the bearing scale rotates with the compass reading.
Course-up: Compass-stabilized relative to ship's orientation at the time of selecting course-up.
North-up: Compass-stabilized with reference to north

True Motion (TM)

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

1.12.1 Choosing presentation mode

By keyboard

Press the [MODE] key consecutively to choose presentation mode desired. The PRESENTATION MODE box shows the current presentation mode. (See the illustration below.)

By trackball

1. Roll the trackball to place the arrow in the PRESENTATION MODE box at the top left corner of the screen.

HEAD UP RM*

* = Other modes:
HEAD UP TB RM, COURSE UP RM,
NORTH UP RM, NORTH UP TM

PRESENTATION MODE box

2. Push the left button to choose mode desired.

Loss of gyrocompass signal
When the compass signal is lost, "HEADING SET" appears in red at the gyro readout, the presentation mode automatically becomes head-up, all ARP and AIS targets and map or chart are erased. After restoring the compass signal, choose the presentation mode with the [MODE] key or the PRESENTATION MODE box.

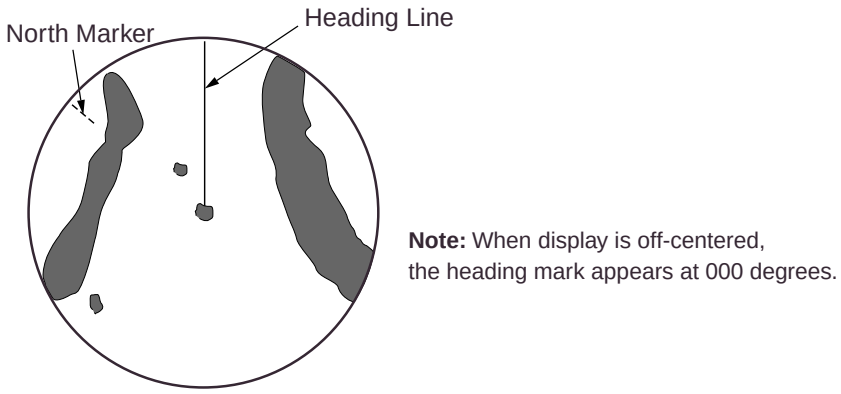
1.12.2 Description of presentation modes

Head-up mode

The head-up mode is a display in which the line connecting own ship and the top of the display indicates own ship's heading.

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

A short line on the bearing scale is the north marker indicating heading sensor north. A failure of the heading sensor input will cause the north marker to disappear and the readout to show ***.*° and the message HDG SIG MISSING appears in red at the lower-right corner of the screen.

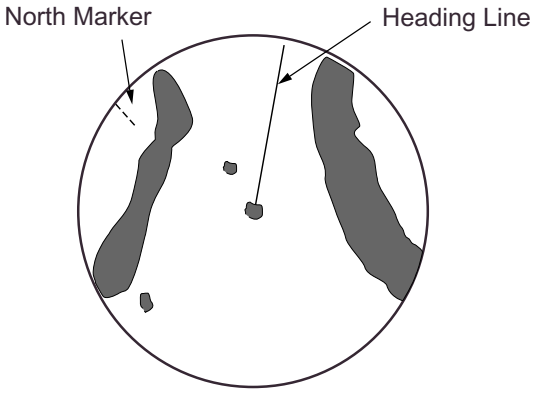


Head-up mode

Course-up mode

The course-up mode is 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. The heading line moves in accordance with ship's yawing and course change. This mode is useful to avoid smearing of picture during course change.



Course-up mode

Head-up TB (True Bearing) mode

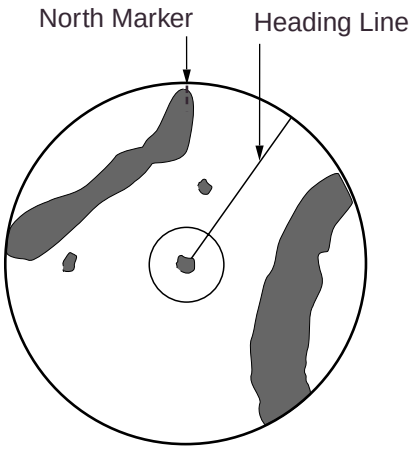
Radar echoes are shown in the same way as in the head-up mode. The difference from normal head-up presentation lies in the orientation of the bearing scale. The bearing scale is heading sensor stabilized. That is, it rotates in accordance with the heading sensor signal, enabling you to know own ship's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

This mode is available when the radar is interfaced with a gyro heading sensor. If the gyro heading sensor fails, the bearing scale returns to the state of head-up mode.

North-up mode

The north-up mode paints target pips at their measured distances and in their true (heading sensor) directions from own ship, north bearing maintained at the top of the screen. The heading line changes its direction according to the ship's heading. Requires heading signal.

If the compass fails, the presentation mode changes to head-up and the north marker disappears. Also, the HDG indication shows ***.*°. And the message HDG SIG MISSING appears in red at the lower-right corner of the screen.



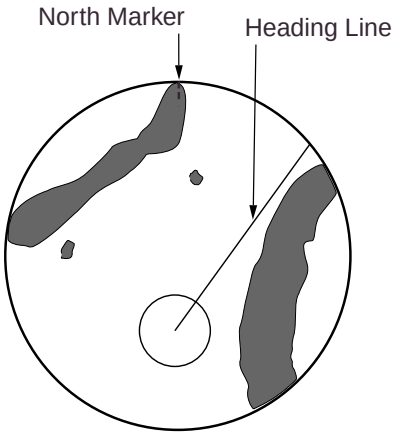
North-up mode

True motion mode

Own ship and other moving objects move in accordance with their true courses and speed. In ground stabilized TM, all fixed targets, such as landmasses, appear as stationary echoes. In the sea stabilized TM without set and drift inputs, the landmass can move on the screen. Note that true motion is not available on the 72 nm (non-IMO type only) or 96 nm range scale. If COG and SOG (both over the ground) are not available on TM mode, enter the set (tide direction) and drift (tide speed) manually referring to the Tide Table.

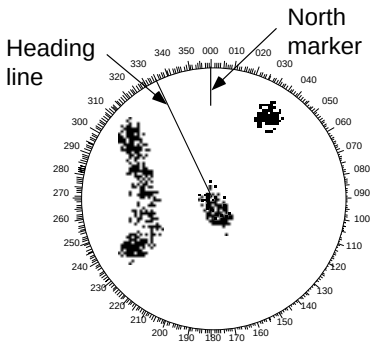
When own ship reaches a point corresponding to 50% of the radius of the display, own ship position is automatically reset to a point of 75% radius opposite to the extension of the heading line passing through the display center. You may also reset the own ship symbol manually by pressing the [CU/TM RESET] key, or roll the trackball to choose the CU/TM RESET box at the bottom right corner of the display and then push the left button.

If the heading sensor fails, the mode is changed to the head-up and the north marker disappears. The HDG readout shows ***.*° and the message HDG SIG MISSING appears in red at the lower-right corner of the screen.

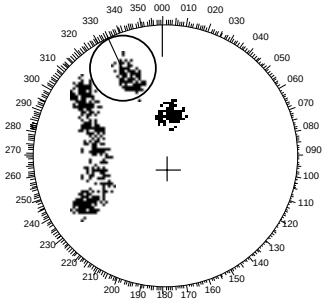


True motion mode

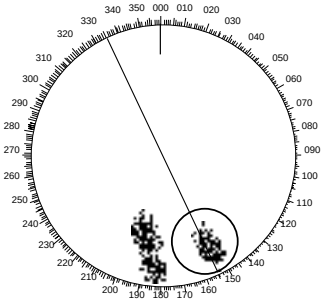
Automatic resetting of own ship mark in true motion mode



(a) True motion is selected



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



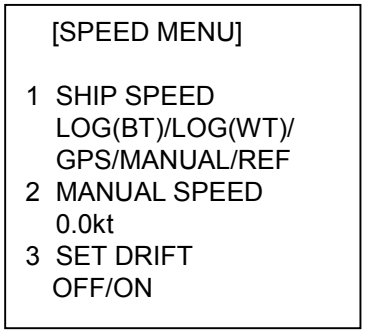
(c) Own ship is automatically reset to 75% of radius

1.13 Entering Own Ship's Speed

The ARP and azimuth stabilized presentation modes require own ship speed input and compass signal. The speed can be entered from a log (STW) or GPS (SOG) or manually on the menu. Note that FURUNO GPS Navigator GP-90 provides COG and SOG.

1.13.1 Automatic speed input by log or GPS navigator

1. Roll the trackball to place the arrow in the SPD box at the top right corner of the screen.
2. Push the right button to display the SPEED menu.



SPEED menu

3. Roll the wheel to choose 1 SHIP SPEED and then push the wheel or the left button.
4. Roll the wheel to choose the appropriate source for automatic speed input and then push the wheel or the left button.
   LOG (BT): Log, speed over ground (SOG). Note that a log cannot produce BT (Bottom Tracking) speed in deep waters without set and drift entry.
   LOG (WT): Log, speed thru water (STW)
   GPS: Speed input by GPS navigator
5. Push the right button to close the menu.

Notes on speed input

- 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 (forward speed).
- Be sure not to choose a LOG option 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, enter speed manually.
- Warning label SPD **.* and LOG appear if no log signal is present for 30 s while the ship's speed has been more than 5 kt.
- With the serial speed inputs and SOG selection, if the type of data is changed from SOG to STW the label SOG appears in red (at the upper right corner of the display).
- When the AIS feature is active, MANUAL and REF are shown in gray to indicate they are not available for selection.

1.13.2 Manual speed input

If the speed log is not working, enter speed manually as below. In this case the speed data type is shown as MANUAL and is speed thru water (STW). Manual speed input is not available when the AIS feature is active.

1. Roll the trackball to place the arrow in the SPD box at the top right corner of the screen.
2. Push the right button to display the SPEED menu.
3. Roll the wheel to choose 1 SHIP SPEED and then push the wheel or the left button.
4. Roll the wheel to choose MANUAL and then push the wheel or the left button.
5. Roll the wheel to choose 2 MANUAL SPEED and then push the wheel or the left button.
6. Roll the wheel to set speed. (For entry through the keyboard, use the numeric keys.)
7. Push the wheel to finish.
8. Push the right button to close the menu.

1.14 Choosing the Range Scale

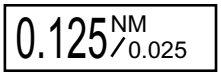
The selected range scale, range ring interval and pulselength are shown at the upper left corner on the screen. When a target of interest comes closer, reduce the range scale so that it appears in 50-90% of the display radius.

By keyboard

Use the [RANGE] key to choose range desired. Hit the “+” part of the key to raise the range; the “-“ part to lower the range.

By trackball

1. Roll the trackball to choose the RANGE box at the top left corner of the screen. The guidance box shows “RANGE DOWN / RANGE UP.”



RANGE box

2. Push the left button to lower the range; the right button to raise the range. You may also choose the range by rolling the wheel and then pushing it or the left button.

1.15 Choosing the Pulselength

The pulselength in use is displayed at the upper-left position of the screen using the indications shown in the table below.

Label and pulselength

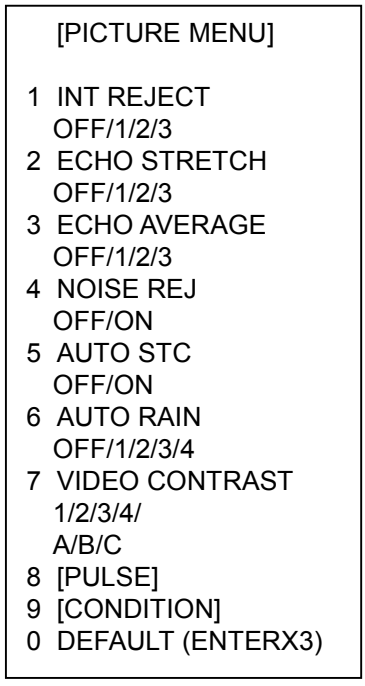
Indication	Pulselength (µs)
S1 (Short pulse 1)	0.07
S2 (Short pulse 2)	0.15
M1 (Medium pulse 1)	0.3
M2 (Medium pulse 2)	0.5
M3 (Medium pulse 3)	0.7
L (Long pulse)	1.2

Appropriate pulselengths are preset to individual range scales and function keys. If you are not satisfied with the current pulselength settings, you may change them as shown below.

1.15.1 Choosing pulselength

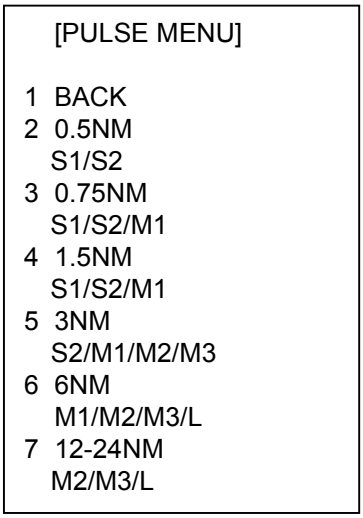
You can choose the pulselength for the 0.5 to 24 nm range scales as below.

1. Roll the trackball to choose the PICTURE box at the left side of the screen.
   Note: The PICTURE box sets up the radar picture according to expected usage, such as harbor navigation, long range, short range, etc. For further details see paragraph 1.33.
2. Push the right button to show the PICTURE menu.



PICTURE menu

3. Roll the wheel to choose 8 [PULSE] and then push the wheel.

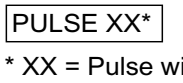


PULSE menu

4. Roll the wheel to choose a range and then push the wheel or the left button.
5. Roll the wheel to choose pulselength desired and then push the wheel or the left button.
6. Push the right button twice to close the menu.

1.15.2 Choosing pulselength

1. Roll the trackball to choose the PULSELENGTH box at the left side of the screen. The guidance box shows “PULSE NARROW / PULSE WIDE.”



* XX = Pulse width setting

PULSELENGTH box

2. Push the left button to shorten the pulselength or the right button to widen the pulselength. You may also choose the pulselength by rolling the wheel and pushing it or the left button.

1.16 Adjusting the Sensitivity

The gain control adjusts the sensitivity of the receiver.

The proper setting is such that the background noise is just visible on the screen. If you set up for too little sensitivity, weak echoes may be missed. On the other hand excessive sensitivity yields too much background noise; strong targets may be missed because of the poor contrast between desired echoes and the background noise on the display.

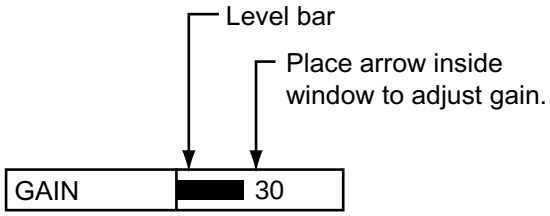
To adjust receiver sensitivity, adjust the gain control so background noise is just visible on the screen.

By keyboard

While monitoring the gain level indicator at the top of the screen, operate the [GAIN] control to adjust the sensitivity.

By trackball

1. Roll the trackball to place the arrow on the gain level indicator at the top of the screen.



GAIN level indicator

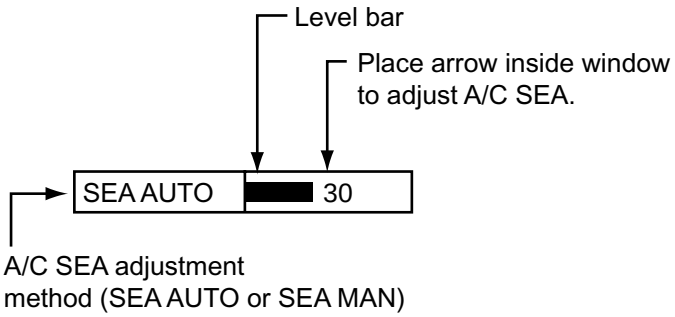
2. Roll the wheel downward to increase the gain or upward to decrease it. 100 levels (0-100) are available.

1.17 Suppressing Sea Clutter

Echoes from waves cover the central part of the display with random signals known as sea clutter. The higher the waves, and the higher the antenna above the water, the further the clutter will extend. When sea clutter masks the picture, suppress it by the A/C SEA control, either manually or automatically.

1.17.1 Choosing method of adjustment

1. Roll the trackball to choose SEA AUTO or SEA MAN (whichever is shown) at the top of the display.



A/C SEA level indicator

2. Push the left button to display SEA AUTO or SEA MAN as appropriate.

1.17.2 Automatic adjustment by the A/C SEA control

Auto A/C SEA allows for fine tuning of the A/C SEA circuit, within ±20 dB. Accordingly, with the bar reading set to 100, gain is not lowered to minimum as with manual A/C SEA on close-in ranges. Further, the auto A/C SEA level is low because the average value of the original input echo is low in areas where there are no sea surface reflections. For example, when the ship is alongside a quay and the radar picture shows echoes from both land and sea, you can observe the size of echoes because the STC curve is different depending size of echoes.

Note: The auto A/C function can erase weak target echoes. Adjust the control carefully, watching the display.

By keyboard

1. Choose SEA AUTO following the procedure in paragraph 1.17.1.
2. While observing the A/C SEA level indicator, adjust the A/C SEA with the [A/C SEA] control. 100 levels are available.

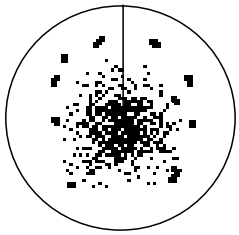
By trackball

1. Choose SEA AUTO following the procedure in paragraph 1.17.1.
2. Roll the trackball to place the arrow in the A/C SEA level indicator at the top of the display.
3. While observing the A/C SEA level indicator, roll the wheel downward to increase the A/C SEA or upward to decrease it. 100 levels (0-100) are available.

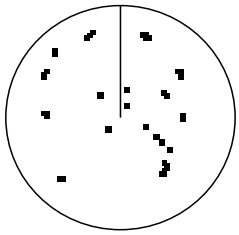
1.17.3 Manual adjustment of A/C SEA

The A/C SEA control reduces the amplification of echoes at short ranges (where clutter is the greatest) and progressively increases amplification as the range increases, so amplification will be normal at those ranges where there is no sea clutter.

The proper setting of the A/C SEA should be such that the clutter is broken up into small dots, and small targets become distinguishable. If the setting is set too low, targets will be hidden in the clutter, while if the setting is too high, both sea clutter and targets will disappear from the display. In most cases adjust the control until clutter has disappeared to leeward, but a little is still visible windward.



Sea clutter at screen center



A/C SEA adjusted; sea clutter suppressed

By keyboard

1. Choose SEA MAN following the procedure in paragraph 1.17.1.
2. Watching the A/C SEA level indicator at the top of the display, adjust the A/C SEA with the [A/C SEA] control. 100 levels (0-100) are available.

By trackball

1. Choose SEA MAN following the procedure in paragraph 1.17.1.
2. Roll the trackball to place the arrow on the A/C SEA level indicator at the top of the display.
3. While observing the A/C SEA level indicator, roll the wheel downward to increase the A/C SEA or upward to decrease it. 100 levels (0-100) are available.

1.18 Suppressing Rain Clutter

Use the AUTO RAIN and A/C RAIN to suppress rain clutter. AUTO RAIN suppresses rain clutter in the picture and A/C RAIN suppresses clutter picked up by the antenna.

1.18.1 Turning AUTO RAIN on or off

1. Roll the trackball to choose the PICTURE box at the left side of the screen.
2. Push the right button to show the PICTURE menu.

[PICTURE MENU]

1 INT REJECT
OFF/1/2/3
2 ECHO STRETCH
OFF/1/2/3
3 ECHO AVERAGE
OFF/1/2/3
4 NOISE REJ
OFF/ON
5 AUTO STC
OFF/ON
6 AUTO RAIN
OFF/1/2/3/4
7 VIDEO CONTRAST
1/2/3/4/
A/B/C
8 [PULSE]
9 [CONDITION]
0 DEFAULT (ENTERX3)

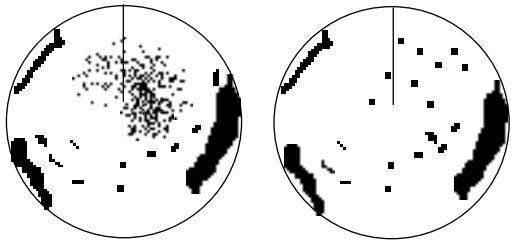
PICTURE menu

3. Roll the wheel to choose 6 AUTO RAIN and then push the wheel.
4. Roll the wheel to choose AUTO RAIN setting desired. The higher the number the greater the degree of rain clutter suppression. OFF turns off the AUTO RAIN feature.
5. Push the right button to close the menu.

1.18.2 Adjusting A/C RAIN

The vertical beam width of the antenna is designed to see surface targets even when the ship is rolling. However, by this design the unit will also detect rain clutter (rain, snow, or hail) in the same manner as normal targets.

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). The higher the setting the greater the anti-clutter effect. When echoes from precipitation mask solid targets, adjust the A/C RAIN control to split up these unwanted echoes into a speckled pattern, making recognition of solid targets easier.



A/C RAIN control OFF

A/C RAIN control adjusted

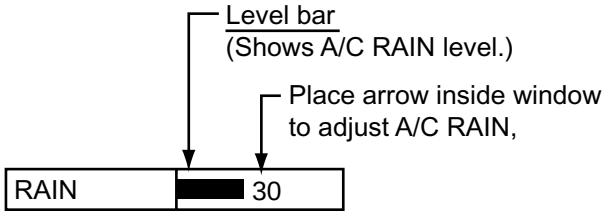
Appearance of rain clutter

Keyboard

Adjust the A/C RAIN with the [A/C RAIN] control.

Trackball

1. Roll the trackball to place the cursor in the A/C RAIN level indicator at the top right side of the display.



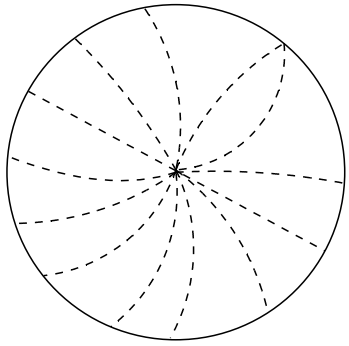
A/C RAIN level indicator

2. While observing the A/C RAIN level indicator, roll the wheel downward to increase the A/C RAIN or upward to decrease it. 100 levels (0-100) are available.

1.19 Interference Rejector

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

The interference rejector is a kind of signal correlation circuit. It compares the received signals over successive transmissions and suppresses randomly occurring signals. There are three levels of interference rejection depending on the number of transmissions that are correlated.



Interference

3. Roll the trackball to choose the PICTURE box at the left side of the screen.
4. Push the right button to show the PICTURE menu.

[PICTURE MENU]

1 INT REJECT
OFF/1/2/3
2 ECHO STRETCH
OFF/1/2/3
3 ECHO AVERAGE
OFF/1/2/3
4 NOISE REJ
OFF/ON
5 AUTO STC
OFF/ON
6 AUTO RAIN
OFF/1/2/3/4
7 VIDEO CONTRAST
1/2/3/4/
A/B/C
8 [PULSE]
9 [CONDITION]
0 DEFAULT (ENTERX3)

PICTURE menu

3. Roll the wheel to choose 1 INT REJECT and then push the wheel.
4. Roll the wheel to choose rejection level desired and then push the wheel or the left button. “3” provides the highest degree of suppression.
5. Push the right button to close the menu.

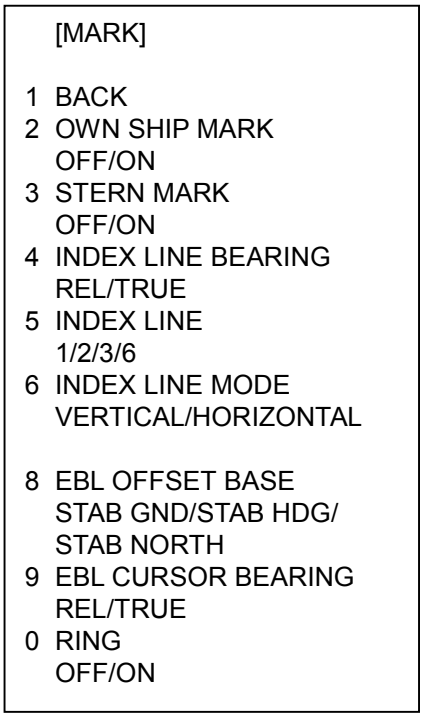
1.20 Measuring the Range

The range to a target may be measured three ways: with the fixed range rings, with the cursor, or with the VRM.

Use the fixed range rings to obtain a rough estimate of the range to a target. They are the concentric solid circles about own ship, or the sweep origin. The number of rings is automatically determined by the selected range scale and their interval is displayed at the upper-left position of the screen. Count the number of rings between the center of the display and the target. Check the range ring interval and judge the distance of the echo from the inner edge of the nearest ring.

1.20.1 Turning range rings on/off

1. Roll the trackball to choose the MENU box at the right side of the screen. The guidance box at the bottom right corner (see the illustration at the bottom of the next page for location) now reads “DISP MAIN MENU.”
2. Push the left button to display the MAIN menu.
3. Roll the wheel to choose 2 [MARK] and then push the wheel or the left button.

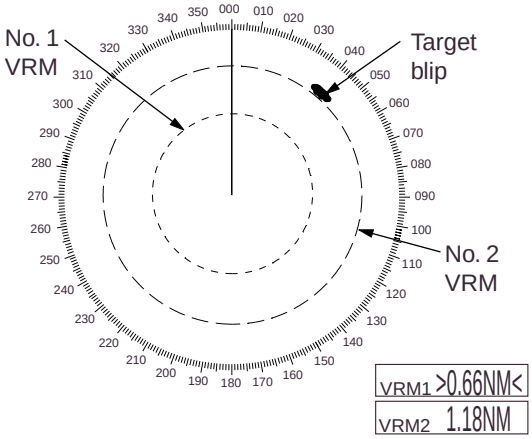


MARK menu

4. Roll the wheel to choose 0 RING and then push the wheel or the left button.
5. Roll the wheel to choose OFF or ON as appropriate and then push the wheel or the left button.
6. Push the right button twice to close the menu.

1.20.2 Measuring range by the variable range marker (VRM)

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.



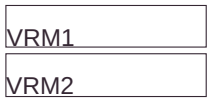
Measuring range with VRMs

By keyboard

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

By trackball

1. Roll the trackball to place the arrow in the VRM1 or VRM2 box, whichever VRM you want to use.



VRM boxes

2. The guidance box reads “VRM ON/.” Push the left button to turn on the VRM. The guidance box now reads “VRM SET L = DELETE /.”
3. Push the left button again and the cursor jumps to inside the effective display area. The guidance box now reads “VRM FIX / EXIT.”

4. Roll the trackball (coarse adjustment) or wheel (fine adjustment) to align the active variable range marker with the inner edge of the target of interest and read its distance at the lower-right corner of the screen. Each VRM remains at the same geographical distance when you operate the [RANGE] key. This means that the apparent radius of the VRM ring changes in proportion to the selected range scale.
5. Push the left button to anchor the VRM and fix its readout, or push the right button to return the VRM to its previous location (range).
6. To erase a VRM, choose the appropriate VRM readout box and then push the left button until the VRM disappears from the screen.

1.21 Measuring the Bearing

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

1.21.1 Measuring the bearing

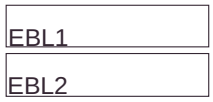
By keyboard

1. Press the [EBL ON] key to display either of the EBLs. Successive presses of the [EBL ON] key toggle the active EBL between No. 1 and No. 2. The currently active marker is enclosed with >.....<.
2. Operate 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.

   Note: 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.
3. Press the [EBL OFF] key to erase each EBL.

By trackball

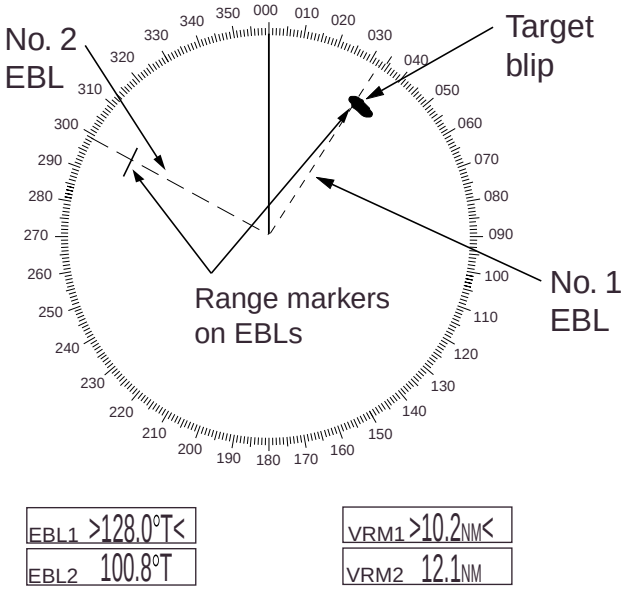
1. Roll the trackball to place the arrow in the EBL1 or EBL2 box, whichever EBL you want to use.



EBL boxes

2. The guidance box reads “EBL ON/.” Push the left button to turn on the EBL. The guidance box now reads “EBL SET L=DELETE /.”
3. Push the left button again and the cursor jumps to inside the effective display area. The guidance box now reads “EBL FIX L=DELETE/.”
4. Roll the trackball (coarse adjustment) or wheel (fine adjustment) to bisect the target with the EBL.

   Note: 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.
5. Push the left button to anchor the EBL and fix its readout, or push the right button to return the EBL to its previous location (bearing).
6. To erase an EBL, choose the appropriate EBL readout box and then push the left button until the EBL disappears from the screen.



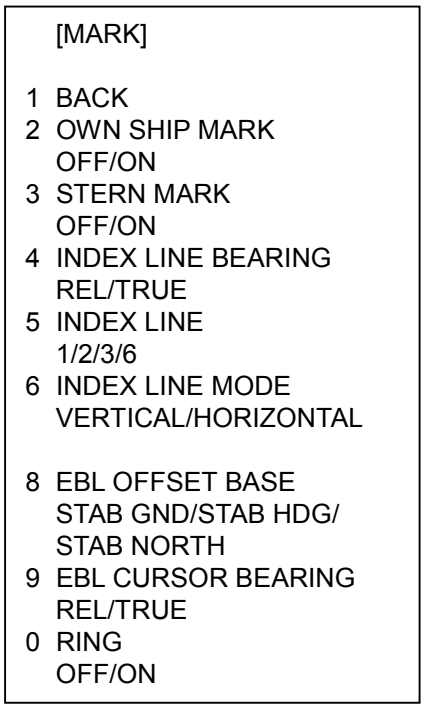
Measuring bearing with EBLs

1.21.2 Choosing true or relative bearing

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. You may choose relative or true in the head-up modes; in all other modes it is always TRUE.

To choose bearing reference in the head-up mode, do the following:

1. Roll the trackball to choose the MENU box and then push the left button to open the MAIN menu.
2. Roll the wheel to choose 2 MARK and then push the wheel or the left button to open the MARK menu.



MARK menu

3. Roll the wheel to choose 9 EBL CURSOR BEARING and then push the wheel or the left button.
4. Roll the wheel to choose REL or TRUE as appropriate and then push the wheel or the left button.
5. Push the right button twice to close the menu.

Note: When the gyrocompass heading changes, the EBL and its indication change as follows:
Head-up, relative: EBL indication and EBL remain unchanged.
Head-up, true: EBL indication remains the same; EBL moves.
Course-up, true: EBL indication and EBL remain unchanged.
North-up, true: EBL indication and EBL remain unchanged.

1.22 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. It is 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.

1.22.1 How to assess risk of collision by the offset EBL

By keyboard

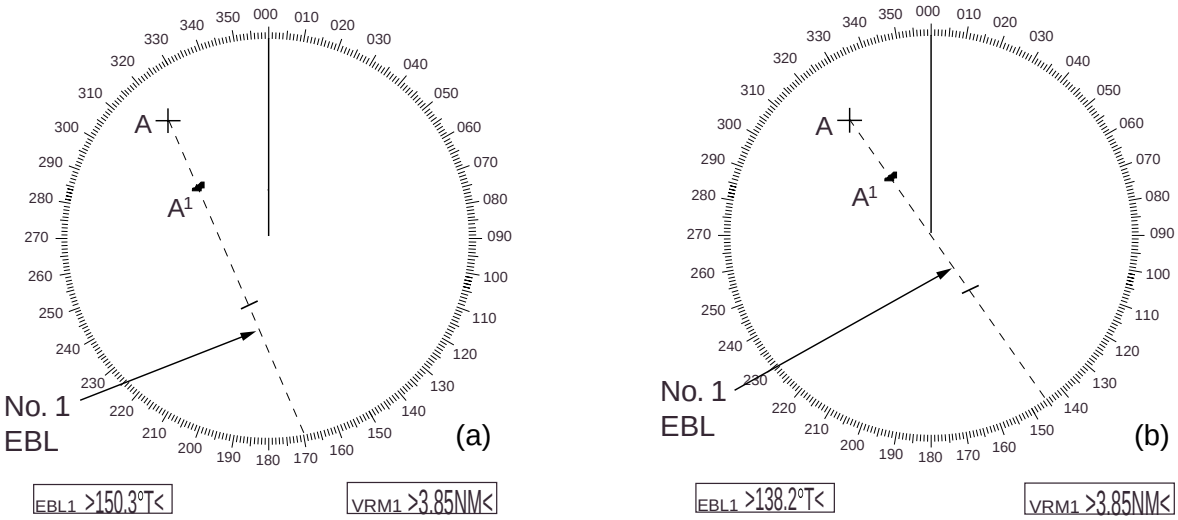
1. Press the [EBL ON] key to display or activate an EBL (No. 1 or No. 2).
2. Place the cursor (+) on a target appearing as threatening (A in the illustrated example on the next page) by operating the trackball.
3. Press the [EBL OFFSET] key, and the origin of the active EBL shifts to the cursor position. 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 rotary 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 EBL bearing reference setting.

   Note: If relative motion is selected, it is also possible to read CPA by using a VRM as shown in left-hand figure at the top of the next page. If the EBL passes through the sweep origin (own ship) as illustrated in the right-hand figure at the top of then next page, 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 twice.

By trackball

1. Display an EBL, following steps 1-3 in “By trackball” in paragraph 1.21.1.
2. With the cursor inside the effective display area, push the left button, roll the wheel to show “EBL OFFSET / EXIT” in the guidance box and then push the left button.
3. Roll the trackball to place the offset EBL on a target appearing as threatening (A in the illustrated example on the next page) and then push the left button to anchor the EBL origin.
4. After waiting for a few minutes (at least 3 minutes), operate the EBL used in step 1 until it 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 EBL bearing reference setting.

To return the EBL origin to the screen center, show “EBL OFFSET / EXIT” in the guidance window and then push the left button.



Collision assessment by offset EBL

1.22.2 Choosing point of reference for origin point of offset EBL

The origin point of the offset EBL can be ground stabilized (geographically fixed) or referenced to own ship's heading (relative).

1. Roll the trackball to choose the MENU box and then push the left button.
2. Roll the wheel to choose 2 MARK and then push the wheel or the left button to display the MARK menu.

[MARK]

1 BACK
2 OWN SHIP MARK
OFF/ON
3 STERN MARK
OFF/ON
4 INDEX LINE BEARING
REL/TRUE
5 INDEX LINE
1/2/3/6
6 INDEX LINE MODE
VERTICAL/HORIZONTAL

8 EBL OFFSET BASE
STAB GND/STAB HDG/
STAB NORTH
9 EBL CURSOR BEARING
REL/TRUE
0 RING
OFF/ON

MARK menu

3. Roll the wheel to choose 8 EBL OFFSET BASE and then push the wheel or the left button.
4. Roll the wheel to choose STAB GND, STAB HDG or STAB NORTH as appropriate and then push the wheel or the left button.
5. Push the right button twice to close the menu.

1.23 Measuring Range and Bearing Between Two Targets

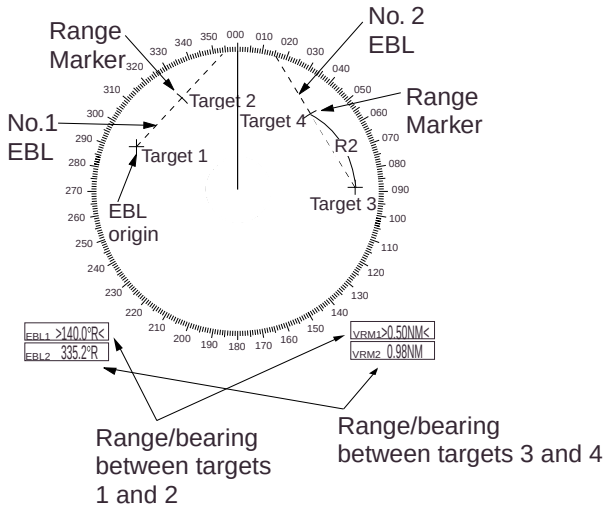
By keyboard

1. Press the [EBL OFFSET] key. Operate the trackball to place the origin of the No. 1 EBL, for example, on a target of interest (target 1 in the illustrated example).
2. Operate the EBL rotary control until the EBL passes through another target of interest (target 2).
3. Operate the VRM rotary control until the range marker on the EBL is on the inside edge of target 2. The active VRM readout at the lower-right corner of the screen indicates the distance between the two targets.
4. You can repeat the same procedure on third and fourth targets (targets 3 and 4) by using the No. 2 EBL and the 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 of EBL CURSOR BEARING in the MARK menu. To return the EBL origin to the screen center, press the [EBL OFFSET] key again.

By trackball

1. Display an EBL, following steps 1-3 in “By trackball” in paragraph 1.21.1.
2. With the cursor inside the effective display area, push the left button, roll the wheel to show “EBL OFFSET / EXIT” in the guidance box and then push the left button.
3. Roll the trackball to place the cursor on target 1 and then push the wheel.
4. Operate the No. 1 VRM until the range marker on the EBL aligns with target 2. The active VRM readout at the lower-right corner of the screen indicates the distance between the two targets.
5. You can repeat the same procedure on third and fourth targets (targets 3 and 4) by using the No. 2 EBL and the No. 2 VRM.



Measuring range and bearing between two targets

To return the EBL origin to the screen center, show “EBL OFFSET / EXIT” in the guidance window and then push the left button.

1.24 Setting a Target Alarm

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

The guard alarm zone has a fixed width of 0.5 nm in the radial direction (depth) and is adjustable from 3.0 to 6.0 nm (guard zone 1) and any distance (guard zone 2). On the Non-IMO radar the boundaries can be set at any distance. On any radar type the sector of the zone can be set from 0 to 360 degrees in any direction.

⚠ CAUTION

- **The alarm should not be relied upon as the sole means for detecting possible collision situations.**
- **A/C SEA, A/C RAIN and GAIN controls should be properly adjusted to be sure the alarm system does not overlook target echoes.**

1.24.1 How to set a target alarm zone

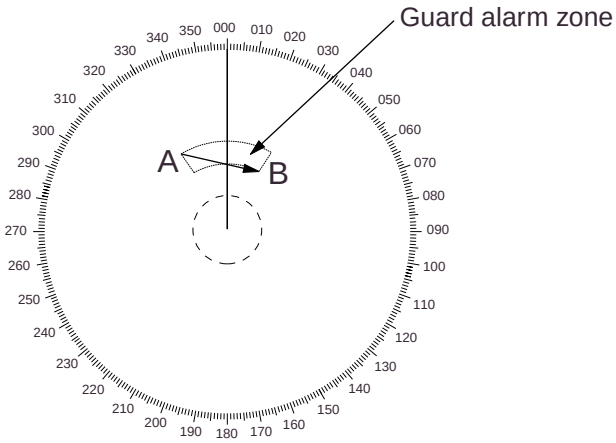
The procedure which follows shows how to set a target alarm zone using the figure below as an example.

1. Roll the trackball to choose the ALARM1 or ALARM2 box, whichever alarm you wish to set.

ALARM 1
ALARM 2

ALARM boxes

2. Push the left button. The cursor jumps into the effective display area and “SET” appears inside the ALARM box chosen.
3. Roll the trackball to place the cursor on point “A” and then push the left button.
4. Roll the trackball to place the cursor on point “B” and then push the left button. “WORK” replaces “SET” in the ALARM box. The guard alarm zone’s lines are dashed and blue.



Target alarm zone

Note 1: If you wish to create a target alarm zone having a 360-degree coverage around own ship, set point “B” in almost the same direction as point “A.”
Note 2: Two target alarm zones may be set. Note however that the 2nd target alarm zone is available only when the 1st target alarm zone is active.
Note 3: When the target alarm zone is not within the range in use the indication UP RNG appears to the right of the ALARM box. In this case choose a range which will display the target alarm zone.

1.24.2 Acknowledging the target alarm

A target in the target alarm zone produces both visual (flashing) and audible (beep) alarms. To silence the audible alarm, press the [ALARM ACK] key on the full keyboard or choose the appropriate ALARM box and then push the left button. The ALARM box shows “ALARMx ACK.” This will deactivate the audible alarm but will not stop the flashing of the offending target. To reactivate the audible alarm, press the [ALARM ACK] key again or choose the ALARM box and then push the left button. (When an external buzzer is connected, the audible alarm does not stop until the alarm zone itself is deactivated.) The ALARM box shows “ALARMx WORK.”

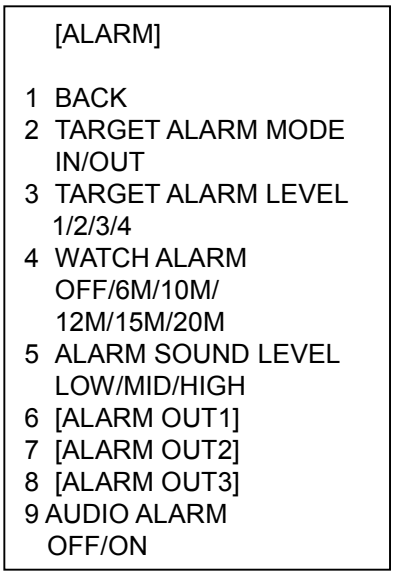
1.24.3 Deactivating a target alarm

1. Roll the trackball to choose the ALARM1 or ALARM2 box, whichever alarm you wish to deactivate.
2. Push the left button until the alarm status in the ALARM box disappears. In the IMO-type radar deactivation of the target alarm zone 1 deactivates target alarm zone 2. Target alarm zones 1 and 2 work independent on the Non-IMO radar.

1.24.4 Target alarm attributes

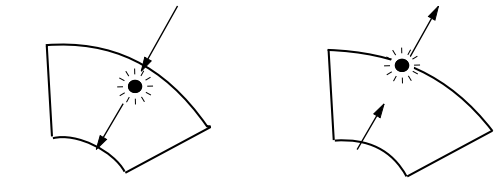
You may choose the echo strength level which triggers the alarm, the condition which generates the target alarm and the volume of the audible alarm as follows:

1. Roll the trackball to choose the MENU box at the right side of the screen and then push the left button.
3. Roll the wheel to choose 3 [ALARM] and then push the wheel or the left button.



ALARM menu

4. Roll the wheel to choose 2 TARGET ALARM MODE and then push the wheel or the left button.
5. Roll the wheel to choose IN (guard zone) or OUT (anchor watch) as appropriate and then push the wheel or the left button.



Alarm types

6. Roll the wheel to choose 3 GUARD ALARM LEVEL and then push the wheel or the left button.
7. Roll the wheel to choose echo strength level which will trigger the alarm and then push the wheel or the left button. “4” is highest strength.
8. Roll the wheel to choose 5 ALARM SOUND LEVEL and then push the wheel or the left button.
9. Roll the wheel to choose audible alarm volume, from among LOW, MID and HIGH, and then push the wheel or the left button.

   Note: 5 ALARM SOUND LEVEL also sets the level of the audible alarm for the watch alarm. 9 AUDIO ALARM enables or disables the audio alarm.

10. Push the right button twice to close the menu.

1.25 Off-Centering the Display

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

This feature is not available on the 72 nm (Non-IMO type only) or 96 nm range scale nor in the true motion mode.

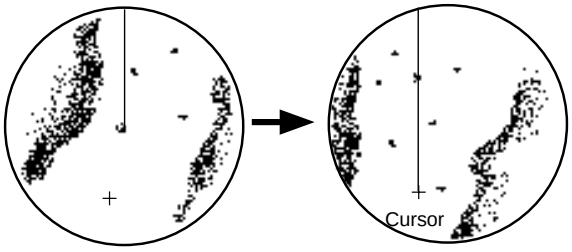
To off-center the radar picture, do the following:

By keyboard

1. Roll the trackball to place the cursor at a position where you wish to move the sweep origin.
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.

By trackball

1. With the cursor inside the effective display area, roll the wheel to display “OFF CENTER / EXIT” in the guidance box and then push the wheel or the left button.
2. Roll the trackball to place the cursor where you want to locate the screen center.
3. Push the left button to off center the sweep origin.
4. To cancel the off-center function, push the left button when the guidance box reads “OFF CENTER / EXIT.”



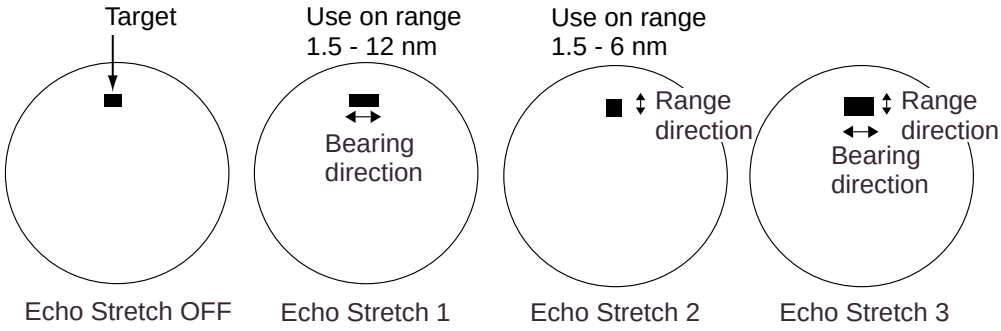
Place cursor where desired and execute appropriate OFF CENTER procedure

Off-centered display

How to off-center the display

1.26 Echo Stretch

The echo stretch feature enlarges targets to make them easier to see, and it is available on the 1.5 -12 nm ranges depending on echo stretch type. There are 3 settings: ES1 to enlarge in bearing direction for long range detection, ES2 to enlarge in range direction and ES3 to enlarge in bearing and range directions.



Echo stretch

Note 1: If the 1.5 nm is preset with a pulselength of S1 or S2, and the 3 nm scale with S2, the echo stretch is not available on those range scales.

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

1. Roll the trackball to choose the PICTURE box at the left side of the display.
2. Push the right button to show the PICTURE menu.

```
[PICTURE MENU]

1  INT REJECT
   OFF/1/2/3
2  ECHO STRETCH
   OFF/1/2/3
3  ECHO AVERAGE
   OFF/1/2/3
4  NOISE REJ
   OFF/ON
5  AUTO STC
   OFF/ON
6  AUTO RAIN
   OFF/1/2/3/4
7  VIDEO CONTRAST
   1/2/3/4/
   A/B/C
8  [PULSE]
9  [CONDITION]
0  DEFAULT (ENTERX3)
```

PICTURE menu

3. Roll the wheel to choose 2 ECHO STRETCH and then push the wheel or the left button.
4. Roll the wheel to choose desired echo stretch and then push the left button.
5. Push the right button to close the menu.

1.27 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, echoes are averaged 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 reduced brilliance, making it easier to discriminate real targets from sea clutter.

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.

Note 1: Do not use the echo average function under heavy pitching and rolling; loss of target detection can result.
Note 2: Echo average can be used without a heading sensor. For further details, contact your dealer.

To properly use the echo average function, it is recommended to first suppress sea clutter with the A/C SEA control. Then, do as follows:

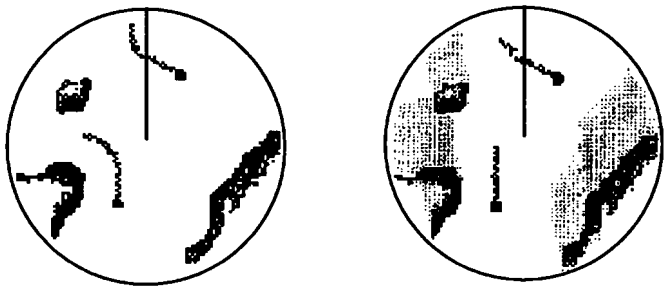
1. Roll the trackball to choose the PICTURE box at the left side of the display.
2. Push the right button to show the PICTURE menu.
3. Roll the wheel to choose 3 ECHO AVERAGE and then push the wheel or the left button.
4. Roll the wheel to choose OFF, 1, 2 or 3 as appropriate and then push the wheel or the left button.
   - OFF: Echo averaging OFF
   - 1: Helps distinguish targets from sea clutter and suppress brilliance of unstable echoes.
   - 2: Distinguishes small stationary targets such as navigation buoys.
   - 3: Stably displays distant target.
5. Push the right button to close the menu.

1.28 Target Trails

The trails of the radar echoes of targets may be displayed in the form of synthetic afterglow. Target trails are chosen either relative or true and may be sea or ground stabilized. True motion trails require a compass signal and own ship speed input.

1.28.1 True or relative trails

You may display echo trails in true or relative motion (only true trail on TM). Relative trails show relative movements between targets and own ship. True motion trails require a 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.



(a) True target trails (No smearing of stationary targets)

(b) Relative target trails Targets moving relative to own ship

Target trails

Note: When true trail is selected on the RM mode, the TRAIL MODE box is shown in red. No true-relative selection on TM; it is only True trails on TM mode.

1. Roll the trackball to place the arrow on the TRAIL MODE box at the bottom right corner of the screen and then push the right button to open the TRAIL menu.

[TRAIL MENU]

1 TRAIL MODE
REL/TRUE/
2 TRAIL GRAD
SINGLE/MULTI
3 NARROW TRAIL*
OFF/ON
4 TRAIL LEVEL
1/2/3/4
5 TRAIL RESTART
OFF/ON
6 TRAIL COPY
OFF/ON
7 OS TRAIL
OFF/ON

*: Non-IMO radar only

TRAIL menu

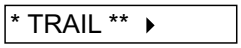
2. Roll the wheel to choose 1 TRAIL MODE and then push the wheel.
3. Roll the wheel to choose TRUE or REL appropriate and then push the wheel or the left button.
4. Push the right button to close the menu.

Note: "TRUE TRAIL" is shown in red when a relative motion presentation mode is used.

1.28.2 Trail time

Trail time, the trail plotting interval, may be chosen as follows:

1. Roll the trackball to place the arrow on the TRAIL MODE box at the bottom right corner of the screen.



* = TRUE or REL
** = Trail time setting

TRAIL MODE box

2. Push the left button to choose plotting interval from among OFF, 15 s, 30 s, 1 min, 3 min, 6 min, 15 min, 30 min or CONT(INUOUS) and then push the wheel. (To choose intervals between 30 s and 30 min, in increments of 30 seconds, roll the wheel.) The longer the trail interval the longer the length of the target trail.
   The maximum time for continuous plotting is 99:59. When the timer counts to 99:59, the timer is reset to zero, all target trails are erased and then trails are restarted.

1.28.3 Trail gradation

- The afterglow can be selected in a single tone or gradual shading.



Trail gradation

1. Roll the trackball to place the arrow on the TRAIL MODE box at the bottom right corner of the screen.
2. Push the right button to display the TRAIL menu.
3. Roll the wheel to choose 2 TRAIL GRAD and then push the wheel or the left button.
4. Roll the wheel to choose SINGLE (single) or MULTI (multiple) as appropriate and then push the wheel or the left button.
5. Push the right button to close the menu.

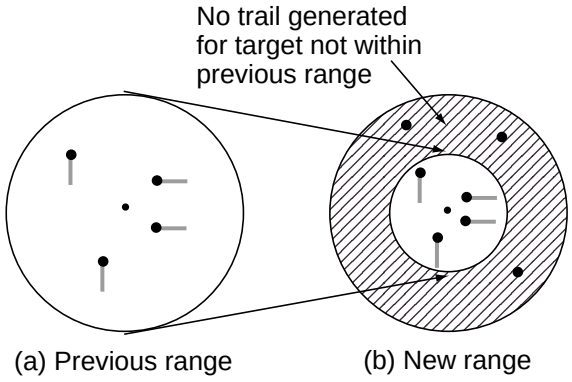
1.28.4 Resetting target trails

You may clear all target trails to restart the trail process. Target trails are cleared and the trailing process restarts from time count zero at the current target trail plot interval.

1. Roll the trackball to place the arrow on the TRAIL MODE box at the bottom right corner of the screen.
2. Push the right button to display the TRAIL menu.
3. Roll the wheel to choose 5 TRAIL RESTART and then push the wheel or the left button.
4. Roll the wheel to choose ON or OFF as appropriate and then push the wheel or the left button.
   ON: Trails start extending on the newly selected range.
   OFF: Trails are shown and extend only on the range where they were initiated.
5. Push the right button to close the menu.

1.28.5 Trail copy

Trails are canceled and restarted whenever the range is changed. However, you may continue trails on the same range, without restarting them, when the range is changed to a next larger or smaller range scale. Note however that when the range is changed, only those trails within the previous range are continued; no trails are generated for targets outside the previous range.



Trail copy

1. Roll the trackball to place the arrow on the TRAIL MODE box at the bottom right corner of the screen.
2. Push the right button to display the TRAIL menu.
3. Roll the wheel to choose 6 TRAIL COPY and then push the wheel or the left button.
4. Roll the wheel to choose ON or OFF as appropriate and then push the wheel or the left button.
5. Push the right button to close the menu.

1.28.6 Trail level

The level (intensity) of the afterglow which extends from radar targets may be chosen as below.

1. Roll the trackball to place the arrow on the TRAIL MODE box at the bottom right corner of the screen.
2. Push the right button to display the TRAIL menu.
3. Roll the wheel to choose 4 TRAIL LEVEL and then push the wheel or the left button.
4. Roll the wheel to choose level desired and then push the wheel or the left button. The higher the number the greater the intensity of the afterglow.
5. Push the right button to close the menu.

1.28.7 Narrow trails (non-IMO type only)

Target trails may be painted with thinner lines if desired. This can be useful when there are a lot of targets on the screen.

1. Roll the trackball to place the arrow on the TRAIL MODE box at the bottom right corner of the screen.
2. Push the right button to display the TRAIL menu.
3. Roll the wheel to choose 3 NARROW TRAIL and then push the wheel or the left button.
4. Roll the wheel to choose ON or OFF as appropriate and then push the wheel or the left button. Choose ON to get thinner trails.
5. Push the right button to close the menu.

1.28.8 Canceling trails

Trails can be canceled as follows:

By keyboard

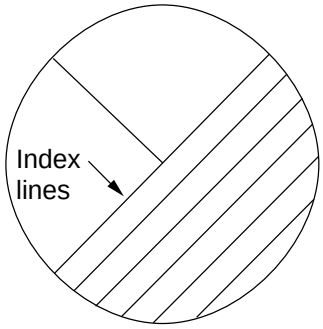
Press the [CANCEL TRAILS] key.

By trackball

1. Roll the trackball to place the arrow on the TRAIL MODE box at the bottom right corner of the screen.
2. Push the left button to display OFF.

1.29 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. Two index lines are available and any two may be displayed. You may control the orientation and line interval.

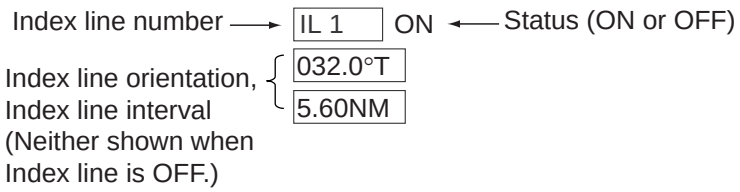


Parallel index lines

1.29.1 Displaying, erasing parallel index lines

By keyboard

1. With the menu closed, press the [INDEX LINE] key. The guidance box shows " DISP INDEX LINE/."
2. While watching the IL (Index Line) box at the left side of the screen, press and hold down the [INDEX LINE] key to activate or deactivate applicable index line. Press down the key again to display (or erase) the index line chosen.



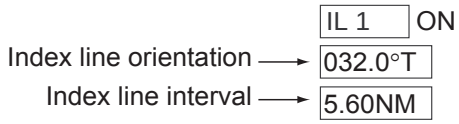
IL (Index Line) box

By trackball

1. Roll the trackball to place the arrow in the IL box at the lower left-hand side of the screen. (See the illustration above.)
2. Roll the wheel to choose index line number and then push the left button or the wheel to turn the index line on or off as appropriate.

1.29.2 Adjusting index line orientation, index line interval

1. Display the index line for which you want to adjust its orientation, referring to paragraph 1.29.1.
2. Roll the trackball to place the arrow in the index line orientation setting window, directly below the IL box.



3. Roll the wheel to adjust the index line orientation, between 000.0-359.9(°T). Enter a negative value to move the index line to the opposite side of the index line passing through the own ship position.
4. Roll the trackball to place the cursor in the index line interval setting window.
5. Roll the wheel to adjust the index line interval.

1.29.3 Index line bearing reference

Index line bearing reference may be relative to own ship' s heading (Relative) or referenced to North (True) as follows:

1. Roll the trackball to choose the MENU box at the right side of the screen and then push the left button.
2. Roll the wheel to choose 2 MARK and then push the wheel or the left button to display the MARK menu.

[MARK]

1 BACK
2 OWN SHIP MARK
OFF/ON
3 STERN MARK
OFF/ON
4 INDEX LINE BEARING
REL/TRUE
5 INDEX LINE
1/2/3/6
6 INDEX LINE MODE
VERTICAL/HORIZONTAL

8 EBL OFFSET BASE
STAB GND/STAB HDG/
STAB NORTH
9 EBL CURSOR BEARING
REL/TRUE
0 RING
OFF/ON

MARK menu

3. Roll the wheel to choose 4 INDEX LINE BEARING and then push the wheel or the left button.
4. Roll the wheel to choose TRUE or REL as appropriate and then push the wheel or the left button.
5. Push the right button twice to close the menu.

1.29.4 Choosing maximum number of index lines to display

The maximum number of index lines to display may be chosen from 2, 3 or 6 lines as below. The actual number of lines visible may be less depending on line interval.

1. Roll the trackball to choose the MENU box at the right side of the screen and then push the left button.
2. Roll the wheel to choose 2 MARK and then push the wheel or the left button to display the MARK menu.
3. Roll the wheel to choose 5 INDEX LINE and then push the wheel or the left button.
4. Roll the wheel to choose 1, 2, 3 or 6 as appropriate and then push the wheel or the left button.
5. Push the right button twice to close the menu.

1.29.5 Index line mode

Index lines orientation may be chosen from horizontal or vertical. This function is available when 5 INDEX LINE in the MARK menu is set for other than “1”.

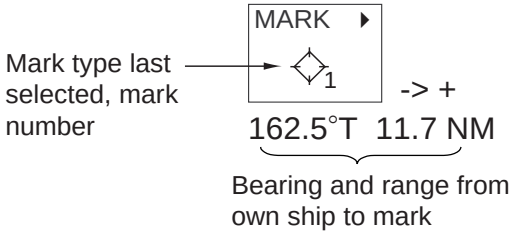
1. Roll the trackball to choose the MENU box at the right side of the screen and then push the left button.
2. Roll the wheel to choose 2 MARK and then push the wheel or the left button to display the MARK menu.
3. Roll the wheel to choose 6 INDEX LINE MODE and then push the wheel or the left button.
4. Roll the wheel to choose VERTICAL or HORIZONTAL as appropriate and then push the wheel or the left button.
5. Push the right button twice to close the menu.

1.30 Origin Mark

You can mark any prominent target or a point of particular interest using the origin mark feature. Twenty origin marks may be entered: 10 standard origin marks (with number) and one each of the 10 symbol origin marks. The marks may be geographically fixed (ground stabilized) or sea stabilized. To display the origin marks, heading signal and own ship position data are required.

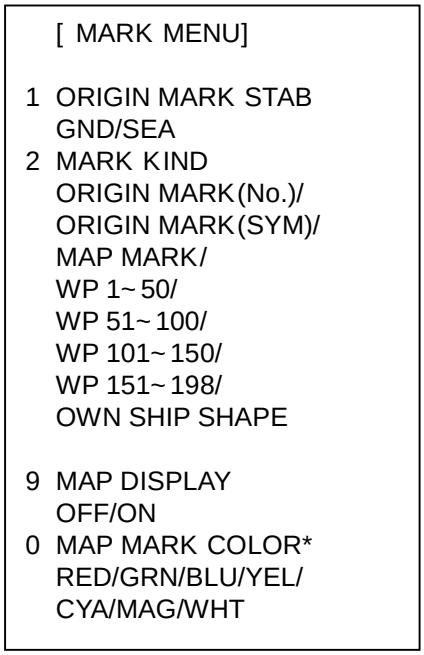
1.30.1 Entering origin marks

1. Roll the trackball to choose the MARK box at the left side of the screen. The guidance box now reads " MARK SELECT / MARK MENU."



MARK box

2. Push the right button to open the MARK menu.

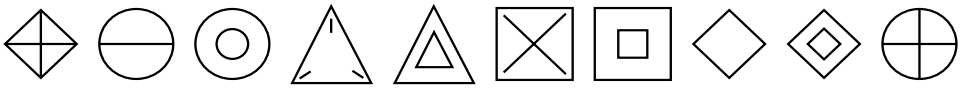


* Not available on IMO radar.

MARK menu

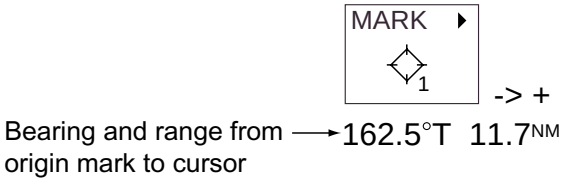
3. Roll the wheel to choose 2 MARK KIND and then push the wheel or the left button.
4. Roll the wheel to choose ORIGIN MARK(No.) or ORIGIN MARK(SYM) as appropriate and then push the wheel or the left button. Choose ORIGIN MARK(No.) to inscribe standard origin mark (◇) plus mark number; ORIGIN MARK(SYM) to inscribe desired origin mark symbol (no number).
5. Push the left button.
6. Push the right button to close the menu. The guidance box now reads " MARK SELECT / MARK MENU."

7. With the cursor choosing the MARK box, roll the wheel to choose mark number desired (“ORIGIN MARK(No.)” chosen at step 4) or origin mark symbol (“ORIGIN MARK(SYM)” chosen at step 4) and then push the left button. The following origin marks are available.



Origin mark (symbols)

8. Push the left button again. The cursor jumps into the effective display area and the guidance box now reads “MARK / EXIT.”
9. Roll the trackball to place the cursor on the location desired.
10. Push the left button to inscribe the origin mark at the cursor location. The bearing and range from the origin mark to the cursor location are shown just below the MARK box.



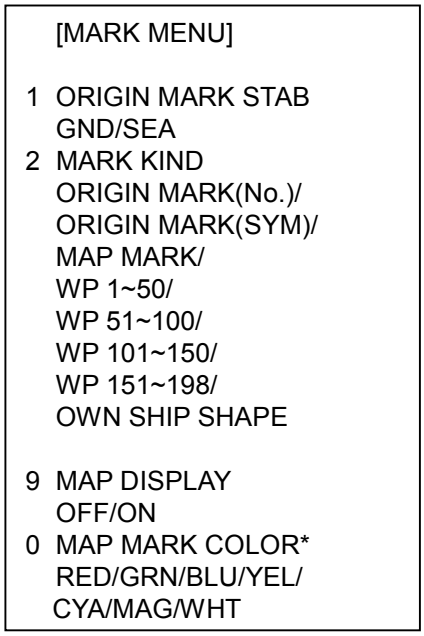
Mark box, showing bearing and range from origin mark

- To inscribe a different standard origin mark number or symbol origin mark, repeat steps 7-10. (“ORIGIN MARK(No.)” or (“ORIGIN MARK(SYM)” should be preselected as appropriate.)
- To quit entering origin marks, push the right button when the guidance box reads “MARK / EXIT.”
- Origin mark data reads “- - -.-” when the cursor is placed outside the effective display area.

1.30.2 Origin mark stabilization

Origin marks may be geographically fixed (ground stabilized) or moving (sea stabilized).

1. Roll the trackball to choose the MARK box.
2. Push the right button to open the MARK menu.



*: Not available on IMO radar.

MARK menu

3. Roll the wheel to choose 1 ORIGIN MARK STAB and then push the wheel.
4. Roll the wheel to choose GND or SEA as appropriate and then push the wheel or the left button.
5. Push the right button to close the menu.

1.30.3 Deleting individual origin marks

The procedure below shows how to delete individual origin marks. Note that origin marks cannot be deleted collectively.

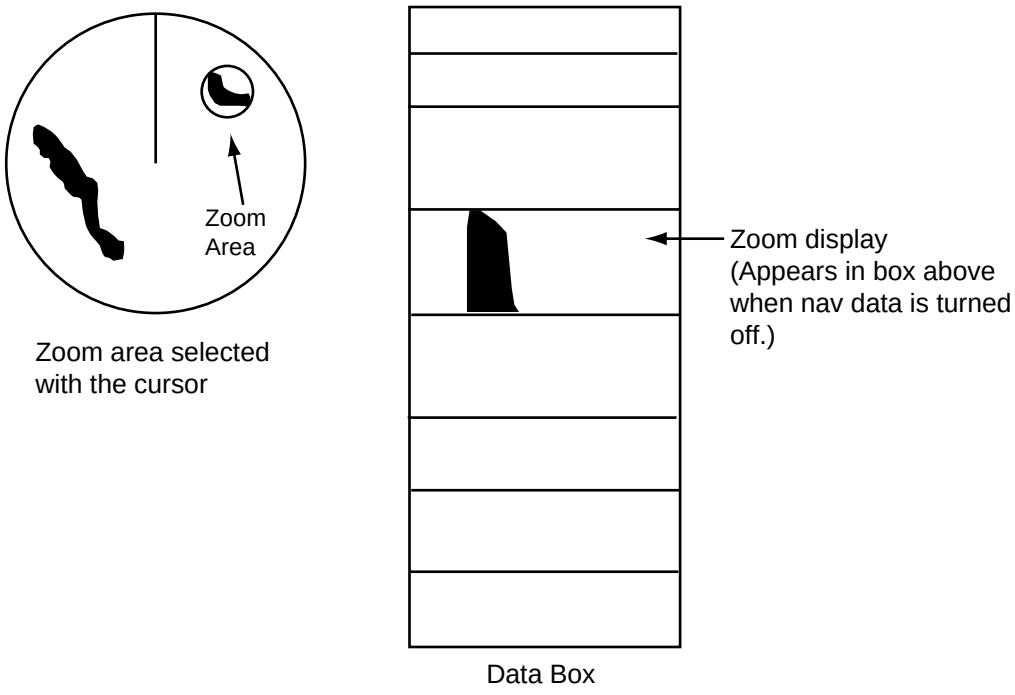
1. With the cursor inside the effective display area, roll the wheel to display “MARK DELETE / EXIT” in the guidance box.
2. Roll the trackball to place the cursor on the origin mark you wish to erase.
3. Push the left button or the wheel to erase the mark.
4. To erase another mark, repeat steps 2 and 3.
5. To finish, push the right button when the guidance box reads “MARK DELETE / EXIT.”

1.31 Zoom

The zoom function enlarges an area of interest as large as twice the normal viewing size, in the text window. To use the zoom display, it must be turned on in the DATA BOX menu. For further details, see paragraph 1.41.

Zoom is not available when the ARP target data setting is “LARGE” and the navigation data is turned on.

1. With the cursor inside the effective display area, roll the wheel to display “ZOOM / EXIT” in the guidance box.
2. Roll the trackball to choose the location to zoom.
3. Push the left button or the wheel. A circle inscribes the location zoomed and the zoom display at the right side of the screen shows the zoomed picture.



Zoom display

To quit the zoom display, push the left button when the guidance box reads “ZOOM / EXIT.”

1.32 Markers

1.32.1 Heading marker and heading line

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

Temporarily erasing the heading line

To temporarily extinguish the heading line to look at targets existing dead ahead of own ship, press the [HL OFF] key on the keyboard, or roll the trackball to choose the HL OFF box at the bottom left corner of the display and then push the left button. In addition to the heading line, the stern marker and all graphics within the effective display are also erased. To redisplay the heading line, etc., release the key or the left button.

1.32.2 Stern marker

The stern marker, which is a dot-and-dash line, appears opposite to the heading line. To display or erase this marker do the following:

1. Roll the trackball to choose the MENU box at the right side of the display and then push the left button to display the MAIN menu.
2. Roll the wheel to choose MARK and then push the wheel or the left button to show the MARK menu.
3. Roll the wheel to choose 3 STERN MARK and then push the wheel or the left button.
4. Roll the wheel to choose OFF or ON as appropriate and then push the wheel or the left button.
5. Push the right button twice to close the menu.

1.32.3 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.

1.32.4 Own ship symbol

The own ship symbol () can be displayed or erased on the MARK menu. This symbol is scaled to indicate the length and beam of the vessel. If the largest dimension of the symbol gets smaller than 6 mm, the symbol will disappear and own ship will be represented with a small dot or circle depending on the range in use. Ship's dimensions should be entered at installation.

1. Roll the trackball to choose the MENU box at the right side of the display and then push the left button to display the MAIN menu.
2. Roll the wheel to choose MARK and then push the wheel or the left button to show the MARK menu.
3. Roll the wheel to choose 2 OWN SHIP MARK and then push the wheel or the left button.
4. Roll the wheel to choose OFF or ON as appropriate and then push the wheel or the left button.
5. Push the right button twice to close the menu.

1.33 Automatic Picture Setup According to Navigation Purpose

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 functions is assigned the buoy detecting function and labeled SHIP on the on the PICTURE box. By choosing SHIP, the radar will be instantly set for optimum detection of ships.

Four user-programmable setups are also provided (labeled PICTURE1-PICTURE4), so that you may have the radar automatically adjusted to those conditions which are not covered by the provided setup options.

Below are the preset picture setup options provided with this radar.

Picture setup options description

Label	Description	Label	Description
NEAR	Optimum setting for short range detection using a range scale of 3 nm or less on calm seas	FAR	Optimum setting for long range detection using a range scale of 6 nm or larger
NEAR BUOY	Optimum setting for detecting navigation buoys, small vessels and other small surface objects at close range	FAR BUOY	Optimum setting for detecting navigation buoys, small vessels and other small surface objects at long range
ROUGH SEA	Optimum setting for rough weather or heavy rain	SHIP	Optimum setting for detecting vessels
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

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, noise rejector, automatic anti-sea and anti-rain clutters, video contrast, pulselength and sea and radar conditions.

Adjusting these features from the PICTURE menu changes the original function key settings. To restore the original settings for a particular picture setup option, it is necessary to choose the default setting. For this reason, we recommended that you use the user-programmable function sets when frequent adjustment of the radar picture is necessary.

Picture setup options and default settings

	1 INT REJECT	2 ECHO STRETCH	3 ECHO AVERAGE	4 NOISE REJ	5 AUTO STC	6 AUTO RAIN	7 VIDEO CONTRAST
PICTURE 1	2	OFF	OFF	OFF	OFF	OFF	2-B
PICTURE 2	2	2	1	OFF	OFF	OFF	3-B
PICTURE 3	2	OFF	2	OFF	ON	OFF	2-B
PICTURE 4	2	OFF	OFF	OFF	OFF	2	2-A
NEAR	2	OFF	OFF	OFF	OFF	OFF	3-B
FAR	2	2	3	OFF	ON	OFF	3-C
NEAR BUOY	2	1	1	OFF	OFF	OFF	3-B
FAR BUOY	2	2	3	OFF	ON	OFF	3-C
ROUGH SEA	2	OFF	2	OFF	ON	OFF	2-A
SHIP	3	2	OFF	OFF	OFF	OFF	3-C
HARBOR	2	OFF	OFF	OFF	OFF	OFF	3-B
COAST	2	OFF	OFF	OFF	OFF	OFF	3-B

	8 PULSE						9 CONDITION	
	P/L on 0.5 nm	P/L on 0.75 nm	P/L on 1.5 nm	P/L on 3 nm	P/L on 6 nm	P/L on 12-24 nm	Sea Cond.	STC Range
PICTURE 1	S1	S1	S2	M1	M2	L	2	±0
PICTURE 2	S1	S1	M1	M2	M3	L	2	±0
PICTURE 3	S1	S1	S2	M1	M2	L	3	±0
PICTURE 4	S1	S1	S2	M1	M2	L	2	±0
NEAR	S1	S1	S2	M1	M2	L	2	±0
FAR	S1	S1	M1	M3	L	L	3	±0
NEAR BUOY	S1	S1	M1	M2	L	L	2	±0
FAR BUOY	S1	S1	M1	M3	L	L	3	±0
ROUGH SEA	S1	S1	S2	M1	M2	M3	4	±0
SHIP	S1	S1	M1	M2	M3	L	2	±0
HARBOR	S1	S1	S2	M1	M3	L	2	±0
COAST	S1	S1	M1	M2	M3	L	2	±0

1.33.1 Choosing a picture setup option

You may choose a picture setup options as follows:

1. Roll the trackball to choose the PICTURE box at the left side of the screen.



* Other indications:
NEAR, FAR, NEAR BUOY,
FAR BUOY, ROUGH SEA,
SHIP, HARBOR, COAST,
PICTURE 1 - PICTURE 4

PICTURE box

2. Push the left button to choose picture setup option desired.

1.33.2 Restoring default picture setup options

Any of the radar functions programmed with the picture setup options may be adjusted as desired. If you get lost in operation and want to restore the default settings for a particular picture setup operation, do the following:

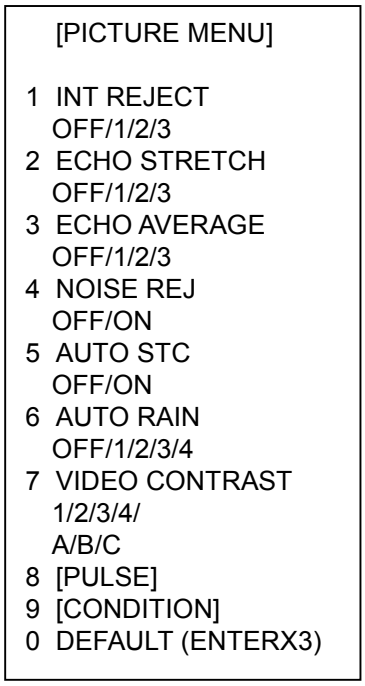
1. Roll the trackball to choose the PICTURE box at the left side of the screen.



* Other indications:
NEAR, FAR, NEAR BUOY,
FAR BUOY, ROUGH SEA,
SHIP, HARBOR, COAST,
PICTURE 1 - PICTURE 4

PICTURE box

2. Push the left button to choose the picture setup option for which you want to restore its default settings.
3. Push the right button to show the PICTURE menu.



PICTURE menu

4. Roll the wheel to choose 0 DEFAULT.
5. Push the wheel or the left button three times to restore default settings for the picture setup selected. (If you are using the keyboard, press the [ENTER MARK] key three times.)
6. Push the right button to close the menu.

1.33.3 User-programmable picture setups

Four user-programmable picture setups are provided and they are labeled PICTURE 1 – PICTURE 4 in the PICTURE box. You may program them as below.

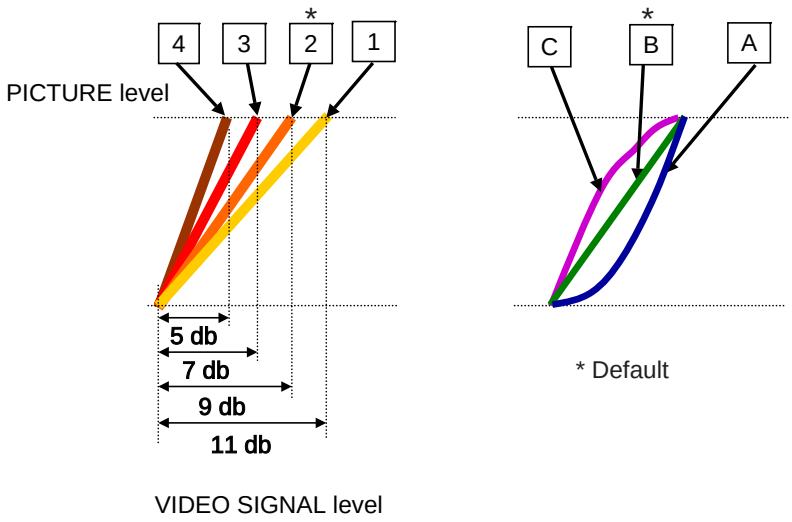
1. Roll the trackball to choose the PICTURE box at the left side of the screen.
2. Push the left button to choose PICTURE 1, PICTURE 2, PICTURE 3 or PICTURE 4, whichever you wish to set.
3. Push the right button to show the PICTURE menu.

```
   [ PICTURE MENU]

1  INT REJ ECT
   OFF/1/2/3
2  ECHO STRETCH
   OFF/1/2/3
3  ECHO AVERAGE
   OFF/1/2/3
4  NOISE REJ
   OFF/ON
5  AUTO STC
   OFF/ON
6  AUTO RAIN
   OFF/1/2/3/4
7  VIDEO CONTRAST
   1/2/3/4/
   A/B/C
8  [ PULSE]
9  [ CONDITION]
0  DEFAULT(ENTERX3)
```

PULSE menu

4. Set items 1-6 and 8 referring to the following paragraphs:
   1 INT REJ ECT: 1.19 5 AUTO STC: 1.1
   2 ECHO STRETCH: 1.26 6 AUTO RAIN: 1.18
   3 ECHO AVERAGE: 1.27 8 PULSE: 1.15
   4 NOISE REJ : 1.35
5. Roll the wheel to choose 7 VIDEO CONTRAST and then push the wheel or the left button.
6. Roll the wheel to choose 1, 2, 3 or 4 (Dynamic Range) or A, B, C (Curve) as appropriate and then push the wheel or the left button. Refer to the description below and the illustration on the next page.
   1-4: Control dynamic range. 1 provides the widest dynamic range; 4 is the narrowest dynamic range.
   A: Mid-level in the curve is low, so this setting is suitable for suppressing rain clutter.
   B: Curve between A and C.
   C: Mid-level in the curve is high, so this setting is suitable for detecting distant targets.



Video contrast settings

7. Roll the wheel to choose 9 [CONDITION] and then push the wheel to show the CONDITION menu.

[CONDITION MENU]

1 BACK
2 SEA CONDITION
1/2/3/4/5
3 ANT HEIGHT
5/7.5/10/15/20/
25/30/35/40/45/
more50m
4 STC RANGE
+00

CONDITION menu

8. Roll the wheel to choose 2 SEA CONDITION and then push the wheel or the left button.
9. Roll the wheel to choose appropriate sea condition and then push the wheel or the left button. The larger the number the rougher the sea state.
10. Roll the wheel to choose 3 ANT HEIGHT and then push the wheel or the left button.
11. Roll the wheel to choose appropriate radar antenna height (above the waterline) and then push the wheel or the left button.
12. If necessary, roll the wheel to choose 4 STC RANGE, to adjust effective STC range, and then push the wheel or the left button. The setting range is – 10 to +10. The larger the number the longer the effective STC range becomes. Roll the wheel to set and then push the wheel or the left button. (Note that the keyboard cannot be used to enter the setting.)
13. Push the right button twice to close the menu.

1.34 Programming Function Keys

Less-often used functions are provided in the menu. To avoid opening the menus to set up the radar for a particular situation, function keys F1-F4 may be assigned any of the functions shown in the CUSTOMIZE•TEST sub menu.

1.34.1 Activating a function key

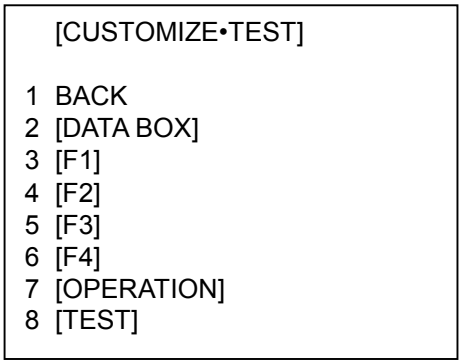
To activate the function assigned to a function key, press the key to instantly set the radar for the preset purpose. Further press the key to choose option.

Function key	Default setting
F1	Interference Rejector
F2	Echo Stretch
F3	Auto Rain
F4	Heading Line Off

1.34.2 Programming the functions keys

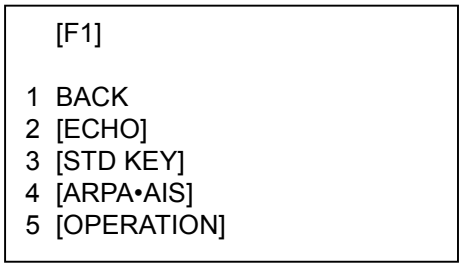
Do the following to program the function keys.

1. Roll the trackball to choose the MENU box at the right side of the display and then push the left button to display the MAIN menu.
2. Roll the wheel to choose 9 [CUSTOMIZE•TEST] and then push the wheel.



CUSTOMIZE•TEST menu

3. Roll the wheel to choose 3 [F1], 4 [F2], 5 [F3] or 6 [F4], whichever function key you want to set, and then push the wheel or the left button. For example, choose 3 [F1] and then push the left button.



F1 menu

4. Roll the wheel to choose appropriate category, ECHO, STD KEY, ARP•AIS or OPERATION and then push the wheel or the left button. Refer to the menus below to choose appropriate category.

[ECHO]

1 BACK
2
PICTURE/
IR
ES/
EAV/
NOISE REJ/
ANT SELECT/
PULSE LENGTH/
A/C SEA SELECT/
AUTO RAIN SELECT/
TUNE SELECT/
ANT HEIGHT/
SEA CONDITION/
2ND ECHO REJ/
PM/
SART/

[STD KEY]

1 BACK
2
ALARM ACK/
STBY TX/
HL OFF/
EBL OFFSET/
MODE/
OFF CENTER/
CU TM RESET/
INDEX LINE/
VECTOR TIME/
VECTOR MODE/
TARGET LIST/
TRAIL/
BRILL/
MARK/
MENU/
RANGE UP/
RANGE DOWN/
ACQ/
TARGET DATA/
TARGET CANCEL

[ARPA•AIS]

1 BACK
2
DISP ARP/
DISP AIS/
TARGET DATA & ACQ/
PAST POSN INTERVAL/
REF MARK/
CPA LIMIT/
CPA/
TCPA/
GZ1/
GZ2/
TARGET LIST SORT/
TRIAL MANEUVER/
ARP•AIS FUSION/
AIS MESSAGE

[OPERATION]

1 BACK
2
ECHO COLOR/
BACK COLOR/
RING/
ALARM1/
ALARM2/
WATCH ALARM RESET/
ZOOM/
MARK DELETE/
CHART ALIGN/
DISPLAY SELECT/
MOB/
USER DEFAULT/
TLL

Function key categories and options

5. Roll the wheel to choose “2” and then push the wheel or the left button.
6. Roll the wheel to choose function desired and then push the wheel or left button.
7. Push the right button twice to close the menu.

Description of function key programs

Item	Description
[ECHO]	
PICTURE	Chooses picture setup function.
IR	Chooses interference rejection level.
ES	Chooses echo stretch function.
EAV	Chooses echo averaging function.
NOISE REJ	Turns noise rejector on/off.
ANT SELECT	Chooses antenna.
PULSE LENGTH	Chooses pulselength.
A/C SEA SELECT	Chooses A/C SEA adjustment method.
AUTO RAIN SELECT	Chooses AUTO RAIN level.
TUNE SELECT	Chooses tuning adjustment method.
ANT HEIGHT	Sets antenna height.
SEA CONDITION	Sets sea condition.
2ND ECHO REJ	Turns 2nd trace echo rejector on/off.
PM	Turns performance monitor on/off.
SART	Turns SART setup conditions on/off.
[STD KEY]	
ALARM ACK	Acknowledges alarm. (Silences audible alarm.)
STBY TX	Toggles between stand-by and transmit.
HL OFF	Turns heading line on/off.
EBL OFFSET	Offsets EBL.
OFF CENTER	Off centers the display.
CU TM RESET	Returns own ship mark to point 75% of range in use.
INDEX LINE	Turns index line on/off.
VECTOR TIME	Sets vector time.
VECTOR MODE	Sets vector mode.
TARGET LIST	Displays target list.
TRAIL	Sets trail parameters.
BRILL	Sets brilliance.
MARK	Chooses mark to inscribe.
MENU	Opens the MAIN menu.
RANGE UP	Raises the range scale.
RANGE DOWN	Lowers the range scale.
ACQ	Acquires ARP target; activate sleeping AIS target.
TARGET DATA	Shows target data.
TARGET CANCEL	Cancels tracking of ARP target; sleep AIS target.

Description of function key programs (con't)

Item	Description
[ARP•AIS]	
DISP ARP	Activates/deactivates ARP.
DISP AIS	Activates/deactivates AIS.
TARGET DATA & ACQ	ARP: Acquires ARP target; shows data for ARP target selected. AIS: Activates sleeping AIS target; shows data for AIS target selected.
PAST POSN INTERVAL	Chooses past position plotting interval.
REF MARK	Inscribes reference mark (for target-based speed).
CPA LIMIT	Turns CPA limit on/off.
CPA	Enters CPA range.
TCPA	Enters TCPA time.
GZ1	Sets Guard Zone 1.
GZ2	Sets Guard Zone 2.
TARGET LIST SORT	Sorts target list.
TRIAL MANEUVER	Executes trial maneuver.
ARP•AIS FUSION	Converts ARP target to AIS target.
AIS MESSAGE	Displays AIS message board.
[OPERATION]	
ECHO COLOR	Chooses echo color.
BACK COLOR	Chooses background color.
RING	Turns range rings on/off.
ALARM1	Sets no. 1 guard alarm.
ALARM2	Sets no. 2 guard alarm.
WATCH ALARM RESET	Resets watch alarm.
ZOOM	Enables zoom.
MARK DELETE	Deletes mark (origin mark, waypoint mark, plotter mark).
CHART ALIGN	Aligns chart with radar picture.
DISPLAY SELECT	Chooses display mode.
MOB	Inscribes MOB mark (WP 200).
USER DEFAULT	Restores default settings.
TLL	Outputs radar target's L/L position to video plotter.

1.35 Ship's Position

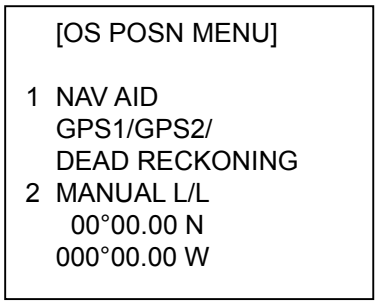
Choose the source of ship's position data as follows:

1. Roll the trackball to choose the OS POSN box at the top right corner of the screen.



OS POSN box

2. Push the right button to show the OS POSN menu.



OS POSN menu

3. Roll the wheel to choose 1 NAV AID and then push the wheel or the left button.
4. Roll the wheel to choose GPS1, GPS2 or DEAD RECKONING as appropriate and then push the wheel or the left button.

   GPS1: GPS Navigator connected to nav port
   GPS2: GPS navigator connected to SPEED LOG port or TRACK CONTROL port.

5. If you have chosen DEAD RECKONING go to step 6 to enter position manually. For GPS1 or GPS2, go to step 7.
6. Roll the wheel to choose 2 MANUAL L/L and then push the wheel. Enter latitude and longitude position as follows:
   1) Roll the wheel to set appropriate digit in the latitude field and then push the wheel. (You may push the wheel again to skip a place.) For keyboard operation, press appropriate numeric keys and then press the [ENTER MARK] key.
   2) Set longitude similar to how you set latitude and then push the wheel. (For keyboard operation, press the [ENTER MARK] key.)

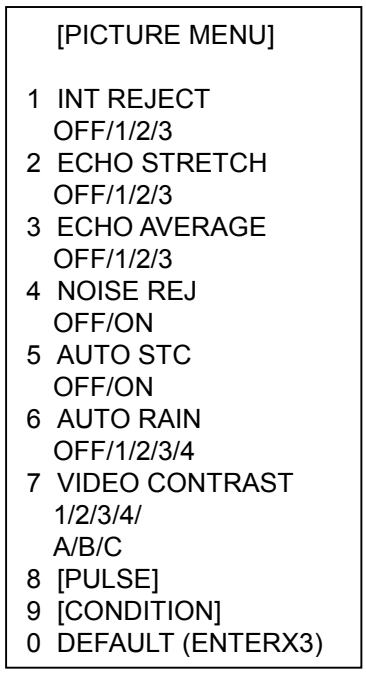
   Note: Co-ordinate polarity may be switched by rolling the wheel or pressing the [2] key in case of keyboard operation.
7. Push the right button to close the menu.

Note: When the AIS function is active, DEAD RECKONING is shown in gray to indicate that it is not available for selection.

1.36 Noise Rejector

White noise may show itself on the screen as random “speckles” spread over the entire radar image. You can remove this noise as follows:

1. Roll the trackball to choose the PICTURE box at the left side of the screen.
2. Push the right button to open the PICTURE menu.

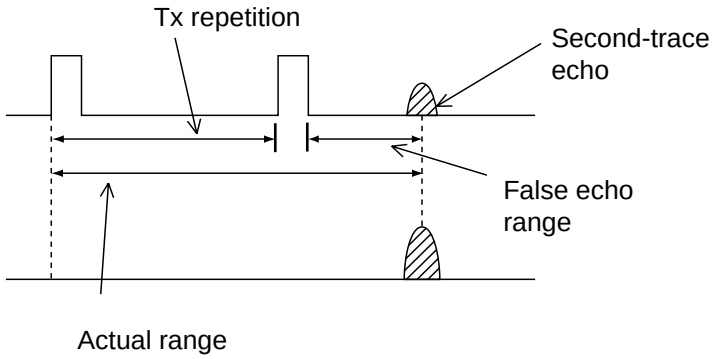


PICTURE menu

3. Roll the wheel to choose 4 NOISE REJ and then push the wheel or the left button.
4. Roll the wheel to choose ON or OFF as appropriate and then push the wheel or the left button.
5. Push the right button to close the menu.

1.37 Suppressing Second-trace Echoes

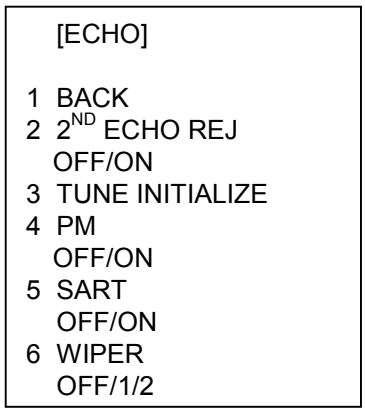
In certain situations, echoes from very distance targets may appear as false echoes (second-trace echoes) on the screen. This occurs when the return echo is received one transmission cycle later, or after a next radar pulse has been transmitted.



Second-trace echoes

To reject second-trace echoes:

1. Roll the trackball to choose the MENU box at the right side of the screen and then push the left button.
2. Roll the wheel to choose 1 ECHO and then push the wheel or the left button to open the ECHO menu.



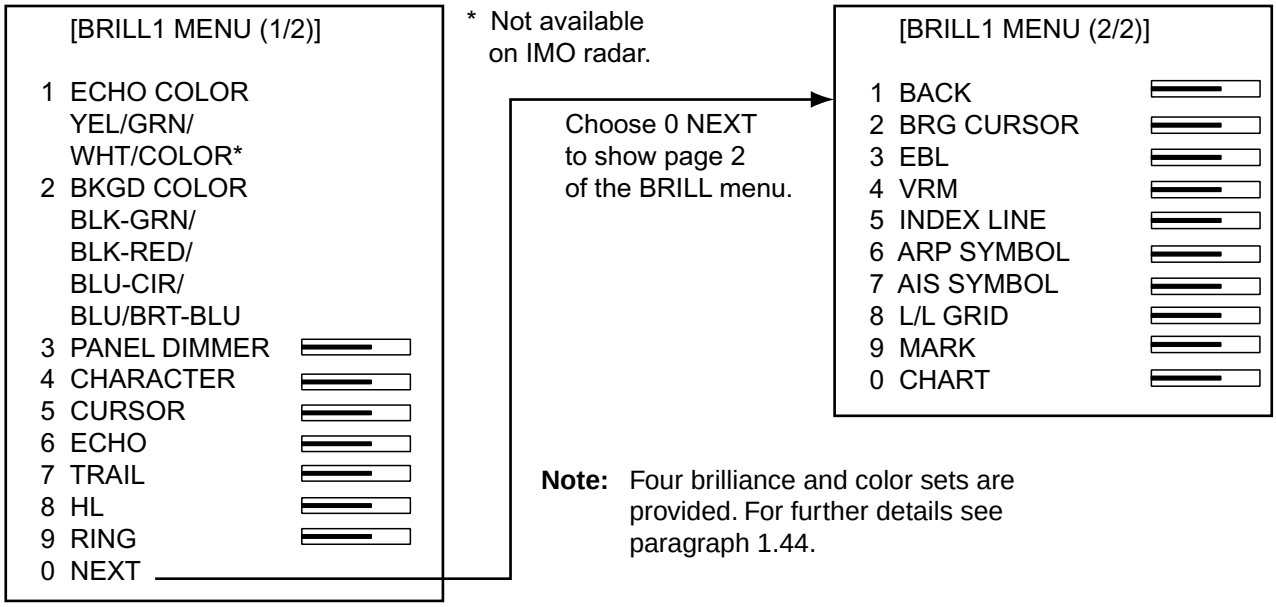
ECHO menu

3. Roll the wheel to choose 2 2ND ECHO REJ and then push the wheel or the left button.
4. Roll the wheel to choose OFF or ON as appropriate and then push the wheel or the left button.
5. Push the right button twice to close the menu.

1.38 Adjusting Brilliance of Screen Data

You can adjust relative brilliance levels of various markers and alphanumeric readouts displayed on the screen.

1. Roll the trackball to choose the BRILL box at the bottom left corner of the screen and then push the right button to show the BRILL menu.



BRILL menu

2. Roll the wheel to choose item you wish to adjust and then push the wheel or the left button. (To go to the second page of the BRILL menu choose 0 NEXT and push the wheel.)

Page 1		Page 2	
Item	**Adjusts brilliance of;**	**Item**	**Adjusts brilliance of;**
1 ECHO COLOR	See para. 1.49.	2 BRG CURSOR	Bearing cursor
2 BKGD COLOR	See para. 1.49.	3 EBL	EBLs
3 PANEL DIMMER	Backlighting of control unit	4 VRM	VRMs
4 CHARACTER	All alphanumeric characters	5 INDEX LINE	Index lines
5 CURSOR	Cursor (+) and arrow	6 ARP SYMBOL	ARP symbols
6 ECHO	Radar echoes	7 AIS SYMBOL	AIS symbols
7 TRAIL	Target trails	8 L/L	Chart grid
8 HL	Heading line	9 MARK	All marks
9 RING	Range rings	0 CHART	Chart

3. Roll the wheel to set brilliance level. The range of adjustment for items except “HL” and “CURSOR” is 0-100%. The range of adjustment for HL and CURSOR is 50-100%.
4. Push the right button once or twice to close the menu.

1.39 Watch Alarm

The watch alarm sounds the audible alarm at the chosen time interval to help you keep regular watch of the radar picture for safety or other purposes.

The WATCH box appears at the lower-left corner of the screen with a watch alarm timer counts down from value set (for example, “12:00”).



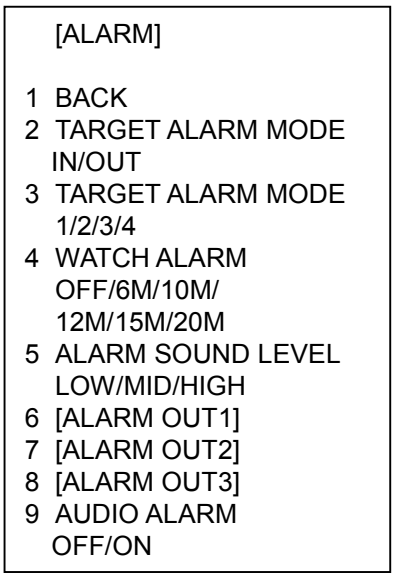
WATCH box

When a preset time interval has elapsed, the audible watch alarm is released, the screen label WATCH turns red and the watch alarm timer freezes at “0:00.” To silence the alarm, press the [ALARM ACK] key on the full keyboard or roll the trackball to choose the ALARM ACK box and then push the left button. 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 [ALARM ACK] key or click the box with the left button before the selected time interval is reached, the watch alarm timer is reset to the initial value and starts the count-down sequence again.

To set watch time interval:

1. Roll the trackball to choose the MENU box at the right side of the screen and then push the left button.
2. Roll the wheel to choose 3 ALARM then push the wheel or the left button.



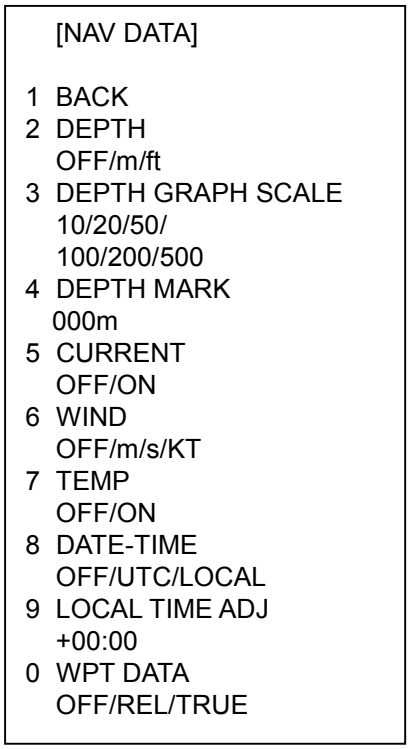
ALARM menu

3. Roll the wheel to choose 4 WATCH ALARM and then push the wheel or the left button.
4. Roll the wheel to choose appropriate time interval and then push the wheel or the left button and then push the right button twice to close the menu.

1.40 Setting Up Nav Data

Wind, depth, ocean current, water temperature, date and time and waypoint data may be set up as follows:

1. Roll the trackball to choose the MENU box at the right side of the screen and then push the left button.
2. Roll the wheel to choose 7 NAV DATA and then push left button to open the NAV DATA menu.



NAV DATA menu

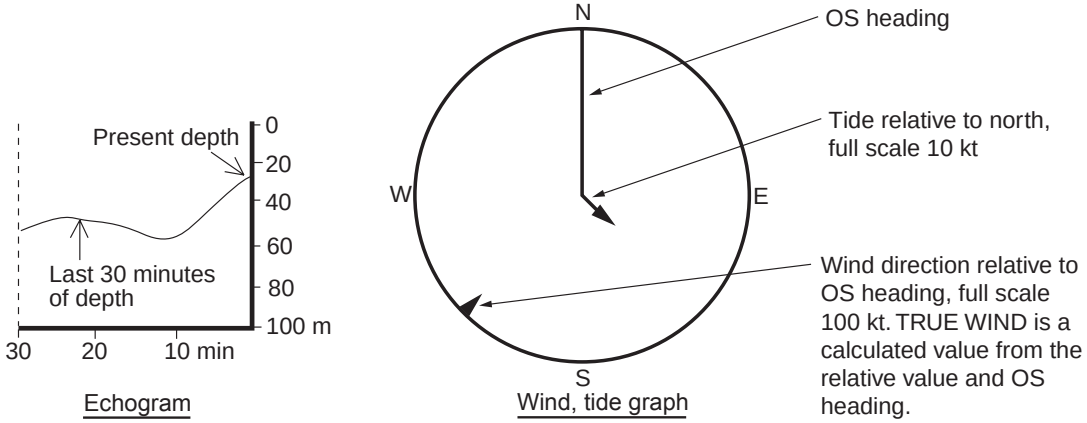
3. Choose appropriate options referring to the table on the next page for details.

Nav data menu description

Item	Description
2 DEPTH	Chooses unit of depth measurement, or turn depth indication off.
3 DEPTH GRAPH SCALE	Chooses depth scale range. The echogram shows the last 30 minutes of sounding along the ship' s track.
4 DEPTH MARK	Chooses the depth at which to show the depth mark.
5 CURRENT	Turns ocean current display on (ocean current relative to North) or off.
6 WIND	Chooses unit of wind speed measurement, or turn wind indication off.
7 TEMP	Turns water temperature indication on/off.
8 DATE-TIME	Chooses how to display date and time: OFF, UTC or LOCAL.
9 LOCAL TIME ADJ	If LOCAL is selected at 8 DATE-TIME, roll the wheel to set the time difference between local time and UTC time. A negative value may be chosen by spinning the wheel past zero.
0 WPT DATA	Turn waypoint data off, or display range and bearing to waypoint.

4. Push the right button twice to close the menu.

Note: Wind and current data require appropriate sensors. Depth data requires appropriate echo-sounding equipment. 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 own ship position, relative to north.

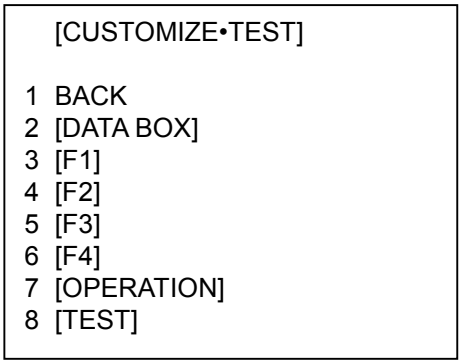


Examples of depth echogram and wind, tide graph

1.41 Text Window Setup

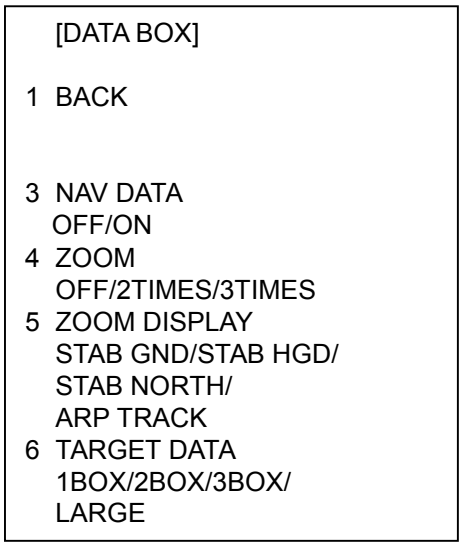
The text window, displayed at the right 1/4 of the screen, mainly shows nav data, zoomed target, and ARP target data. You can set up this window as follows:

1. Roll the trackball to choose the MENU box at the right side of the screen and then push the left button.
2. Roll the wheel to choose 9 [CUSTOMIZE•TEST] and then push the wheel or the left button.



CUSTOMIZE•TEST menu

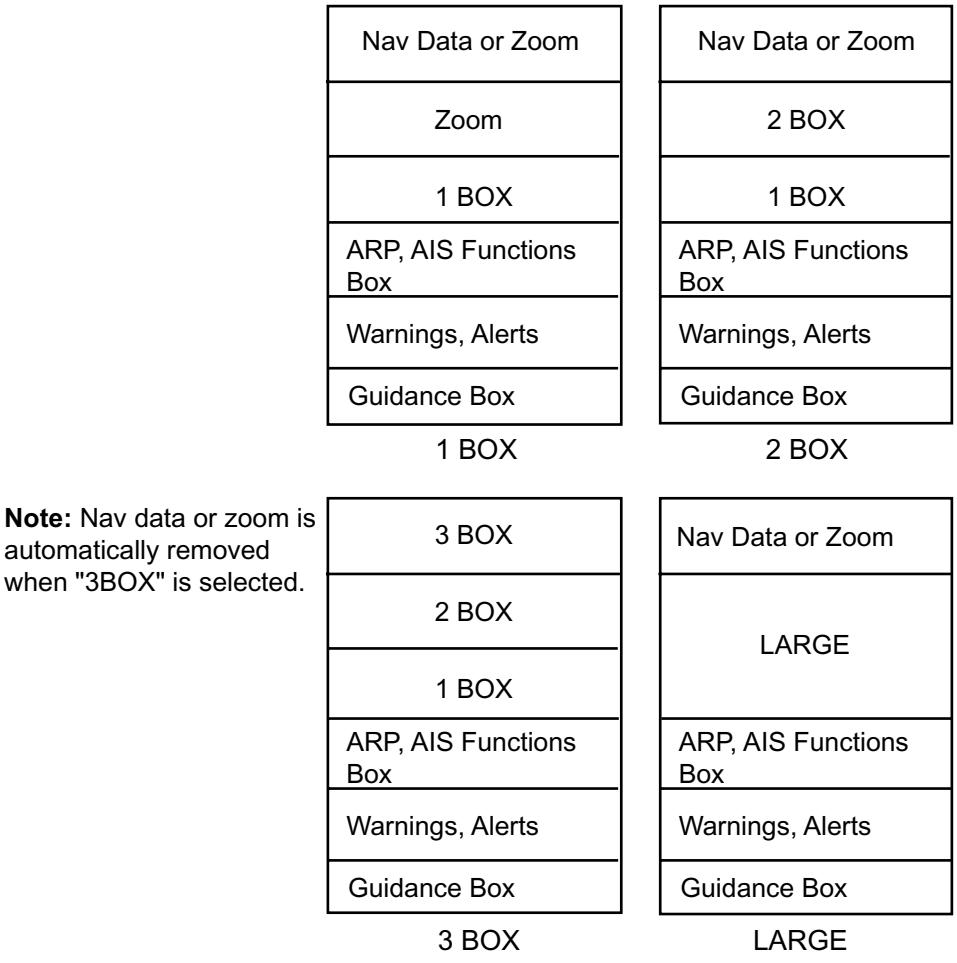
3. Roll the wheel to choose 2 [DATA BOX] and then push the wheel or the left button.



DATA BOX menu

4. Roll the wheel to choose 3 NAV DATA and then push the wheel or the left button.
5. Roll the wheel to choose OFF or ON as appropriate and then push the wheel or the left button.
6. Roll the wheel to choose 4 ZOOM and then push the wheel or the left button.
7. Roll the wheel to choose OFF or zoom magnification factor (2TIMES or 3 TIMES) and then push the wheel or the left button.
8. If you chose a zoom factor at step 7, go to step 9. Otherwise, go to step 11.
9. Roll the wheel to choose 5 ZOOM DISPLAY and then push the wheel or the left button.

10. Roll the wheel to choose zoom display format and then push the wheel or the left button.
    REL: Zoom display moves in relative motion
    STAB: Zoom display is ground stabilized (geographically fixed)
    ACQ: Zoom ARP targets
11. Roll the wheel to choose 6 TARGET DATA and then push the wheel or the left button.
12. Roll the wheel to choose quantity of ARP target data to show among 1BOX, 2BOX, 3BOX and LARGE and then push the wheel or the left button.



Note: Nav data or zoom is automatically removed when "3BOX" is selected.

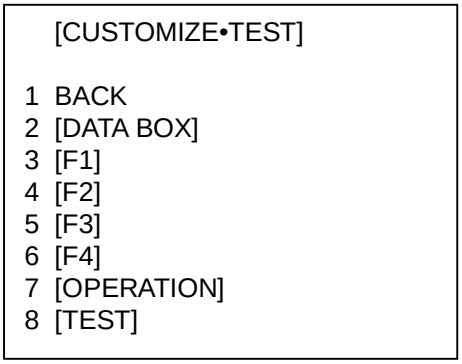
ARP target data setting and data box arrangement

13. Push the right button three times to close the menu.

1.42 Customizing Operation

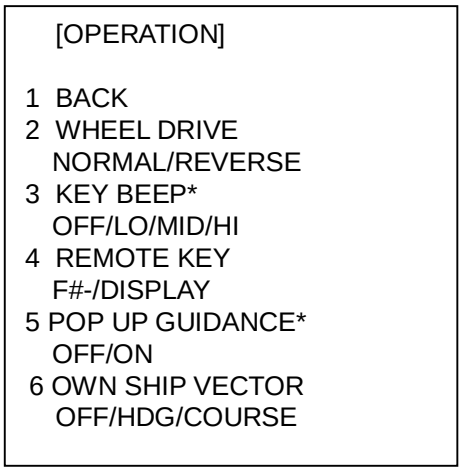
Several operation items may be customized to suit your needs.

1. Roll the trackball to choose the MENU box at the right side of the screen and then push the left button.
2. Roll the wheel to choose 9 [CUSTOMIZE•TEST] and then push the wheel or the left button to open the CUSTOMIZE•TEST menu.



CUSTOMIZE•TEST menu

3. Roll the wheel to choose 7 [OPERATION] and then push the wheel or the left button.



* Non-IMO type radar only

OPERATION menu

4. Set each item as appropriate, referring to the table on the next page for details.
5. Push the right button to close the menu.

Operation menu items

Item No.	Description	Options
2 WHEEL DRIVE	Choose how to cycle data when using the wheel.	NORMAL: Cycles numeral data in numeric order and indication data in clockwise order. REVERSE: Reverse of NORMAL.
3 KEY BEEP (Non-IMO type only)	Key beeps when key sequence has been correctly executed.	OFF: No key beep LO, MID, HI: Loudness of key beep (Loudness adjustment on Non-IMO type only)
4 REMOTE KEY	Choose function of keys F1-F4 on control unit.	F*: Operates as function key. DISPLAY: Control unit operates radar it is connected to.
5 POP UP GUIDANCE	Pop up guidance	You may turn the guidance off or on.
6 OWN SHIP VECTOR	Choose what the own ship vector displays.	OFF: No own ship vector HDG: Vector shows heading direction. COURSE: Vector shows course.

1.43 Alarms

When error is detected, the appropriate alarm indication appears (in red) and the audible alarm sounds. Silence the audible alarm with the [ALARM ACK] key or choose the ALARM ACK box and then push the left button. The error indication remains on the display until the reason for the alarm is removed.

1.43.1 Alarm description

Alarm description

Warning	Audible alarm	Visual alarm	To quit alarm status
GYRO failure	2 beeps	HDG indication reads "***.*" and the message HEADING SET appears at the lower-left corner of the screen. GYRO in red. Display is automatically switched to head-up mode within 1 min.	Pres the [MODE] key top erase the message. Match the on-screen HDG readout with the actual compass reading, if necessary.
Guard alarm	Beeps	Target flashes.	Press the [ALARM ACK] key or click the ALARM ACK box with the left button.
WATCH alarm	Beeps	WATCH 0:00 (WATCH appears and time count freezes at 0:00).	Press the [ALARM ACK] key or click the WATCH box with the left button. The WATCH box is displayed in normal video and the timer is reset.
Own ship lat/lon Cursor lat/lon	None	"***.*" In own ship position field "***.*" In cursor position field	Make sure that own ship position data is fed from external radionav equipment.
System failure	None	Message GYRO appears at screen bottom. No radar echoes. SYSTEM FAIL in red at the lower left of the display during test.	Make sure the antenna is turned on.
Incorrect keystroke	Double beep tone (Non-IMO type)	None	Correct keystroke is responded by a single beep provided that KEY BEEP ON is selected in the OPERATION menu.
Log failure	2 beeps	LOG **.* and LOG appear in red, if no log signal is input for 30 s while the ship speed has been more than 5.0 kt.	If the SDME has failed, use the Manual Speed mode or other appropriate sensor.

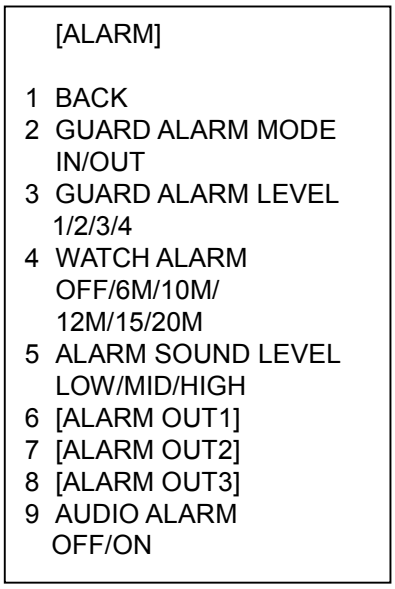
Alarm description (con't from previous page)

Warning	Audible alarm	Visual alarm	To quit alarm status
EPFS failure	Continuous beep	EPFS in red (EPFS: electronic position-fixing system) in the warning and indication cell. The indication also appears when the GPS mode is switched between GPS and DGPS.	To silence the beep and erase the message, press the [ALARM ACK] key or click the ALARM ACK box with the left button. Message cannot be erased if position signal is missing; it is automatically erased when signal is restored.
SOG indication	none	The SOG (Speed Made Good) indication turns red at the top data cell when SOG option is selected on the menu and the associated SDME (Speed and Distance Measuring Equipment = Speed log) fails to detect a bottom tracking speed, resulting in the "Speed through the water" (STW) mode automatically.	
COLLISION	Continuous beep	COLLISION comes on when ARP-tracked target is on collision course.	Take evasive action or terminate tracking of target. Then, the visual indication goes off.
TRUE VECTOR indication	None	The TRUE VECTOR indication turns red when the TRUE Vector is selected in the RM mode, and returns to the normal text color in the North-up TM mode.	
Guard Zone alarm	Continuous beep	The label GZ appears in red if a target enters to the target alarm zone. Target is masked by a flashing inverted triangle.	Press the [ALARM ACK] key or click the ALARM ACK box with the left button to acknowledge it.
GZ OUT alarm	None	If the range scale has been reduced to make one of GZs positions more than 1.5 times of the range scale, the label GZ OUT appears in red.	Change the range scale of GZ.

1.43.2 Outputting alarm signal

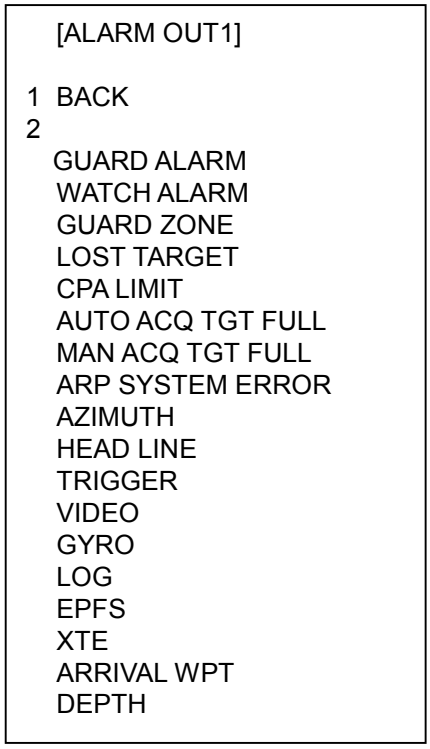
Four ports are provided from which to output alarm signals to external equipment. Choose the port and alarm signals to output as follows:

1. Roll the trackball to choose the MENU box and then push the left button.
2. Roll the wheel to choose 3 ALARM and then push the wheel or the left button.



ALARM menu

3. Roll the wheel to choose appropriate “ALARM OUT” item (6-8), and then push the wheel or the left button.



ALARM OUT1 menu

4. Roll the wheel to choose an alarm to output and then push the wheel or the left button. The alarm chosen is underlined.
5. Repeat step 5 to choose other alarms to output.
6. Push the right button three times to close the menu.

1.44 Choosing the Antenna, Displaying Antenna Information

This radar's interswitch uses an Ethernet to exchange video and control signals and actual interswitching is done with a digitized signal. Max. 4 antennas may be selected from the menu.

1.44.1 Choosing the antenna

For the ship which carries multiple antennas you may choose the antenna to use as follows:

1. Roll the trackball to place the arrow in the ANTENNA box at the left side of the screen.



ANTENNA box

2. Push the left button to choose the antenna to use.

Note: When the interswitch functions, all processor units viewing the image from the same antenna show the same radar picture, due to the nature of the LAN. Functions other than those listed below are controlled mutually.

Independently controlled functions in interswitching

Echo stretch
Echo averaging
Echo trails
Zoom
Wiper
Vector mode, vector time
ARP, AIS track interval
Target alarm
Speed data
L/L data

1.44.2 Displaying antenna information

The antenna information display shows data (radar band, model and position) on the radar antennas currently powered. If an antenna is not powered, its data area is blank.

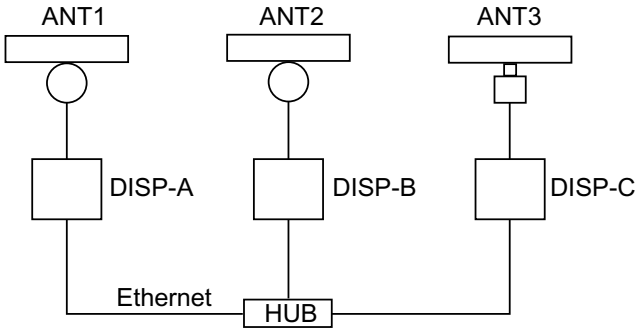
1. Roll the trackball to place the arrow in the ANTENNA box at the left side of the screen.
2. Push the left button to choose the antenna for which you want to find information. (You cannot choose an antenna which does not exist or one which is not powered.)
3. Push the right button to show the antenna information display.

```
   [ANT INFORMATION]

ANT NO 1
    BAND    : X-BAND
    MODEL   : 12 UP
    POS     : FORE
ANT NO 2
    BAND    : X-BAND
    MODEL   : 25 UP
    POS     : MAIN TOP
ANT NO 3
    BAND    : S-BAND
    MODEL   : 30 UP
    POS     : MAIN 2ND
ANT NO 4
    BAND    :
    MODEL   :
    POS     :

OWN RADAR NO.
```

Using the information shown on the antenna information display at left, the antenna system configuration looks as below.



ANTENNA INFORMATION display

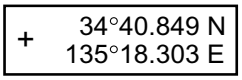
4. Push the right button to close the antenna information display.

The interswitch function permits control of all antennas from any display, using an Ethernet In the antenna system configuration shown above, for example, ANT1 can be controlled directly from DISPLAY-A, and also can be controlled from other displays, via the Ethernet. Further, if ANT1 is out of order or its power has been turned off, any display can switch to ANT2 or ANT3. The ANT INFORMATION display shows which antennas can be used. Refer to it to know antenna status.

1.45 Cursor Data

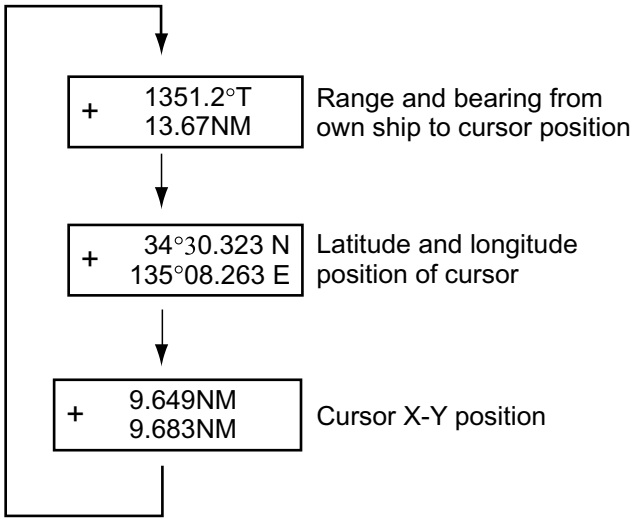
Cursor data can be shown in range and bearing from own ship, latitude and longitude position or cursor's X-Y coordinates.

1. Roll the trackball to choose the CURSOR DATA box at the right side of the display.



CURSOR DATA box (L/L position)

2. Push the left button to choose the cursor data to show. The cursor data changes in the sequence shown below.



Cursor data options

Note 1: For the X-Y coordinates display, the Y-axis is the heading line, right/top is "plus" and left/lower is "minus."

Note 2: When displaying latitude and longitude position and the cursor has been aligned (on the PLOTTER menu), the indication "ALIGN" appears at the right side of the screen (in red).

Note 3: Cursor data reads "- - -.-" when the cursor is placed outside the effective display area.

1.46 Performance Monitor

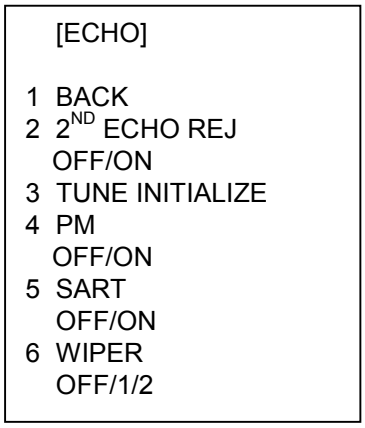
A performance monitor is required for a radar installed on vessels of 300 GT and upward engaged in international voyages. Two units are available:

X-band radar: PM-31 (9410 ± 45 MHz)
S-band radar: PM-51 (3050 ± 30 MHz).

The performance monitor is incorporated in the antenna unit.

1.46.1 Activating, deactivating the performance monitor

1. Roll the trackball to choose the MENU box and then push the left button.
2. Roll the wheel to choose 1 ECHO and then push the wheel or the left button.



ECHO menu

3. Roll the wheel to choose 4 PM and then push the wheel or the left button.
4. Roll the wheel to choose OFF or ON as appropriate and then push the wheel or the left button.
5. Push the right button twice to close the menu.

“PM” appears on the display when the performance monitor is active.

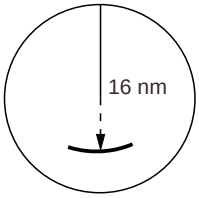
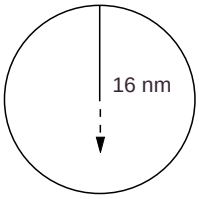
1.46.2 Checking radar performance

1. The radar is automatically set up as follows:

Range:	24 nm
Pulselength:	Long
Shadow Sector:	Off
STC:	Off
RAIN:	Off
Echo Stretch:	Off
Echo Average:	Off
Video Contrast:	A
Tune:	Auto
Gain:	Initial setting (as set with PM GAIN ADJ at installation)

2. Turn on the performance monitor referring to paragraph 1.46.1.
3. After observing the results turn off the performance monitor.

The range scale is automatically set to 24 nm. The radar screen will show on or two arcs. 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 are should appear at 16 nm. The performance monitor can observe a total of 10 dB loss in transmitter and receiver.

Display	Radar State
	**Transmitter:** normal **Receiver:** normal
	**Transmitter and receiver:** 10 db loss Echo is not visible

1.47 Wiper

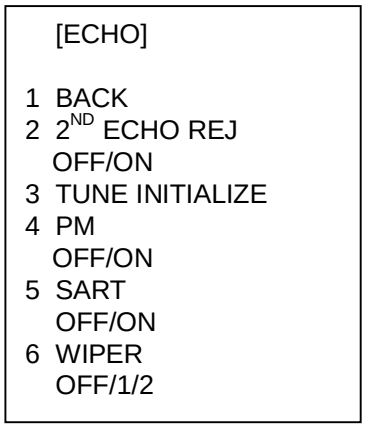
The wiper feature automatically changes the brilliance of weak signals to facilitate picture observation, and its affect depends on the wiper setting used and whether each averaging is turned on or off.

Condition 1: Wiper setting “1” or “2”, Echo averaging OFF
The brilliance of weak signals such as noise, sea clutter and rain clutter is reduced to clear the picture of those unwanted echoes. The wiper setting “2” provides greater suppression of brilliance of weak echoes than does setting “1”.

Condition 2: Wiper setting “2”, Echo averaging ON (EAV1/2/3)
With the wiper setting “2” and echo averaging on, you can observe the picture before and after echo averaging. For example, after observing the movement of a high-speed craft on the display, you can view the picture in which only the brilliance of sea clutter is suppressed, after echo averaging.

To activate the wiper feature, do the following:

1. Roll the trackball to choose the MENU box and then push the left button.
2. Roll the wheel to choose 1 ECHO and then push the wheel or the left button.



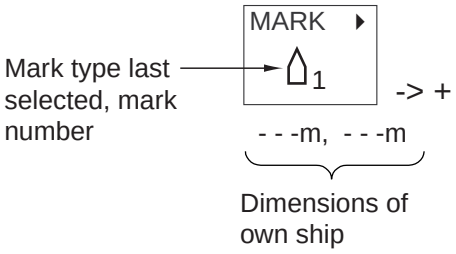
ECHO menu

3. Roll the wheel to choose 6 WIPER and then push the wheel or the left button.
4. Roll the wheel to choose OFF, 1 or 2 as appropriate and then push the wheel or the left button.
5. Push the right button twice to close the menu.

1.48 Own Ship Symbol

Own ship symbol ( ) may be inscribed on the screen as below. You may enter ten such symbols. Each own ship symbols is shown with a number.

1. Roll the trackball to choose the MARK box at the left side of the screen. The guidance box now reads " MARK SELECT / MARK MENU."



Mark box

2. Push the right button to open the MARK menu.

```
   [ MARK MENU]

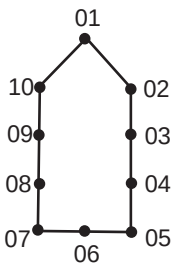
1  ORIGIN MARK STAB
   GND/SEA
2  MARK KIND
   ORIGIN MARK(No.)/
   ORIGIN MARK(SYM)/
   MAP MARK/
   WP 1~50/
   WP 51~100/
   WP 101~150/
   WP 151~198/
   OWN SHIP SHAPE

9  MAP DISPLAY
   OFF/ON
0  MAP MARK COLOR*
   RED/GRN/BLU/YEL/
   CYA/MAG/WHT
```

* Not available on IMO radar.

MARK menu

3. Roll the wheel to choose " 2" and then push the wheel or the left button.
4. Roll the wheel to choose OWN SHIP SHAPE and then push the wheel or the left button.
5. Push the right button to close the menu.
6. Use the trackball to choose the own ship symbol at the bottom left corner.
7. Roll the wheel to choose the point number for which you want to change its position. See figure at right.
8. Push the left button twice. The cursor positions at the point number chosen.
9. Use the trackball to drag the point to location desired.
10. Push the left button to confirm chosen location.
11. Repeat steps 6-10 continue changing symbol shape.



1.49 Color and Brilliance Sets

This radar provides four sets of color and brilliance sets to match any ambient lighting condition. The default colors are as shown in the table below. The default brilliance setting for any item is “50%”.

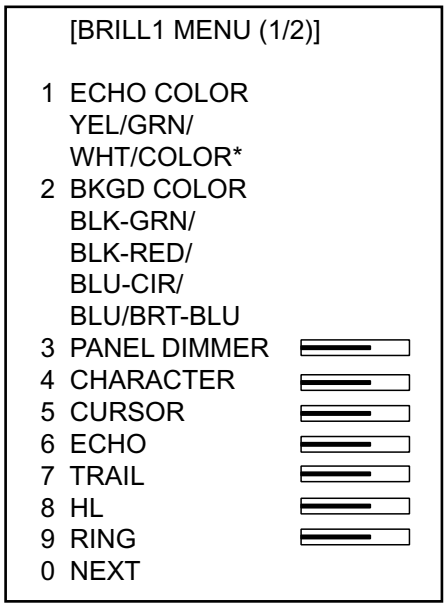
	BRILL1	BRILL2	BRILL3	BRILL4
Echo	Yellow	Yellow	Yellow	Yellow
Inside Display, Outside Display	Black, Black	Black, Black	Blue, Black	Blue, Blue
Menu	Yellow	Yellow	Yellow	Yellow
Characters	Green	Red	Green	White
Bearing Scale	Blue	Red	White	Green

1.49.1 Choosing color and brilliance set

1. Roll the trackball to choose the BRILL box at the left side of the screen.
2. Roll the wheel to choose color and brilliance set from among BRILL1 – BRILL4.
3. Push the wheel to finish.

1.49.2 Presetting color and brilliance set

1. Roll the trackball to choose the BRILL box at the left side of the screen.
2. Push the right button to open the BRILL menu.



* Not available on IMO radar.

BRILL menu

3. Roll the wheel to choose 1 ECHO COLOR and then push the wheel or the left button.
4. Roll the wheel to choose echo color desired and then push the wheel or the left button. “COLOR,” available on the Non-IMO radar, displays echoes in colors of red, yellow and green, corresponding to signal levels of strong, medium and weak.

5. Roll the wheel to choose 2 BKGD COLOR and then push the wheel or the left button.
6. Roll the wheel to choose background color and surrounding color combination desired and then push the wheel or the left button.
7. Set brilliance-related items referring to paragraph 1.38.
8. Push the right button to close the BRILL menu.

1.50 Reference Point for CPA/TCPA

The common reference point for CPA/TCPA can be chosen from antenna position or conning position as shown below. Echo sweep center and sector blanking symbol are always referenced to antenna position regardless of reference point chosen. For conning position, which is entered at installation, EBL and VRM are referenced to conning position.

1. Roll the trackball to choose the Reference Point Box at the top of the screen.



Reference point box

2. Push the right button to choose ANT POSN or CONN POSN as appropriate.

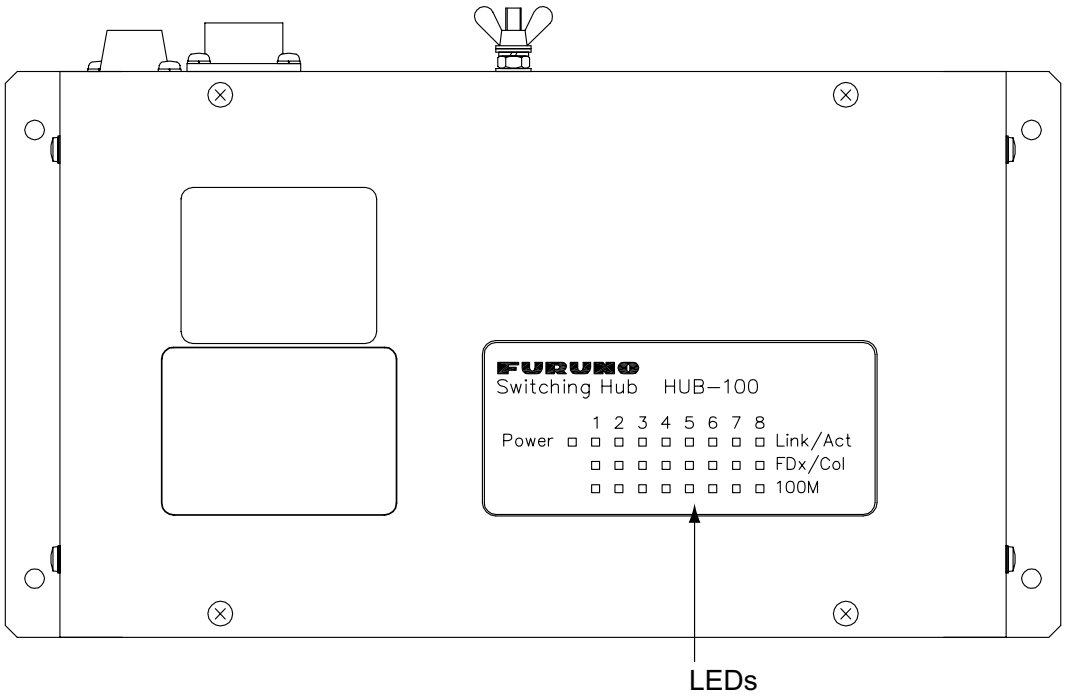
1.51 Switching Hub HB-100 (option)

The HB-100 provides switching for a card interface unit and multiple processor units (max. 7), using an Ethernet interface (100BASE-TX/10BASE-T). LEDs display link/activity, mode (full-duplex or half-duplex) and collision statuses.

No operation is required of the user. Simply turn on the HUB-100's AC power source to power it.

LED display

The LEDs on the top of the unit light, flash or go off according to equipment status. When the equipment is powered all LEDs light and then go off.



Switching Hub HUB-100

LED status and meaning

LED	Status	Meaning
Power	Lit Off	Equipment powered Equipment off
Link/Act	Lit Off Flashing	Connection with terminal normal Connection with terminal disconnected Data TX or RX
FDx/Col	Lit Off Flashing	Full-duplex Half-duplex Collision
100M	Lit Off	100Mbps connection 10Mbps connection

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2 RADAR OBSERVATION

2.1 General

2.1.1 Minimum and maximum ranges

Minimum range

The minimum range is defined by the shortest distance at which, using a scale of 1.5 or 0.75 nm, a target having an echoing area of 10 m^2 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 MSC.64(67) Annex 4 (Shipborne radar) and A.820: 1995 (High Speed Craft Radar) require the minimum range to be less than 50 m and 35 m, respectively. This series of radars satisfy this requirement.

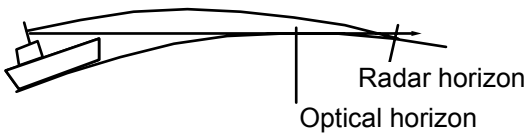
Maximum range

The maximum detecting range of the radar, Rmax, 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 Rmax is given in the following equation.

$$R_{max} = 2.2 \times (\sqrt{h1} + \sqrt{h2})$$

where Rmax: 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 equation on the previous page 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 determined by pulselength only. Practically, a 0.08 microsecond pulse offers the discrimination better than 35 m as do so with all FURUNO radars.

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

Bearing accuracy

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

Range measurement

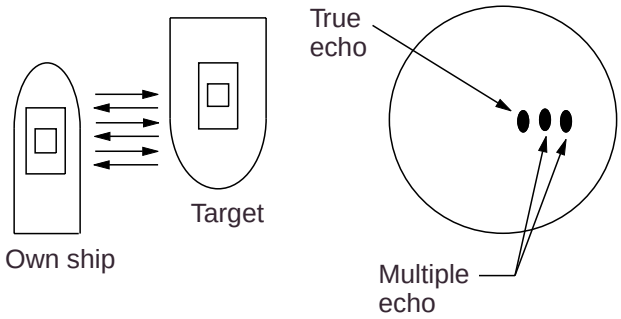
Measurement of the range to a target is also a very important function of the radar. Generally, there are two means of measuring range: the fixed range rings and the variable range marker (VRM). The fixed range rings appear on the screen with a predetermined interval and provide a rough estimate of the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

2.2 False Echoes

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

Multiple echoes

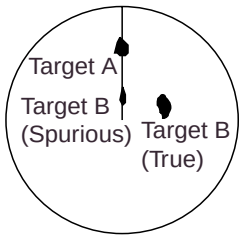
Multiple echoes occur when a transmitted pulse returns from a solid object like a large ship, bridge, or breakwater. A second, a third or more echoes may be observed on the display at double, triple or other multiples of the actual range of the target as shown below. Multiple reflection echoes can be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



Multiple echoes

Sidelobe echoes

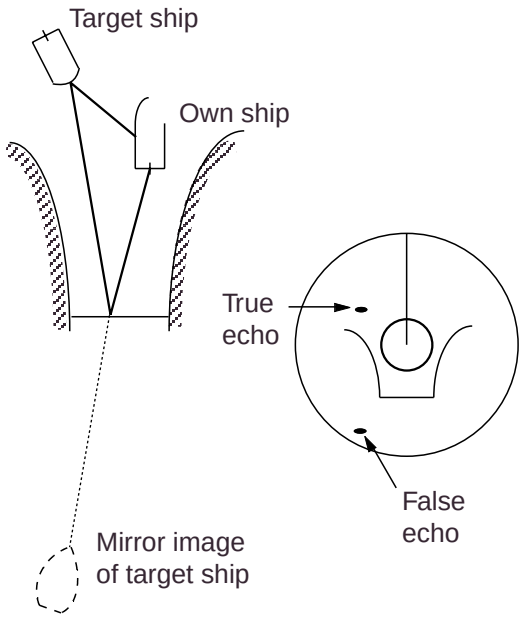
Every time the radar pulse is transmitted, some radiation escapes on each side of the beam, called “sidelobes.” If a target exists where it can be detected by the side lobes as well as the main lobe, the side echoes may be represented on both sides of the true echo at the same range. Side lobes show 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.



Sidelobe echoes

Virtual image

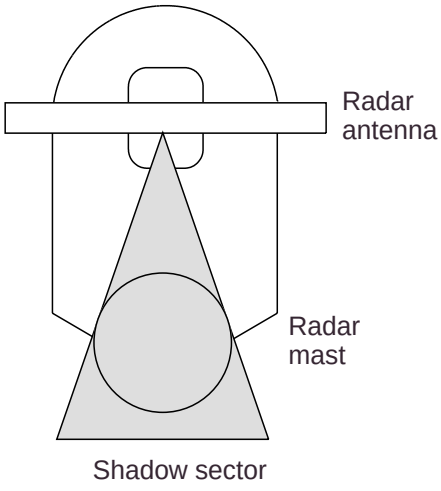
A relatively large target close to your ship may be represented at two positions on the screen. One of them is the true echo directly reflected by the target and the other is a false echo which is caused by the mirror effect of a large object on or close to your ship as shown in the figure below. If your ship comes close to a large metal bridge, for example, such a false echo may temporarily be seen on the screen.



Virtual image

Shadow sectors (see above right)

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



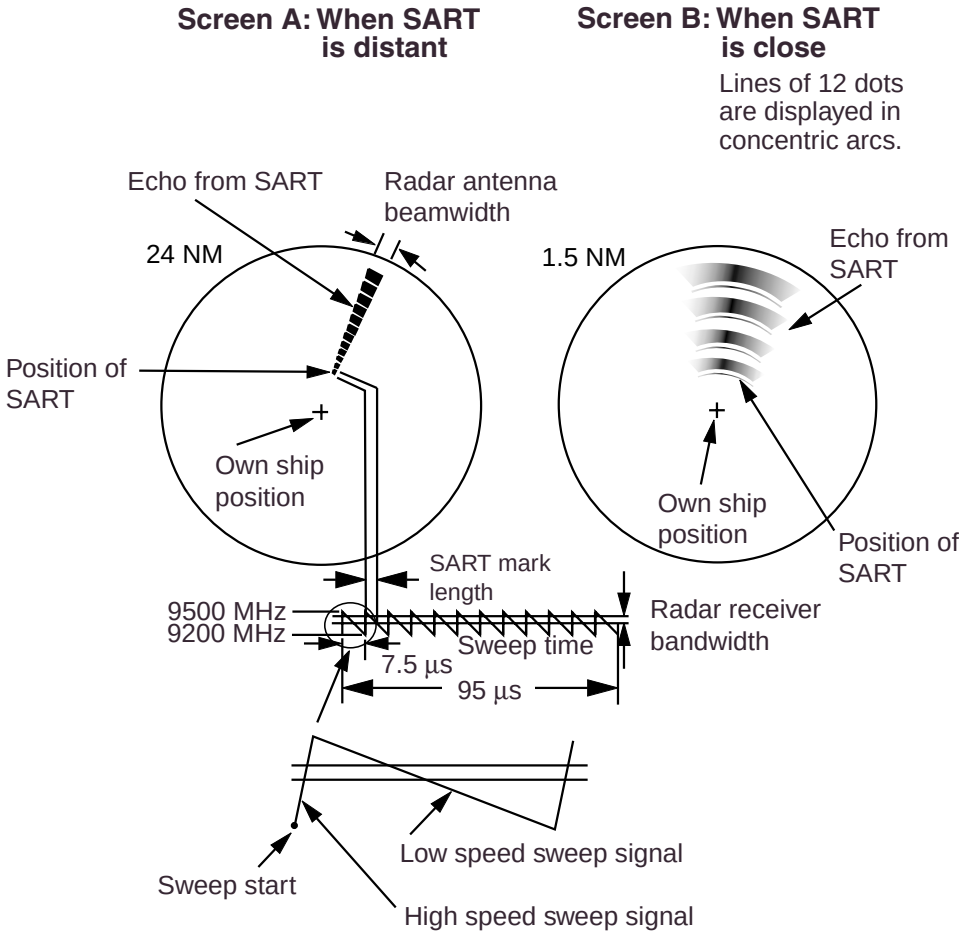
Shadow sectors

2.3 SART (Search and Rescue Transponder)

2.3.1 SART description

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 µs) through the band before beginning a relatively slow sweep (7.5 µs) 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 radar to the SART is reduced to about 1 nm, the radar display my show also the 12 responses generated during the fast sweeps. These additional dot responses, which also are equally spaced by 0.64 nautical miles, will be interspersed with the original line of 12 dots. They will appear slightly weaker and smaller than the original dots.



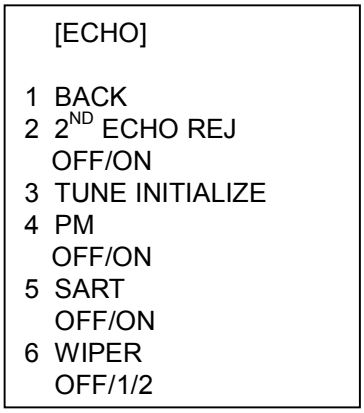
SART

2.3.2 Showing SART marks on the radar display

This radar is equipped with a feature which optimally sets up the radar for SART detection. This feature automatically detunes the radar receiver out of its best tuning condition. This erases or weakens all normal radar echoes, but the SART marks are not erased because the SART response signal scans over all frequencies in the 9 GHz band. When the radar approaches the SART in operation, the SART marks will enlarge to large arcs, blurring a large part of the screen.

To set up for SART detection do the following:

1. Roll the trackball to choose the MENU box and then push the wheel or the left button.
2. Roll the wheel to choose 1 ECHO and then push the wheel or the left button.



Echo menu

3. Roll the wheel to choose 5 SART and then push the wheel or the left button.
4. Roll the wheel to choose ON and then push the wheel or the left button.

   With SART turned on radar functions are set as follows:

Range:	12 nm
Pulselength:	Long
Echo Stretch:	Off
Noise Rejector:	Off
Echo Averaging:	Off
Interference Rejector:	Off
Performance Monitor:	Off
A/C RAIN:	Off

5. Push the right button twice to close the menu.

“SART” appears at the bottom of the display when this feature is active. Be sure to turn off the SART feature when SART detection is no longer your objective.

2.3.3 General remarks on receiving SART

SART range errors

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

Radar bandwidth

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

A 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.

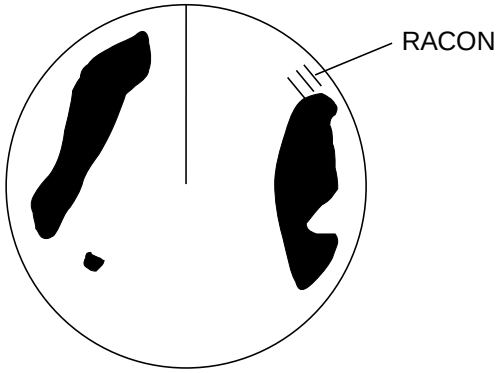
Radar side lobes

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 own ship.

Note: SART information excerpted from IMO SN/Circ 197 OPERATION OF MARINE RADAR FOR SART DETECTION.

2.4 RACON

A RACON is a radar beacon which emits radar receivable signals in the radar frequency spectrum (X- or S-band). There are several signal formats; in general, the RACON signal appears on the radar screen as a rectangular echo originating at a point just beyond the position of the radar beacon. It has a Morse coded pattern. Note that the position on the radar display is not accurate.



RACON

3 ARP OPERATION

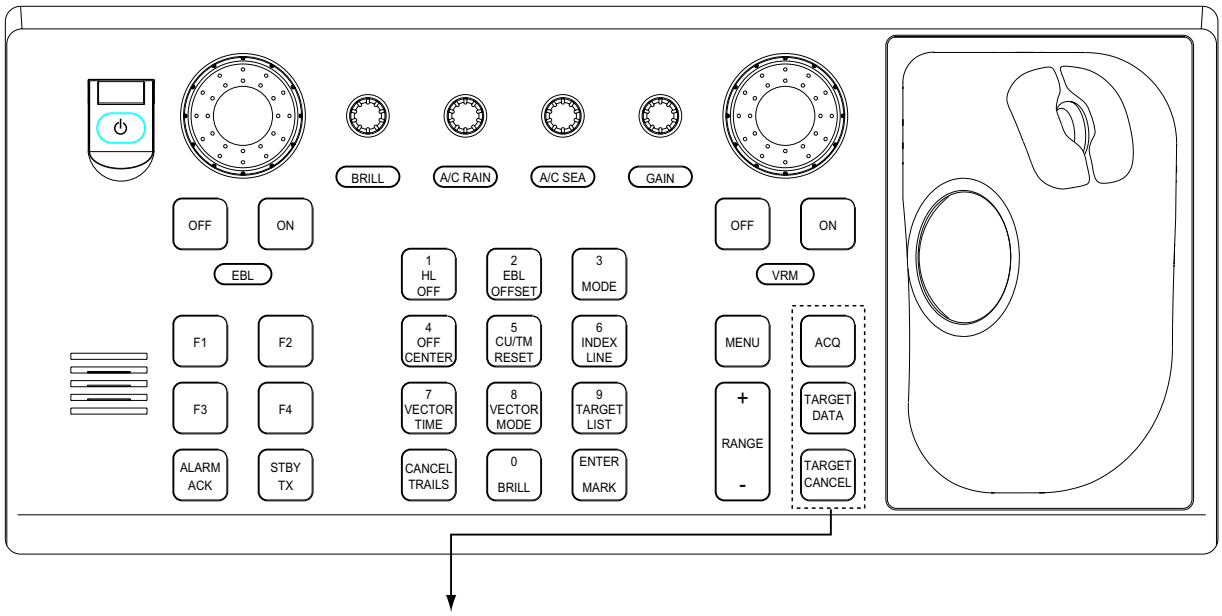
3.1 Usage Precautions

- This function is designed to meet the IMO requirements of both ARPA and ATA, and the desired function is selected during the installation of the equipment. For sake of brevity, this manual uses “ ARP” when referring to ARPA or ATA.
- The plotting accuracy and response of this ARP meets IMO standards. Tracking accuracy is affected by the following:
  - Tracking accuracy is affected by course change. One to two minutes is needed to restore vectors to full accuracy after an abrupt course change. (The actual amount depends on gyrocompass specifications.)
  - The amount of tracking delay is inversely proportional to the relative speed of the target. Delay is on the order of 15-30 seconds for high relative speed; 30-60 seconds for low relative speed.
- The data generated by this ARP are intended for reference only. Refer to official nautical charts for detailed and up-to-date information.
- 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.

3.2 Controls for ARP

Keyboard

The ARP uses the keys shown below.



ACQ: Manually acquires a target.
TARGET DATA: Displays data on ARP target chosen with the trackball.
TARGET CANCEL: Terminates tracking of ARP target chosen with the trackball.

Control unit RCU-014

Trackball

With the cursor inside the effective display area, you can access ARP functions by rolling the wheel or choosing appropriate ARP function from the CURSOR menu.

Roll the wheel to show the following indications in the guidance box to access respective ARP function:

TARGET DATA & ACQ: Manually acquires a target, or displays data of the cursor-selected ARP target.
TARGET CANCEL: Cancels tracking on cursor-selected ARP target.
ACQ: Manually acquires a target.

3.3 Activating, Deactivating ARP

To activate or deactivate the ARP:

1. Roll the trackball to place the arrow in the ARP ACQ MODE box at the right side of the display. (Note that “ ATA” replaces “ ARPA” when the ATA feature is used.)



ARPA ACQ MODE box

2. Push the left button to show OFF, MAN or AUTO MAN as appropriate.

3.4 Entering Own Ship's Speed

The ARP requires own ship' s speed and heading data. The speed can be STW, BT, SOG or echo-referenced speed (based on 3 max. stationary objects). Manual input is also possible.

For automatic or manual input, see paragraph 1.13. For echo-referenced speed input follow the procedure below.

3.4.1 Echo-referenced speed input

The use of echo-referenced speed is recommended when:

- The speed log is not operating properly or not connected to the radar.
- The vessel has no device which can measure ship' s leeward movement (Doppler sonar, speed log, etc.) when leeward movement can not be disregarded.

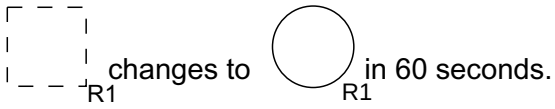
If you select echo-referenced speed, the ARP calculates own ship' s speed relative to a fixed reference target. The number of targets may be 1, 2 or 3. They appear as tracked targets, each shown in a small circle. When a plural of objects are selected, the mean value is used for stabilization and speed.

Note that this feature is not available when the AIS is active.

1. With the cursor inside the effective display area, roll the wheel to display “ REF MARK / EXIT” in the guidance box.
2. Select a small fixed island or any radar prominent point located at 0.2 to 24 nm from own ship.
3. Roll the trackball to place the cursor (+) on the target selected at step 2.

4. Push the left button to enter the reference mark. (The mark may also be entered by pressing the [ENTER MARK] key on the full keyboard.)

   The reference target mark (see below) appears at the cursor position and the own ship position data label changes from “LOG,” “NAV” or “MANUAL” to “REF.” Note that it takes 60 scans or approximately 1 min before a new speed is displayed. If tracking has failed for a reference target, the target is marked with a lost target mark (symbol formed with two triangles).



Reference target

5. Repeat steps 2-4 to continue entering reference marks. Three may be entered.

Notes on speed input by reference target

- When the reference target is lost or goes out of the acquisition range, the reference target mark blinks and the speed reads “**.*.” Select a different reference target in this case.
- When all targets are deleted, the reference target mark is also deleted and the target-based speed becomes invalid. The speed is indicated as KTBT where BT means Bottom Track (speed over ground).
- Reference targets may be marked with a vector. This can be done with 3 REF TARGET VECTOR on the ARP TARGET menu.

Canceling echo-referenced speed input

Open the SPD menu, referring to paragraph 1.13, and set 1 SHIP SPEED to LOG, NAV or MANUAL as appropriate.

3.5 Automatic Acquisition

The FAR-2xx7 radars can acquire a maximum of 100 targets, the number of automatically and manually acquired targets determined by the ARP TGT menu setting.

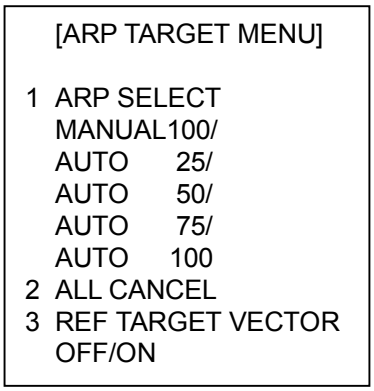
ARP TGT menu setting and target acquisition condition

Menu Setting	Acquisition condition
MANUAL100	100 targets manually
AUTO25	25 targets automatically, 75 targets manually
AUTO50	50 targets automatically, 50 targets manually
AUTO75	75 targets automatically, 25 targets manually
AUTO100	100 targets automatically

A target just acquired automatically is marked with a broken square and a vector appears within 20 scans (3 s for HSC) of the antenna to indicate the target's motion trend. Within 60 scans (20 scans for HSC), the initial tracking stage is finished and the target becomes ready for stable tracking. At this point, the broken square mark changes to a solid circle. (Targets automatically acquired are distinguished from those acquired manually. The targets which are acquired manually are displayed by bold symbol.)

3.5.1 Enabling auto acquisition

1. Roll the trackball to place the arrow in the ARP ACQ MODE box at the right side of the screen and then push the right button to show the ARP TARGET menu.



ARP TARGET menu

2. Roll the wheel to choose 1 ARP SELECT and then push the wheel or the left button.
3. Roll the wheel to choose automatic acquisition condition desired, referring to the table above for details, and then push the wheel or the left button.
4. Push the right button to close the menu.

Note 1: The ARP ACQ MODE box shows AUTO or AUTO MAN depending on the automatic acquisition condition selected.

Note 2: When the menu-set number of automatically acquired targets is reached, the message “TARGET-FULL(AUTO)” is displayed at the right-hand side of screen.

3.5.2 Terminating tracking of targets (including reference targets)

When the ARP has acquired the menu-set number of targets automatically, the message “TARGET-FULL(AUTO)” appears at the right side of the screen and no more auto acquisition occurs unless targets are lost. Should this happen, cancel tracking of less important targets or perform manual acquisition.

Canceling individual targets

By keyboard:

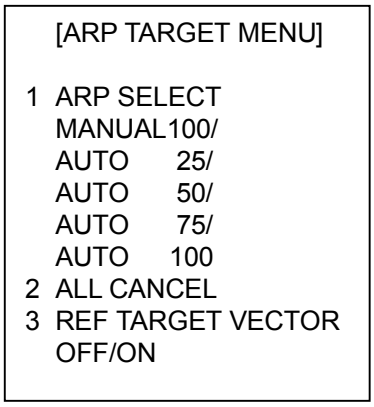
1. Roll the trackball to place the cursor (+) on the ARP or reference target to cancel tracking.
2. Press the [TARGET CANCEL] key.

By trackball:

1. With the cursor inside the effective display area, roll the wheel to show TARGET CANCEL / EXIT in the guidance box.
2. Roll the trackball to place the cursor on the ARP target or reference target to cancel tracking.
3. Push the left button or the wheel to cancel tracking on the target selected.
4. To finish, push the right button.

Canceling tracking on all targets

1. Roll the trackball to choose the ARP ACQ MODE box at the right side of the screen and then push the right button.



ARP TARGET menu

2. Use the wheel to choose 2 ALL CANCEL.
3. Push the wheel or the left button to cancel tracking on all ARP targets.

3.6 Manual Acquisition

Maximum 100 targets may be acquired manually depending on the acquisition condition set on the ARP TGT menu.

3.6.1 Setting manual acquisition conditions

1. Roll the trackball to place the arrow in the ARP ACQ MODE box at the right side of the screen and then push the right button to show the ARP TARGET menu.

```
   [ARP TARGET MENU]

1  ARP SELECT
   MANUAL100/
   AUTO     25/
   AUTO     50/
   AUTO     75/
   AUTO    100
2  ALL CANCEL
3  REF TARGET VECTOR
```

ARP TARGET menu

2. Roll the wheel to choose 1 ARP SELECT and then push the wheel.
3. Roll the wheel to choose MANUAL 100, AUTO 25, AUTO 50 or AUTO 75 as appropriate and then push the wheel or the left button. For details see the table on page 3-5.
4. Push the right button to close the menu.

3.6.2 Manually acquiring a target

By keyboard

1. Roll the trackball to place the cursor on the target you want to acquire.
2. Press the [ACQ] key.

By trackball

1. With the cursor inside the effective display area, roll the wheel to show “TARGET DATA & ACQ” or “ACQ” in the guidance box.
2. Roll the trackball to place the cursor on the target you want to acquire.
3. Push the left button to acquire the target.

The plotting symbol is drawn by broken lines during the initial acquisition 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 plotting symbol changes to a solid circle. If acquisition fails, the target plotting symbol blinks and disappears shortly.

ARP Symbol	Meaning
	Immediately after acquisition, this plotting symbol is shown in broken lines.
	Within 20 scans (3 s for HSC with antenna running at 42 rpm)) of the antenna after acquisition, a vector appears to show a trend of movement.
	Within 60 scans (20 scans for HSC with antenna speed of 42 rpm) of the antenna after acquisition, the plotting symbol changes to a small circle, indicating steady-state tracking condition.

Note 1: For successful acquisition, the target to be acquired should be within 0.2 to 32 nm from own ship and not obscured by sea or rain clutter.

Note 2: When the capacity for manual acquisition is reached, the message “TARGET-FULL(MAN)” is displayed at the screen bottom. Cancel tracking of non-threatening targets if you wish to acquire additional targets manually.

⚠ CAUTION

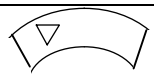
Target Swap

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

3.7 ARP Symbols and ARP Symbol Attributes

3.7.1 ARP symbols

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

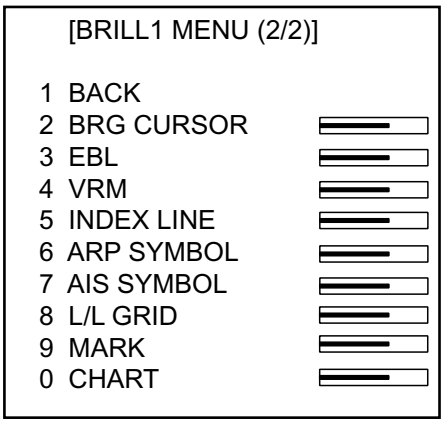
Item	Symbol	Status	Remarks
Automatically acquired targets		Initial stage	Broken square around an echo to indicate the target under acquisition and initial stage of tracking, before steady-state tracking.
			Between 20 and 60 scans of the antenna after acquisition (vector still unreliable)
		Steady tracking	Solid circle with vector indicating steady state tracking (60 scans after acquisition)
	 (flashing)	CPA alarm	Plotting symbol changes to an equilateral triangle, flashing to indicate the target is predicted to come into CPA or TCPA.
		CPA alarm acknowledge	Flashing stops after CPA/TCPA alarm is acknowledged.
	 (flashing)	Lost target	Lost target is indicated by flashing diamond symbol. The diamond is formed from two equal triangles.
Manually acquired targets		Initial stage	Plotting symbol selected for a target acquired manually is shown in bold broken lines.
			Bold broken square for 20 - 60 scans (3 scans for HSC) of the antenna after acquisition
		Steady tracking	Manual plotting symbol in a bold solid circle (60 scans after acquisition)
	 (flashing)	CPA alarm (collision course)	Plotting symbol changes to an equilateral triangle flashing if a target is predicted to come into the preset CPA or TCPA.
			Flashing stops after CPA/TCPA alarm is acknowledged.
	 (flashing)	Lost target	Lost target is indicated by flashing diamond symbol. The diamond is formed from two equal triangles.
Guard zone	 (flashing)	On target passing through operator-set guard zone	Plotting symbol changes to an equilateral triangle, apex down, flashing together with vector if target enters guard zone.
Target selected for data readout	 01	On selected target	Target data (range, bearing, course, speed, CPA and TCPA)
Reference target	 R In 60 scans, changes to  R	On reference target	Used to calculate own ship's over-the-ground speed (echo-referenced speed) for ground stabilization.

Other ARP symbols

Item	Symbol	Status	Remarks
Trial maneuver	T (flashing)	Bottom center	Appears during execution of a trial maneuver.
Performance test	XX (flashing)	Bottom center	Appears during performance test.

3.7.2 ARP symbol brilliance

1. Roll the trackball to choose the BRILL box at the left side of the screen and then push the right button.
2. Roll the wheel to choose 0 NEXT and then push the wheel or the left button.



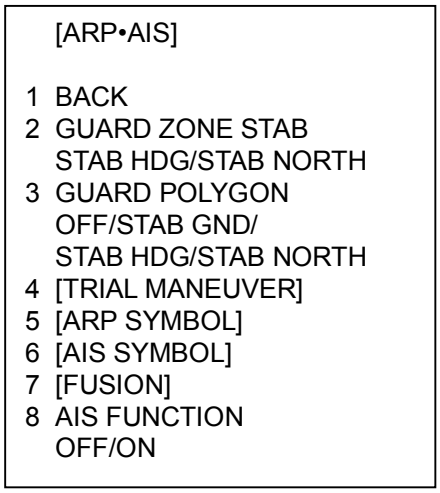
BRILL menu, page 2

3. Roll the wheel to choose 6 ARP SYMBOL and then push the wheel or the left button.
4. Roll the wheel to adjust brilliance.
5. Push the right button twice to close the menu.

3.7.3 ARP symbol color and size

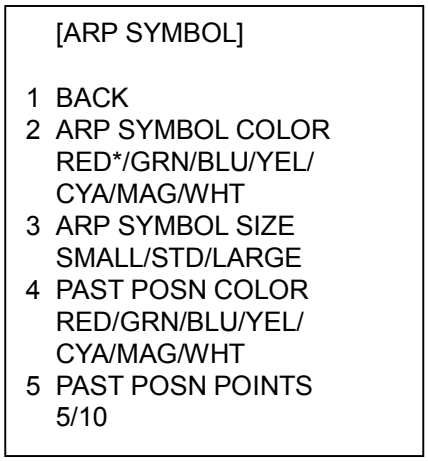
You may choose the color and size of the ARP symbol as follows:

1. Roll the trackball to choose the MENU box at the right side of the screen and then push the left button.
2. Roll the wheel to choose 4 ARP•AIS and then push the wheel or the left button.



ARP•AIS menu

3. Roll the wheel to choose 5 [ARP SYMBOL] and then push the wheel or the left button.



*: Not available on IMO radar.

ARP SYMBOL menu

4. Roll the wheel to choose 2 ARP SYMBOL COLOR and then push the wheel or the left button.
5. Roll the wheel to choose color desired and then push the wheel or the left button.
6. Roll the wheel to choose 3 ARP SYMBOL SIZE and then push the wheel or the left button.
7. Roll the wheel to choose SMALL, STD(Standard) or LARGE as appropriate and then push the wheel or the left button.
8. Push the right button three times to close the menu.

3.8 Displaying Target Data

The ARP mode provides the full functionality of ARP as required by the IMO Resolution A.823(19) and IEC 60972-1, including display of 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.

3.8.1 Displaying individual target data

By keyboard

Roll the trackball to place the cursor on a desired ARP target and press the [TARGET DATA] key. The target' s shape changes to a square. To erase a target' s data from the data box, press the key again.

By trackball

1. With cursor inside the effective display area, roll the wheel to show " TARGET DATA & ACQ / CURSOR MENU" in the guidance box.
2. Roll the trackball to place the cursor on a desired ARP target and then push the left button.
3. To erase a target' s data from the data box, choose the target on the radar display and then push the left button.

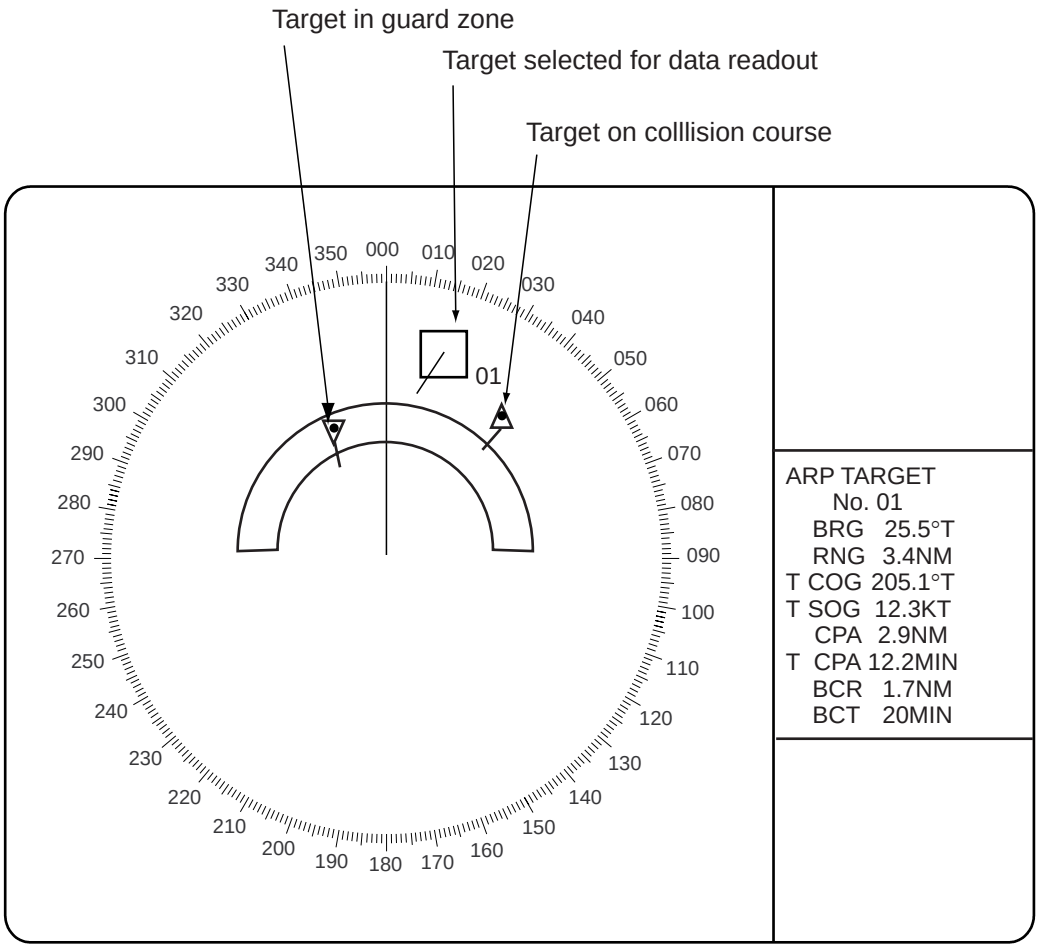
Target data display is as below.

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

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

CPA/TCPA: CPA(Closest Point of Approach) is the closest range a target will approach to own ship. TCPA is the time to CPA. Both CPA and TCPA are automatically calculated. When the CPA has passed clear of own ship, it is indicated by a TCPA with a negative (-) sign. TCPA is counted to 99.9 min and beyond this, it is indicate as TCPA> -99.9MIN.

BCR/BCT: BCR is the closest range at which the chosen target is predicted to cross your ship' s bow. BCT is the time at which the chosen target is predicted to cross your ship' s bow.



BRG: Bearing from own ship to target
in R (Relative) or T (True)
RNG: Range from own ship to target
COG: Course of target over ground, True or Relative
SOG: Speed of target over ground
CPA: Closest Point of Approach of target
to own ship
TCPA: Time to CPA
BCR: Bow crossing range of target
BCT: Bow crossing time of target

ARP target display

You may display the target data for two targets per data box and the data for as many as six targets may be displayed. For further details, see paragraph 1.41.

3.8.2 Target list

The target list provides a comprehensive data display of all ARP (and AIS) targets being tracked.

Displaying the target list

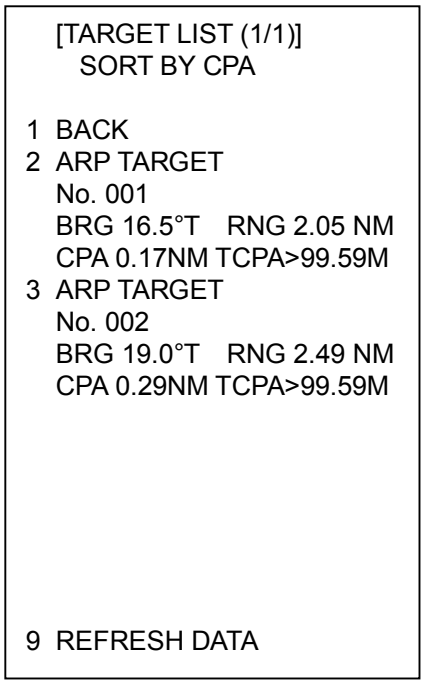
To display the target list, do the following:

1. Roll the trackball to choose the TARGET LIST box at the right side of the screen.



TARGET LIST box

2. Push the left button to display the TARGET LIST. “>” in the TCPA means that the time is greater than 99:59.



Target list

3. To scroll the list when there are more than three targets, select 0 NEXT and then push the wheel or the left button.

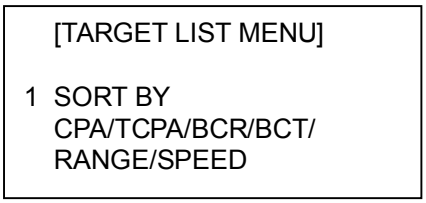
   Note: To refresh data, choose 9 REFRESH DATA and then push the wheel. This is not necessary when the sorting method is changed (see next page); data is automatically updated whenever the sorting method is changed.

4. Push the right button to close the list.

Sorting the target list

You may sort the target list by CPA, TCPA, BCR, BCT, RANGE or SPEED as follows: 72 nm or 96 nm range scale

1. Roll the trackball to choose the TARGET LIST box at the right side of the screen.
2. Push the right button to open the TARGET LIST menu.



TARGET LIST menu

3. Roll the wheel to choose 1 SORT BY and then push the wheel or the left button.
4. Roll the wheel to choose sorting method desired and then push the wheel or the left button.
5. Push the right button to close the menu.

3.9 Vector Modes

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

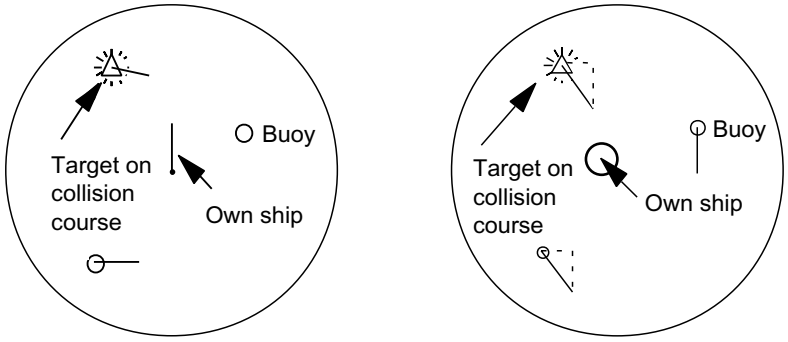
3.9.1 Description of vectors

Ground stabilization and sea stabilization

Target vectors can be ground stabilized or sea stabilized. Sea stabilization is a mode where own ship and all targets are referenced to the sea using a compass heading and single axis log water speed inputs in the True Motion mode. Ground stabilization is a mode where own ship and all targets are referenced to the ground using the ground track or set and drift inputs. If the accuracy seems unsatisfactory, enter the set and drift correction. Note that set and drift should not be used when the radar is displaying AIS targets.

True vector

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



True vectors in head-up mode

Relative vectors in head-up mode

True and relative vectors

Relative vector

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.)

3.9.2 Vector motion and length

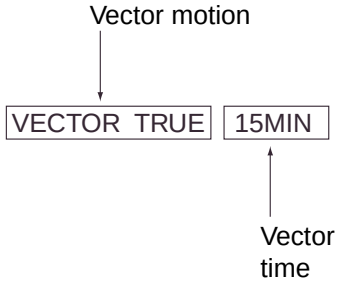
Vectors may be displayed in true or relative motion. Vector time (or the length of vectors) can be set to 30 seconds, 1, 2, 3, 6, 12, 15 or 30 minutes.

By keyboard

1. Press the [VECTOR MODE] key consecutively to choose relative or true vector mode. Your selection is shown on the Vector motion box. (Note that this also selects the vector mode for the past position display.)
2. Press the [VECTOR TIME] key consecutively to choose vector time. Your selection appears in the vector length box (see illustration below).

By trackball

1. Roll the trackball to choose VECTOR TRUE or VECTOR REL (whichever is displayed) at the right side of the screen.



ARP VECTOR boxes

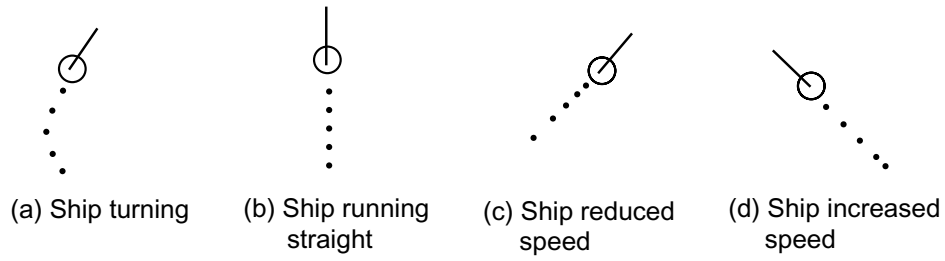
2. Push the left button to display VECTOR TRUE or VECTOR REL as appropriate. (Note that this also selects the vector mode for the past position display.)
3. Roll the trackball to choose the vector time box.
4. Push the left button to display time desired.

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.

3.10 Past Position Display

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

A new dot is added every minute (or at other 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.



Past position display

3.10.1 Displaying and erasing past position points, choosing past position plot interval

1. Roll the trackball to choose the PAST POSN box at the right side of the screen.

PAST POSN REL 2MIN

PAST POSN box

2. Push the left button to choose plot interval desired: OFF, 30 seconds, 1, 2, 3 or 6 minutes. Choose OFF to erase all past position points and deactivate the past position display.

3.10.2 Past position display attributes

You may choose the number of past point points to display per plotting interval and the color of past position points.

1. Roll the trackball to choose the MENU box at the right side of the screen and then push the left button.
2. Roll the wheel to choose 4 ARP•AIS and then push the wheel or the left button.

[ARP•AIS]

1 BACK
2 GUARD ZONE STAB
STAB HDG/STAB NORTH
3 GUARD POLYGON
OFF/STAB GND/
STAB HDG/STAB NORTH
4 [TRIAL MANEUVER]
5 [ARP SYMBOL]
6 [AIS SYMBOL]
7 [FUSION]
8 AIS FUNCTION
OFF/ON

ARP•AIS menu

3. Roll the wheel to choose 5 [ARP SYMBOL] and then push the wheel or the left button.

[ARP SYMBOL]

1 BACK
2 ARP SYMBOL COLOR
RED*/GRN/BLU/YEL/
CYA/MAG/WHT
3 ARP SYMBOL SIZE
SMALL/STD/LARGE
4 PAST POSN COLOR
RED/GRN/BLU/YEL/
CYA/MAG/WHT
5 PAST POSN POINTS
5/10

*: Not available on IMO radar.

ARP SYMBOL menu

3. Roll the wheel to choose 4 PAST POSN COLOR and then push the wheel or the left button.
4. Roll the wheel to choose color desired and then push the wheel or the left button.
5. Roll the wheel to choose 5 PAST POSN POINTS and then push the wheel or the left button.
6. Roll the wheel to choose 5 or 10 as appropriate and then push the wheel or the left button.
7. Push the right button three times to close the menu.

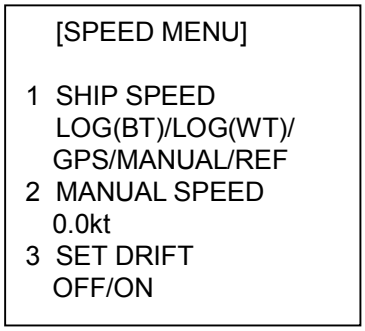
3.11 Set and Drift

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. Refer to the tide table on board the ship for setting information. These values are applied to all targets. If stationary targets have vectors, set and drift values should be adjusted until they lose vectors.

To enter set and drift do the following:

1. Roll the trackball to choose the SPD box and then push the right button.



SPEED menu

2. Roll the wheel to choose 3 SET DRIFT and then push the wheel or the left button.
3. Roll the wheel to choose ON and then push the wheel or the left button.
4. Push the right button to close the menu. Then, the SET and DRIFT boxes appear at upper right-hand side of the display.
5. Roll the trackball to choose the SET box at the right side of the screen.



SET box

6. Use the wheel to set value, rolling it to choose numeral and pushing it to set. (Setting range: 000.0 – 359.9 (°T))
7. Roll the trackball to choose the DRIFT box at the right side of the screen.



DRIFT box

8. Use the wheel to set value, rolling it to choose numeral and pushing it to set. (Setting range: 00.0 – 19.9(kt))

Note 1: Set and drift is available when using water tracking log. The speed source is shown as WTC in this case.
Note 2: Set and drift should be checked periodically for correctness.

3.12 Setting CPA/TCPA Alarm Ranges

> **⚠ CAUTION**
>
> **CPA/TCPA Alarm**
>
> The CPA and 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.

The ARP continuously monitors the predicted range at the Closest Point of Approach (CPA) and predicted time to CPA (TCPA) of each tracked target to own ship. When the predicted CPA of any target becomes smaller than a preset CPA alarm range and its predicted TCPA less than a preset TCPA alarm limit, the ARP releases an audible alarm and displays the warning label COLLISION on the screen. In addition, the ARP 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.

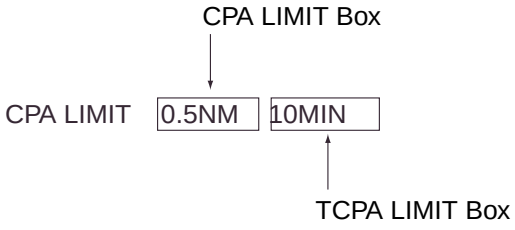
CPA/TCPA alarm ranges must be set up properly taking into consideration the size, tonnage, speed, turning performance and other characteristics of own ship.

Note: The reference point for CPA/TCPA calculation may be chosen from antenna position or conning position. For further details, see paragraph 1.50.

3.12.1 Setting CPA/TCPA alarm ranges

To set the CPA/TCPA alarm ranges, do the following:

1. Roll the trackball to choose the CPA LIMIT box. If only “CPA LIMIT OFF” appears press the left button to show the CPA and TCPA boxes.



CPA LIMIT and TCPA LIMIT boxes

2. Push the left button or roll the wheel to choose the CPA LIMIT box and then push the wheel.
   Left button: 0.5, 1, 1.5, 2, 3, 4, 5, 6(nm)
   Wheel: 0.5 - 20(nm), 0-10 nm in 1 nm increments, 0.5 nm increments thereafter
3. Roll the trackball to choose the TCPA limit box.
4. Push the left button or roll the wheel to choose TCPA value desired and then push the wheel.
   Left button: 1, 2, 3, 4, 5, 6, 12, 15(minutes), Wheel: 1-60 m, 1 m increments

3.12.2 Acknowledging CPA/TCPA alarm

To acknowledge and silence the CPA/TCPA alarm, press the [ALARM ACK] key on the keyboard, or choose the ALARM ACK box with the trackball and then push the left button.

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

Note that when the COLLISION alarm is generated the AIS display is automatically turned on.

3.13 Setting a Guard Zone

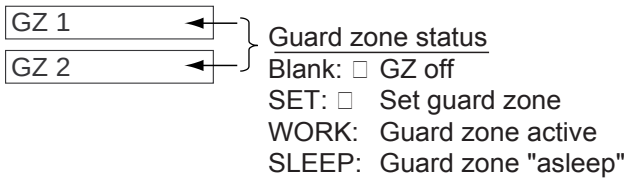
When a target transits the operator-set guard zone, the buzzer sounds and the indication GUARD appears (in red) at the screen bottom. The target causing the warning is clearly indicated with an inverted flashing triangle. The guard zone also functions as an automatic acquisition area when automatic acquisition is active. Any targets entering the zone will be automatically acquired.

3.13.1 Activating the guard zone

One or two guard zones may be selected. The No. 1 guard zone is available between 3 and 6 nm and No. 2 guard zone can be set anywhere when the No. 1 zone is already in use. The ARP/AIS guard zone' s lines are white and dashed so as to distinguish them from the radar guard alarm.

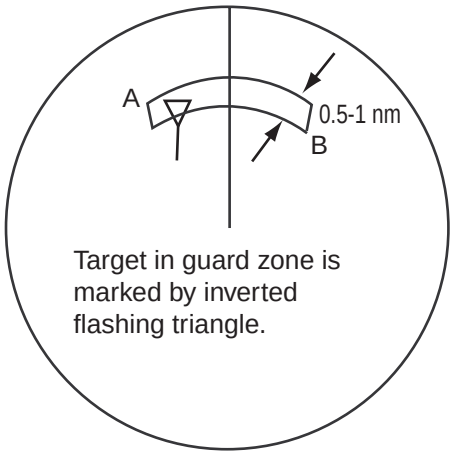
The procedure below shows how to set a guard zone, using the example at the bottom of the page.

1. Roll the trackball to choose one of the GZ (GUARD ZONE) boxes at the right side of the screen.



GZ boxes

2. Push the left button. The GZ box now reads " GZx SET."
3. Roll the trackball to place the cursor on point A and then push the left button.
4. Roll the trackball to place the cursor on point B and then push the left button. The GZ box now reads " GZx WORK."



Guard zone

If you are setting a polygon guard zone with GZ2, set at least three points. Press the right button to finish. Note that the status indication should be WORK or SLEEP to set GZ2.

When an ARP or AIS target violates the guard zone, the message “GUARD” appears (in red) at the right side of the display and the offending target is marked with an inverted triangle. Further, the AIS display is automatically turned on.

Note 1: 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. ±3°) as point A and then push the left button.

Note 2: If the range scale is changed to less than half of the guard zone, the GZ box reads “GZx OUT.” If the left button is pushed in this state, the guard alarm zone goes into “sleep” state and the guidance box reads “GZ WORK L = DELETE.”

Note 3: The default guard zone is fan shaped. It may also be a polygon having 3-10 points. For details, see paragraph 3.13.5.

Note 4: Two more alarm zones (No. 1 and No. 2 Guard Alarm Zones) may be added in addition. This means a maximum 4 alarm zones are available at a time. ARP symbols are not changed to inverted triangles in the guard alarm zone, only those in guard zone do so.

3.13.2 Sleeping, deactivating a guard zone

1. Roll the trackball to choose the appropriate GZ box.
2. Sleep or deactivate the guard zone as appropriate:

   Sleep guard zone: Push the left button momentarily to remove the guard zone from the screen. The indication in the GZ box changes from “GZx WORK” to “GZx SLEEP.” To reactivate and display the guard zone, repeat this procedure to display “GZx WORK.”

   Deactivate guard zone: Push and hold down the left button until the GZ box goes blank.

3.13.3 Acknowledging the guard zone alarm

To acknowledge and silence the guard zone audible alarm, press the [ALARM ACK] key, or choose the ALARM ACK box and then push the left button.

3.13.4 Guard zone reference

The guard zone may be referenced to heading or North as follows:

1. Roll the trackball to choose the MENU box at the right side of the screen and then push the left button.
2. Roll the wheel to choose 4 ARP•AIS and then push the wheel or the left button.



ARP•AIS menu

3. Roll the wheel to choose 2 GUARD ZONE STAB and then push the wheel or the left button.
4. Roll the wheel to choose STAB HDG or STAB NORTH as appropriate and then the push the wheel or the left button.
5. Push the right button twice to close menu.

3.13.5 Guard zone shape and stabilization

The shape of the No. 2 guard zone may be a sector or a polygon having up to 10 points. (The shape of the No.1 guard zone is always a sector.)

1. Roll the trackball to choose the MENU box at the right side of the screen and then push the left button.
2. Roll the wheel to choose 4 ARP•AIS and then push the wheel or the left button.
3. Roll the wheel to choose 3 GUARD POLYGON and then push the wheel or the left button.
4. Roll the wheel to choose OFF, STAB GND, STAB HDG or STAB NORTH as appropriate and then the push the wheel or the left button.
   - OFF: Guard zone is a sector; number of points limited to four.
   - STAB GND: Guard zone stabilized against ground; guard zone may be a polygon having 3-10 points.
   - STAB HDG: Guard zone stabilized against heading; guard zone may be a polygon having 3-10 points.
   - STAB NORTH: Guard zone stabilized against ground; guard zone may be a polygon having 3-10 points.
5. Push the right button twice to close menu.

3.14 Operational Warnings

There are six main situations which cause the ARP to trigger visual and audible alarms:

- Collision alarm
- Guard zone alarm
- Lost target alarm
- Target full alarm for manual acquisition
- Target full alarm for automatic acquisition
- System failure

Collision (CPA/TCPA) alarm

Visual (COLLISION) and audible alarms are generated a target falls with a preset limits. To acknowledge the audible alarm, press the [ALARM ACK] key, or choose the ALARM ACK box and then push the left button.

Guard zone alarm

Visual (“GUARD”) and audible alarms are generated when a target transits the operator-set guard zone. To acknowledge and silence the guard alarm, press the [ALARM ACK] key, or choose the ALARM ACK box and then push the left button.

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 audible alarm is produced for one second.

To acknowledge and silence the lost target audible alarm, press the [ALARM ACK] key, or choose the ALARM ACK box and then push the left button. Then, the lost target mark disappears.

Target full alarm

When the memory becomes full, the memory full status is indicated by “TARGET-FULL(AUTO+MAN)” and the relevant indication appears on the screen and a short beep sounds.

Manually acquired targets

The indication “TARGET-FULL(MAN)” appears at the screen bottom and a short beep tone sounds when the capacity for manually acquired targets, as set on the menu, is reached.

Automatically acquired targets

The indication “TARGET-FULL(AUTO)” appears at the screen bottom and a short beep sounds when the capacity for automatically acquired targets, as set on the menu, is reached.

System failure alarm

When the SPU Board receives no signal input from the radar or external equipment, the screen shows both “ARP SYSTEM ERROR” associated with an indication denoting offending equipment, also releasing an audible alarm. The missing signals are denoted as shown below.

Missing Signal	Indication
* Speed log signal	LOG
* Heading signal, Gyrocompass	GYRO
Trigger signal from radar	TRIGGER
Video from radar	VIDEO
* Bearing signal from radar antenna	AZIMUTH
* Heading pulses from radar antenna	HEADLINE

* The alarm is available with or without ARP.

3.15 Trial Maneuver

The trial maneuver feature simulates the effect on all tracked targets against own ship's maneuver without interrupting the updating of target information. It is available for use with the ARPA function; it is inoperative on the ATA.

3.15.1 Types of trial maneuvers

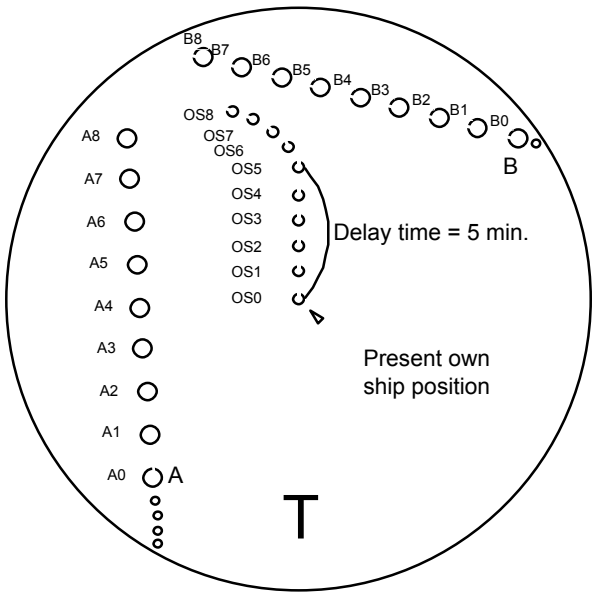
There are two types of trial maneuvers: static and dynamic.

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

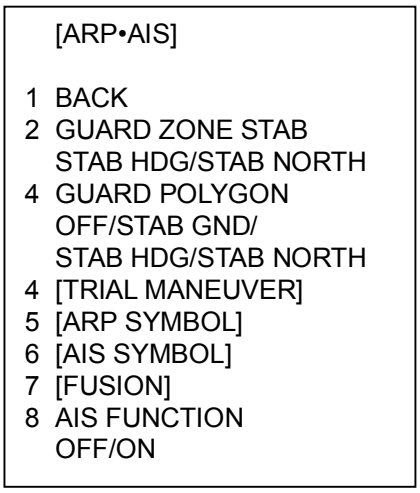
A static trial maneuver displays only the final situation of the simulation. If you enter the same trial speed, course and delay time under the same situation as in the aforementioned example of dynamic trial maneuver, the screen will instantly show position OS7 for own ship, position A7 for target A 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 during the installation.

3.15.2 Performing a trial maneuver

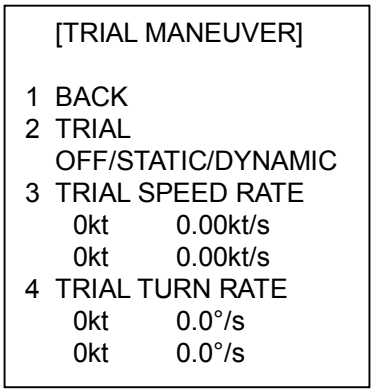
To perform a trial maneuver, do the following:

1. Roll the trackball to choose the MENU box at the right side of the screen and then push the left button.
2. Roll the wheel to choose 4 ARP•AIS and then push the wheel or the left button.



ARP•AIS menu

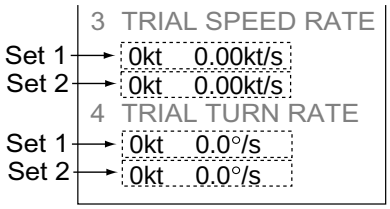
3. Roll the wheel to choose 4 TRIAL MANEUVER and then push the wheel or the left button.



TRIAL MANEUVER menu

4. Roll the wheel to choose 2 TRIAL and then push the left button or the wheel.
5. Roll the wheel to choose STATIC or DYNAMIC as appropriate and then push the wheel or the left button.
6. Roll the wheel to choose 3 TRIAL SPEED RATE. Set trial speed rate with the wheel: Roll the wheel to choose numeral; push the wheel to set.
7. Roll the wheel to choose 4 TRIAL TURN RATE. Set trial turn rate with the wheel: Roll the wheel to choose numeral; push the wheel to set.

   Note: Two sets of trial speed and trial turn rate combinations are provided. Enter the data by sets as shown in the figure below. This is done to provide accurate trial maneuver results for various ship's speed.

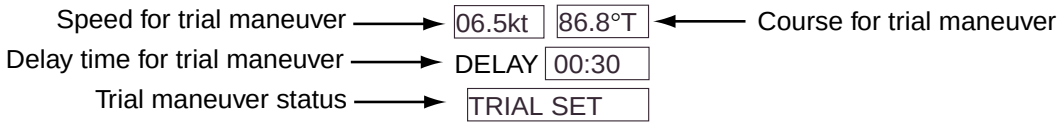


8. Push the right button three times to close the menu. Then, the TRIAL box appears at the right side of the display.



TRIAL box

9. Roll the trackball to choose the TRIAL box and then push the wheel or the left button to display TRIAL SET. Then, the TRIAL box reads TRIAL SET and boxes appear above the TRIAL box as below.



Boxes for setting trial maneuver parameters

10. Use the wheel to set delay time at DELAY. 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. Roll the wheel to choose location; push the wheel to set.

11. Roll the wheel to choose the course setting box. Use the wheel to set the course: Roll the wheel to choose location; push the wheel to set.
12. Roll the wheel to choose the speed setting box. Use the wheel to set the speed: Roll the wheel to choose location; push the wheel to set.
13. Roll the wheel to choose TRIAL SET. Push the left button or the wheel to show TRIAL WORK.

    The trial maneuver takes place for 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 plotting symbol changes to a triangle and flashes. If this happens, change own ship's trial speed, course or delay time to obtain a safe maneuver. The trial maneuver is automatically terminated and the normal radar picture is restored three minutes later.

3.15.3 Terminating a trial maneuver

A trial maneuver is automatically terminated three minutes after start. To terminate it manually, do the following:

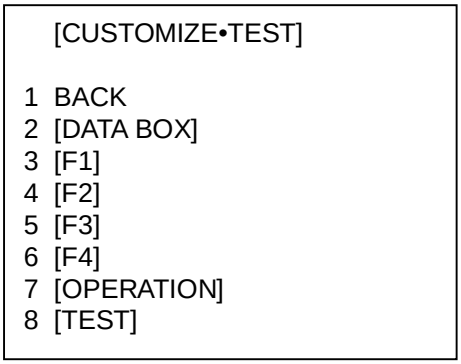
1. Roll the trackball to choose the TRIAL box at the right side of the screen.
2. Push and hold down the left button to show TRIAL OFF.

Note: To disable the trial maneuver function, choose OFF at step 5 in the procedure in paragraph 3.15.2 and then push the wheel or the left button.

3.16 ARP Performance Test

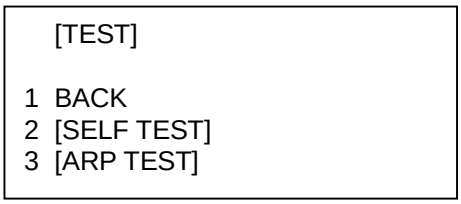
A test program is provided for assessing overall performance of the ARP. Normal operation is suspended and the indication “XX” appears at the bottom of the effective display area during the test. The test may be terminated at any time.

1. Roll the trackball to choose the MENU box and then push the left button.
2. Roll the wheel to choose 9 [CUSTOMIZE•TEST] and then push the wheel or the left button.



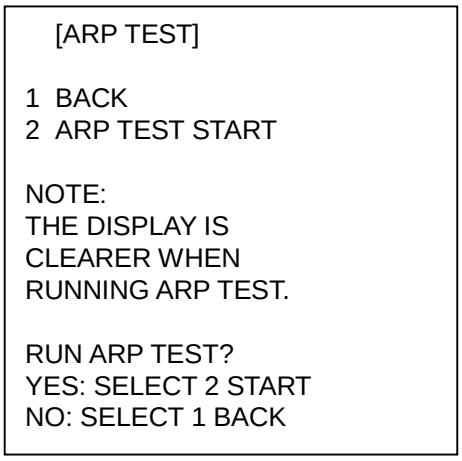
CUSTOMIZE•TEST menu

3. Roll the wheel to choose 8 [TEST] and then push the wheel or the left button.



TEST menu

4. Roll the wheel to choose 3 [ARP TEST].



ARP TEST menu

5. Roll the wheel to choose 2 ARP TEST START and then push the wheel or the left button to start the test.

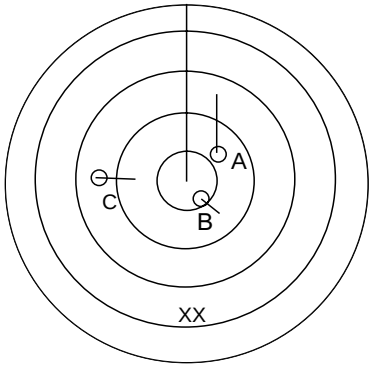
   An alert " XX" flickers during the test. It takes approximately three minutes for all vectors to be displayed. The test does not need echo signals, gyro nor speed log input. Three targets having different speeds and courses, as shown in the table below, are simulated automatically, together with current targets. These targets can be treated as you would an ordinary ARP target – you may cancel them, display their data, etc.

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

To terminate the test, press the [STBY TX] key or choose the TX STBY box at the bottom left corner and then push the left button.

Select any target with the cursor and check that the selected target shows the course and speed as in the table. CPA and TCPA shown in the table are with ship' s speed of 0 kt. Range, CPA and TCPA change with time; bearing and speed are fixed.

	Range (nm)	Bearing (°)	Speed (kt)	Course (°)	CPA (nm)	TCPA (min)
Target A	3.0	45.0	20.0	0	2.1	-6.4
Target B	2.0	120.0	5.0	120.0	0.0	-24.0
Target C	7.0	270.0	10.0	90.0	0.0	42.0



3.17 Criteria for Selecting Targets for Tracking

The FURUNO ARP 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 ARP) requirements, an indication of the motion trend should be available within 20 scans of antenna and full vector accuracy within 60 scans. The FURUNO ARPs comply with these requirements.

Acquisition and tracking

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

Targets not detected in five consecutive scans become “lost targets.”

Quantization

The entire picture is converted to a digital from 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 five consecutive radar pulses with 1’s indicating an echo presence at the exact same range, a target “start” is initiated. Since receiver noise is random, it is not three-bang correlated, and it is filtered out and not classified as an echo.

The same is true of radar interference. Electronic circuits track both the closet and most distant edges of the echo. At the end of the scanning of the echo, the discriminator indicates the measured maximum range extent and total angular extent subtended by the echo. If the echo is larger than a ship-sized echo in range extent and/or angular width, adjusted as a function of range, it is declared to be a coastline and the closet edge is put into memory as a map of the area.

This land outline is used to inhibit further acquisition and tracking of ship-sized echoes beyond the closest coast outline. Five consecutive scans of coastal outline are retained in memory to allow for signal variation. All smaller echoes are declared to be ship sized and the middle of the leading edge is used to provide precise range and bearing coordinates of each echo on every scan. This range/bearing data is matched to previous data and analyzed from scan-to-scan for consistency. When it is determined to be as consistent as a real target, automatic acquisition occurs and tracking is initiated. Continued tracking and subsequent calculation develop the relative course and speed of the target.

The true course and speed of own ship are computed from own ship's gyro and speed inputs, and the resulting course and speed of each tracked target 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.

Qualitative description of tracking error

The FURUNO ARP accuracy complies with or exceed IMO standards.

Own ship maneuvers

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

Other ship maneuvers

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

3.18 Factors Affecting ARP 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. ARP display will be missing on one or more targets that could only be visible if the radar sensitivity control (GAIN control) were increased.

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

Manual acquisition is done if a target is positively displayed more than once. Automatic acquisition is done when the target is detected 5-7 times continuously. Tracking is achieved when the target is detected five times (not necessarily continuously) out of 10 scans. If not detected six times out of 10 scans, the target will become a “lost target.” The ARP 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.

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 ARP 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 ARP 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 ARP can acquire and track the false echo if it is detected by five consecutive scans. Reduction in radar gain can eliminate the multiple echoing but care should be taken as range detection also will be reduced.

Radar interference

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

To receive radar beacon or SART signals, turn on “SART” in the ECHO menu.

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4 AIS OPERATION

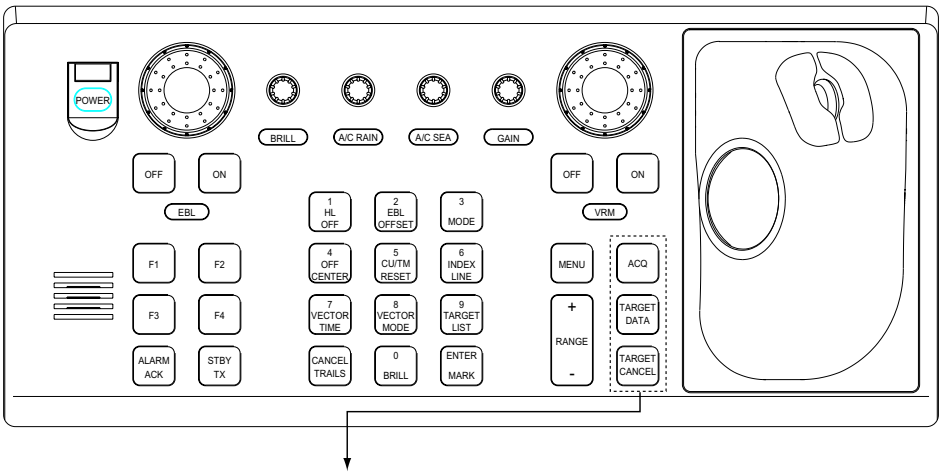
The FURUNO AIS (Automatic Identification System) model FA-100 exchanges with other AIS-fitted ships all data and information required by the SOLAS 1994 as amended. However, they are displayed in text form. By interfacing the FA-100 with this radar, the AIS information is graphically indicated together with the radar and ARP information.

This radar accepts position data fixed by WGS-84 geodetic datum. Set the datum to WGS-84 on the EPFS (GPS, etc.) connected to this radar. If other type of datum is input, the error message "DATUM" appears and the AIS feature is inoperative.

4.1 Controls for AIS

Keyboard

The AIS uses the keys shown below.



ACQ: Activates chosen AIS target.
TARGET DATA: Displays data on AIS target selected by the trackball.
TARGET CANCEL: Sleeps chosen AIS target.

Control unit RCU-014

Trackball

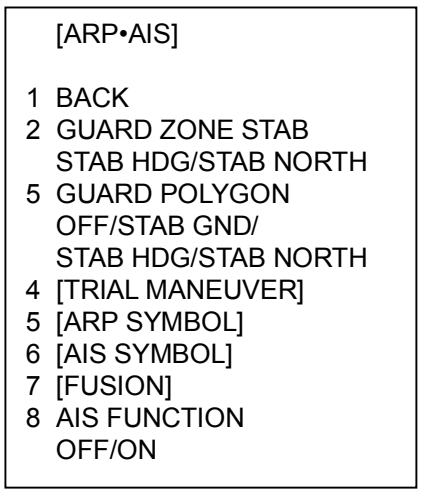
With the cursor inside the effective display area, you can access AIS functions by rolling the wheel or choosing appropriate AIS function from the CURSOR menu.

Roll the wheel to show the following indications in the guidance box to access respective AIS function:

TARGET DATA & ACQ: Activates chosen AIS target; displays target data for AIS target chosen with the trackball.
TARGET CANCEL: Sleeps chosen AIS target.
ACQ: Activates chosen AIS target.

4.2 Enabling/Disabling the AIS

1. Roll the trackball to choose the MENU box at the right side of the screen and then push the left button.
2. Roll the wheel to choose 4 ARP•AIS and then push the wheel or the left button.



ARP•AIS menu

3. Roll the wheel to choose 8 AIS FUNCTION and then push the wheel or the left button.
4. Roll the wheel to choose OFF or ON as appropriate and then push the wheel or the left button.
5. Push the right button twice to close the menu.

“AIS” appears at the lower right hand corner of the screen when the AIS function is active.

4.3 Turning AIS Display On/Off

1. Roll the trackball to choose the AIS DISP box at the right side of the screen.



AIS DISP box

2. Push the left button to display AIS ON or AIS OFF as appropriate.

   ON: All targets received from the AIS transponder are displayed with symbols.

   OFF: All AIS symbols disappear.

When the AIS is turned on, AIS targets are marked with appropriate AIS symbol as below.



AIS symbols

Note 1: The equipment continues to process AIS targets when the AIS feature is switched off. When the AIS is again turned on, symbols are immediately displayed.

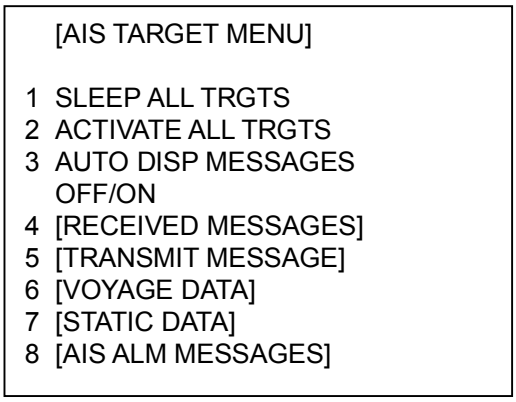
Note 2: AIS symbols are momentarily erased after the screen is redrawn when the heading is changed in the Head-up mode.

Note 3: When no AIS data is received, the message “RECEIVE” appears in the text window. Check the AIS transponder.

4.4 Setting Up for a Voyage

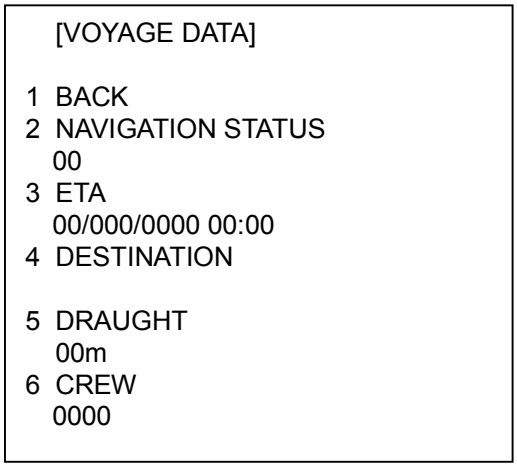
There are five items on the VOYAGE DATA menu you will need to enter at the start of a voyage: navigational status, ETA, destination, draught and crew.

1. Roll the trackball to choose the AIS DISP box at the right side of the screen.
2. Push the right button to open the AIS TARGET menu.



AIS TARGET menu

3. Roll the wheel to choose 6 VOYAGE DATA and then push the wheel or the left button.



VOYAGE DATA menu

4. Roll the wheel to choose 2 NAVIGATION STATUS and then push the left button.

5. Roll the wheel to choose appropriate navigation status number referring to the information below. Push the wheel.

   00: Underway using engine (default)
   01: At anchor
   02: Not under command
   03: Restricted maneuverability
   04: Constrained by draught
   05: Moored
   06: Aground
   07: Engaged in fishing
   08: Underway by sailing
   09: Reserved for high speed craft (HSC)
   10: Reserved for wing in ground (WIG, for example, hydrofoil)
   11-15: Reserved for future use

6. Roll the wheel to choose 3 ETA and then push the wheel or left button.
7. Use the wheel to enter estimated date and time of arrival, in order of day (two digits), month, year (four digits) and time. Push the wheel after entering the data.
8. Roll the wheel to choose 4 DESTINATION and then push the wheel or left button.
9. Enter destination: Roll the wheel to choose alphanumeric character, push the wheel to enter.
10. Roll the wheel to choose 5 DRAUGHT and then push the wheel or left button.
11. Roll the wheel to set ship's draught (setting range: 0.1-25 m) and then push the wheel.
12. Roll the wheel to choose 6 CREW and then push the wheel or left button.
13. Roll the wheel to set number of crew (0–8191) and then push the wheel.
14. Push the right button to close the menu.

4.5 Activating Targets

When you convert a sleeping target to an activated target, that target's course and speed are shown with a vector. You can easily judge target movement by monitoring the vector.

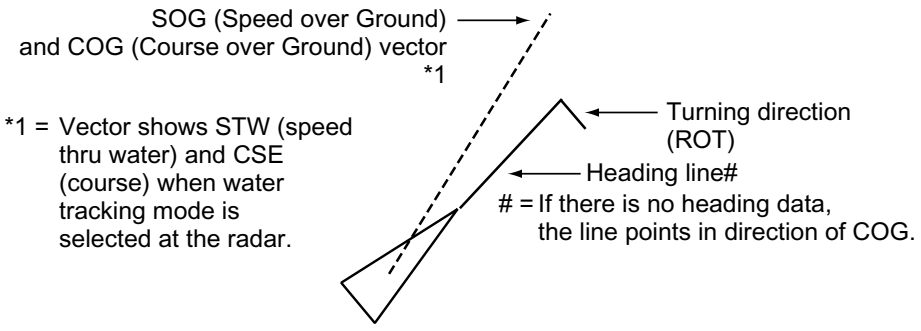
4.5.1 Activating specific target

By keyboard

1. Roll the trackball to place the cursor on the AIS target you wish activate.
2. Press the [ACQ] key to activate the target.

By trackball

1. With the cursor inside the effective display area, roll the wheel to display "TARGET DATA & ACQ / CURSOR MENU" in the guidance box.
2. Roll the trackball to place the cursor on the sleeping AIS target you wish to activate; that is, know more about a vessel's motion.
3. Push the left button to activate the target.



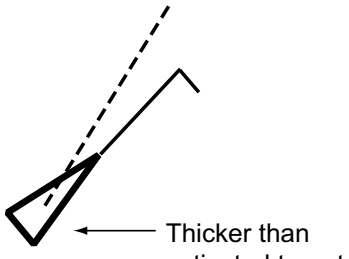
Activated target

4.5.2 Activating all targets

1. Roll the trackball to choose the AIS DISP box at the right side of the screen.
2. Push the right button to open the AIS TARGET menu.
3. Roll the wheel to choose 2 ACTIVATE ALL TRGTS and then push the wheel or the left button.
4. Push the right button to close the menu.

Dangerous target

When an activated target violates the CPA/TCPA alarm setting its symbol changes to the dangerous target symbol (red and flashing) and the indication COLLISON appears. Press the [ALARM ACK] key (or click the ALARM ACK box with the left button) to acknowledge the CPA/TCPA alarm. The audible alarm is silenced and the symbol stops flashing. Take appropriate action to avoid collision.

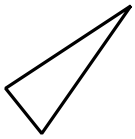


4.6 Sleeping Targets

4.6.1 Sleeping an AIS target

You may “sleep” an AIS target as below when the screen becomes filled with targets which might prevent important radar and AIS displays from being identified. Note that targets that have been activated automatically cannot be “slept.”

1. With the cursor inside the effective display area, roll the wheel to display “TARGET CANCEL / EXIT” in the guidance box.
2. Roll the trackball to place the cursor on an activated AIS target symbol.
3. Push the left button. The activated target symbol should be replaced with the sleeping target symbol.



Sleeping target

4.6.2 Sleeping all AIS targets

1. Roll the trackball to choose the AIS DISP box at the right side of the screen.
2. Push the right button to open the AIS TARGET menu.

```
   [AIS TARGET MENU]

1  SLEEP ALL TRGTS
5  ACTIVATE ALL TRGTS
6  AUTO DISP MESSAGES
   OFF/ON
7  [RECEIVED MESSAGES]
5  [TRANSMIT MESSAGE]
6  [VOYAGE DATA]
7  [STATIC DATA]
9  [AIS ALM MESSAGES]
```

AIS TARGET menu

3. Roll the wheel to choose 1 SLEEP ALL TGTS.
4. Push the left button or the wheel to sleep all targets.
5. Push the right button to close the menu.

4.7 Displaying Target Data

You may display an AIS target's data by selecting it on the display.

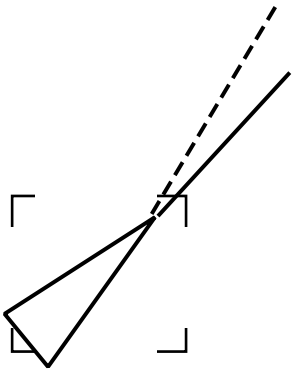
4.7.1 Basic data

By keyboard

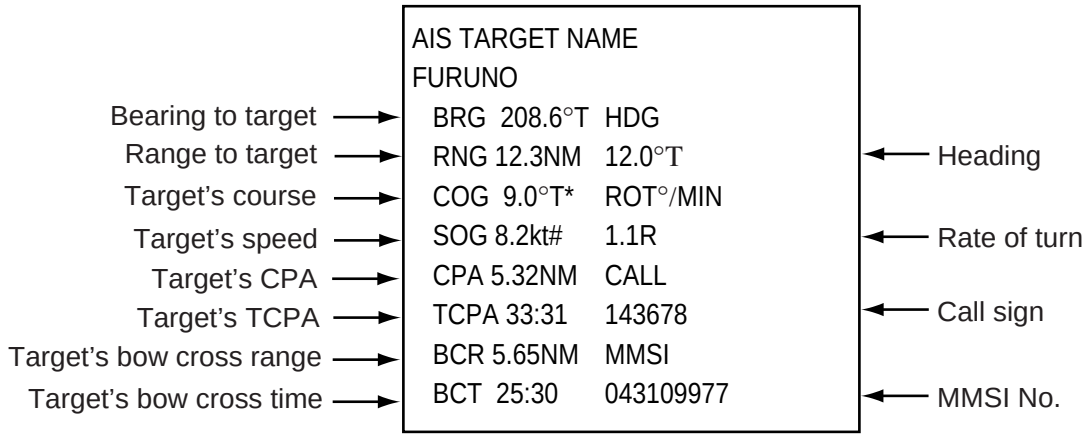
1. Roll the trackball to place the cursor on the AIS target symbol you want to know its data.
2. Press the [TARGET DATA] key.

By trackball

1. With the cursor inside the effective display area, roll the wheel to display "TARGET DATA & ACQ / CURSOR MENU".
2. Roll the trackball to place the cursor on an AIS target symbol and then push the wheel or the left button. The selected target is marked with a broken square and AIS data is shown in the AIS data box when the target is correctly selected. Ship name is shown near the target. If this data is not available, MMSI no. appears.



Activated target selected for data display

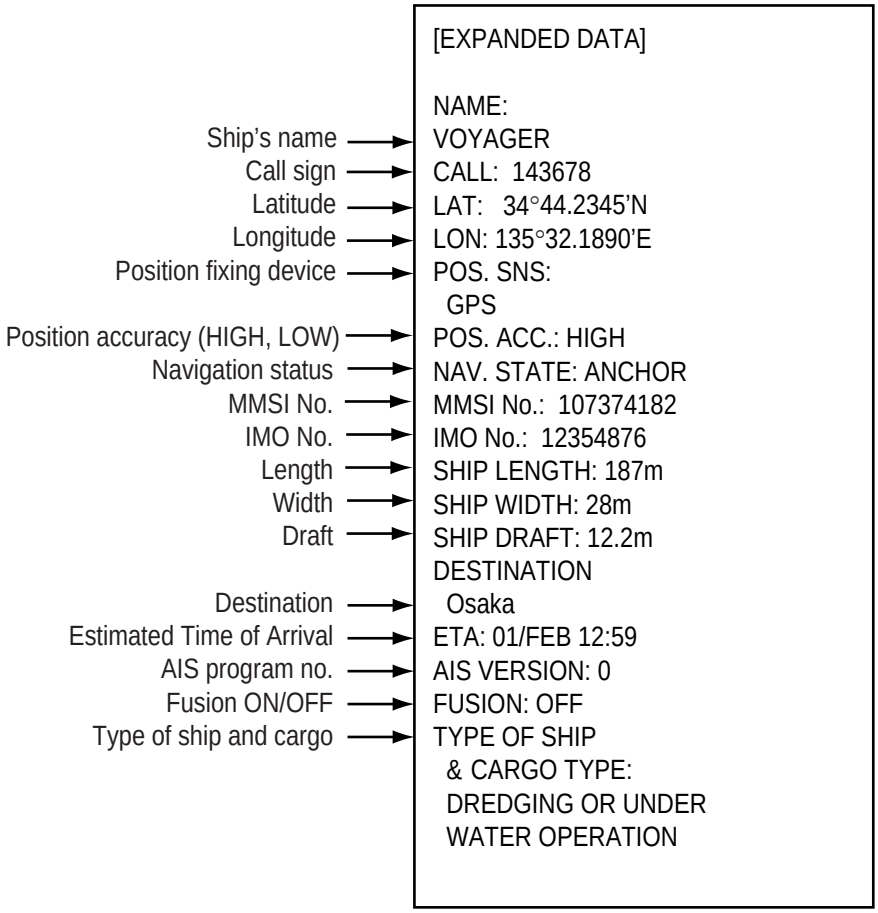


* = CSE (course) when water tracking mode is selected at radar.
\# = STW (speed thru water) when water tracking mode is selected at radar.

AIS data display

4.7.2 Detailed target data

1. Roll the trackball to place the cursor on the desired AIS target in the data box at the right side of the screen.
2. Push the left button to show detailed data.



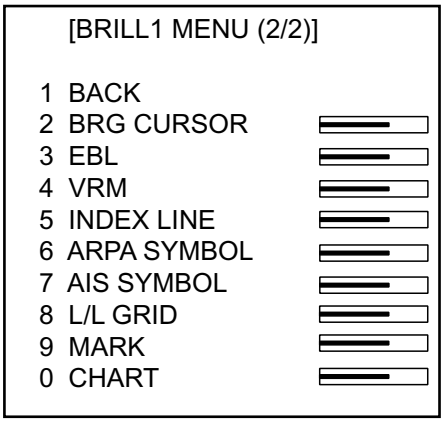
Expanded data

4.8 AIS Symbol Attributes

You may adjust the brilliance and choose the size and color of the AIS symbol.

4.8.1 AIS symbol brilliance

1. Roll the trackball to choose the BRILL box at the left side of the screen and then push the right button.
2. Roll the wheel to choose 0 NEXT and then push the wheel or the left button.



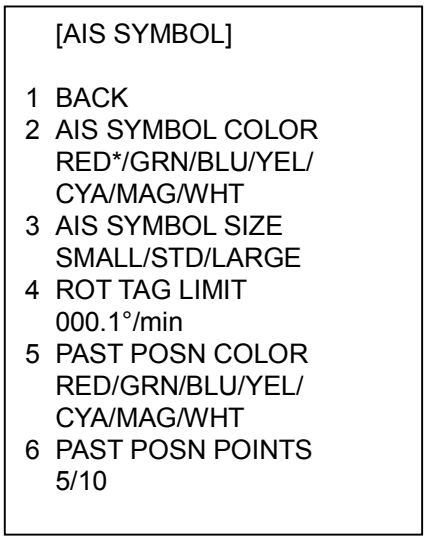
BRILL menu, page 2

3. Roll the wheel to choose 7 AIS SYMBOL and then push the wheel or the left button.
4. Roll the wheel to adjust brilliance.
5. Push the right button twice to close the menu.

4.8.2 AIS symbol size and color

You may choose the size and color of the AIS symbol as follows:

1. Roll the trackball to choose the MENU box and then push the left button.
2. Roll the wheel to choose 4 [ARPA•AIS] and then push the wheel or the left button.
3. Roll the wheel to choose 6 [AIS SYMBOL] and then push the wheel or the left button.



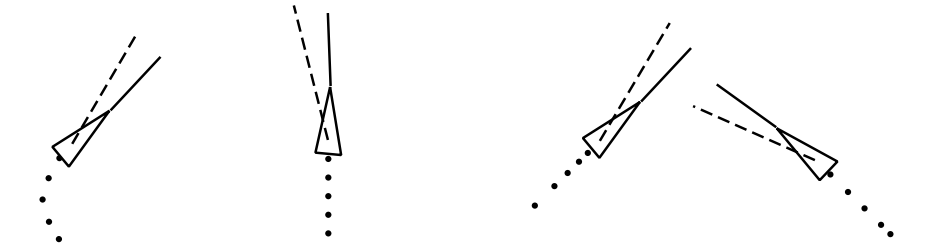
AIS SYMBOL menu

4. Roll the wheel to choose 2 AIS SYMBOL COLOR and then push the wheel or the left button.
5. Roll the wheel to choose color desired and then push the wheel or the left button.
6. Roll the wheel to choose 3 AIS SYMBOL SIZE and then push the wheel or the left button.
7. Roll the wheel to choose SMALL, STD(Standard) or LARGE as appropriate and then push the wheel or the left button.
8. Push the right button three times to close the menu.

4.9 Past Position Display

The past position display shows equally time-spaced dots marking past positions of activated AIS targets. A new dot is added at preset time intervals until the preset number is reached. If a target changes its speed, the spacing will be uneven. If it changes course, its plotted course will not be a straight line.

Below are sample past position displays.



Sample past position displays

4.9.1 Displaying and erasing past position points, choosing past position plot interval

1. Roll the trackball to choose the PAST POSN box at the right side of the screen.

PAST POSN REL 2MIN

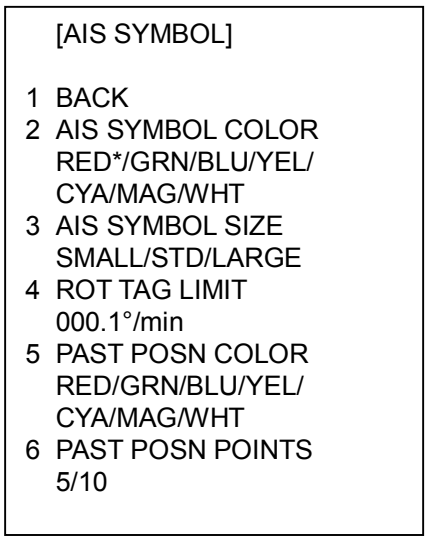
PAST POSN box

2. Push the left button to choose plot interval desired: OFF, 30 s, 1, 2, 3 or 6 min. Choose OFF to erase all past position points and turn off the past position display.

4.9.2 Past position display attributes

You may choose the number of past position points to show per plot interval and the color of past position points.

1. Roll the trackball to choose the MENU box and then push the left button.
2. Roll the wheel to choose 4 ARPA•AIS and then push the wheel or the left button.
3. Roll the wheel to choose 7 [AIS SYMBOL] and then push the wheel or the left button.

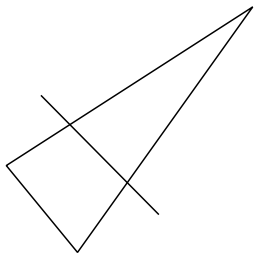


AIS SYMBOL menu

4. Roll the wheel to choose 5 PAST POSN COLOR and then push the wheel or the left button.
5. Roll the wheel to choose color desired and then push the wheel or the left button.
6. Roll the wheel to choose 6 PAST POSN POINTS and then push the wheel or the left button.
7. Roll the wheel to choose 5 or 10 as appropriate and then push the wheel or the left button.
8. Push the right button three times to close the menu.

4.10 Lost Target

A target is declared a lost target when it fails to produce data for six minutes or five reporting intervals, whichever is the shorter. When this occurs, the target is marked with the (flashing) lost target symbol and the indication “LOST” appears. To acknowledge a lost target, press the [ALARM ACK] key or roll the trackball to choose the ALARM ACK box and then push the left button.



Lost target

Note 1: If an ARPA lost target mark is displayed when the [ALARM ACK] key is pressed (or the ALARM ACK box is clicked) to acknowledge an AIS lost target, the ARPA lost target will also be erased.

Note 2: The AIS data transmission interval depends on target’s speed. For example, the data is transmitted every 10 seconds on ship speed of 0 to 14 kt and every two seconds on the ship speed of more than 23 knots. For details see the owner’s manual of the AIS.

4.11 ROT Setting

You may set the lower limit of the ROT (Rate Of Turn) at which the heading line on target symbols will point in direction of turning of the vessel.

1. Roll the trackball to choose the MENU box and then push the left button.
2. Roll the wheel to choose 4 ARPA•AIS and then push the wheel or the left button.
3. Roll the wheel to choose 6 [AIS SYMBOL] and then push the wheel or the left button.

[AIS SYMBOL]

1 BACK
2 AIS SYMBOL COLOR
RED*/GRN/BLU/YEL/
CYA/MAG/WHT
3 AIS SYMBOL SIZE
SMALL/STD/LARGE
4 ROT TAG LIMIT
000.1°/min
5 PAST POSN COLOR
RED/GRN/BLU/YEL/
CYA/MAG/WHT
6 PAST POSN POINTS
5/10

*: Not available on IMO radar.

AIS SYMBOL menu

4. Roll the wheel to choose 4 ROT TAG LIMIT and then push the wheel or the left button.
5. Use the numeral keys or the wheel to enter ROT (setting range: 0.1 to 720.0°/min).
6. Push the right button three times to close the menu.



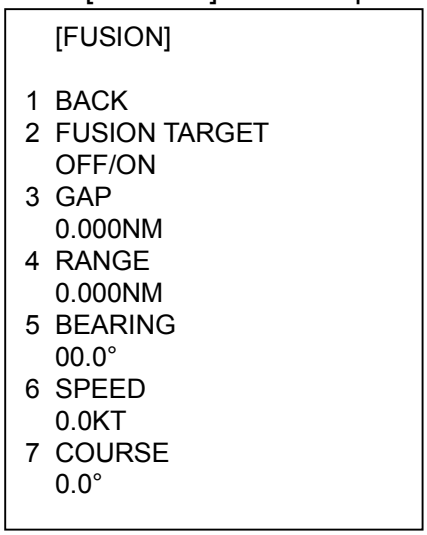
ROT display

4.12 Fusion of ARP and AIS Targets

An AIS-equipped ship is usually displayed by two symbols on the radar display. This is because the AIS ship position is measured by a GPS navigator (L/L) on that ship whereas the radar detects the same ship by PPI principle (range and bearing relative to own ship radar antenna).

To avoid the presentation of two target symbols for the same physical target, the “fusion” function is incorporated. If target data from AIS and from radar plotting functions are available and if the fusion criteria is fulfilled, only the activated AIS target symbol is presented.

1. Confirm that the ARP ACQ MODE box shows AUTO or AUTO MANU.
2. Roll the trackball to choose the MENU box and then push the left button.
3. Roll the wheel to choose 4 ARP•AIS and then push the left button.
4. Roll the wheel to choose 7 [FUSION] and then push the left button.



FUSION menu

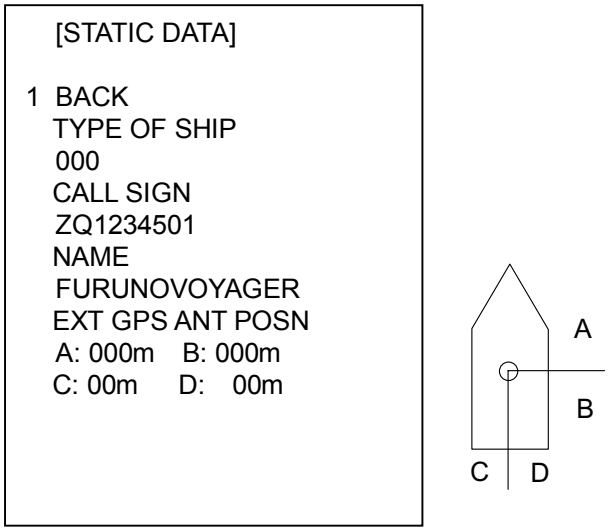
5. Roll the wheel to choose FUSION TARGET and then push the wheel.
6. Roll the wheel to choose ON and then push the wheel.
7. Enter the information below, pushing the wheel (or the [MARK ENTER] key) after entering each data. This information will be used to determine which ARPA targets to convert.
   - **GAP:** Range between AIS target and ARP target. (setting range: 0.000-0.999(nm))
   - **RANGE:** Enter the range difference from own ship to AIS target and ARP target. (setting range: 0.000-0.999(nm))
   - **BEARING:** Enter the bearing difference from own ship to AIS target and ARPA target. (setting range: 0.0-9.9(°))
   - **SPEED:** Enter the speed difference between AIS target and ARP target. (setting range: 0.0-9.9(kt))
   - **COURSE:** Enter the course difference between AIS target and ARP target. (setting range: 0.0-9.9(°))
8. Push the right button three times to close the menu.

When the fusion criteria is met, the ARP symbol is erased and only the AIS symbol is displayed. Further, “ARPA FUSION” appears at the bottom right corner of the display at the time of conversion and the ARP target no. appears next to the AIS symbol. An ARP target whose speed is less than 1 kt is converted to an AIS target if it meets all criteria other than course.

4.13 Own Ship's Data

Own ship's static data (type of ship, call sign, name and position of internal and external GPS antennas) can be viewed as follows

1. Roll the trackball to choose the AIS DISP box at the right side of the screen.
2. Push the right button to open the AIS TARGET menu.
3. Roll the wheel to choose 7 STATIC DATA and then push the wheel or the left button.



STATIC DATA menu

4. Push the right button to close the menu.

4.14 Messages

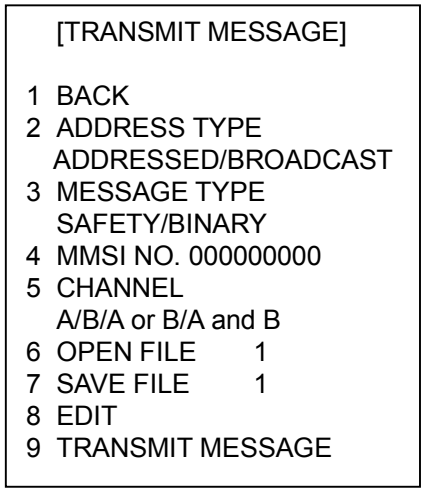
You may transmit and receive messages via the VHF link, to a specified destination (MMSI) or all ships in the area. Messages can be sent to warn of safety of navigation, for example, an iceberg sighted. Routine messages are also permitted.

Short safety related messages are only an additional means to broadcast safety information. They do not remove the requirements of the GMDSS.

4.14.1 Creating, saving a message

This section shows you how to create and save a message. Nine messages may be saved.

1. Roll the trackball to choose the AIS DISP box at the right side of the screen.
2. Push the right button to open the AIS TARGET menu.
3. Roll the wheel to choose 5 TRANSMIT MESSAGE and then push the wheel or the left button.



TRANSMIT MESSAGE menu

4. Roll the wheel to choose 2 ADDRESS TYPE and then push the wheel or the left button.
5. Roll the wheel to choose ADDRESSED (message for specific MMSI) or BROADCAST (message to all AIS-equipped vessels in area) and then push the wheel or the left button.
6. Roll the wheel to choose 3 MESSAGE type and then push the wheel or the left button.
7. Roll the wheel to choose SAFETY for safety message or BINARY for routine message.
8. For ADDRESSED message, do this step. For BROADCAST message, go to step 9.
   1) Roll the wheel to choose 4 MMSI NO. and then push the wheel or the left button.
   2) Use the wheel to enter ship's MMSI no.: Roll the wheel to choose alphanumeric character and then push the wheel.

9. Roll the wheel to choose 5 CHANNEL NO. and then push the wheel or the left button.
10. Roll the wheel to choose the channel to transmit your message over: A, B, A or B, or A and B. Push the wheel after making your selection.
11. Roll the wheel to choose 8 EDIT and push the wheel or left button. A mini keyboard at the bottom of the menu to enter your message.



Mini keyboard

12. Roll the trackball to choose character desired and then push the wheel. Repeat to enter message. The maximum number of characters allowable is as follows:
    ADDRESSED BINARY: 151
    ADDRESSED SAFETY: 156
    BROADCAST BINARY: 151
    BROADCAST SAFETY: 161
13. Roll the trackball to choose END and then push the wheel.
14. Roll the trackball to choose 7 SAVE FILE and then push the wheel or the left button.
15. Roll the wheel to choose appropriate number and then push the wheel or the left button.
16. Push the right button to close the menu.

4.14.2 Transmitting a message

There are two ways to transmit a message: create a message on the spot and transmit it or choose and transmit a message saved in the memory.

1. Roll the trackball to choose the AIS DISP box at the right side of the screen.
2. Push the right button to open the AIS TARGET menu.
3. Do one of the following:
   ① Create a message as described in steps 1-13 in paragraph 4.13.1.
   ② Load a file saved in the memory by choosing 6 OPEN FILE, pushing the left button and then rolling the wheel to choose file number.
4. To transmit the message, choose 9 TRANSMIT MESSAGE and then push the wheel or the left button.
5. Press the right button to close the menu.

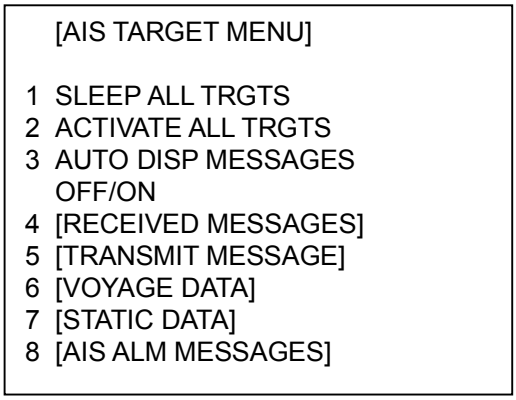
4.14.3 Viewing AIS messages

When an AIS message is received, the display shows an appropriate icon to alert you. If you are set up to automatically display AIS messages they are automatically displayed upon receipt. The system stores up to 20 AIS messages. When the storage capacity is reached the oldest AIS message is automatically erased to make room for the latest. Note that received messages and alarm messages are not backed up when the power is turned off.

Manually viewing received AIS messages

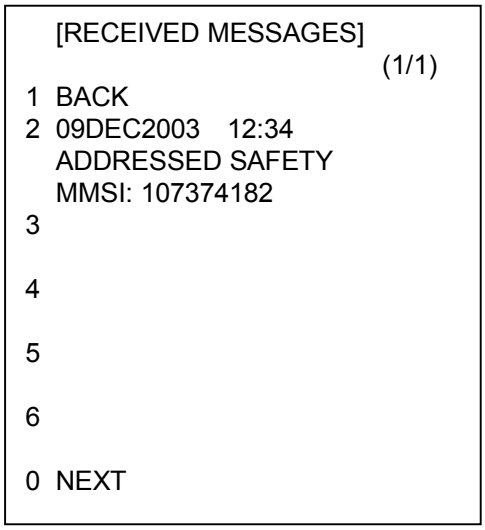
To view received AIS messages do the following:

1. Roll the trackball to choose the AIS DISP box at the right side of the display.
2. Push the right button to open the AIS TARGET menu.



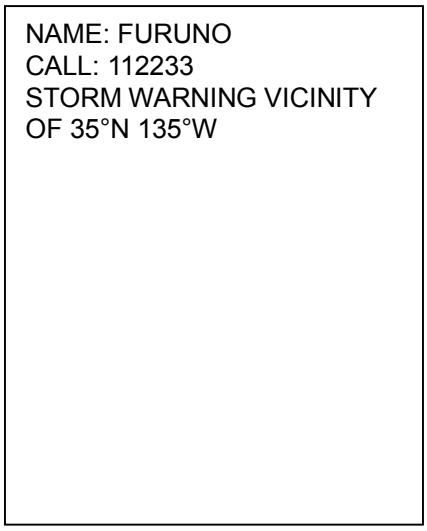
AIS TARGET menu

3. Roll the wheel to choose 4 RECEIVED MESSAGES and then push the wheel or the left button. (Up to five received messages are displayed.)



RECEIVED MESSAGES menu

4. Roll the wheel to choose the message which you want to see and then push the wheel or the left button.



Example of received AIS message (max. 180 characters)

5. Press the right button several times to close the message and the menu.

Automatically displaying AIS messages

You can display AIS messages upon receipt as follows:

1. Roll the trackball to choose the AIS DISP box at the right side of the display.
2. Push the right button to open the AIS TARGET menu.
3. Roll the wheel to choose 3 AUTO DISP MESSAGES and then push the wheel or the left button.
4. Roll the wheel to choose ON as appropriate and then push the wheel or the left button.
5. Push the right button to close the menu.

When a message arrives the message arrival icon (✉) appears at the right-hand side of the display. Click the icon with the left button to show the message.

Manually viewing AIS alarm messages

The transponder outputs various alarm messages. You can view them as follows:

1. Roll the trackball to choose the AIS DISP box at the right side of the display.
2. Push the right button to open the AIS TARGET menu.
3. Roll the wheel to choose 8 AIS ALM MESSAGES and then push the wheel or the left button.
4. Roll the wheel to choose ON as appropriate and then push the wheel or the left button.
5. Push the right button to close the menu.

4.15 AIS System Messages

AIS system messages are displayed at the bottom right corner of the screen. The table below shows the AIS system messages and their meanings.

AIS system messages

Message	Meaning
ARPA FUSION	ARPA target merged with AIS target. The indication disappears when the target no longer meets the criteria set in paragraph 4.12. When the message " RECEIVE" is displayed, ARPA FUSION is not displayed.
COLLISION	CPA and TCPA of an activated AIS target are below value set on the menu.
TARGET-FULL	Displayed when 1000 AIS targets have been received. (The radar can only display 1000 AIS targets closest in range to own ship.)
LOST	Lost target. A target is declared a lost target when a dangerous target fails to produce data for six minutes or five reporting intervals, whichever is the shorter.
RECEIVE	Not receiving AIS data from own AIS (VDO message).
GUARD	Displayed when an AIS target enters the guard zone.
CPA/TCPA	CPA/TCPA cannot be calculated. Further the CPA/TCPA value in the basic data display is marked with an asterisk to indicate that it is not reliable.
AIS ALARM	Alarm received from AIS transponder.

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5 VIDEO PLOTTER OPERATION

5.1 General

The video plotter

- Plots own and other ships' tracks
- Enters waypoints nav lines and marks
- Records data onto memory cards (optional card interface required).

It uses two types of memory cards, a memory card (RAM card) for storing own ship and other ship's tracks and marks, and a digital chart card (ROM card). 30 nav lines may be stored and each line may contain up to 30 waypoints. Five nav lines may be simultaneously shown on the display. 200 waypoints are available. Own ship and other ship tracks may be stored at a selected interval.

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

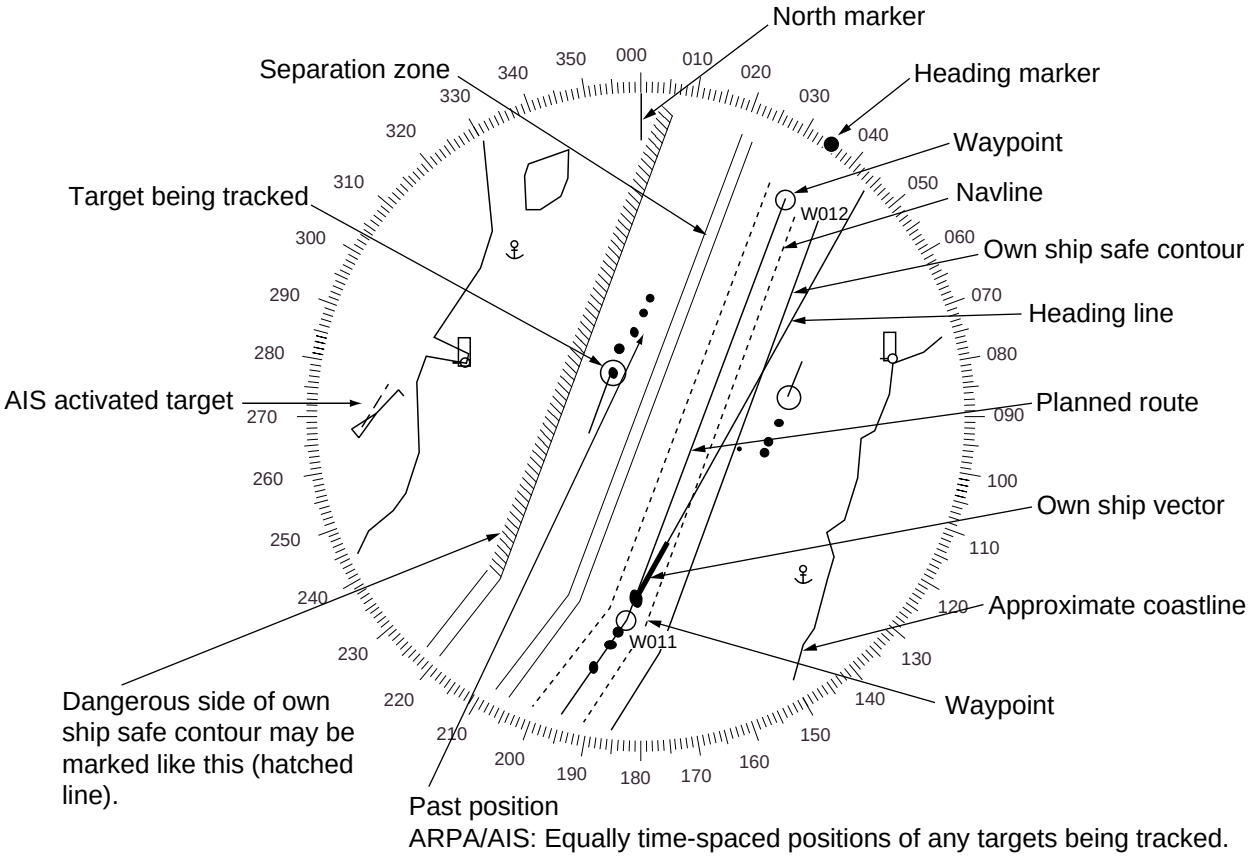
Note that that neither chart nor target track are available on the IMO-type radar.

5.2 Display Modes

This radar has two display modes: Radar and Radar + Video Plotter. Use the DISPLAY MODE box to choose a mode. (When the video plotter mode is displayed more than five seconds, the radar automatically goes into standby.)

Note 1: Display mode cannot be chosen when the menu is open. Close the menu to choose a display mode.
Note 2: Only the radar display is available on the IMO-type radar.

Sample video plotter display



Video plotter display

5.3 Presentation Modes

Five presentation modes are available: North-up, Course-up, Head-up, Head-up TB (True Bearing) and North-up TM (True Motion). To choose a mode, use the [MODE] key or choose the PRESENTATION MODE box and then push the left button. For a description of the presentation modes, see paragraph 1.12.

Note 1: Chart data is not displayed on the HEAD UP and HEAD UP TB modes.
Note 2: The screen may flash when the heading is changed more than one degree in the HEAD UP or HEAD UP TB mode.

Automatic resetting of own ship mark in true motion mode

In the true motion mode, the own ship mark is automatically returned sternward 75% from the screen center when it reaches a location 75% of the display radius.

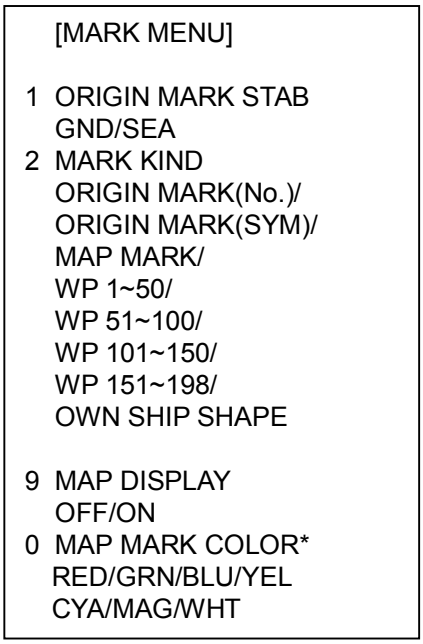
5.4 Radar Map

A radar map is a combination of map lines and symbols whereby the user can define and input the navigation data, route planning and monitoring data.
The radar map may contain 3,000 points of data. The map data can be memorized to facilitate repeated use on a routine navigation area.
The user can create a radar map on-real time while using the radar for navigation or at leisure time at anchor or while the radar is not being used. Place of a map can be made for any waterways apart from the actual own ship location.

The radar map feature is available with the non-IMO radar. All radar map functions are accessed from the radar display. To choose the radar display, use the trackball to choose the DISPLAY MODE box and push the left button to display “RADAR.” Then, follow the procedures in this section to create a radar map.

5.4.1 Turning on the radar map display

1. Roll the trackball to choose the MARK box.
2. Push the right button to open the MARK menu.

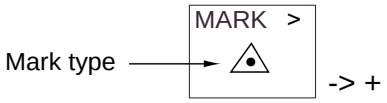


MARK menu

3. Roll the wheel to choose 9 MAP DISPLAY and then push the wheel.
4. Roll the wheel to choose ON and then push the wheel or the left button.
5. Push the right button to close the menu.

5.4.2 Inscribing radar map marks and lines

1. Roll the trackball to choose the MARK box at the left side of the display.



MARK box

2. Push the right button to open the MARK menu.

```
   [MARK MENU]

1  ORIGIN MARK STAB
   GND/SEA
2  MARK KIND
   ORIGIN MARK(No.)/
   ORIGIN MARK(SYM)/
   MAP MARK/
   WP 1~50/
   WP 51~100/
   WP 101~150/
   WP 151~198/
   OWN SHIP SHAPE

9  MAP DISPLAY
   OFF/ON
0 MAP MARK COLOR*
   RED/GRN/BLU/YEL
   CYA/MAG/WHT
```

*: NOT available on IMO radar.

MARK menu

3. Roll the wheel to choose 2 MARK KIND and then push the wheel or the left button.
4. Roll the wheel to choose MAP MARK and then push the wheel or the left button.

   Note: For non-IMO type radars you may specify mark color by choosing 0 MAP MARK COLOR, pushing the wheel and the choosing color desired.
5. Push the right button to close the menu. The guidance box now reads "MARK SELECT / MARK MENU."
6. With the cursor choosing the MARK box, roll the wheel to choose the mark or line type you wish to inscribe and then push the left button. See the next page for available marks.
7. Push the left button again. The cursor jumps into the effective display area and the guidance box now reads "MARK / EXIT."
8. Roll the trackball to place the cursor on the location desired. (You can see the range and bearing from own ship to the cursor location by monitoring the bearing and range indication just below the MARK box.)
9. Push the left button to inscribe the mark or line point.

- To continue entering the same mark or line (with the guidance box showing “MARK / EXIT”), roll the trackball to choose location and then push the left button.
- To quit entering marks or lines, push the right button when the guidance box reads “MARK / EXIT.”

Non-IMO	IMO
Cyan Available in seven colors	Red
Purple Available in seven colors	Green
Red Available in seven colors	Red
Red Available in seven colors	Green
Red Available in seven colors	Red
Red Available in seven colors	Green
Cyan Available in seven colors	Red
Purple Available in seven colors	Green
Cyan Available in seven colors	Purple
Cyan Available in seven colors	Purple
Cyan Available in seven colors	Cyan
Cyan Available in seven colors	Cyan
Cyan Available in seven colors	Cyan
Cyan Available in seven colors	Purple NAV LINE
Cyan Available in seven colors	White COAST LINE
Purple NAV LINE Available in seven colors	Gray CONTOUR LINE
White COAST LINE Available in seven colors	Purple PROHIBITED AREAS
Gray CONTOUR LINE Available in seven colors	Purple CABLE
Purple PROHIBITED AREAS Available in seven colors	Cyan
Purple CABLE Available in seven colors	Cyan

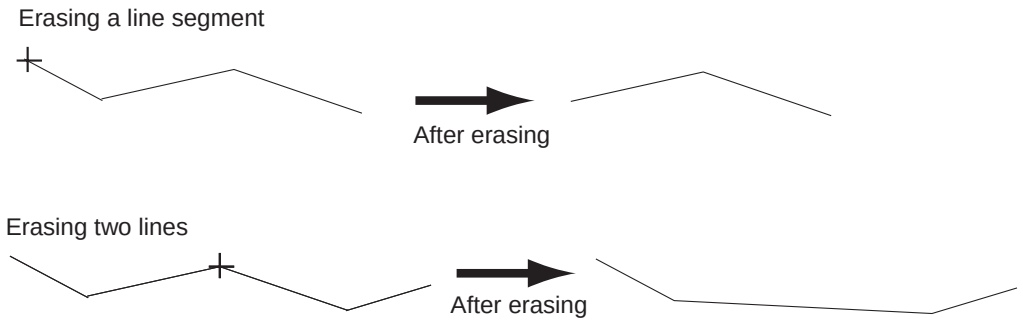
5.5 Erasing Radar Map Marks and Lines

A total of 3,000 points is allotted for radar map marks and lines. When this amount is exceeded, no more map marks or lines may be entered unless you erase unnecessary marks or lines.

5.5.1 Erasing individual radar map marks and lines

1. With the cursor inside the effective display area, roll the wheel to show " MARK DELETE / EXIT" in the guidance box.
2. Roll the trackball to place the cursor on the radar map mark or line you wish to erase.
3. Push the left button to erase selected mark or line.

Note: When erasing a line, the cursor location determines how the line will be erased. To erase a single line segment, place the cursor on the starting point of the line. When the junction point between two line segments is erased, the line is redrawn connecting the line segments which were before and after the erased junction. See the figure below for an example.

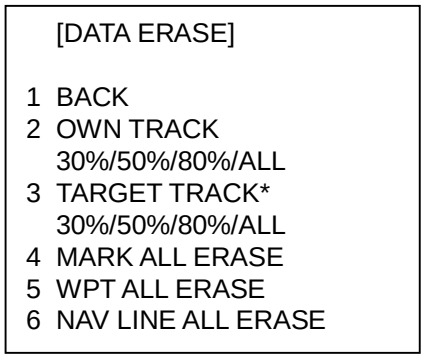


Cursor location and line processing

5.5.2 Erasing all radar map marks and lines

You can erase all radar map marks and lines from the screen as below. Be absolutely sure you want to erase all map marks and lines – erased marks and lines cannot be restored.

1. Roll the trackball to choose the MENU box at the right side of the screen and then push the left button.
2. Roll the wheel to choose 5 PLOTTER and then push the wheel or the left button.
3. Roll the wheel to choose 8 [DATA ERASE] and then push the wheel or the left button.



*: Not available on IMO radar.

DATA ERASE menu

4. Roll the wheel to choose 4 MARK ALL ERASE.
5. Push the wheel or the left button to erase all marks.
6. Push the right button three times to close the menu.

5.6 Radar Map Corrections

5.6.1 Radar map correction

When there is positional error between the radar screen and radar map marks and lines, do the following to correct it.

1. With the cursor inside the effective display area, roll the wheel to display “CHART ALIGN L=OFF / EXIT” in the guidance box.
2. Operate the trackball to align the radar map with the radar screen.
3. Push the left button to set. “MAN ALIGNED” appears at the right side of the screen.

To release the radar map correction, display “CHART ALIGN L=OFF / EXIT” in the guidance box and then push the left button until “MAN ALIGNED” disappears from the screen.

5.6.2 Cursor data correction

You can correct cursor data as below.

1. Roll the trackball to choose the MENU box at the right side of the screen and then push the left button.
2. Roll the wheel to choose 5 PLOTTER and then push the wheel or the left button.

[PLOTTER]

1 BACK
2 CHART COLOR*
GRN/YEL/CYA
ORANGE/GRAY
3 OWN TRACK INTERVAL
OFF/10S/30S/
1M/2M/3M/6M
4 OWN TRACK COLOR
RED/GRN/BLU/YEL/
CYA/MAG/WHT
5 TGT TRACK INTERVAL*
10S/30S/1M/
2M/3M/6M
6 TGT TRACK COLOR*
RED/GRN/BLU/YEL/
CYA/MAG/WHT
7 CURSOR L/L ALIGN
OFF/ON
8 [DATA ERASE]
9 [DISPLAY]

*: Not available on IMO radar.

PLOTTER menu

3. Roll the wheel to choose 7 CURSOR L/L ALIGN and then push the wheel or the left button.

4. Roll the wheel to choose ON and then push the wheel or the left button. “ALIGN” appears (in red) next to cursor position in the text area. (To remove the correction, choose OFF. If you are using the AIS function, choose ON.)
5. Push the right button twice to close the menu.

5.7 Chart Cards

Charts may be overlaid on the radar image of the non-IMO radar when it is interfaced with the optional Card I/F Unit CU-200. (Charts cannot be used with the IMO-type radar.) This radar accepts both FURUNO and NAVIONICS chart cards.

⚠ CAUTION

Handle chart cards and memory cards with care.

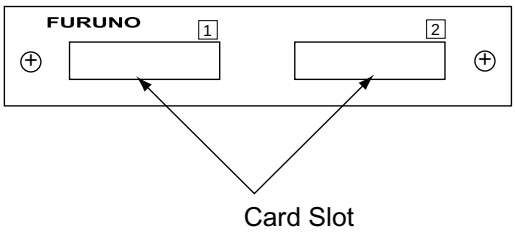
- Keep cards away from direct sunlight, heat sources, and active gases.
- Keep cards away from water and chemicals.
- Keep the connector free foreign material.
- Do not drop the cards.

Chart cards are intended as an aid to navigation. The navigator has the responsibility to check all aids available to confirm position.

5.7.1 Displaying a chart

To display a chart:

1. Insert a chart card in either of the two card slots in the Card I/F Unit CU-200.



Card slot location

2. Press the [POWER] button on the control unit to turn the power on. With the radar in transmit status, choose the radar display NU, CU, TM modes only) or the radar/video plotter display to display the chart.

To display a chart after the power has been turned on, change the range by pressing the [RANGE+] or [RANGE-] key or operating the RANGE box.

5.7.2 Chart position correction

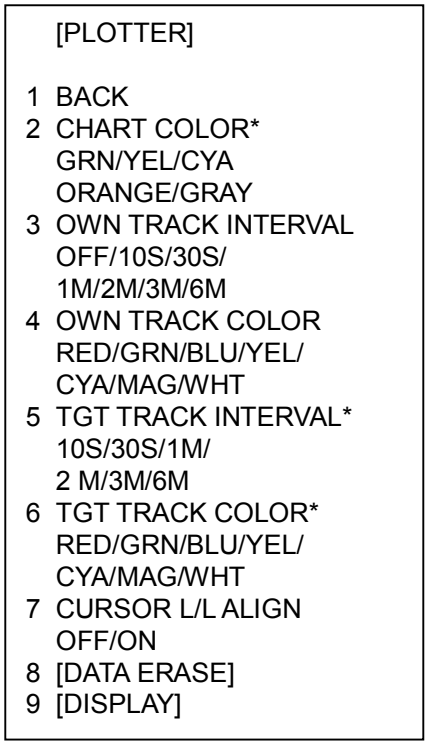
There may be a case where the chart overlay is not aligned with the radar image. This is due to an error in the position fixing system (GPS, Loran, etc.) or the different coordinates between the position fixing system and the radar. In this case, align the chart with the radar image as below.

1. With the cursor inside the effective display area, roll the wheel to display "CHART ALIGN L=OFF / EXIT" in the guidance box.
2. Operate the trackball to align the chart with the radar map. Note that track is neither recorded nor displayed at this point.
3. Push the left button to set. "CHART ALIGN" appears (in red) at the right side of the screen.

To release the chart position correction, display "CHART ALIGN L=OFF / EXIT" in the guidance box and then push the left button until "CHART ALIGN" disappears from the screen.

5.7.3 Correcting cursor data

1. Roll the trackball to choose the MENU box at the right side of the screen and then push the left button.
2. Roll the wheel to choose 5 PLOTTER and then push the left button.



*: Not available on IMO radar.

PLOTTER menu

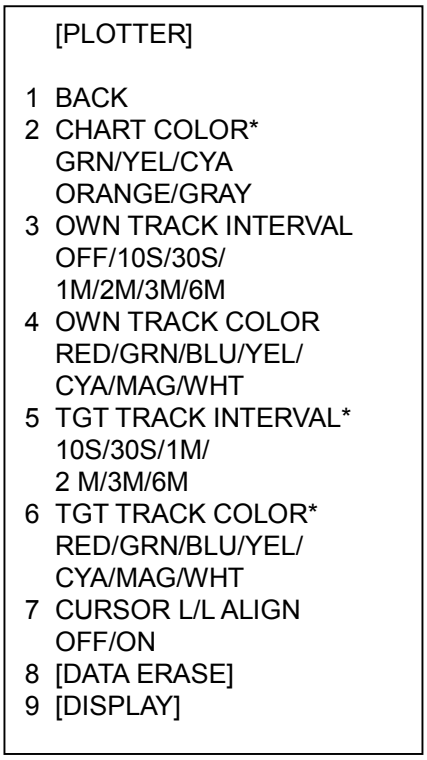
3. Roll the wheel to choose 7 CURSOR L/L ALIGN and then push the wheel or the left button.

4. Roll the wheel to choose ON and then push the wheel or the left button. “ALIGN” appears (in red) next to cursor position in the cursor data box. (To remove the correction, choose OFF. If you are using the AIS function, choose ON.)
5. Push the right button twice to close the menu.

5.7.4 Chart land color

You may choose the color for the land on charts as follows:

1. Roll the trackball to choose the MENU box at the right side of the screen and then push the left button.
2. Roll the wheel to choose 5 PLOTTER and then push the left button.

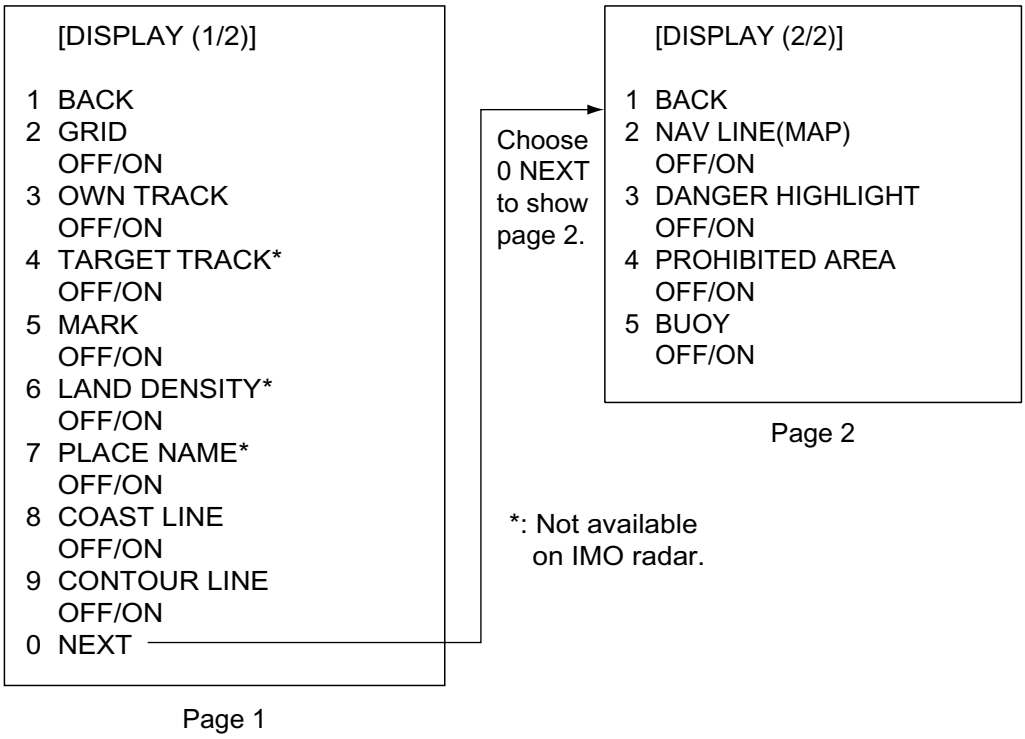


PLOTTER menu

3. Roll the wheel to choose 2 CHART COLOR and then push the left button or the wheel.
4. Choose color desired and push the wheel or the left button.
5. Push the right button twice to close the menu.

5.8 Hiding/Showing Graphics on the Video Plotter Display

1. Roll the trackball to choose the MENU box at the right side of the screen and then push the left button.
2. Roll the wheel to choose 5 PLOTTER and then push the wheel or the left button.
3. Roll the wheel to choose 9 [DISPLAY] and then push the wheel or the left button. Roll the wheel to choose an item and then push the wheel or the left button. To go to page 2, choose 0 NEXT and then push the wheel or the left button. You may return to page 1 by choosing 1 BACK and pressing the wheel or the left button.



DISPLAY menus

4. Push the wheel to choose OFF or ON as appropriate.

   Note: LAND DENSITY fills (ON) or hollows (OFF) land on an electronic chart. Land will be hollow when wrong card or wrong scale is used, regardless of LAND DENSITY setting.
5. Repeat steps 3 and 4 to set other items.
6. Push the right button three or four times to close the menu depending on which page of the DISPLAY menu you are using.

5.9 Track

5.9.1 Plotting own ship's track

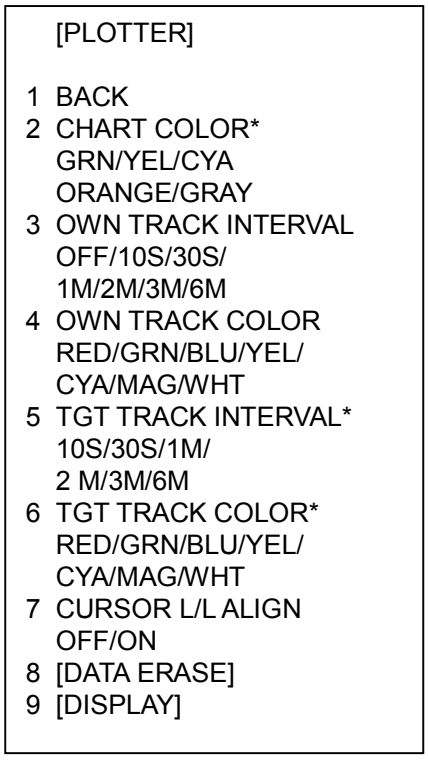
A total of 6,000 points are allotted for storage of own ship's track, marks and lines. When this memory becomes full, the oldest track is deleted to make room for the latest. For that reason you may want to adjust the recording interval to conserve the memory.

The table below shows the relation between plotting interval and maximum track recording time.

Own track plotting interval and storage time

Interval	Max. Recording Time	Interval	Max. Recording Time
10 s	55 hr 30 min	2 min	27 days 18 hr 40 min
30 s	166 hr 40 min	3 min	41 days 16 hr
1 min	13 days 21 hr 20 min	6 min	83 days 8 hr

1. Roll the trackball to choose the MENU box at the right side of the screen and then push the left button.
2. Roll the wheel to choose 5 PLOTTER and then push the wheel or the left button.



*: Not available on IMO radar.

PLOTTER menu

3. Roll the wheel to choose 3 OWN TRACK INTERVAL and then push the wheel or the left button.
4. Roll the wheel to choose appropriate track plotting interval and then push the wheel or the left button. Choose OFF to stop plotting own ship's track.
5. Push the right button twice to close the menu.

5.9.2 Plotting other ships' track

The tracks of 10 targets (other ships) can be recorded. The memory capacity for other ships' track is 20,000 points, but this value is divided equally among ten targets, so there are 2,000 points per target. When the other ships' track memory becomes full the oldest track is deleted to make room for the latest. For that reason you may want to adjust the recording interval to conserve the memory. Note that the track of ARP targets 1 thru 10 may be displayed. The track of ARP targets 11 thru 30 cannot be displayed.

Note: This feature is not available on the IMO-type radar.

The table below shows the relation between plotting interval and maximum track recording time for other ships' track.

Other target plot interval and storage time

Interval	Max. Recording Time	Interval	Max. Recording Time
10 s	5 hrs 33 min	2 min	66 hrs 40 min
30 s	16 hrs 40 min	3 min	100 hrs
1 min	33 hrs 20 min	6 min	200 hrs

1. Roll the trackball to choose the MENU box at the right side of the screen and then push the left button.
2. Roll the wheel to choose 5 PLOTTER and then push the wheel or the left button.
3. Roll the wheel to choose 5 TGT TRACK INTERVAL and then push the wheel or the left button.
4. Roll the wheel to choose appropriate track plotting interval and then push the wheel or the left button.
5. Push the right button twice to close the menu.

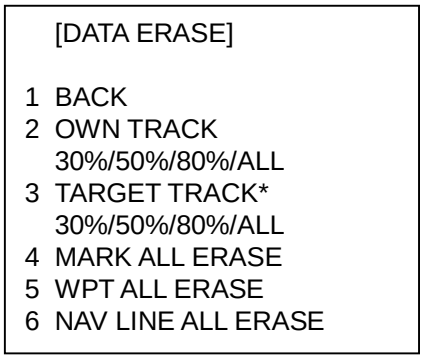
5.9.3 Choosing track color

1. Roll the trackball to choose the MENU box at the right side of the screen and then push the left button.
2. Roll the wheel to choose 5 PLOTTER and then push the wheel or the left button.
3. Roll the wheel to choose 4 OWN TRACK COLOR or 6 TGT TRACK COLOR (not available on IMO radar), whichever track color you want to set, and then push the wheel or the left button.
4. Roll the wheel to choose color desired and then push the wheel or the left button.
5. Push the right button twice to close the menu.

5.9.4 Erasing track

The display may become full of track when, for example, own ship traces the same route several times or there are many tracks from other ships. You can erase all or a percentage of your track or other tracks to clear the display.

1. Roll the trackball to choose the MENU box at the right side of the screen and then push the left button.
2. Roll the wheel to choose 5 PLOTTER and then push the wheel or the left button.
3. Roll the wheel to choose 8 [DATA ERASE] and then push the wheel or the left button.



*: Not available on IMO radar.

DATA ERASE menu

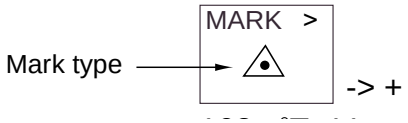
4. Roll the wheel to choose 2 OWN TRACK or 3 TARGET TRACK, whichever track you want to erase, and then push the wheel or the left button.
5. Roll the wheel to choose the percentage of track to erase and then push the wheel or the left button. For example, “30” erases the oldest 30% of the track selected at step 4. Choose “ALL” to erase all of the corresponding track.
6. Push the right button three times close the menu.

5.10 Marks and Lines

You can inscribe marks on the display to denote important points, for example, a buoy or a wreck. The memory for marks, lines and own ship's track is 6,000 points.

5.10.1 Inscribing marks and lines

1. Roll the trackball to choose the MARK box at the left side of the screen.



Mark box

2. Push the right button to open the MARK menu.

```
[MARK MENU]

1  ORIGIN MARK STAB
   GND/SEA
2  MARK KIND
   ORIGIN MARK(No.)/
   ORIGIN MARK(SYM)/
   MAP MARK/
   WP 1~50/
   WP 51~100/
   WP 101~150/
   WP 151~198/
   OWN SHIP SHAPE
9 MAP DISPLAY
   OFF/ON
0  MAP MARK COLOR*
   RED/GRN/BLU/YEL
   CYA/MAG/WHT
```

*: Not available on IMO radar.

MARK menu

3. Roll the wheel to choose 2 MARK KIND and then push the wheel or the left button.
4. Roll the wheel to choose MAP MARK and then push the wheel or the left button.

   Note: For non-IMO type radars you may specify mark color by choosing 0 MAP MARK COLOR, pushing the wheel and the choosing color desired.
5. Push the right button to close the menu. The guidance box now reads "MARK SELECT / MARK MENU."

6. With the MARK box selected, roll the wheel to choose mark desired and then push the left button. See the list on page 5-5 for available marks.
7. Push the left button again. The cursor jumps into the effective display area and the guidance box reads “MARK / EXIT.”
8. Roll the trackball to place the cursor where you want to inscribe a mark and then push the left button to inscribe the mark. (You can see the range and bearing to the cursor location by monitoring the mark range and bearing indication just below the MARK box.)

- To continue inscribing the same mark, repeat step 8.
- To enter a different mark, push the right button when the guidance box reads “MARK / EXIT” and then do steps 6-8. (“MAP MARK” should be chosen on the MARK menu beforehand.)
- To quit entering marks, push the right button when the guidance box reads “MARK / EXIT”.

.

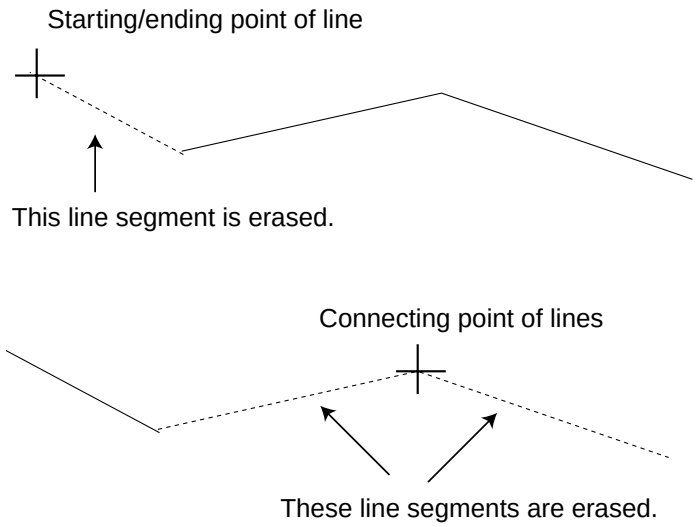
5.11 Erasing Marks and Lines

Up to 6,000 points of own ship's track, marks and lines may be entered. When this amount is exceeded no more marks or lines can be entered unless unnecessary marks, lines or track are erased.

5.11.1 Erasing individual marks/lines

1. With the cursor inside the effective display area, roll the wheel to show "MARK DELETE / EXIT" in the guidance box.
2. Roll the trackball to place the cursor on the mark or line you wish to erase. A flashing "X" appears on the mark when it is correctly selected.
3. Push the left button to erase.

   Note: When erasing a line, the cursor location determines how the line will be erased. To erase a single line segment, place the cursor on the starting (or ending point depending on the line) of the line. To erase two consecutive line segments, place the cursor at the junction between the line segments.

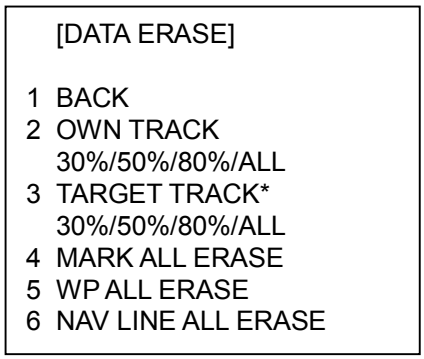


Cursor location and line erasure

5.11.2 Erasing all marks and lines

To erase all plotter marks and lines from the memory, follow the procedure below.

1. Roll the trackball to choose the MENU box at the right side of the screen and then push the left button.
2. Roll the wheel to choose 5 PLOTTER and then push the wheel or the left button.
3. Roll the wheel to choose 8 [DATA ERASE] and then push the wheel or the left button.



*: Not available on IMO radar.

DATA ERASE menu

4. Roll the wheel to choose 4 MARK ALL ERASE.
5. Push the wheel or the left button to erase all plotter-related marks and lines.
6. Push the right button three times to close the menu.

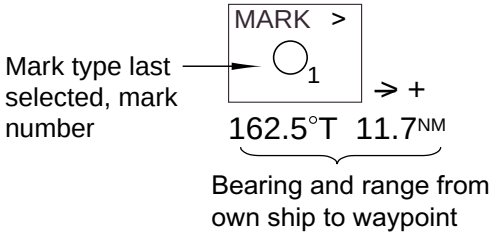
5.12 Waypoints

A particular location is known as a “waypoint,” whether it be a starting point, a destination point or an intermediate point on a voyage. This unit can store 200 waypoints, numbered 001 to 200. Waypoints may be entered with the cursor or by input of latitude and longitude.

5.12.1 Entering waypoints

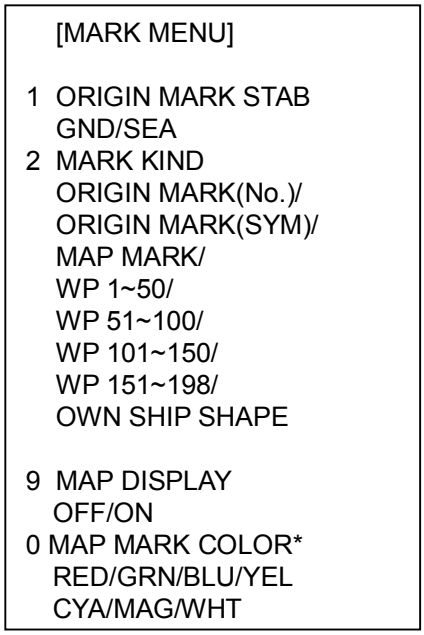
Entering waypoints with the cursor

1. Roll the trackball to choose the MARK box at the left side of the screen.



MARK box

2. Push the right button to open the MARK menu.



*: Not available on IMO radar.

MARK menu

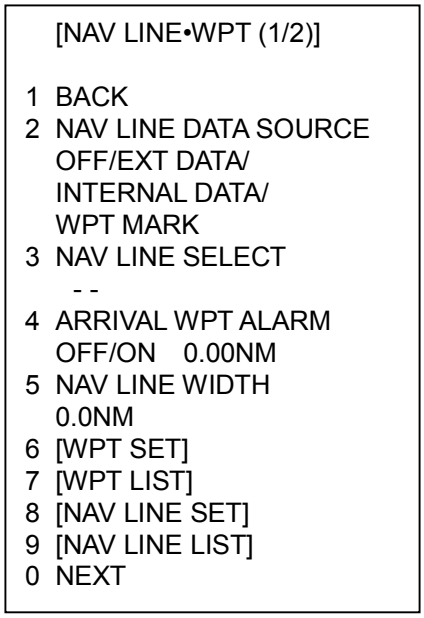
3. Roll the wheel to choose 2 MARK KIND and then push the wheel.
4. Roll the wheel to choose the WPT item which best matches the waypoint number you wish to enter and then push the wheel or the left button. For example, if you want to enter waypoint number 59, choose “WPT 51-100.”
5. Push the right button to close the menu. The guidance box now reads “MARK SELECT / MARK MENU.”
6. With the MARK box selected, roll the wheel to display waypoint number desired and then push the left button. The cursor jumps into the effective display area and the guidance box reads “MARK / EXIT.”

7. Roll the trackball to place the cursor where you want to inscribe a waypoint mark and then push the left button to inscribe the mark. The waypoint mark ("⬭" + waypoint number) appears at the location selected. (You can see the range and bearing to the cursor location by monitoring the mark range and bearing indication just below the MARK box.)

- To enter another waypoint, push the right button when the guidance box reads "MARK / EXIT" and then repeat steps 6-8. ("WPT" should be chosen on the MARK menu.)
- To quit entering waypoints, push the right button when the guidance box reads "MARK / EXIT."

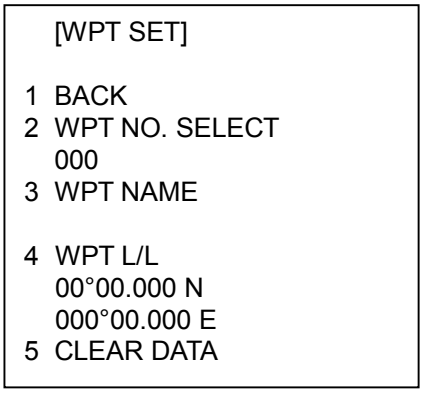
Entering waypoints by manual input of latitude and longitude

2. Roll the trackball to choose the MENU box at the right side of the screen and then push the left button.
3. Roll the wheel to choose 8 [NAV LINE•WPT] and then push the wheel or the left button.



NAV LINE•WPT menu

4. Roll the wheel to choose 6 [WPT SET] and then push the wheel or the left button.



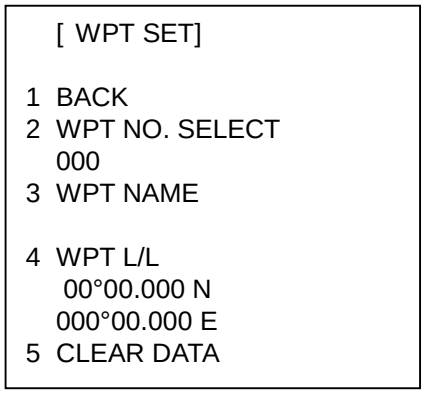
WPT SET menu

5. Roll the wheel to choose 2 WPT NO. SELECT and then push the wheel or the left button.
6. Use the wheel to choose waypoint number: Roll the wheel to choose location and then push the wheel to set.
7. To enter waypoint name, follow the procedure below. If you do not require waypoint name go to step 7.
   1) Roll the wheel to choose 3 WPT NAME and then push the wheel or the left button.
   2) Roll the wheel to choose alphanumeric character desired and then push the wheel.
   3) Repeat step 2 to complete the waypoint name. You may use up to 15 alphanumeric characters for waypoint name.
8. Roll the wheel to choose 4 WPT L/L and then push the wheel or the left button.
9. Enter latitude and longitude position as follows:
   1) Roll the wheel to choose location desired and then push the wheel. (The wheel may be pushed again to skip a place.) For input by keyboard, press appropriate numeric keys and then press the [ENTER MARK] key.
   2) To switch co-ordinate polarity, roll the wheel or use the [2] key in case of keyboard operation.
10. To enter another waypoint, repeat steps 4-8.
11. Push the right button three times to close the menu.

5.12.2 Editing, erasing waypoints from the menu

You may edit or erase waypoints from the menu as follows:

1. Roll the trackball to choose the MENU box at the right side of the screen and then push the left button.
2. Roll the wheel to choose 8 [NAV LINE• WPT] and then push the wheel or the left button.
3. Roll the wheel to choose 6 [WPT SET] and then push the wheel or the left button.



WPT SET menu

4. Roll the wheel to choose 2 WPT NO. SELECT and then push the wheel or the left button.
5. Use the wheel to enter waypoint number you wish to edit and then push the wheel or the left button. Then, do one of the following:
   - **To change the waypoint name,** roll the wheel to choose 3 WPT NAME and then push the wheel or the left button. Use the wheel to edit waypoint name.
   - **To edit the waypoint position,** roll the wheel to choose 4 WPT L/L and then push the wheel or the left button. Use the wheel to edit waypoint position.
   - **To erase the waypoint,** roll the wheel to choose 5 CLEAR DATA and then push the wheel or the left button. Note that a waypoint cannot be erased if it is part of a nav line.
6. Push the right button three times to close the menu.

5.12.3 Erasing waypoints

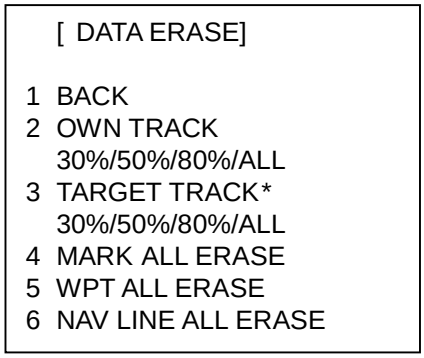
Waypoints may be erased individually or collectively. Note that a waypoint cannot be erased if it is part of a nav line.

Erasing individual waypoints

1. With the cursor inside the effective display area, roll the wheel to display " MARK DELETE / EXIT" in the guidance box.
2. Roll the trackball to place the cursor on the waypoint you wish to erase. A flashing " +" appears on the mark when it is correctly selected.
3. Push the left button or the wheel to erase the waypoint.
4. To erase another waypoint, repeat steps 2 and 3.
5. To finish, push the right button when the guidance reads " MARK DELETE / EXIT" .

Erasing all waypoints

1. Roll the trackball to choose the MENU box at the right side of the screen and then push the left button.
2. Roll the wheel to choose 5 PLOTTER and then push the wheel or the left button.
3. Roll the wheel to choose 8 [DATA ERASE] and then push the wheel or the left button.



*: Not available on IMO radar.

DATA ERASE menu

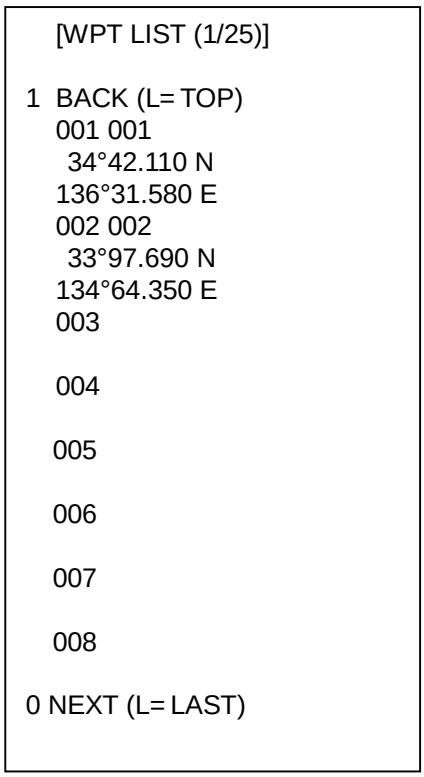
4. Roll the wheel to choose 5 WPT ALL ERASE.
5. Push the wheel or the left button to erase all waypoints.
6. Push the right button three times to close the menu.

5.12.4 Waypoint list

The waypoint list stores position data of all registered waypoints. Each page of the waypoint list holds eight waypoints.

To display the waypoint list:

1. Roll the trackball to choose the MENU box at the right side of the screen.
2. Roll the wheel to choose 8 NAV LINE•WPT and then push the wheel or the left button.
3. Roll the wheel to choose 7 [WPT LIST] and then push the wheel or the left button. Asterisks indicate no data.



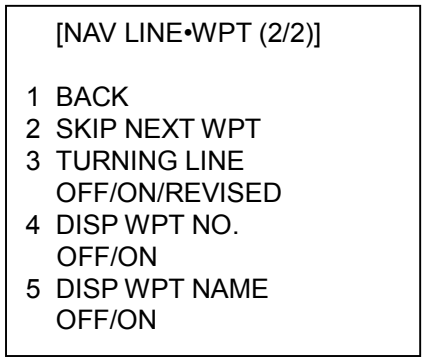
WPT list

4. To go to a next page, choose 0 NEXT and then push the wheel or the left button.
5. Push the right button several times to close the waypoint list and the menu.

5.12.5 Displaying waypoint name and number

You may turn waypoint name and number display on or off as desired.

1. Roll the trackball to choose the MENU box at the right side of the screen and then push the left button.
2. Roll the wheel to choose 8 [NAV LINE•WPT] and then push the wheel or the left button.
3. Roll the wheel to choose 0 NEXT and then push the wheel or the left button.



NAV LINE•WPT menu (2/2)

4. Roll the wheel to choose 4 DISP WPT NO. and then push the wheel or the left button.
5. Roll the wheel to choose OFF or ON as appropriate and then push the wheel or the left button.
6. Roll the wheel to choose 5 DISP WPT NAME and then push the wheel or the left button.
7. Roll the wheel to choose OFF or ON as appropriate and then push the wheel or the left button.
8. Push the right button three times to close the menu.

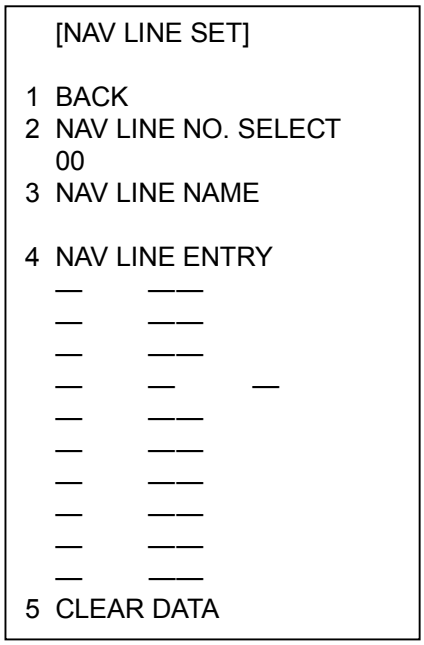
5.13 Nav Lines

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

5.13.1 Entering new nav line

To enter a nav line, first enter appropriate waypoints. Then, do the following:

1. Roll the trackball to choose the MENU box and then push the left button.
2. Roll the wheel to choose 8 [NAV LINE•WPT] and then push the wheel or the left button.
3. Roll the wheel to choose 8 [NAV LINE SET] and then push the wheel or the left button.



NAV LINE SET menu

4. Roll the wheel to choose 2 NAV LINE NO. SELECT and then push the wheel or the left button.
5. Use the wheel to enter nav line no., in two digits.
6. Roll the wheel to choose 3 NAV LINE NAME and then push the wheel or the left button.
7. Use the wheel to enter a name.
8. Roll the wheel to choose 4 NAV LINE ENTRY and then push the wheel or left button.
9. Use the wheel to enter waypoint numbers (in three digits): Roll the wheel to choose numeral and push it to set.

10. To enter another nav line, roll the wheel to choose 0 BACK to return to the NAV LINE SET menu and then repeat steps 4-9.
11. To finish, push the right button several times to close the menu.

5.13.2 Editing nav lines

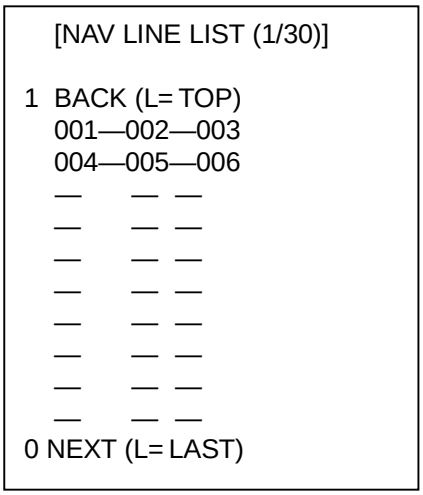
Follow the procedure below to edit a nav line. Before editing a nav line it must be disabled. See paragraph 5.13.6.

1. Roll the trackball to choose the MENU box and then push the left button.
2. Roll the wheel to choose 8 [NAV LINE• WPT] and then push the wheel or the left button.
3. Roll the wheel to choose 8 [NAV LINE SET] and then push the wheel or the left button.
4. Roll the wheel to choose 2 NAV LINE NO. SELECT and then push the wheel or the left button.
5. Use the wheel to enter nav line number to edit and then push the wheel or the left button.
6. To edit nav line name, roll the wheel to choose 3 NAV LINE NAME and then push the wheel or the left button. Use the wheel to change name.
7. To rep**lace waypoints in a nav line,** do the following:
   1) Roll the wheel to choose 4 [NAV DATA ENTRY] and then push the wheel or the left button.
   2) Roll the wheel to choose 2 NAV LINE WPT and then push the wheel or the left button.
   3) Push the wheel to choose the waypoint you wish to replace.
   4) Roll the wheel to set new waypoint number.
   5) Push the wheel to finish.
8. Push the right button several times to close the menu.

5.13.3 Nav line list

The nav line list, which shows all nav lines registered, may be displayed as follows:

1. Roll the trackball to choose the MENU box and then push the left button.
2. Roll the wheel to choose 8 [NAV LINE•WPT] and then push the wheel or the left button.
3. Roll the wheel to choose 9 [NAV LINE LIST] and then push the wheel or the left button.



NAV LINE LIST

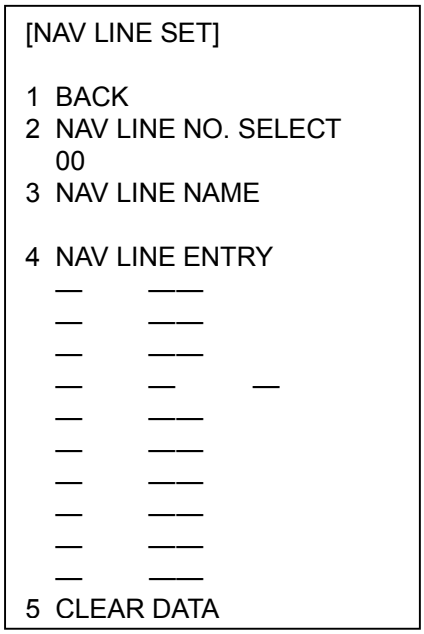
4. To go to a next page choose 0 NEXT and then push the wheel or the left button. To return to a previous page, choose 1 BACK and then push the wheel or the left button.
5. Push the right button as many times as necessary to close the menu.

5.13.4 Erasing nav lines

30 nav lines may be entered. You may erase unnecessary nav lines as shown below. A nav line which is currently in use cannot be erased.

Erasing individual nav lines

1. Roll the trackball to choose the MENU box at the right side of the screen and then push the left button.
2. Roll the wheel to choose 8 [NAV LINE•WPT] and then push the wheel or the left button.
3. Roll the wheel to choose 8 [NAV LINE SET] and then push the wheel or the left button.

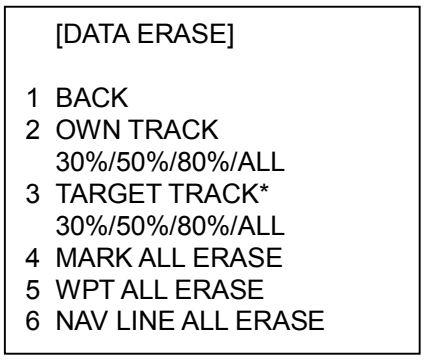


NAV LINE SET menu

4. Roll the wheel to choose 2 NAV LINE NO. SELECT and then push the wheel or the left button.
5. Use the wheel to enter nav line no., in two digits.
6. Roll the wheel to choose 5 CLEAR DATA.
7. Push the wheel or the left button to delete the nav line.
8. Push the right button three times to close the menu.

Erasing all nav lines

1. Roll the trackball to choose the MENU box and then push the left button.
2. Roll the wheel to choose 5 PLOTTER and then push the wheel or the left button.
3. Roll the wheel to choose 8 [DATA ERASE] and then push the wheel or the left button.



*: Not available on IMO radar.

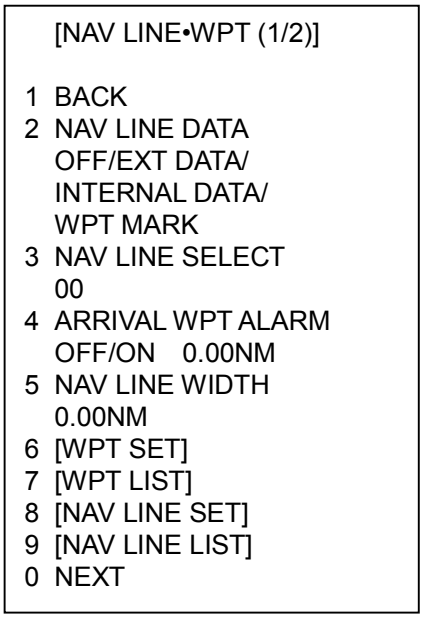
DATA ERASE menu

4. Roll the wheel to choose 6 NAV LINE ALL ERASE.
5. Push the wheel or the left button to erase all nav lines and their data.
6. Push the right button three times to close the menu.

5.13.5 Setting up nav lines

Nav lines can be set up as follows:

1. Roll the trackball to choose the MENU box and then push the left button.
2. Roll the wheel to choose 8 [NAV LINE•WPT] and then push the wheel or the left button.



NAV LINE•WPT menu (1/2)

3. Roll the wheel to choose 2 NAV LINE DATA and then push the wheel or the left button.

4. Roll the wheel to choose INTERNAL DATA and then push the wheel or the left button.
5. Roll the wheel to choose 5 NAV LINE WIDTH.
6. Use the wheel to enter the width for the nav line, from 0.0-9.9(nm). A pair of red lines mark the width of the nav line.
7. If you want to be alerted when own ship nears a waypoint by a preset distance, roll the wheel to choose 4 ARRIVAL WPT ALARM and then push the wheel or the left button. Push the wheel to choose ON.
8. Use the wheel to enter the arrival alarm range, in three digits.

9. Roll the wheel to choose 0 NEXT and then push the wheel or the left button.

[NAV LINE•WPT (2/2)]

1 BACK
2 SKIP NEXT WPT
3 TURNING LINE
OFF/ON/REVISED
4 DISP WPT NO.
OFF/ON
5 DISP WPT NAME
OFF/ON

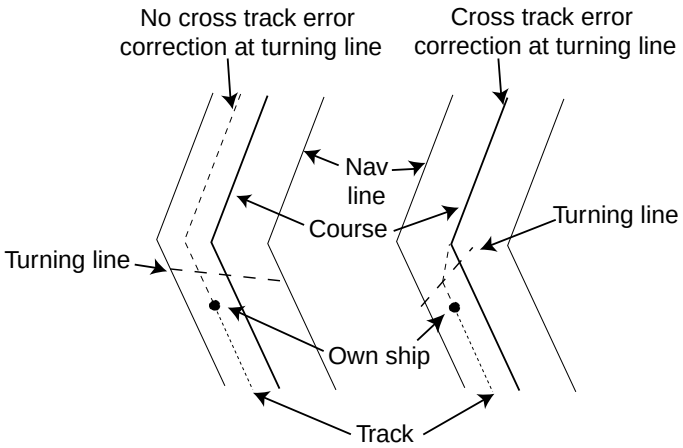
NAV LINE•WPT menu (2/2)

10. Roll the wheel to choose 3 TURNING LINE and then push the wheel or the left button.
11. Roll the wheel to choose appropriate option and then push the wheel or the left button.

OFF: Turns turning lines off.

ON: Use this setting when the vessel is not to correct cross track error to return to course set, after arriving at turning line location.

REVISED: Use this setting when vessel is to return to course set after correcting cross track error, after arriving at turning line location.



TURNING LINE: ON | TURNING LINE: REVISED

Turning line

12. Push the right button three times to close the menu.

5.13.6 Displaying nav line, waypoint mark

Displaying internal nav lines

1. Roll the trackball to choose the MENU box and then push the left button.
2. Roll the wheel to choose 8 [NAV LINE•WPT] and then push the wheel or the left button.
3. Roll the wheel to choose 2 NAV LINE DATA and then push the wheel or the left button.
4. Roll the wheel to choose INTERNAL DATA and then push the wheel or the left button.
5. Roll the wheel to choose 2 NAV LINE SELECT and then push the wheel or the left button.
6. Use the wheel to enter the nav line number you want to display. Roll the wheel to choose numeral and push it to set. Note that the same nav line no. cannot be entered more than once.
7. To skip the next waypoint, roll the wheel to choose 2 SKIP NEXT WPT and then push the wheel or the left button.
8. Push the right button twice to close the menu.

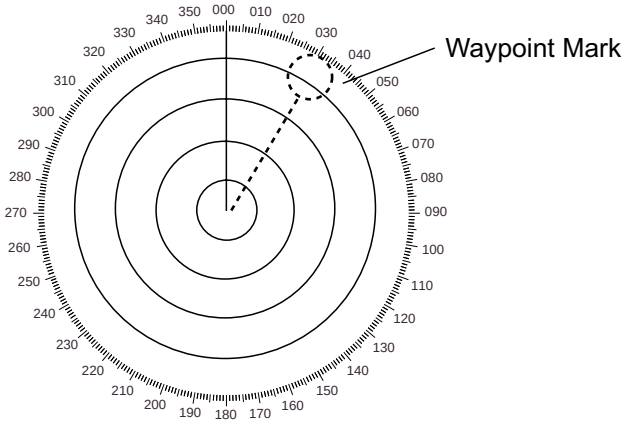
Displaying external nav lines

Nav lines from an external navigator can be displayed as below. RTE and WPL sentences are necessary to display a nav line from a navigator.

1. Roll the trackball to choose the MENU box and then push the left button.
2. Roll the wheel to choose 8 [NAV LINE•WPT] and then push the wheel or the left button.
3. Roll the wheel to choose 2 NAV LINE DATA and then push the wheel or the left button.
4. Roll the wheel to choose EXT DATA and then push the wheel or the left button.
5. Do the following as appropriate:
   1) Set width (0.0-9.9 nm) of the nav line with 5 NAV LINE WIDTH.
   2) Turn waypoint number display on or off with 4 DSP WPT NO (page 2 of NAV LINE•WPT menu).
   3) Set turning line with 3 TURNING LINE (page 2 of NAV LINE•WPT menu).
6. Push the right button two or three times depending on which page of the NAV LINE•WPT menu you are using.

Waypoint mark

The waypoint mark shows the location of a destination waypoint which is set on a navigator. You may mark this location on the radar display by following the procedure shown below.



Waypoint mark

1. Roll the trackball to choose the MENU box and then push the left button.
2. Roll the wheel to choose 8 [NAV LINE•WPT] and then push the wheel or the left button.
3. Roll the wheel to choose 2 NAV LINE DATA and then push the wheel or the left button.
4. Roll the wheel to choose WPT MARK and then push the wheel or the left button.
5. Push the right button twice to close the menu.

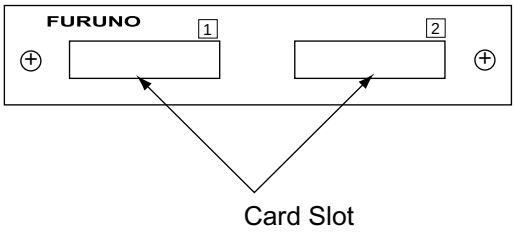
5.14 Recording Data

The optional Card I/F Unit CU-200 is required to record or replay data. The CU-200 has two card slots and you can connect two units, for a total of four card slots.

5.14.1 Initializing memory (RAM) cards

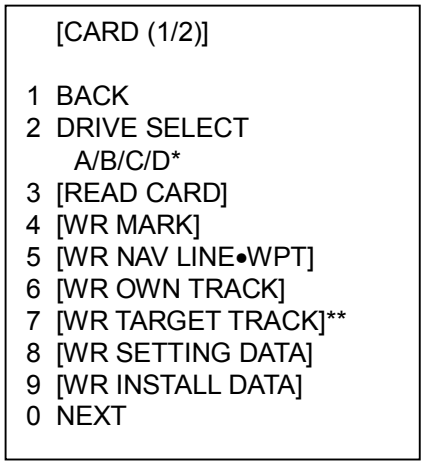
Before you can use a memory (RAM) card it must be initialized. Formatting prepares the recording surface of the card for use with the system, and deletes all data recorded in the memory card. You can format cards you've used before, however, in which case all prior information on them is erased.

1. Insert a blank memory card into the appropriate card slot in the Card I/F Unit.



Card I/F unit, front view

2. Roll the trackball to choose the MENU box and then push the left button.
3. Roll the wheel to choose 6 [CARD] and then push the wheel or the left button. (Note that "WR" in the CARD menu means "Write.")



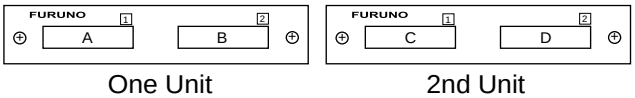
*: Drives available are shown.

**: Not available on IMO type radar.

CARD menu, page 1

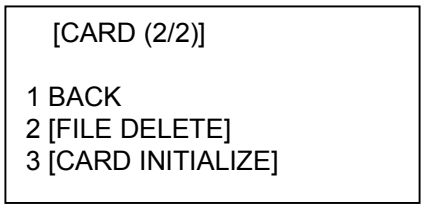
4. Roll the wheel to choose 2 DRIVE SELECT and then push the wheel or the left button.
5. Roll the wheel to choose appropriate drive and then push the wheel or the left button.

Note: If one unit is connected the drives are, from the left drive on the unit, A=1 and B=2. In case of a second drive unit, its drives are, from the left drive on the unit, C=1 and D=2.



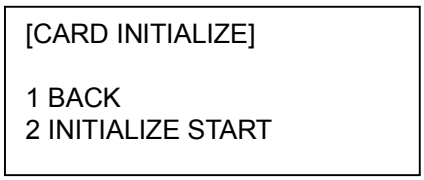
One Unit 2nd Unit

6. Roll the wheel to choose 0 NEXT and then push the wheel or the left button.



CARD menu, page 2

7. Roll the wheel to choose 3 CARD INITIALIZE and then push the wheel or the left button.



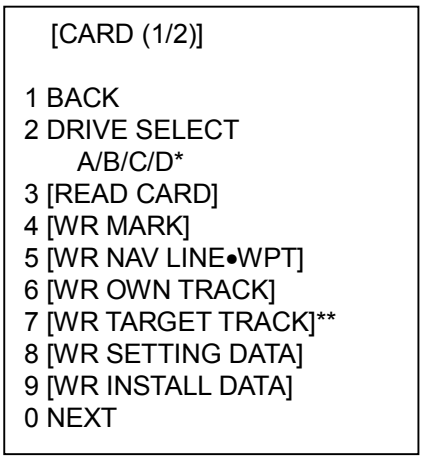
CARD INITIALIZE menu

8. Roll the wheel to choose 2 INITIALIZE START and then push the wheel or the left button to initialize the card. The LED near the card flashes, the CARD menu disappears and the message “FORMAT CARD” appears.

5.14.2 Recording data

When the memory becomes full, the oldest track is erased to make room for the latest. Further, when the memory is full you cannot enter another mark or line unless you erase unnecessary marks, lines or track. Thus you should save important data to a memory card so as not to lose important data.

1. Insert initialized memory card into appropriate drive in Card I/F Unit.
2. Roll the trackball to choose the MENU box and then push the left button.
3. Roll the wheel to choose 6 [CARD] and then push the wheel or the left button.

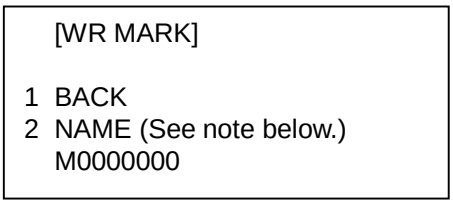


*: Drives available are shown.

**: Not available on IMO type radar.

CARD menu

4. Roll the wheel to choose DRIVE SELECT and then push the wheel or the left button.
5. Roll the wheel to choose appropriate drive and then push the wheel or the left button.
6. Roll the wheel to choose data to record (one item among 4-9) and then push the wheel or the left button. For example choose 4 WR MARK and then push the wheel or the left button. The display then looks something like the one below.



CARD WRITE menu

Note: The file name is composed of a single alphabet, the file type, and seven digits, the file number. The file type is denoted as follows:
M: Mark
W: Waypoint, nav line
T: Own track
A: Target track
S: Setting data
I: Installation data

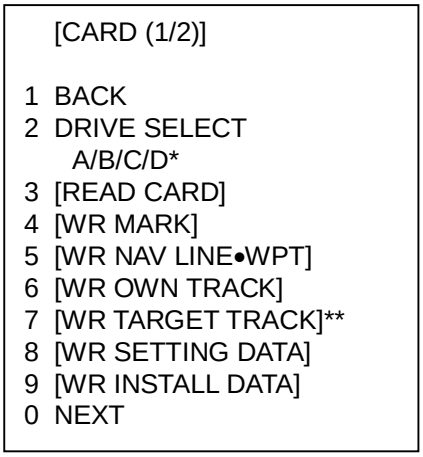
7. Use the wheel and the left button to enter file title. You may use up to seven digits.
8. After entering the last digit of the file name the chosen item is recorded.

The message “WR CARD DATA” is shown during recording.

5.15 Replaying Data

Video plotter data (track, marks, etc.) may be replayed on the screen. This is useful for analyzing past data.

1. Insert memory card into the appropriate slot in an I/F card unit.
2. Roll the trackball to choose the MENU box and then push the left button.
3. Roll the wheel to choose 6 [CARD] and then push the wheel or the left button.

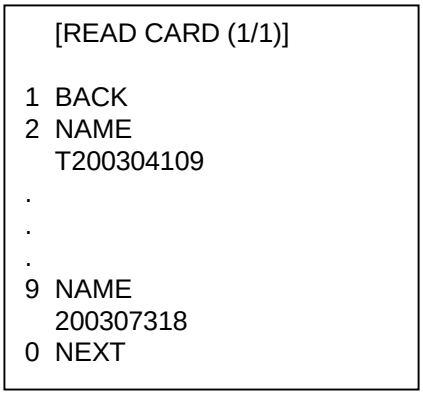


*: Drives available are shown.

**: Not available on IMO type radar.

CARD menu

4. Roll the wheel to choose 2 DRIVE SELECT and then push the wheel or the left button.
5. Roll the wheel to choose the drive where you inserted the memory card.
6. Push the wheel or the left button.
7. Roll the wheel to choose 3 READ CARD and push the wheel or the left button.



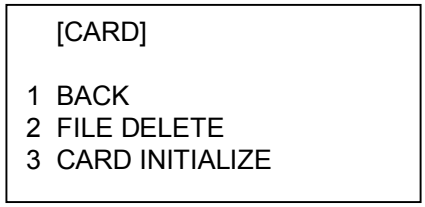
READ CARD menu

8. Roll the wheel to choose the data to replay.
9. Push the wheel or the left button to replay chosen data.

The message “RD CARD DATA” is shown during playback. If you chose WR INSTALL DATA, the prompt “POWER ON RESET” appears; turn the power off and on again to read in installation data.

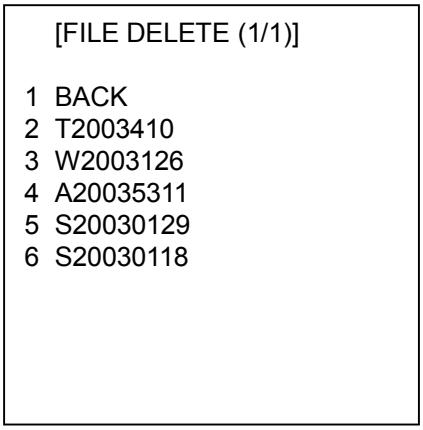
5.16 Deleting Files

1. Roll the trackball to choose the MENU box and then push the left button.
2. Roll the wheel to choose 6 [CARD] and then push the wheel or the left button.
3. Roll the wheel to choose 2 DRIVE SELECT and then push the wheel or the left button.
4. Roll the wheel to choose the appropriate drive and then push the wheel or the left button.
5. Roll the wheel to choose 0 NEXT and then push the wheel or the left button.



CARD menu, page 2

6. Roll the wheel to choose 2 FILE DELETE and then push the wheel or the left button.



FILE DELETE display

7. Roll the wheel to choose the file to delete and then push the wheel or the left button.

The message “DELETE CARD DATA” appears while data is being deleted.

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6 MAINTENANCE, TROUBLESHOOTING

Periodic checks and maintenance are important for proper operation of any electronic system. This chapter contains maintenance and troubleshooting instructions to be followed to obtain optimum performance and the longest possible life of the equipment. Before attempting any maintenance or troubleshooting procedure please review the safety information below.

⚠ WARNING



Do not open the equipment.

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





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

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



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

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

6.1 Periodic Maintenance Schedule

Regular maintenance is essential to good performance. A regular maintenance program should be established and should at least include the items shown in the table below.

Maintenance schedule

Interval	Check point	Check and measures	Remarks
When needed	The LCD will in time accumulate a layer of dust which tends to dim the picture	Wipe the LCD carefully to prevent scratching, using tissue paper and an LCD cleaner. To remove stubborn dirt, use an LCD cleaner, wiping slowly with tissue paper so as to dissolve the dirt. Change paper frequently so the dirt will not scratch the LCD.	Do not use chemical-based cleaners to clean the LCD. They can remove paint and markings.
	Processor unit cleanliness	Dust and dirt may be removed with a soft cloth.	Do not use chemical-based cleaners to clean the processor unit. They can remove paint and markings.
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 chemical-based cleaners for cleaning. They can remove paint and markings. If you need to remove ice from the 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 (TECHNICIANS only)	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	Terminal strips, sockets, earth terminal on processor unit (TECHNICIANS only)	Check for loose connections. Check contacts and plugs for proper seating, etc.	

6.2 Life Expectancy of Major Parts

Parts	Type	Life expectancy	Remarks
Antenna motor	D8G-516 (24 rpm, X-band) D8G-571 (42 rpm, X-band) RM-7398 (21/26 rpm, S-band) RM-7435 (21/26 rpm, S-band) RM-9519 (45 rpm, S-band) RM-9520 (45 rpm, S-band) RM-9521 (45 rpm, S-band)	Gears more than 10,000 h	Wind load 100 kt
Magnetron	MAF 1425B, MG4010 (X-band, 12 kW) MG5436 (X-band, 25 kW) MG5223F (S-band, 30 kW)	2,000 - 3,000 h	

6.3 Replacing the Fuse

The fuse at the rear of the processor unit in the display unit protects the equipment from overcurrent (overvoltage in case of AC set) and equipment fault. If you cannot turn on the power, first check the fuse. Find the cause of the trouble before replacing the fuse. Be sure to use the proper fuse. Use of a wrong fuse can seriously damage the equipment and void the warranty.

⚠ WARNING

Use the proper fuse.

Use of a wrong fuse can result in damage to the equipment or cause fire.

Ship's mains and fuse to use

Unit	Fuse to use
Processor Unit	
24 VDC	20A
100-115 VAC	10A
220-230 VAC	5A
Display Unit MU-201CR	
AC spec.	2A
DC spec.	5A
Display Unit MU-231CR	
AC spec.	2A
DC spec.	6A

6.4 Replacement of Battery on GC Board

The battery installed on the GC (GyroCompass) Board inside the processor unit preserves gyro data when the power is turned off. The life of the battery is about five years. When the battery voltage is low, NG appears at the diagnostic test for the GC Board. When this occurs, contact your dealer for replacement.

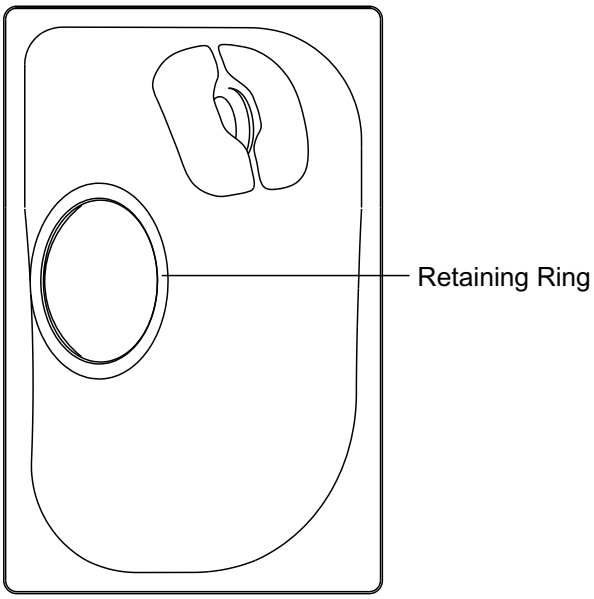
Battery on GC Board

	Battery type	Code number
GC board	CR 1/2 8.L	000-103-769

6.5 Trackball Maintenance

If the cursor skips or moves abnormally, clean the trackball as below.

1. Turn the retaining ring counterclockwise 45° to unlock it.



2. Remove the retaining ring and ball.
3. Clean the ball with a soft, lint-free cloth, and then blow carefully into the ball-cage to dislodge dust and lint.
4. Look for a build-up of dirt on the metal rollers. If dirty, clean the rollers using a cotton swab moistened lightly with isopropyl-rubbing alcohol.
5. Make sure that fluff from the swab is not left on the rollers.
6. Replace the ball and retaining ring. Be sure the retaining ring is not inserted reversely.

6.6 Easy Troubleshooting

This paragraph provides troubleshooting procedures which the user may follow to restore normal operation. If you cannot restore normal operation, do not attempt to check inside any unit. Any repair work is best left to a qualified technician.

Easy troubleshooting procedures

Problem	Cause	Remedy
Key beep inaudible	Key beep turned off (Non-IMO type only)	Adjust key beep level on the OPERATION menu, referring to paragraph 1.42.
Picture not updated or picture freeze-up	Video freeze-up	Turn the power off and on again to restore normal operation.
Marks, indications and noise appear but no echo	Blown fuse	Check for blown fuse in processor unit.
Range changed but radar picture does not change	Defective range key or video freeze up	Try to hit RANGE [+] and [-] range keys (or RANGE box) several times. (If unsuccessful, replacement of keypad may be required in case of the keyboard-type control unit.) If that does not work try to turn the power off and on again to see if the problem might be video freeze up.
Only 2 parallel index lines when 6 lines are wanted	Incorrect setting of index line intervals	Incorrect setting of index line intervals. Adjust index line interval, referring to paragraph 1.29.2. Also, the setting for number of index of lines to display may be inappropriate. Check the menu setting for number of index lines, referring to paragraph 1.29.4.
Range rings are not displayed	Range rings turned off	Try turning on the range rings with 0 RINGS in the MARK menu. If they do not appear, their brilliance may be too low. Adjust their brilliance at page 1 of the BRILL menu.
ARPA target not tracked correctly	Poor definition of targets in sea clutter	Adjust A/C SEA and A/C RAIN referring to paragraph 1.17 and 1.18.
Tuning adjusted but poor sensitivity	2nd trace echo rejector on or dirt on radiator face	• Turn off the 2nd trace echo rejector, referring to paragraph 1.37. • Clean the radiator face.

6.7 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.

Advanced troubleshooting

Problem	**Probable causes or check points**	**Remedy**
Power turned on but radar does not operate at all	1) Blown fuse. 2) Mains voltage/polarity 3) Power supply board	1) Replace blown fuse. 2) Correct wiring and input voltage. 3) Replace power supply board.
Brilliance adjusted but no picture	SPU board	Replace SPU board.
Antenna not rotating	1) Antenna drive mechanism 2) Defective antenna drive motor relay (thermal relay K2, 200/220/380, 440/100 VAC)	1) Replace antenna drive mechanism. 2) Press relay reset button.
Data and marks not displayed in Transmit status	SPU board	Replace SPU board.
Adjust GAIN with A/C SEA set at minimum. Marks and indications appear but no noise or echo	1) IF amplifier 2) Signal cable between antenna and processor unit 3) Video amplifier board	1) Replace IF amplifier. 2) Check continuously 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.

(Continued on next page)

Advanced troubleshooting (con't)

Problem	Probable causes or check points	Remedy
Marks, indications and noise appear but no echo (Transmission leak representing own ship position is absent)	1) TX fuse	1) If fuse is blown, replace it. If it blows again, the modulator or associated circuit may be defective.
	2) Magnetron	2) Check magnetron current. Replace magnetron.
	3) Modulator board	3) Replace modulator board.
	4) SPU board	4) Replace SPU board.
Picture not updated or picture freeze-up	1) Bearing signal generator board (in antenna unit)	1) Check the connection of signal cables.
	2) SPU board	2) Replace SPU board.
	3) Video freeze-up	3) Turn off and on the radar.
Incorrect orientation of picture	1) SPU board	1) The message HDG SIG MISSING appears when the heading pulse is not received during standby.
	2) Gyro interface	2) Replace the gyro interface.
Cannot operate radar from on-screen boxes	SPU Board	Replace SPU Board.
Radar is properly tuned but poor sensitivity	1) Deteriorated magnetron	1) With the radar transmitting on 48 nm range, check magnetron current. If current is below normal, magnetron may be defective. Replace it.
	2) Detuned MIC	2) Check MIC detecting current. If it is below normal value, MIC may have become detuned. MIC must be tuned.
	3) Dirt on radiator face	3) Clean the radiator surface.
	4) Water ingress to the waveguide or other feeder line	4) Remove water from the feeder line.
	5) Second trace echo rejection is ON	5) Disable the second-trace echo rejector referring to paragraph 1.37.
Range changed but radar picture not changing	1) Defective range key	1) Try to hit RANGE [+] and [-] keys several times. If unsuccessful, replacement of keypad may be required.
	2) SPU board	2) Replace SPU board.
	3) Video freeze-up	3) Turn off and on radar.

(Continued on next page)

Advanced troubleshooting (con't)

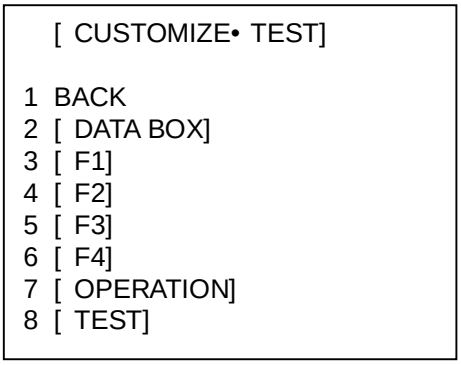
Problem	**Probable causes or check points**	**Remedy**
Interference rejector is inoperative (interference rejection level not displayed)	SPU board	Replace SPU board.
Echo stretch is ineffective (neither ES1, ES2 nor ES3 is displayed)	SPU board	Replace SPU board.
Range rings are not displayed	1) Adjust the brilliance of range rings on the BRILL menu to see if intensity is increased 2) SPU board	1) Replace associated circuit board if unsuccessful. 2) Replace SPU board.
Poor discrimination in range	Sea clutter control not functioning properly	Improper setting of A/C SEA. If A/C SEA is seen only at very close range, suspect inaccurate frequency of reference oscillator.
True motion presentation not working correctly	1) Poor contact of MODE key (full keyboard) 2) Selection not accessed. 3) Speed entry incorrect 4) TM display inaccurate	1) Try to press MODE key a little harder. 2) Press MODE key or operate PRESENTATION MODE box until TM appears. 3) Enter correct own ship speed referring to paragraph 1.13. 4) Make sure that speed and compass inputs are accurate.
Target not tracked correctly	Poor definition of targets in sea clutter	Adjust A/C SEA and A/C RAIN controls referring to paragraph 1.17 and 1.18.
Buttons on trackball module operated but no response	Trackball module	Replace trackball module.

6.8 Diagnostics

A diagnostic test program is provided to test major circuit boards in the control unit, processor unit and card I/F unit. Note that the normal radar picture is lost during this test.

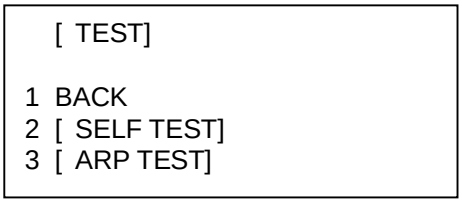
Proceed as follows to execute the diagnostic test:

1. Roll the trackball to choose the MENU box and then push the left button.
2. Roll the wheel to choose 9 [CUSTOMIZE• TEST] and then push the wheel or the left button.



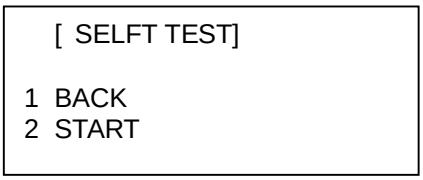
CUSTOMIZE•TEST menu

3. Roll the wheel to choose 8 [TEST] and then push the wheel or the left button.



TEST menu

4. Roll the wheel to choose 2 [SELF TEST] and push the wheel or the left button.



SELF TEST menu

5. Roll the wheel to choose 2 START and then push the wheel or the left button to start the test.

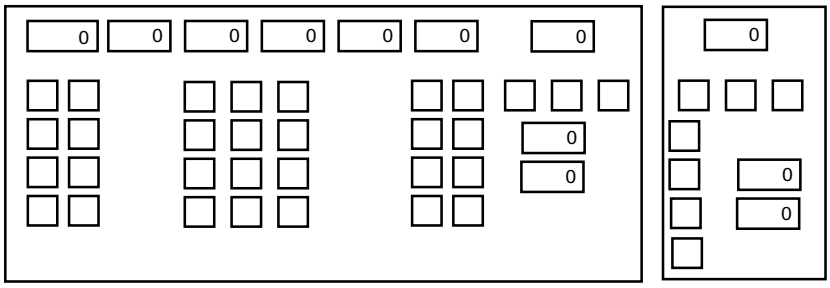
   In a few moments the results of the test are displayed and the buzzer sounds continuously. The ROMs and RAMs of the SPU, RFC, KEYBOARD (Control Unit), REMOTE (Trackball-only Control Unit) and CARD I/F UNIT are checked for proper operation. OK appears for normal operation. If NG (No Good) appears, corresponding components may be defective. Consult your dealer. In the middle of the display the rpm of the antenna unit and various voltages are displayed.

<SELF TEST>

	PROGRAM No.	ROM	RAM	DIP SW
SPU	0359204-01.**	OK	OK	0000
RFC	0359202-01.**	OK	OK	
KEY	0359203-01.**	OK	OK	
REMOTE1	0359203-01.**	OK	OK	
REMOTE2				
# CARD	0359209-01.**	OK	OK	0000

PROCESSOR UNIT MONITOR	
-12V	-11.6
3.3V	3.3
5V	4.9
12V	11.6
SCANNER MOTOR	20.7

RF UNIT MONITOR	
TEMPERATURE	27.3
TUNE IND	0.2
HV	174.3
R. MONITOR	1.6
MAG. CURRENT	1.5
HEATER	4.0
12V	11.9
-12V	-11.8
5V	4.8
32V	38.2
TUNE OUT	0.0
TRIGGER FREQ	2273
ANT SPEED	21.6



*.**: Program Version No.
#: Installed card units are shown.

Self test results, keyboard test

6. The small squares and circles displayed at the bottom of screen are for testing the control and keys on the control unit. As you operate controls and keys, corresponding squares are highlighted, indicating that your control/key operations are properly recognized. Numerals indicate the position of the controls under check.

7. Press the [F1] key to change the display. The buzzer stops and the screen shows the sentences being input to the radar, under the categories of GPS1 and GPS2 (position), speed, heading and nav data. Below is an example. (The sentences shown depend on your system settings.)

<GPS1>
GGA
GLL
RMC
RMB
VTG
ZDA
DTM
BWR
BWC
<GPS2>
GGA
GLL
RMC
RMB
VTG
ZDA
DTM
BWR
BWC
<SPEED>
VBW
VHW
VDR
<HEADING>
HDT
<NAV DATA>
WPL
RTE
MWV
VWT
VWR
DPT
DBT
DBS
MTW
VDM

Sentence input display

8. To terminate the test, press the [F1] key.

6.9 System Messages

This sections provides all the error messages which may appear on the display screen.

System messages

Message	Alarm	Meaning
Signal Missing		
DATUM	Continuous	Wrong chart datum (only WGS84 is permitted)
GYRO	Continuous	No bearing data
LOG	Continuous	No speed log data
EPFS	Continuous	No position data
TRIGGER	Continuous	No trigger signal (antenna)
VIDEO	Continuous	No video signal
AZIMUTH	Continuous	No antenna rotation signal
HEADLINE	Continuous	No heading signal
ARPA Alarm		
COLLISION	Continuous	A tracked target' s CPA and TCPA fulfill criteria for collision course
GUARD	Continuous	A tracked target is present in the guard zone
LOST	Beep	A tracked target becomes a lost target
ARPA SYSTEM ERROR	Continuous	No status data from ARPA
TARGET-FULL (AUTO+MAN)	Continuous	Capacity for automatic and manually acquired targets has been reached
TARGET-FULL (AUTO)	Continuous	Capacity for automatically acquired targets has been reached
TARGET-FULL (MAN)	Continuous	Capacity for manually acquired targets has been reached
AIS Alarms		
COLLISION	Continuous	A tracked target' s CPA and TCPA fulfill criteria for collision course
LOST	Beep	A tracked target becomes a lost target
ARPA FUSION	Beep	ARPA and AIS target combined
RECEIVE	None	Not receiving AIS data from own AIS (VDO message)
GUARD	Continuous	Tracked target is inside the guard zone
CPA/TCPA	Continuous	CPA/TCPA cannot be calculated; Ground data (VTG, L/L) no present
TARGET-FULL	None	Capacity for AIS target has been reached
AIS ALARM	Continuous	Alarm received from AIS transponder

(Continued on next page)

System messages (con't from previous page)

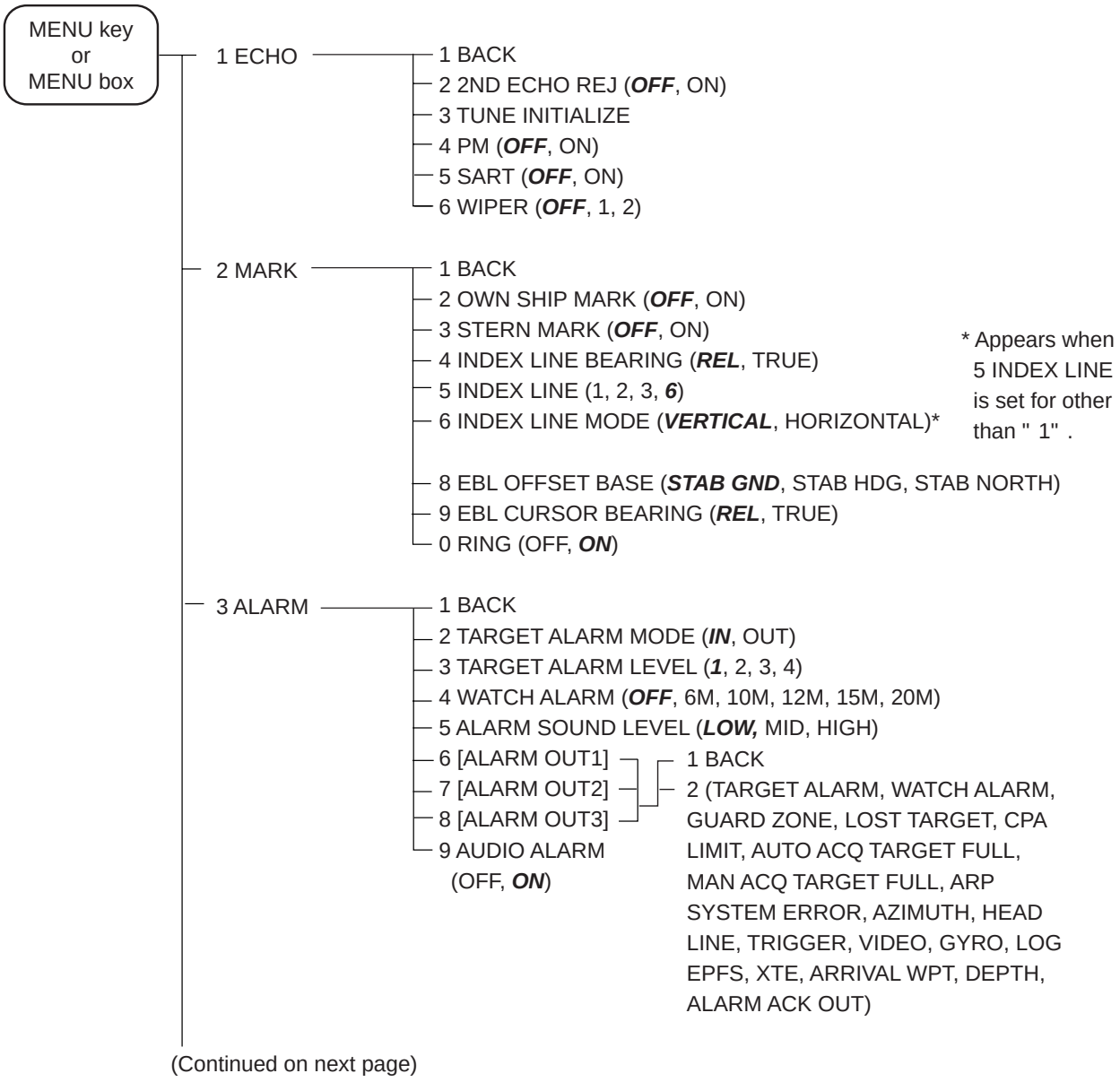
Message	Alarm	Meaning
Other Alarms		
CHK INT-SW	Continuous	Image from currently selected antenna becomes lost
DEPTH	Continuous	Water is shallower than preset depth
HEADING SET	None	Gyro re-set with MODE key
XTE	Continuous	Cross-track error: Ship has crossed over a nav line by a preset range
WATCH	Continuous	Watchman time has elapsed
ARRIVAL	Continuous	Ship has arrived to a waypoint
KEY	Continuous	No status data from keyboard
RF	Continuous	No status data from antenna
Work in Progress		
TUNE INITIALIZE	None	Tune initialization in progress
PM	None	Performance monitor is in use
USER DEFAULT	None	
SART	None	Radar is set up for SART detection
WR CARD DATA	None	Writing memory card
RD CARD DATA	None	Reading memory card
FORMAT CARD	None	Formatting memory card
DELETE CARD DATA	None	Deleting file from memory card
POWER ON RESTART	None	Prompt which appears after loading installation settings from memory card.

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APPENDIX

1. Menu Tree

Main menu (accessed by MENU key or MENU box)



(Continued on next page)

(Continued from previous page)

- 4 ARP•AIS
  - 1 BACK
  - 2 GUARD ZONE STAB (***STAB HDG***, STAB NORTH)
  - 3 GUARD POLYGON (***OFF***, STAB GND, STAB HDG, STAB NORTH)
  - 4 [TRIAL MANEUVER]
    - 1 BACK
    - 2 TRIAL (***OFF***, STATIC, DYNAMIC)
    - 3 TRIAL SPEED RATE (0.0 kt, 0.00 °/s, two sets)
    - 4 TRIAL TURN RATE (0.0 kt, 0.00 °/s, two sets)
  - 5 [ARP SYMBOL]
    - 1 BACK
    - 2 ARP SYMBOL COLOR (RED*, GRN, BLU, YEL, CYA, MAG, ***WHT***)
    - 3 ARP SYMBOL SIZE (***SMALL***, STD, LARGE)
    - 4 PAST POSN COLOR (RED, GRN, BLU, YEL, CYA, MAG, ***WHT***)
    - 5 PAST POSN POINTS (***5***, 10)
  - 6 [AIS SYMBOL]
    - 1 BACK
    - 2 AIS SYMBOL COLOR (RED*, GRN, BLU, YEL, CYA, MAG, ***WHT***)
    - 3 AIS SYMBOL SIZE (***SMALL***, STD, LARGE)
    - 4 ROT TAG LIMIT (***000.1***- 720.0°/min)
    - 5 PAST POSN COLOR (RED, GRN, BLU, YEL, CYA, MAG, ***WHT***)
    - 6 PAST POSN POINTS (***5***, 10)
  - 7 [FUSION]
    - 1 BACK
    - 2 FUSION TARGET (OFF/ON)
    - 3 GAP (***0.000*** - 0.999 (nm))
    - 4 RANGE (***0.000*** - 0.999 (nm))
    - 5 BEARING (***0*** - 9.9°)
    - 6 SPEED (***0.0*** - 9.9 (kt))
    - 7 COURSE (***0*** - 9.9°)
  - 8 AIS FUNCTION — (***OFF***, ON)

*: Not available on IMO-type radar.

- 5 PLOTTER
  - 1 BACK
  - 2 CHART COLOR (***GRN***, YEL, CYAN, ORANGE, GRAY)*
  - 3 OWN TRACK INTERVAL (***OFF***, 10S, 30S, 1M, 2M, 3M, 6M)
  - 4 OWN TRACK COLOR (***RED***, GRN, BLU, YEL, CYA, MAG, WHT)
  - 5 TGT TRACK INTERVAL (***10S***, 30S, 1M, 2, 3M, 6M)*
  - 6 TGT TRACK COLOR (***RED***, GRN, BLU, YEL, CYA, MAG, WHT)*
  - 7 CURSOR L/L ALIGN (***OFF***, ON)
  - 8 [DATA ERASE]
    - 1 BACK
    - 2 OWN TRACK (30%/50%/80%/ALL)
    - 3 TARGET TRACK (30%/50%/80%/ALL)*
    - 4 MARK ALL ERASE
    - 5 WPT ALL ERASE
    - 6 NAV LINE ALL ERASE

(Continued on next page)

(Continued from previous page)

- 9 [DISPLAY]
  - 1 BACK
  - 2 GRID (OFF, ***ON***)
  - 3 OWN TRACK (OFF, ***ON***)
  - 4 TARGET TRACK (OFF, ***ON***)*
  - 5 MARK (OFF, ***ON***)
  - 6 LAND DENSITY (OFF, ***ON***)*
  - 7 PLACE NAME (OFF, ***ON***)*
  - 8 COAST LINE (OFF, ***ON***)
  - 9 CONTOUR LINE (OFF, ***ON***)
  - 0 NEXT
    - 1 BACK
    - 2 NAV LINE(MAP) (OFF, ***ON***)
    - 3 DANGER HIGHLIGHT (OFF, ***ON***)
    - 4 PROHIBITED AREA (OFF, ***ON***)
    - 5 BUOY (OFF, ***ON***)
- 6 CARD
  - 1 BACK
  - 2 DRIVE SELECT (Available drives shown)
  - 3 [READ CARD]
  - 4 [WR MARK]
  - 5 [WR NAV LINE•WPT]
  - 6 [WR OWN TRACK]
  - 7 [WR TARGET TRACK]*
  - 8 [WR SETTING DATA]
  - 9 [WR INSTALL DATA]
  - 0 NEXT
    - 1 BACK
    - 2 [FILE DELETE]
    - 3 [CARD INITIALIZE]

*: Not available on IMO-type radar.

- 7 NAV DATA
  - 1 BACK
  - 2 DEPTH (***OFF***, m, ft)
  - 3 DEPTH GRAPH SCALE (***10***, 20, 50, 100, 200, 500)
  - 4 DEPTH MARK (***000*** - 500 (m))
  - 5 CURRENT (***OFF***, ON)
  - 6 WIND (***OFF***, m/s, kt)
  - 7 TEMP (***OFF***, ON)
  - 8 DATE-TIME (***OFF***, UTC, LOCAL)
  - 9 LOCAL TIME ADJ (***00:00*** - ±13:30)
  - 0 WPT DATA (***OFF***, REL, TRUE)
- 8 NAV LINE•WPT
  - 1 BACK
  - 2 NAV LINE DATA (***OFF,*** EXT DATA, INTERNAL DATA, WPT MARK)
  - 3 NAV LINE SELECT (Enter nav line no.)
  - 4 ARRIVAL WPT ALARM (***OFF,*** ON)
  - 5 NAV LINE WIDTH (***0.0*** - 9.9 (nm))
  - 6 [WPT SET]
    - 1 BACK
    - 2 WPT NO. SELECT
    - 3 WPT NAME
    - 4 WPT L/L
    - 5 CLEAR DATA

(Continued on next page)

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- 7 [WPT LIST]
- 8 [NAV LINE SET]
  - 1 BACK
  - 2 NAV LINE NO. SELECT
  - 3 NAV LINE NAME
  - 4 NAV LINE ENTRY
  - 5 CLEAR DATA
- 9 [NAV LINE LIST]
- 0 NEXT
  - 1 BACK
  - 2 SKIP NEXT WPT
  - 3 TURNING LINE (***OFF***, ON, REVISED)
  - 4 DISP WPT NO. (***OFF***, ON)
  - 5 DISP WPT NAME (***OFF***, ON)

9 CUSTOMIZE• TEST

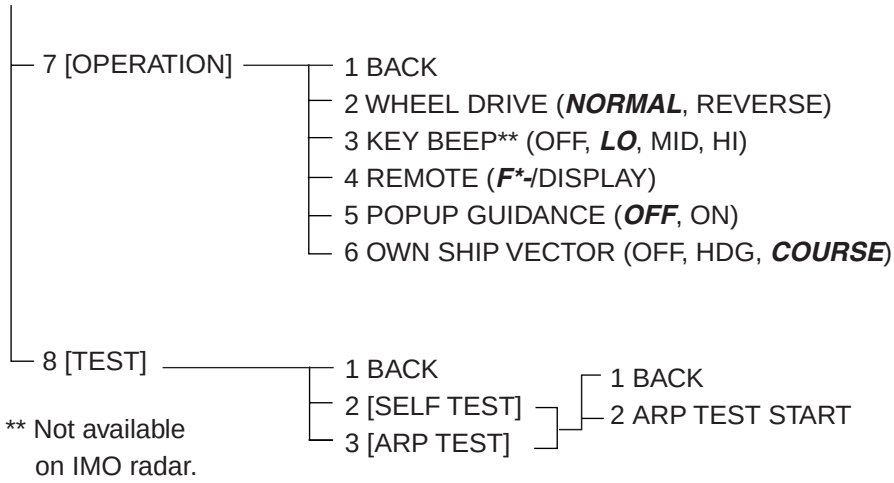
- 1 BACK
- 2 [DATA BOX]
  - 1 BACK
  - 3 NAV DATA (***OFF***, ON)
  - 4 ZOOM (***OFF***, 2TIMES, 3TIMES)
  - 5 ZOOM DISPLAY (***STAB GND***, STAB HDG, STAB NORTH, ARPA TRACK)
  - 6 TARGET DATA (***1BOX***, 2BOX, 3BOX, LARGE)
- 3 [F1]
- 4 [F2]
- 5 [F3]
- 6 [F4]

  - 1 BACK
  - 2 [ECHO]
    - 1 BACK
    - 2 (PICTURE, IR, ES, EAV, NOISE REJ , ANT SELECT, PULSE LENGTH, A/C SEA SELECT, AUTO RAIN SELECT, TUNE SELECT, ANT HEIGHT SEA CONDITION, 2ND ECHO REJ , PM, SART)
  - 3 [STD KEY]
    - 1 BACK
    - 2 (ALARM ACK, STBY TX, HL OFF, EBL OFFSET, MODE, OFF CENTER, CU TM RESET, INDEX LINE, VECTOR TIME, VECTOR MODE, TARGET LIST, TRAIL, BRILL, MARK, MENU, RANGE UP, RANGE DOWN, ACQ, TARGET DATA, TARGET CANCEL)
  - 4 [ARPAIS]
    - 1 BACK
    - 2 (DISP ARP, DISP AIS, TARGET DATA & ACQ, PAST POSN INTERVAL, REF MARK, CPA LIMIT, CPA, TCPA, GZ1, GZ2, TARGET LIST SORT, TRIAL MANEUVER, ARPA•AIS FUSION, AIS MESSAGE)
  - 5 [OPERATION]
    - 1 BACK
    - 2 (ECHO COLOR, BACK COLOR, RING, ALARM1, ALARM2, WATCH ALARM RESET, ZOOM, MARK DELETE, CHART ALIGN, DISPLAY SELECT, MOB, USER DEFAULT, TLL)

Default Programs:
F1: INT REJ ECT
F2: ECHO STRETCH
F3: AUTO RAIN
F4: HL OFF

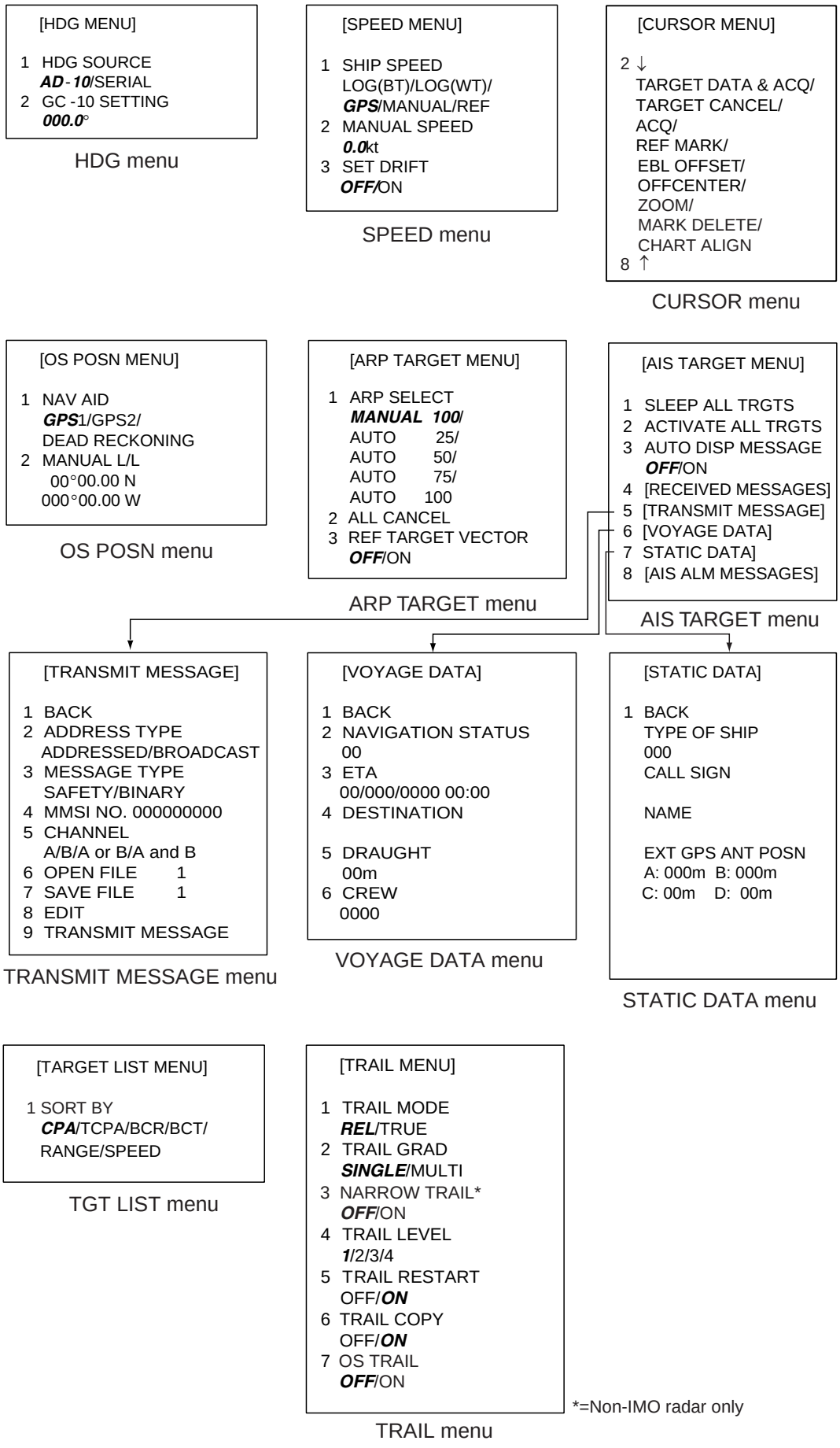
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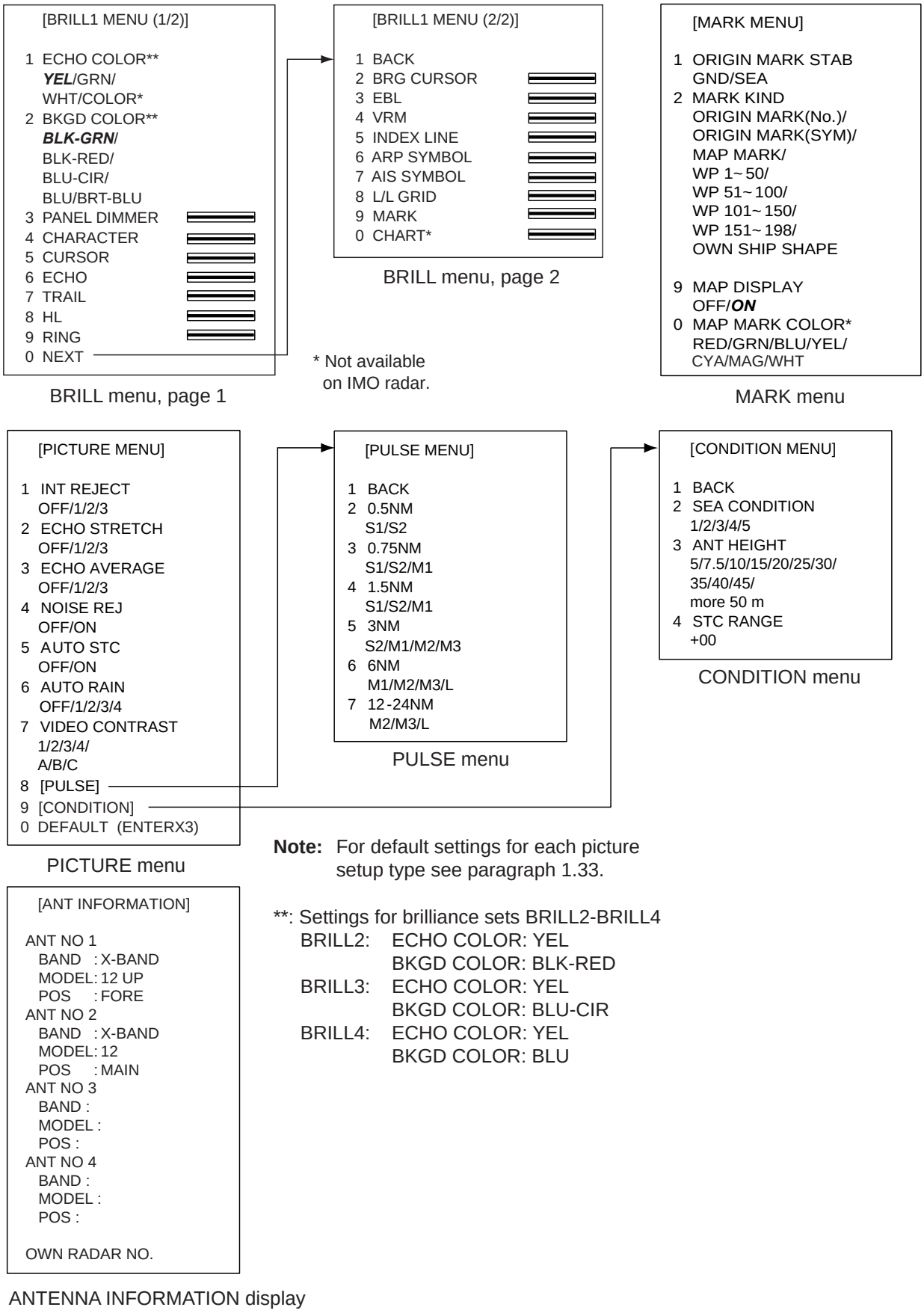
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** Not available on IMO radar.

Pop-up menus of on-screen boxes




[BRILL1 MENU (1/2)]
1 ECHO COLOR**
YEL/GRN/
WHT/COLOR*
2 BKGD COLOR**
BLK-GRN/
BLK-RED/
BLU-CIR/
BLU/BRT-BLU
3 PANEL DIMMER
4 CHARACTER
5 CURSOR
6 ECHO
7 TRAIL
8 HL
9 RING
0 NEXT
BRILL menu, page 1
[BRILL1 MENU (2/2)]
1 BACK
2 BRG CURSOR
3 EBL
4 VRM
5 INDEX LINE
6 ARP SYMBOL
7 AIS SYMBOL
8 L/L GRID
9 MARK
0 CHART*
BRILL menu, page 2
* Not available on IMO radar.
[MARK MENU]
1 ORIGIN MARK STAB
GND/SEA
2 MARK KIND
ORIGIN MARK(No.)/
ORIGIN MARK(SYM)/
MAP MARK/
WP 1~50/
WP 51~100/
WP 101~150/
WP 151~198/
OWN SHIP SHAPE
9 MAP DISPLAY
OFF/ON
0 MAP MARK COLOR*
RED/GRN/BLU/YEL/
CYA/MAG/WHT
MARK menu
[PICTURE MENU]
1 INT REJECT
OFF/1/2/3
2 ECHO STRETCH
OFF/1/2/3
3 ECHO AVERAGE
OFF/1/2/3
4 NOISE REJ
OFF/ON
5 AUTO STC
OFF/ON
6 AUTO RAIN
OFF/1/2/3/4
7 VIDEO CONTRAST
1/2/3/4/
A/B/C
8 [PULSE]
9 [CONDITION]
0 DEFAULT (ENTERX3)
PICTURE menu
[PULSE MENU]
1 BACK
2 0.5NM
S1/S2
3 0.75NM
S1/S2/M1
4 1.5NM
S1/S2/M1
5 3NM
S2/M1/M2/M3
6 6NM
M1/M2/M3/L
7 12-24NM
M2/M3/L
PULSE menu
[CONDITION MENU]
1 BACK
2 SEA CONDITION
1/2/3/4/5
3 ANT HEIGHT
5/7.5/10/15/20/25/30/
35/40/45/
more 50 m
4 STC RANGE
+00
CONDITION menu
Note: For default settings for each picture setup type see paragraph 1.33.
**: Settings for brilliance sets BRILL2-BRILL4
BRILL2: ECHO COLOR: YEL
BKGD COLOR: BLK-RED
BRILL3: ECHO COLOR: YEL
BKGD COLOR: BLU-CIR
BRILL4: ECHO COLOR: YEL
BKGD COLOR: BLU
[ANT INFORMATION]
ANT NO 1
BAND : X-BAND
MODEL: 12 UP
POS : FORE
ANT NO 2
BAND : X-BAND
MODEL: 12
POS : MAIN
ANT NO 3
BAND :
MODEL :
POS :
ANT NO 4
BAND :
MODEL :
POS :
OWN RADAR NO.
ANTENNA INFORMATION display

2. Digital Interface

Input sentences (RP Board, J4)

BWC*, BWR*, DBS, DBT, DPT, DTM, GGA, GLC, GLL, HDT, MTW, MWV, RMA, RMB, RMC, RTE VBW, VDR, VHW, VTG, VWR, VWT, WPL, ZDA, ! AIVDM, ! AIVDO, $ AIALR

Output sentences

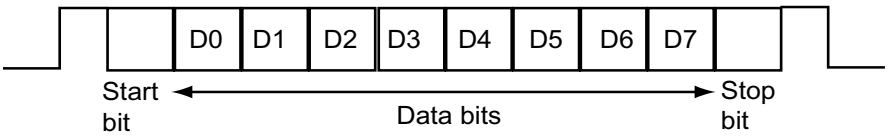
OSD, TLL*, TTM, RSD

*: Not available on IMO radar

Data reception

Data is received in serial asynchronous form in accordance with the standard referenced in IEC 61162-2.

The following parameters are used:
Baud rate: 38,400 bps: HDT, ! AIVDM, ! AIVDO and $ AIALR. All other sentences: 4800 bps
Data bits: 8 (D7 = 0), Parity: none, Stop bits: 1



Data sentences

Data used is shown in bold italics.

Input sentences

BWC - Bearing and distance to waypoint

$--BWC, hhmmss.ss, llll.ll, a yyyyy.yy, a, x.x, T, x.x, M, x.x, N, c--c, a*hh<CR><LF>

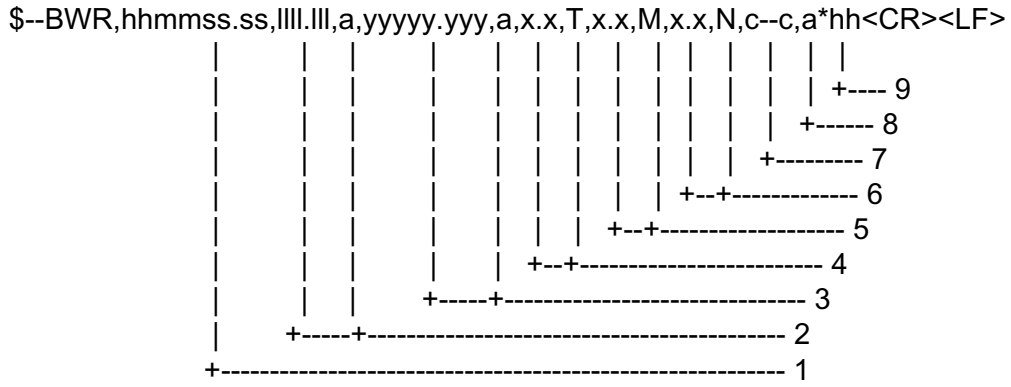
- ***Checksum***
- ***Mode indicator*** (see note 1)
- ***Waypoint ID***
- Distance, nautical miles
- Bearing, degrees magnetic
- Bearing, degrees true
- ***Waypoint longitude, E/W***
- ***Waypoint latitude, N/S***
- UTC of observation*

NOTE 1: Positioning system Mode indicator:

A = Autonomous
D = Differential
E = Estimated (dead reckoning)
M = Manual input
S = Simulator
N = Data not valid

The Mode indicator field shall not be a null field.

BWR - Bearing and distance to waypoint - rhumb line



1. UTC of observation
2. Waypoint latitude, N/S
3. Waypoint longitude, E/W
4. Bearing, degrees true
5. Bearing, degrees magnetic
6. Distance, nautical miles
7. Waypoint ID
8. Mode indicator(see note)
9. Checksum

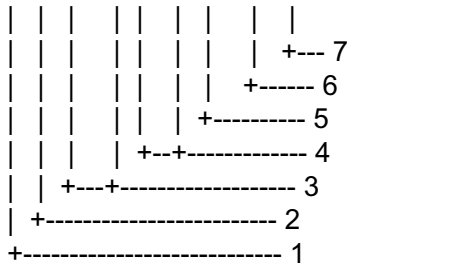
NOTE Positioning system Mode indicator:

A = Autonomous
D = Differential
E = Estimated (dead reckoning)
M = Manual input
S = Simulator
N = Data not valid

The Mode indicator field shall not be a null field.

DTM - Datum reference

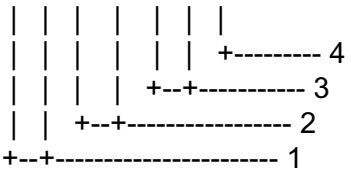
$--DTM,ccc,a,x.x,a,x.x,a,x.x,ccc*hh<CR><LF>



1. Local datum W84 - WGS84
W72 - WGS72
S85 - SGS85
P90 - PE90
999 - User defined
IHO datum code
2. Local datum subdivision code
3. Lat offset, min, N/S
4. Lon offset, min, E/W
5. Altitude offset, m
6. Reference datum W84 - WGS84
W72 - WGS72
S85 - SGS85
P90 - PE90
7. Checksum

DBS - Depth below surface

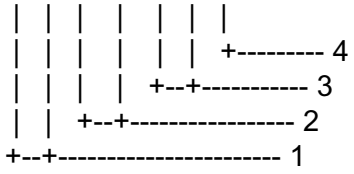
$--DBS,x.x,f,x.x,M,x.x,F*hh<CR><LF>



1. Water depth, feet
2. Water depth, m
3. Water depth, fathoms
4. Checksum

DBT - Depth below transducer

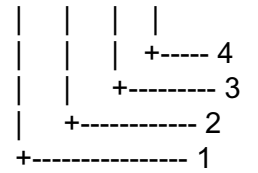
$--DBT,x.x,f,x.x,M,x.x,F*hh<CR><LF>



1. Water depth, feet
2. Water depth, m
3. Water depth, fathoms
4. Checksum

DPT - Depth

$--DPT,x.x,x.x,x.x*hh<CR><LF>

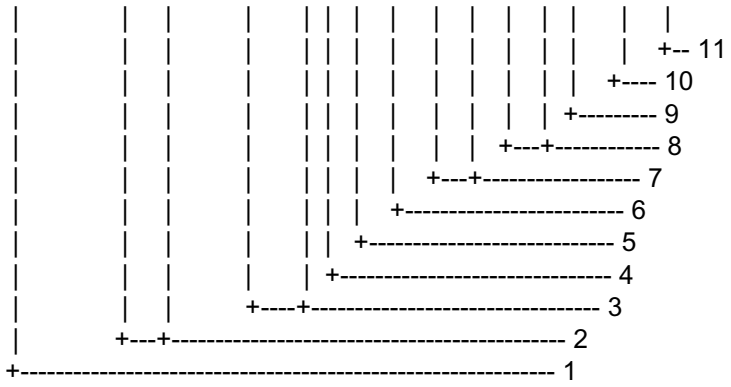


1. Water depth relative to trancsducer, in meters
2. Offset from transeducer, in meters(see notes 1 and 2)
3. Maximum range scale in use
4. Checksum

NOTE1 "positive"=distance from transeduser to water-line.
"-"=distance from transducer to keel.
NOTE2 For IEC applications the offset should always be applied so as to provide depth relative to the keel.

GGA - Global positioning system fix data

$--GGA,hhmmss.ss,llll.lll,a,yyyyy.yyy,a,x,xx,x.x,x.x,M,x.x,M,x.x,xxxx*hh<CR><LF>



1. UTC of position
2. Latitude, N/S
3. Longitude, E/W
4. GPS quality indicator (see note)
5. Number of satellite in use,00-12, may be different from the number in view
6. Horizontal dilution of precision
7. Antenna altitude above/below mean sea level, m
8. Geoidal separation, m
9. Age of differential GPS data
10. Differential reference station ID, 0000-1023
11. Checksum

NOTE

0 = fix not available or invalid

1 = GPS SPS mode, fix valid

2 = differential GPS, SPS mode, fix valid

3 = GPS PPS mode, fix valid (GPS_PPS)

4 = Real Time Kinetic. Satellite system used in RTK mode with fixed integers (GPS_RTK_I)

5 = Float RTK. Satellite system used in RTK mode with floating integers (GPS_RTK_F)

6 = Estimated (dead reckoning) mode

7 = Manual input mode

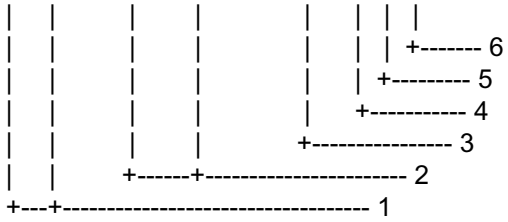
8 = Simulator mode

The GPS quality indicator shall not be a null field.

Position data shown in green in case of 1 and 5; red in case of "0" and "6-8".

GLL - Geographic position, latitude/longitude

$--GLL,llll.lll,a,yyyyy.yyy,a,hhmmss.ss,A,a*hh<CR><LF>



1. Latitude, N/S
2. Longitude, E/W
3. UTC of position
4. Status: A=data valid, V=data invalid
5. Mode indicator(see note)
6. Checksum

NOTE Positioning system Mode indicator:

A = Autonomous
D = Differential
E = Estimated (dead reckoning)
M = Manual input
S = Simulator
N = Data not valid

The Mode indicator field supplements the Status field. The Status field shall be set to V=invalid for all values of Operating Mode except for A=Autonomous and D=Differential. The positioning system Mode indicator and Status field shall not be null fields.
Position data shown in green in case of A=data valid and A and D; red in case of V=data invalid, E, M, S and N.

HDT - Heading, true

```
$--HDT,x.x,T*hh<CR><LF>
          |    |  |
          |    |  +--------- 2
          +----+-------------- 1
```

1. Heading, degrees true
2. Checksum

MTW - Water temperature

```
$--MTW,x.x,C*hh<CR><LF>
            |   |  |
            |   |  +--------- 2
            +---+-------------- 1
```

1. Temperature, degrees C
2. Checksum

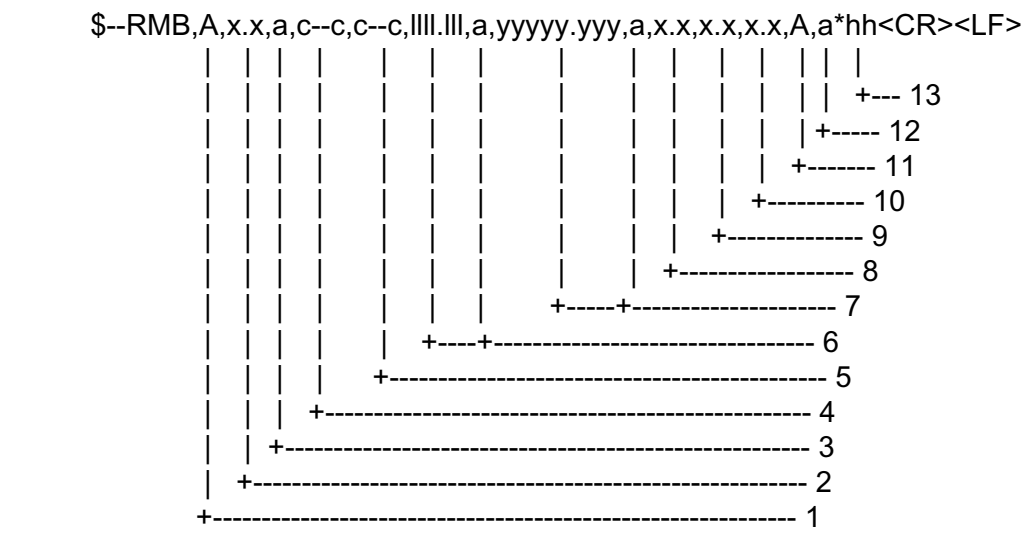
MWV - Wind speed and angle

```
$--MWV,x.x,a,x.x,a,A*hh<CR><LF>
          |    |   |  | |  |
          |    |   |  | |  +--------- 6
          |    |   |  | +-------------- 5
          |    |   |  +---------------- 4
          |    |   +------------------- 3
          |    +----------------------- 2
          +---------------------------- 1
```

1. Wind angle, 0 to 359 (degrees)
2. Reference, R=relative, T=true
3. Wind speed
4. Wind speed units, K/M/N
5. Status, A=data valid, V=data invalid
6. Checksum

Data is used in case of A=data valid.
Data is not used in case of V=data invalid.

RMB - Recommended minimum navigation information



1. Data status: A=data valid, V=navigation receiver warning
2. Cross track error(see note 2) n.miles
3. Direction to steer L/R
4. Origin waypoint ID
5. Destination waypoint ID
6. Destination waypoint latitude,N/S
7. Destination waypoint longitude,E/W
8. Range to destination, n.miles(see note 1)
9. Bearing to destination, degrees true
10. Destination closing velocity, knots
11. Arrival status: A=arrival circle entered or perpendicular passed
12. Mode indicator(see note 3)
13. Checksum

NOTES
1 If range to destination exceeds 999.9 nautical miles, display 999.9.
2 If cross track error exceeds 9.99 nautical miles, display 9.99.

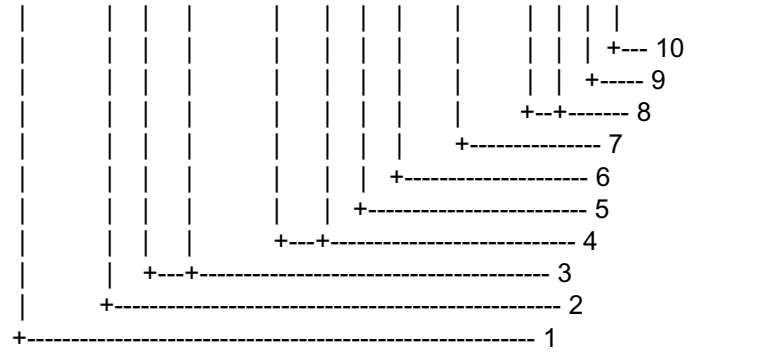
3 Positioning system Mode indicator:
A = Autonomous
D = Differential
E = Estimated (dead reckoning)
M = Manual input
S = Simulator
N= Data not valid

The Mode indicator field supplements the Status field. The Status field shall be set to V=invalid for all values of Operating Mode except for A=Autonomous and D=Differential. The positioning system Mode indicator and Status field shall not be null fields.

Data is used in case of A=data valid and A and D. Data is not used in case of V=data invalid, E, M, S and N.

RMC - Recommended minimum specific GPS/TRANSIT data

$--RMC,hhmmss.ss,A,llll.lll,a,yyyyy.yyy,a,x.x,x.x,xxxxxx,x.x,a,a*hh<CR><LF>



1. UTC of position fix
2. Status: A=data valid, V=navigation receiver warning
3. Latitude, N/S
4. Longitude, E/W
5. Speed over ground, knots
6. Course over ground, degrees true
7. Date: dd/mm/yy
8. Magnetic variation, degrees E/W
9. Mode indicator(see note)
10. Checksum

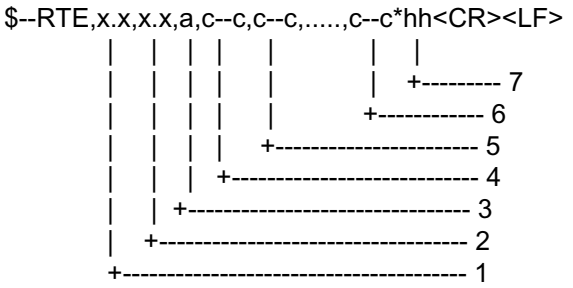
NOTE Positioning system Mode indicator:

A = Autonomous
D = Differential
E = Estimated (dead reckoning)
M = Manual input
S = Simulator
N = Data not valid

The Mode indicator field supplements the Status field. The Status field shall be set to V=invalid for all values of Operating Mode except for A=Autonomous and D=Differential. The positioning system Mode indicator and Status field shall not be null fields.

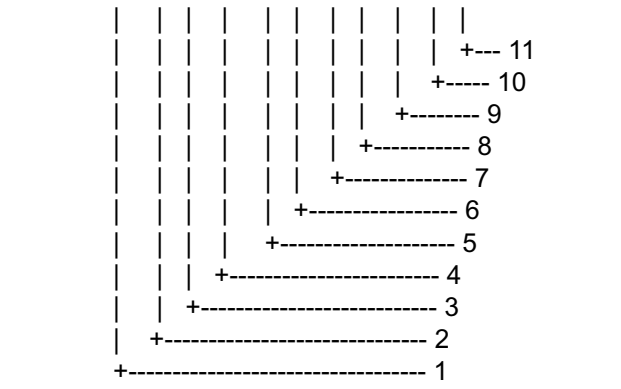
Data is used in case of A=data valid and A and D. Data is not used in case of V=data invalid, E, M, S and N.

RTE - Route



1. Total number of messages being transmitted
2. Message number
3. Message mode:
c=complete route, all waypoints
w=working route, first listed waypoint is "FROM",
second is "TO" and remaining reset of route
4. Route identifier
5. Waypoint identifier
6. Waypoint "n" identifier
7. Checksum

VBW - Dual ground/water speed

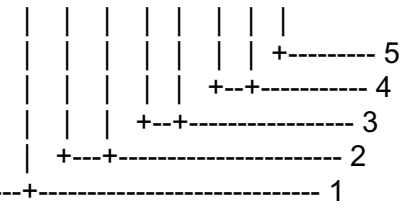


1. Longitudinal water speed, knots
2. Transverse water speed, knots
3. Status: water speed, A=data valid* V=data invalid**
4. Longitudinal ground speed, knots
5. Transverse ground speed, knots
6. Status: ground speed, A=data valid* V=data invalid**
7. Stern transverse water speed, knots
8. Status: stern water speed, A=data valid V=data invalid
9. Stern transverse ground speed, knots
10. Status: stern ground speed, A=data valid V=data invalid
11. Checksum

*= Data shown in green
**= Data shown in red

VHW - Water speed and heading

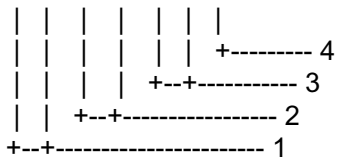
$--VHW,x.x,T,x.x,M,x.x,N,x.x,K*hh<CR><LF>



1. Heading, degrees true
2. Heading, degrees magnetic
3. Speed, knots
4. Speed, km/h
5. Checksum

VDR - Set and drift

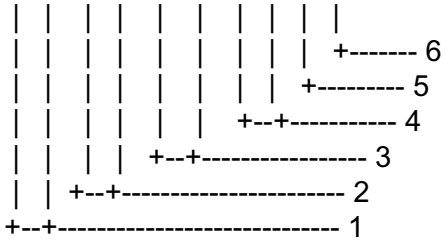
$--VDR,x.x,T,x.x,M,x.x,N*hh<CR><LF>



1. Direction, degrees true
2. Direction, degrees magnetic
3. Current speed, knots
4. Checksum

VTG - Course over ground and ground speed

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



1. Course over ground, degrees true
2. Course over ground, degrees magnetic
3. Speed over ground, knots
4. Speed over ground, km/h
5. Mode indicator(see note)
6. Checksum

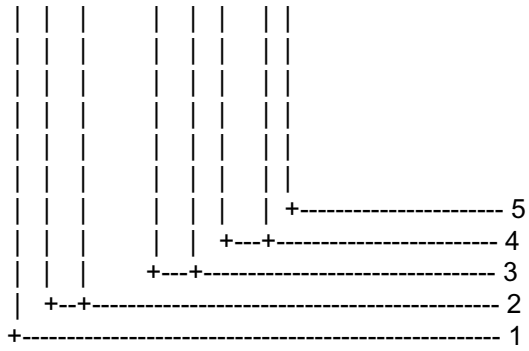
NOTE Positioning system Mode indicator:

A = Autonomous
D = Differential
E = Estimated (dead reckoning)
M = Manual input
S = Simulator
N = Data not valid

The positioning system Mode indicator field shall not be a null field.
Data shown in green in case of A and D; red in case of E, M, S and N.

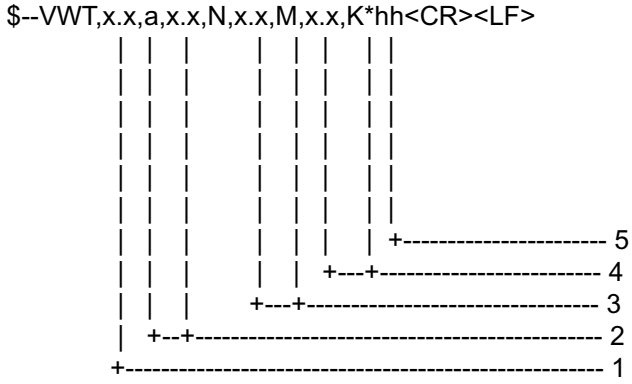
VWR - Relative (Apparent) wind speed and angle

$--VWR,x.x,a,x.x,N,x.x,M,x.x,K*hh<CR><LF>



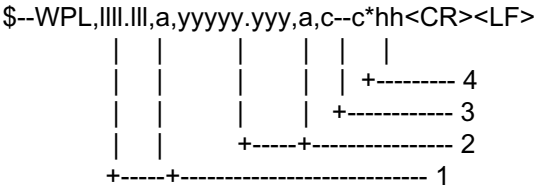
1. Measured wind angle relative to the vessel, 0 to 180°, left/right L/R of vessel heading
2. Measured wind speed, knots
3. Wind speed, meters/second
4. Wind speed, Km/Hr
5. Checksum

VWT - True wind speed and angle



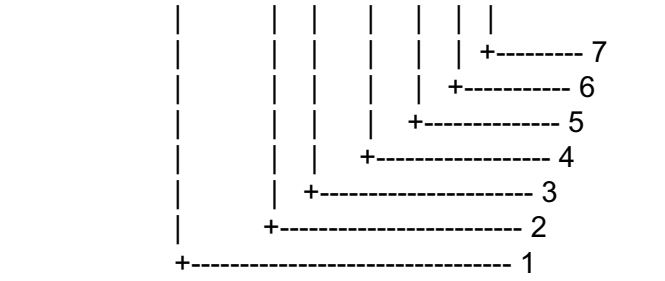
1. Calculated wind angle relative to the vessel, 0 to 180°, left/right L/R of vessel heading
2. Calculated wind speed, knots
3. Wind speed, meters/second
4. Wind speed, Km/Hr
5. Checksum

WPL - Waypoint location



1. Waypoint latitude, N/S
2. Waypoint longitude, E/W
3. Waypoint identifier
4. Checksum

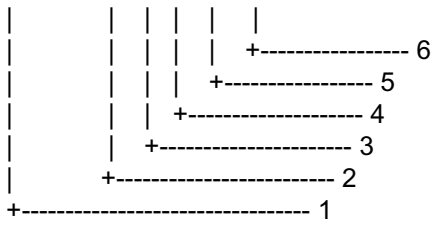
ZDA - Time and date



1. UTC
2. Day, 01 to 31(UTC)
3. Month, 01 to 12(UTC)
4. Year(UTC)
5. Local zone hours, 00h to +-13h
6. Local zone minutes, 00 to +59
   as local hours
7. Checksum

$AIALR - Set alarm state

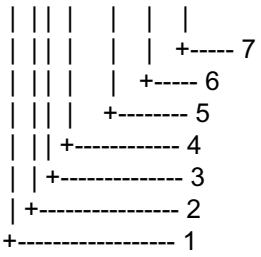
$AIALR,hhmmss.ss,xxx,A,A,c--c*hh<CR><LF>



1. Time of alarm condition change, UTC
2. Local alarm number(identifier)
3. ***Alarm condition(A=threshold exceeded, V=not exceeded)***
4. ***Alarm's acknowledge state, A=acknowledged V=unacknowledged***
5. ***Alarm's description text***
6. ***Checksum***

!AIVDM - VHF data-link message

!AIVDM,x,x,x,a,s--s,x*hh<CR><LF>

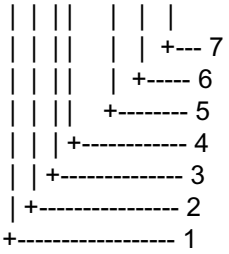


1. ***Total number of sentences needed to transfer the message, 1 to 9***
2. ***Message sentence number, 1 to 9***
3. ***Sequential message identifier, 0 to 9***
4. AIS channel Number
5. ***Encapsulated ITU-R M.1371 radio message****
6. ***Number of fill-bits, 0 to 5***
7. ***Checksum***

*= Message no. 1, 2, 3, 5, 6, 8, 12, 14, 18, 19 are used.

!AIVDO - UAIS VHF Data-link Own-vessel report

!AIVDO,x,x,x,a,s--s,x*hh<CR><LF>



1. Total number of sentences needed to transfer the message, 1 to 9
2. Message sentence number, 1 to 9
3. Sequential message identifier, 0 to 9
4. AIS channel Number
5. Encapsulated ITU-R M.1371 radio message*
6. Number of fill-bits, 0 to 5
7. Checksum

*= Data are MMSI no., navigation status, ETA, destination, draught, type of ship, call sign, ship's name and GPS antenna position.

Output sentences

OSD- Own ship data

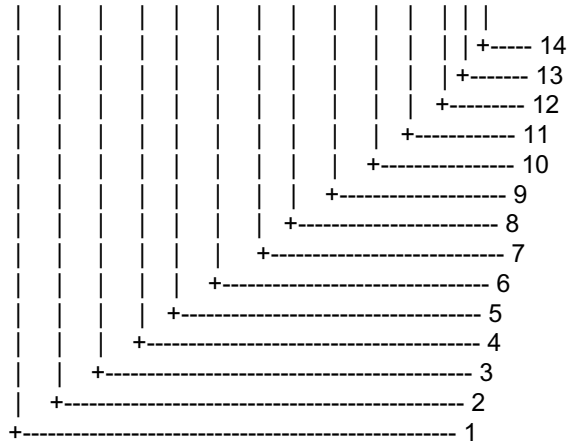
```
$--OSD,x.x,A,x.x,a,x.x,a,x.x,x.x,a*hh<CR><LF>
          |  |   |  |  |  |   |   |   |   |
          |  |   |  |  |  |   |   |   |   +--------- 10
          |  |   |  |  |  |   |   |   +------------- 9
          |  |   |  |  |  |   |   +----------------- 8
          |  |   |  |  |  |   +--------------------- 7
          |  |   |  |  |  +------------------------- 6
          |  |   |  |  +---------------------------- 5
          |  |   |  +------------------------------- 4
          |  |   +---------------------------------- 3
          |  +------------------------------------- 2
          +---------------------------------------- 1
```

1. Heading, degrees true
2. Heading status: A=data valid, V=data invalid
3. Vessel course, degrees true
4. Course reference, B/M/W/R/P(see note)
5. Vessel soeed
6. Speed refereence, B/M/W/R/P(see note)
7. Vessel set, degrees true---Manually entered
8. Vessel drift(speed) ---Manually entered
9. Speed units, K(km/h) / N(Knots) / S(statute miles/h)
10. Checksum

NOTES - 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

$RARSD,x.x,x.x,x.x,x.x,x.x,x.x,x.x,x.x,x.x,x.x,x.x,x.x,a,a*hh<CR><LF>



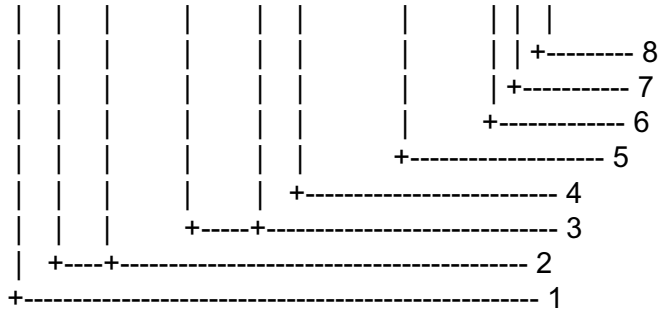
1. Origin 1 range, from own ship (see note 2)
2. Origin 1 bearing, degrees from 0 (see note 2)
3. Variable range maker 1(VRM1), range
4. Bearing line 1(EBL1), degrees from 0
5. Origin 2 range (see note 2)
6. Origin 2 bearing (see note 2)
7. VRM2, range
8. EBL2, degrees
9. Cursor range, from own ship
10. Cursor bearing, degrees clockwise from 0
11. Range scale in use
12. Range units, K/N/S
13. Display rotation (see note 1)
14. Checksum

NOTES
1 Display rotation:
C = course-up, course-over-ground up, degrees true
H = head-up, ship's heading(center-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.

TLL - Target latitude and longitude

For non-IMO specification radar, this function outputs event mark position.

$--TLL,xx,llll.lll,a,yyyyy.yyy,a,c--c,hhmmss.ss,a,a*hh<CR><LF>

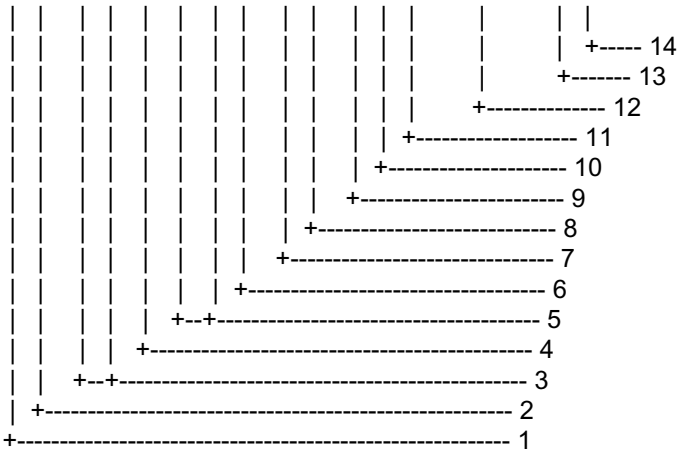


1. Target number 00 - 99
2. Latitude, N/S
3. Longitude, E/W
4. Target name
5. UTC of data
6. Target status(see note)
7. Reference target=R,null otherwise
8. Checksum

NOTE - Target status
L = lost, tracked target has beenlost
Q = query, target in the process of acquisition
T = tracking

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>



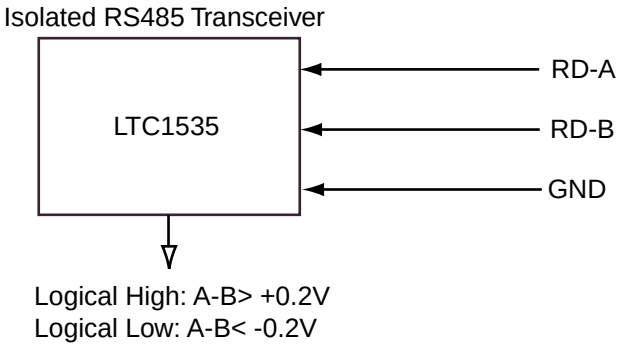
1. Target number, 00 to 99
2. Target distance from own ship
3. Bearing from own ship, degrees, true/relative(T/R)
4. Target speed
5. Target course, degrees true/relative(T/R)
6. Distance of closet point of approach
7. Time to CPA, min., "-"increasing
8. Speed/distance units, K/N/S
9. User data(e.g. target name)
10. Target status(see note)
11. Reference target = R, null otherwise
12. Time of data(UTC)
13. Type of acquisition A=automatic, M=manual, R=reported
14. Checksum

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

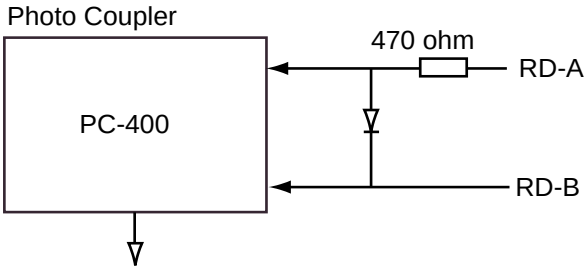
Serial interface – input ports

Heading sensor

Transmission rate is selectable from 4800 bps and 28.4 kbps.



Log/navigator



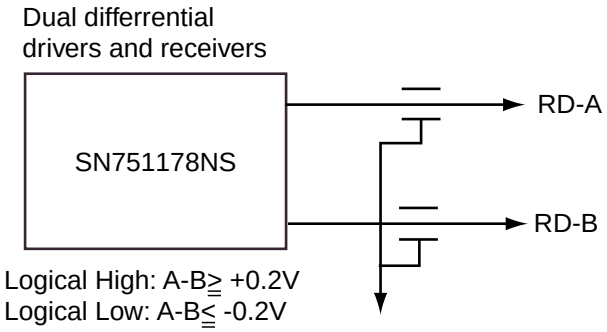
This port is an opticoupler used to isolate I/F terminal on RD terminal.

Absolute maximum rating
Input
Forward current: 50 mA
Reverse voltage: 6 V

Output
Supply voltage: 16 V
High level output voltage: 16 V
Low level output current: 50 mA

Serial interface – output ports

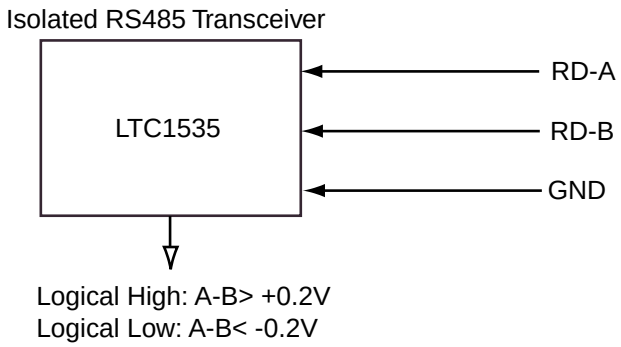
ARPA for ECDIS



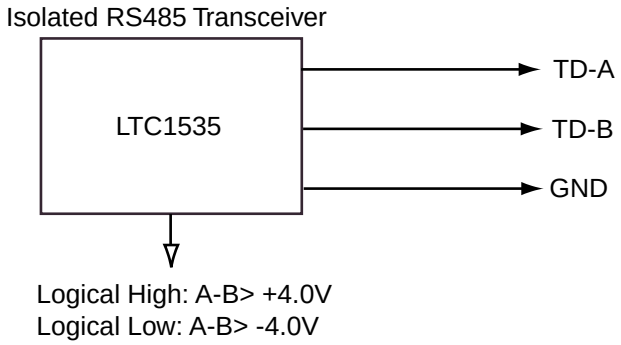
Serial interface – input/output ports

Transmission rate is selectable from 4800 bps and 28.4 kbps.

Input port (RD-A, B)



Output port (TD-A, B)



3. Parts Lists and Parts Location

Parts lists

Processor unit RPU-014, Control unit RCU-104/105, Display unit MU-201CR/ MU-231CR

FURUNO

Model	FR-21x7/28x7 Series (incl. BB series)
Unit	Processor Unit RPU-013 Control Unit RCU-014 Control Unit RCU-015 Display Unit MU-201CR Display Unit MU-231CR

ELECTRICAL PARTS LIST

2003/10

SYMBOL	PRINTED CIRCUIT BOARD/ ASSY. TYPE	REMARKS
PROCESSOR UNIT RPU-013		
PTU Board	03P9339	AC spec.
	03P9338	DC spec.
SPU Board	03P9337	
HV Board	HV9017	
Terminal Board	03P9342	
NET Board	03P9332	
CONTROL UNIT RCU-014		
PNL Board	03P9343	
BUZ Board	03P9362	
Trackball Assy.	TA4726N	
CONTROL UNIT RCU-015		
PNL Board	03P9344	
Trackball Assy.	TA4726N	
DISPLAY UNIT MU-201CR		
PWR Pack	RKW-12-13RE	AC spec.
DC-DC Board	03P9359	DC spec.
Noise Filter	CF-205A	AC spec.
	MXB-1206-33	DC spec.
DVI I/F Board	SCBFRNB-A	
INVERTER Board	201PW021-C	
LCD Board	201PW023-H	
LCD Unit	210NL128102AC31-02	
DISPLAY UNIT MU-231CR		
PCB	BSM-501A	
PWR Pack	RKW-12-13RE	AC spec.
DC-DC Board	03P9359	DC spec.
Noise Filter	CF-205A	AC spec.
	MXB-1206-33	DC spec.
FIL Board	03P9360	
INVERTER Board	NA19002-4241	
LCD Board	NA21808	
LCD Unit	FLC59UXC8V-04	
DVI I/F Board	BSM-501A	

Antenna unit RSB-096/097 (for FAR-2117(-BB)/2127(-BB)/2817/2827)

FURUNO

ELECTRICAL PARTS LIST

2003/10

Model	FAR-2117(BB)/2127(BB)/2817(BB)/2827(BB)
Unit	Antenna Unit RSB-096/097

SYMBOL	NAME	REMARKS
	PRINTED CIRCUIT BOARD	
RF	03P9349	
BP	03P9347	
MD	03P9244-A	FAR-2117/2817
	03P9244-B	FAR-2127/2827
	SCANNER CHASSIS	
	RSB-096	24 rpm
	RSB-097	42 rpm
	RF MODULE	
	RTR-078	FAR-2117/2817
	RTR-079	FAR-2127/2827
	MIC ASSEMBLY	
	RU-9601	FAR-2117/2817
	RU-9603	FAR-2127/2827
	MOTOR	
	D8G-516	24 rpm, w/capacitor
	D8G-571	42 rpm, w/capacitor
	DIODE LIMITER	
	RU-9099	FAR-2117/2127/2817/2827
	CIRCULATOR	
	RC-3686	FAR-2117/2127/2817/2827
	PULSE TRANSFORMER	
	RT-9023	FAR-2117/2817
	RT-9025	FAR-2127/2827
	MAGNETRON	
	MG5241	FAR-2117/2817
	MG5436	FAR-2127/2827

Antenna unit RSB-103/104/105 (FAR-2827W)

FURUNO

ELECTRICAL PARTS LIST

2003/10

Model	FAR-2827W
Unit	Antenna Unit RSB-104/105

SYMBOL	NAME	REMARKS
	PRINTED CIRCUIT BOARD	
TB	03P9349	
BP GEN	03P9347	
	MOTOR	
	D8G-516	

Transceiver unit RTR-081 (FAR-2827W)

FURUNO

ELECTRICAL PARTS LIST

2003/10

Model	FAR-2827W
Unit	Transceiver Unit RTR-081

SYMBOL	NAME	REMARKS
	PRINTED CIRCUIT BOARD	
TB	03P9349	
IF AMP	03P9335	
PWR	03P9348	
MD	03P9244	
RFC	03P9346	
	MIC ASSEMBLY	
	RU-9603	
	MOTOR	
	109P0824H602	24 rpm
	TR LIMITER	
	RU-9290	
	CIRCULATOR	
	RC_3686	
	PULSE TRANSFORMER	
	RT-9023	
	MAGNETRON	
	MG5436	

Antenna unit RSB-098/099/100/101/102 (for FAR-2137S-BB)/2837S)

FURUNO

ELECTRICAL PARTS LIST

2003/10

Model	FAR-2137S(BB), FAR-2837S(BB)	
Unit	Antenna Unit	RSB-098/099
		RSB-100/101/102

SYMBOL	NAME		REMARKS
	PRINTED CIRCUIT BOARD		
TB	03P9349		
IF AMP	03P9335		
PWR	03P9348		
MD	03P9244		
RFC	03P9346		
MSS	MSS-7497		200/220V, 3ϕ
MSS	MSS-7497A		380/440V, 3ϕ
	SCANNER CHASSIS		
	RSB-098		21/26 rpm
	RSB-099		21/26 rpm
	RSB-100		45 rpm
	RSB-101		45 rpm
	RSB-102		45 rpm
	RF MODULE		
	RTR-080		
	MIC ASSEMBLY		
	RU-9427		
	MOTOR		
	RM-7398	RSB-098/099	21/26 rpm, 200/220V, 3ϕ
	RM-7435	RSB-098/099	21/26 rpm, 380/440V, 3ϕ
	RM-9519	RSB-100/101/102	45 rpm, 220V, 3ϕ, 50 Hz
	RM-9520	RSB-100/101/102	45 rpm, 220V, 3ϕ, 60 Hz
	RM-9521	RSB-100/101/102	45 rpm, 440V, 3ϕ, 60 Hz
	DIODE LIMITER		
	RU-9426		
	CIRCULATOR		
	RC_6584S		
	PULSE TRANSFORMER		
	RT-9273		
	MAGNETRON		
	MG5223F		

Power Supply Unit PSU-007 (for FAR-2137S(-BB)/2837S

FURUNO	Model	PSU-007
	Unit	Power Supply Unit
ELECTRICAL PARTS LIST		
2003/10		

SYMBOL	NAME	REMARKS
	PRINTED CIRCUIT BOARD	
TB1		
	RELAY	
	HG3_DC12V	

Antenna unit RSB-104/105 (for FAR-2837SW)

FURUNO	Model	FAR-2837SW
	Unit	Antenna Unit RSB-104/105
ELECTRICAL PARTS LIST		
2003/10		

SYMBOL	NAME		REMARKS
	PRINTED CIRCUIT BOARD		
TB	03P9349		
BP GEN	03P9347		
MSS	MSS-7497		200/220V, ϕ3
	MSS-7497-A		380/440V, ϕ3
	MOTOR		
	RM-7398	RSB-104	21 rpm: 200 V, 3ϕ, 50 Hz
		RSB-104	26 rpm: 220 V, 3ϕ, 60 Hz
	RM-7345	RSB-105	21 rpm: 380 V, 3ϕ, 50 Hz
		RSB-105	26 rpm: 440 V, 3ϕ, 60 Hz

Transceiver unit RTR-082 (for FAR-2837SW)

FURUNO

ELECTRICAL PARTS LIST

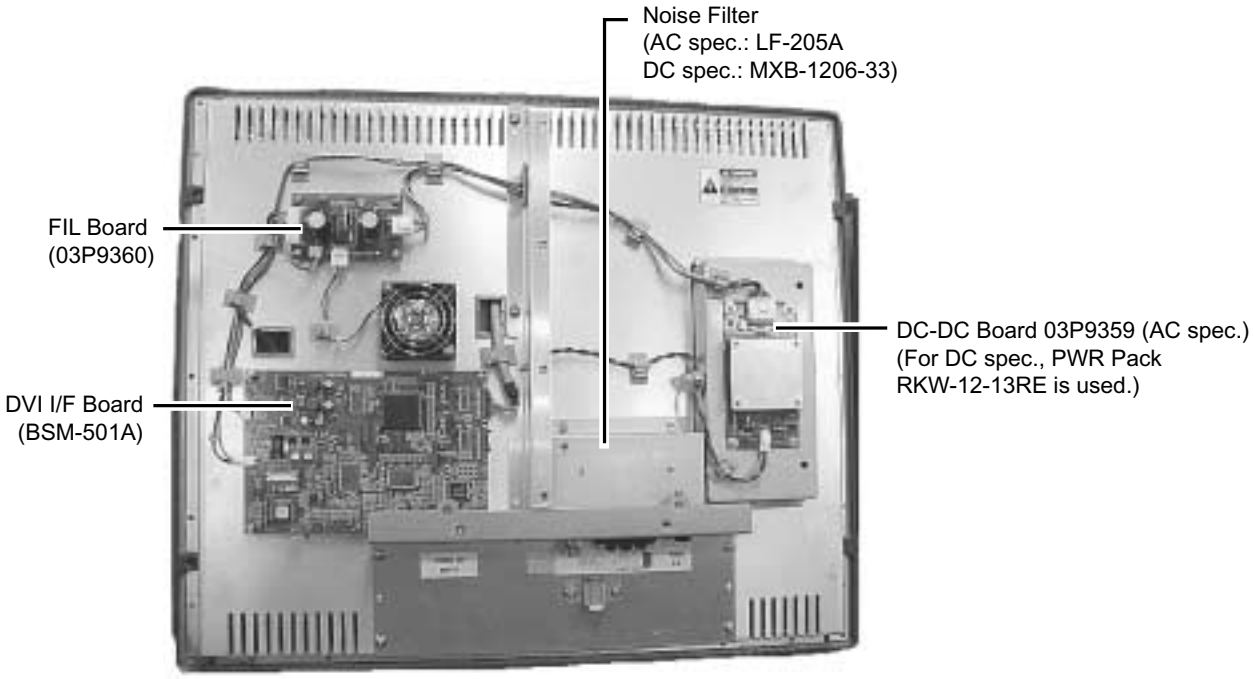
2003/10

Model	FAR-2837SW
Unit	Transceiver Unit RTR-082

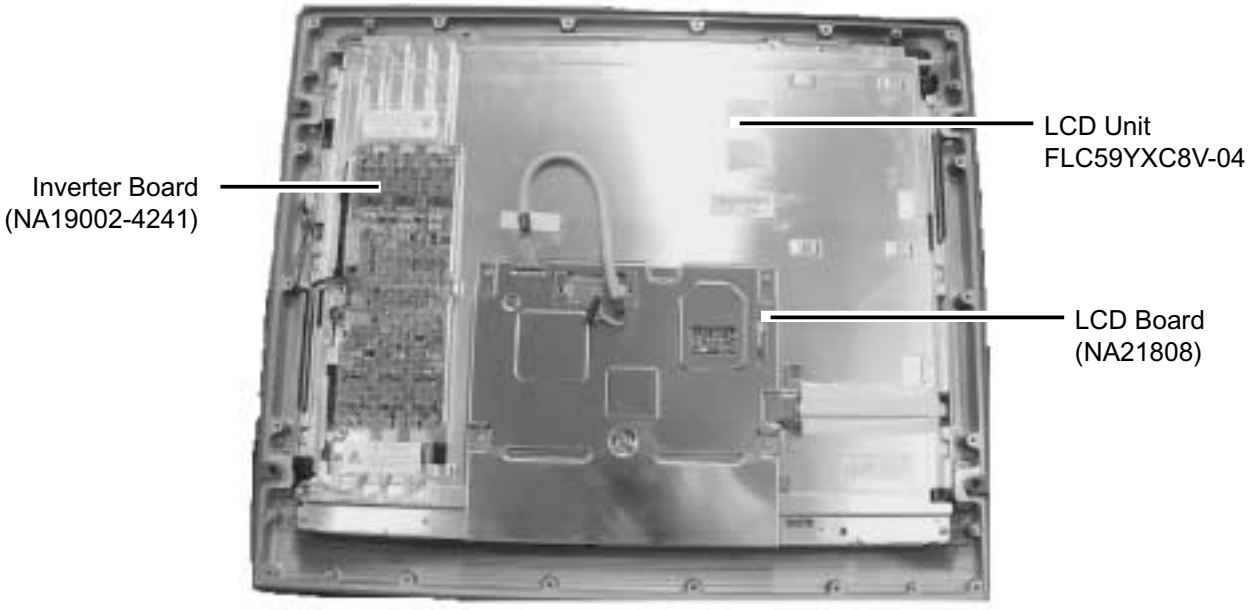
SYMBOL	NAME	REMARKS
	PRINTED CIRCUIT BOARD	
TB	03P9349	
IF AMP	03P9335	
PWR	03P9348	
MD	03P9244	
RFC	03P9346	
	MIC ASSEMBLY	
	RU-9427	
	MOTOR	
	109P0824H602	
	TR LIMITER	
	TL378A	
	CIRCULATOR	
	RC_6584S or RC4910S	
	PULSE TRANSFORMER	
	RT-9273	
	MAGNETRON	
	MG5223F	

Parts location

Display unit MU-231CR (AC specification)

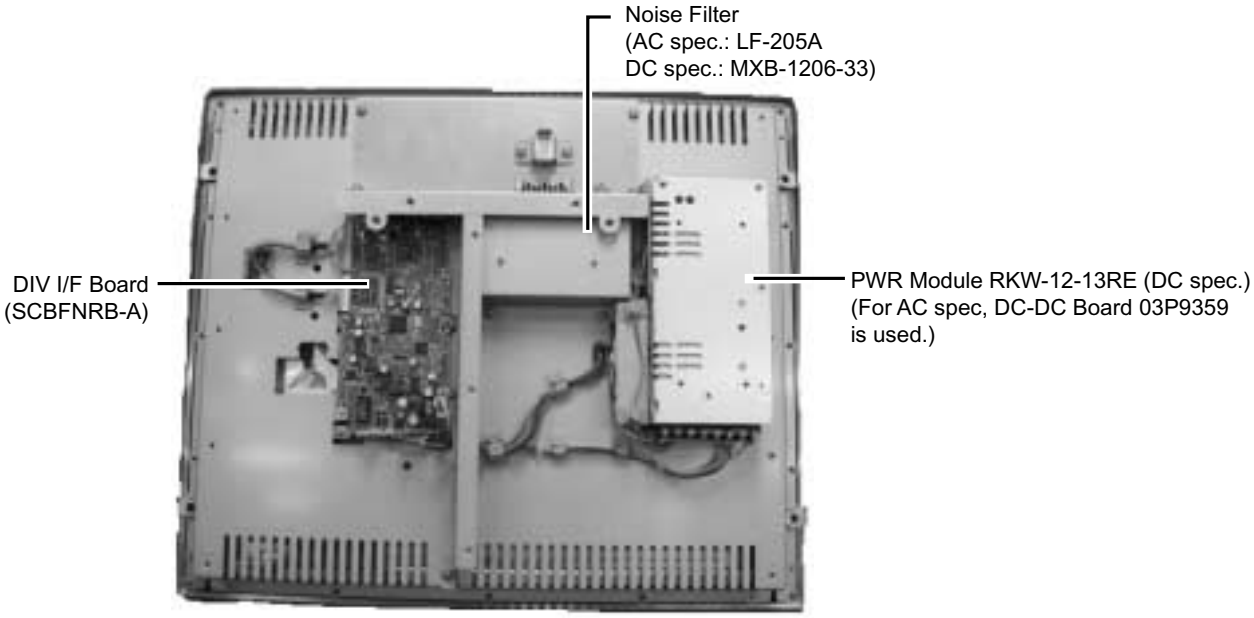


Display unit MU-231CR, rear cover removed

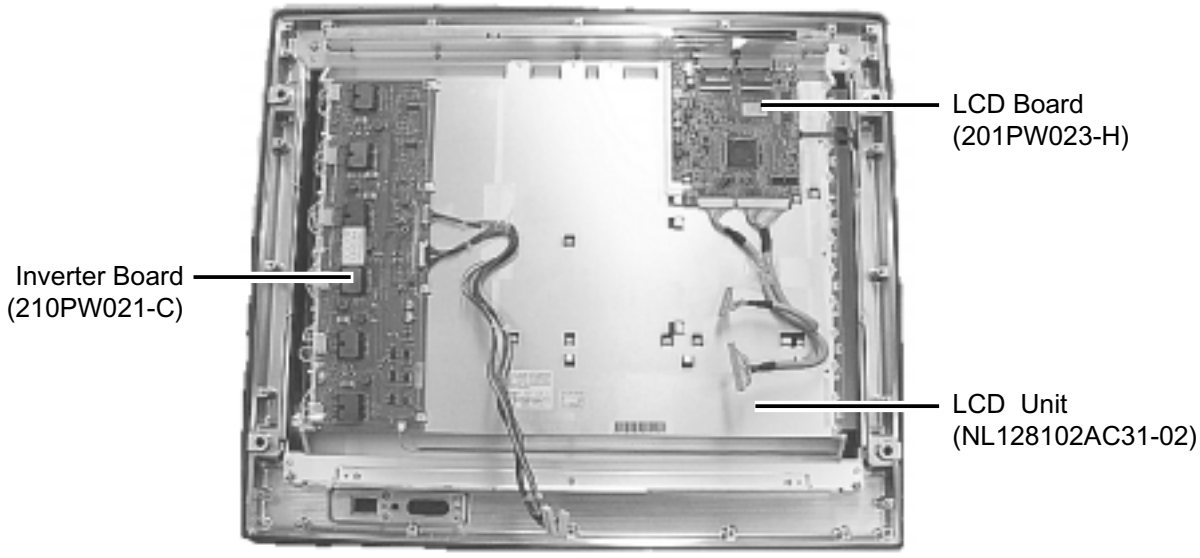


Display unit MU-231CR, inner shield plate removed

Display unit MU-201CR (DC specification)

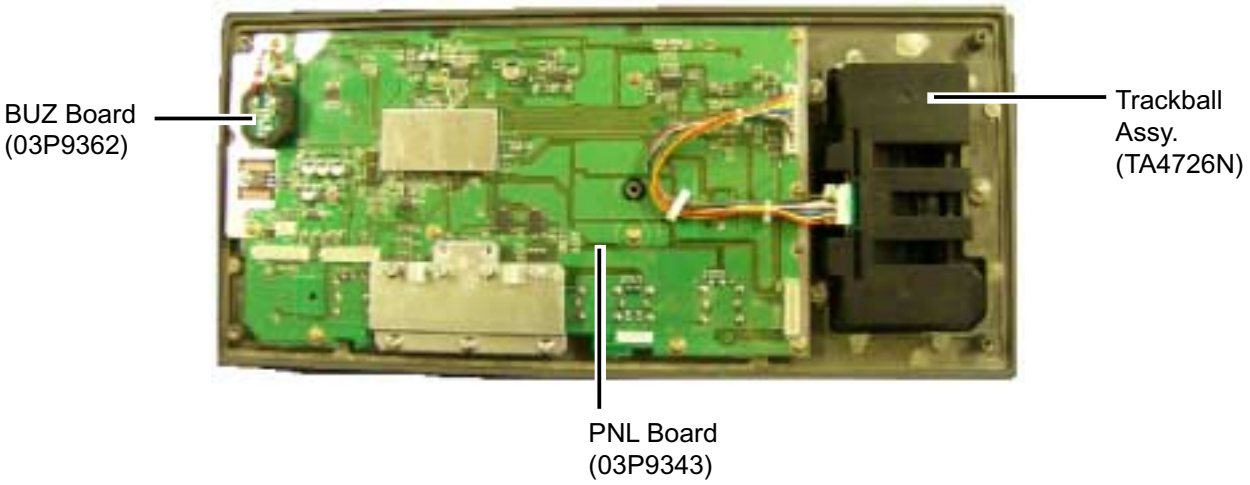


Display unit MU-201CR, rear cover removed



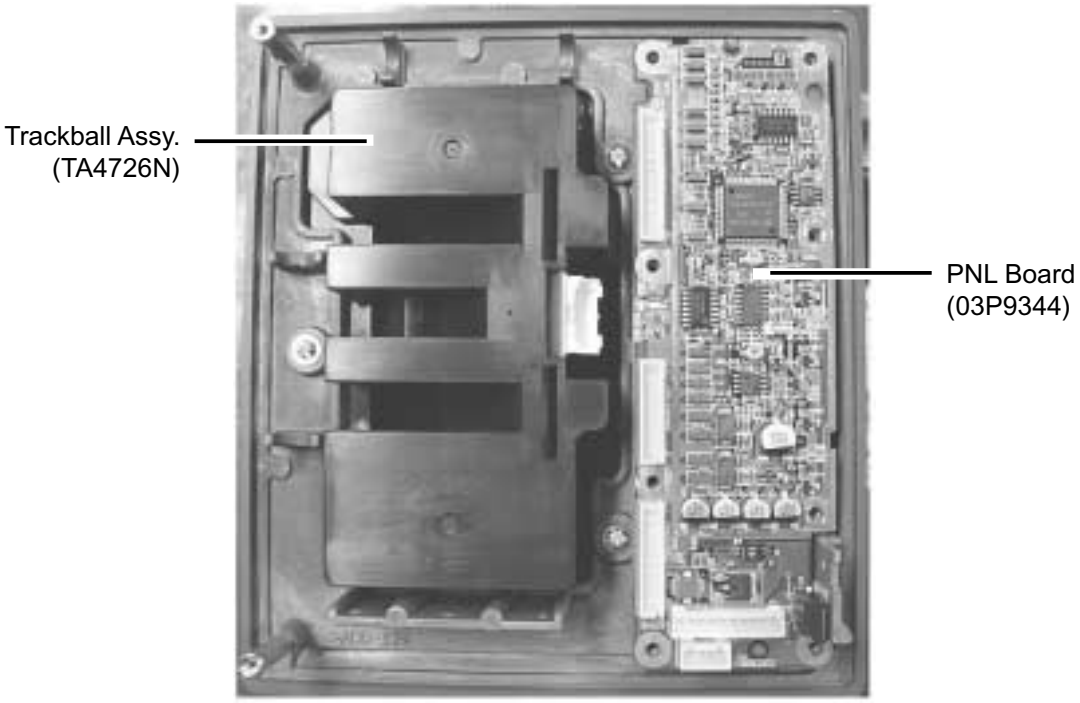
Display unit MU-201CR, inner shield plate removed

Control unit RCU-014



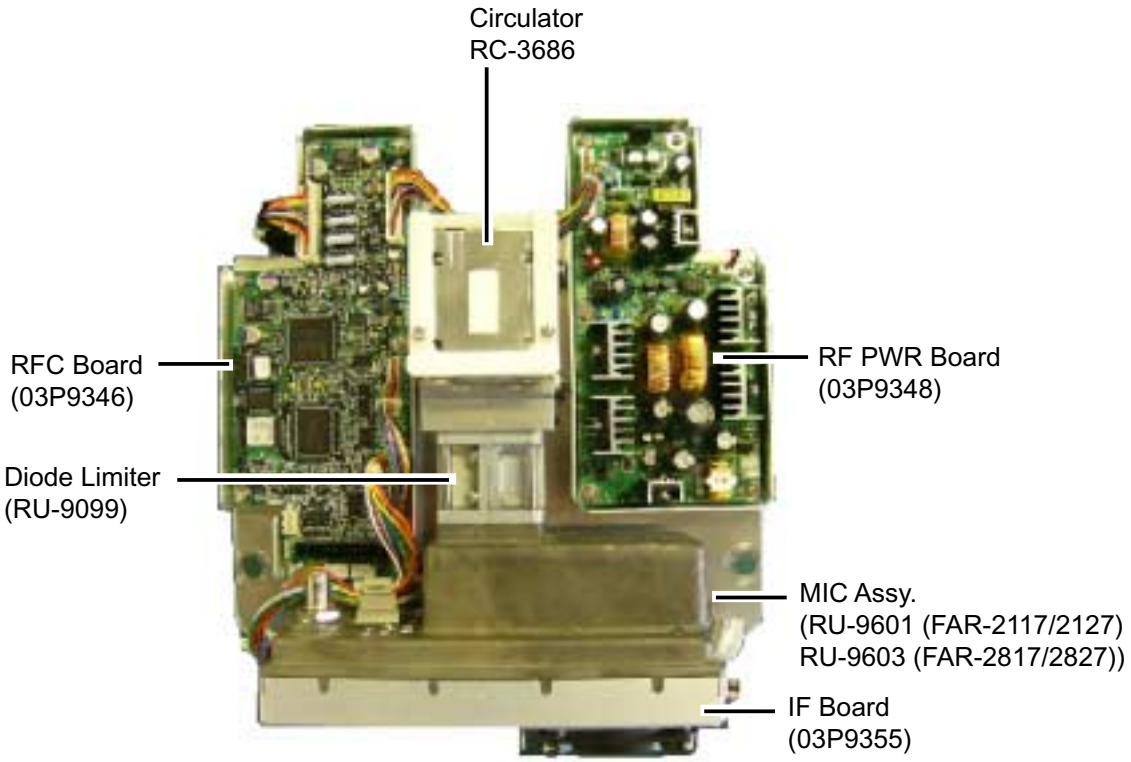
Control unit RCU-014, rear cover removed

Control unit RCU-015

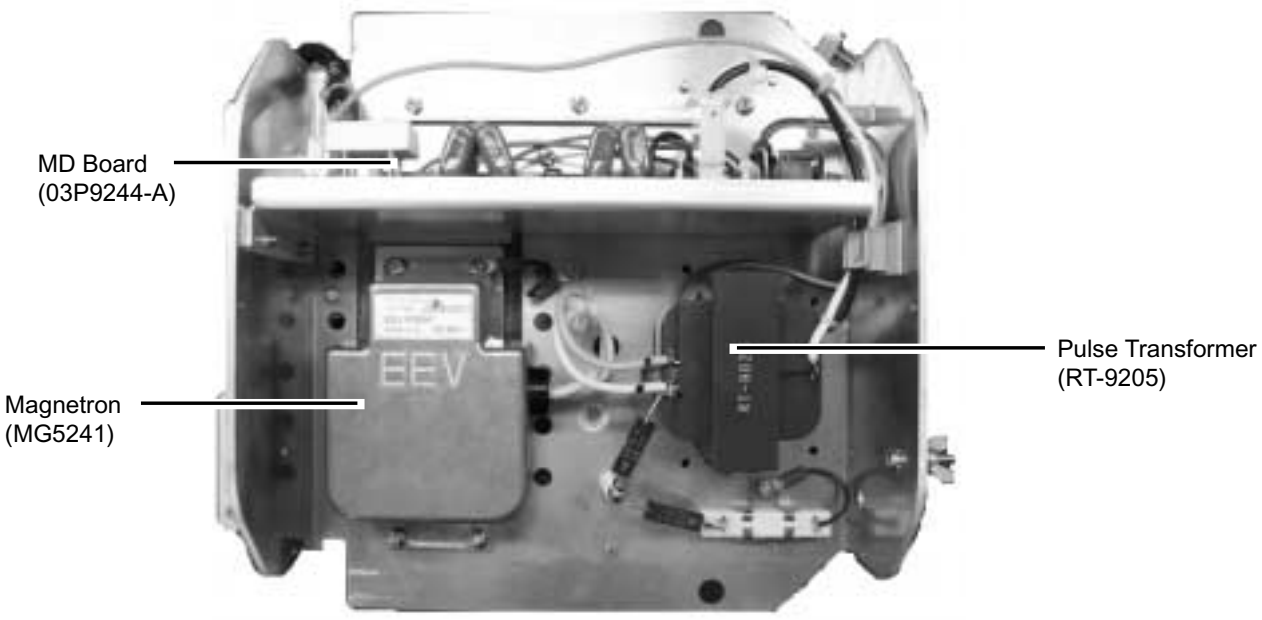


Control unit RCU-015, rear cover removed

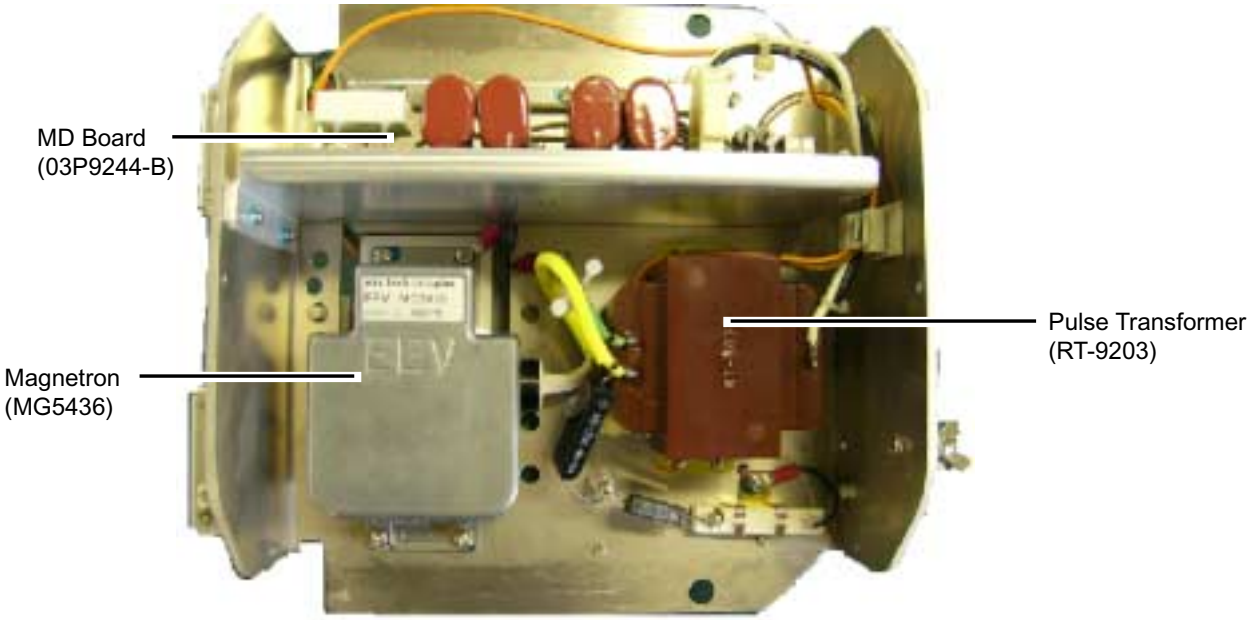
Transceiver unit RTR-078/079 (for FAR-2117(-BB)/2127(-BB)/2817/2827



Transceiver unit RTR-078/079 (for FAR-2117(-BB)/2127(-BB)/2817/2827), upper half

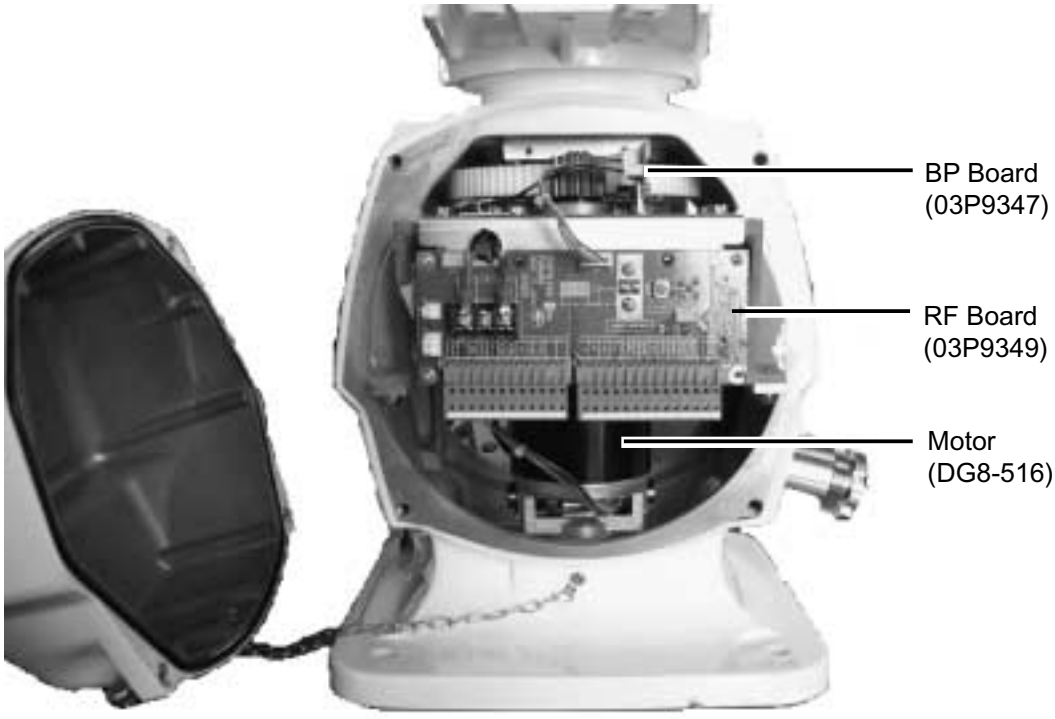


Transceiver unit RTR-078 (for FAR-2117(-BB)/2127(-BB)/2817/2827), lower half



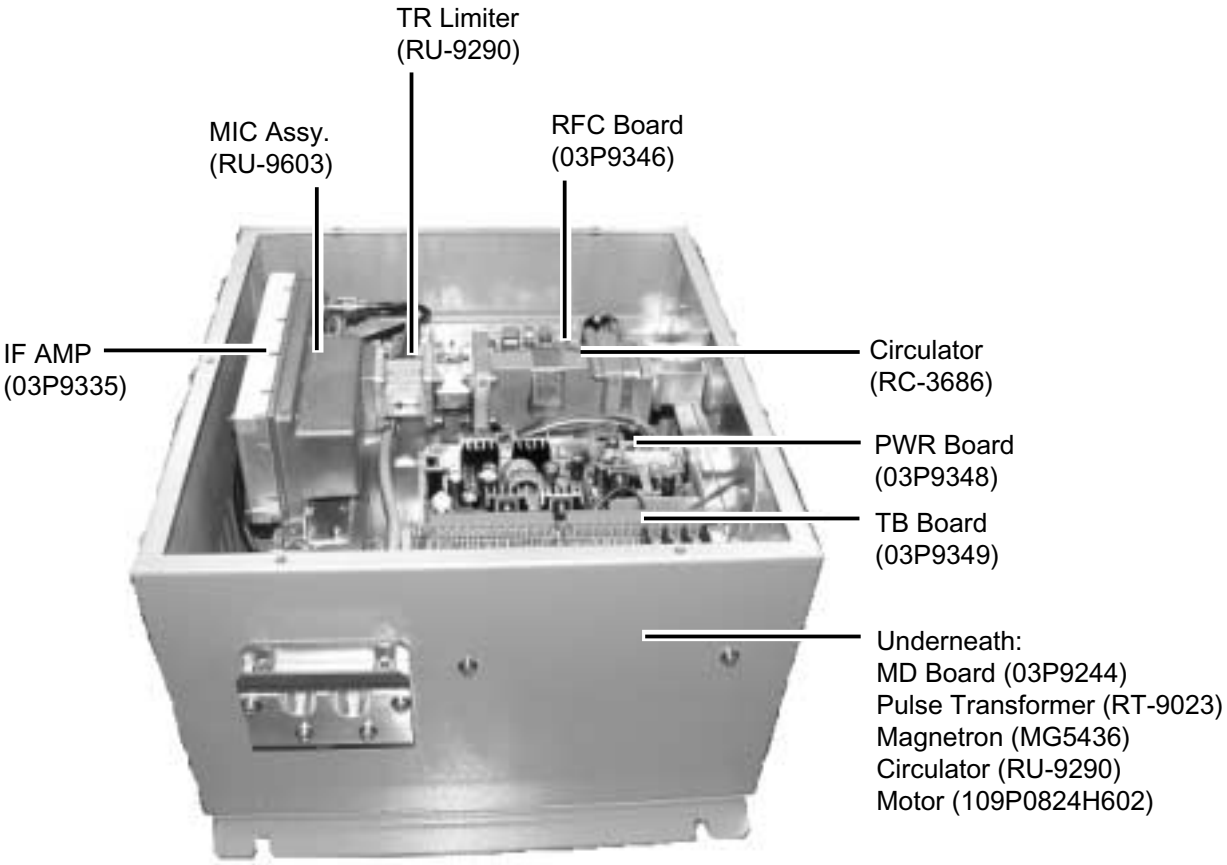
Transceiver unit RTR-079 (for FAR-2117(-BB)/2127(-BB)/2817/2827, lower half

Antenna unit RSB-103 (for FAR-2827W)



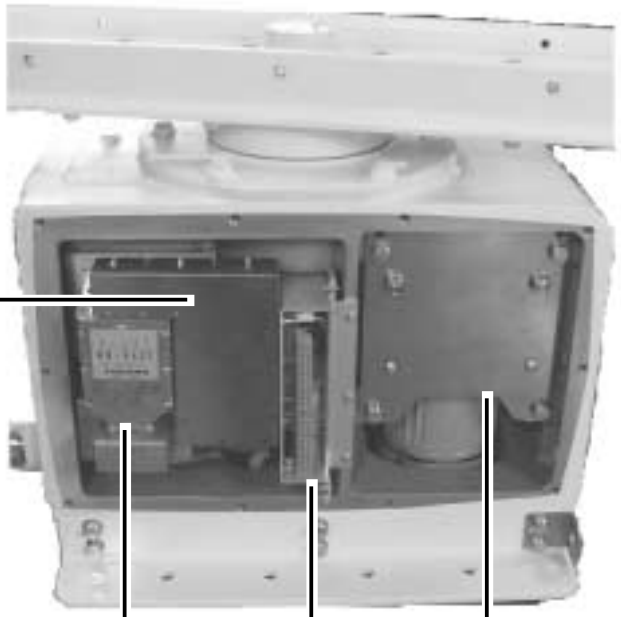
Antenna unit RSB-103 (for FAR-2827W)

Transceiver unit RTR-081 (for FAR-2827W)

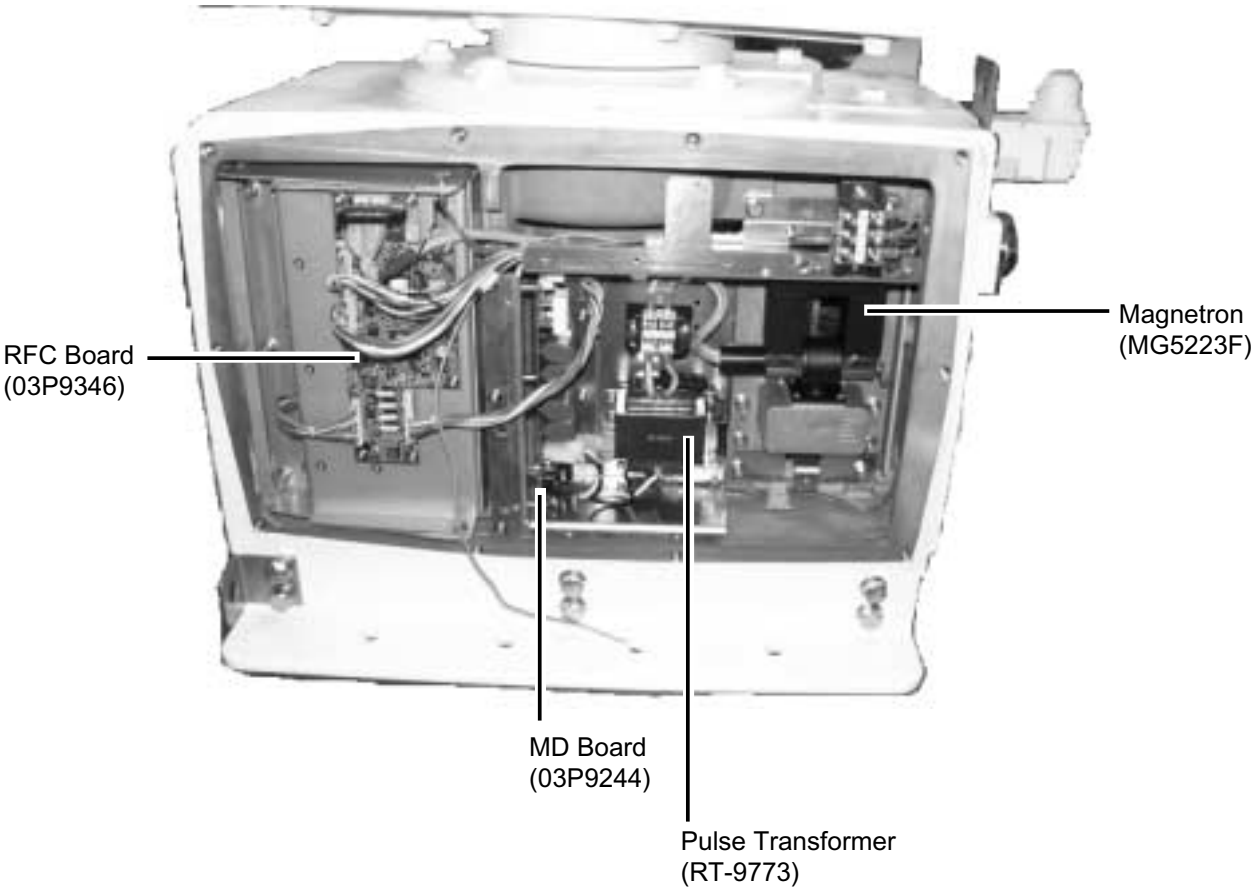


Transceiver unit TR-081 (for FAR-2827W), cover opened

Antenna unit RSB-098/099/100/101/102 (for FAR-2137S(-BB)/2837S)

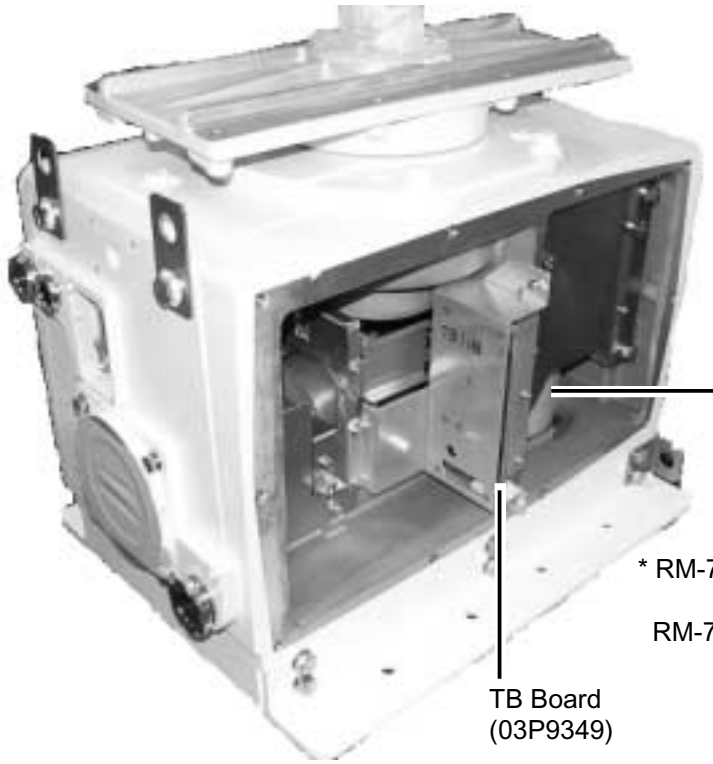


Antenna unit RSB-098/099/100/101/102 (for FAR-2137S-(BB)/2837S), cover opened



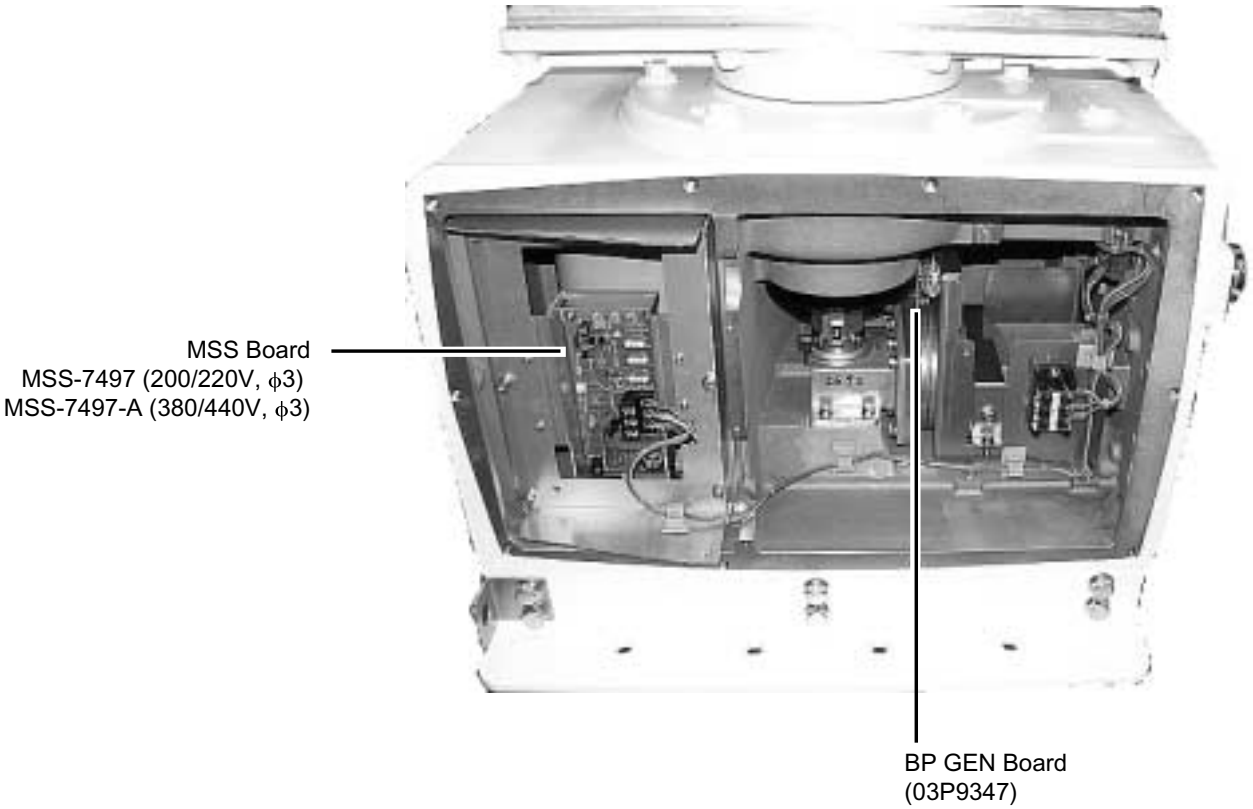
Antenna unit RSB-098/099/100/101/102 (for FAR-2137S(-BB)/2837S), cover opened

Antenna unit RSB-104/105 (for FAR-2837SW)



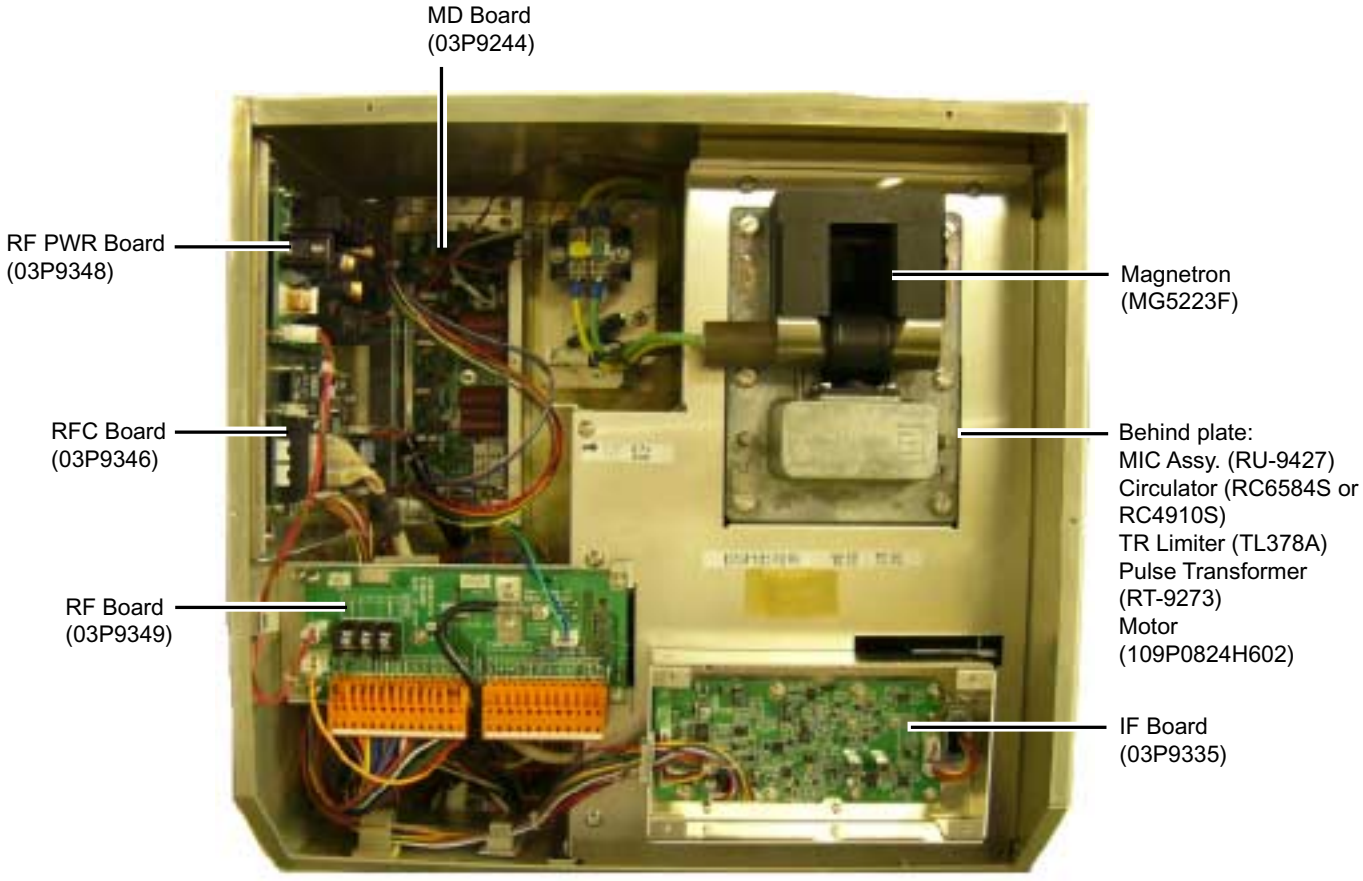
* RM-7398 (For RSB-104, 21 rpm, 200 V, 3ϕ, 50 Hz;
For RSB-104, 26 rpm, 220 V, 3ϕ, 60 Hz)
RM-7345 (For RSB-105, 21 rpm, 380 V, 3ϕ, 50 Hz;
For RSB-105, 26 rpm, 440 V, 3ϕ, 60 Hz)

Antenna unit RSB-104/105 (for FAR-2837SW), cover opened



Antenna unit RSB-104/105 (for FAR-2837SW), cover opened

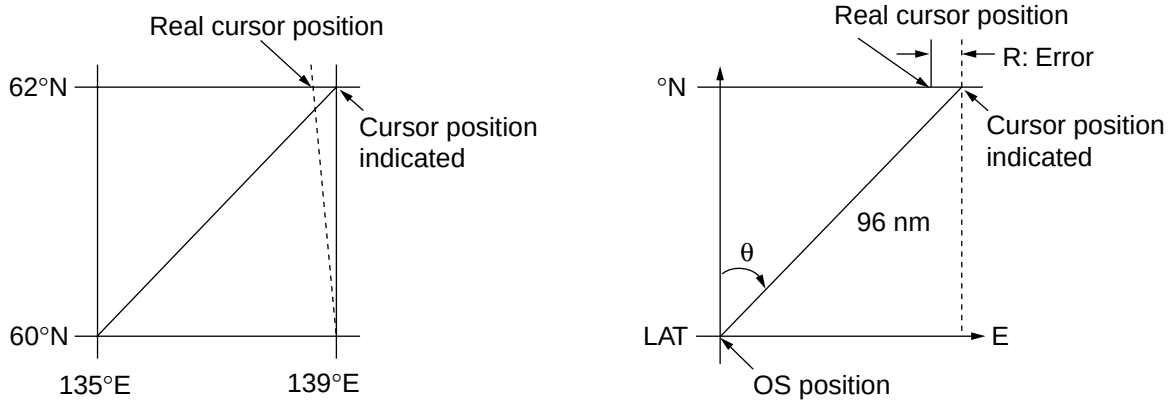
Transceiver unit RTR-082 (for FAR-2837SW)



Transceiver unit RTR-082 (for FAR-2837SW), cover opened

4. Longitude Error Table (on 96 nm range scale)

The longitude lines concentrate on the north pole and south pole, namely, 1 nm is equivalent to 1 minute at 0 degree latitude, 2 minutes at 60 degrees latitude, 3 minutes at 70 degrees latitude and so on. For this reason, a longitude error occurs on the radar display. For example, when own ship is at 60°N and 135°E, even if the cursor indication is 62°N and 139°E, the real cursor position is deviated to the left (west) side. The table below shows the longitude error, represented from 0° to 90° at 96 nm from the radar center (own ship).



Distance error in direction of longitude due to latitude

(nm)

θ / LAT	5°	10°	15°	20°	25°	30°	35°	40°	45°
75°	0.2256	0.4444	0.6496	0.8350	0.9950	1.1248	1.2202	1.2786	1.2980
70°	0.21980213	0.43290201	0.632803	0.8134132	0.96923215	1.09551918	1.1884382	1.24517456	1.26402037
65°	0.21229339	0.41810678	0.61115946	0.78556318	0.93600295	1.05790007	1.14755221	1.20224625	1.22034042
60°	0.20316898	0.40012949	0.58486463	0.75173456	0.89565021	1.0122297	1.09793265	1.15016811	1.16737294
55°	0.19249832	0.37910698	0.55411863	0.71218478	0.84848102	0.95885565	1.03998717	1.08933651	1.10552105
50°	0.18036264	0.35519924	0.51915545	0.66721485	0.79485438	0.89818413	0.97406698	1.02021439	1.03525547
45°	0.16685429	0.32858822	0.48024119	0.61716701	0.73517843	0.83067689	0.90076355	0.94332783	0.95711098
40°	0.15207608	0.29947644	0.437672	0.56242216	0.66990732	0.7568477	0.82060477	0.85926197	0.87168229
35°	0.13614047	0.26808546	0.39177186	0.53339693	0.59953781	0.67725844	0.73420069	0.76865661	0.77961957
30°	0.11916876	0.2346542	0.3428901	0.44054055	0.52460545	0.59251483	0.6422089	0.67220131	0.68162348
25°	0.10129001	0.19943707	0.29139874	0.37433139	0.44568053	0.50326182	0.54532952	0.57063015	0.57843983
20°	0.08264056	0.16270211	0.23768966	0.30527334	0.36336372	0.41017869	0.44429984	0.46471615	0.47085389
15°	0.06336208	0.12472888	0.18217162	0.23389198	0.27828148	0.31397386	0.33988878	0.35526538	0.35968447
10°	0.04360137	0.0858064	0.12526714	0.16073056	0.19108136	0.21537949	0.23289096	0.24311083	0.24577764
5°	0.02350833	0.04623087	0.0674093	0.08634588	0.10242699	0.11514595	0.1241207	0.12910605	0.13000029
0°	0.00323737	0.0063035	0.00903844	0.01130406	0.01299309	0.01403609	0.0144058	0.0141187	0.01323356

(nm)

θ / LAT	50°	55°	60°	65°	70°	75°	80°	85°	90°
75°	1.2780	1.2192	1.1233	0.9933	0.8332	0.6479	0.4431	0.2249	0
70°	1.24442563	1.18701379	1.09356117	0.96694117	0.81103484	0.3061092	0.43117887	0.21881975	0
65°	1.20131324	1.14577786	1.05546143	0.93315023	0.78260251	0.60843159	0.41596331	0.21107193	0
60°	1.14905813	1.09582188	1.00932899	0.89225746	0.74821409	0.58162173	0.397582	0.20171772	0
55°	1.08805799	1.03752602	0.95551494	0.84457408	0.70813132	0.55038538	0.37617487	0.19082831	0
50°	1.0187708	0.97133397	0.89442885	0.79046297	0.66265924	0.51496026	0.35190481	0.17848659	0
45°	0.94174265	0.89774948	0.82653562	0.73033596	0.61214392	0.47561599	0.32495654	0.16478648	0
40°	0.85754099	0.81733258	0.75235195	0.66465066	0.55696981	0.43265198	0.29553516	0.14983224	0
35°	0.76681293	0.73069528	0.63744242	0.59390696	0.49755683	0.38639524	0.26386458	0.13373769	0
30°	0.67024897	0.63849695	0.58741521	0.51864327	0.43435714	0.33719779	0.23018583	0.11662531	0
25°	0.568584	0.54143927	0.49791741	0.43943239	0.36785173	0.28543407	0.19475522	0.09862535	0
20°	0.46259176	0.44026091	0.40463016	0.35687717	0.29854675	0.23149802	0.15784242	0.07987479	0
15°	0.35307892	0.3357319	0.30826343	0.2716059	0.22696965	0.17580013	0.11972833	0.06051633	0
10°	0.2487894	0.22864776	0.20955062	0.18426754	0.15366517	0.1187643	0.08070304	0.0406973	0
5°	0.12684572	0.11982348	0.10624302	0.09552679	0.0791912	0.04106355	0.04106355	0.02056855	0
0°	0.01184713	0.01008727	0.008104	0.00605903	0.00411455	0.00111154	0.00111154	0.00028325	0

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Pub NO. DOC-711

Declaration of Conformity CE 0560

We FURUNO ELECTRIC CO., LTD.
(Manufacturer)

9-52 Ashihara-Cho, Nishinomiya City, 662-8580, Hyogo, Japan
(Address)

declare under our sole responsibility that the product

Marine radar Types FAR-2117, FAR-2127, FAR-2137S, FAR-2117-BB, FAR-2127-BB and FAR-2137S-BB
(See configuration matrix at page 2/2 of this Declaration for details.)
(Model name, serial number)

are in conformity with the essential requirements as described in the Directive 1999/5/EC of the European Parliament and of the Council of 9 March 1999 on radio equipment and telecommunications terminal equipment (R&TTE Directive) and satisfies all the technical regulations applicable to the product within this Directive

EN 60945: 2002 (IEC 60945 Fourth edition: 2002-08)
EN 60950: 2000-01 (IEC 60950 Third edition: 1999-04)
IEC 60936-1 Amendment 1 Annex D: 2002-06
ITU Radio Regulations Appendix S3, table 2
ITU-R M.1177-3: 2003-06, ITU-R SM.1539: 2002-11, ITU-R SM.1541: 2002-11 and ITU-R SM.329-9: 2003-02
(title and/or number and date of issue of the standard(s) or other normative document(s))

For assessment, see

- Statement of Opinion N° 04214039/AA/01 of 7 June 2004 issued by Telefication, The Netherlands
- Test reports FLI 12-03-057 of 15 January 2003, FLI 12-03-052 of 22 September 2003, FLI 12-03-053 of 26 September 2003, FLI 12-03-029 of 25 July 2003, FLI 12-03-027 of 25 July 2003, FLI 12-04-015 of 19 March 2004 and FLI 12-04-032 of 10 May 2004 prepared by Furuno Labotech International Co., Ltd.
- QinetiQ/FST/TR031505 of 17 March 2003 prepared by QinetiQ ltd., UK

On behalf of Furuno Electric Co., Ltd.

Hiroaki Komatsu
Manager,
International Rules and Regulations

Nishinomiya City, Japan
June 28, 2004
(Place and date of issue)

(name and signature or equivalent marking of authorized person)

Configuration matrix of FAR-2117, FAR-2127, FAR-2137S, FAR-2117-BB, FAR-2127-BB and FAR-2137S-BB

(This page is part pf the Declaration of Conformity DOC-711.)

Unit \ Type		FAR-2117	FAR-2127	FAR-2137S	FAR2117-BB	FAR-2127-BB	FAR-2137S-BB	
Scanner	XN-12AF	x	x		x	x		4 ft X-band
	XN-20AF	x	x		x	x		6.5 ft X-band
	XN-24AF	x	x		x	x		8 ft X-band
	SN-30AF			x			x	10 ft S-band
	SN-36AF			x			x	12 ft S-band
Transceiver	RTR-078	x			x			12 kW X-band
	RTR-079		x			x		25 kW X-band
	RTR-080			x			x	30 kW S-band
Turning unit	RSB-096	x	x		x	x		24 rpm X-band
	RSB-097	x	x		x	x		42 rpm X-band
	RSB-098			x			x	21/26 rpm, 200/220 VAC 3 ø S-band
	RSB-099			x			x	21/26 rpm, 380/440 VAC 3 ø S-band
	RSB-100			x			x	45 rpm, 220 VAC 3 ø 50 Hz S-band
	RSB-101			x			x	45 rpm, 220 VAC 3 ø 60 Hz S-band
	RSB-102			x			x	45 rpm, 440 VAC 3 ø 60 Hz S-band
Display unit, Monitor	MU-201CR	x	x	x				For –BB types, user supply
Processor unit	RPU-013	x	x	x	x	x	x	
Full-keyboard control unit	RCU-014	x	x	x	x	x	x	To be specified when ordering
Trackball control unit	RCU-015	x	x	x	x	x	x	
Power supply unit	PSU-007			x			x	For FAR-2137S/2137S-BB
Optional equipment	RCU-016							Remote control unit
	PM-31	x	x		x	x		Performance monitor X-band
	PM-51			x			x	Performance monitor S-band
	AD-100	x	x	x	x	x	x	either one of AD-100 (Gyro converter) or GC-10 (Gyro interface)
	GC-10	x	x	x	x	x	x	
	RJB-001	x	x	x	x	x	x	Junction box

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Pub NO. DOC-713

Declaration of Conformity CE 0560

We FURUNO ELECTRIC CO., LTD.
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(Address)

declare under our sole responsibility that the product

Marine radar/ARPA Types FAR-2817, FAR-2827 and FAR-2837S
(See configuration matrix at page 2/2 of this Declaration for details.)
(Model name, serial number)

are in conformity with the essential requirements as described in the Directive 1999/5/EC of the European Parliament and of the Council of 9 March 1999 on radio equipment and telecommunications terminal equipment (R&TTE Directive) and satisfies all the technical regulations applicable to the product within this Directive

EN 60945: 2002 (IEC 60945 Fourth edition: 2002-08)
EN 60950: 2000-01 (IEC 60950 Third edition: 1999-04)
IEC 60936-1 Amendment 1 Annex D: 2002-06
ITU Radio Regulations Appendix S3, table 2
ITU-R M.1177-3: 2003-06, ITU-R SM.1539: 2002-11, ITU-R SM.1541: 2002-11 and ITU-R SM.329-9: 2003-02
(title and/or number and date of issue of the standard(s) or other normative document(s))

For assessment, see

- Statement of Opinion N° 04214040/AA/01 of 7 June 2004 issued by Telefication, The Netherlands
- Test reports FLI 12-03-057 of 15 January 2003, FLI 12-03-048 of 26 September 2003, FLI 12-03-049 of 26 September 2003, FLI 12-03-029 of 25 July 2003, FLI 12-03-027 of 25 July 2003, FLI 12-04-014 of 19 March 2004 and FLI 12-04-032 of 10 May 2004 prepared by Furuno Labotech International Co., Ltd.
- QinetiQ/FST/TR031505 of 17 March 2003 prepared by QinetiQ ltd., UK

On behalf of Furuno Electric Co., Ltd.

Hiroaki Komatsu
Manager,
International Rules and Regulations

Nishinomiya City, Japan
July 1, 2004
(Place and date of issue)

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Configuration matrix of FAR-2817, FAR-2827 and FAR-2837S

(This page if part of the Declaration of Conformity DOC-712.)

Unit \ Type		FAR-2817	FAR-2827	FAR-2837S	Remarks
Scanner	XN-12AF	x	x		4 ft X-band
	XN-20AF	x	x		6.5 ft X-band
	XN-24AF	x	x		8 ft X-band
	SN-30AF			x	10 ft S-band
	SN-36AF			x	12 ft S-band
Transceiver	RTR-078	x			12 kW X-band
	RTR-079		x		25 kW X-band
	RTR-080			x	30 kW S-band
Turning unit	RSB-096	x	x		24 rpm X-band
	RSB-097	x	x		42 rpm X-band
	RSB-098			x	21/26 rpm, 200/220 VAC 3 ø S-band
	RSB-099			x	21/26 rpm, 380/440 VAC 3 ø S-band
	RSB-100			x	45 rpm, 220 VAC 3 ø 50 Hz S-band
	RSB-101			x	45 rpm, 220 VAC 3 ø 60 Hz S-band
	RSB-102			x	45 rpm, 440 VAC 3 ø 60 Hz S-band
Display unit, Monitor	MU-231CR	x	x	x	
Processor unit	RPU-013	x	x	x	
Full-keyboard control unit	RCU-014	x	x	x	To be specified when ordering
Trackball control unit	RCU-015	x	x	x	
Power supply unit	PSU-007			x	For FAR-2137S/2137S-BB
Optional equipment	RCU-016	x	x	x	Remote control unit
	PM-31	x	x		Performance monitor X-band
	PM-51			x	Performance monitor S-band
	AD-100	x	x	x	either one of AD-100 (Gyro converter) or GC-10 (Gyro interface)
	GC-10	x	x	x	
	RJB-001	x	x	x	Junction box

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Pub NO. DOC-712

Declaration of Conformity CE 0560

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(Address)

declare under our sole responsibility that the product

Marine radar/ARPA Types FAR-2817, FAR-2827 and FAR-2835S
(See configuration matrix at page 2/2 of this Declaration for details.)
(Model name, serial number)

are in conformity with the essential requirements as described in the Directive 1999/5/EC of the European Parliament and of the Council of 9 March 1999 on radio equipment and telecommunications terminal equipment (R&TTE Directive) and satisfies all the technical regulations applicable to the product within this Directive

EN 60945: 2002 (IEC 60945 Fourth edition: 2002-08)
EN 60950: 2000-01 (IEC 60950 Third edition: 1999-04)
IEC 60936-1 Amendment 1 Annex D: 2002-06
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For assessment, see

- Statement of Opinion N° 04214040/AA/01 of 7 June 2004 issued by Telefication, The Netherlands
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- QinetiQ/FST/TR031505 of 17 March 2003 prepared by QinetiQ ltd., UK

On behalf of Furuno Electric Co., Ltd.

Hiroaki Komatsu
Manager,
International Rules and Regulations

Nishinomiya City, Japan
June 28, 2004
(Place and date of issue)

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Configuration matrix of FAR-2817, FAR-2827 and FAR-2835S

(This page if part of the Declaration of Conformity DOC-712.)

Unit	Type	FAR-2817	FAR-2827	FAR-2837S	Remarks
Scanner	XN-12AF	x	x		4 ft X-band
	XN-20AF	x	x		6.5 ft X-band
	XN-24AF	x	x		8 ft X-band
	SN-30AF			x	10 ft S-band
	SN-36AF			x	12 ft S-band
Transceiver	RTR-078	x			12 kW X-band
	RTR-079		x		25 kW X-band
	RTR-080			x	30 kW S-band
Turning unit	RSB-096	x	x		24 rpm X-band
	RSB-097	x	x		42 rpm X-band
	RSB-098			x	21/26 rpm, 200/220 VAC 3 ø S-band
	RSB-099			x	21/26 rpm, 380/440 VAC 3 ø S-band
	RSB-100			x	45 rpm, 220 VAC 3 ø 50 Hz S-band
	RSB-101			x	45 rpm, 220 VAC 3 ø 60 Hz S-band
	RSB-102			x	45 rpm, 440 VAC 3 ø 60 Hz S-band
Display unit, Monitor	MU-231CR	x	x	x	
Processor unit	RPU-013	x	x	x	
Full-keyboard control unit	RCU-014	x	x	x	To be specified when ordering
Trackball control unit	RCU-015	x	x	x	
Power supply unit	PSU-007			x	For FAR-2137S/2137S-BB
Optional equipment	RCU-016	x	x	x	Remote control unit
	PM-31	x	x		Performance monitor X-band
	PM-51			x	Performance monitor S-band
	AD-100	x	x	x	either one of AD-100 (Gyro converter) or GC-10 (Gyro interface)
	GC-10	x	x	x	
	RJB-001	x	x	x	Junction box