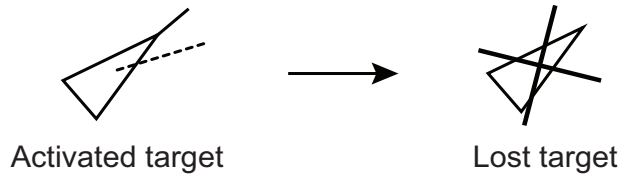


3.7 Lost Target

When AIS data is not received from a target within 3-5 report intervals (see Note 2), the target symbol changes to the lost target symbol (flashing). No audio or visual alarm is given for a lost target.

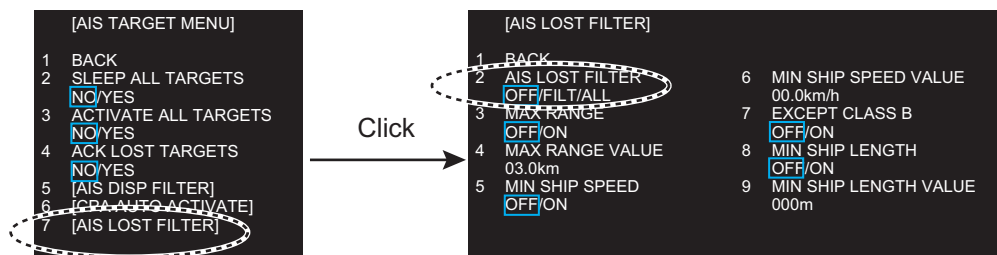


Note: The AIS data transmission interval depends on target's speed. For example, the data is transmitted every 10 seconds on ship speed of 0 to 14 knots and every two seconds on the ship speed of more than 23 knots. For details see the operator's manual of the AIS transponder.

3.7.1 Lost target filter

If there are a lot of AIS targets in your area, the lost target alarm may sound frequently. In this case you may wish to have the alarm ignore lost targets whose range, speed, class or length are below the threshold value you specify.

1. Right-click the [AIS] icon to show [AIS TARGET MENU].
2. Click [AIS LOST FILTER].
3. Click [AIS LOST FILTER] in the [AIS LOST FILTER] menu.



4. Click the target alarm to enable.
 [OFF]: Disable the alarm.
 [FILT]: Get the alarm against the targets whose criteria meet the settings on the [AIS LOST FILTER] menu.
 [ALL]: Get the alarm against all lost targets.
5. Click [MAX RANGE VALUE] and [MIN SHIP SPEED VALUE] as appropriate, referring to the description below.
 [MAX RANGE], [MAX RANGE VALUE]: Any AIS lost target beyond the range set here is not shown.
 [MIN SHIP SPEED], [MIN SHIP SPEED VALUE]: Any AIS lost target slower than this setting is not shown.
 [EXCEPT CLASS B]: Select [ON] to prevent trigger lost Class B AIS lost target.
 [MIN SHIP LENGTH], [MIN SHIP LENGTH VALUE]: Any AIS lost target whose length is shorter than this setting is not shown.

3.7.2 How to acknowledge a lost target

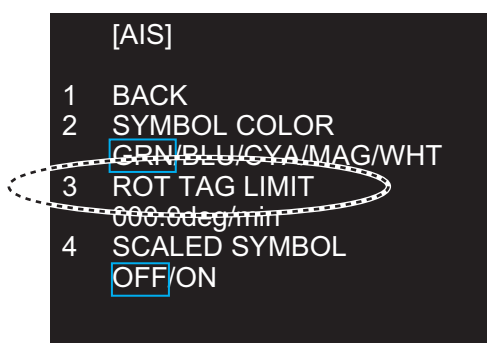
1. Click the [AIS] icon to show [AIS TARGET MENU].
2. Right-click [ACK LOST TARGETS].

3. Click [YES]. The lost target disappears from the screen.

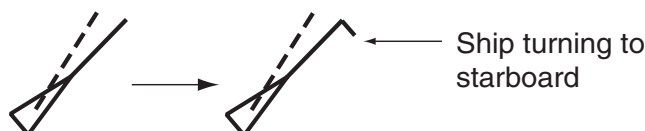
3.8 ROT Setting

You may set the lower limit of the ROT (Rate Of Turn) at which the heading line on target symbols points the ship's turning direction.

1. Open [MAIN MENU], click [TT·AIS].
2. Click [SYMBOL].
3. Click [AIS].
4. Click [ROT TAG LIMIT].



5. Click the setting value then enter ROT with the setting knob (setting range: 0.1 to 720.0 (deg/min)).
6. Click outside the menu window to close the menu.



3.9 CPA/TCPA Alarm

The AIS continuously monitors the predicted range at the Closest Point of Approach (CPA) and predicted time to CPA (TCPA) of each AIS target. When the predicted CPA of an AIS target becomes smaller than a preset CPA range and its predicted TCPA less than a preset TCPA limit, the audio alarm sounds. In addition, the symbol of the offending AIS target is red and flashes together with its vector.

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

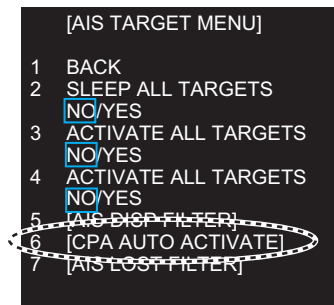
The reference point for CPA, TCPA calculation may be selected from antenna position or conning position.

To set this alarm, see section 2.12 "CPA/TCPA Alarm".

3.10 Automatic Target Activation

You can get automatic activation of a sleeping AIS target when its CPA is within the CPA/TCPA alarm setting. Further, you can select which AIS targets to automatically activate.

1. Right-click the [AIS] icon to show the [AIS TARGET MENU] window.
2. Click [CPA AUTO ACTIVATE].



3. Click [CPA AUTO ACTIVATE].



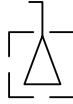
4. Click the activating mode for AIS target.
[OFF]: Disable automatic activation of AIS target by CPA.
[FILT]: Activate only the targets that fulfill the requirements set on the [CPA AUTO ACTIVATE] menu.
[ALL]: For all targets.
5. Set items 3 to 9 referring to the description below.
[MAX RANGE], [MAX RANGE VALUE]: Any AIS target beyond the range set here will not be activated.
[MIN SHIP SPEED], [MIN SHIP SPEED VALUE]: Any AIS target slower than this setting will not be activated.
[EXCEPT CLASS B]: Select [ON] to prevent automatic activation of class B AIS targets.
[MIN SHIP LENGTH], [MIN SHIP LENGTH VALUE]: Any AIS target whose length is shorter than this setting will not be activated.
6. Click outside the menu window to close the menu.

3.11 AIS Target Data

You may display an AIS target's data by selecting it on the display. This data is shown for the activated AIS target only. The selected AIS target is enclosed in a broken square. The target data is shown on the [AIS INFO] window.



AIS

Selected AIS to
display the information

[AIS INFO]			
NAME	:XXXX	RNG/BRG	:0.77km/324.4°R
FLAG	:NETHERLANDS	SOG/COG	:11.1km/h/100.0°T
CALL SIGN	:PFXXXX	CPA/TCPA	:0.49km/03m10s
MMSI	:123456789	HDG	:missing
IMO NO.	:missing	ROT	:missing
LAT	:51°53.661' N	LEN/BEAM	:135m/14.0m
LON	:004°18.376' E	BLUE SIGN	:NO

[AIS INFO] window

[NAME]: Name of ship
 [FLAG]: Flag state
 [CALL SIGN]: Call sign
 [MMSI]: MMSI No.
 [IMO NO.]: IMO No.
 [LAT]: Latitude
 [LON]: Longitude

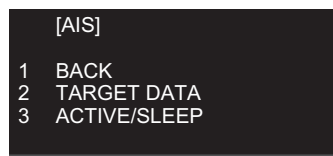
[RNG/BRG]: Range/Bearing to target
 [SOG/COG] (or [STW/CTW]): Target's speed and course
 [CPA/TCPA]: Target's CPA/TCPA
 [HDG]: Heading
 [ROT]: Rate of turn
 [LEN/BEAM]: Ship's length/Beam
 [BLUE SIGN]: Blue sign status

Symbol operation

Left-click the AIS target to show the selected target's information window.

Menu operation

1. Right-click the AIS target to show the [AIS] window.



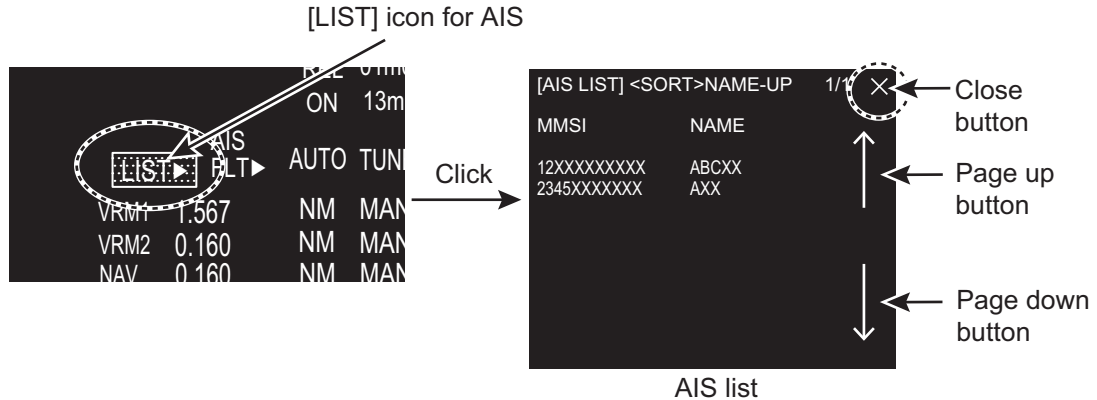
2. Click [TARGET DATA] to show the [AIS INFO] window.
3. Click the close button or outside the information window to close the menu.

3.12 AIS List

The AIS list provides a comprehensive information about all AIS targets being tracked.

How to display the AIS list

Click the [LIST] icon for AIS at the bottom right corner on the screen.



You can see [MMSI] and [NAME] for AIS targets. To close the [AIS LIST] window, click the close button on the list.

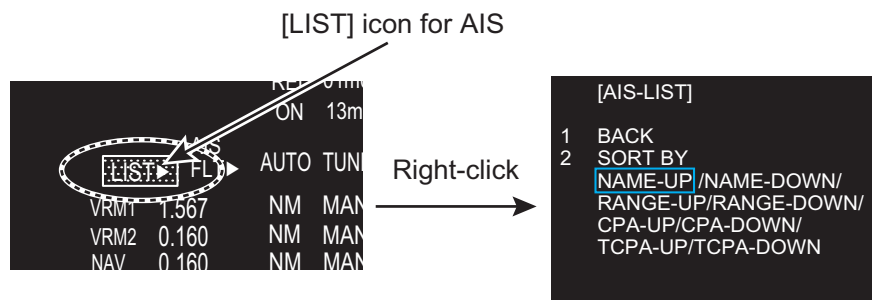
How to display AIS target data

Click the target on [AIS LIST] to show the [AIS INFO] window. See section 3.11.

How to sort the target list

You may sort the target list by RANGE, CPA, TCPA. Also, you can sort in ascending or descending order.

1. Right-click the [LIST] icon for AIS to show the [AIS-LIST] window.



2. Click [SORT BY].
3. Click the sorting method desired.
 [NAME-UP], [NAME-DOWN]: Sort by name
 [RANGE-UP], [RANGE-DOWN]: Sort by range
 [CPA-UP], [CPA-DOWN]: Sort by CPA
 [TCPA-UP], [TCPA-DOWN]: Sort by TCPA
4. Click outside the menu window to close the menu.

3. AIS OPERATION

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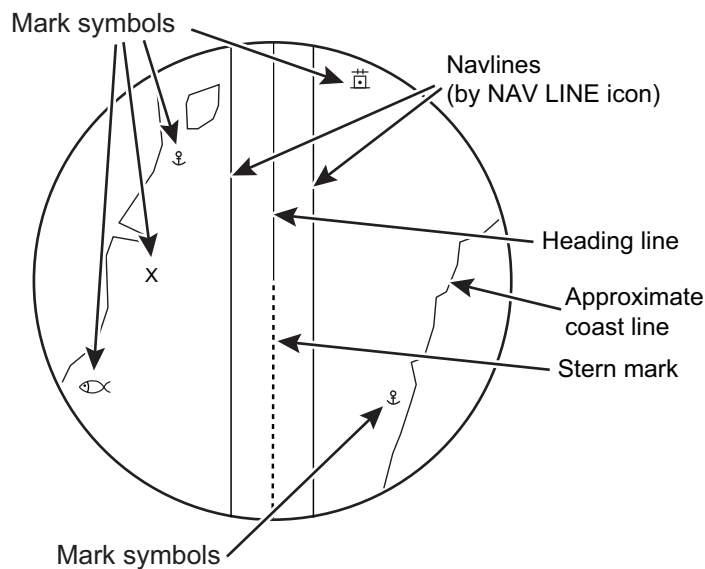
4. RADAR MAP

4.1 What is a Radar Map?

The radar map feature, available in the [RIVER] mode, is a combination of map lines and symbols whereby the user can define and input the navigation, route planning and monitoring data on the screen. Map lines are a navigational facility whereby the observer can define lines to indicate channels or traffic separation schemes.

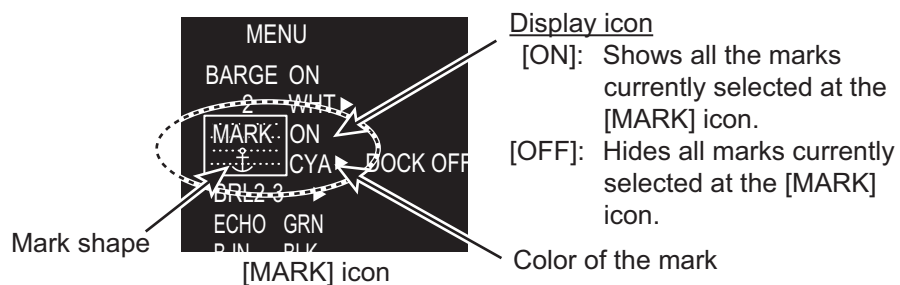
The user can create a radar map on real-time base while using the radar for navigation or at leisure time at anchor. The map data is stored on the Flash ROM memory which is mounted on the main processor board.

Note: Radar map function requires heading and positioning data.



4.2 [MARK] icon

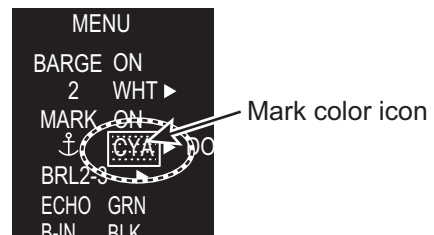
The [MARK] icon, located at the bottom left corner on the screen, is used to create marks and lines, line operations. This radar can save a total of 5,000 marks and lines.



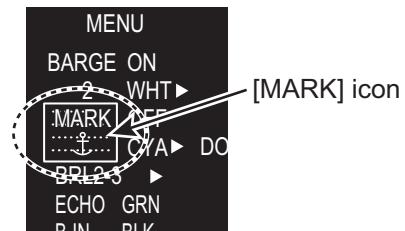
4.3 How to Enter Marks, Lines

4.3.1 How to enter a mark, line with at the cursor position

1. Click the mark color icon to select the required color for the mark.



2. Highlighting the [MARK] icon then rotate the setting knob to select a mark.

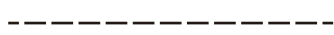


3. Press the left button on the appropriate mark to decide the mark (or line) shape.

Marks

Triangle 	Lighthouse 3 	Fish 	Diamond 
Dash with 3 bar-line 	Circle 	Square 	
Lighthouse 1 	Small dot 	Anchor 	
Lighthouse 2 	Cross 	Dot 	

Lines

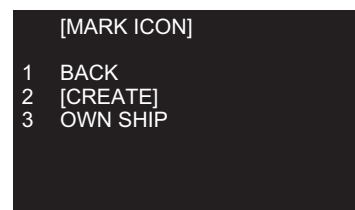
1	Long dashed line	
2	Dashed line	
3	Coast line	
4	Contour line / Prohibited areas	
5	Cable	

4. Press the left button. For lines, press the left button on the next point of the line then repeat this operation to complete the line.
5. Press the right button to quit.

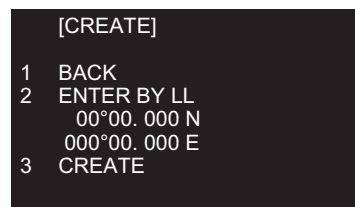
4.3.2 How to enter a mark by latitude and longitude position input

This function is not available for entering lines.

1. Right-click the [MARK] icon to show the [MARK ICON] window.



2. Click [CREATE] to show the [CREATE] window.



3. Click [ENTER BY LL].
4. The cursor is on the far left-hand digit on the latitude line. Rotate the setting knob to click a numeral. The cursor moves to the next digit. Enter other numbers similarly.
5. Right-click the last digit to finish.

4.3.3 How to enter a mark at current position

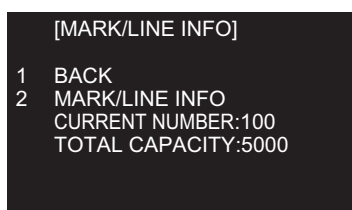
This function is not available for entering lines.

1. Right-click the [MARK] icon to show the [MARK ICON] window.
2. Click [OWN SHIP].

4.4 Mark/Line information

You can confirm the number of marks and lines which you have entered.

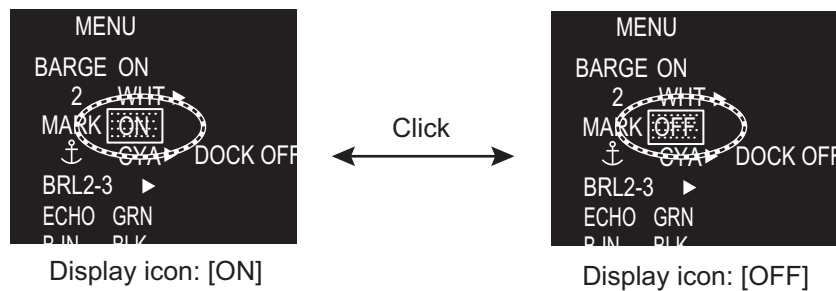
1. Open [MAIN MENU], click [RADAR MAP].
2. Click [MARK/LINE INFO] to open the information window.



4.5 How to Show, Hide Marks on the Screen

By menu icon

Click the mark display icon to show or hide the marks.



By [DISPLAY] menu

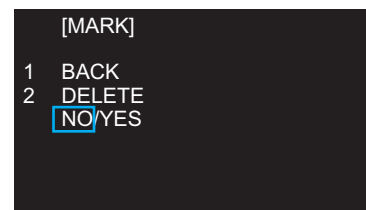
This menu is available in the [RIVER] mode only.

1. Open [MAIN MENU], click the [DISPLAY] menu.
2. Click [MARK/LINE].
3. Click [ON] or [OFF].

4.6 How to Delete Marks, Lines

How to delete marks, lines individually

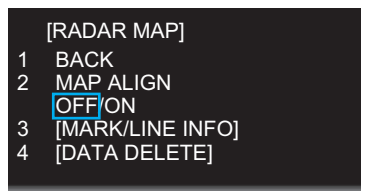
1. Right-click the mark to delete.



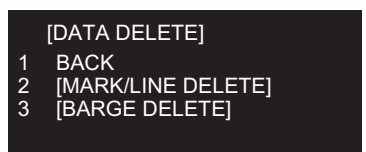
2. Click [DELETE].
3. Click [YES].

How to delete marks, lines by color, shape

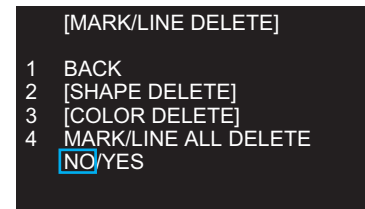
1. Open [MAIN MENU], click [RADAR MAP] to show the [RADAR MAP] menu.



2. Click [DATA DELETE].



- Click [MARK/LINE DELETE].



- Click the sort to delete.
[SHAPE DELETE]: Select the shape to delete then select [YES] in [DELETE].
[COLOR DELETE]: Select the color to delete then select [YES] in [DELETE].
- Click [DELETE].
- Click [YES].
- Click outside the menu window to close the menu.

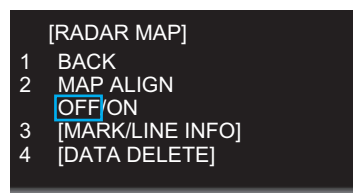
How to delete all marks, lines

- Open [MAIN MENU], click [RADAR MAP] to show the [RADAR MAP] menu.
- Click [DATA DELETE].
- Click [MARK/LINE DELETE].
- Click [MARK/LINE ALL DELETE].
- Click [YES].
- Click outside the menu window to close the menu.

4.7 How to Align the Radar Map

When the map is not overlaid on the radar picture correctly, you can align the map with the [MAP ALIGN] menu.

- Open [MAIN MENU], click [RADAR MAP].



- Click [MAP ALIGN].
- Click [ON] to align the radar echo to the radar map. The cursor moves the center of the radar display. The mark symbols are moved in conjunction with the cursor movement.
- Click anywhere in the radar display to complete the alignment.

4. RADAR MAP

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5. MAINTENANCE, TROUBLE-SHOOTING

 WARNING	NOTICE
 Do not open the equipment. Hazardous voltage which can cause electrical shock exists inside the equipment. Only qualified personnel should work inside the equipment.	Do not apply paint, anti-corrosive sealant or contact spray to coating or plastic parts of the equipment. Those items contain organic solvents that can damage coating and plastic parts, especially plastic connectors.
 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.	
 A transmitting radar antenna emits electromagnetic waves, which can be harmful, particularly the eyes.	
 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.	

5.1 Preventive Maintenance

Regular maintenance helps keep your equipment in good condition and prevents future problems. Check the items shown on next page to help keep your equipment in good condition for years to come.

Ground terminal on processor units

Tighten or replace as necessary.

Connectors on monitor and processor units

Tighten if the connectors are loosened.

Exposed nuts and bolts on the antenna unit

Exposed bolts and nuts are subject to corrosion. Further, they may loosen by vibration. Check that bolts and nuts are securely fastened. Refasten if necessary. If corroded, and coat with anti-corrosive sealant.

Antenna radiator

Dust, dirt and salt deposits on the radiator cause signal attenuation, resulting in loss of sensitivity. Wipe the radiator with a freshwater-moistened cloth. The radiator is made of fiber-glass reinforced plastic. Therefore, do not use gasoline, benzene and the like to clean the radiator. If the radiator is iced, use a wooden or plastic headed hammer to remove the ice.

5.2 How to replace the Fuse

A fuse is located on the front of the processor unit. The fuse protects the equipment from reverse polarity of the ship's mains and equipment fault. If a fuse blows, find the cause before replacing it. Use the correct fuse. Using the wrong fuse will damage the equipment and void the warranty.



WARNING

Use the correct fuse.

A wrong fuse can damage the equipment and cause fire.

Unit	Type	Code No.	Remarks
Processor Unit	FGBO-A 125V 10A PBF	000-155-826-10	24 VDC

5.3 Life Expectancy of Major Parts

This radar has consumable parts, and the table that follows shows the estimated life expectancy for the consumable parts. Life expectancy estimates are based on use under normal conditions. Request a FURUNO agent or dealer to replace the consumable parts, to get the best performance and longest possible life from the equipment.

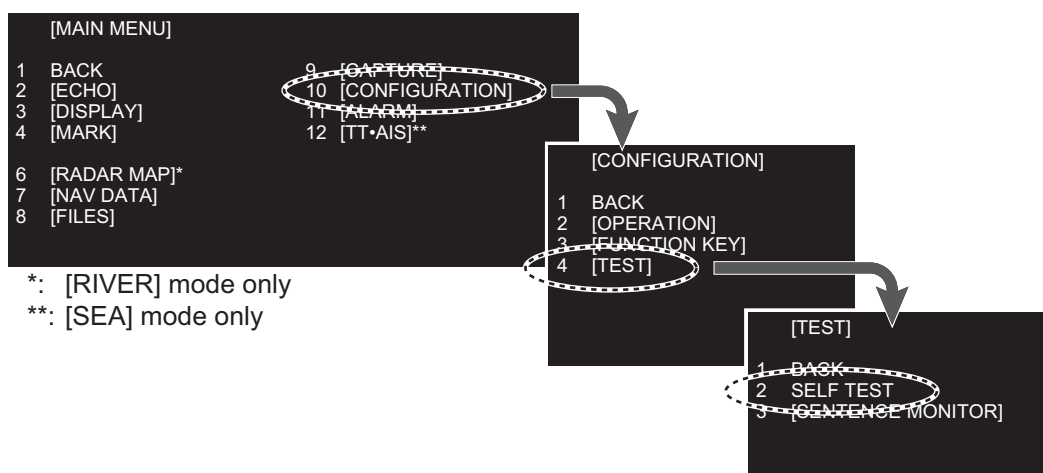
Part	Type	Life expectancy	Remarks
Antenna Motor	D8G-516	10,000 hours	
Carbon Brush	S885026-1A-61	4,000 hours	Check for wear at, or before, 2,000 hours of Tx time. Replace if worn.
Magnetron	MAF1611B (4kW, FR-1908V-BB)	5,000 hours	Check no. of hours used at Tx time. Reset time after replacement.
	MAF1615B (12kW, FR-1918V-BB)		

Note: The magnetron is a consumable item. The effectiveness of your magnetron will decrease over time, causing lower-than-normal signal strength and loss of echoes. Magnetrons should be changed regularly. The table above shows the typical life-span of a magnetron used under normal conditions.

5.4 Diagnostic Test

5.4.1 Self Test

The diagnostic test checks the system for correct operation. This test is for use by service technicians, but the user can do this test to provide the service technician with information.



RPU PROGRAM VERSION			×
1	APPL NO.	0359451-01.**	
2	ECHO FPGA NO.	0359275-01.**	
3	DRAW FPGA NO.	0359276-01.**	
4	STARTER NO.	0359272-01.**	
5	BOOTER NO.	0359273-01.**	
RCU PROGRAM VERSION			
6	APPL NO.	0359252-01.**	
7	BOOTER NO.	0359260-01.**	
RADAR PROCESSING UNIT (RPU)			
8	ROM		OK
9	RAM		OK
10	ECHO FPGA		OK
11	DRAW FPGA		OK
12	MAC ADDRESS	00-D0-1D-05-2A-CB	
13	IP ADDRESS	172. 031. 003. 016	
14	DIP-SW	00000	
CONTROL HEAD (RCU)			
15	ROM		OK
16	RAM		OK

Example of the Self Test result

1. Open [MAIN MENU], click [CONFIGURATION].
2. Click [TEST].
3. Click [SELF TEST]. Test results of processor unit and control unit are displayed. Items 8 to 11, 15 and 16 are displayed [OK] if normal and [NG] if abnormal. When [NG] is displayed, request a service.
4. To close the window, click the close button (×).
5. Click outside the menu window to close the menu.

5.4.2 NMEA sentences checks

You can check the sentences read into the equipment.

1. Open [MAIN MENU], click [CONFIGURATION].
2. Click [TEST].
3. Click [SENTENCE MONITOR].

[SENTENCE MONITOR]	
1	BACK
2	NMEA1
3	NMEA2
4	NMEA3
5	NMEA4
6	NMEA5
7	NMEA6

4. Click the item to display. Each item refers to the external equipment connection port in the processor unit.
5. To close the window, click the close button (×).
6. Click outside the menu window to close the menu.

5.5 Easy Troubleshooting

This section provides troubleshooting procedures that the user may follow to restore normal operation. If you cannot restore normal operation, do not attempt to check inside any unit. Leave any repair work to a qualified technician.

Easy troubleshooting

Problem	Remedy
You can not turn on the power.	• Check for blown fuse. • Check that the power connector is fastened. • Check for corrosion on the power cable connector. • Check for damaged power cable. • Check the input source for monitor.
There is no response when a key is pressed.	Long press the POWER key for approx. seven seconds to turn off the power. Then, turn on the power again.
Key beep inaudible	Adjust key beep level on the [OPERATION] menu, referring to paragraph 1.37.4.
Picture not updated or picture freeze.	Long press the POWER key for approx. seven seconds to turn off the power. Then, turn on the power again.
The power is on and you operated the STBY/TX key to transmit. The marks and characters appear, but no echo appears.	• Check that the antenna cable is fastened. • Adjust the GAIN and STC levels. • Adjust the echo brilliance.
Tuning is correctly adjusted, but sensitivity is poor.	• Clean the radiator face. • Replace the magnetron. Contact your dealer.
There are unwanted echo around own ship.	Adjust the STC level.
• The icons are automatically hidden. • You can not find the icon.	Turn [HIDDEN ICON] to [OFF]. See paragraph 1.36.2.
You can not adjust the brilliance of the screen.	Turn [EXT BRILL CTRL] to [ON] on the monitor MU-190V.
You can not set the orientation mode.	• Check the connected equipment. • Check the heading input (Sentence monitor, Input port, Baud rate).
• The AIS symbols are not shown. • The true trails are not shown. • The radar map is not shown.	Check the connected equipment.
Range rings are not shown.	Adjust their brilliance with [FIXED RING]. See paragraph 1.6.3.

5.6 Advanced Troubleshooting

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

Advanced troubleshooting

Problem	Probable causes or check points	Remedy
You cannot turn on the power.	• Blown fuse. • Mains voltage/polarity • Power supply board	• Replace blown fuse. • Correct wiring and input voltage. • Replace power supply board.
Power turned on but radar does not operate at all.	Panel board	Replace panel board.
Antenna not rotating	• Antenna switch setting (See the Installation manual.) • Check for the voltage for motor. • Antenna switch of antenna unit • Gear mechanism • RF_TB board	• Check the setting of antenna switch. • Replace PSU board. • Check if antenna switch is ON. • Replace the motor. • Replace RF_TB board.
Set [GAIN] to maximum with [STC] and [RAIN] settings at minimum. Marks and indications appear but no noise or echo.	• IF amplifier • Signal cable between antenna and processor unit • VIDEO_AMP board • SPU cable connection on the VIDEO_AMP board	• Replace IF amplifier. • Check continuity and isolation of coaxial cable. • Replace video amplifier.
Marks, indications and noise appear but no echo in short range.	• Magnetron • Modulator board • SPU board	• Check magnetron current. • Replace modulator board. • Replace SPU board.
Picture not updated or picture freeze-up.	• Bearing signal generator • SPU board	• Check that signal cables are fastened. • Replace SPU board. • Turn off and on the radar.
GAIN is poor.	Tuning	Do the [TUNE INITIALIZE] setting. See paragraph 1.8.4.
Radar is correctly tuned but sensitivity is poor.	• Deteriorated magnetron • Dirt on radiator face	• Check the magnetron current with the radar transmitting on 48 nm range. • Clean radiator.

APPENDIX 1 RADIO REGULATORY INFORMATION

USA-Federal Communications Commission (FCC)

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions:

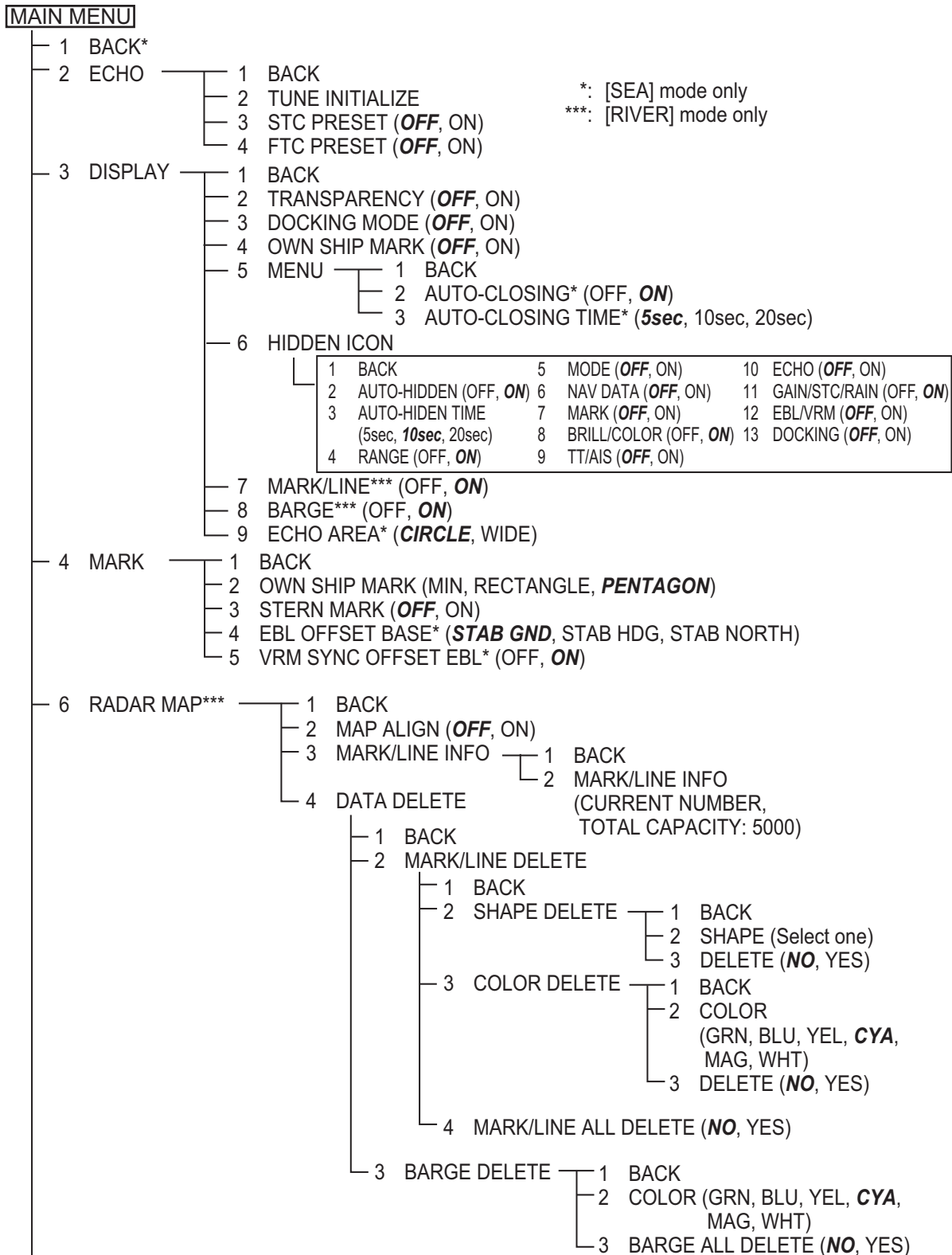
- (1) This device may not cause harmful interference, and
- (2) This device must accept any interference received, including interference that may cause undesired operation. Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

Caution: Exposure to Radio Frequency Radiation

- This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment and meets the FCC radio frequency (RF) Exposure Guidelines in Supplement C to OET65.
- This equipment should be installed and operated keeping the radiator at least 50 cm (FR-1908V-BB) , 340 cm (FR-1918V-BB) or more away from person's body.
- This device must not be co-located or operating in conjunction with any other antenna or transmitter.

APPENDIX 2 MENU TREE

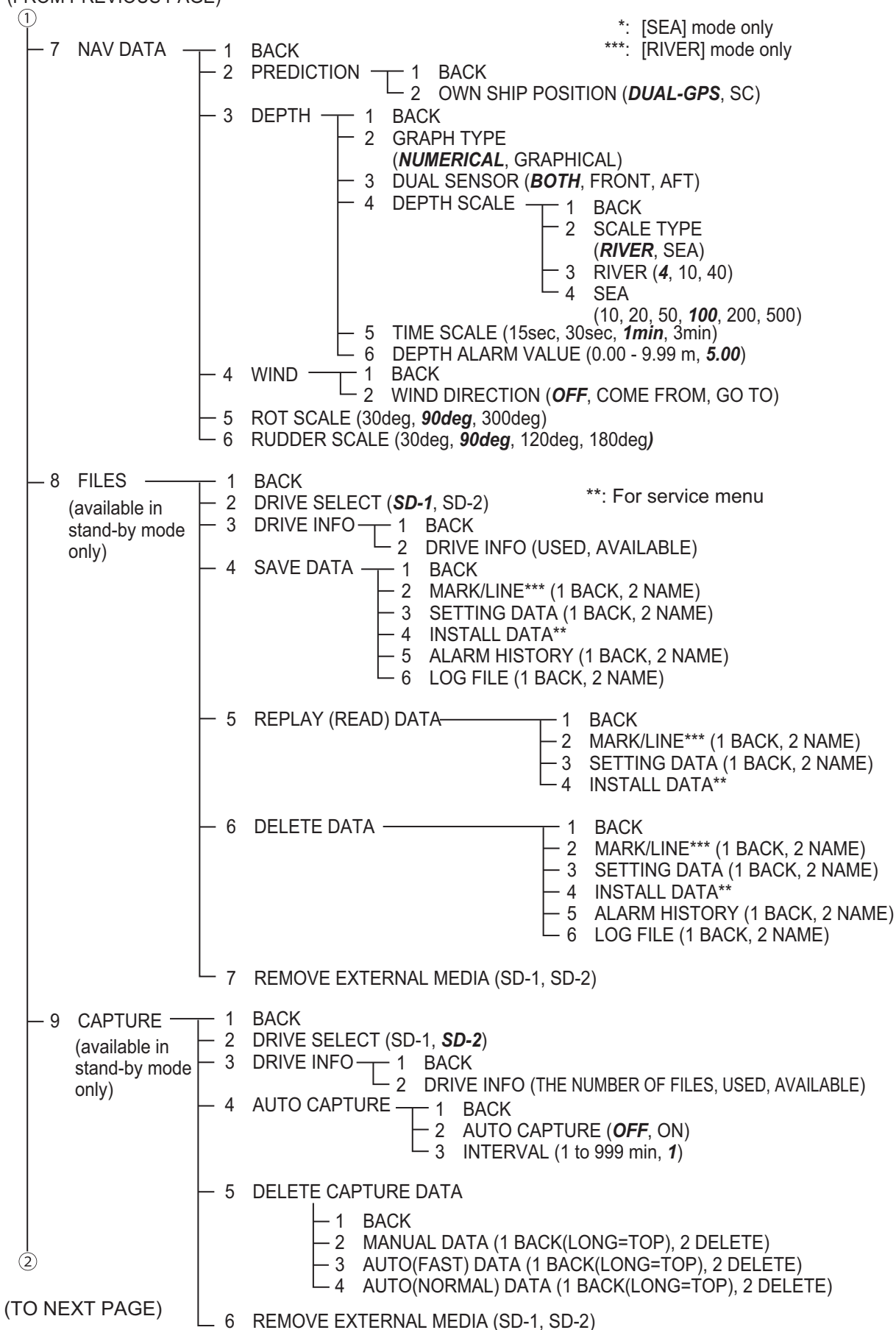
MAIN MENU



①

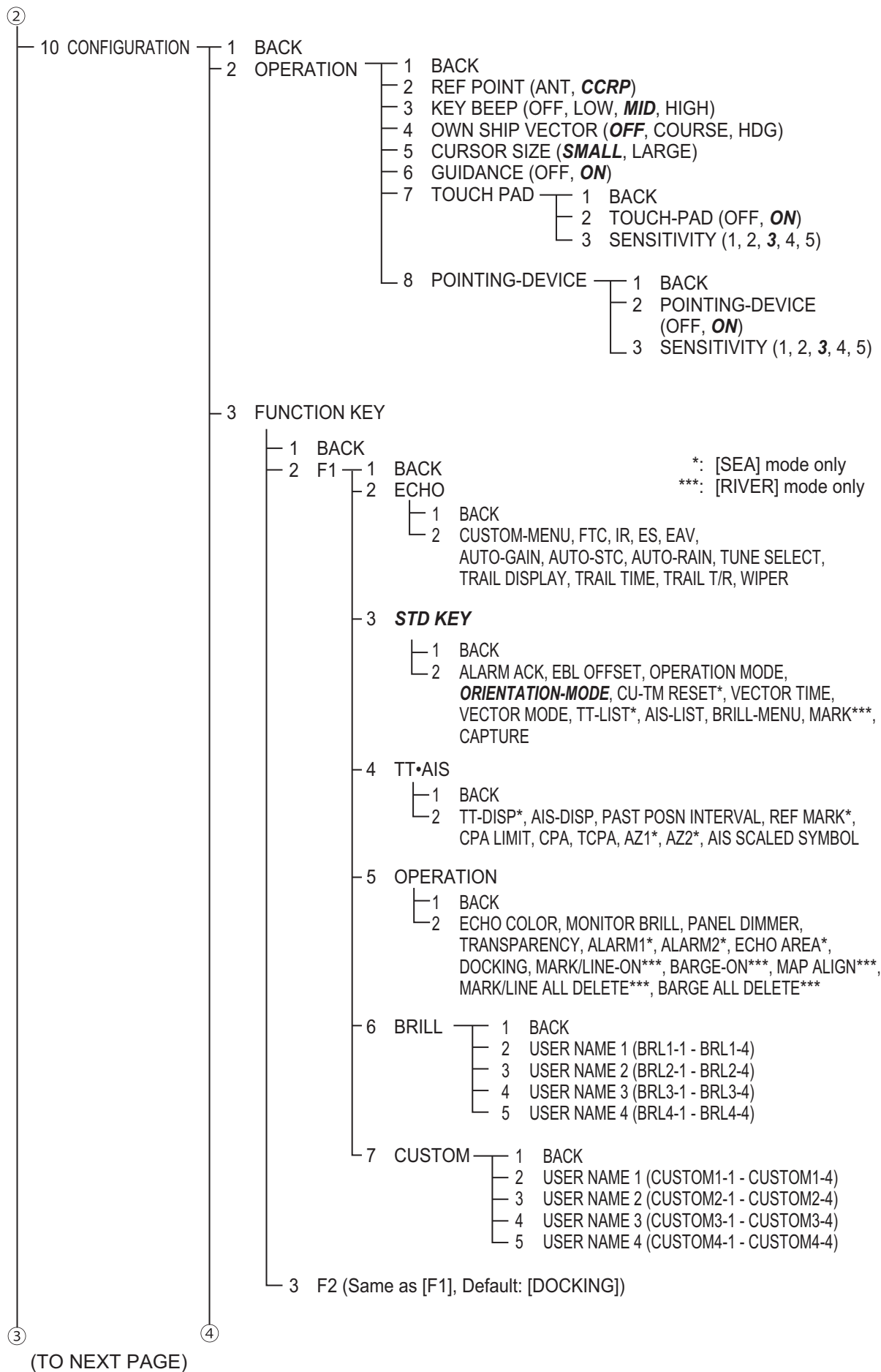
(TO NEXT PAGE)

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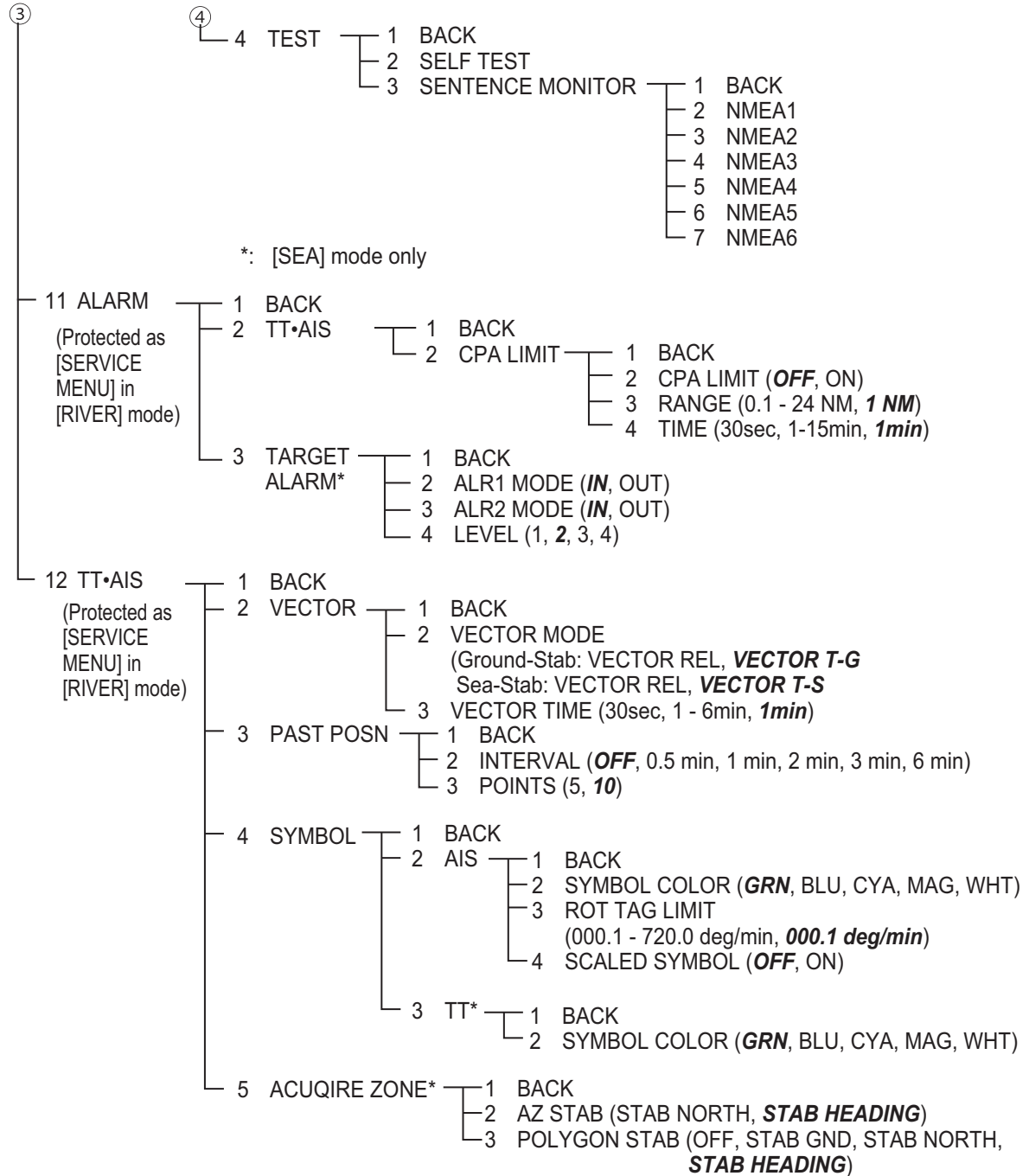


APPENDIX 2 MENU TREE

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APPENDIX 3 DIGITAL INTERFACE (IEC61162-1)

Input sentences

ALR : Set alarm state

\$**ALR,Hhmmss.ss,xxx,A,A,c—c,*hh<CR><LF>
1 2 3 4 5

1. Time of alarm condition change, UTC (000000.00 - 240001.00)
2. Unique alarm number (identifier) at alarm source (000 - 999)
3. Alarm condition (A=threshold exceeded, V=not exceeded)
4. Alarm acknowledge state (A=acknowledged, V=not acknowledged)
5. Alarm description text (alphanumeric)

DBS : Depth Below Surface

\$**DBS,x.x,f,x.x,M,x.x,F,*hh<CR><LF>
1 2 3 4 5 6

1. Water depth (0.00-99999.99)
2. feet
3. Water depth (0.00-99999.99)
4. Meters
5. Water depth (0.00-99999.99)
6. Fathom

DBT : Depth Below Transducer

\$**DBT,xxxx.x,f,xxxx.x,M,xxxx.x,F,*hh<CR><LF>
1 2 3 4 5 6

1. Water depth (0.00-99999.99)
2. feet
3. Water depth (0.00-99999.99)
4. Meters
5. Water depth (0.00-99999.99)
6. Fathoms

DPT : Depth

\$**DPT,x.x,x.x,x.x,*hh<CR><LF>
1 2 3

1. Water depth relative to the transducer, meters (0.00-99999.99)
2. Offset from transducer, meters (-99.99 - 99.99)
3. Minimum range scale in use (no use)

DTM : Datum Reference

\$**DTM,ccc,a,x.x,a,x.x,a,x.x,ccc,*hh<CR><LF>
1 2 3 4 5 6 7 8

1. Local datum (W84=WGS84 W72=WGS72 S85=SGS85, P90=PE90
User defined=999, IHO datum code)
2. Local datum subdivision code (NULL or one character)
3. Lat offset, min (-59.99999 - 59.99999)
4. N/S
5. Lon offset, min (no use)
6. E/W
7. Altitude offset, meters (no use)
8. Reference datum (W84=WGS84 W72=WGS72 S85=SGS85, P90=PE90)

GBS : GNSS satellite fault detection

\$**GBS,hhmmss.ss,x.x,x.x,x.x,xx,x.x,x.x,x.x*hh<CR><LF>
 1 2 3 4 5 6 7 8

1. UTC time of GGA or GNS fix associated with this sentence
2. Expected error in latitude (0.0 - 999.9)
3. Expected error in longitude (0.0 - 999.9)
4. Expected error in altitude (no use)
5. ID number of most likely failed satellite (no use)
6. Probability of missed detection for most likely failed satellite (no use)
7. Estimate of bias in meters on most likely failed satellite (no use)
8. Standard deviation of bias estimate (no use)

GGA : Global Positioning System Fix Data

\$**GGA,hhmmss.ss,lll.lll,a,yyyyy.yyy,a,x,xx,x.x,x.x,M,x.x,M,x.x,xxxx,*hh<CR><LF>
 1 2 3 4 5 6 7 8 9 10 11 12 13 14

1. UTC of position (no use)
2. Latitude (0.00000 - 9000.00000)
3. N/S
4. Longitude (0.00000 - 18000.00000)
5. E/W
6. GPS quality indicator (1 -5, 8)
7. Number of satellite in use (00 -99)
8. Horizontal dilution of precision (0.00 - 999.99)
9. Antenna altitude above/below mean sea level (-999.99 - 9999.99)
10. Unit, m
11. Geoidal separation (-999.99 - 9999.99)
12. Unit, m
13. Age of differential GPS data (0 - 99)
14. Differential reference station ID (0000-1023)

GLL : Geographic Position

\$**GLL,lll.lll,a,yyyyy.yyy,a,hhmmss.ss,a,x,*hh<CR><LF>
 1 2 3 4 5 6 7

1. Latitude (0.00000 - 9000.00000)
2. N/S
3. Longitude (0.00000 - 18000.00000)
4. E/W
5. UTC of position (no use)
6. Status (A=data valid V=data invalid)
7. Mode indicator (A=Autonomous D=Differential S=Simulator)

GNS : GNSS Fix Data

\$**GNS,hhmmss.ss,lll.lll,a,llll.lll,a,c--c,xx,x.x,x.x,x.x,x.x,x.x,a*hh<CR><LF>
 1 2 3 4 5 6 7 8 9 10 11 12 13

1. UTC of position (no use)
2. Latitude (0.00000 - 9000.00000)
3. N/S
4. Longitude (0.00000 - 18000.00000)
5. E/W
6. Mode indicator
 N=No fix A=Autonomous D=Differential P=Precise R=Real Time Kinematic
 F=Float RTK E=Estimated Mode M=Manual Input Mode S=Simulator Mode
7. Total number of satellites in use (00 - 99)
8. HDOP (0.0 - 999.99)
9. Antenna altitude, meters (-999.99 - 9999.99)
10. Geoidal separation (-999.99 - 9999.99)
11. Age of differential data (0 - 999)
12. Differential reference station ID (0000 - 1023)
13. Navigational status indicator

ROT : Rate of Turn

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

1 2

1. Rate of turn, deg/min, "-"=bow turns to port (-9999.9 - 9999.9)
2. Status: A=data valid, V=data invalid

RSA : Rudder Sensor Angle

\$**RSA,x.x,A,x.x,A*hhCR>&ltLF>

1 2 3 4

1. Starboard(or single) rudder sensor data (-180 - 180.0, NULL)
2. Starboard(or single) rudder sensor status (A=Vaild N=Data invalid)
3. Port rudder sensor data (-180 - 180.0, NULL)
4. Port rudder sensor status (A=Vaild N=Data invalid)

THS : True heading & status

\$**THS,xxx.x,a*hh<CR><LF>

1 2

1. Heading, degrees True (0.00 to 360.00)
2. Mode indicator (A=autonomous E=estimated M=manual input
S=simulator V=data not valid)

VDM: AIS VHF data-link message

\$**VDM,x,x,x,x,s--s,x,*hh<CR><LF>

1 2 3 4 5 6

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, NULL)
4. AIS channel Number (A or B)
5. Encapsulated ITU-R M.1371 radio message (1 - 63 bytes)
6. Number of fill-bits (0 to 5)

VDO: AIS VHF data-link own-vessel report

!AIVDO,x,x,x,x,s--s,x,*hh<CR><LF>

1 2 3 4 5 6

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, NULL)
4. AIS channel Number (A or B)
5. Encapsulated ITU-R M.1371 radio message (1 - 63 bytes)
6. Number of fill-bits (0 to 5)

VHW : Water speed and heading

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

1 2 3 4 5 6 7 8

1. Heading, degrees (0.0 - 359.9, NULL)
2. T=True (fixed)
3. Heading, degrees (0.0 - 359.9, NULL)
4. M=Magnetic (fixed)
5. Speed, knots (0.0 - 9999.9)
6. N=Knots (fixed)
7. Speed, knots (0.0 - 9999.9)
8. K=km/hr (fixed)

VTG : Course over ground and ground speed

\$GPVTG,x.x,T,x.x,M,x.x,N,x.x,K,a,*hh <CR><LF>
1 2 3 4 5 6 7 8 9

1. Course over ground, degrees (0.0 - 359.9)
2. T=True (fixed)
3. Course over ground, degrees (0.0 - 359.9)
4. M=Magnetic (fixed)
5. Speed over ground, knots (0.00-9999.9)
6. N=Knots (fixed)
7. Speed over ground (0.00 - 9999.9)
8. K=km/h (fixed)
9. Mode indicator (A=Autonomous, D=Differential E = Estimated (dead reckoning)
M=Manual input S=Simulator N=Data not valid)

VWR : Wind relative Bearing and Velocity

\$**VWR,x.x,x,x.x,N,x.x,M,x.x,K<CR><LF>
1 2 3 4 5 6 7 8

1. Measured wind angle relative to the vessel, degrees (0.0 - 180.0)
2. L=Left semicircle, R=Right semicircle
3. Velocity, knots (0.0 - 9999.9)
4. Unit (N, fixed)
5. Velocity (0.0 - 999.9)
6. Unit (M, fixed)
7. Velocity, km/h
8. Unit (K, fixed)

VWT : True Wind Speed and Angle

\$**VWT,x.x,x,x.x,N,x.x,M,x.x,K<CR><LF>
1 2 3 4 5 6 7 8

1. Measured wind angle relative to the vessel, degrees (0.0 - 180.0)
2. L=Left semicircle, R=Right semicircle
3. Velocity, knots (0.0 - 9999.9)
4. Unit (N, fixed)
5. Velocity (0.0 - 999.9)
6. Unit (M, fixed)
7. Velocity, km/h
8. Unit (K, fixed)

ZDA : Time and date

\$GPZDA,hhmmss.ss,xx,xx,xxxx,xx,xx<CR><LF>
1 2 3 4 5 6

1. UTC (000000 - 235959)
2. Day (01 - 31)
3. Month (01 -12)
4. Year (UTC, 0000 - 9999)
5. Local zone, hours (-13 to ±13)
6. Local zone, minutes (00 to ±59)

Output sentences

TTM : Tracked target message

\$RATTM,05,12.34,23.4,R,45.67,123.4,T,1.23,8.23,N,c--c,T,R,hhmmss.ss,M*hh<CR><LF>
 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

1. Target number (00 to 99)
2. Target distance from own ship (0.000 - 999.9)
3. Bearing from own ship,degrees (0.0 - 359.9)
4. True or Relative
5. Target speed (0.00 - 99.9, 100.0 - 999.9)
6. Target course, degrees (0.0 - 359.9)
7. True or Relative
8. Distance of closet point of approach (0.000 - 999.9)
9. Time to CPA, min., "-"increasing (-6000 - 6000)
10. Speed/distance units, K=Km, km/h N=nm, km S=sm, mph)
11. Target name (c--c)
12. Target status (L=Lost Q=Acquiring T=Tracking)
13. Reference target (R, NULL otherwise)
14. UTC of data (hhmmss.ss)
15. Type of acquisition (A=automatic M=manual R=reported)

SPECIFICATIONS OF RIVER RADAR FR-1908V-BB/1918V-BB

1 ANTENNA UNIT

- 1.1 Radiator type Slotted waveguide array
- 1.2 Polarization Horizontal
- 1.3 Antenna rotation speed 26 rpm nominal
- 1.4 Radiator length 6.5 ft (XN20AF), 8 ft (XN24AF)
- 1.5 Horizontal beam width
 - 3dB 1.23° (XN20AF) 0.95° (XN24AF)
 - 20dB 2.84° (XN20AF), 2.5° (XN24AF)
- 1.6 Vertical beam width 20° (-3dB)
- 1.7 Sidelobe attenuation -26 dB or less (within $\pm 10^\circ$ of main-lobe)
-32 dB or less (outside $\pm 10^\circ$ of main-lobe)
- 1.8 Antenna gain 30.0 dB (XN20AF), 31 dB (XN24AF)
- 1.9 Wind load 100 km/h relative

2 RF TRANSCEIVER

- 2.1 Frequency 9410 MHz ± 30 MHz (X band)
- 2.2 Modulation P0N
- 2.3 Peak output power
 - FR-1908V-BB 4 kW nominal
 - FR-1918V-BB 12 kW nominal
- 2.4 Range, Pulselength, Pulse Repetition Rate (PRR)

River mode

	Range (SM)	Pulselength (μ s)	PRR (Hz)
S	0.125 to 2	0.04/0.06 (4/12kW)	4000
M1	1.6 to 4	0.12	2000
M2	4 to 16	0.28	2000
L	8 to 64	0.6	1000*

*: 750 Hz for 64 SM

Sea mode (1)

	Range (NM/SM)	Pulselength (μ s)	PRR (Hz)
S	0.125 to 2	0.04/0.06 (4/12kW)	4000
M1	1.5 to 4	0.12	2000
M2	3 to 16	0.28	2000
L	6 to 64	0.6	1000*

*: 750 Hz for 64 NM/SM

Sea mode (2)

	Range (km/kyd)	Pulselength (μ s)	PRR (Hz)
S	0.125 to 4	0.04/0.06 (4/12kW)	4000
M1	3 to 8	0.12	2000
M2	6 to 32	0.28	2000
L	12 to 64	0.6	1000

- 2.5 Modulator FET switching
- 2.6 Intermediate Frequency 60 MHz, Logarithmic amplifier
- 2.7 Tuning Manual/Automatic
- 2.8 Receiver front end MMIC
- 2.9 Duplexer Ferrite circulator with diode limiter

3 PROCESSOR UNIT

- 3.1 Orientation mode
 - River mode Head-up or Stern-up, relative motion
 - Sea mode Head-up, Head-up TB or Stern-up (relative motion),
North-up or Course-up (relative/true motion)

- 3.2 Range, Range ring interval (RRI), Number of rings

River mode

Range (SM)	0.125	0.25	0.5	0.8	1.2	1.6	2	4	8	16	32	64
RRI (SM)	0.025	0.05	0.1	0.2	0.2	0.4	0.4	1	2	4	8	16
Number of rings	5	5	5	4	6	4	5	4	4	4	4	4

Sea mode

Range (NM/SM/km/kyd)	0.125	0.25	0.5	0.75	1	1.5	2	3	4	6	8	12	16	24	32	48	64
RRI (NM/SM/km/kyd)	0.025	0.05	0.1	0.25	0.25	0.25	0.4	0.5	1	1	2	2	4	4	8	8	16
Number of rings	5	5	5	3	4	6	5	6	4	6	4	6	4	6	4	6	4

- 3.3 Minimum range 15 m (FR-1908V-BB), 20 m (FR-1918V-BB)
- 3.4 Range discrimination 15 m (FR-1908V-BB), 20 m (FR-1918V-BB)
- 3.5 Range accuracy 1.5% of range or 5 m, whichever is the greater
- 3.6 Bearing accuracy $\pm 0.5^\circ$
- 3.7 Echo trail
 - River mode Off/1.25/2.5/5 sec. (relative/true*)
 - Sea mode Off/5/15/30 sec., 1/3/6 min. (relative/true*)
- 3.8 Off-center 0/20/40/60 %
- 3.9 Radar map* Available (mark: 5,000 points)
- 3.10 Target tracking** (TT) 100 targets
- 3.11 AIS 300 targets

*: compass and L/L data required. **: compass and speed data required.

4 INTERFACE

- 4.1 Data format IEC61162-1/2 Ver.1.5/2.0/3.0/4.0: 2 ports (heading, AIS)
IEC61162-1 Ver.1.5/2.0/3.0/4.0: 4 ports (speed, L/L, others)
- 4.2 Data sentences
 - Input ALR, DBS, DBT, DPT, DTM, GBS, GGA, GLL, GNS, HDT, HTD, MWV, RMC, ROT, RSA, THS, VDM, VDO, VHW, VTG, VWR, VWT, ZDA
 - Output TTM
- 4.3 Radar signal output 1 port (HD, BP, Trg, Video)
- 4.4 Ethernet 1 port (for maintenance)
- 4.5 USB port 2 ports for control monitor brilliance
- 4.6 Picture data output DVI-D, RGB
- 4.7 SD card slot 2 slots, SD/SDHC

5 POWER SUPPLY

- 5.1 Processor unit 24 VDC: 3.9 A (FR-1908V-BB), 5.0 A (FR-1918V-BB)
- 5.2 Rectifier (RU-1746B-2, option) 100-115/220-230 VAC, 1 phase, 50/60Hz

6 ENVIRONMENTAL CONDITIONS

- 6.1 Ambient temperature
 - Antenna unit -25°C to +55°C (storage: -25°C to +70°C)
 - Processor unit -15°C to +55°C
- 6.2 Relative humidity 93% or less at +40°C
- 6.3 Degree of protection
 - Antenna unit IP46
 - Processor unit IP20
 - Control unit IP22
- 6.4 Vibration IEC 60945 Ed.4

7 UNIT COLOR

- 7.1 Antenna unit N9.5
- 7.2 Processor/Control unit N2.5

8 COMPASS SAFE DISTANCE

- 8.1 Processor unit Standard: 0.70 m, Steering: 0.40 m
- 8.2 Control unit Standard: 0.60 m, Steering: 0.35 m

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