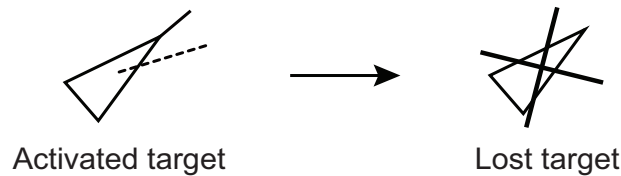# 3.7 Lost Target

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.


Activated target   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.
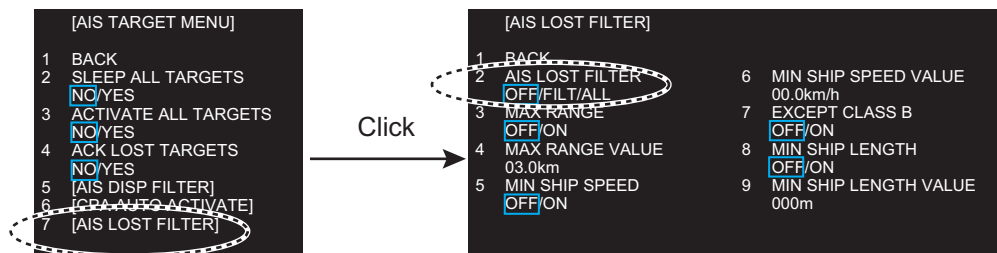
4. Click the target alarm to enable.
   [OFF]: Disable the alarm.
   [FILT]: Get the alarm against the targets whose criteria meet the settings on the [AIS LOST FILTER] menu.
   [ALL]: Get the alarm against all lost targets.

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.
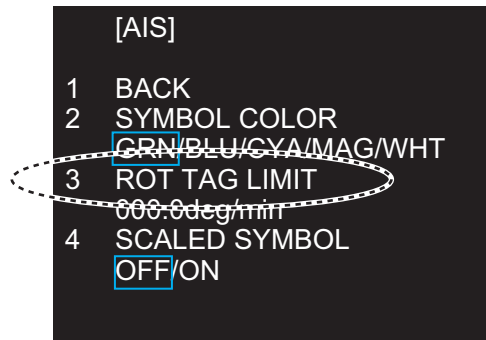
3.7.2 How to acknowledge a lost target

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].

```
        [AIS]

    1   BACK
    2   SYMBOL COLOR
        GRN/BLU/CYA/MAG/WHT
    3   ROT TAG LIMIT
        000.0deg/min
    4   SCALED SYMBOL
        OFF/ON
```

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.

Ship turning to starboard
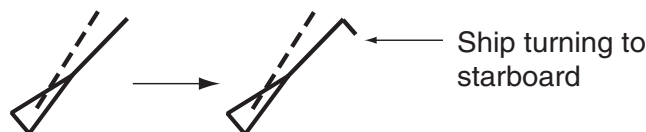
3.9   CPA/TCPA Alarm

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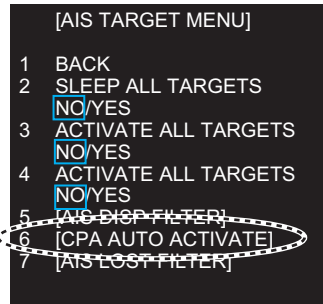
The reference point for CPA, TCPA calculation may be selected from antenna position or conning position.

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].

```
        [AIS TARGET MENU]

   1    BACK
   2    SLEEP ALL TARGETS
        NO/YES
   3    ACTIVATE ALL TARGETS
        NO/YES
   4    ACTIVATE ALL TARGETS
        NO/YES
   5    [AIS DISP FILTER]
   6    [CPA AUTO ACTIVATE]
   7    [AIS LOST FILTER]
```

3. Click [CPA AUTO ACTIVATE].

```
   [CPA AUTO ACTIVATE]

   1   BACK
   2   CPA AUTO ACTIVATE        6   MIN SHIP SPEED VALUE
       OFF/FILT/ALL                 00.0km/h
   3   MAX RANGE                7   EXCEPT CLASS B
       OFF/ON                       OFF/ON
   4   MAX RANGE VALUE          8   MIN SHIP LENGTH
       03.0km                       OFF/ON
   5   MIN SHIP SPEED           9   MIN SHIP LENGTH VALUE
       OFF/ON                       000m
```

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
```
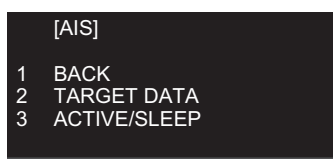
[AIS INFO] window

[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.

```
[AIS]

1   BACK
2   TARGET DATA
3   ACTIVE/SLEEP
```
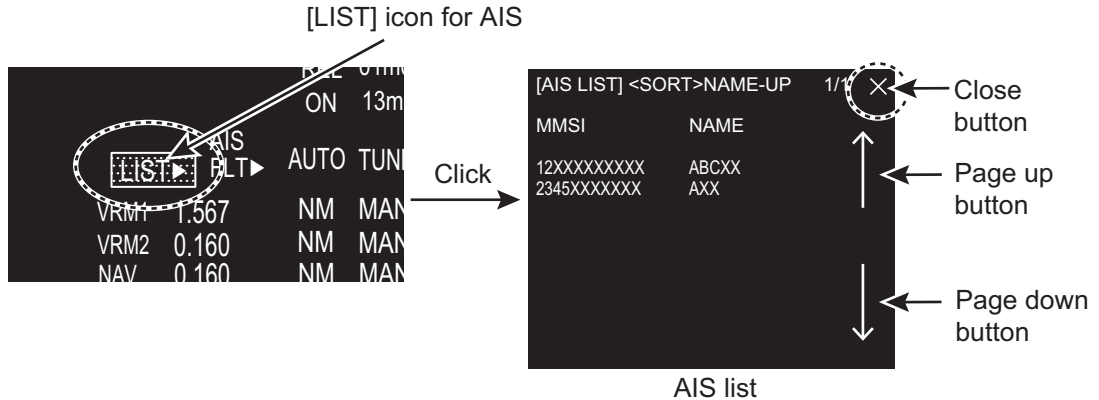
2. Click [TARGET DATA] to show the [AIS INFO] window.

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.
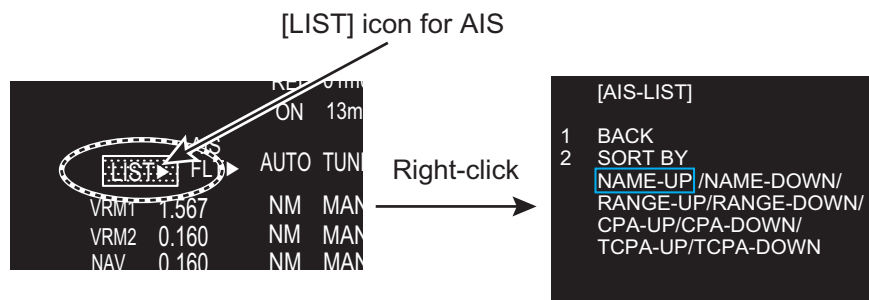
2. Click [SORT BY].

3. Click the sorting method desired.
   [NAME-UP], [NAME-DOWN]: Sort by name
   [RANEG-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.

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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.
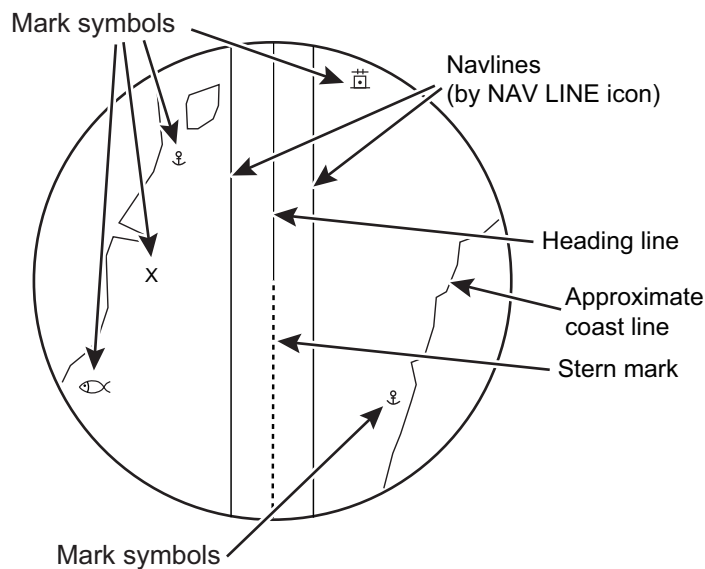
4.2 [MARK] icon

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.
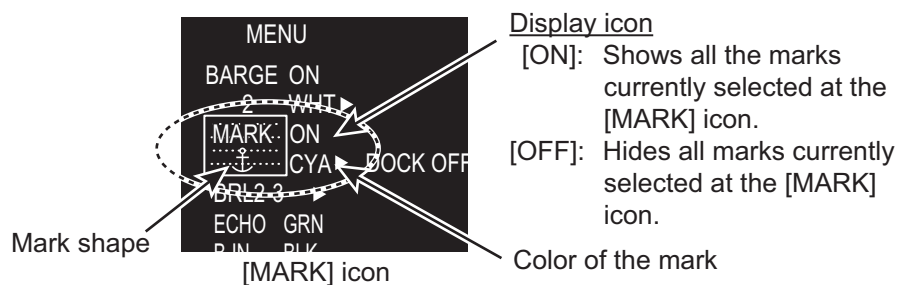
4.3 How to Enter Marks, Lines

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.

```
MENU
BARGE  ON
   2    WHT ▶
MARK   ON
  ⚓  [CYA]▶ DO
BRL2 3
ECHO   GRN
R-IN   BLK
```
→ Mark color icon
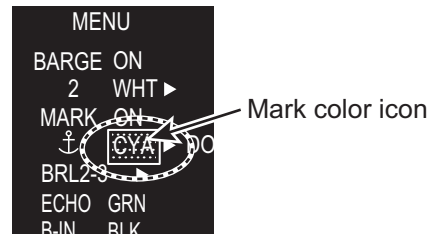
2. Highlighting the [MARK] icon then rotate the setting knob to select a mark.

```
MENU
BARGE  ON
   2    WHT ▶
MARK   DEE
  ⚓   CYA▶ DO
BRL2 3      ▶
ECHO   GRN
R-IN   BLK
```
→ [MARK] icon
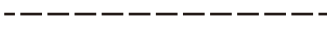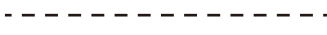
3. Press the left button on the appropriate mark to decide the mark (or line) shape.

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.

```
[MARK ICON]

1   BACK
2   [CREATE]
3   OWN SHIP
```
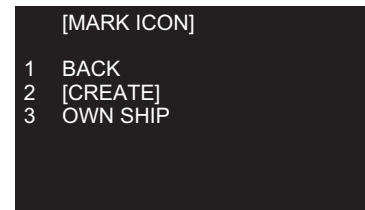
2. Click [CREATE] to show the [CREATE] window.

```
[CREATE]

1   BACK
2   ENTER BY LL
       00°00. 000 N
      000°00. 000 E
3   CREATE
```
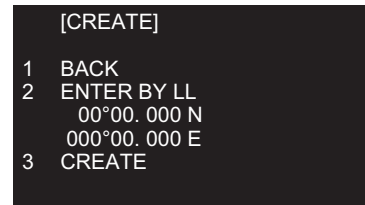
3. Click [ENTER BY LL].

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.

```
[MARK/LINE INFO]

1   BACK
2   MARK/LINE INFO
    CURRENT NUMBER:100
    TOTAL CAPACITY:5000
```
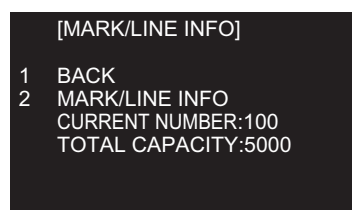
4.5 How to Show, Hide Marks on the Screen

By menu icon

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

Display icon: [ON]

Click

Display icon: [OFF]
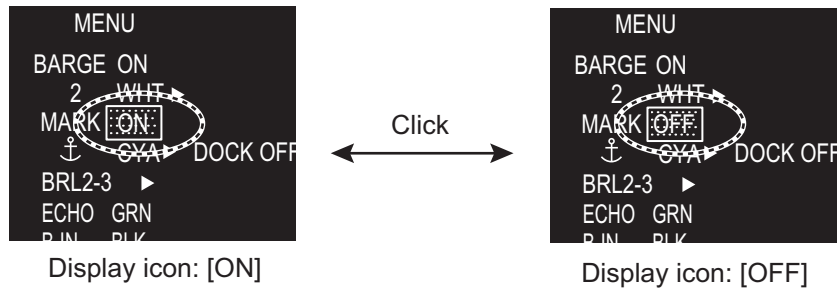
By [DISPLAY] menu

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].
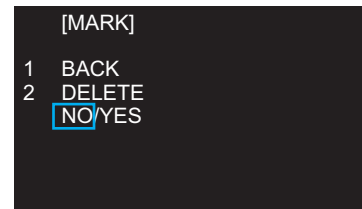
How to delete marks, lines by color, shape

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

2. Click [DATA DELETE].

3. Click [MARK/LINE DELETE].

```
[MARK/LINE DELETE]

1  BACK
2  [SHAPE DELETE]
3  [COLOR DELETE]
4  MARK/LINE ALL DELETE
   NO/YES
```
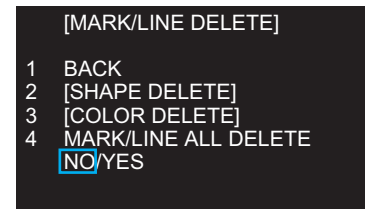
4. Click the sort to delete.
   [SHAPE DELETE]: Select the shape to delete then
   select [YES] in [DELETE].
   [COLOR DELETE]: Select the color to delete then select [YES] in [DELETE].

5. Click [DELETE].

6. Click [YES].

7. Click outside the menu window to close the menu.

How to delete all marks, lines

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

2. Click [DATA DELETE].

3. Click [MARK/LINE DELETE].

4. Click [MARK/LINE ALL DELETE].

5. Click [YES].

6. 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.

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

```
[RADAR MAP]
1  BACK
2  MAP ALIGN
   OFF/ON
3  [MARK/LINE INFO]
4  [DATA DELETE]
```
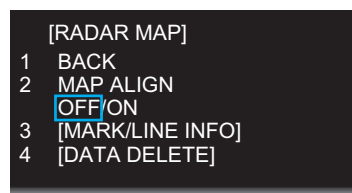
2. Click [MAP ALIGN].

3. 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.

4. Click anywhere in the radar display to complete the alignment.

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5. MAINTENANCE, TROUBLE-SHOOTING

⚠ 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.

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.

NOTICE

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.

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 radiator with a freshwater-moistened cloth. The radiator is made of fiber-glass reinforced plastic. Therefore, do not used 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   Parts Replacement

Fuse

The fuse in the processor unit protects the equipment from overcurrent and equipment fault. If the fuse blows, find the cause before you replace the fuse. Use the correct fuse. A wrong fuse can damage the equipment.

⚠ 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

Magnetron

The magnetron gradually deteriorates over time. When long distance sensitivity decreases greatly, request replacement of the magnetron.

Model	Magnetron Type	Code No.	Estimated life
FR-1908V-BB	MAF1611B, X-band, 4 kW	—	Approx. 3,000 hours

Other consumable parts

Parts	Type	Estimated life
Motor	D8G-516 (26 rpm)	Approx. 10,000 hours
Carbon Brush	S755123-1A-02	Approx. 2,000 hours

5.3 Diagnostic Test

5.3.1 Self Test

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

```
[MAIN MENU]

1   BACK                    9   [CAPTURE]
2   [ECHO]                 10   [CONFIGURATION]
3   [DISPLAY]              11   [ALARM]
4   [MARK]                 12   [TT•AIS]**

6   [RADAR MAP]*
7   [NAV DATA]
8   [FILES]
```

*: [RIVER] mode only
**: [SEA] mode only

```
[CONFIGURATION]

1   BACK
2   [OPERATION]
3   [FUNCTION KEY]
4   [TEST]
```

```
[TEST]

1   BACK
2   SELF TEST
3   [SENTENCE MONITOR]
```
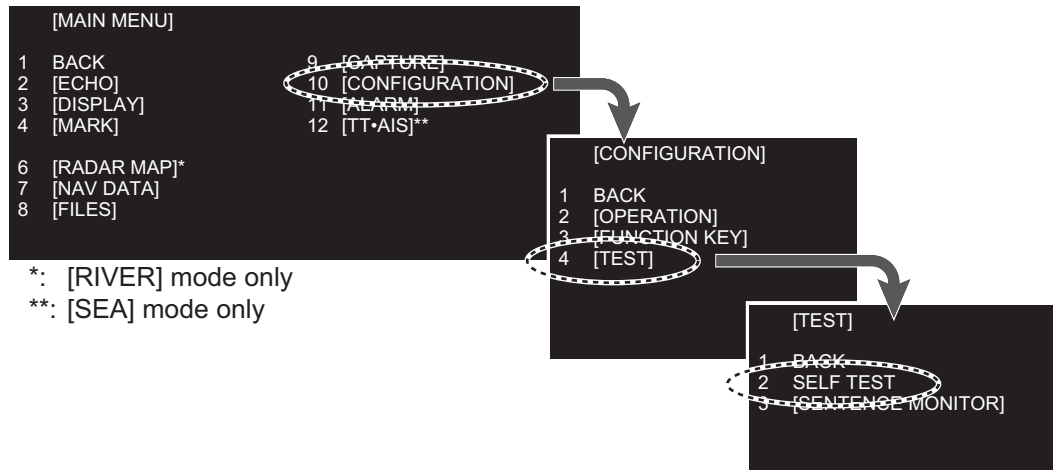
1. Open [MAIN MENU], click [CONFIGURATION].

2. Click [TEST].

3. Click [SELF TEST]. Test results of mother board, control unit and processor unit are displayed. Items 5 to 10 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.

5.3.2 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
```
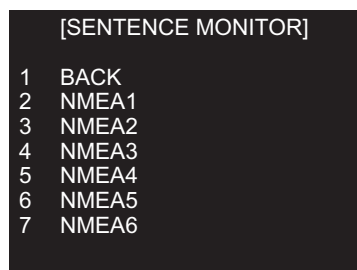
4. Click the item to display. Each item refers to the external equipment connection port in the processor unit.

5. To close the window, click the close button (×).

6. Click outside the menu window to close the menu.

5.4 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-190RH.
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.

5.5   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.

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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 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

MAIN MENU
```
├─ 1  BACK*
├─ 2  ECHO ──────┬─ 1  BACK                         *:   [SEA] mode only
│                 ├─ 2  TUNE INITIALIZE             ***: [RIVER] mode only
│                 ├─ 3  STC PRESET (OFF, ON)
│                 └─ 4  FTC PRESET (OFF, ON)
│
├─ 3  DISPLAY ───┬─ 1  BACK
│                 ├─ 2  TRANSPARENCY (OFF, ON)
│                 ├─ 3  DOCKING MODE (OFF, ON)
│                 ├─ 4  OWN SHIP MARK (OFF, ON)
│                 ├─ 5  MENU ──────┬─ 1  BACK
│                 │                 ├─ 2  AUTO-CLOSING* (OFF, ON)
│                 │                 └─ 3  AUTO-CLOSING TIME* (5sec, 10sec, 20sec)
│                 │
│                 ├─ 6  HIDDEN ICON
│                 │    ┌───────────────────────────────────────────────────────────────────┐
│                 │    │ 1  BACK              5  MODE (OFF, ON)     10  ECHO (OFF, ON)      │
│                 │    │ 2  AUTO-HIDDEN (OFF, ON)  6  NAV DATA (OFF, ON)  11  GAIN/STC/RAIN (OFF, ON)│
│                 │    │ 3  AUTO-HIDEN TIME   7  MARK (OFF, ON)     12  EBL/VRM (OFF, ON)   │
│                 │    │    (5sec, 10sec, 20sec)  8  BRILL/COLOR (OFF, ON)  13  DOCKING (OFF, ON)│
│                 │    │ 4  RANGE (OFF, ON)   9  TT/AIS (OFF, ON)                           │
│                 │    └───────────────────────────────────────────────────────────────────┘
│                 ├─ 7  MARK/LINE*** (OFF, ON)
│                 ├─ 8  BARGE*** (OFF, ON)
│                 └─ 9  ECHO AREA* (CIRCLE, WIDE)
│
├─ 4  MARK ──────┬─ 1  BACK
│                 ├─ 2  OWN SHIP MARK (MIN, RECTANGLE, PENTAGON)
│                 ├─ 3  STERN MARK (OFF, ON)
│                 ├─ 4  EBL OFFSET BASE* (STAB GND, STAB HDG, STAB NORTH)
│                 └─ 5  VRM SYNC OFFSET EBL* (OFF, ON)
│
└─ 6  RADAR MAP*** ───┬─ 1  BACK
                       ├─ 2  MAP ALIGN (OFF, ON)
                       ├─ 3  MARK/LINE INFO ──┬─ 1  BACK
                       │                       └─ 2  MARK/LINE INFO
                       │                           (CURRENT NUMBER,
                       │                            TOTAL CAPACITY: 5000)
                       └─ 4  DATA DELETE
                            ├─ 1  BACK
                            ├─ 2  MARK/LINE DELETE
                            │    ├─ 1  BACK
                            │    ├─ 2  SHAPE DELETE ──┬─ 1  BACK
                            │    │                     ├─ 2  SHAPE (Select one)
                            │    │                     └─ 3  DELETE (NO, YES)
                            │    ├─ 3  COLOR DELETE ──┬─ 1  BACK
                            │    │                     ├─ 2  COLOR
                            │    │                     │    (GRN, BLU, YEL, CYA,
                            │    │                     │     MAG, WHT)
                            │    │                     └─ 3  DELETE (NO, YES)
                            │    └─ 4  MARK/LINE ALL DELETE (NO, YES)
                            └─ 3  BARGE DELETE ──┬─ 1  BACK
                                                  ├─ 2  COLOR (GRN, BLU, YEL, CYA,
                                                  │          MAG, WHT)
                                                  └─ 3  BARGE ALL DELETE (NO, YES)

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①

*: [SEA] mode only
***: [RIVER] mode only

- 7 NAV DATA
  - 1 BACK
  - 2 PREDICTION
    - 1 BACK
    - 2 OWN SHIP POSITION (*DUAL-GPS*, SC)
  - 3 DEPTH
    - 1 BACK
    - 2 GRAPH TYPE (*NUMERICAL*, GRAPHICAL)
    - 3 DUAL SENSOR (*BOTH*, FRONT, AFT)
    - 4 DEPTH SCALE
      - 1 BACK
      - 2 SCALE TYPE (*RIVER*, SEA)
      - 3 RIVER (*4*, 10, 40)
      - 4 SEA (10, 20, 50, *100*, 200, 500)
    - 5 TIME SCALE (15sec, 30sec, *1min*, 3min)
    - 6 DEPTH ALARM VALUE (0.00 - 9.99 m, *5.00*)
  - 4 WIND
    - 1 BACK
    - 2 WIND DIRECTION (*OFF*, COME FROM, GO TO)
  - 5 ROT SCALE (30deg, *90deg*, 300deg)
  - 6 RUDDER SCALE (30deg, *90deg*, 120deg, 180deg)

- 8 FILES
  (available in stand-by mode only)
  - 1 BACK
  - 2 DRIVE SELECT (*SD-1*, SD-2)
  - 3 DRIVE INFO
    - 1 BACK
    - 2 DRIVE INFO (USED, AVAILABLE)
  - 4 SAVE DATA
    - 1 BACK
    - 2 MARK/LINE*** (1 BACK, 2 NAME)
    - 3 SETTING DATA (1 BACK, 2 NAME)
    - 4 INSTALL DATA**
    - 5 ALARM HISTORY (1 BACK, 2 NAME)
    - 6 LOG FILE (1 BACK, 2 NAME)
  - 5 REPLAY (READ) DATA
    - 1 BACK
    - 2 MARK/LINE*** (1 BACK, 2 NAME)
    - 3 SETTING DATA (1 BACK, 2 NAME)
    - 4 INSTALL DATA**
  - 6 DELETE DATA
    - 1 BACK
    - 2 MARK/LINE*** (1 BACK, 2 NAME)
    - 3 SETTING DATA (1 BACK, 2 NAME)
    - 4 INSTALL DATA**
    - 5 ALARM HISTORY (1 BACK, 2 NAME)
    - 6 LOG FILE (1 BACK, 2 NAME)
  - 7 REMOVE EXTERNAL MEDIA (SD-1, SD-2)

**: For service menu

- 9 CAPTURE
  (available in stand-by mode only)
  - 1 BACK
  - 2 DRIVE SELECT (SD-1, *SD-2*)
  - 3 DRIVE INFO
    - 1 BACK
    - 2 DRIVE INFO (THE NUMBER OF FILES, USED, AVAILABLE)
  - 4 AUTO CAPTURE
    - 1 BACK
    - 2 AUTO CAPTURE (*OFF*, ON)
    - 3 INTERVAL (1 to 999 min, *1*)
  - 5 DELETE CAPTURE DATA
    - 1 BACK
    - 2 MANUAL DATA (1 BACK(LONG=TOP), 2 DELETE)
    - 3 AUTO(FAST) DATA (1 BACK(LONG=TOP), 2 DELETE)
    - 4 AUTO(NORMAL) DATA (1 BACK(LONG=TOP), 2 DELETE)
  - 6 REMOVE EXTERNAL MEDIA (SD-1, SD-2)

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— 10 CONFIGURATION ─┬─ 1 BACK
                  ├─ 2 OPERATION ─┬─ 1 BACK
                                    ├─ 2 REF POINT (ANT, *CCRP*)
                                    ├─ 3 KEY BEEP (OFF, LOW, *MID*, HIGH)
                                    ├─ 4 OWN SHIP VECTOR (*OFF*, COURSE, HDG)
                                    ├─ 5 CURSOR SIZE (*SMALL*, LARGE)
                                    ├─ 6 GUIDANCE (OFF, *ON*)
                                    ├─ 7 TOUCH PAD ─┬─ 1 BACK
                                                        ├─ 2 TOUCH-PAD (OFF, *ON*)
                                                   └─ 3 SENSITIVITY (1, 2, *3*, 4, 5)
                                    └─ 8 POINTING-DEVICE ─┬─ 1 BACK
                                                              ├─ 2 POINTING-DEVICE (OFF, *ON*)
                                                              └─ 3 SENSITIVITY (1, 2, *3*, 4, 5)

├─ 3 FUNCTION KEY

├─ 1 BACK
├─ 2 F1 ─┬─ 1 BACK
        ├─ 2 ECHO

*: [SEA] mode only
***: [RIVER] mode only

├─ 1 BACK
└─ 2 CUSTOM-MENU, FTC, IR, ES, EAV, AUTO-GAIN, AUTO-STC, AUTO-RAIN, TUNE SELECT, TRAIL DISPLAY, TRAIL TIME, TRAIL T/R, WIPER

├─ 3 *STD KEY*

├─ 1 BACK
└─ 2 ALARM ACK, EBL OFFSET, OPERATION MODE, *ORIENTATION-MODE*, CU-TM RESET*, VECTOR TIME, VECTOR MODE, TT-LIST*, AIS-LIST, BRILL-MENU, MARK***, CAPTURE

├─ 4 TT•AIS

├─ 1 BACK
└─ 2 TT-DISP*, AIS-DISP, PAST POSN INTERVAL, REF MARK*, CPA LIMIT, CPA, TCPA, AZ1*, AZ2*, AIS SCALED SYMBOL

├─ 5 OPERATION

├─ 1 BACK
└─ 2 ECHO COLOR, MONITOR BRILL, PANEL DIMMER, TRANSPARENCY, ALARM1*, ALARM2*, ECHO AREA*, DOCKING, MARK/LINE-ON***, BARGE-ON***, MAP ALIGN***, MARK/LINE ALL DELETE***, BARGE ALL DELETE***

├─ 6 BRILL ─┬─ 1 BACK
          ├─ 2 USER NAME 1 (BRL1-1 - BRL1-4)
          ├─ 3 USER NAME 2 (BRL2-1 - BRL2-4)
          ├─ 4 USER NAME 3 (BRL3-1 - BRL3-4)
          └─ 5 USER NAME 4 (BRL4-1 - BRL4-4)

└─ 7 CUSTOM ─┬─ 1 BACK
            ├─ 2 USER NAME 1 (CUSTOM1-1 - CUSTOM1-4)
            ├─ 3 USER NAME 2 (CUSTOM2-1 - CUSTOM2-4)
            ├─ 4 USER NAME 3 (CUSTOM3-1 - CUSTOM3-4)
            └─ 5 USER NAME 4 (CUSTOM4-1 - CUSTOM4-4)

└─ 3 F2 (Same as [F1], Default: [DOCKING])

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③   ④

    └─ 4 TEST ─┬─ 1 BACK
               ├─ 2 SELF TEST
               └─ 3 SENTENCE MONITOR ─┬─ 1 BACK
                                       ├─ 2 NMEA1
                                       ├─ 3 NMEA2
                                       ├─ 4 NMEA3
                                       ├─ 5 NMEA4
                                       ├─ 6 NMEA5
                                       └─ 7 NMEA6

        *: [SEA] mode only

─ 11 ALARM ─┬─ 1 BACK
             ├─ 2 TT•AIS ─┬─ 1 BACK
    (Protected as   └─ 2 CPA LIMIT ─┬─ 1 BACK
    [SERVICE   ├─ 2 CPA LIMIT (*OFF*, ON)
    MENU] in   ├─ 3 RANGE (0.1 - 24 NM, *1 NM*)
    [RIVER] mode)   └─ 4 TIME (30sec, 1-15min, *1min*)

             └─ 3 TARGET ─┬─ 1 BACK
                  ALARM*   ├─ 2 ALR1 MODE (*IN*, OUT)
                           ├─ 3 ALR2 MODE (*IN*, OUT)
                           └─ 4 LEVEL (1, *2*, 3, 4)

─ 12 TT•AIS ─┬─ 1 BACK
              ├─ 2 VECTOR ─┬─ 1 BACK
    (Protected as   ├─ 2 VECTOR MODE
    [SERVICE   │   (Ground-Stab: VECTOR REL, *VECTOR T-G*
    MENU] in   │   Sea-Stab: VECTOR REL, *VECTOR T-S*
    [RIVER] mode)   └─ 3 VECTOR TIME (30sec, 1 - 6min, *1min*)

              ├─ 3 PAST POSN ─┬─ 1 BACK
              │   ├─ 2 INTERVAL (*OFF*, 0.5 min, 1 min, 2 min, 3 min, 6 min)
              │   └─ 3 POINTS (5, *10*)

              ├─ 4 SYMBOL ─┬─ 1 BACK
              │   ├─ 2 AIS ─┬─ 1 BACK
              │   │   ├─ 2 SYMBOL COLOR (*GRN*, BLU, CYA, MAG, WHT)
              │   │   ├─ 3 ROT TAG LIMIT
              │   │   │   (000.1 - 720.0 deg/min, *000.1 deg/min*)
              │   │   └─ 4 SCALED SYMBOL (*OFF*, ON)
              │   │
              │   └─ 3 TT* ─┬─ 1 BACK
              │   └─ 2 SYMBOL COLOR (*GRN*, BLU, CYA, MAG, WHT)
              │
              └─ 5 ACUQIRE ZONE* ─┬─ 1 BACK
                                   ├─ 2 AZ STAB (STAB NORTH, *STAB HEADING*)
                                   └─ 3 POLYGON STAB (OFF, STAB GND, STAB NORTH,
                                                      STAB HEADING)

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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 - 59.59999)
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,llll.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,llll.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,llll.lll,a,IIIII.III,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

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HDT : Heading True

$**HDT,xxx.x,T*hh<CR><LF>
        1 2

1. Heading, degrees (0.00 to 360.00)
2. True (T)

HTD : Heading/Track control data

$**HTD,A,x.x,a,a,a,x.x,x.x,x.x,x.x,x.x,x.x,a,A,A,A,x.x*hh<CR><LF>
     1 2 3 4 5 6 7 8 9 10 11 12 13 141516 17

1. Override, A = in use, V = not in use
2. Commanded rudder angle, degrees
3. Commanded rudder direction, L/R = port/starboard
4. Selected steering mode
5. Turn mode R = radius controlled
          T = turn rate controlled
          N = turn is not controlled
6. Commanded rudder limit, degrees (unsigned)
7. Commanded off-heading limit, degrees (unsigned)
8. Commanded radius of turn for heading changes, n.miles
9. Commanded rate of turn to heading changes, deg/min
10. Commanded heading-to-steer, degrees
11. Commanded off-track limit, n.miles (unsigned)
12. Commanded track, degrees
13. Heading reference in use, T/M
14. Rudder status (A = within limits, V = limit reached or exceeded)
15. Off-heading status (A = within limits, V = limit reached or exceeded)
16. Off-track status (A = within limits, V = limit reached or exceeded)
17. Vessel heading, degrees

MWV : Wind Speed and Angle

$**MWV,x.x,a,x.x,a,A*hh<CR><LF>
       1 2 3 4 5

1. Wind angle, degrees (0 - 350)
2. Reference (R/T)
3. Wind speed (0.00 - 9999.99)
4. Wind speed units (K=km/h M=m/s N=nm)
5. Status (A=Valid V=Not valid)

RMC : Recommended Minimum Specific GNSS Data

$GPRMC,hhmmss.ss,A,llll.ll,a,yyyyy.yy,a,x.x,x.x,ddmmyy,x.x,a,a,a*hh<CR><LF>
           1   2 3 4   5   6 7 8   9   10 11 1213

1. UTC of position fix (000000 - 235959)
2. Status (A=data valid, V=navigation receiver warning)
3. Latitude (0.0000 - 9000.0000)
4. N/S
5. Longitude (0.0000 - 18000.0000)
6. E/W
7. Speed over ground, knots (0.0 - 9999.9)
8. Course over ground, degrees true (0.0 - 359.0)
9. Date (010100 - 311299)
10. Magnetic variation, degrees E/W (0.0 - 180.0/NULL)
11. E/W
12. Mode indicator (A= Autonomous   D= Differential mode E=Estimated (dead reckoning) mode)
    M=Manual input mode S= Simulator N=Data not valid)
13. Navigational status indication

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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)

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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)

AP-11

SPECIFICATIONS OF RIVER RADAR
FR-1908V-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	7 ft (XN20AF), 8 ft (XN24AF)
1.5	Horizontal beam width	
	-3dB	1.12° (XN20AF) 0.95° (XN24AF)
	-20dB	2.84° (XN20AF), 2.5° (XN24AF)
1.6	Vertical beam width	25° (-3dB)
1.7	Sidelobe attenuation	-26 dB or less (within ±10° of main-lobe)
		-32 dB or less (outside ±10° of main-lobe)
1.8	Antenna gain	31 dB (XN24AF), 30.0 dB (XN21AF)
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	4 kW nominal
2.4	Range, Pulselength, Pulse Repetition Rate (PRR)	

River mode

	Range (SM)	Pulselength (μs)	PRR (Hz)
S	0.125 to 2	0.04	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 (μs)	PRR (Hz)
S	0.125 to 2	0.04	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 (μs)	PRR (Hz)
S	0.125 to 4	0.04	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
3.4	Range discrimination	15 m
3.5	Range accuracy	1.5% of range or 5 m, whichever is the greater
3.6	Bearing accuracy	±0.5°
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	OSD, RSD, TTM
4.3	Radar signal output	1 port (HD, BP, Trg, Video)
4.4	Ethernet	100Base-TX, UTP (CAT5e)
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

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

FURUNO

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