CE 0191

KODEN

INSTALLATION MANUAL

MARINE RADAR

MDC-2900

SERIES

This product is specifically designed to be installed on boats and other means of maritime transport. If your country forms part to the EU, please contact your dealer for advice before attempting to install elsewhere.

MDC-2900.SER.IM.E 0092629012-07

MDC-2900 Series Installation Manual

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When part of the document needs to be revised, the document has advanced revision number.

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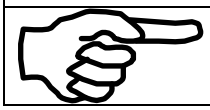
For Your Safe Operation

Symbol used in this Installation Manual

This manual uses the following symbols. Understand the meaning of each symbol and implement the maintenance and inspection.

Symbol	Meaning
	**Mark for warning** This symbol denotes that there is a risk of death or serious injury when not dealing with it correctly.
	**Mark for danger high voltage** This symbol denotes that there is a risk of death or serious injury caused by electric shock when not dealing with it correctly.
	**Mark for caution** This symbol denotes that there is a risk of slight injury or damage of device when not dealing with it correctly.
	**Mark for prohibition** This symbol denotes prohibition of the specified conduct. Description of the prohibition is displayed near the mark.
IMPORTANT	**Mark for important matters** This mark denotes that there is a possibility that data loss may interfere the operation or that the expected result may not be obtained when the radar is not dealt correctly.
	**Mark for reference** This mark shows the part to be referred to concerning this description.

Caution Item on Equipment

	**Caution on a high voltage inside.** A high voltage, which may risk your life, is used. This high voltage remains in the circuit after you have powered off switch. To prevent touching the high voltage circuit inadvertently, the protective cover is provided to the high voltage circuit and the high voltage caution label is affixed. Ensure to power off switch for your safety and discharge the electricity remaining in the capacitor before starting to check. An engineer authorized by our company should inspect and maintain the circuit.
 **Warning**	**Be sure to switch off the power in the boat.** If the power switch is inadvertently powered on during work, you will be electrified. To prevent such accident from occurring, ensure to switch off the power in the boat and the power of equipment. Furthermore, it is safer to hang the caution tag with description of [Under Work] near the power switch of equipment.
 **Warning**	**Caution on dust** Inhaling dust may cause A respiratory disease. When cleaning the inside of equipment, be careful not to inhale dust. Wearing a safety mask is recommended.
 **Caution**	**Caution on location of equipment** Do not install the equipment where it is excessively damp and suffers from excessive water drops.
 **Caution**	**Caution on static electricity** The static electricity may be generated from the carpet on the floor in the cabin or clothes made of synthetic fiber. The static electricity may destroy the electronic parts on the circuit board. Handle the circuit board, taking the suitable anti-static measures.

Caution Item on Handling

Caution	**Caution on the rotating aerial** The radar antenna may start to rotate without notice. Please stand clear from the antenna for your safety.

Caution

Caution on electromagnetic disturbance

The operating Antenna & Scanner unit radiates high-energy electromagnetic wave. It may cause harmful effect for human body due to its continuous irradiation. As International regulation says, electromagnetic waves less than 100 watt/m^2 does not have a harmful effect on human bodies, but some kind of medical devices such as heart pacemakers are sensitive even under the low energy electromagnetic wave. Any personnel with such a device should keep away from the electromagnetic wave generating position at all times.

Specified power density and distance from the radar (in accordance with the provision as specified in IEC 60945)

Model name	Xmit power/ Antenna length	100W/m^2	50W/m^2	10W/m^2
MDC-2960	6kW / 4 feet Antenna	1.09m	1.55m	3.46m
MDC-2960BB	6kW / 6 feet Antenna	1.30m	1.84m	4.11m
MDC-2910	12kW / 4 feet Antenna	1.55m	2.19m	4.89m
MDC-2910BB	12kW / 6 feet Antenna	1.84m	2.60m	5.81m
MDC-2920	25kW / 4 feet Antenna	2.37m	3.36m	7.50m
MDC-2920BB	25kW / 6 feet Antenna	2.82m	3.99m	8.91m

 **Warning**	Do not disassemble or modify. It may lead to trouble, fire, smoking or electric shock. In case of trouble, contact our dealer or our company.
 **Warning**	In case of smoke or fire, switch off the power in the boat and the power of equipment. It may cause fire, electric shock or damage.
	**Caution on the remaining high voltage**. A high voltage may remain in the capacitor for several minutes after you have powered off. Before inspecting inside, wait at least 5 minutes after powering off or discharging the remaining electricity in an appropriate manner. Then, start the work.
 **Caution**	The information displayed in this unit is not provided directly for your navigation. For your navigation, be sure to see the specified material.
 **Caution**	Use the specified fuse. If un-specified fuse is used, it may cause a fire, smoke or damage.

Disposal of used cell and this radar

Warning	A high-energy density lithium ion cell is built in this radar. Improper disposal of a lithium ion cell is discouraged as the cell has a possibility of short-circuiting. If it gets wet, the generation of heat, explosion or ignition may occur resulting in an injury or a fire.

Treatment of the used lithium ion cell

To dispose of built-in lithium ion cell (CR-2032) in this radar, insulate each terminal with scotch tape, etc. and wrap in plastic bag, etc.

The disposal and collection rules may be different depending on each municipal district. Obey the directions of each district.

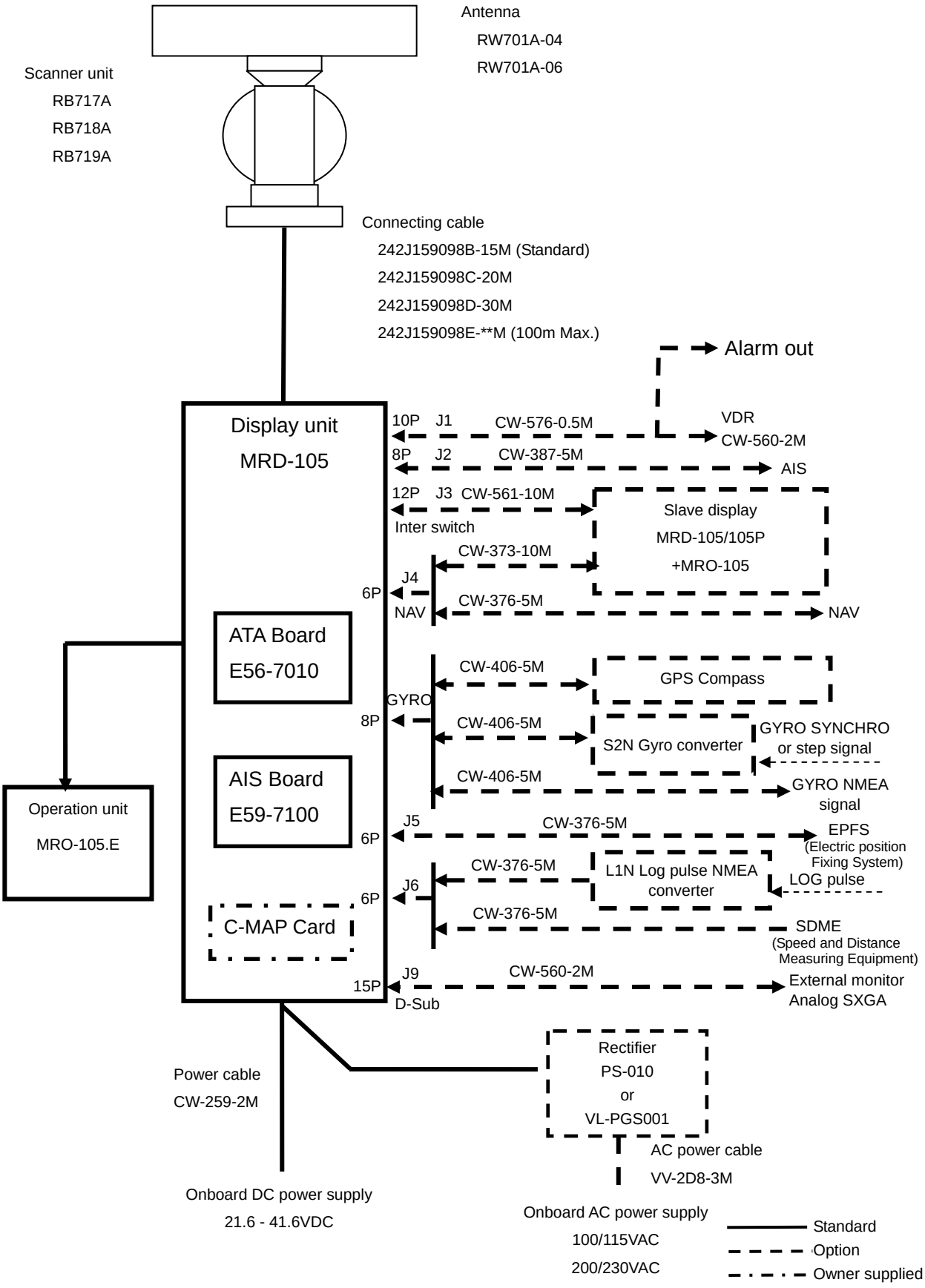
Disposal of this radar

This radar shall be disposed according to the municipal regulations or rules.

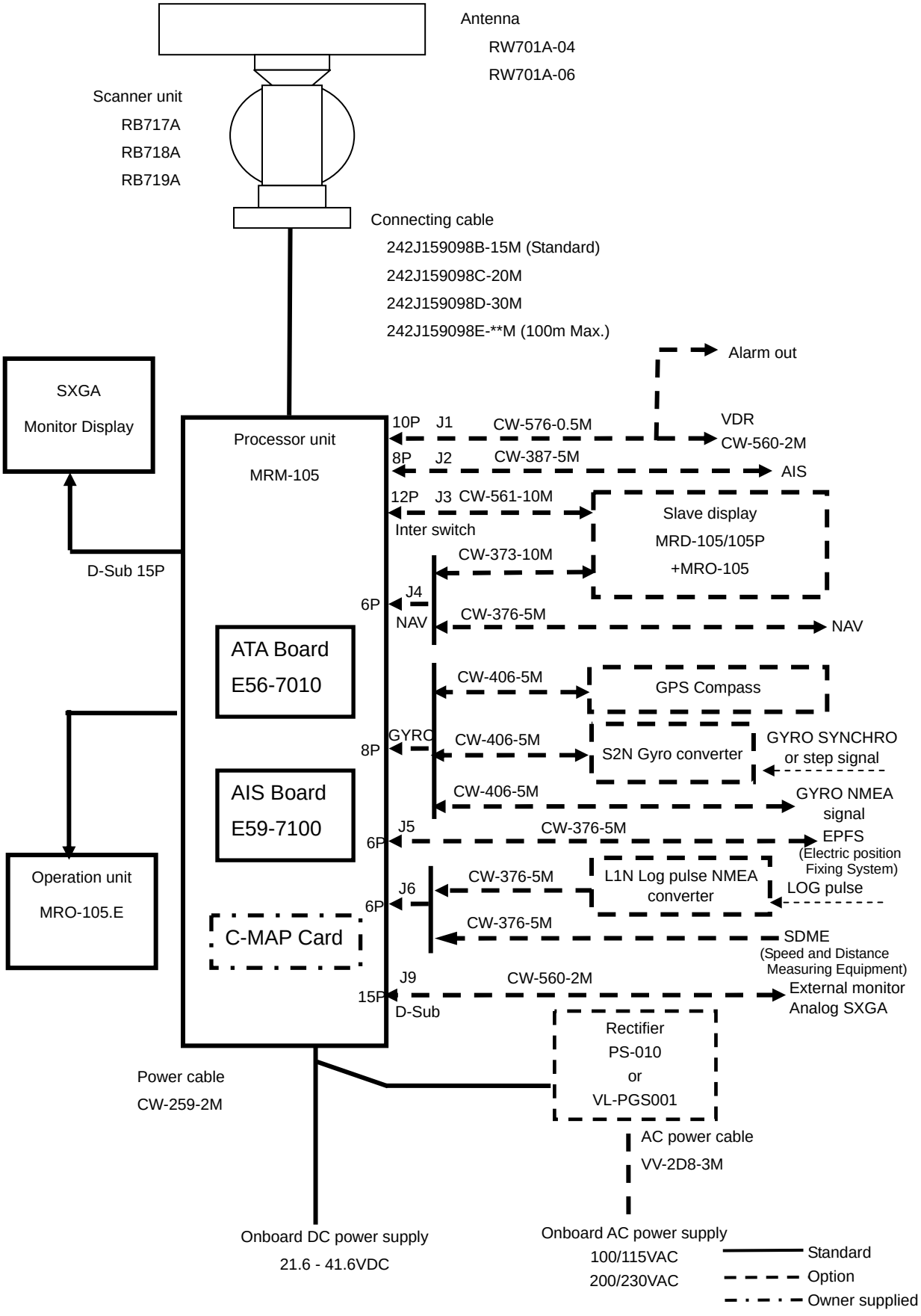
Contents

System Configuration

MDC-2960/2910/2920 series system configuration



MDC-2960BB/2910BB/2920BB series system configuration



Configuration Equipment

Standard configuration list

MDC-2960

No.	Name	Type	Comment	Weight/ Length	Quantity
1	Antenna	RW701A-04	4 ft	6 kg	1
		RW701A-06	6 ft	8 kg	
2	Scanner unit	RB717A	6 kW	17 kg	1
3	Display unit	MRD-105		15 kg	1
4	Operation unit	MRO-105		1.8 kg	1
5	Connecting cable	242J159098B-15M	With connectors on the both sides	15 m	1
6	Power cable	CW-259-2M	With a connector on the single side	2 m	1
7	Spare parts	SP-100	See spare parts list		1 set
8	Installation material	M12-BOLT.KIT	See installation material list		1 set
9	Cover	E59MC11160	Hard cover	0.5 kg	1
10	Document	MDC-2900.SER.OM.E	Operation manual		1
11	Document	MDC-2900.SER.IM.E	Installation manual		1
12	Document	MDC-2900.SER.QR.E	Quick Reference		1

MDC-2910

No.	Name	Type	Comment	Weight/ Length	Quantity
1	Antenna	RW701A-04	4 ft	6 kg	1
		RW701A-06	6 ft	8 kg	
2	Scanner unit	RB718A	12 kW	17 kg	1
3	Display unit	MRD-105		15 kg	1
4	Operation unit	MRO-105		1.8 kg	1
5	Connecting cable	242J159098B-15M	With connectors on the both sides	15 m	1
6	Power cable	CW-259-2M	With a connector on the single side	2 m	1
7	Spare parts	SP-100	See spare parts list		1 set
8	Installation material	M12-BOLT.KIT	See installation material list		1 set
9	Cover	E59MC11160	Hard cover	0.5 kg	1
10	Document	MDC-2900.SER.OM.E	Operation manual		1
11	Document	MDC-2900.SER.IM.E	Installation manual		1
12	Document	MDC-2900.SER.QR.E	Quick Reference		1

MDC-2920

No.	Name	Type	Comment	Weight/ Length	Quantity
1	Antenna	RW701A-04	4 ft	6kg	1
		RW701A-06	6 ft	8 kg	
2	Scanner unit	RB719A	25 kW	21 kg	1
3	Display unit	MRD-105		15 kg	1
4	Operation unit	MRO-105		1.8 kg	
5	Connecting cable	242J159098B-15M	With connectors on the both sides	15 m	1
6	Power cable	CW-259-2M	With a connector on the single side	2 m	1
7	Spare parts	SP-100	See spare parts list		1 set
8	Installation material	M12-BOLT.KIT	See installation material list		1 set
9	Cover	E59MC11160	Hard cover	0.5 kg	1
10	Document	MDC-2900.SER.OM.E	Operation manual		1
11	Document	MDC-2900.SER.IM.E	Installation manual		1
12	Document	MDC-2900.SER.QR.E	Quick Reference		1

MDC-2960BB

No.	Name	Type	Comment	Weight/ Length	Quantity
1	Antenna	RW701A-04	4 ft	6 kg	1
		RW701A-06	6 ft	8 kg	
2	Scanner unit	RB717A	6 kW	17 kg	1
3	Processor unit	MRM-105		12.4 kg	1
4	Operation unit	MRO-105		1.8 kg	
5	Connecting cable	242J159098B-15M	With connectors on the both sides	15 m	1
6	Power cable	CW-259-2M	With a connector on the single side	2 m	1
7	Spare parts	SP-100	See spare parts list		1 set
8	Installation material	M12-BOLT.KIT	See installation material list		1 set
9	Document	MDC-2900.SER.OM.E	Operation manual		1
10	Document	MDC-2900.SER.IM.E	Installation manual		1
11	Document	MDC-2900.SER.QR.E	Quick Reference		1

MDC-2910BB

No.	Name	Type	Comment	Weight/ Length	Quantity
1	Antenna	RW701A-04	4 ft	6 kg	1
		RW701A-06	6 ft	8 kg	
2	Scanner unit	RB718A	12 kW	17 kg	1
3	Processor unit	MRM-105		12.4 kg	1
4	Operation unit	MRO-105		1.8 kg	
5	Connecting cable	242J159098B-15M	With connectors on the both sides	15 m	1
6	Power cable	CW-259-2M	With a connector on the single side	2 m	1
7	Spare parts	SP-100	See spare parts list		1 set
8	Installation material	M12-BOLT.KIT	See installation material list		1 set
9	Document	MDC-2900.SER.OM.E	Operation manual		1
10	Document	MDC-2900.SER.IM.E	Installation manual		1
11	Document	MDC-2900.SER.QR.E	Quick Reference		1

MDC-2920BB

No.	Name	Type	Comment	Weight/ Length	Quantity
1	Antenna	RW701A-04	4 ft	6 kg	1
		RW701A-06	6 ft	8 kg	
2	Scanner unit	RB719A	25 kW	21 kg	1
3	Processor unit	MRM-105		12.4 kg	1
4	Operation unit	MRO-105		1.8 kg	
5	Connecting cable	242J159098B-15M	With connectors on the both sides	15 m	1
6	Power cable	CW-259-2M	With a connector on the single side	2 m	1
7	Spare parts	SP-100	See spare parts list		1 set
8	Installation material	M12-BOLT.KIT	See installation material list		1 set
9	Document	MDC-2900.SER.OM.E	Operation manual		1
10	Document	MDC-2900.SER.IM.E	Installation manual		1
11	Document	MDC-2900.SER.QR.E	Quick Reference		1

Spare parts list

SP-100

No.	Name	Specification	Comment	Type (Dimension)	Quantity	Usage
1	Fuse	F-1065-15A	Normal type	Tubular (·6.4 x 30)	1	Main power
2	Fuse	MF51NN250V5A	Normal type	Tubular (·5.2 x 20)	1	Motor power
3	Fuse	FGMB-A 250V0.5A	Normal type	Tubular (·5.2 x 20)	1	High voltage power supply
4	Carbon brush	24Z125209B			1 set	Antenna motor

Installation material list

M12-BOLT.KIT

No.	Name	Specification	Quantity	Usage
1	Hexagon bolt	B12X55U	4	Antenna unit
2	Nut	N12U	8	Antenna unit
3	Plain washer	2W12U	8	Antenna unit
4	Spring washer	SW12U	4	Antenna unit

Options

(Common)

No.	Name	Specification	Comment	Weight /Dimension /Quantity
1	Gyro converter	S2N, U/N 9028C	qwerty-electronik	
2	Log pulse NMEA converter	L1N, U/N 9181A	qwerty-electronik 200pulse/NM only	
3	Power rectifier unit	PS-010	5A fuse attached	3.5 kg
		VL-PGS001	VEINLAND GmbH 20A fuse attached	4.5kg
4	AC power cable	VV-2D8-3M	Without connectors on the both sides	3 m
5	Connecting cable	CW-373- select 5M or 10M,30M	With 6-pin water resistant connectors at both ends (cable for data)	5 m or 10 m, 30 m
		CW-374-5M	With a 6-pin connector and a 6-pin water resistant connector (cable for data)	5 m
		CW-406-5M	With a 8-pin water resistant connector and one end plain (cable for THD)	5 m
		CW-376-5M	With a 6-pin water resistant connector and one end plain (cable for data)	5 m
		CW-387-5M	With a 8-pin water resistant connector and one end plain (cable for AIS)	5 m
		CW-561- select 10M or 30M	With 12-pin water resistant connectors at both ends (connector for slave display)	10 m or 30 m
		CW-576-0.5M	With a 10-pin water resistant connector and D-Sub connector (RGB) +Alarm out	0.5 m
		CW-560-2M	With 15-pin water resistant D-Sub conectors at both ends (Cable for external display unit)	2m
6	Antenna-Scanner unit and Display unit connecting cable	242J159098C-20M	With connectors on the both sides	20 m
		242J159098D-30M	With connectors on the both sides	30 m
		242J159098E-XM	With connectors on the both sides	65 m Max. (Designated)

Chapter 1 Prior to installation

1.1 Installation precautions

In order to obtain the maximum performance of radar systems, this radar system should be installed by qualified engineers in charge of installation and maintenance. Installation procedures include the following:

(1) Unpacking of components;
(2) Inspection of composition units, spare parts, accessories and installation materials;
(3) Checking of supply voltage and current capacity;
(4) Selection of the location for installation;
(5) Installation of the Antenna-Scanner unit;
(6) Installation of the Display unit;
(7) Attachment of accessories;
(8) Planning and implementation of cable laying and connection;
(9) Coordination after installation.

1.2 Unpacking of components

Unpack components and check that all items correspond with the description of the packing list. When a discrepancy or damage has been found, please contact the transportation/insurance firm, and follow procedures for searching for loss items and claim of expense.

1.3 Appearance verification of each unit and accessories

Please check the appearance of each unit carefully, confirm that any dent and crack free. Moreover, please also check the interior of each unit and confirm that there is no electric or mechanical damage.

The illumination panel (back light) of the LCD module is made of glass. If the unit is dropped, damage may occur. Since the presence of damage might not be found by checking of the appearance, please confirm in the display screen after power turning on.

1.4 Selection of location for installation

In order to obtain the maximum performance of the units, it is necessary to install them in consideration of matters as described below.

1.4.1 Antenna-Scanner unit

(1) Blind sectors shall be kept to a minimum, and shall not be placed in an arc of the horizon from the right ahead direction to 22.5° abaft the beam and especially shall avoid the right ahead direction (relative bearing 000°). The installation of the Antenna shall be in such a manner that the performance of the radar system is not substantially degraded. The Antenna shall be mounted clear of any structure that may cause signal reflections, including other Antenna and deck structure or cargo. In addition, the height of the Antenna shall take account of target detection performance relating to range of first detection and target visibility in sea clutter.

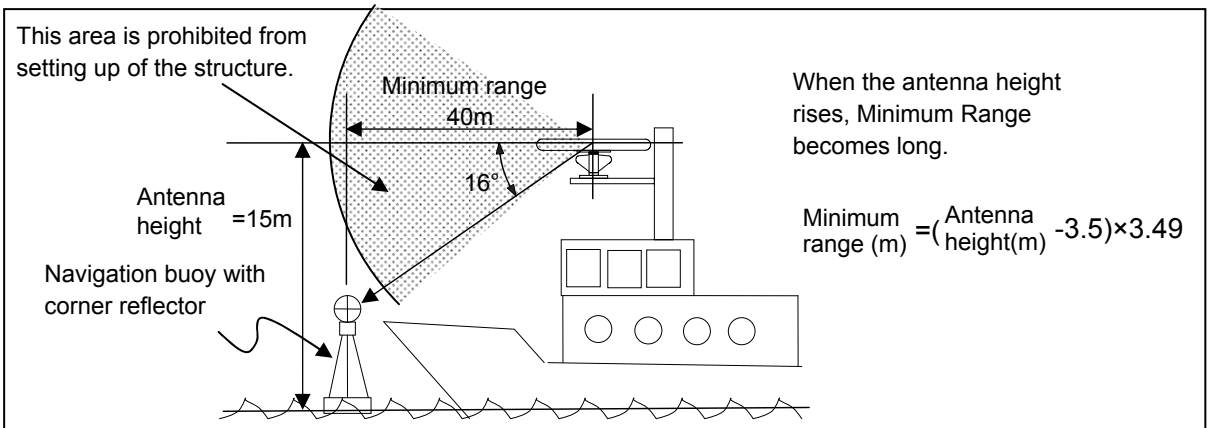


Figure 1.1 Vertical pattern of recommended antenna installation position.

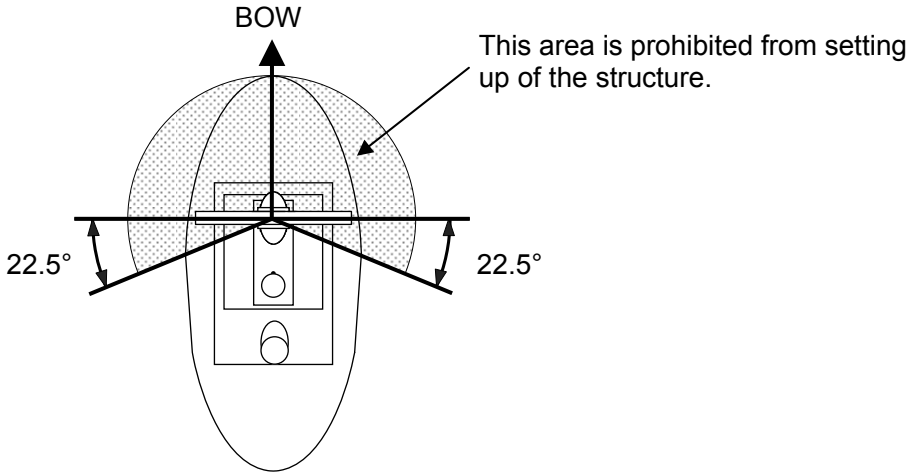


Figure 1.2 Horizontal pattern of recommended antenna installation position.

(2) The Antenna-Scanner unit should be located on a straight line connecting the bow and the stern without blockage that could prevent radar beam radiation.
(3) The Antenna-Scanner unit should be installed 0.6m above living quarters to prevent any electromagnetic wave effects on a human body. Installation in a high location also has an advantage to extend the detection range. However, it becomes difficult to detect close targets especially when using radar to dock. Also, the intensity of sea clutter becomes stronger if the location of the antenna is very high.
(4) Keep the surface of the Antenna-Scanner unit platform horizontal as much as possible.
(5) The Antenna-Scanner unit should be installed in front of large objects or exhaust stack to prevent a blind sector or the effects on the Antenna by engine exhaust soot.
(6) Keep sufficient maintenance area.
(7) Keep safety distance from magnetic compass.

Table 1.1 Safety distance of compass from the Scanner unit

Scanner unit type	Standard compass	Steering compass
RB717A	1.4 m	0.95 m
RB718A	1.4 m	0.95 m
RB719A	1.2 m	0.65 m

1.4.2 Display unit and Operation unit

(1) The orientation of the Display unit shall be such that the user is looking ahead, the lookout view is not obscured and there is minimum ambient light on the display viewing surface.
(2) Choose the best location from humidity, spray, rain, and direct sunlight.
(3) Keep sufficient maintenance area. Especially sufficient space is required near the back panel where cables are concentrated.
(4) Keep as far as possible from other radio devices.
(5) Keep a safe distance from the magnetic compass.

Table1.2 Safety distance of compass from Display unit

Display unit type	Standard compass	Steering compass
MRD-105	1.90 m	1.20 m
MRM-105	0.60 m	0.45 m
MRO-105	1.65 m	1.10 m

1.5 Cable wiring and interconnection

1.5.1 Antenna-Scanner unit

(1) The connecting cable between the Antenna-Scanner unit and the Display unit should run apart from any other radio antenna cable or power cables of the other devices. Do not lay the radar cable in parallel to the sea surface together with other cables. These considerations are effective to prevent random radio interference between systems. When these measures cannot be applied because of space limitations, use metal pipes for each cable or other suitable ways to shield.
(2) In order to maximize the performance of the radar, the antenna cable and the power cable should be as short as possible, and should be laid within the nominal length
(3) Connect the shielded braided wire of the antenna cable to the grounding terminal inside the Antenna unit.

1.5.2 Display unit

(1) Ground the braided wire of a cable firmly with the cable clamp fixing screw to the back panel.
(2) The Display unit housing should be grounded to the ship ground by using the ground terminal of the back panel.

Chapter 2 Method of installation

2.1 How to install the Antenna-Scanner unit

2.1.1 Installation of the Antenna-Scanner unit

The Antenna-Scanner unit is equipped to orient the notch of the attachment to stern as shown in Figure 2.1. Installation in this way eases maintenance work. Also refer to the consideration on equipment shown in 1.4.1.

(1) Four mounting hole 14mm in diameter are made in the attachment side on the platform with reference to Figure 2.1.

(2) The Antenna-Scanner unit is put on the location secured with four 12mm stainless steel bolts contained in installation material.

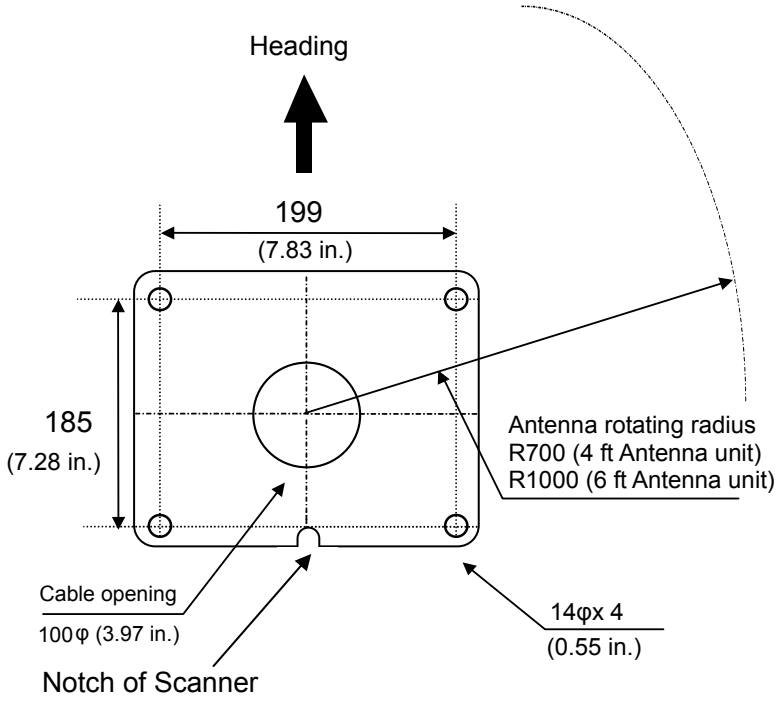


Figure 2.1 Plain view of mounting hole

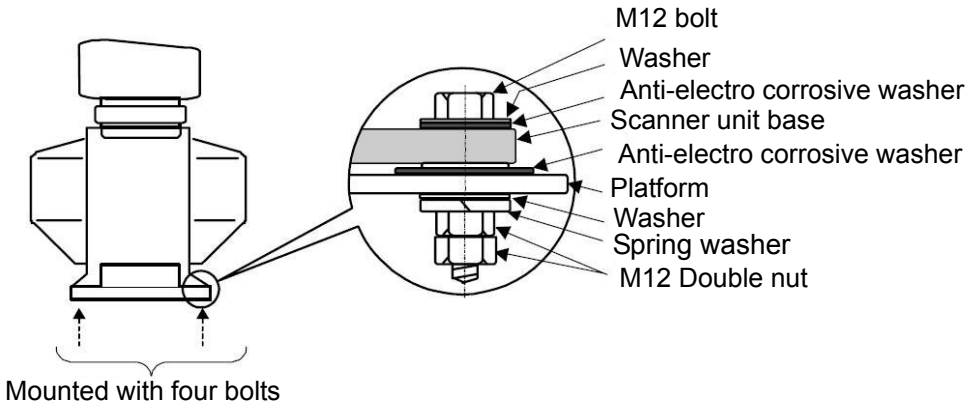


Figure 2.2 Assembly of Scanner unit base

2.1.2 Mounting Antenna

(1) Remove the protective cap on top of the Scanner unit rotational shaft.

(2) Remove four bolts tentatively fixed to the base of the antenna and install the Scanner unit to the rotating base. Align the direction of antenna radiation side (KODEN –mark side) with the projection mark on the rotating base.

(3) Fix the aerial with four bolts removed in step 2.

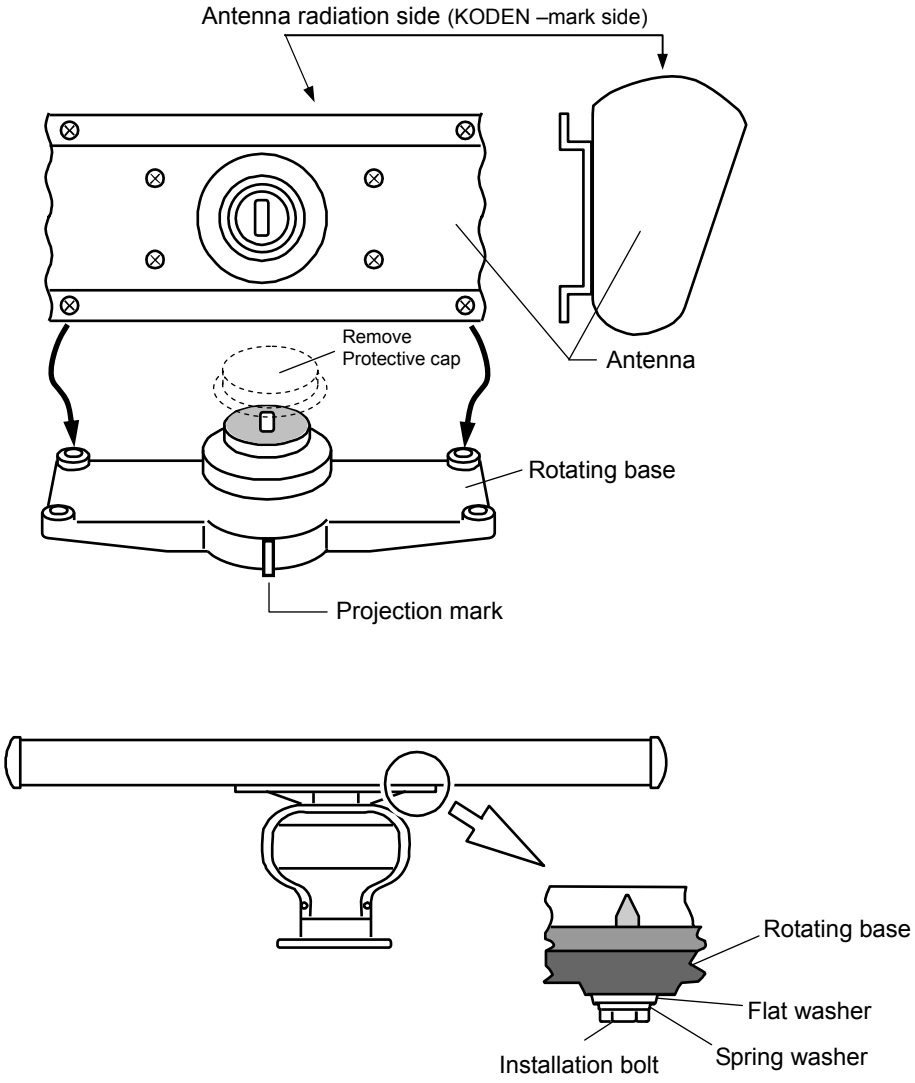


Figure 2.3 Antenna assembly to the rotating shaft

2.1.3 Connecting the cables

Open Antenna 6kW (RB717A), 12kW (RB718A)

(1) Make sure power supply of the Scanner unit is OFF.

(2) Disassemble the front cover of the Scanner unit from the rear cover by loosening fixing bolts.

(3) Remove the TR unit by disconnecting the connector J3 and J4 after loosening fixing bolts of the TR unit. Please make sure magnetron does NOT touch metals.

(4) Remove the cable holder plate and the rubber packing by loosening bolts at the bottom of the Scanner unit box.

(5) Antenna cable shall be taken into the Scanner unit box through the cable inlet hole.

(6) Antenna cable shall be fixed as described in the illustration below, using the cable holder plate and the rubber packing removed in 4. Shield braid terminal shall be fixed under the cable holder plate together with lug terminal, after removing the edge portion of heat contraction tube of the antenna cable.

(7) Mount the TR unit after connecting the J3 and J4 connectors (removed in 3) by fixing bolts.

(8) 7 pin connector shall be connected to J2 of the TR unit, 9 pin connector to J1.

(9) Antenna cable shall be clamped onto the TR unit. Please make sure the antenna cable does NOT touch magnetron lead wires.

(10) The front and rear covers of the Scanner unit shall be fixed by fixing bolts.

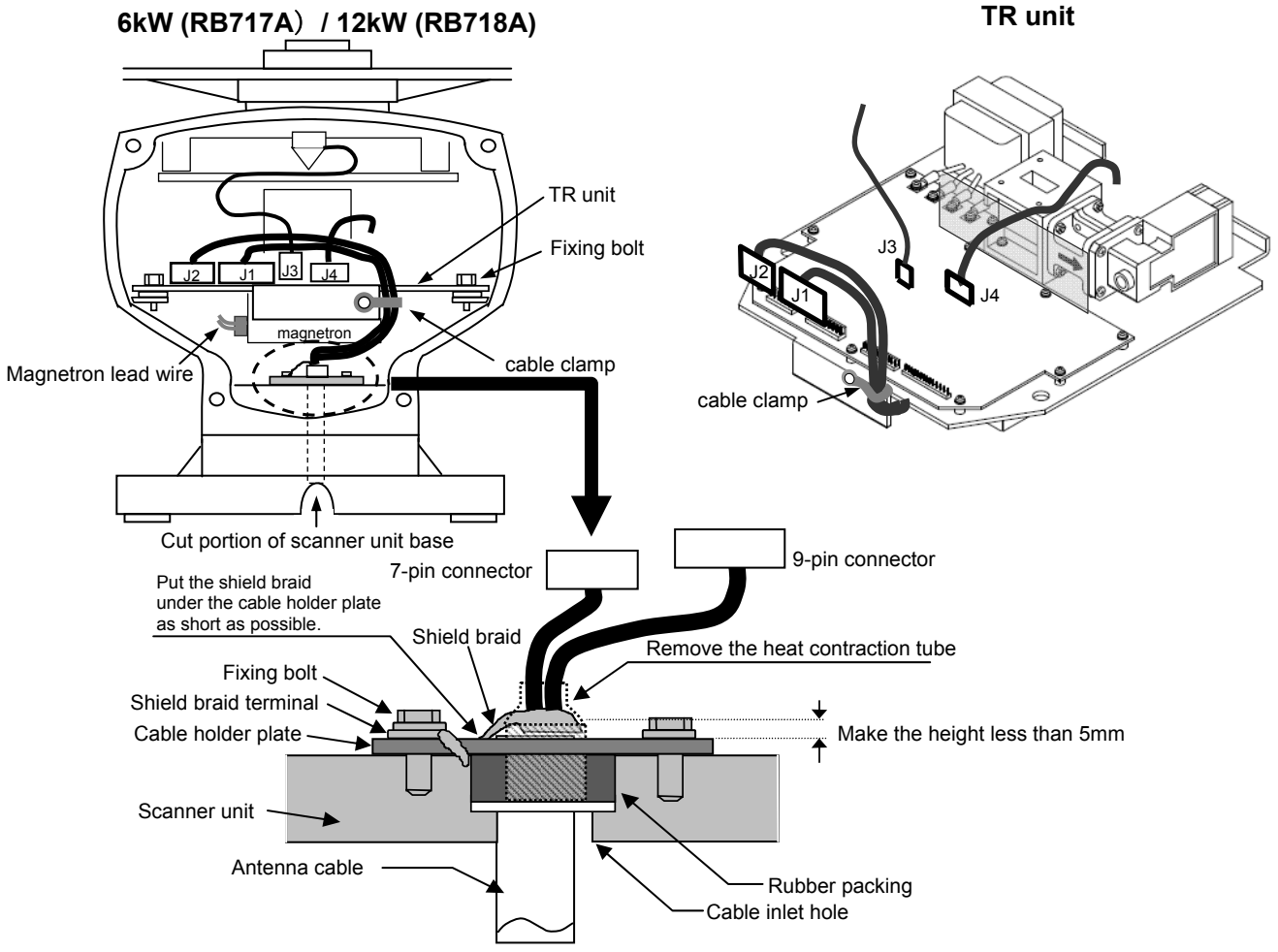


Figure 2.4.1 Connection of cable to Scanner Unit (RB717A、RB718A)

Open Antenna 25kW (RB719A)

(1) Make sure power supply of the Scanner unit is OFF.

(2) Disassemble the front cover of the Scanner unit from the rear cover by loosening fixing bolts.

(3) Remove the TR unit by disconnecting the connector J3 and J4 after loosening fixing bolts of the TR unit. Please make sure magnetron does NOT touch metals.

(4) Remove the cable holder plate and the rubber packing by loosening bolts at the bottom of the Scanner unit box.

(5) Antenna cable shall be taken into the Scanner unit box through the cable inlet hole.

(6) Antenna cable shall be fixed as described in the illustration below, using the cable holder plate and the rubber packing removed in 4. Shield braid terminal shall be fixed under the cable holder plate together with lug terminal, after removing the edge portion of heat contraction tube of the antenna cable.

(7) Mount the TR unit after connecting the J3 and J4 connectors (removed in 3) by fixing bolts.

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(9) Antenna cable shall be clamped onto the TR unit. Please make sure the antenna cable does NOT touch magnetron lead wires.

(10) The front and rear covers of the Scanner unit shall be fixed by fixing bolts.

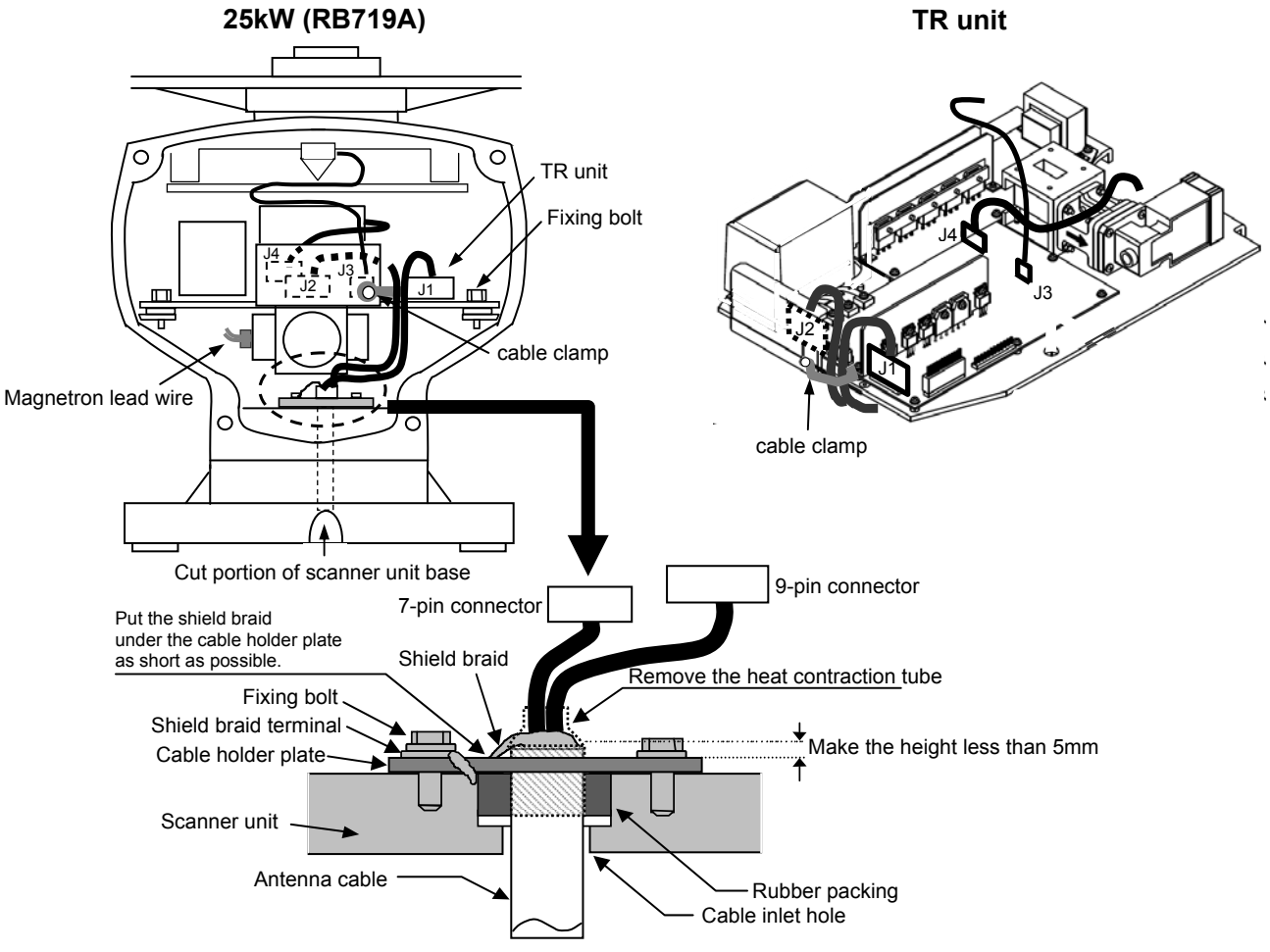


Figure 2.4.2 Connection of cable to Scanner Unit (RB719A)

2.2 Interconnection diagram of cable

Antenna-Scanner unit

P2

Description	Cable colour	No.
+250V	Purple	1
NC	-	2
GND	Yellow	3
+40V	Red (thick)	4
+40V	Yellow (thick)	5
+40V-RTN	Green (thick)	6
+40V-RTN	Blue (thick)	7

P1

Description	Cable colour	No.
+24V	Blue	1
NC	-	2
+12V	Orange (thick)	3
DATA-RTN	Shield	4
DATA	Red (coax)	5
BP/SHF-R	Shield	6
BP/SHF	Brown (coax)	7
V/TRIG-RTN	Shield	8
V/TRIG	Grey (coax)	9

Ground terminal

GND	Shield	1

Display unit

PX

No.	Cable colour	Description
1	Purple	+250V
2	Blue	+24V
3	Orange (thick)	+12V
4	Yellow	GND
5	Shield	DATA-RTN
6	Red (coax)	DATA
7	-	-
8	Brown (coax)	BP/SHF
9	Shield	BP/SHF-RTN
10	Grey (coax)	V/TRIG
11	-	
12	Red (thick)	+40V
13	Yellow (thick)	+40V
14	Shield	V/TRIG-RTN
15	Green (thick)	+40V-RTN
16	Blue (thick)	+40V-RTN

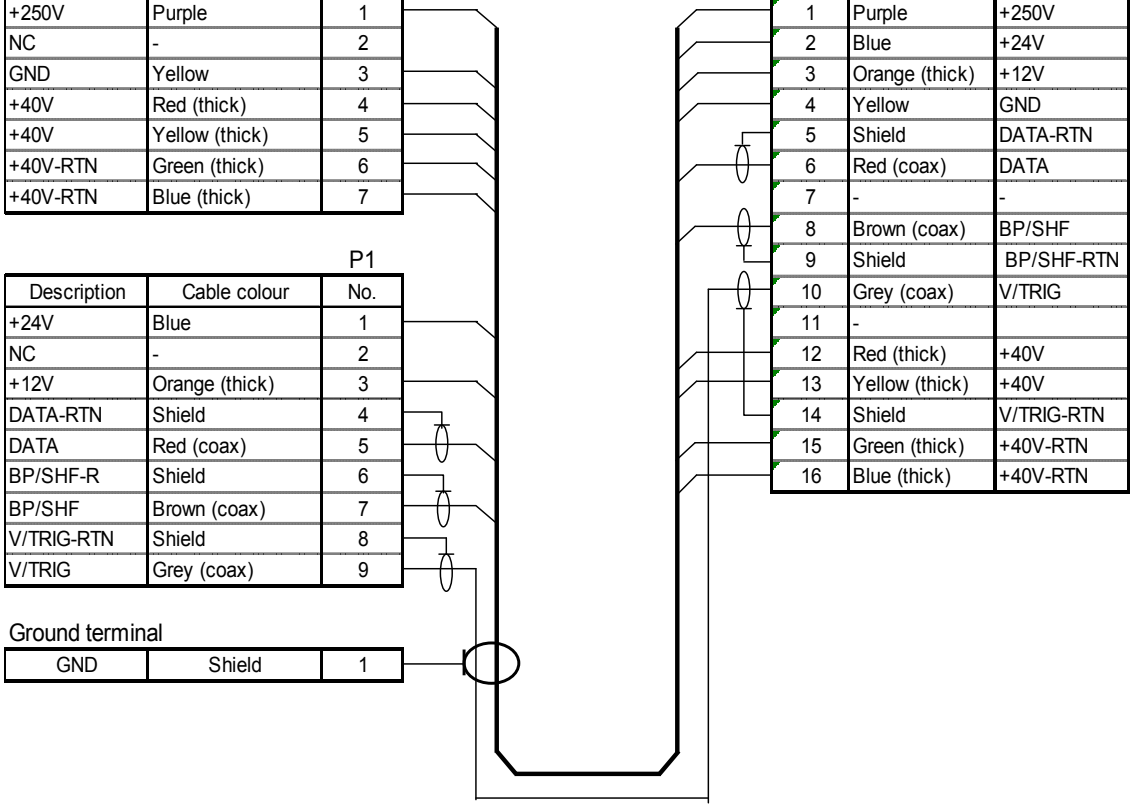


Figure 2.5 Interconnection of cable between Antenna-Scanner unit and Display unit

2.3 Installation of the Display unit

The Display unit can be mounted on a table or a panel. The procedure is as follows.

2.3.1 Installation of MRD-105

2.3.1.1 Table mounting of MRD-105

(1) Remove four knob bolts from which the Display unit is secured on the mounting bracket.

(2) Remove the Display unit from the mounting bracket and put it on a stable, flat and horizontal place.

(3) Place the mounting bracket in the appropriate setting position and secure it with five M5 screws.

(4) Remount the Display unit on the mounting bracket and secure it with knob bolts which were removed in (1).

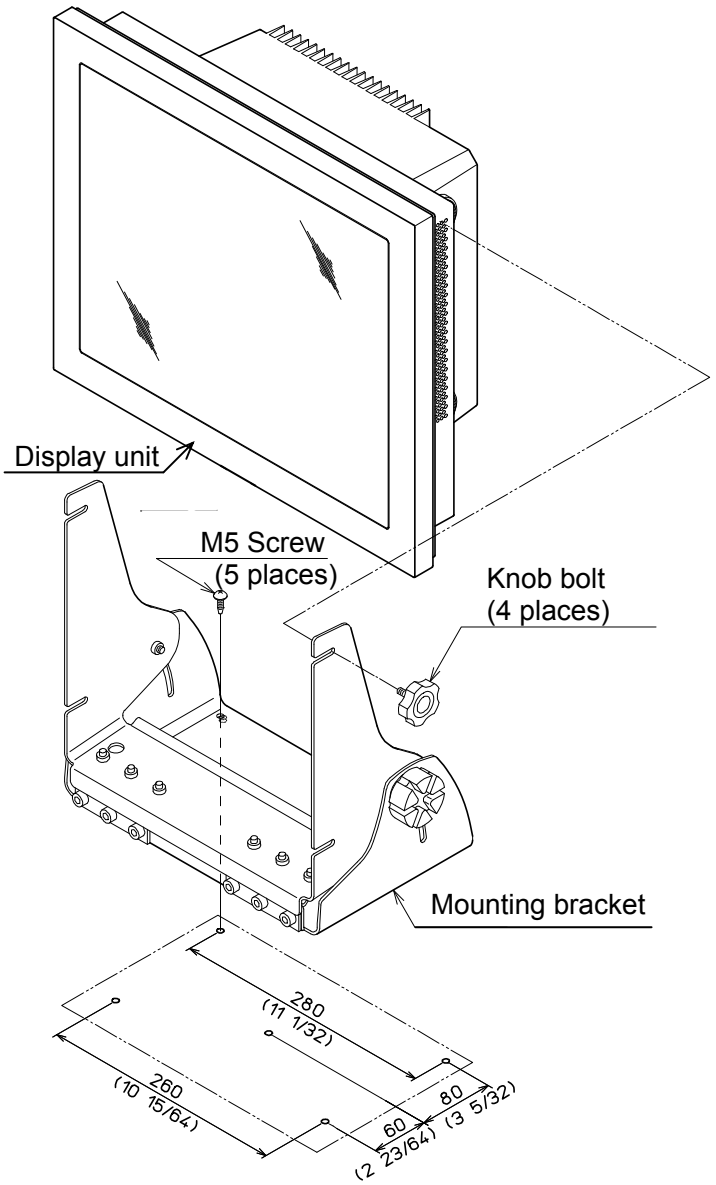
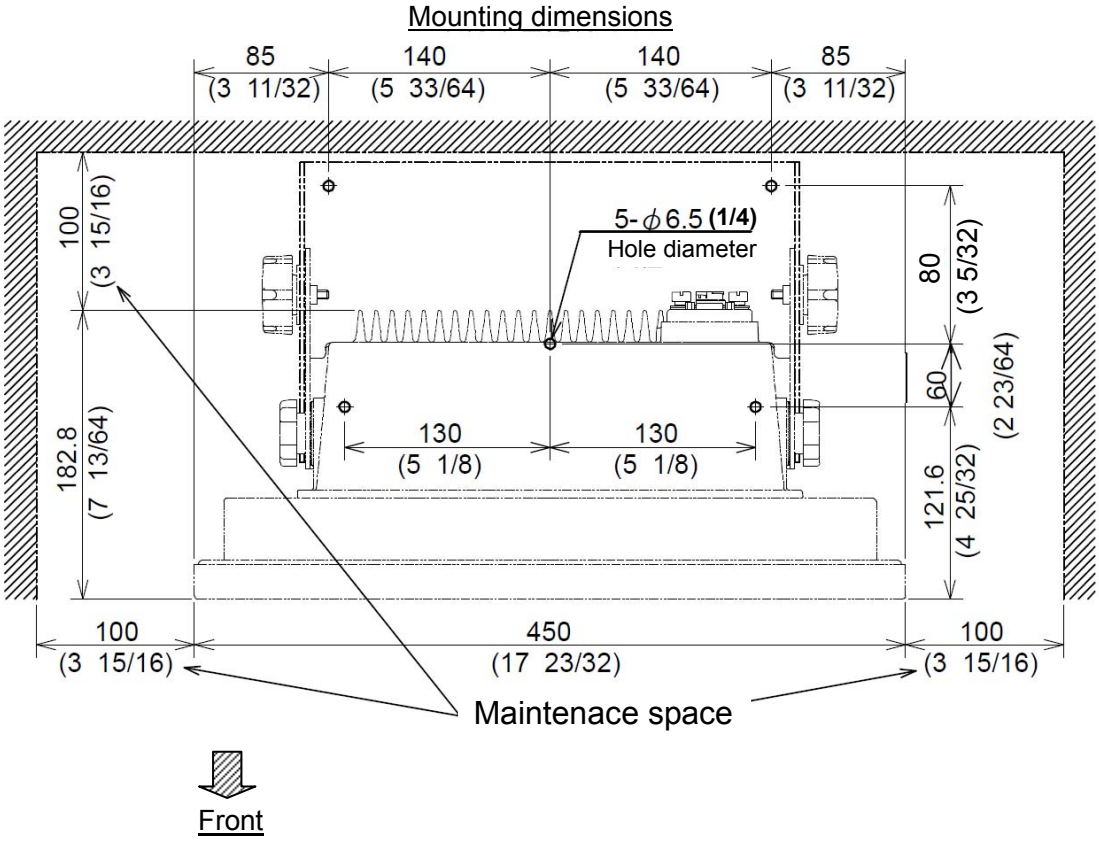


Figure 2.6 Diagram of installation procedure on the table

Unit: mm (inch)

NOTE: In the case of mounting the Display unit on the table, some maintenance space is required for cabling, connector access, fuse replacement, fastening of bolts, etc. as shown in the following figure.



Unit: mm (inch)

Figure 2.7 Maintenance space necessary for tabletop display

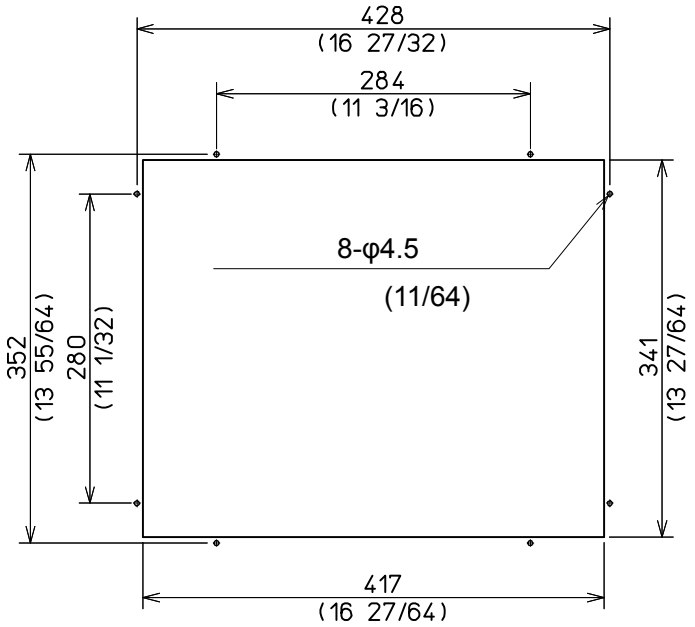
2.3.1.2 Flush Mounting of MRD-105

Preparation:

(1) Cut an opening and drill 4.5 mm eight holes with the size shown in Figure 2.8, on the side for attachment of a display unit on a panel.

(2) Unscrew four knob bolts that hold the display unit to the mounting bracket.

(3) Remove the display unit from the mounting bracket and put it on a horizontal stable place.



Unit: mm (inch)

Figure 2.8 Opening and nut-holes for display unit

Installation:

(1) Place the Display unit in the precut opening on the panel.

(2) Secure the Display unit with 8 places fastened with M4 screw as shown in the following figure.

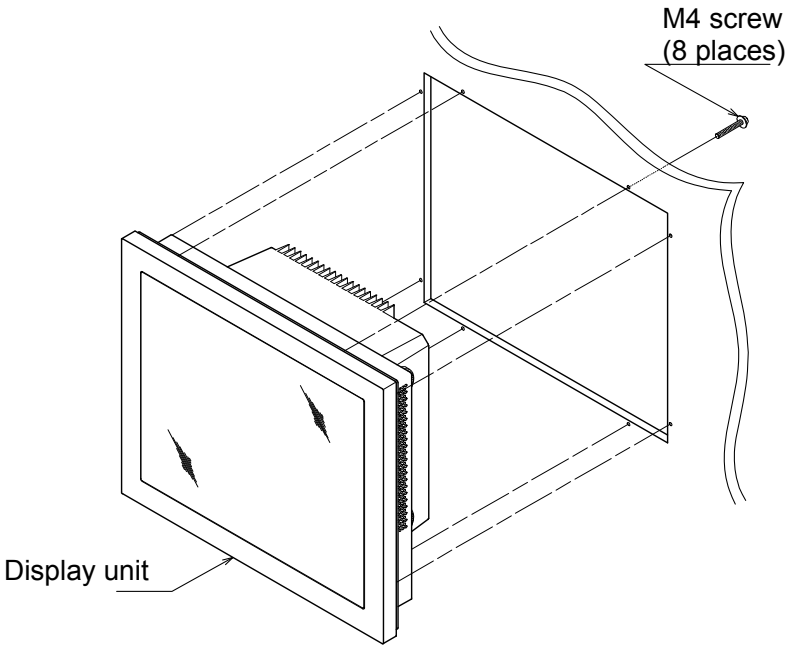


Figure 2.9 Flush-mount Installation

2.3.2 Installation of MRM-105

The Processor unit MRM-105 can be mounted on a table or a panel. The procedure is as follows.

(1) Drill four nut-holes with the size shown in Figure 2.10.

(2) Fit the Processor unit.

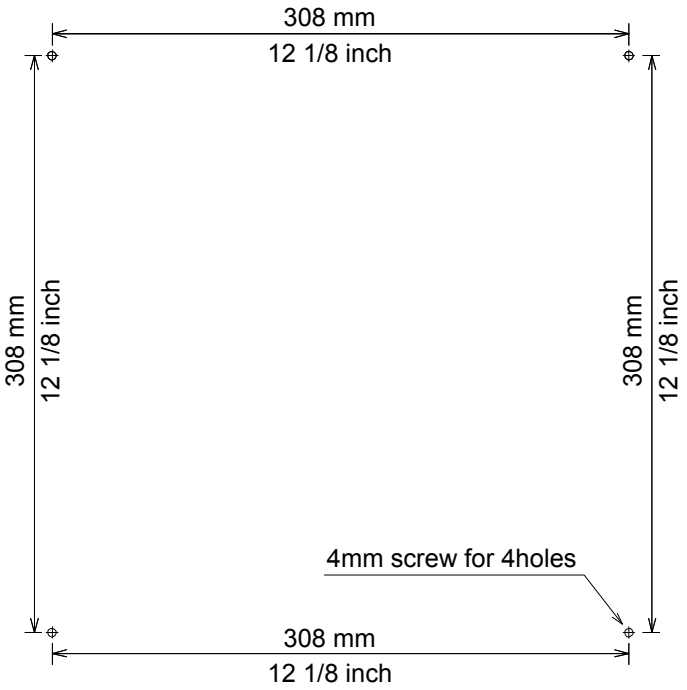


Figure 2.10 Holes for mounting a Processor unit Unit: mm (inch)

2.3.3 Installation of MRO-105

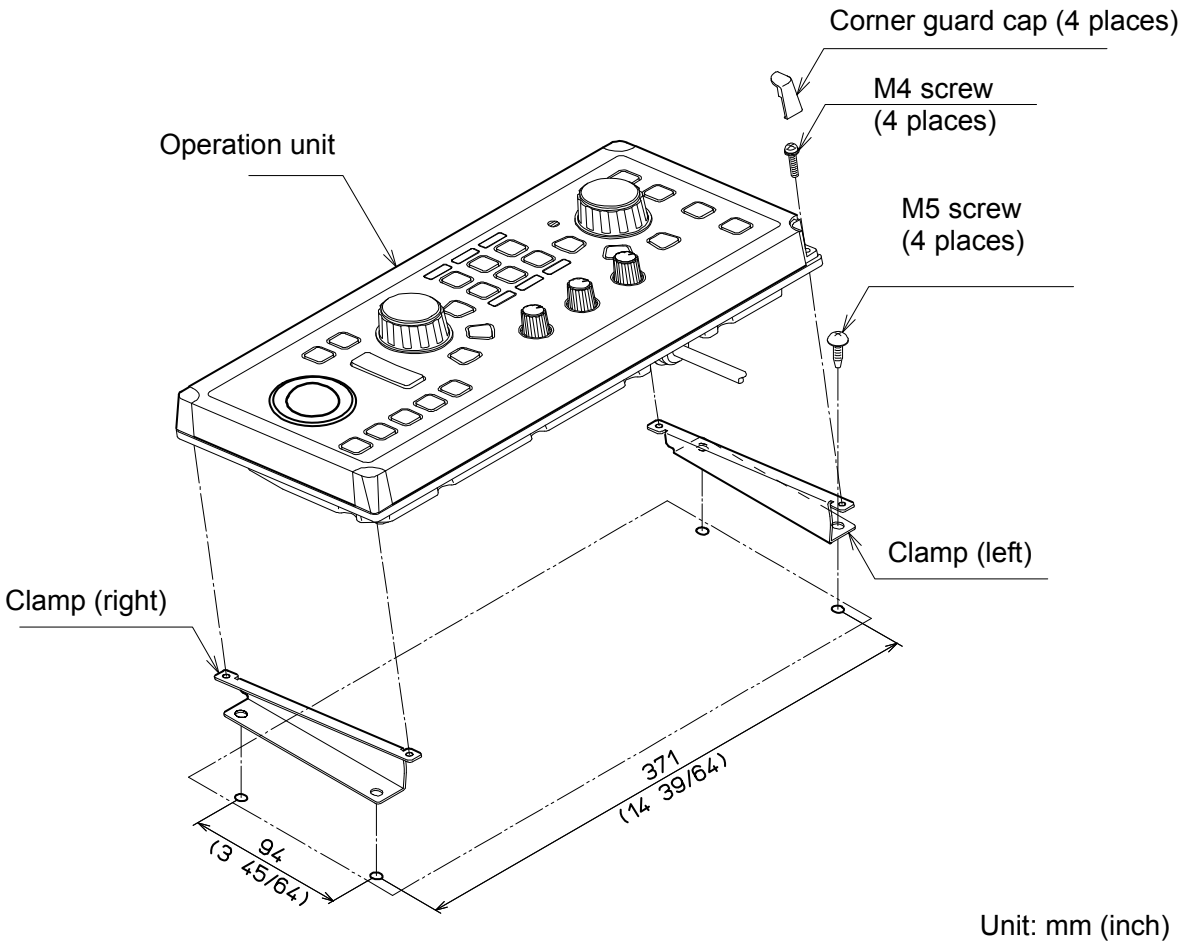
2.3.3.1 Installation of Operation unit MRO-105

(1) Remove the corner guard caps of four places on the Operation unit. Insert the tip of a small flat-blade screwdriver carefully between a corner guard cap and the front bezel of Operation unit to make a gap, and then pinch and pull up the corner guard cap with fingers. Take care not to damage the bezel of Operation unit by the tip of flat-blade screwdriver.

(2) Remove M4 (4 mm) screws and remove the Operation unit from the mounting bracket.

(3) Mark the place as shown in the following figure, and then secure the mounting bracket with 5M (5 mm) tapping screws at four places.

(4) Secure the Operation unit to clamps with M4 (4 mm) screws that were removed in (2) and fit the corner guard caps of the four corners.



Unit: mm (inch)

Figure 2.11 Installation of MRO-105

Mounting dimesions

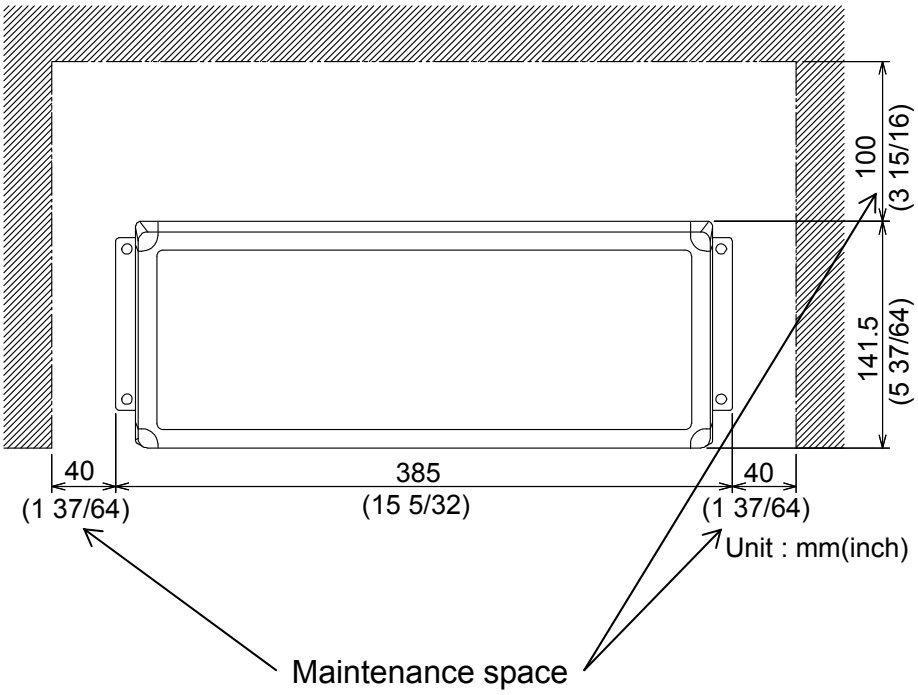


Figure2.12 Maintenance space necessary for Operation unit

2.3.3.2 Installation of Flush mounting the Operation unit MRO-105

Preparation:

(1) Cut an opening with the size as shown in Figure 2.13 on the side for mounting a Display unit on the panel.
(2) Mark the place of holes for mounting.

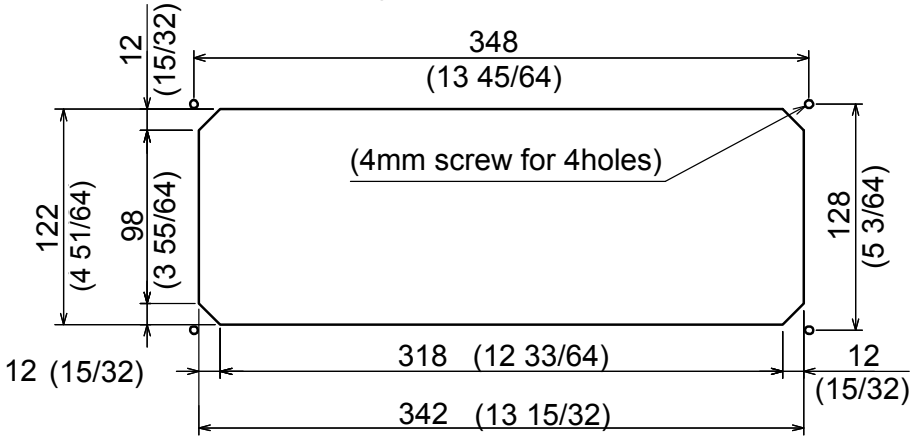


Figure 2.13 Diagram of processing nut-holes for mounting an Operation unit

Installation:

(1) Remove corner guard caps of four corners of the Operation unit.
(2) Insert the Operation unit and its connecting cable into the opening and adjust the Operation unit parallel to the mounting face (Figure 2.14).
(3) Secure the Operation unit to the panel with 4 mm tapping screw (4 places).
(4) Return corner guard caps removed in (1) to the original places.

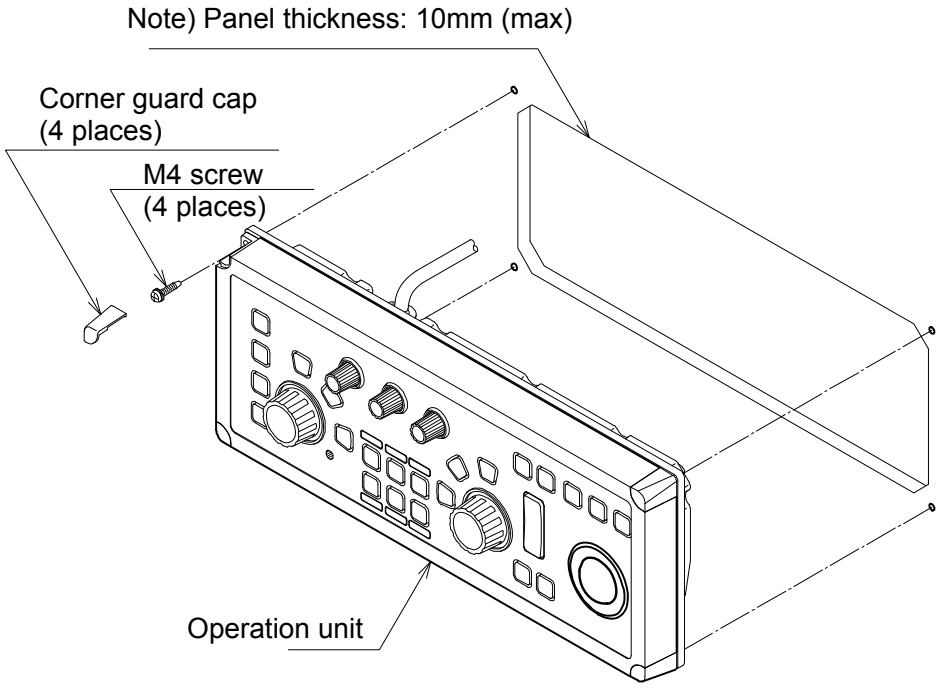
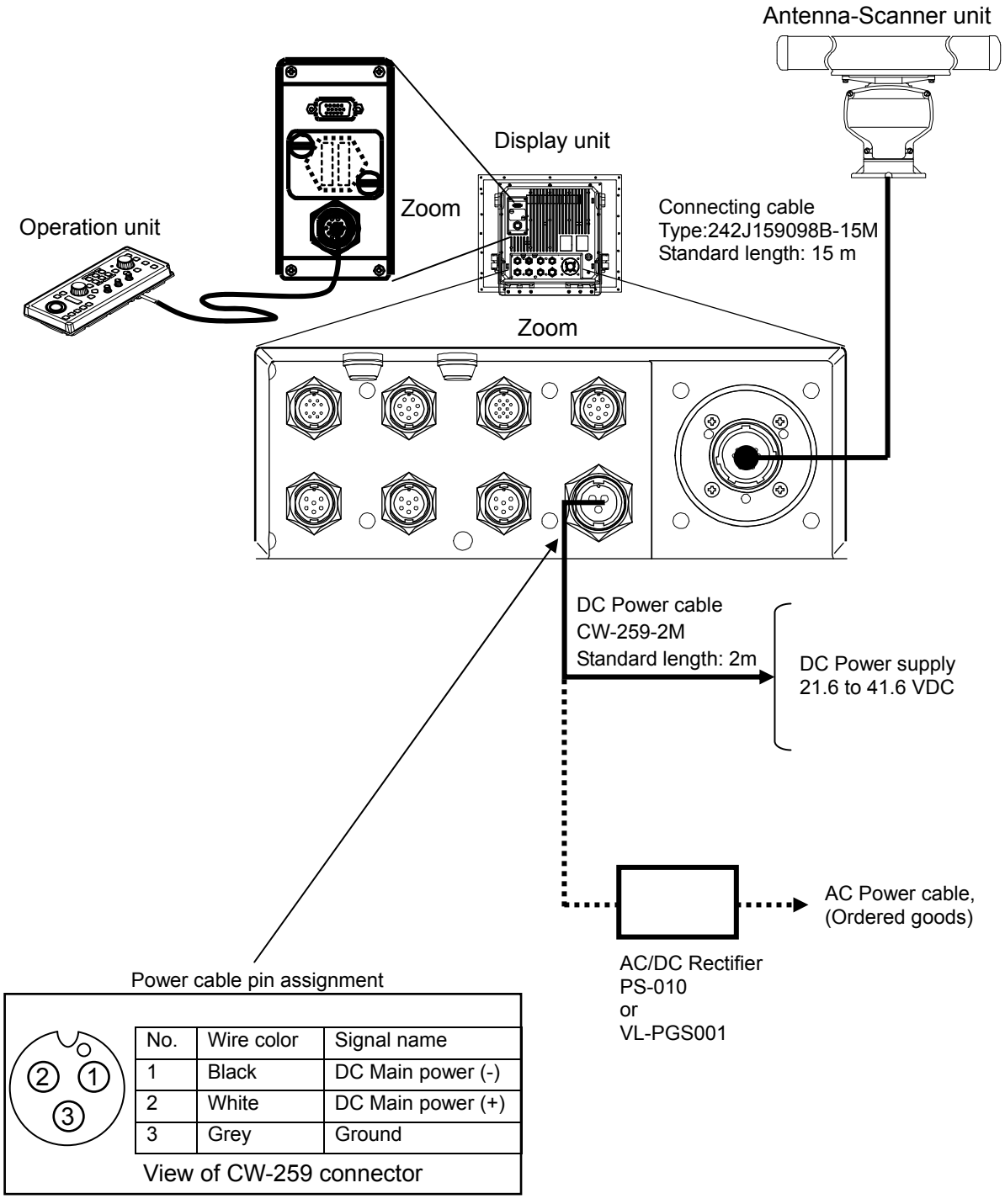


Figure 2.14 Flush Mounting the Operation unit

2.4 Cable connection to a Display unit

2.4.1 Cable connection for MRD-105 Display unit

Attach the connectors of cables from an Antenna-Scanner unit, power source and Operation unit, to corresponding receptacles as shown in Figure 2.15.



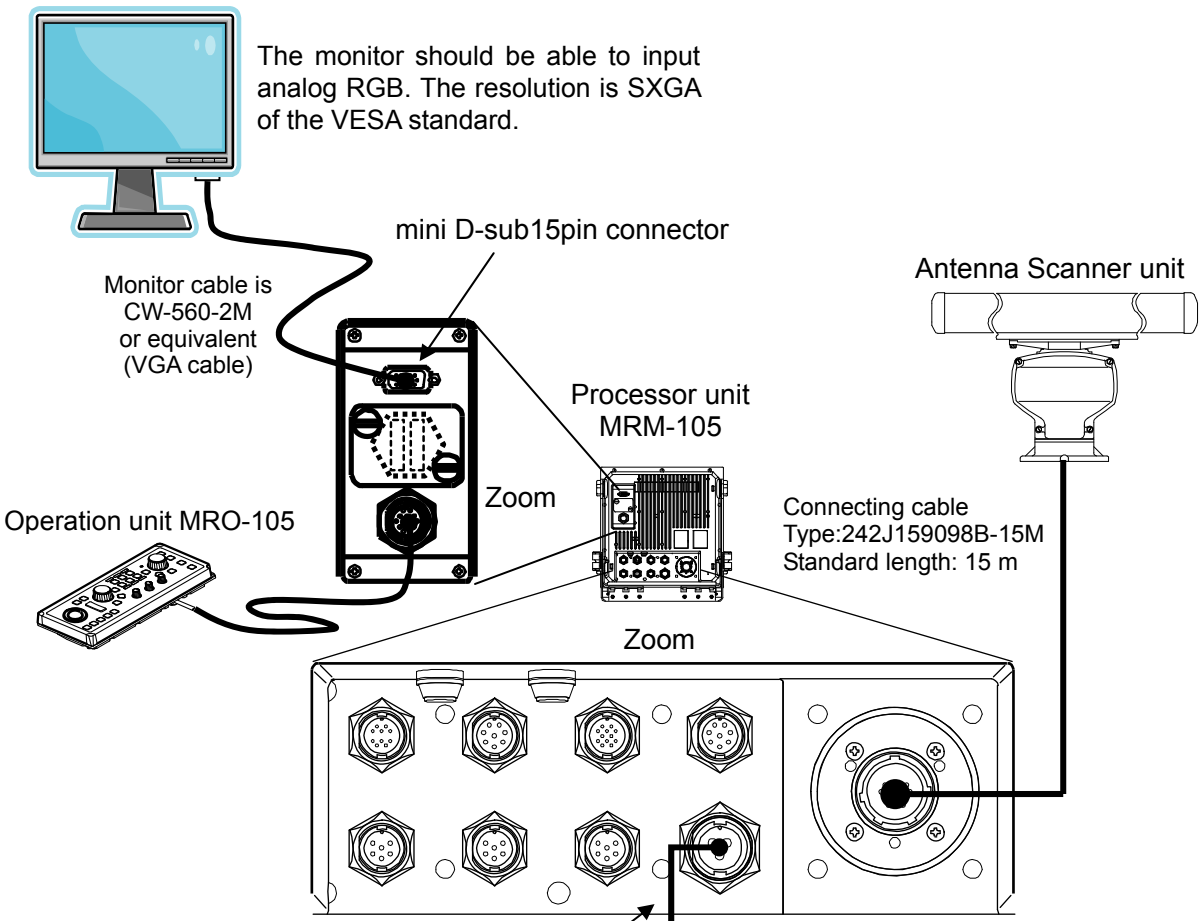
No.	Wire color	Signal name
1	Black	DC Main power (-)
2	White	DC Main power (+)
3	Grey	Ground

View of CW-259 connector

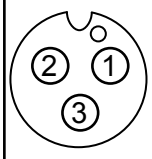
Figure 2.15 Cable connections for standard configuration of MRD-105 Display unit

2.4.2 Cable connection for MRM-105 Processor unit

Attach the connectors of cables from an Antenna-Scanner unit, power source and Operation unit, to corresponding receptacles as shown in Figure 2.16.



Power cable pin assignment



No.	Wire color	Signal name
1	Black	DC Main power (-)
2	White	DC Main power (+)
3	Grey	Ground

View of CW-259 connector

Figure 2.16 Cable connections for standard configuration of MRM-105 Processor unit

2.4.3 Connecting the Display unit to GPS Compass (KGC-1)

When using the GPS Compass (KGC-1), connect the J6 port of the Display unit to DATA2 connector of KGC-1. This connection allows high data speed.

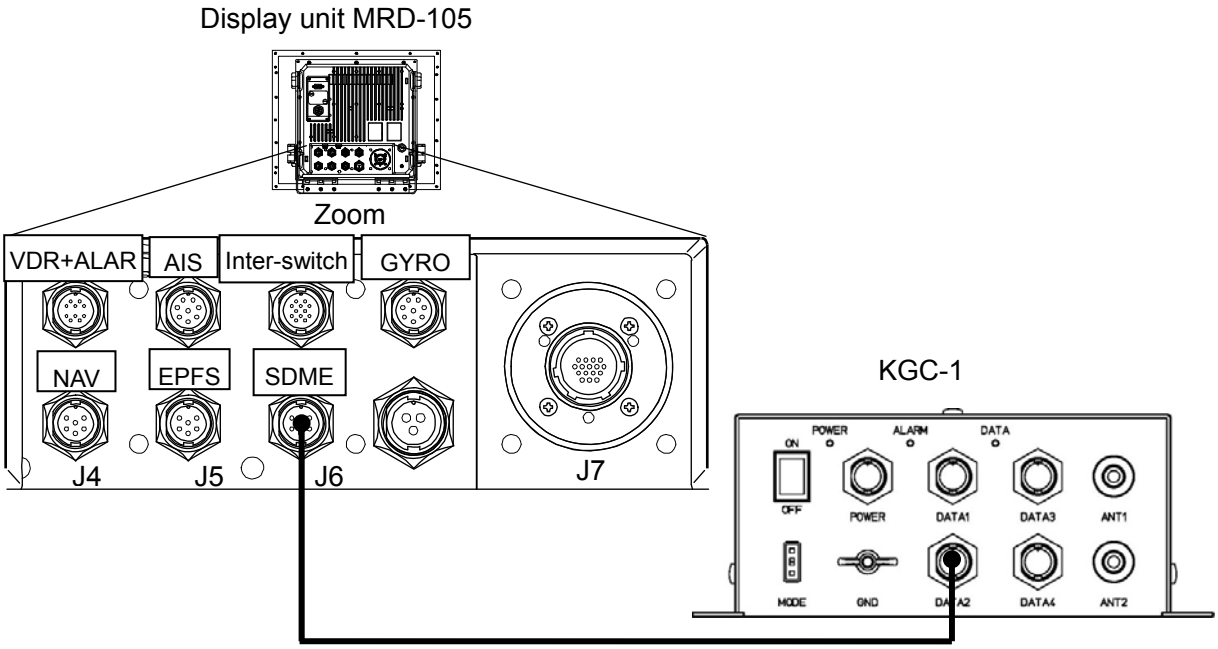


Figure 2.17 Cable connection between display unit and KGC-1

The procedure to Switch to high-speed communication mode

(1) Press [MENU] key to display “Menu”.

(2) Place a cursor on “SYSTEM” and roll the trackball to the right to display the sub-menu.

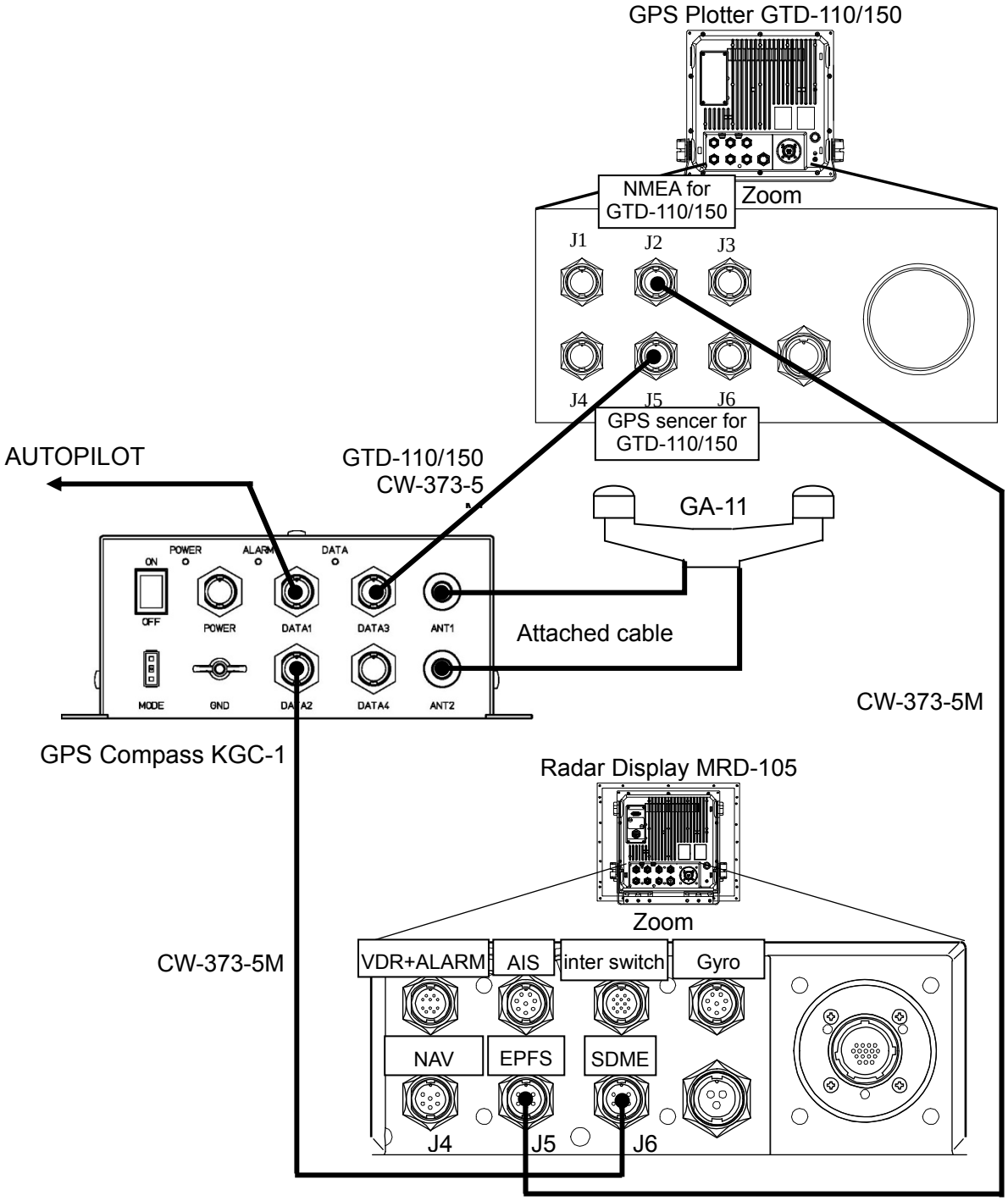
(3) Please rotate the track ball, and select bellow;
[SYSTEM] => [PROTECT MENU] => [ON], and then press [ENT] key.
The display of [PROTECT MENU ON] changes into [PROTECT MENU 0000].
Please rotate the track ball, and select bellow;
[PROTECT MENU] => [0000] => password, and then press [ENT] key.
Note: Initial password is [0000]

(4) Menu display is disappeared once after correct password is input. Press [MENU] once again to use [Menu].

(5) Please rotate the track ball, and select bellow;
[MAINTENANCE] => [I/O] => [DETAIL] => [KGC-1 SET] => [INITIAL] => [GO], and then press [ENT] key. The communication baud rate is set to 38400 bps for both Display unit and KGC-1. Start the KGC-1 to output HDT, GGA, and VTG signals.
NOTE: The KGC-1 DATA2 port (connecting port to radar) is set as 38400 bps, signal duration 50 ms, signal type: HDT, GCA, and VTG by this initialization. When this DATA2 port is used for another device that cannot handle this baud setting, connect this device to DATA1 port or do not perform initialization.

2.4.4 Connecting the KGC-1 or GTD-110/150 to a Display unit

Note: Refer to each operation manual for the connections to other devices.

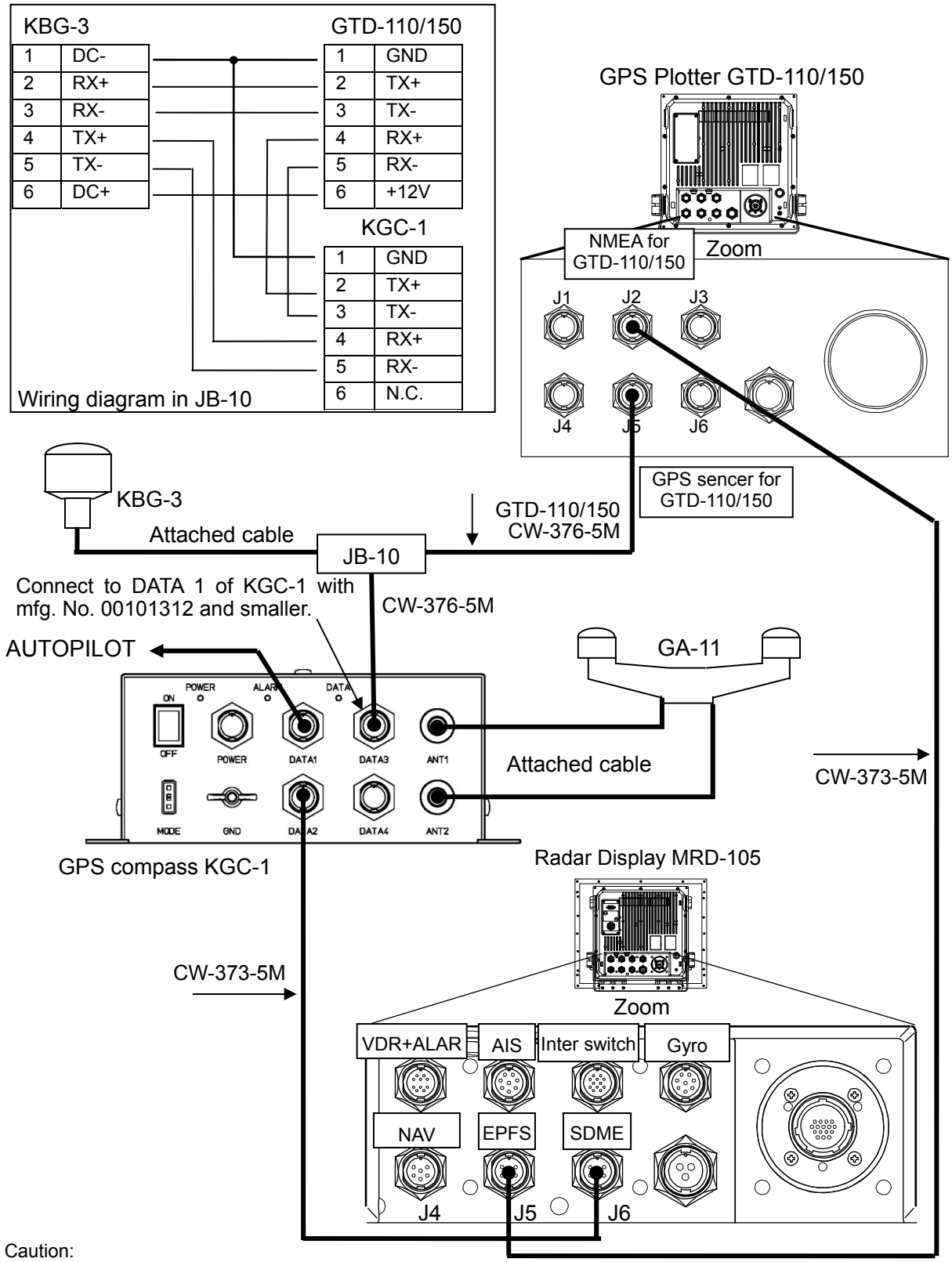


Cautions:
As the same sentence will be input from 2 ports, please assign SDME (ship's speed) as the input port of GGA, GLL, VTG and ZDA. As for setting, see 3.2.11.
Set TLL and TTM of EPFS output at 1.0 second in order to display TT on the plotter referring to 3.2.8.

Figure 2.18 Cable connection of Display unit to KGC-1 or plotter

2.4.5 Connecting the Display unit to KGC-1, GTD-110/150 and KGB-3

Note: Refer to each operation manual for the other devices.



Caution:
As the same sentence will be input from 2 ports, please assign EPFS (position) as the input port of GGA, GLL, VTG and ZDA.
As for setting, see 3.2.11. Set TLL and TTM of EPFS outputs at 1.0 second in order to display TT on the plotter referring to 3.2.8.

Figure 2.19 Cable connection of Display unit to KGC-1, Plotter and KBG-3

2.4.6 Connecting the 2nd monitor with MRD-105

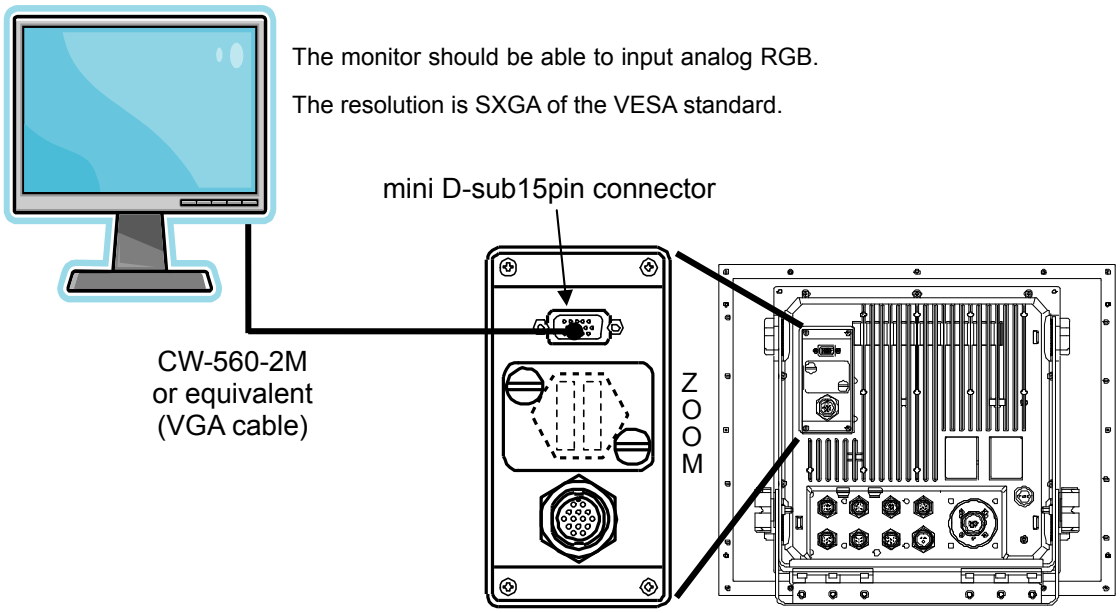


Figure2.20 Cable connection of Display unit to ext. monitor

2.4.7 Connecting the VDR or the 2nd Monitor (MRM-105) and the Alarm output

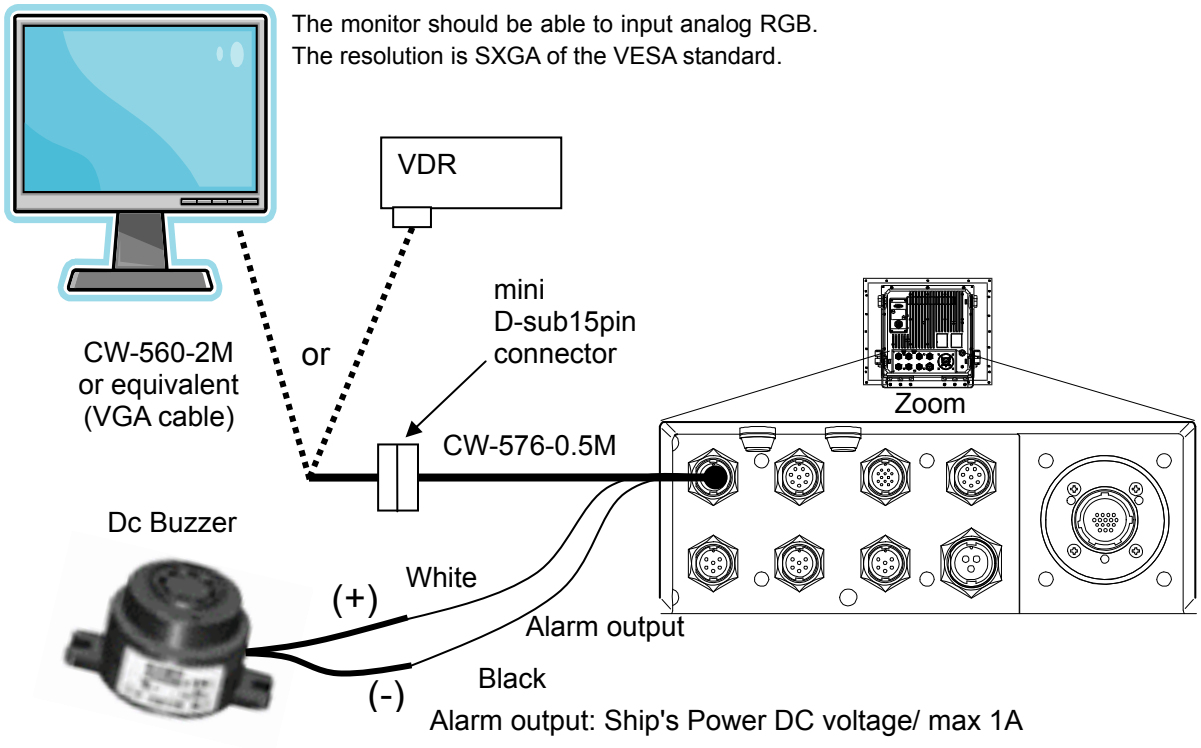
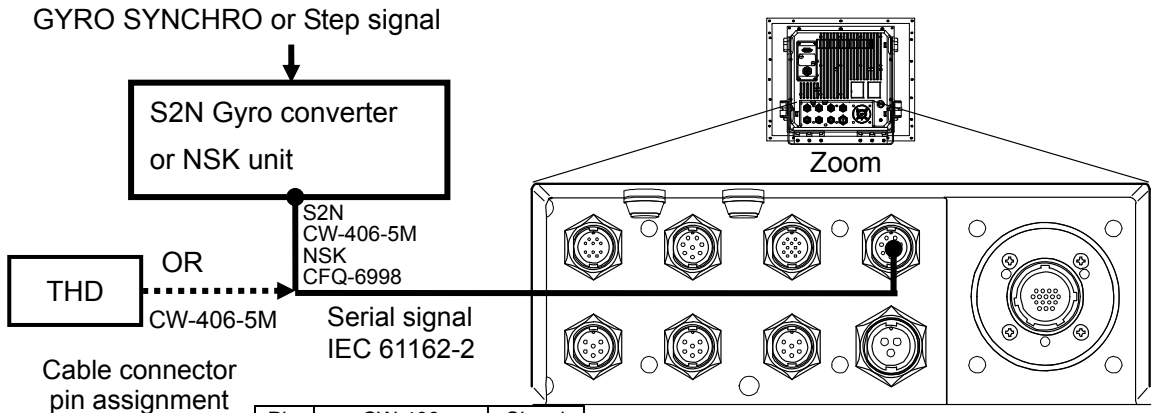


Figure 2.21 Cable connection of Display unit to VDR and Alarm OUT

2.4.8 Connecting the Gyro converter unit or THD

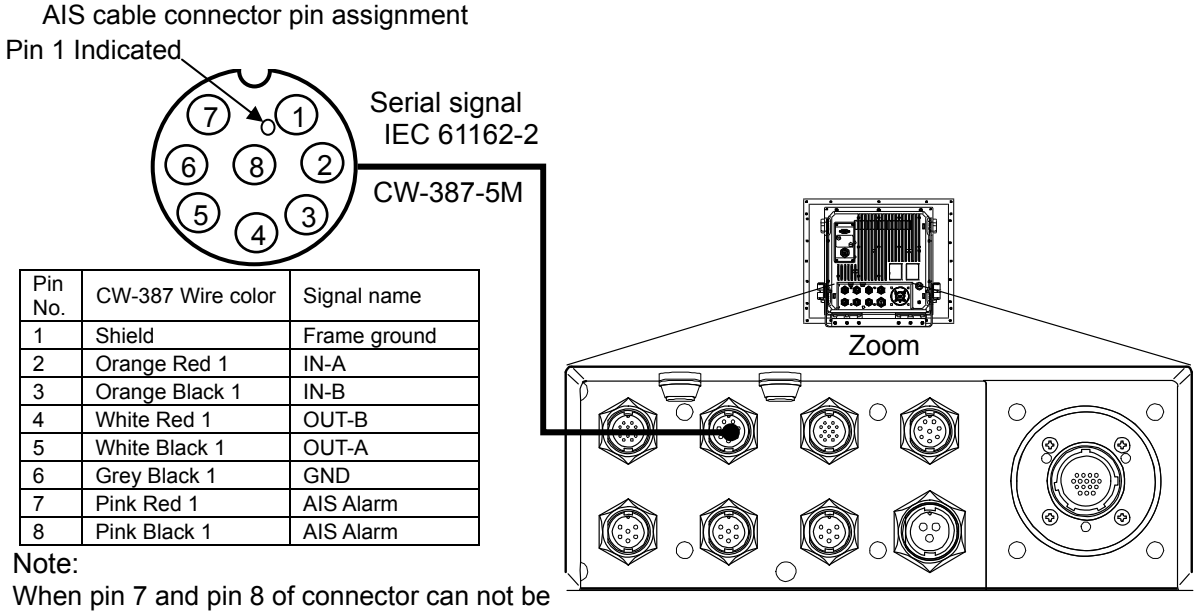


Pin No.	CW-406 Wire color	Signal name
1	White Red 1	OUT A
2	White Black 1	OUT-B
3	Orange Red 1	IN-A
4	Orange Black 1	IN-B
5	Grey Black 1	GND
6		NC
7		NC
8	Grey Red 1	+5VDC

Cautions: 1. When the following operations are excuted, the input setting of radar is set at optimum condition for the NSK unit.
MENU=>MAINTENANCE=>I/O=>DETAIL =>NSK SET=> INITIAL=>GO
Please refer to Chapter 3.2.3.2 for details.
2. Please set the output of S2N and THD (gyro serial output) as follows.
Baud rate=38400, TX cycle=25ms-50ms, sentence=HDT,checksum=ON
Please refer to the operation manual of each unit for details.

Figure 2.22 Cable connection of Display unit to Gyro converter unit or THD

2.4.9 AIS cable connection

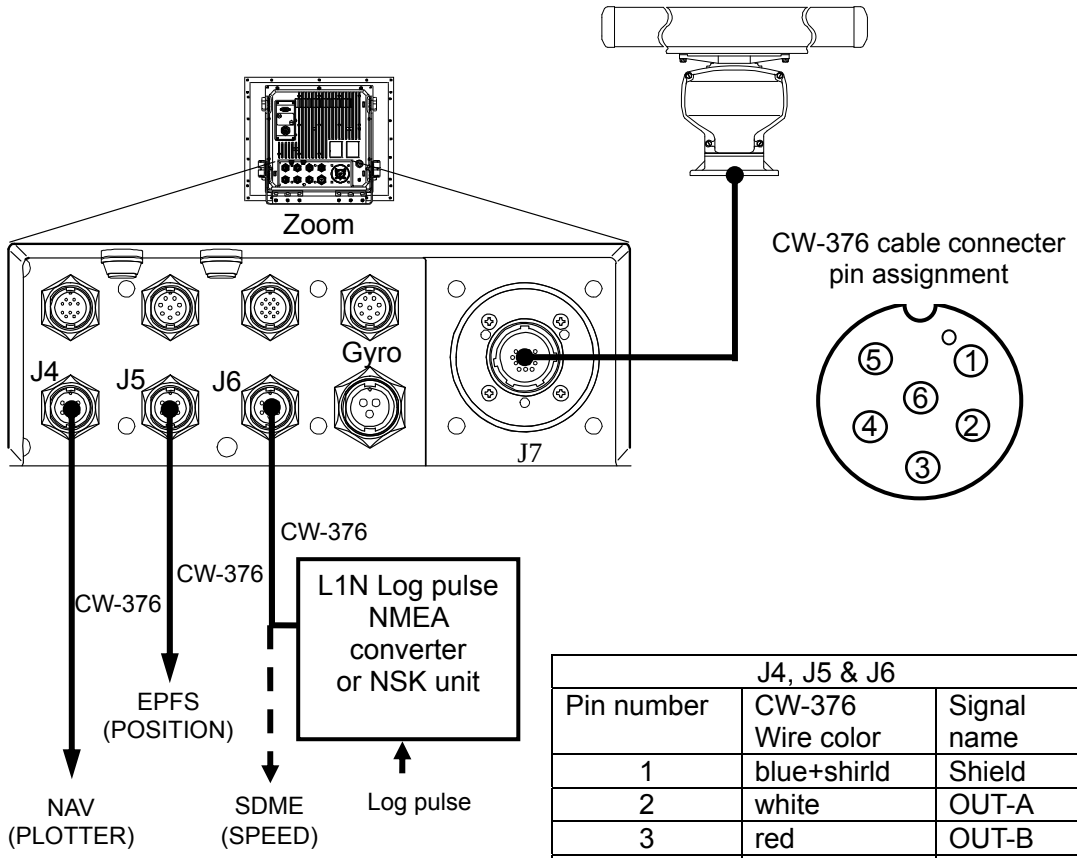


Pin No.	CW-387 Wire color	Signal name
1	Shield	Frame ground
2	Orange Red 1	IN-A
3	Orange Black 1	IN-B
4	White Red 1	OUT-B
5	White Black 1	OUT-A
6	Grey Black 1	GND
7	Pink Red 1	AIS Alarm
8	Pink Black 1	AIS Alarm

Note:
When pin 7 and pin 8 of connector can not be connected to the AIS alarm, please short-circuit.
AIS alarm will be sounding if this circuit is left open.

Figure 2.23 AIS cable connection

2.4.10 Cable connection for NAV, EPFS and SDME or Log



J4, J5 & J6		
Pin number	CW-376 Wire color	Signal name
1	blue+shirld	Shield
2	white	OUT-A
3	red	OUT-B
4	orange	IN-A
5	black	IN-B
6	green	Ground

An initial value of the I/O format of the port is as follows.

NAV port: IEC 61162-2
EPFS port: IEC 61162-1
SDME port: IEC 61162-1
GYRO port: IEC 61162-2

The I/O format can switch IEC 61162-1 or 2 in the radar menu.
The sentence input to these ports is shown below.

Position information: GGA, GLL, GNS, RMC
Heading information: THS, HDT
Spead information: VBW, VTG, VHW,
Set and drift: VDR
Waypoint information: RMB, BWC
Routes RTE, WPL
Cross-track RMB, XTE
Datum: DTM
Depth DBT, DPT
Temperature MTW
Date: ZDA

These sentences can select the port of each sentence input in the radar menu.
The output port is NAV port and EPFS port. As for the EPFS port, the transmission cycle is set at 0 seconds and not output in the state of the factory shipment. The NAV port is output at the following cycles.

RSD=1.0s, OSD=1.0s, TLB=5.0s, TTD=1.0s, TTM=1.0s

Figure 2.24 Cable connection for NAV, EPFS and SDME or Log

2.4.11 Cable connection for interswitch

2.4.11.1 Cable connection for cross, dual and independent connection

In the case of a dual, cross, or master/slave connection using two sets of radar system or Display unit, the remote cable and data cable are connected as shown in the figure.

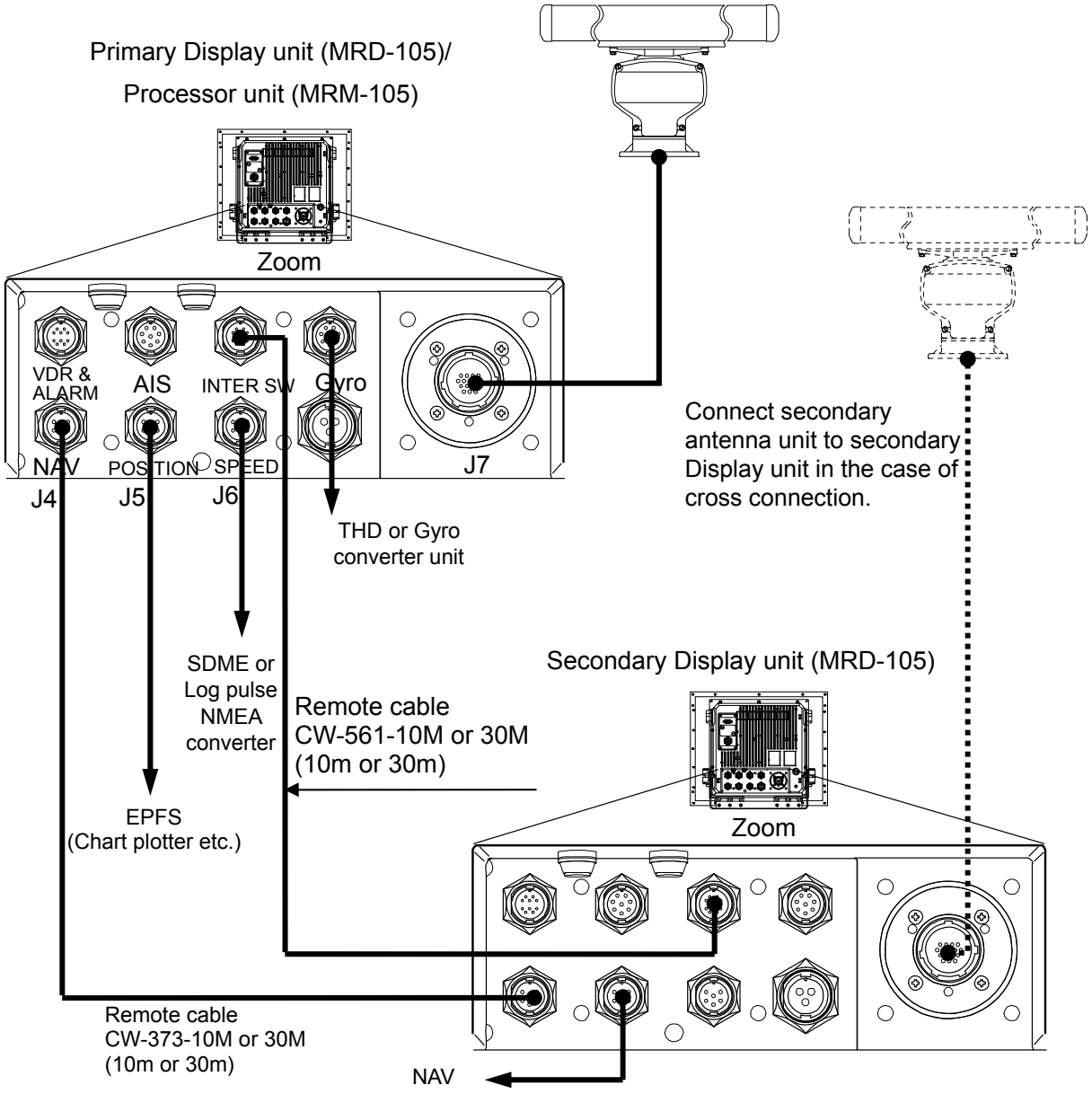


Figure 2.25 Connecting a secondary Display unit on
Cross, dual and independent connection

(1) The heading, speed and latitude/longitude signals input to the data connector of primary Display unit and are supplied to the secondary Display unit via remote cable. The secondary Display unit can also use TT(ARPA) and chart option functions in the same way as the primary one.
(2) Connect the secondary Scanner unit to the secondary Display unit in a cross connection.
(3) Operation unit (MRO-105) is required for MRD-105

2.4.11.2 Cable connection for secondary Display unit used as a monitor

When the secondary Display unit for radar is used as monitor, the remote cable is connected as follows.

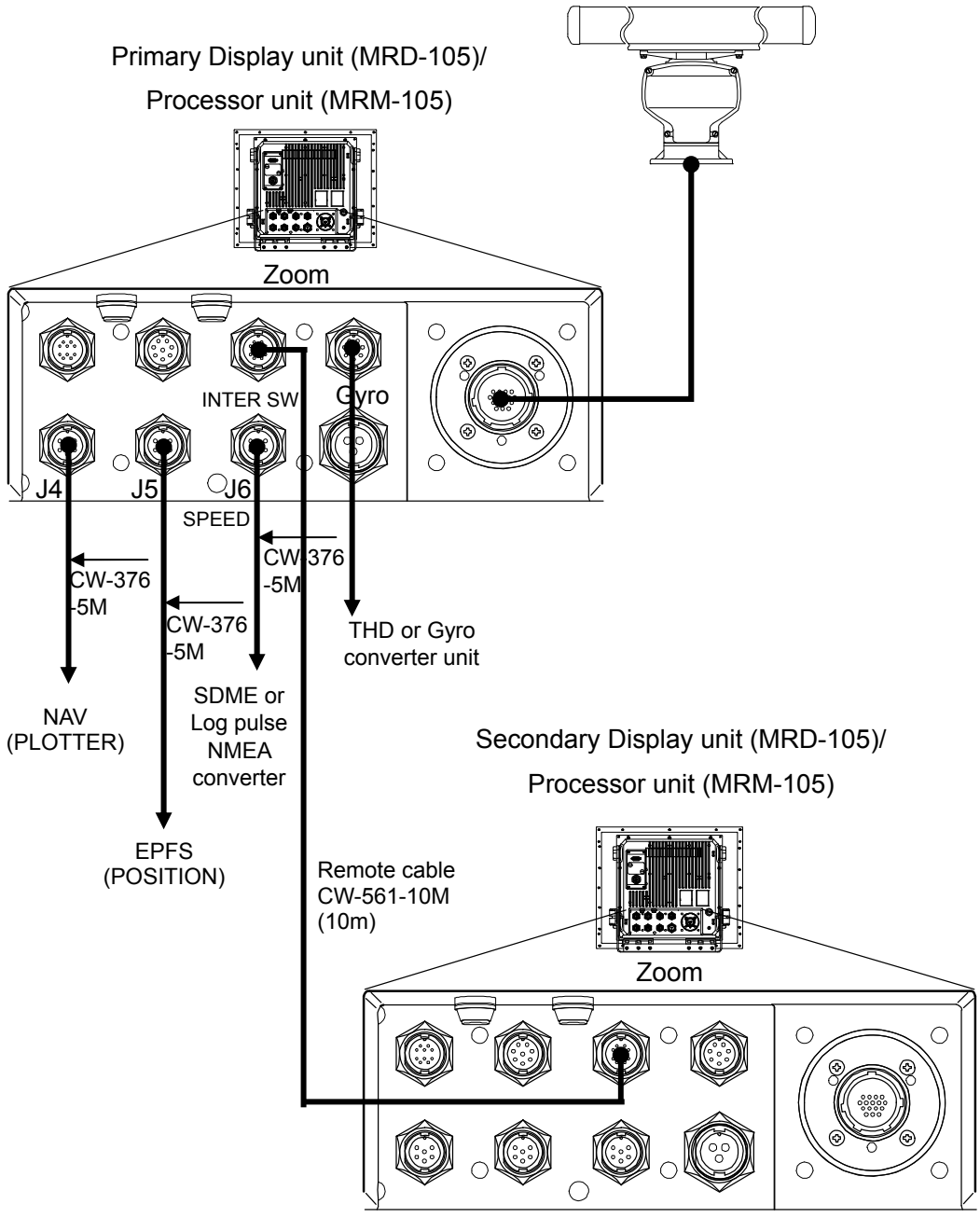


Figure 2.26 Connecting a secondary Display unit as a monitor

(1) When used as a monitor, the secondary Display unit cannot control the Scanner unit. The monitor (secondary Display unit) will display its range in accordance with the primary one.

(2) Operation unit (MRO-105) is required for MRD-105.

Chapter 3 Setup after installation

Some setup procedures are required after system installation. Before performing the setup procedures, please check the following items for normal operation:

(1) The onboard power supply powering the radar system has the specified voltage.

(2) No one is in the area around the Antenna unit or the mast. The indication “Under the radar coordination, do not touch the Operation unit.” is marked on the Display unit.

3.1 The execution order of the STARTUP menu

Please execute the item in the STARTUP menu to the equipment adjustment in the following order.

(1) ANT HEIGHT

(2) ANT CABLE LENGTH

(3) AUTO ADJ

(4) TX DELAY

(5) HL OFFSET

(6) MBS

(7) FUNCTION KEY

3.1.1 Set up Antenna installation height from sea level

Press [MENU] key to display “Menu”.

Select [MAINTENANCE] => [STARTUP] => [ANT HEIGHT], and select Antenna height from sea level, then press [ENT] key by the trackball.

selectable value 0 - 5m, 5 - 10m, 10 - 20m, 20m or more

Note: This setup value influences each curve of manual STC and automatic STC.

3.1.2 Setup antenna cable length

Set up antenna cable length.

Improper setting of antenna cable length may result in degraded target detection.

Press [MENU] key to display “Menu”.

Select [MAINTENANCE] => [STARTUP] => [ANT CABLE] => and select antenna cable length (Disply-scanner), then press [ENT] key.

Selectable value 20m, 40m, and 60m

Note: This setup value influences each curve of manual STC and automatic STC.

3.1.3 Adjustment of automatic tune

In order to achieve best performance, adjustment of the automatic tune is required at the time of a new installation or a magnetron exchange.
It may be impossible to obtain optimum sensitivity without adjusting the automatic tune.

(1) Change the range scale to 12 NM or more by pressing “+” (or “-”) key on the Operation unit. Find the stable object such as the mountain or the island of 6 NM or more as far as possible. Adjust “GAIN” knob to decrease up to the gain where the object can be slightly observed.
(2) Press [MENU] key, select MAINTENANCE=> STARTUP => TUNE and set it to AUTO by the trackball.
(3) Select MAINTENANCE => STARTUP => TUNE AUTO => VALUE will show the current setting of the input value by highlighting the last digit value by the trackball.
(4) Roll the trackball up or down to change the value, and obtain the maximum magnitude of the target in the screen. When a target becomes too strong to find the peak, lower a gain with “GAIN” knob once again and adjust the tune to obtain the maximum magnitude of target.
(5) Press [ENT] key to save the result of the maximum magnitude of target.

3.1.4 Adjustment of transmitting delay time (Trigger Delay)

This adjustment is intended to match the picture on the radar display with the distance of an actual target by the adjustment of the transmission delay time. For the most accurate adjustment, find a close, hard, long, straight object such as a quay wall. Select or chose within 100m an object for the best result. Transmitting delay time is adjusted in accordance with the following procedures.

(1) Change the range scale to 0.25 NM by pressing “+” (or “-”) key on the Operation unit.
(2) Press [MENU] key, select MAINTENANCE=>STARTUP => TX DELAY => VALUE will show the current setting of the input value by highlighting the last digit value by the trackball.
(3) Roll the trackball up or down to adjust the value to get a straight picture of the straight object in the screen as shown in Figure 3.1.
(4) Press [ENT] key to save the adjustment result.

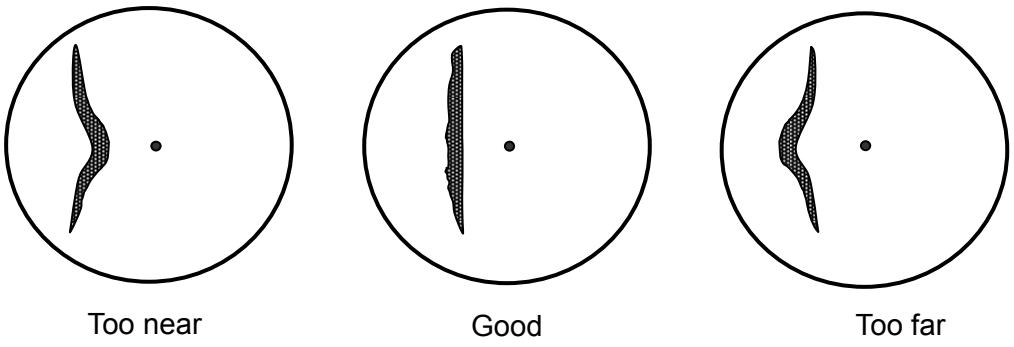


Figure 3.1 Picture display of Trigger Adjustment

3.1.5 Display bearing adjustment

The bearing of a target on the radar screen can be adjusted.

(1) Change the range scale to 1 NM or more by pressing “+” (or “-”) key on the Operation unit.
(2) Select a visible fixed object as far as possible and measure its bearing using magnetic compass or equivalence. Measure the bearing of the same target on the radar screen. Adjust it according to the following procedures when both values differ 1 degree or more.
(3) Press [MENU] key, select MAINTENANCE => STARTUP => HL OFFSET => VALUE will show the current setting of the input value by highlighting the last digit value by the trackball.
(4) Roll the trackball up or down to adjust the value to match the bearing value of the target picture to the compass value.
(5) Press [ENT] key to save the adjustment result.

3.1.6 Setup of MBS value (Main Bang Suppression)

This setting is utilized to suppress the center spot signal at the middle of the picture as shown in Figure 3.2.

(1) Set range to 0.25 NM, RAIN knob to 0, SEA knob to 0, GAIN knob to 8, and brilliance set to bar maximum respectively.
(2) Press [MENU] key, select MAINTENANCE => STARTUP => MBS => to highlight the last digit value, using the trackball.
(3) Turn SEA knob to display center spot in the middle of the picture.
(4) Roll the trackball up or down to increase MBS value from 0 with observing the center circle until the circle is faded out. Press [ENT] key to save the setting.

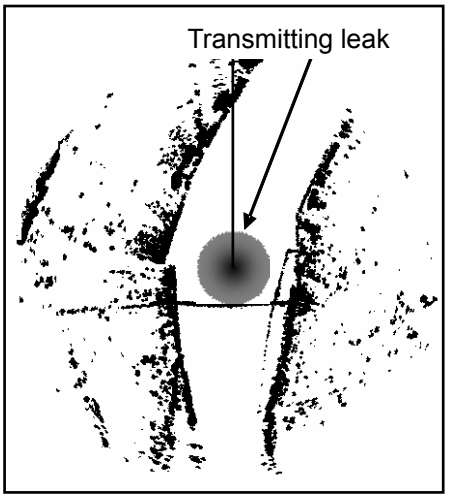


Figure 3.2 Center spot

3.1.7 Function key usage

For quick function access, this radar is provided with six dedicated function keys (“F1”, “F2”, “F3” , “F4” , “F5” , “F6”). You can switch to a prespecified function by pushing each key.

The function key has been assigned as follows at delivery from factory settings:

F1: VECTOR TIME F2: VECT T/REL F3: MAP DISP

F4: TRAIL TIME F5: TRAIL T/REL F6: AIS

Table 3.1 Table of function that can be selected.

>RADAR-ALARM	>OS/TGT-TOOL	>MAP-SYSTEM	>SHORT CUT
STAB	VECT T/REL	MAP DISP	
PROCESS	VECT TIME	CHART	
ENH	TGT ID DISP	DEPTH	
IR	PAST POSN T/REL	COAST CURSOR	
VIDEO	PAST POSN TIME	NAVLINE CURSOR	
TRAIL T/REL	AUTO ACQ AREA ON/OFF	ROUTE CURSOR	
TRAIL TIME	AUTO ACQ AREA EDIT	EVENT CURSOR	
TRAIL RESET	OS PAST TRK TIME	AREA CURSOR	
TM RESET	OS PAST TRK RESET	MAP DELETE	
C UP RESET	OS OUTLINE	EVENT OWN	
HOLD	AIS	TTL OUT	
ZOOM	TT DELETE	TIME	
FERRY MODE	TT ALL DELETE	ASSISTANT DISP	
ECHO ALARM ON/OFF	TT REF ACQ	TGT LIST SORT	
ECHO ALARM EDIT	RR		
GZ ALARM ON/OFF	BRG T/REL		
GZ ALARM EDIT			
PERFORMANCE			

1 Press [MENU] key to display “Menu”.
Select [MAINTENANCE] => [STARTUP] => [F1], and then press [ENT] key after selection.
*No numerical value is displayed in function key operation.

2 The same procedure as step 1 is applied for [F2], [F3], [F4], [F5], [F6], by selecting each item and pressing the [ENT] key.

[SHORT CUT]: This function makes it easy to access a menu item that was previously set up by pressing the F key once.

1 Select F key to be assigned as short cut key (for example [F1] key).

2 Move to the menu that you want to assign for short cut function.

3 Push a [F1] key by holding a [OFF] key.

4 The setup is complete when beeping the buzzer for 2 second.

5 Push [F1] key without menu, and then assigned short cut menu will appear immediately.

3.2 Setup Interface

For display mode, TT(ARPA), true ship's trail and own ship's trail, it is necessary to input ship's bearing data and ship's speed data from other devices. In addition, for AIS, mapping function, display of own ship's information and display of latitude and longitude, it is necessary to input latitude and longitude data of own ship's data. In order to use these datum, set the following menu items after connection in accordance with 2.4 "Cable connection to a Display unit".

Example Display : [MENU] => [MAINTENANCE] => [I/O]

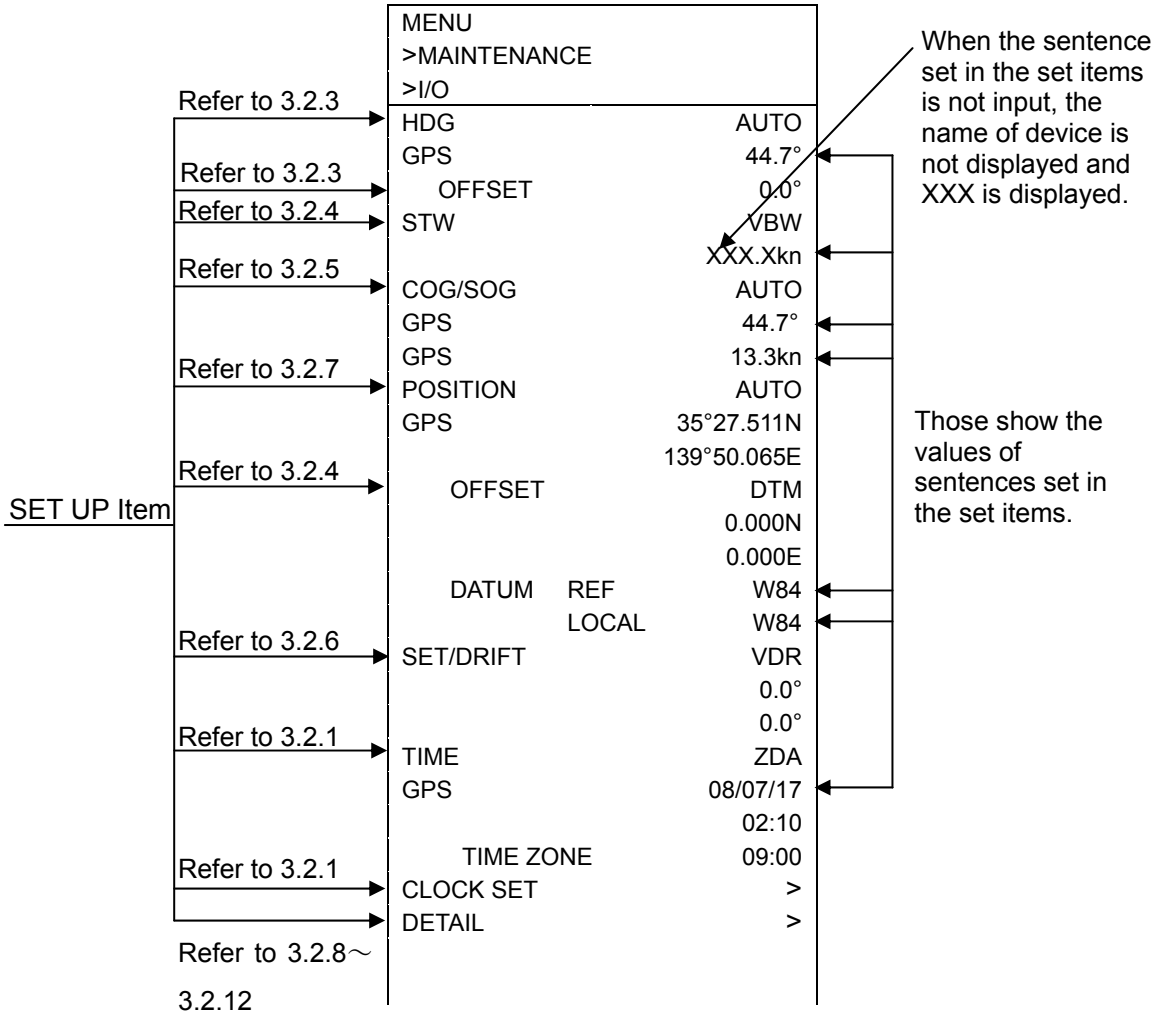


Figure3.3 I/O menu

3.2.1 Setup TIME

Set up time related items to be displayed in the top right part of the screen.

Select information source of time to be indicated.

Select [MAINTENANCE] => [I/O] => [TIME] => [EPFS or CLOCK] and then press [ENT] key.

CLOCK: Internal clock of the radar

In order to use the internal clock of the radar, time set is required.

1. Select [MAINTENANCE] => [I/O] => [TIME] => [CLOCK] and then press [ENT] key.
2. Set the internal clock for year, month and day by UTC.

Select [MAINTENANCE] => [I/O] => [CLOCK SET] => [DATE] => to highlight the value of [Day/Month/Year]. Roll the trackball up or down to match it to the coordinated universal time, and then press [ENT] key.

3. Set the internal clock for time by UTC.

Select [MAINTENANCE] => [I/O] => [CLOCK SET] => [TIME] => to highlight the value of [hour: minute]. Roll the trackball up or down to match it to the coordinated universal time, and then press [ENT] key.

4. Input time difference between local time and UTC.

Select [MAINTENANCE] => [I/O] => [TIME ZONE] => to highlight the value of [hour: minute]. Roll the trackball up or down to match it to the time difference, and then press [ENT] key.

3.2.2 Use without connection of HDG, SPD, LAT/LON and Way Point, etc.

To make the use of the function of this device, the default is set provided that all external input shall be connected at the initial status. Therefore, when only basic function of radar (excluding navigation function, mapping function, display of data, TT(ARPA) and AIS, etc.) will be used without connection to other devices, an alarm with sound is displayed to remind an operator of input of ship's bearing, ship's speed and latitude and longitude. Please use this device with keeping the ship's bearing, ship's speed and latitude and longitude OFF as follows:

Method of setting:

Press [MENU] key and set as follows with the track ball:

When HDG is not input (GPS compass and gyro are not connected):

[MAINTENANCE] => [I/O] => [DETAIL] => [SENTENCE SET] => [HDG INPUT] => ［OFF], and then press [ENT] key after selection.

When SPD is not input (LOG and GPS are not connected):

[MAINTENANCE] => [I/O] => [DETAIL] => [SENTENCE SET] => [SPD INPUT] => [OFF], and then press [ENT] key after selection.

When LAT/LON is not input (GPS and plotter are not connected):

[MAINTENANCE] => [I/O] => [DETAIL] => [SENTENCE] => [LAT/LON INPUT] => [OFF], and then press [ENT] key after selection.

When way point and Rout are not input (Plotter and ECDIS are not connected):

[MAP] => [MONITORED ROUT] => [OFF], and then press [ENT] key after selection.

[MAP] => [WPT ID DISP] => [OFF], and then press [ENT] key after selection.

3.2.3 Set up heading interfaces

3.2.3.1 Connection of KGC-1 for obtaining ship's bearing signal

Connect KGC-1 to the SDME (ship's speed) port. See 2.4.3 for its connection.

[MAINTENANCE] => [I/O] => [DETAIL] => [SENTENCE SET] => [HDG INPUT] => [ON], and then press [ENT] key after selection.

[MAINTENANCE] => [I/O] => [HDG] => [AUTO], and then press [ENT] key after selection.

Initialize KGC-1, and DATA 2 in KGC-1 and SDME port of the radar are optimally reset.

[MAINTENANCE] => [I/O] => [DETAIL] => [KGC-1 SET] => [INITIAL] => [GO], and then press [ENT] key after selection.

Caution: With this initialization, DATA 2 (ports connected to the radar) of KGC-1 is set at 38400 for baud rate, 50 ms for signal cycle, and HDT, GGA and VTG for signal type. When DATA 2 is used by other device and they do not correspond to the adobe signals, other devices shall be connected to DATA 1. Alternatively, do not perform the initialization.

Compensate angles of KGC-1.

When the mounting direction of KGC-1 has been out of alignment, compensation of the misalignment allows KGC-1 to output HDT signal as follows:

[MAINTENANCE] => [I/O] => [DETAIL] => [KGC-1 SET] => [BRG COR] => [0.0°] and then select the last digit of entry frame for a numerical value and set with [ENT] key after pointing at the angle to be compensated by turning the trackball up and down.

3.2.3.2 Connection of NSK unit to obtain ship's bearing signal

Connect NSK unit to the port of GYRO. See 2.4.6 for connection.

[MAINTENANCE] => [I/O] => [DETAIL] => [SENTENCE] => [HDG INPUT] => [ON], and then press [ENT] key after selection.

[MAINTENANCE] => [I/O] => [HDG] => [AUTO], and then press [ENT] key after selection.

When the gyro port is initialized for the NSK unit, the port is optimized for NSK unit.

[MAINTENANCE] => I/O => [DETAIL] => NSK SET=> [INITIAL] => [GO], and then press [ENT] key after selection.

When there is always any constant error in the values input from NSK unit, it can be used after compensation.

[MAINTENANCE] => [I/O] => [DETAIL] => [NSK SET] => [BRG CORR] => [0.0°] and select the last digit of entry frame for a numerical value and set with [ENT] key after pointing at the angle to be compensated by turning the trackball up and down.

3.2.3.3 Connection of output device of ship's bearing (THD) such as gyro to obtain ship's bearing signal

In the case of a gyro with analogue signal output such as step signal or synchronous signal (see 2.4.6 for connection), insert a S2N gyro convertor or a NSK unit between them, convert the analogue signal into that of IEC 61162-2, and then input the signal into the gyro port of this device. When a THD (a gyro with output based on IEC 61162) or a GPS gyro from another manufacturer is connected (see2.4.6), connect the output based on IEC 61162 directly to the gyro port of this device. Setting can be performed with pressing [MENU] key as follows:

[MAINTENANCE] => [I/O] => [DETAIL] => [SENTENCE] => [HDG INPUT] => [ON], and then press [ENT] key after selection.

[MAINTENANCE] => [I/O] => [HDG] => [AUTO], and then press [ENT] key after selection.

Set values: AUTO, THS, HDT, HDG, HDM, VTG, RMC

AUTO: Selection is done in order to priority shown in the table in 6.1.2.

Caution: In case of either HDG or HDM or VTG or RMC is selected, TT(ARPA) function and True Trail function will not always work properly.

Compensation of angle of ship's bearing

When there is any constant error in input ship's bearing, it can be used after compensated as follows:

[MAINTENANCE] => I/O => [HDG OFFSET] => [0.0°] and select the last digit of entry frame for a numerical value and set with [ENT] key after pointing at the angle to be compensated by turning the trackball up and down.

Caution: Interface of the connected devices shall be set at the following values in accordance with each instruction manual:

Baud rate: 38400 bps

Sentence: THS or HDT

Update cycle: 50 ms or 25 ms

3.2.4 Setting of STW to be used for SEA STAB

Select an input device for STW to be used for TT(ARPA), AIS, TM, Trail and PST POSN at stabilized speed against water.

In the case of speed meter against water with pulse output such as LOG, the output shall be put in SDME of this unit after conversion of the signal into that of IEC 61162-1 through L1N LOG convertor or NSK unit inserted between them (see 2.4.8). Speed signal from KGC-1 and GPS can be also input. For setting of this, use of [AUTO] is recommended as shown below:

[MAINTENANCE] => [I/O] => [DETAIL] => [SENTENCE] => [SPD INPUT] => [ON], and then press [ENT] key after selection.

[MAINTENANCE] => [I/O] => [STW] => [AUTO], and then press [ENT] key after selection.

Set values: AUTO, VHW, VBW, VTG, RMC, RMA and MAN

MAN: This function is intended to input speed values manually. [MAN] is provided as an emergency measure, because many functions of radar become unavailable when the speed meter is faulty. However, when [MAN] is selected, AIS is not available.

AUTO: Selection is done in order to priority shown in the table in 6.1.2.

Caution: In NSK, speed pulses are required to have been input from speed LOG unit. Stability against water can be reached with calculation of ship's bearing and speed against water. Therefore, it is not right to use VTG, RMC and RMA that are speed against ground. However, there are many devices that are not provided with a speed meter against water, and for such devices, stabilizing function against water cannot be used. For this reason, speed meter against ground has been also made available instead. Please understand that this function of the devices is different from the traditional stabilizing function against water.

3.2.5 Setting of COG/SOG to be used for GROUND STAB

Select an input device of COG/SOG to be used for TT(ARPA), AIS, TM, Trail and PAST POSN at stabilized speed against ground. It is necessary to connect to GPS, Navigation device (VTG, RMC and RMA), 2-axis SDME (VBW) or current meter (CURRENT).

[MAINTENANCE] => [I/O] => [COG/SOG] => [AUTO], and then press [ENT] key after selection.

Set values: AUTO, VBW, VTG, RMC, RMA and CURRENT

CURRENT: COG/SOG is calculated from STW in 3.2.4 and current selected in 3.2.6.

AUTO: Selection is done in order to priority in the table of 6.1.2.

Caution: When a ship has been brought to or is sailing, VTG, RMC and RMA of GPS may wamble in the course. Therefore, the speed vector of TT(ARPA) may also wamble. In this case, use it at the stabilized apeed against water.

3.2.6 Select SET/DRIFT input

When [CURRENT] is selected in 3.2.5, the device to input SET/DRIFT is selected.

Select the sensor of SET/DRIFT when [CURRENT] is selected at COG/SOG.

[MAINTENANCE] => [I/O] => [SET/DRIFT] => [VDR or MAN] and then press [ENT] key.

Set values : VDR, MAN

MAN: Use SET/DRIFT value manually input. When [MAN] is selected, entry of SET/DRIFT becomes possible in the data display area.

Note: AIS display does not work when [MAN] is selected.

3.2.7 Setting of sentences for input of latitude and longitude

When [MAP] function, map, AIS or Way Point, etc. is used, necessary sentences of latitude and longitude are selected from GPS or navigation devices.

[MAINTENANCE] => [I/O] => [POSITION] => [AUTO], and then press [ENT] key after selection.

Set values: AUTO, GNS, GGA, GLL, RMC, RMA and MAN

MAN: Manual input function as an emergency measure when positioning meter such as GPS is faulty.

AUTO: Selection is done in order to priority in the table in 6.1.2.

Selection of sentences to be used for [OFFSET]

When the geodetic system in navigator and that in the map used are different, the position may become different even with the same values of latitude and longitude. In this case, input of [OFFSET] allows these positions to be matched.

[MAINTENANCE] => [I/O] => [POSITION OFFSET] => [MAN], and then press [ENT] key after selection.

Set values: VDR and MAN

MAN: Setting is done by manual input of values.

For setting in [MAN] mode, set the radar in N-UP mode to display map. Transmit radar and display the echo. Then, comparing the landscape of the radar image with the map, input offset values of latitude and longitude with the trackball. When a value of latitude is input in N-UP mode, the map moves up and down, and when a value of longitude is input, it moves right and left. Compensation can be easily applied.

3.2.8 Setting of output of NAV and EPFS

The data of tracking targets can be output on the plotter and ECDIS. There are two ports of [NAV] and [EPFS] that can be output. Setting method is: When [MAINTENANCE] => I/O => [DETAIL] => [OUTPUT NAV] or [OUTPUT EPFS] is selected, menu of the figure to the right is displayed.
If time of each sentence is set with the trackball in this menu, the set sentences are output in accordance with the set cycles.
Sentences set at 0.0 s are not output.

Set values: 0.0 to 10.0 s

MENU		
>MAINTENANCE		
>I/O		
>DETAIL		
>OUTPUT NAV		
DTM	0 .0	s
GLL	0 .0	s
HDT	0 .0	s
ROT	0 .0	s
RSD	0 .0	s
OSD	0 .0	s
THS	0 .0	s
TLB	0 .0	s
TLL	0 .0	s
TTD	0 .0	s
TTM	0 .0	s
VBW	0 .0	s
VDR	0 .0	s
VHW	0 .0	s
VTG	0 .0	s
ZDA	0 .0	s

Figure 3.4 OUTPUT Menu

3.2.9 TLL output

The positions of marks and a crosshair cursor can be output to external devices.

Select the kinds of TLL sentences to be output.

[MAINTENANCE] => [I/O] => [DETAIL] => [TLL OUT] => [TT, MARK or TARGET], and then press [ENT] key after selection.

Set values: [TT], [MARK], [TARGET]

TT: The position of automatic tracking target captured is output with the cycle set in 3.2.8.

MARK: The positions marked in drawing will be output at every marking.

TARGET: TLL output is set on the function key. Every press of the function key allows the position of crosshair cursor to be output as TLL on the screen.

3.2.10 ALR output

Signal (ALR) of alarm generated by radar can be output to external devices. In addition, it is possible to stop the alarm from the radar with receipt of signals (ACK) to stop it from the external devices.

Select a port for transmission of fault alarm in radar to external devices.

[MAINTENANCE] => [I/O] => [DETAIL] => [ALR OUT SEL] => [NAV], and then press [ENT] key after selection.

Set values: NAV, EPFS, SDME, GYRO

3.2.11 Limiting of type of signal to input port

When the device is connected with multiple nautical instruments, the same signals from HDT and GGL, etc. are input from several input ports. If the values of these input signals are different, interference that may cause jumping of ship's bearing and LAT/LON may occur. In these cases, an input port can be assigned for each signal type.

Select as [MAINTENANCE] => [I/O] => [DETAIL] => [INPUT] and display the setting sub-menu as follows:

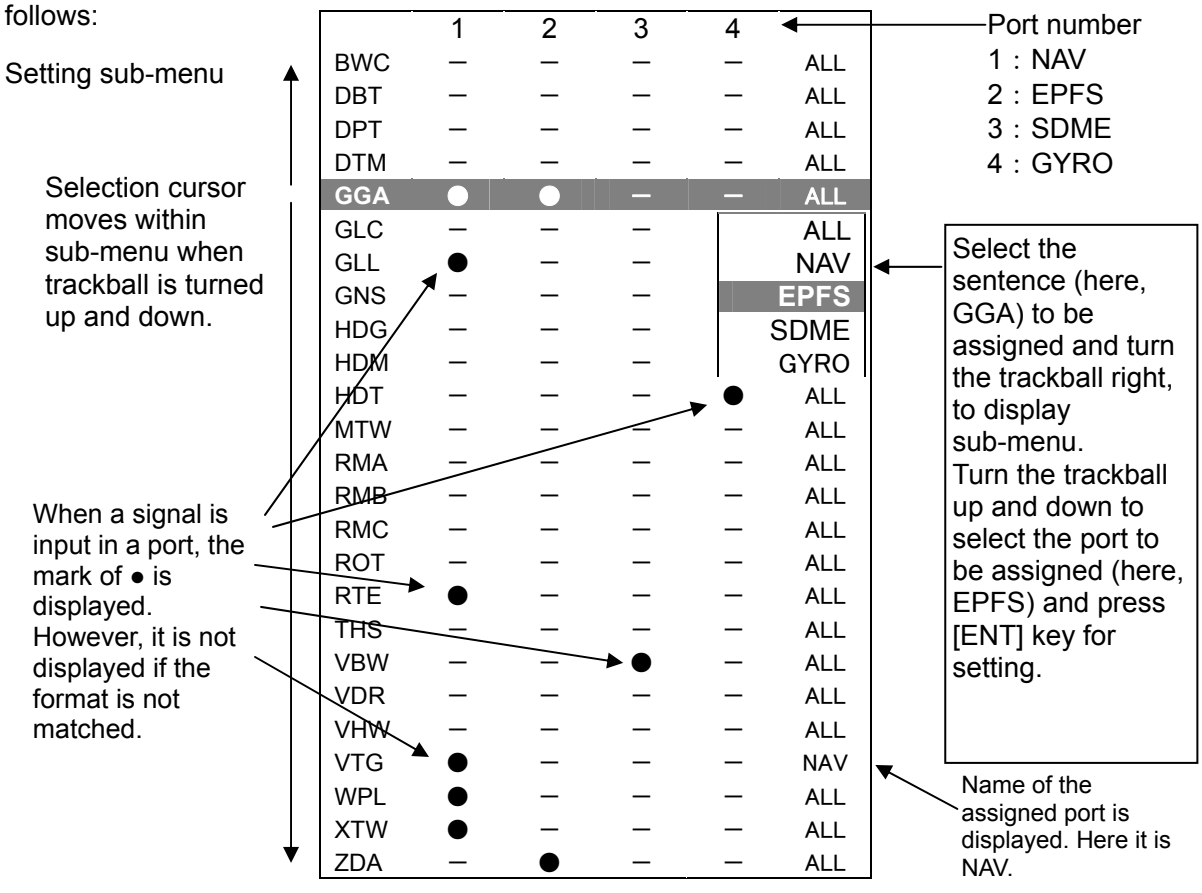


Figure 3.5 INPUT Menu

3.2.12 Changing of formats of input/output ports of navigation devices, position and ship speed (IEC 61162).

When the data is correctly input in each port and is not displayed on the screen, the formats of signals (IEC 61162) may be unmatched. In this case, display [INPUT] menu mentioned in 3.2.11, and confirm that a mark is displayed at the intersection point of the input sentence and the input port. When a mark is not displayed, set each format (baud rate) of input/output so as to match with those of connected sensors with input sentences.

The baud rates are:

IEC 61162-1: 4800 bps
IEC 61162-2: 38400 bps
NSK: NSK original format

Default values per port is set as follows:

Navigation device: IEC 61162-2
Position (EPFS): IEC 61162-1
Ship speed (SDME): IEC 61162-1
Gyro (Gyro): IEC 61162-2

Example of change of setting:

[MAINTENANCE] => [I/O] => [DETAIL] => [FORMAT] => [NAV] => [IEC 61162-1], and then press [ENT] key after selection.

Caution: When NSK is initialized as shown in 3.2.3.2, the gyro port is set to the NSK original format. It is not possible to set input and output to a different format separately in a port.

3.3 Setting of [PRESET] menu

3.3.1 Change of maximum adjustable range of [GAIN] knob

Display sensitivity of the screen against the knob of GAIN is set. When the sensitivity against rotation of the knob is too high or too low, it can be adjusted with knob.

(1) Press [+] key (or [-]) key of the range on the transmission screen to set the range of the screen at 12 NM or higher.

(2) Set the knobs of RAIN and SEA at 0, the knob of GAIN at scale 8 and the knob of BRILL at the maximum, respectively.

(3) Please confirm that IR is 3. Otherwise, set the IR at 3. Setting procedure of IR3: Put the cursor => on IR OFF or numerical value on the screen and press [ENT] key to make the numerical value to be 3.

(4) Select [MAINTENANCE] => [PRESET] => [GAIN MAN] => to highlight the last digit value.

(5) Watching the white noise on the screen, change the setting value for gain with moving the trackball up and down, and press [ENT] key at an appropriate point for setting.

The set value is applied to the entire range.

3.3.2 Setting when there is difference in GAIN at changeover of range

Maximum gain can be set per pulse width corresponding to ranges. At first, watch a target on the radar screen. If the strength of this target varies with changes of the range, it is necessary to adjust GAIN OFFSET BW.

Adjustment method:

(1) Press [+] key (or [-]) key of the range on the transmission screen to set the range of the screen at 6 NM.

(2) Press [SP/LP] key to set pulse width to be [LP 1].

(3) Watch a stabilized target with intermediate level of gradation.

(4) Press [SP/LP] key to set pulse width at [MP 4].

When the target with [MP 4] pulse width is weak:

Press [MENU] key and proceed to [MAINTENANCE] => [PRESET] => [GAIN OFFSET BW] => [MP 4] => highlight the last digit value in the entry frame of numerical value. Turn the trackball upward to increase the value so that the target has the same strength. And then, press [ENT] key at an appropriate point for setting.

When the target with [LP 1] pulse width is weak:

Press [SP/LP] key once more to set [MP 4] pulse width. Press [MENU] key and watch a stabilized target wit intermediate level of gradation, and highlight the last digit of value in the entry frame of numerical value. And then, turn the trackball upward to increase the value so that the target has the same strength and press [ENT] key at an appropriate point for setting.

(5) Set the range at 3 NM and press [SP/LP] key to set [MP 4] pulse width. Watch a stabilized target with intermediate level around 1 NM and press [SP/LP] key to set [MP 2] pulse width. Following the same procedure as that in item (4) above, adjust [MP 2].

(6) Set the range at 1.5 NM. In order that the target around 1 NM watched in the 3 NM range has the same strength, adjust the value in the processes of [MAINTENANCE] => [PRESET] => [GAIN OFFSET BW] => [MP 3].

In the same 1.5 NM, press [SP/LP] key to set the pulse width to be [MP 1]. Following the same procedure as that in item (4) above, adjust [MP 1].

(7) In the range of 1.5 NM, press [SP/LP] key to make the pulse width to be [MP 1]. Watch a stabilized target with intermediate level of gradation whose distance is not more than 0.7 NM. Set the range at 0.75 NM. Following the same procedure as that in item (4) above, adjust [SP].

3.3.3 Preset of SEA AUTO level

Gradation of clutter displayed in the screen can be adjusted by SEA AUTO LAND and SEA AUTO SEA.

The use of automatic anti-sea clutter allows suppression effect of sea clutter to be strengthened or weakened, if desired. This adjustment can be applied at area where there is no land within 1 km and the sea clutter is strong.

1. SET SEA to AUTO (Refer to Operation manual 2.8 Reject sea clutter)

2. Follow the steps below.

Select [MAINTENANCE] => [PRESET] => [SEA AUTO SEA] => to highlight the last digit value. Make sea clutter displayed by even dark level in the screen by rolling the trackball up and down while watching the screen. Then press [ENT] key.

3. Follow the steps below.

Select [MAINTENANCE] => [PRESET] => [SEA AUTO LAND] => to highlight the last digit value. Enter the same value by rolling the trackball up and down as SEA AUTO SEA. And then press [ENT] key.

3.3.4 Change of maximum value of [SEA] knob

The use of manual SEA suppression allows the suppression effect at the maximum position of [SEA] knob to be adjusted:

(1) Set the range at 12 NM range, [RAIN] and [SEA] knobs at 0, [GAIN] knob at scale 8 and [BRILL] at maximum.

(2) Turn VRM 1 ON and set VRM at 8.0 NM.

(3) Put the cursor on IR 3 on the screen, press [ENT] key to select OFF. When IR is turned OFF, white noise on the screen increases. Keep [GAIN] knob at scale 8.

(4) Set [SEA] knob at scale 10 (maximum).

With the trackball, follow [MAINTENANCE] => [PRESET] => [SEA MAN MAX] => and highlight of the last digit of entry frame for numerical values.

(5) Move the trackball up and down watching white noise on the screen to increase the set value of [SEA MAN MAX] from 0. When the white noise on the screen disappears from the area between the center and 8 NM, stop the movement of the trackball and press [ENT] key for setting.

(6) After completion of all setting, return to IR3.

The set value of [SEA MAN MAX] is applied to the entire ranges.

3.3.5 Use of PRE-SEA suppression under the Manual SEA

This setting is a function to make the value set under Sea suppression effective even when [SEA] knob is set at the minimum. Due to the raise of the minimum value, this function allows the effect against the angle of rotation of the knob to be moderated and the adjustment with the knob to be made easier. This adjustment can be used in common for the entire range. Please carry out the adjustment at mild state of sea.

(1) Set the range at 0.75 NM, knobs of [RAIN] and [SEA] at 0, knob of [GAIN] at scale 8 and [BRILL] at the maximum.

(2) Press [MENU] key and follow the process of [MAINTENANCE] => [PRESET] => [SEA MAN MIN] => and highlight of the last digit of entry frame of numerical value with trackball.

(3) Change the numerical value with turning the trackball up and down, erase sea clutter on the screen that may be generated by dust and birds, and set not to erase bondens and seaway buoys. Press [ENT] key for setting.

3.3.6 When there is difference in the effect in Manual SEA suppression at changeover of ranges

The level of suppression effect of Manual SEA can be set for each pulse width corresponding to each range. At first, set [SEA] at [MAN] and turn [SEA] knob to a moderate degree. Watch a target on the radar screen. If the strength of this target varies according to the changes of the range, [SEA MAX OFFSET] needs to be adjusted.

Adjustment method:

(1) Press [+] key (or [-]) key of the range on the transmission screen to set the range of the screen at 6 NM. Set [SEA] knob to a moderate degree.

(2) Press [SP/LP] key to set the pulse width at [LP 1].

(3) Watch a stabilized target with intermediate level of gradation.

(4) Press [SP/LP] key to set the pulse width at [MP 4].

When the watched target with MP 4 is weak:

Press [MENU] key and follow the process of [MAINTENANCE] => [PRESET] => [SEA MAX OFFSET] => [MP4] => and highlight the last digit of the entry frame of numerical values. Turn the trackball up and down to increase the value so that the target has the same strength and press [ENT] key at an appropriate point for setting.

(5) Set the range at 3 NM and press [SP/LP] key to set the pulse width at MP 4. Then, watch a stabilized target with intermediate level of gradation adjacent to 1 NM, and press [SP/LP] key to set the pulse width at MP 2. Following the same procedure as that in item (4) above, adjust [MP 2].

(6) Set the range at 1.5 NM. Follow the process of [MAINTENANCE] => [PRESET] => [SEA MAX OFFSET] => [MP 3] and adjust the value so that the watched target adjacent to 1 NM in the range of 3 NM has the same strength.

Press [SP/LP] key in the same 1.5 NM range to set the pulse width at MP 1. Following the same procedure as that in item (4) above, adjust [MP 1].

(7) Press [SP/LP] key in the range of 1.5 NM to set the pulse width at MP 1. Watch a stabilized target with intermediate level of gradation whose distance is not more than 0.7 NM and set the range at 0.75 NM. Following the same procedure as that in item (4) above, adjust [SP].

3.3.7 Switching over of FTC or CFAR in anti-rain clutter suppression mode

This mode allows anti-rain clutter suppression knob to be switched over to CFAR or FTC (DIFF). This has the same function as the anti-rain clutter suppression switch on the operating panel and the pressing of [ENT] key on the screen with cursor.

3.3.8 Changing of the maximum of anti-rain clutter suppression knob at FTC

This is intended to adjust the maximum value of anti-rain clutter knob when anti-rain clutter is used in DIFF. When the effect of anti-rain clutter suppression is weak or strong, this can be used.

Set the anti-rain clutter suppression knob at scale 8 in rainfall.

Press [MENU] key and follow the process of [MAINTENANCE] => [PRESET] => [ANTI-RAIN CLUTTER MAX] and highlight the last digit of the numerical entry frame. Move the trackball up and down watching the screen, and press [ENT] key when large blocks of rain clutter become smaller points and just before small boats and seaway buoys will disappear.

3.3.9 Set preset DIFF (FTC)

Preset FTC can be set. This is a function to make FTC effective even when anti-rain clutter suppression knob is set at minimum.

This function has also effect to moderate the effect against turned angle of the knob and to make adjustment easy. This setting can be applied to the entire range.

(1) Press [RAIN] knob to set anti-rain clutter at DIFF.

(2) Set [RAIN] knob at 0, [SEA] knob at moderate, [GAIN] knob at scale 8 and [BRILL] at maximum.

(3) Press [MENU] key and follow with the trackball [MAINTENANCE] => [PRESET] => [RAIN MIN] and highlight the last digit of the numerical entry frame.

(4) Move the trackball up and down to change the value, and press [ENT] key when bondens and seaway buoys have reduced small enough in sizes on the screen.

3.3.10 Change of maximum value of Anti-rain clutter suppression at [CFAR]

This is intended to adjust the maximum value of [RAIN] knob when anti-rain clutter is used in CFAR. This is to adjust when effect of sea clutter and anti-rain clutter suppression function is too weak or too strong.

In rainfall or sea clutter, the knob of [RAIN] knob shall be set at scale 8.

Press [MENU] key and follow with the trackball as [MAINTENANCE] => [PRESET] => [CFAR MAX] => and highlight of the last digit of the entry frame for numerical values. Move the trackball up and down watching the screen, and press [ENT] key when large blocks of rain clutter become smaller points, and just before small boats and seaway buoys will disappear.

3.3.11 Setting of preset CFAR

Preset CFAR is set. When this is set, CFAR can be made effective even when [RAIN] knob is set at the minimum. This function has also effect to moderate the effect against turned angle of the knob and to make adjustment easy. This setting can be applied to the entire range.

(1) Press [RAIN] knob to set anti-rain clutter at CFAR.

(2) Set [RAIN] knob at 0, [Screen brightness] at the maximum.

(3) Press [MENU] key and follow with the trackball as [MAINTENANCE] => [PRESET] => [CFAR MIN] => and highlight of the last digit of entry frame for numerical values.

(4) Move the trackball up and down, and press [ENT] key just before the sizes of bondens and seaway buoys on the screen have reduced small enough.

3.3.12 Setting of signal detection threshold of TT(ARPA)

This is to set detection level of TT(ARPA) target.

When the set value is decreased, sensitivity increases and weak echo can be captured. When the set value is increased, sensitivity decreases and weak echo such as noise cannot be captured.

A value of a target level represents the threshold of the target signal. When there is strong sea clutter around a target, tracking may move from the target to the sea clutter to lose the target. In the case of a target of which signal strength varies on a grand scale, TT(ARPA) may lose the target. The initial value is “15”.

3.3.13 Change of background noise and target signal gradation

With this function, it is possible to make edges of target images sharper and also to change the colors of sea clutter and rain to different colors with more neutral tone.

With colors with more neutral tone, it could become easy to distinguish sea clutter and rain from targets with difference of colors, but sensitivity may seem to have decreased due to weaker images of weak signals. However, these images are suitable for heavy weather.

3.3.13.1 Change of background noise

Background noise level and display gradation against target echo intensity level can be changed when VIDEO MODE is 0, 1, 2 or 3.

1. Move the cursor on to VIDEO MODE and set for the number to change. Refer to Operation manual 4.5 VIDEO MODE to detail.
2. Set [GAIN] knob at scale 9, [RAIN] knob at DIFF and 0, [SEA] knob at MANUAL and 0, [BRILL] at maximum, IR at 3 and the range at 6 NM.
3. Press [MENU] key, and select [MAINTENANCE] => [PRESET] => [VIDEO SETUP] => [LOW LEVEL] => to highlight the last digit value, roll the trackball up or down to change the value, and then press [ENT] key.

3.3.13.2 Change of Signal gradation

When signals of a particular transmission pulse length are displayed weaker, enhancement of echoes can be arranged by making, HIGH LEVEL value smaller. On the contrary, when clutter and target echoes are displayed by same intensity and there exist no gradation difference, clutter echoes can be presented weaker by increasing HIGH LEVEL value.

1. Display desired pulse length.
2. Press [MENU] key, and select [MAINTENANCE] => [PRESET] => [VIDEO SETUP] => [HIGH LEVEL], if a trackball is rolled to the right, the following sub-menus will be displayed.
3. Confirm Pulse length in the top left area of the screen, and highlight the desired pulse length value to change the value by rolling the trackball up and down to desired value while watching echoes. Then press [ENT] key to fix.

S P	8 0
M P 1	8 0
M P 2	8 0
M P 3	9 4
M P 4	9 4
L P 1	9 4
L P 2	9 4

Figure 3.6 HIGH LEVEL Menu

3.4 Setting of CCRP (common reference position) and own ship profile

To match the measured values with those of GPS and gyro, a common reference position can be set. In addition, own ship profile can be displayed overlapping on the radar screen.

Setting method:

Press [MENU] key and select [MAINTENANCE] => [OS PROFILE] to display a sub-menu as shown below. Turning the trackball up and down, select dimensions A, B, C, D, dx and dy, etc. to highlight the last digit of the entry frame for numerical values. Enter actual values with the trackball and set with [ENT] key.

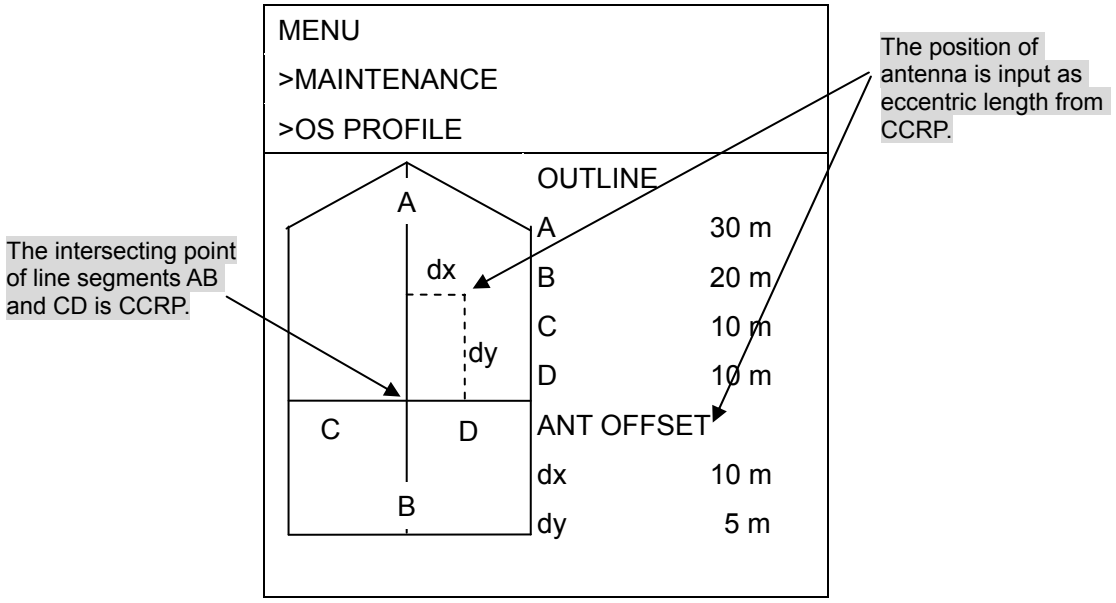


Figure 3.7 OS PROFILE Menu

3.5 Stopping of transmission to certain angle

When false images are generated by objects such as masts, it is possible to reduce the false images by stopping transmission to the direction to the mast.

(1) Press [MENU] key.

(2) Input the angle seen from the heading line to which transmission shall be stopped.

[MAINTENANCE] => [SECTOR MUTE] => [START] => and highlight the last digit of the entry frame for numerical values. Turn the trackball up and down, and input the angle and fix with [ENT] key.

(3) Input the angle seen from the heading line to which transmission shall be started.

[MAINTENANCE] => [SECTOR MUTE] => [END] => and highlight the last digit of the entry frame for numerical values. Turn the trackball up and down, and input the angle and fix with [ENT] key.

(4) Follow [MAINTENANCE] => [SECTOR MUTE] => [ON] and fix with pressing [ENT] key.

3.6 Backup of set values

The set values of radar functions can be stored internally and externally to retrieve them. All changes after delivery from plant such as menu settings, screen setting and mapping input data can be recorded.

3.6.1 Internal storage

Internal storage should be performed after setting of installation. When recovery to the original status after operation of various functions is not easy, it is possible to recover the original status after retrieving the internally stored data.

Internal storage method of data:

Press [MENU] key and follow [MAINTENANCE] => [BACKUP] => [SETUP SAVE] => [GO] and press [ENT] key.

Retrieval method of internally stored data:

Press [MENU] key and follow [MAINTENANCE] => [BACKUP] => [SETUP LOAD] => [GO] and press [ENT] key.

3.6.2 External storage

As external storage does not have influence of initialization, this can be used for replacement of PCB and devices.

External storages shall be PCs that can be equipped with serial communication (with serial port or with USB-serial conversion cable).

The PC needs to be provided with dedicated software (MDC-2XXX.exe).

Connection between a PC and this device shall be done with a dedicated cable (CW-395). Port J4 on this device for navigation equipment (NAV) shall be used. It shall be confirmed that the COM port connected to PC and the COM port of the channel displayed when MDC-2XXX.exe is activated are matched.

After confirming that the external storage PC has been activated to be reservable for the set values or readable (MDC-2XXX.exe is activated), follow the below:

To store the stings in externally:

Press [MENU] key and follow [MAINTENANCE] => [BACKUP] => [EXT SAVE] => [GO] and fix with [ENT] key.

To read settings from external storage:

Press [MENU] key and follow [MAINTENANCE] => [BACKUP] => [EXT LOAD] => [GO] and fix with [ENT] key.

3.7 Use of interswitch function

Connecting 2 sets of radars or 2 sets of Display units, the radars can be used with switching over. As for cable connection, see 2.4.11.

3.7.1 Cross connection

Cross connection is used when 2 sets of aerial wire are located at different positions such as backward and forward or right and left side of a ship, and used for switching over of the aerial wires when images from one aerial is wished to see on another Display unit. For example:

(1) In the case where the ship has approached a port and image from forward aerial is requested to be seen on the Display unit connected to the aerial located at center of the ship.

(2) In the case where aerial wires are located at right and left side and false images have been generated by multi-path and switching over of right and left side aerial wires is necessary to determine whether the displayed images are false or not.

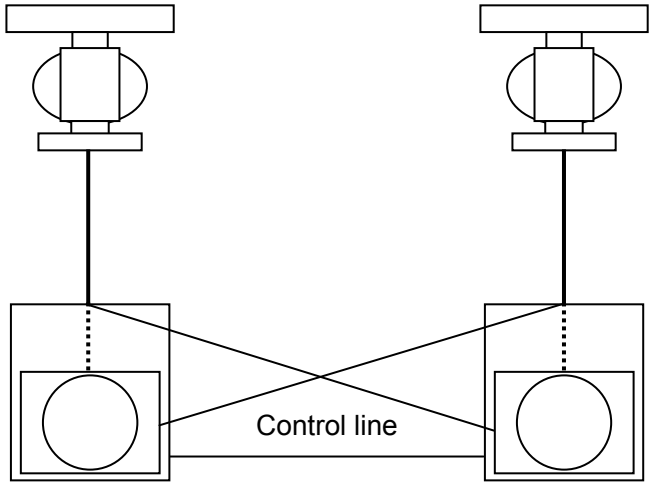


Figure 3.8 Cross connection

Setting method:

(1) Press [MENU] key and follow [SYSTEM] => [INTER SWITCH] => [MODE] => [CROSS] with the trackball and fix with pressing [ENT] key.

(2) One Display unit is set to be in [CROSS], another is also set automatically to be in [CROSS]. Under cross connection, each other's aerial wire can be completely independently controlled. In addition, input from sensors such as ship's bearing, ship speed and latitude/longitude in one Display unit is used in both units. In this case, the Display unit not connected to sensors can be offset the bearing of images with the ship's bearing.

How to offset of image bearing:

(1) Watching images, press [MENU] key and follow [MAINTENANCE] => [I/O] => [HDG OFFSET] => with the trackball and highlight the last digit of entry frame for numerical values.

(2) Press [ENT] key for setting.

3.7.2 DUAL connection

This is function to control one aerial wire with 2 sets of Display units. As for connection, see 2.4.11.2

When there are 2 sets of radars and one of the 2 aerial wires has been put out of commission due to degradation of its performance, images from normal aerial wire can be seen on the both Display units.

In addition, 2 sets of Display units can be connected to one aerial wire and installed at different locations to provide the same images at different places.

In this function, in particular, 2 sets of Display units work with completely. For instance, change of range on one unit is set the same range on another unit. However, TT(ARPA), AIS, GAIN, SEA, RAIN and marks function independently.

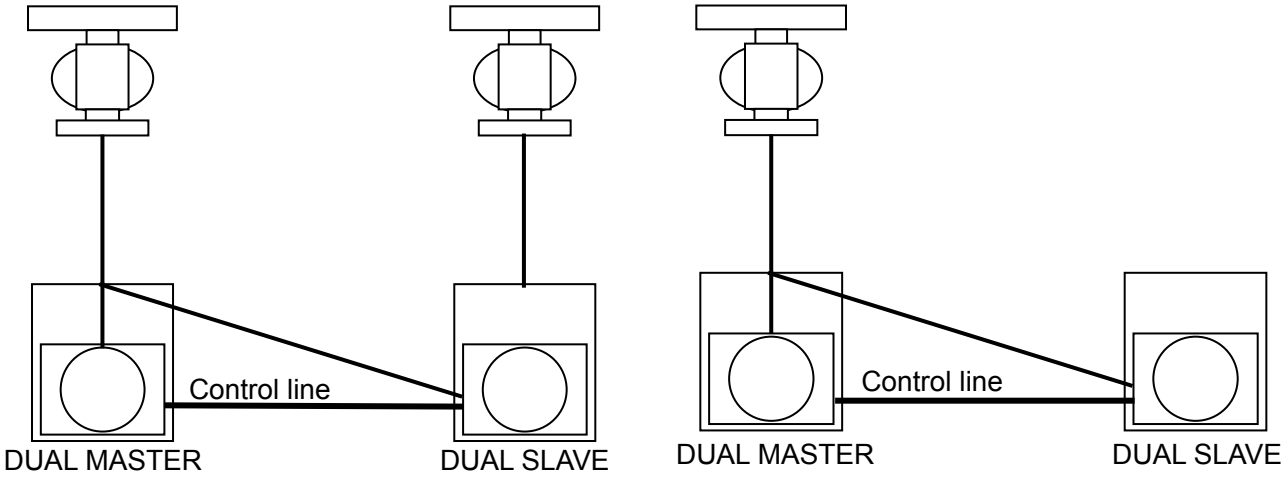


Figure 3.9 DUAL connection

Setting method:

(1) Press [MENU] key and follow [SYSTEM] => [INTER SWITCH] => [MODE] => [DUAL MASTER] with the trackball and press [ENT] key for setting.

(2) In dual connection, when one Display unit is set in [DUAL MASTER], another Display unit is automatically set in [DUAL SLAVE]. In addition, input from sensors such as ship's bearing, ship speed and latitude/longitude in one Display unit is used in both units. In this case, the Display unit not connected to sensors can offset the bearing of images.

How to offset of image bearing:

(1) Watching images, press [MENU] key and follow [MAINTENANCE] => [I/O] => [HDG OFFSET] => with the trackball and highlight the last digit of entry frame for numerical values

(2) Press [ENT] key for setting.

3.7.3 MASTER/SLAVE connection

Just like the case of DUAL connection, the images from one aerial wire can be seen on two Display units. However, SLAVE cannot control aerial wires. See 2.4.9.1 for connection.

For example, this can be set when the ship's captain is operating MASTER and does not wish the

pulse width from SLAVE to be changed without permission. However, it is necessary to set the range of SLAVE in line with the pulse width of the range used in MASTER because SLAVE cannot control aerial wires. If the range is not matched with pulse width, no normal images can be obtained.

TT(ARPA), AIS, GAIN, SEA, RAIN and marks function independently in SLAVE.

The relation between MASTER and SLAVE shown in Figure 3.10 can be exchanged.

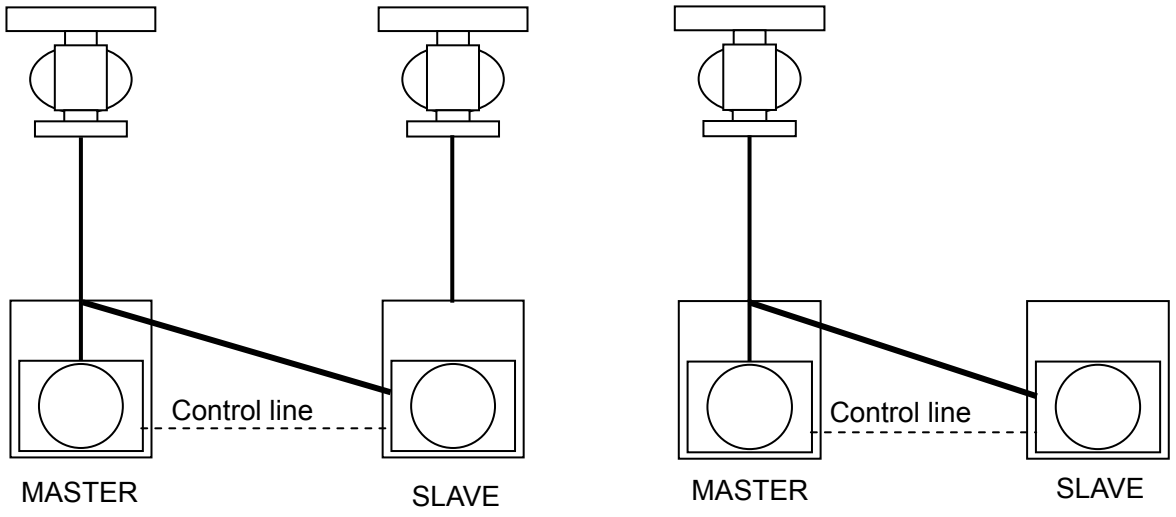


Figure 3.10 MASTER/SLAVE

Setting method:

(1) Press [MENU] key at the side for Master and follow [SYSTEM] => [INTETR SWITCH] => [MODE] => [MASTER] with the trackball, and press [ENT] key for setting.

(2) In MASTER/SLAVE connection, when one Display unit is set as MASTER, another Display unit is automatically set as SLAVE. In addition, input from sensors such as ship's bearing, ship speed and latitude/longitude in one Display unit can be used in both units. In this case, the image bearing can offset.

How to offset of image bearing:

(1) Watching images, press [MENU] key and follow [MAINTENANCE] => [I/O] => [HDG OFFSET] => with the trackball and highlight the last digit of entry frame for numerical values

(2) Press [ENT] key for setting.

3.7.4 Connection of monitor

A monitor displays radar images based on signals of image, bearing and turning angle received from a Display unit. The monitor operates just like a SLAVE in MASTER/SLAVE connection, it is necessary to input speed, ship's bearing and latitude/longitude in the monitor, when map lapping, TT(ARPA), AIS, stabilization reference, TM and true trail are used.

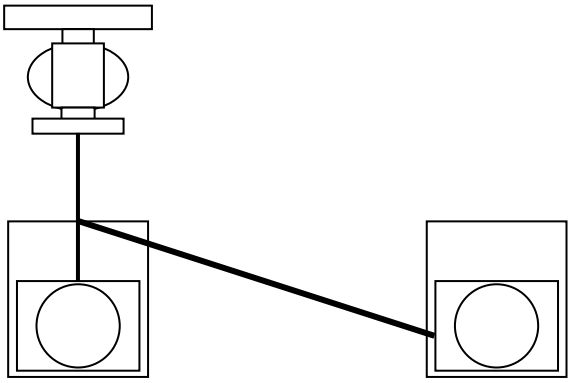


Figure 3.11 Connection of monitor

Setting method:

(1) Press [MENU] key of monitor and follow [SYSTEM] => [INTER SWITCH] => [MODE] => MONITOR with the trackball and highlight the last digit of entry frame for numerical values.

(2) Press [ENT] key for setting.

3.7.5 Setup of Antenna location information

Environmental factors such as dead angle, false images, distances to targets depend on the installation environment. For this reason, it is necessary for radar operators to operate radars keeping these environmental factors in mind.

In the case of a ship where multiple radars are installed, radar antennas have been installed in different environmental locations. Therefore, environmental factors affect on each set of radar will be different.

MDC-2900 series radars are equipped with a function to display antenna position on the screen to remind operators of these environmental factors.

Example of setting:

(1) Press [MENU] key and follow [SYSTEM] => [INTER SWITCH] => [ANT POSN] => [UPPER] with the trackball and highlight the last digit of entry frame for numerical values.

(2) Press [ENT] key for setting.

It is displayed on the screen, “Upper”.

The antennas locations to be displayed on the screen are listed below:

PORT, STBD, FWD, MID, AFT, FWD PORT, FWD STBD, MID PORT, MID STBD, AFT PORT, AFT STBD, UPPER, LOWER

Chapter 4 Troubleshooting and on-board repair

In this chapter we provide troubleshooting procedures to find malfunction parts on a ship.

4.1 Necessary information at the time of repair request

Please note the following items:

(1) Ship name and phone number of the satellite communication system if equipped
(2) Product type name
(3) Product serial number
(4) Software version name described in the [MAINTENANCE Menu] screen.
(5) A following port of call, arrival schedule, and agency name
(6) Status of malfunction and results of diagnostics on a ship

4.2 Provided self diagnostic tools

The alarm display on the display and lamp for internal status is provided for self-diagnostics of this device.

4.2.1 Alarm display and how to cancel

Alarm display may appear at the lower right of the radar screen as shown in Figure 4.1 when a malfunction or operation error has been detected in the device.

Abnormalities are categorized as [Alarm] and [Warning]. When [Alarm] display actually appears and there is something wrong with radar, record the alarm details by type, location and status and push [OFF] button. The alarm sound and display will disappear. Multiple errors may be displayed one by one. Record all alarms and push [OFF] button for every alarm. The types of alarm, alarm and warning are shown in Table 4.1 and Table 4.2.

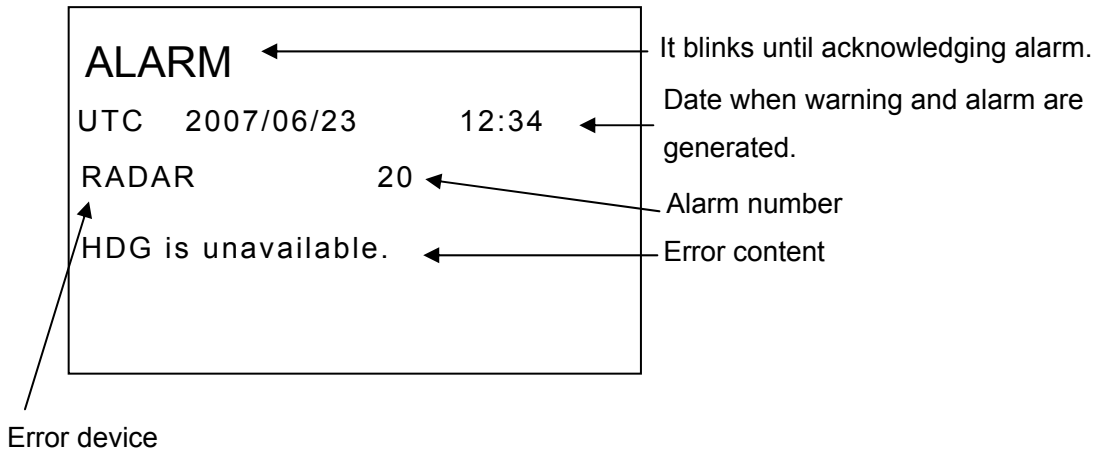


Figure 4.1 Alarm and Warning display

4.2.1.1 Alarm display list

Table 4.1 Alarm display list of radar

No.	Contents	Cause
1	Tracked target is lost. Ref tracked target is lost.	TT(ARPA) has been lost. Ref tracked target is lost.
2	Tracked target exceeded the CPA/TCPA limit.	Tracked target has turned in dangerous target.
3	Tracked target entered into the guard zone.	Tracked target has entered into the guard zone.
4	Auto acquisition of a radar target.	Captured a target entered into auto acquisition area.
5	AIS target is lost.	AIS target is lost.
6	AIS target exceeded the CPA/TCPA limit.	AIS target has turned in dangerous target.
7	AIS target entered into the guard zone.	AIS target entered into the guard zone.
8	Auto activation of AIS target.	A sleeping target has been activated.
9	Activated AIS target without HDG or COG.	There is neither ship's bearing nor fairway of AIS active target in input data to HDG or COG.
10	Panel not connected.	No communication between operating panel is available. Connector (J9) is disconnected.
11	Tracked target interface not connected.	Something is wrong with interface with ATA Board. Connection of ATA Board or PCB is faulty.
12	Navline Exceeded.	Own ship crossed the Navline.
13	Echo map area alarm detected.	Images were detected in map area.
14	Change to relative bearing.	True bearing is not inputed.
15	Change to relative vector.	VBW, VTG or VDR are not inputed.
16	Change to relative past position.	VBW, VTG or VDR are not inputed.
17	Change to relative trails.	VBW, VTG or VDR are not inputed.
18	Change to head up.	THS, HDT, HDM or VTG, RMA, RMC are not inputed.
19	Change EBL origin position.	THS, HDT, HDM or VTG, RMA, RMC are not inputed.
20	HDG is unavailable.	THS or HDT, HDM are not inputed.
21	SPD is unavailable.	VBW, VTG, RMA, RMC are not inputed.
22	SET/DRIFT data is unavailable.	VDR is not inputed.
23	LAT/LON data is unavailable.	GLL or GGA, GNS, RMC, RMA are not inputed.
24	DATUM data is unavailable.	DTM is not inputed.
25	Time data is unavailable.	ZDA or RMC, GGA are not inputed.
27	Change to sea stabilization.	Ship's bearing: THS, HDT, HDM, VTG Course against water: VBW Speed: VBW, VTG, VHW are not inputed.
30	External loading error.	At establishment of backup data, read-in of the setting has failed.
31	External saving error.	At establishment of backup data, write-in of the setting has failed.

32	Illegal data of loading.	Version No. of backup data does not agree.
33	Flash memory error.	Write-in of backup data into logic PCB has failed.
49	Antenna not connected.	Connector of Antenna may not be connected to Antenna, or Scanner unit may be faulty.
50	Antenna magnetron current abnormal.	Magnetron may be at the end of life or transmission high voltage fuse blown.
51	Antenna magnetron heater abnormal.	Something is wrong with magnetron or Scanner unit.
52	Antenna magnetron high voltage abnormal	High voltage fuse for transmission is blown.
53	Interswitch not connected.	NAV ports between master and slave are not connected.
54	Azimuth abnormal.	BP signal from Scanner unit is not received. May be fault in angle detecting sensor in Scanner unit or poor connection at connector.
55	Head line signal abnormal.	SHF signal from Scanner unit is not received. May be fault in SHF sensor in Scanner unit or rotation of Antenna may be stopped.
56	Trigger abnormal.	Trigger from Scanner unit is not received.
57	Radar video abnormal.	IF video from Scanner unit is not received.
59	Echo area alarm detected.	Images are detected in echo alarm area.
60	Tracked target exceeded the limit.	Number of tracked targets in TT(ARPA) exceeded the maximum 60.
61	AIS target exceeded the limit.	Number of AIS targets exceeding the maximum 255 has been input.
69	AIS interface not connected.	Something is wrong with AIS. Secure the board.
70	AIS alarm signal.	Alarm for abnormality is input in AIS alarm terminal of AIS port or the terminals are open.
71	AIS no OS COG/SOG data.	Own ship's data that is necessary for AIS are not inputed.
72	AIS no data.	There is no AIS data. VDM is not input from AIS.
75	Received AIS message.	Message from AIS was received.
76	Change to reference Antenna.	The set CCRP went beyond radar screen. Reference has moved to Antenna position.
77	No WGS84 DATUM	Input geodetic system is not WGS84.

4.2.1.2 Warning display list

Warning is displayed when the function is not available because of lack of information required for its operation.

Table 4.2 Warning list

No.	Contents	Cause
95	Tracked target full.	Captured targets beyond the maximum tracking number.
96	Tracked target no data.	Deleted TT(ARPA) targets as there were no tracking targets.
97	Tracked target out of range.	Captured targets beyond operating distance set for targets.
99	Pre heating.	Operated transmission key during pre-heating countdown.
100	No HDG, SPD signal.	No HDG, SPD signal.
101	No HDG, LAT/LON signal.	As signals of ship's bearing, latitude/longitude had not been input, functions that need those signals have been disabled.
102	No HDG signal.	As signals of ship's bearing had not been input, functions that need ship's bearing signal were disabled.
103	No SPD signal.	As speed signal had not been input, functions that need speed signal were disabled.
104	No Zoom area or minimum range.	Zoomed beyond the minimum range or 70 % of the range.
105	Map data full.	More than the specified number of sea lines, NAV lines, marks and areas try to be attempted to register in map function.
106	Interswitch changed the mode.	During interswiitch connection, one Display unit switched over interswitch mode.
107	Cursor off.	Another function is being specified.
108	No offcenter.	In the maximum range, off center function was disabled.
109	AIS target overload.	Number of AIS targets being input exceeded 242.
110	Tracked target overload.	Number of tracking targets exceeded 57.
111	Tracking malfunction. REL CRS	As the result of TT test, accuracy of relative course has exceeded the reference.
112	Tracking malfunction. REL SPD	As the result of TT test, the accuracy of relative speed has exceeded the reference.
113	Tracking malfunction. CPA	As the result of TT test, accuracy of CPA has exceeded the reference.
114	Tracking malfunction. TCPA	As the result of TT test, accuracy of TCPA has exceeded the reference.
115	Tracking malfunction. T CRS	As the result of TT test, accuracy of true course has exceeded the reference.
116	Tracking malfunction. T SPD	As the result of TT test, accuracy of true speed has exceeded the reference.

117	Mode Hold.	Attempted to change mode during operation of performance monitor. The mode is fixed at H-UP.
118	Range Hold.	During starting up of performance monitor, attempted to change the range. The range is fixed at 24 NM.
119	Time trial manoeuvre is less than 30 second.	Time trial manoeuvre is less than 30 second.
120	Reference target overload.	Attempted to capture reference targets beyond 3.

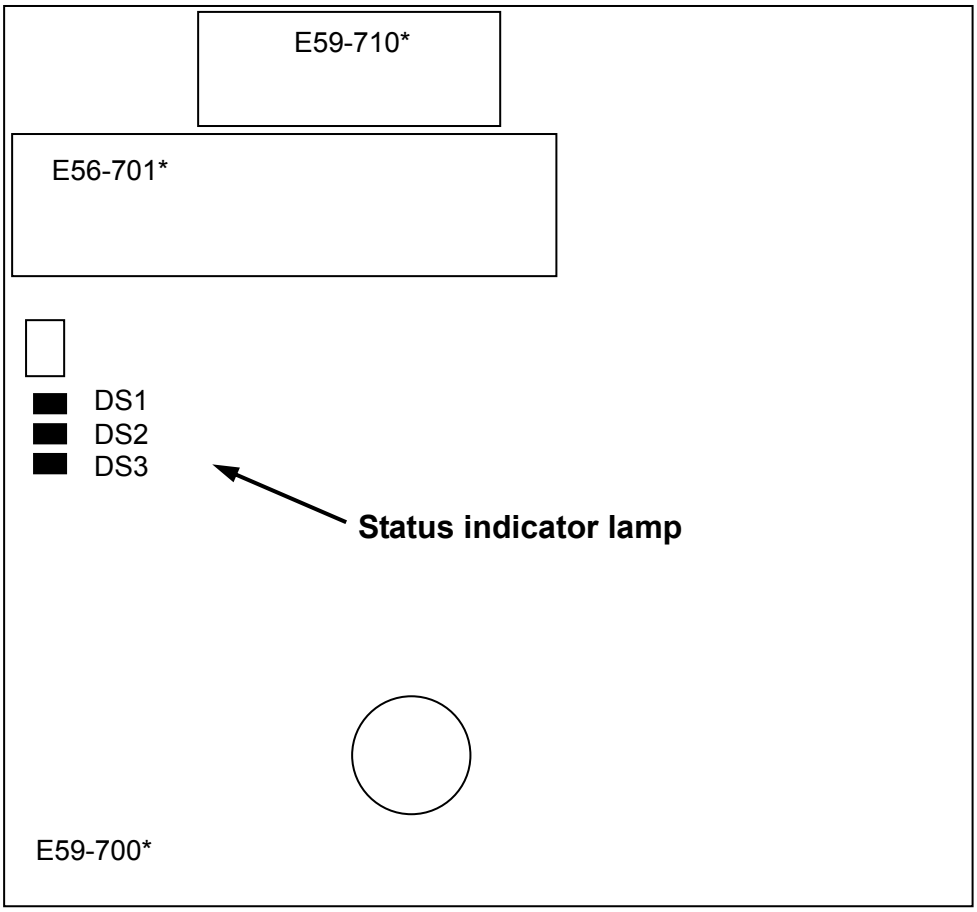
4.2.2 Status indicator lamp

Three LED (Light Emitting Diodes) lamps are provided on the logic PCB in the Display unit. The operational conditions are indicated by these LED's. Refer to the following table for details.

Table 4.3 Status indicator lamps

LED No.	Content	Operation status	LED status
DS1	Software status	Normal	Flashing
		Abnormal	OFF
DS2	Hardware status	Normal	Flashing
		Abnormal	ON or OFF
DS3	FPGA status	Normal	Flashing
		Abnormal	ON or OFF

Location of status indicator lamps



*Subject to version change

Figure 4.2 Status indicator lamp locations

4.3 Malfunction diagnostics

This chapter specifies necessary information required troubleshooting and repair of the radar system.

4.3.1 Malfunction detection step

As a first step of on-board repair, refer to the following tables describing outlines of malfunction diagnostics procedure.

Table 4.4 basic malfunctions

Failure status	Possible cause	Measure
No power.	1. Power cable is disconnected. 2. Supply voltage is out of range. 3. Main power fuse is blown.	1. Connect power cable firmly and secure connector. 2. Use proper power source. 3. Change fuse with new one.
Power is applied but no display	1. Screen brilliance is adjusted to the minimum. 2. Failure of LCD unit 3. Failure of LCD driver unit	1. Press [BRILL] key and rotate EBL knob clockwise to adjust properly. 2. Request repair. 3. Request repair.

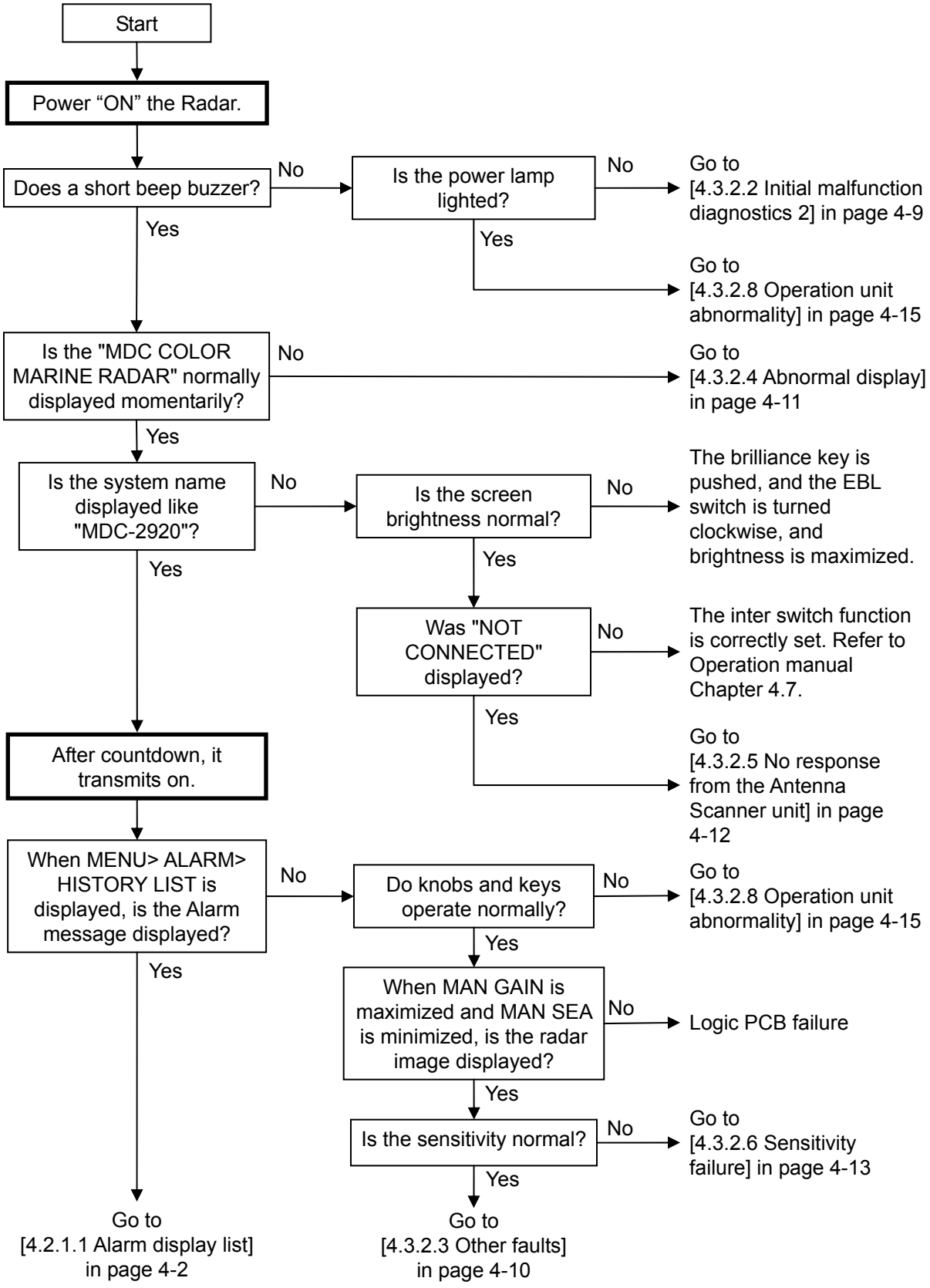
Table 4.5 possible malfunctions

Error status	Possible cause	Measure
Picture is dark.	1. Adjustment of display brilliance is incorrect. 2. Failure of LCD driver circuit	1. Press [BRILL] key and rotate EBL knob clockwise to adjust properly. 2. Request repair
No radar picture is displayed.	1. Receiver is detuned. 2. Video contrast adjustment error 3. Failure of transceiver	1. Readjust by referring to chapter [3.1.3]. 2. Readjust by referring to Operation manual Chapter 4.6. 3. Request repair
Picture is too weak.	1. Receiver is detuned. 2. Failure of Magnetron or MIC (front-end)	1. Readjust by referring to chapter [3.1.3]. 2. Request repair
Markers (Heading, EBL, VRM, Range Rings, Parallel index, Alarm range) are not displayed.	1. Improper marker brilliance adjustment. 2. Failure of Logic PCB	1. Readjust by referring to Operation manual Chapter 4.6. 2. Request repair
Heading line is not displayed.	1. No heading line signal input.	1. Check [BP/HG] signal between an Antenna-Scanner unit and a Display unit.
Antenna does not rotate.	1. Motor fuse is blown. 2. Motor power is not supplied. 3. Motor brush is worn out.	1. Replace fuse with a new one. 2. Check motor power connection. 3. Replace motor brushes with a new set.

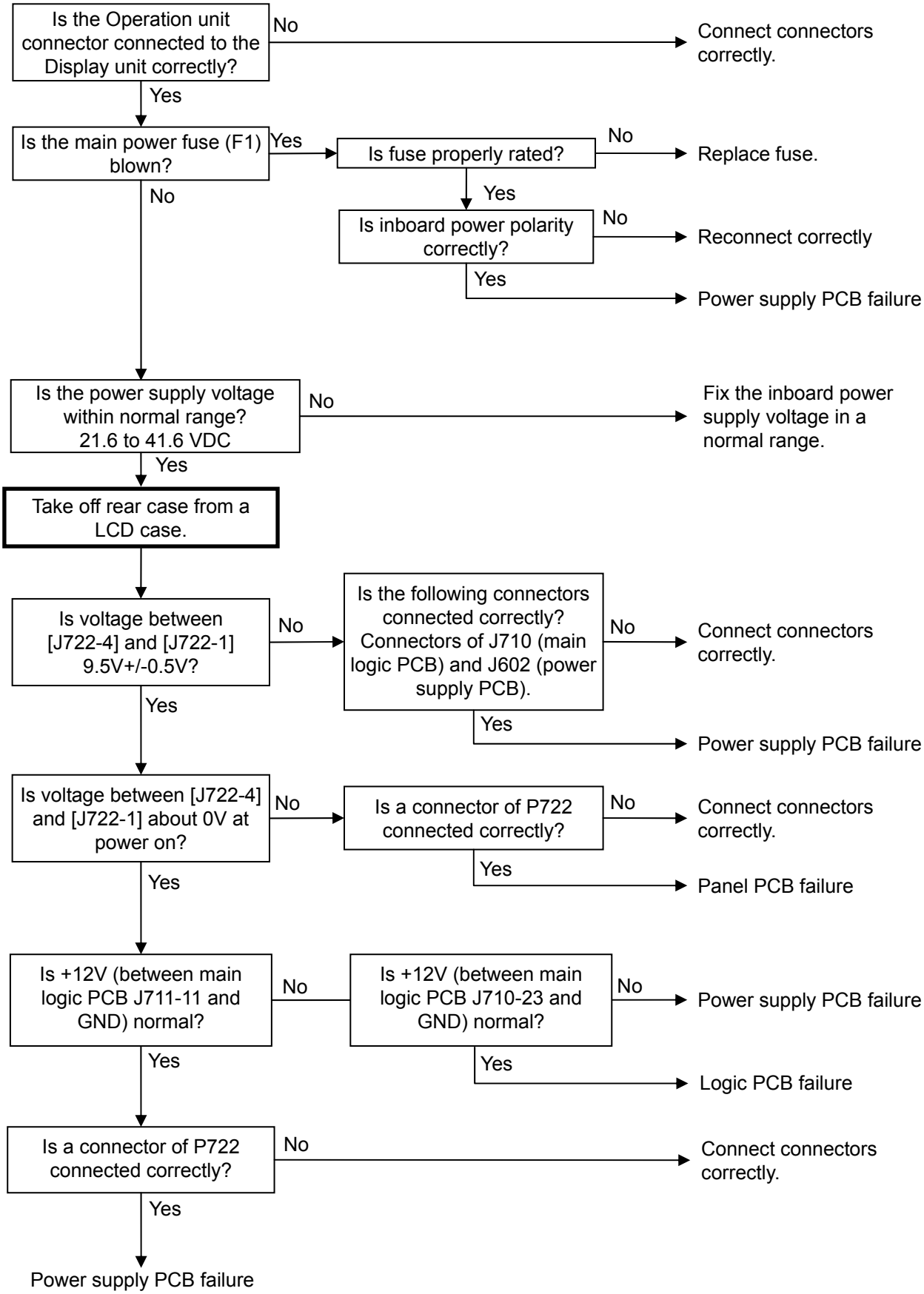
4.3.2 Malfunction diagnostics flow chart

The following malfunction analysis chart can be used by service personnel for malfunction diagnostics and location of defect module. This chart shows flow chart of dignostics for basic malfunction troubleshooting.

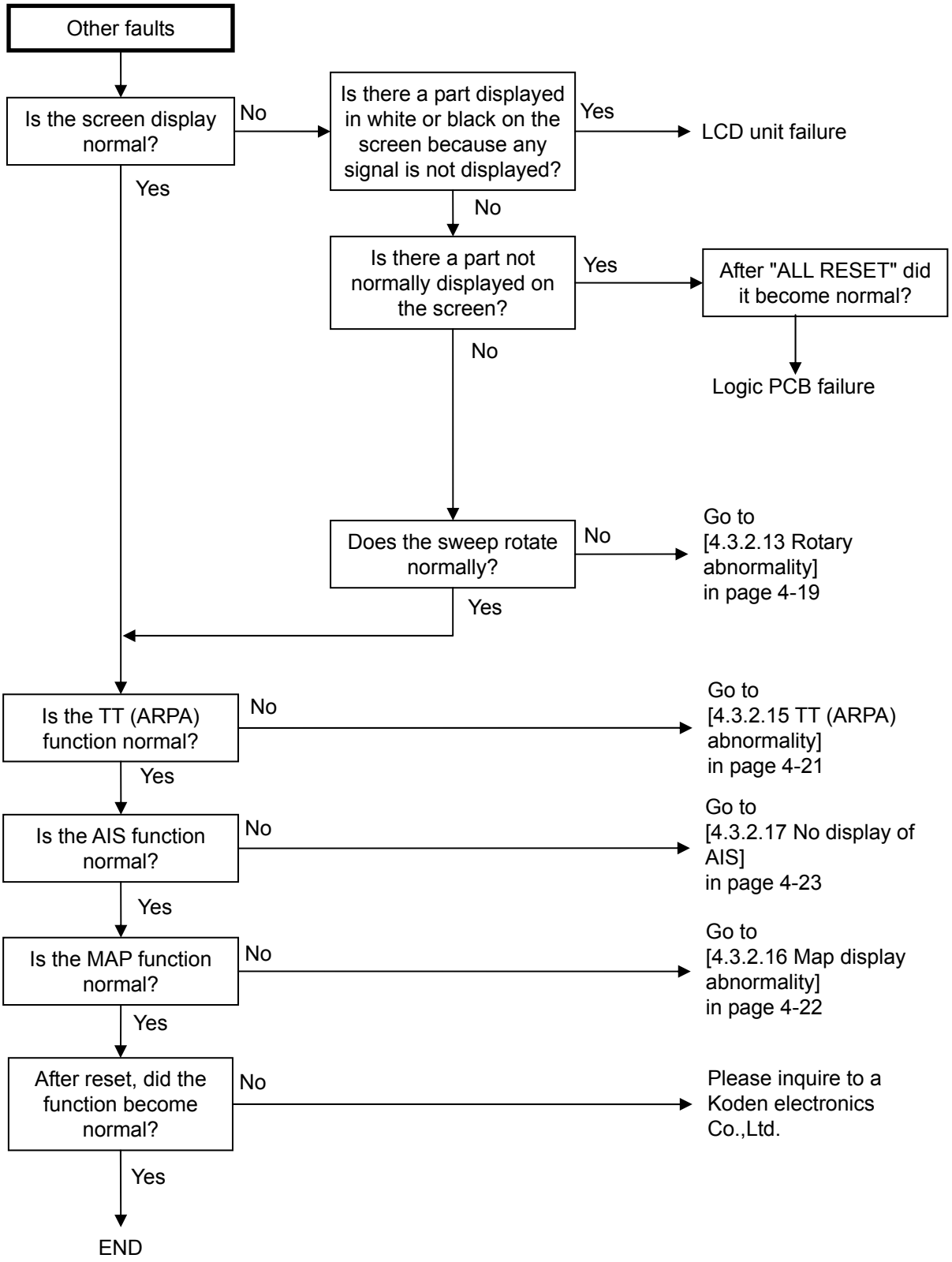
4.3.2.1 Initial malfunction diagnostics 1



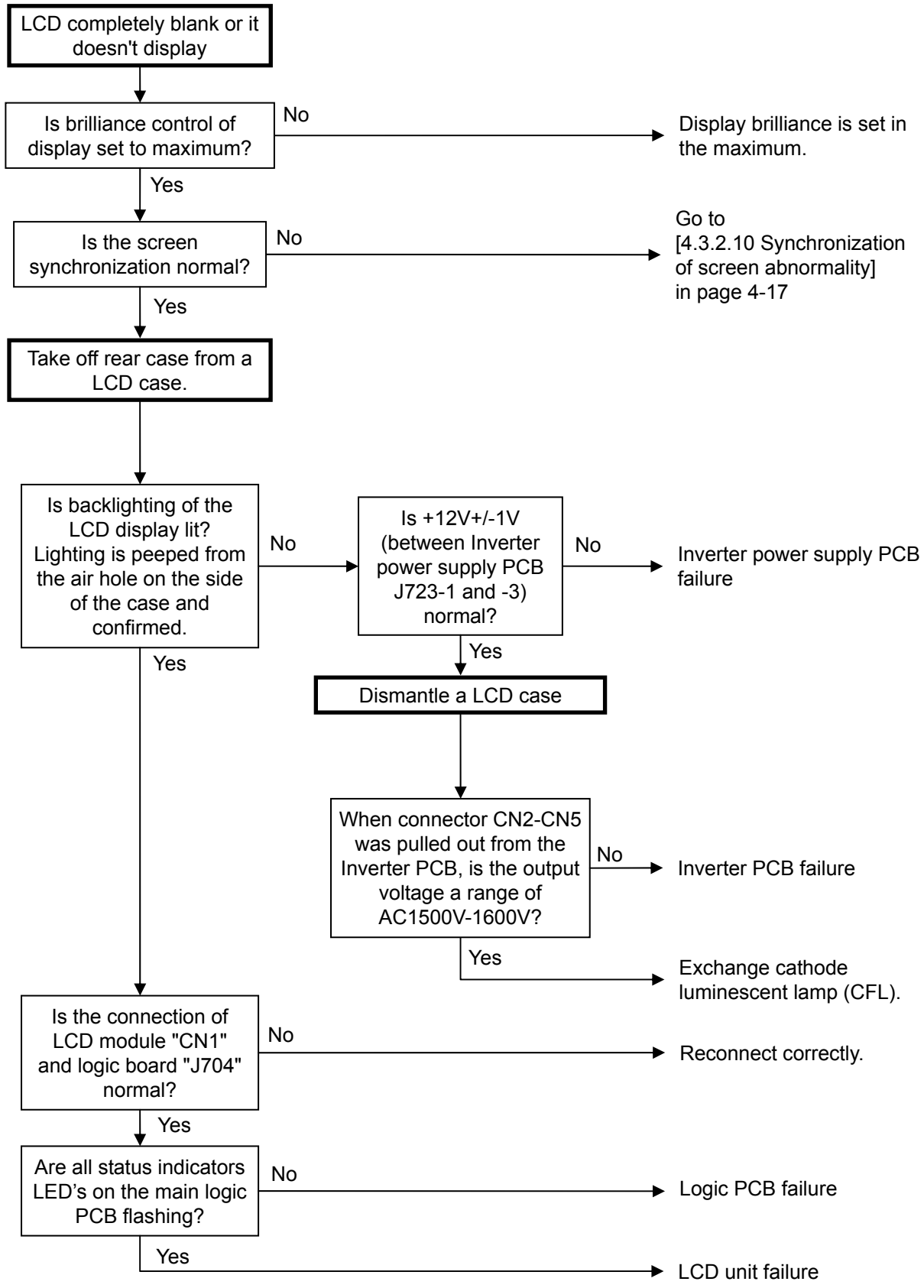
4.3.2.2 Initial malfunction diagnostics 2



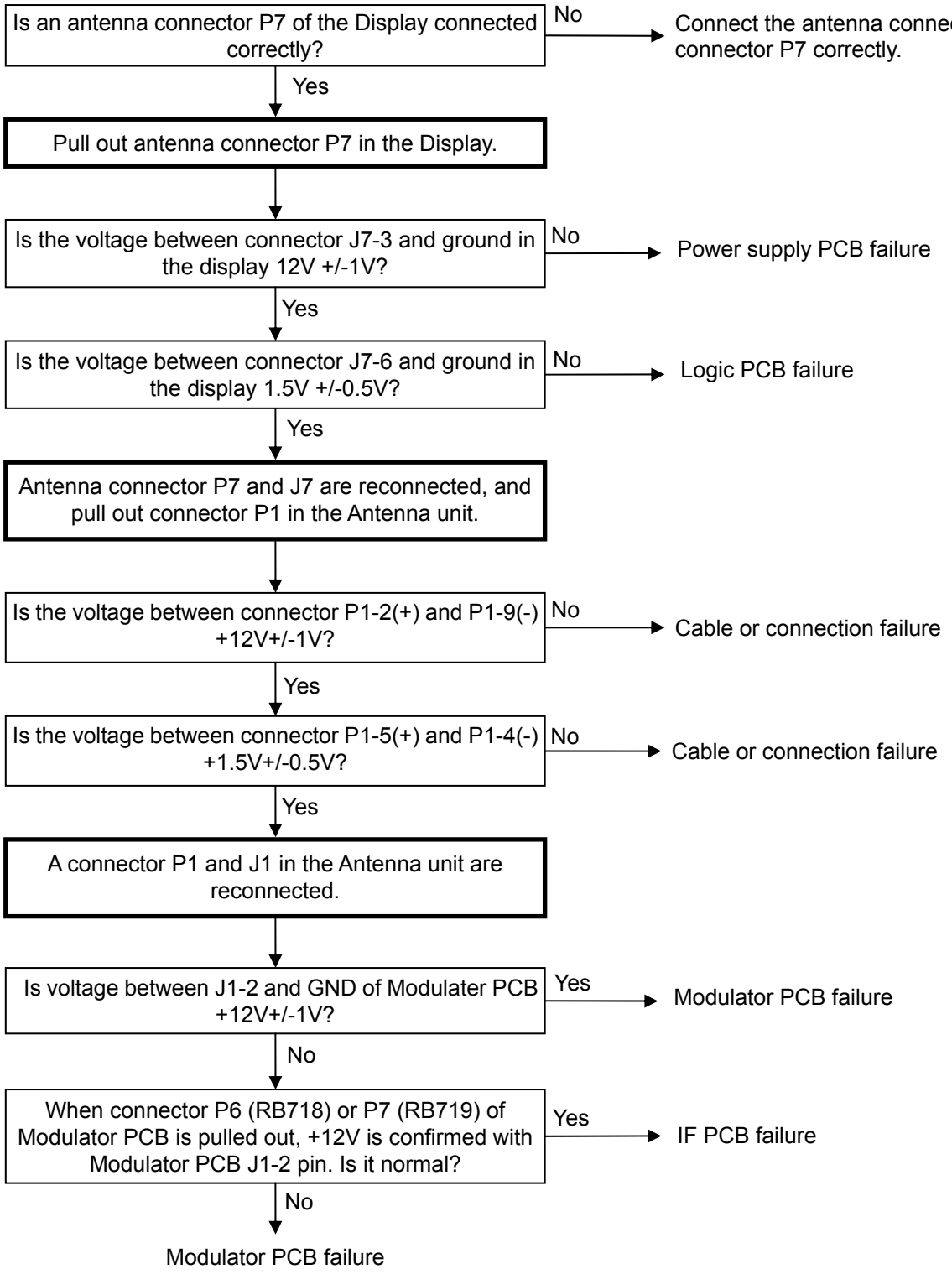
4.3.2.3 Other faults (Display unit)



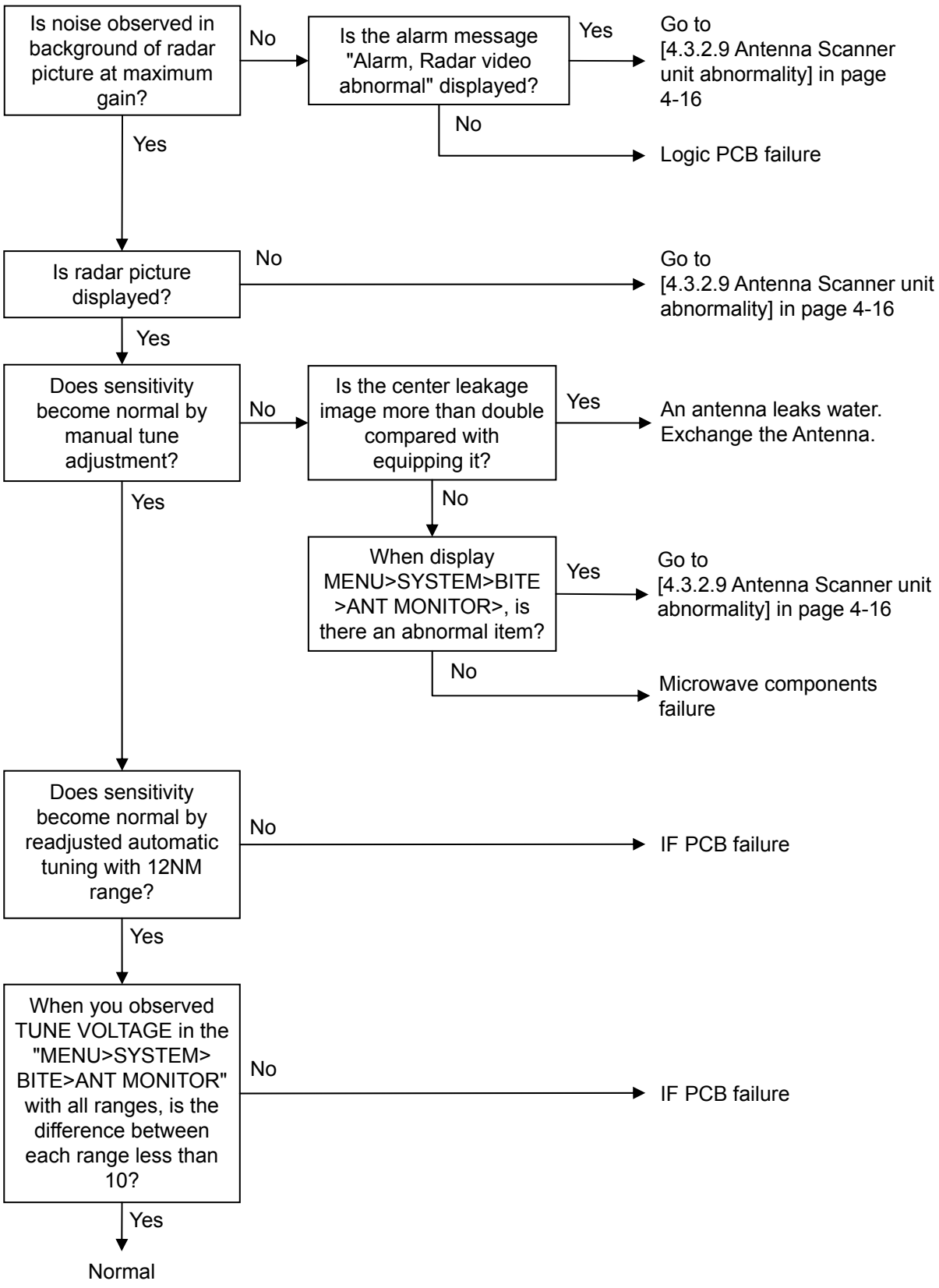
4.3.2.4 Abnormal display



4.3.2.5 No response from the Antenna Scanner unit

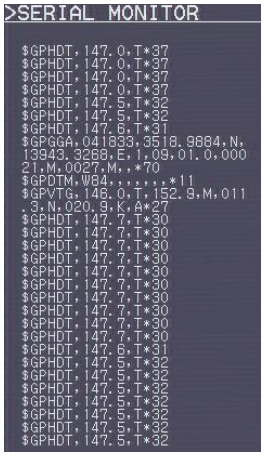


4.3.2.6 Sensitivity failure



4.3.2.7 No display of ship's bearing, speed and latitude/longitude

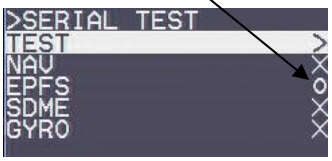
Is the navigation data (IEC 61162-1) normally input from the connectors (J4, J5, J6) and displayed?
When a connector number to be checked is selected in the process of MENU > SYSTEM > BITE > SERIAL SEL, a sentence of NAV data input is displayed on the serial monitor screen?



No → Is the polarity of signals (A and B) normal?

No → Set the polarity normal.

Yes → When I/O of CW-376 and CW-406 are short-circuited and MENU > OPTION 1 > BITE > SERIAL TEST is performed, is ○ displayed?



No → Logic PCB failure

Yes → The external connecting device that outputs serial signal may be faulty.

Yes → Is the data format input from the connectors (J4, J5, and J6) a proper format?

No → Select a data format conforming to the format that receives MENU > MAINTENANCE > I/O > DETAIL > FORMAT > IEC 61162-1 or IEC 61162-2.

Yes → Are the mode display, positioning status and speed status in the input sentence all effective?

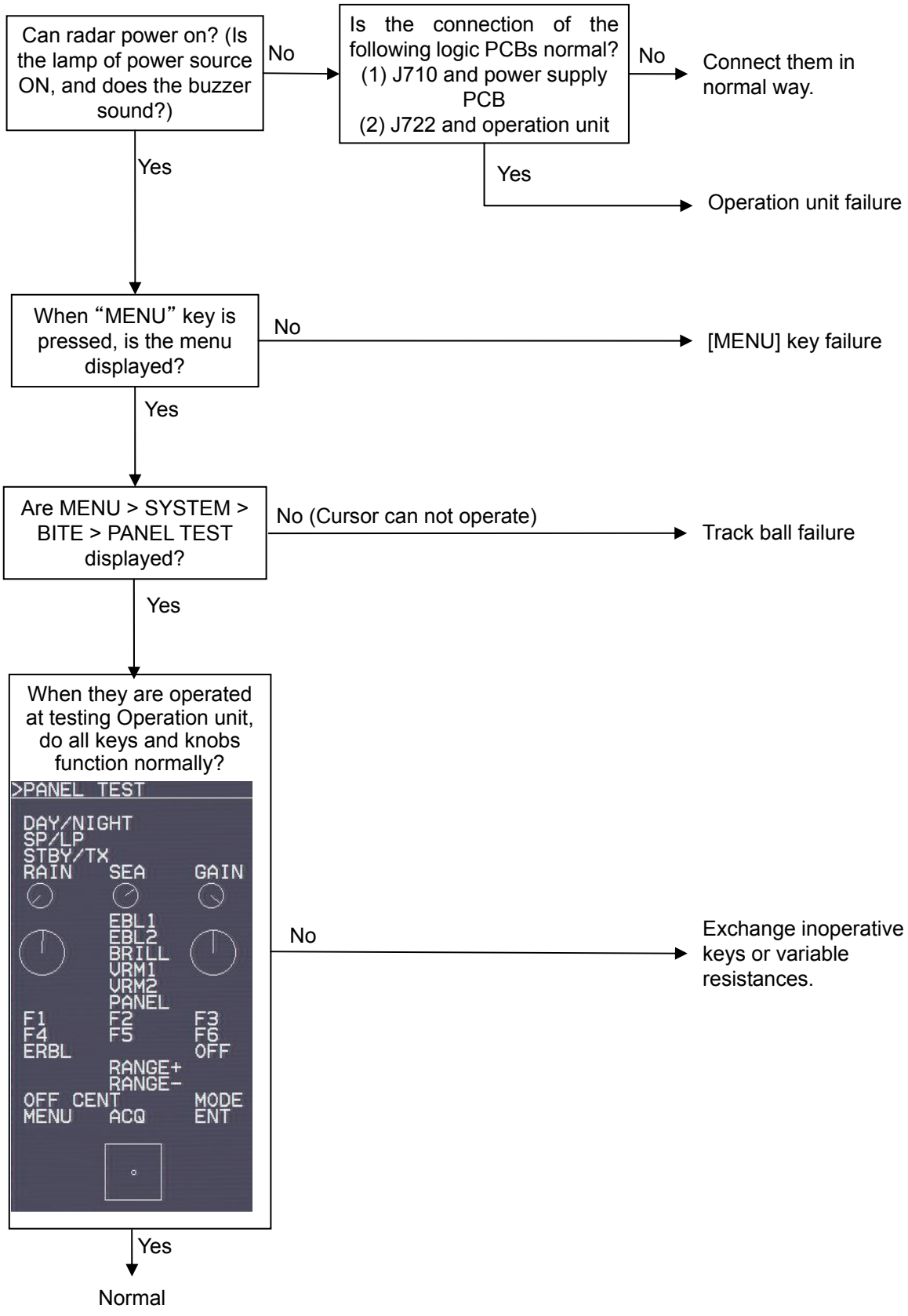
No → The external connecting device that outputs serial signal may be unstable. Check the external connecting device.

Yes → Is MENU > MAINTENANCE > I/O > HDG, STW, COG/SOG, LAT/LON correctly set?

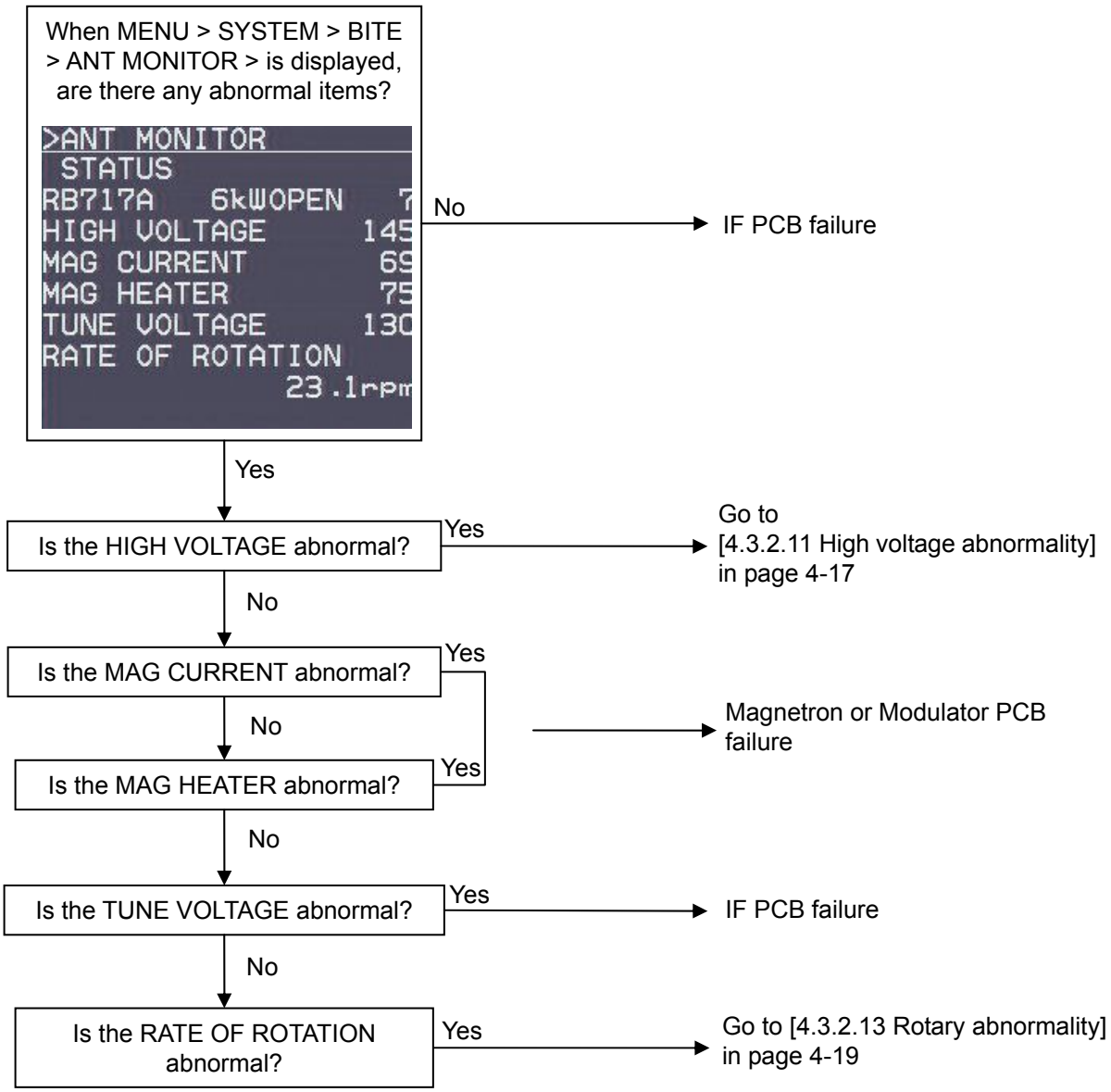
No → Set the input settings of HDG, STW, LAT/LON and COG/SOG correctly.

Yes → Logic PCB failure

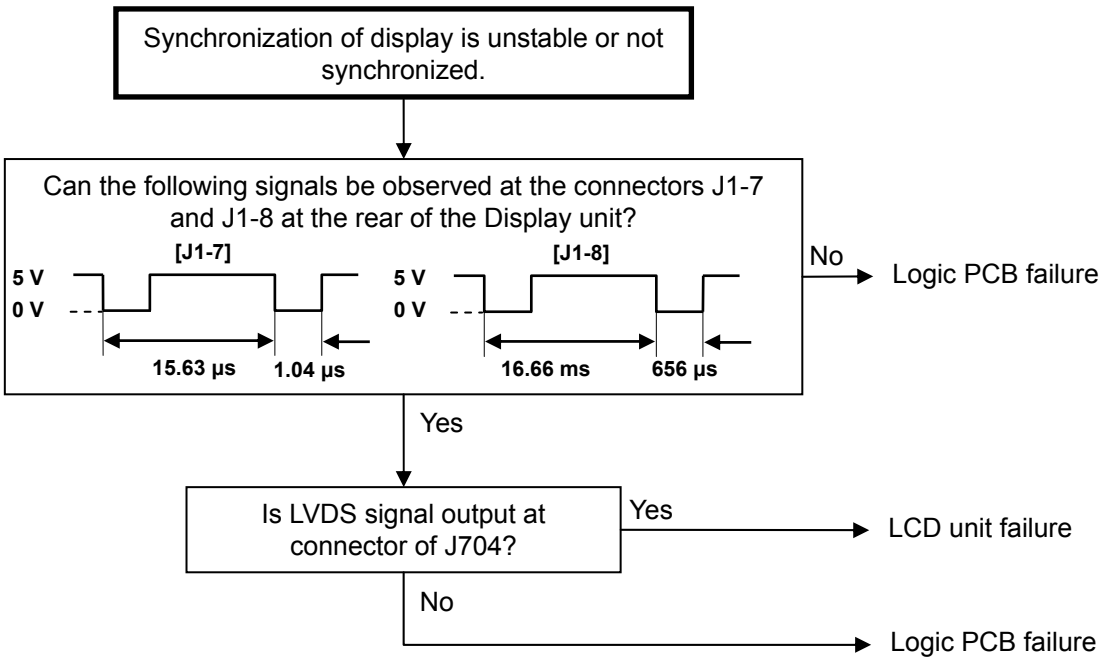
4.3.2.8 Operation unit abnormality



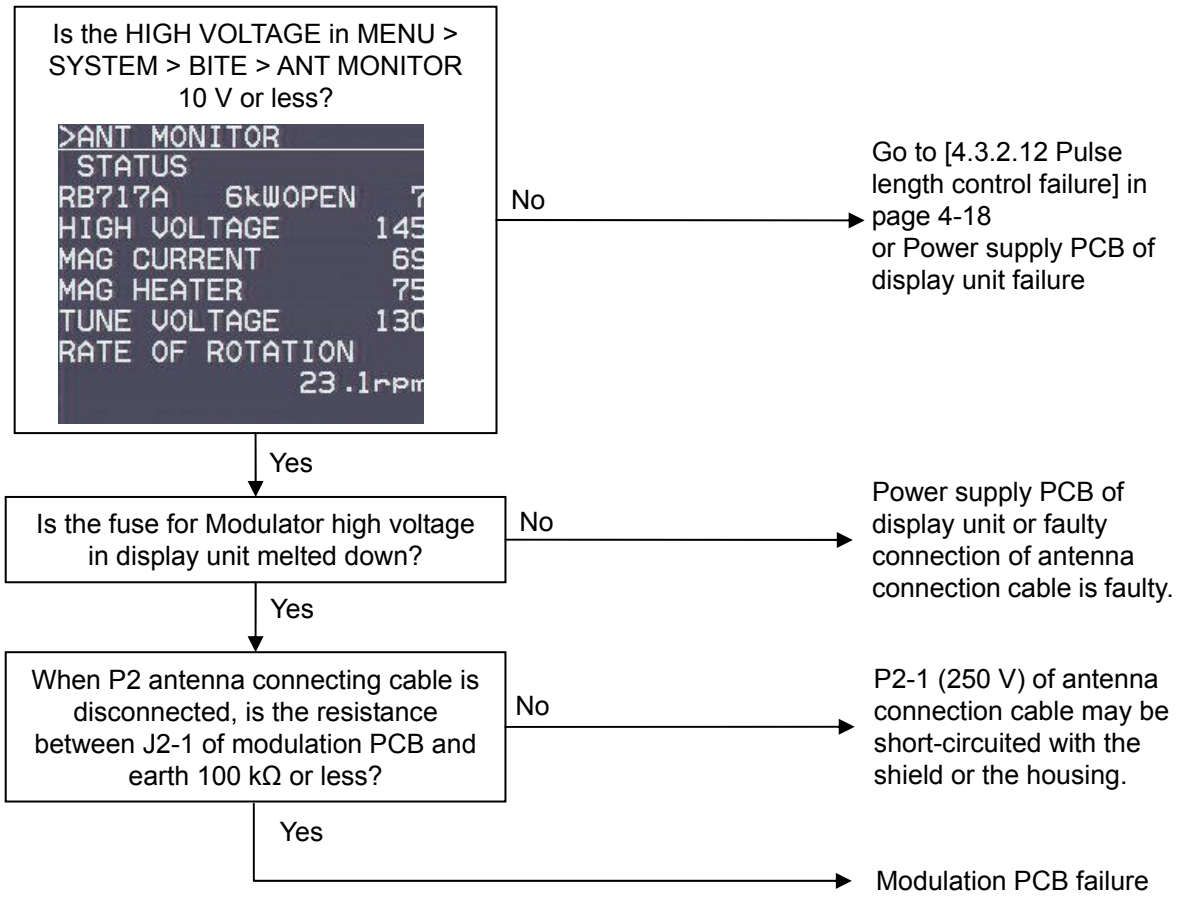
4.3.2.9 Antenna Scanner unit abnormality



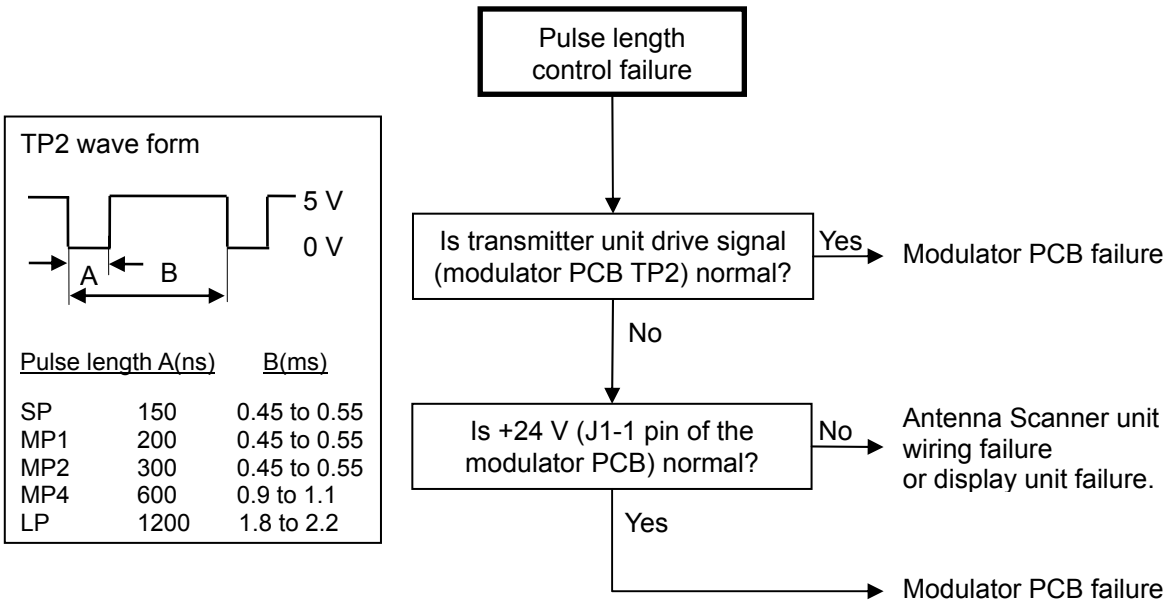
4.3.2.10 Synchronization of screen abnormality



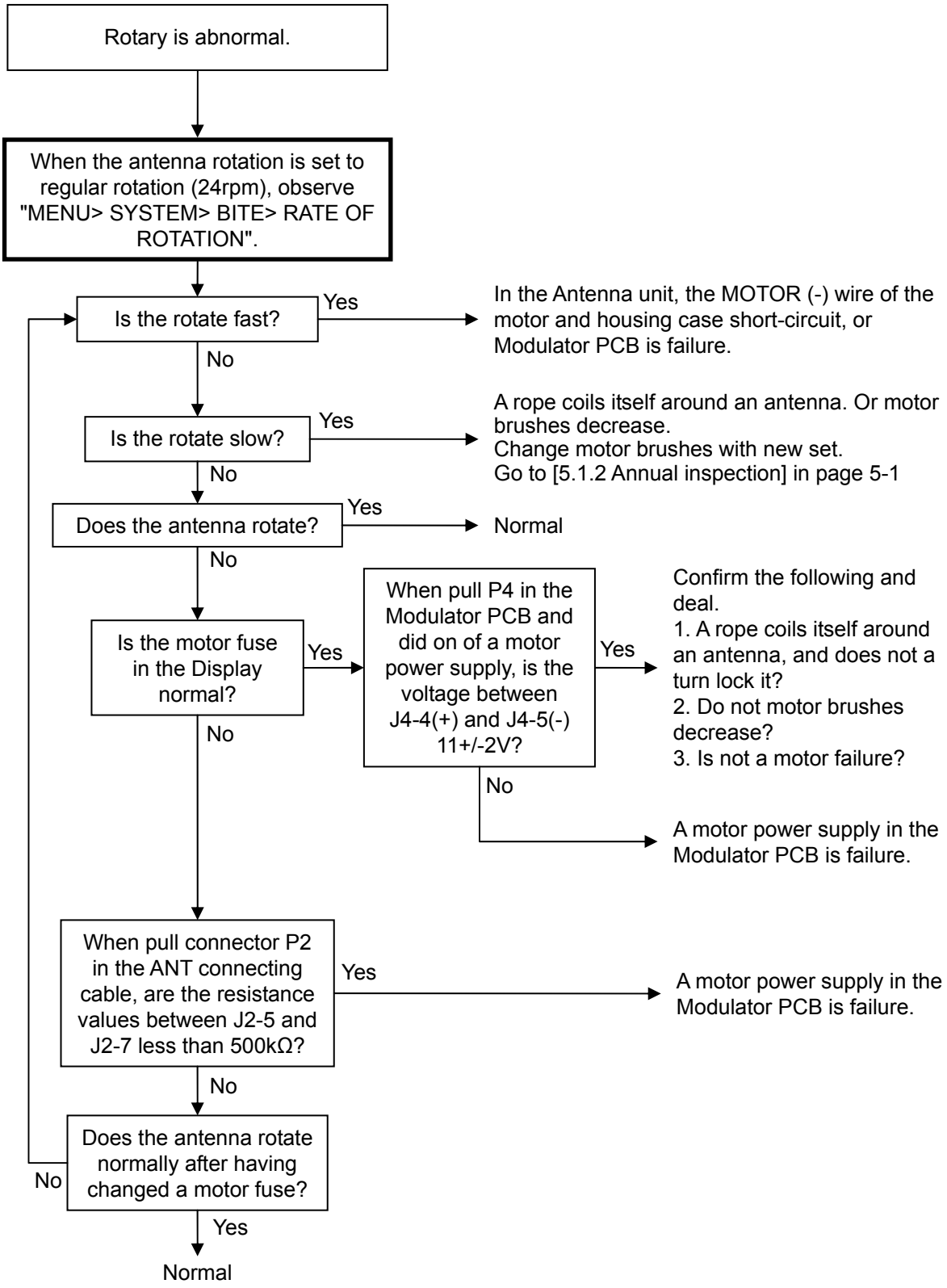
4.3.2.11 High voltage abnormality



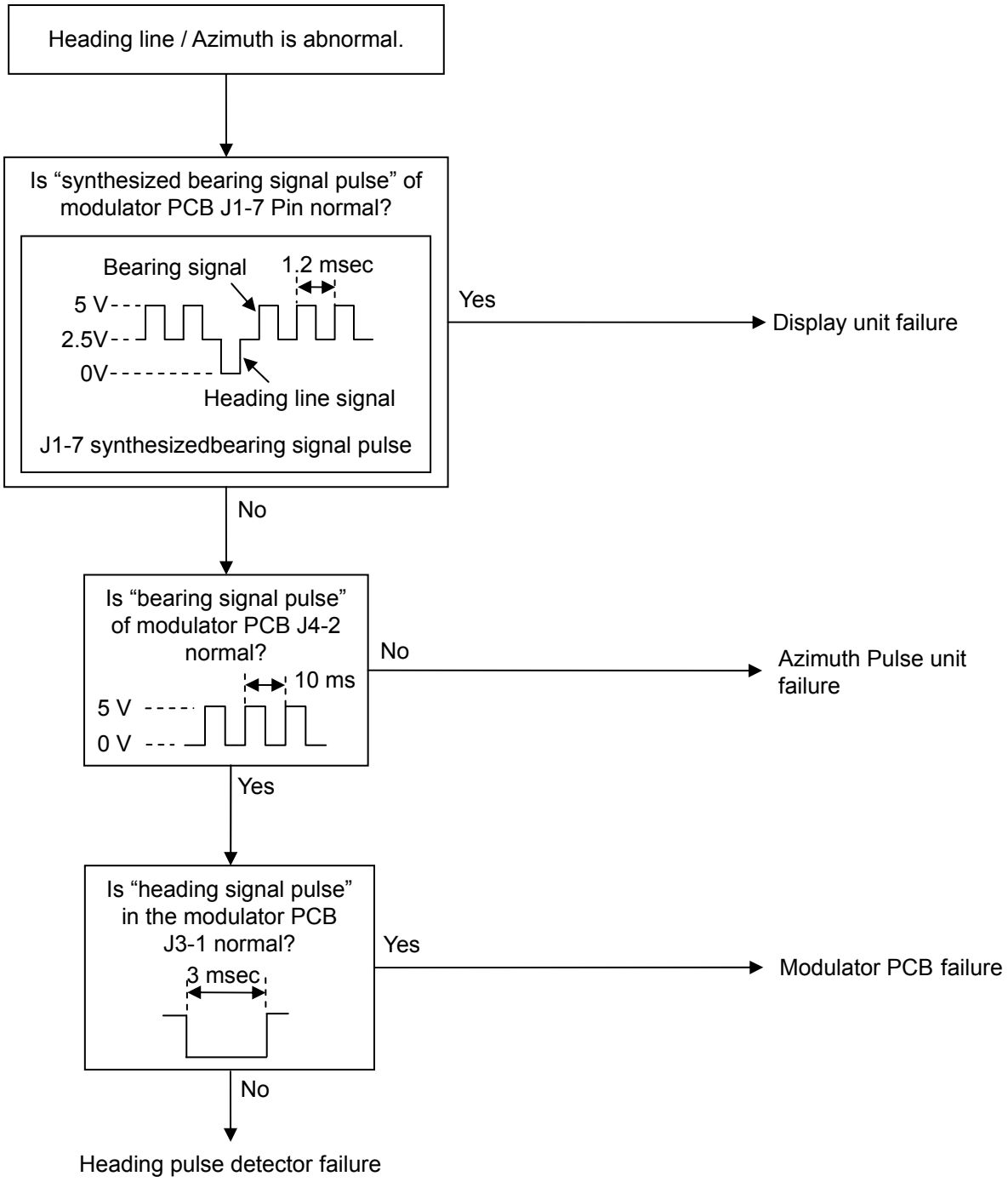
4.3.2.12 Pulse length control failure



4.3.2.13 Rotary abnormality



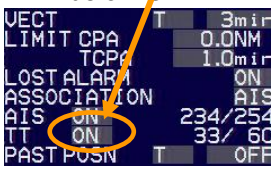
4.3.2.14 Heading line and Azimuth abnormality



4.3.2.15 TT (ARPA) abnormality

TT (ARPA) is abnormal.

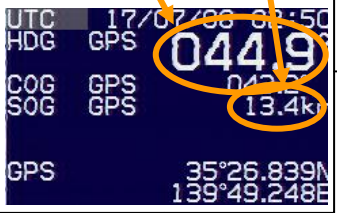
Is TT in the figure shown below ON?



No → At the placing the cursor on OFF, and pushing “ENT” key, will the display change to ON?

No → Check whether TT (ARPA) PCB is present and connectors are normally connected.

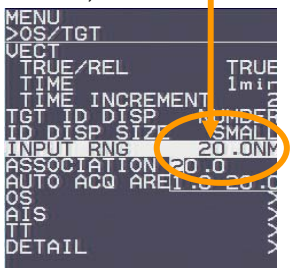
Yes → Are HDG and SPD displayed on screen?



No → Go to [4.3.2.7 No display of ship’s bearing, speed and lat/lon] in page 4-14

Yes → When cursor is placed on a target and “ACQ” key is pushed, is a circle of dotted line displayed on the target?

No → Follow MENU > OS > TGT > INPUT RNG, set at 20.0 NM.



Yes → Thereafter, will the symbol dotted line circle for TT turn in solid line circle, and continue tracking of the target?

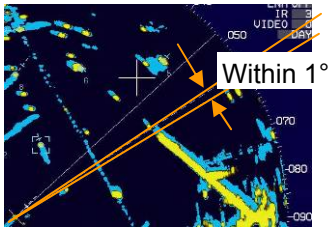
No → When followed MENU > OS/TGT > TT > TEST TGT > ON and the test target is acquired, will TT continue tracking?

No → TT (ARPA) PCB failure

Yes → Reset MENU>MAINTENANCE> PRESET>TT TGT LEVEL

Yes → Can the vector of the target indicate a stable bearing?

No → When TRAIL/TRUE/6 min is set, is the ship’s trail generated in the angular direction of the fixed target within 1 degree?



No → The interval of transmission of HDT may be longer or the performance of the compass is not good enough. Improve the compass device.

Yes → Change STAB to SEA.

Yes → Normal

4.3.2.16 Map display abnormality

Display of map is abnormal.

Is map displayed on the screen?

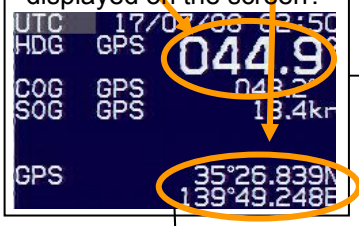
No → Is the map card correctly inserted into the holder?

No → Insert the map card correctly into the card holder.

Yes

Yes

Are HDG and LAT/LON displayed on the screen?



No → Go to [4.3.2.7 No display of ship's bearing, speed and lat/lon] in page 4-14

Yes

In the process of MENU > MAP > DETAIL > CHART SELECT, are "GLOBAL" and "CHART" ON?

No → Select "GLOBAL" in MENU > MAP > DETAIL > CHART SELECT and "ON" in MAP > DETAIL > CHART respectively.

Yes

In the process of MENU > OPTION 1 > BITE > CARD, Is "C-MAP" displayed?

No → Check the contacts of the card socket and the connection of the logic PCB J726.

Yes

Does the radar image match with the map?

No → Is GPS WGS84?

Yes → Select MENU > MAP > DATUM > "W84" and then select MAP > OFFSET > "DTM".

Yes

No

When GPS has output DTM sentence, input MENU > MAP > EDIT USER DATUM > "LOCAL DTM" and select MAP > DTM > "LOCAL DTM". Also select MAP > OFFSET > "DTM".
When GPS has not output DTM sentence, select MENU > MAP > OFFSET > "MAN". Push "MODE" key a few times and select "N UP RM" for display. Viewing the screen, select a proper correction value of in MAP > "OFFSET" so as to match the echo with the map.
To display AIS, select MENU > OPTION 1 > CHART ALIGN ONLY > "OFF".

Normal

4.3.2.17 No display of AIS

AIS is not displayed.

Note: About self diagnosis:
When any setting is changed and "AIS self diagnosis" is used for confirmation of the change, close the MENU once and start displaying again.

Is AIS in the picture below ON?

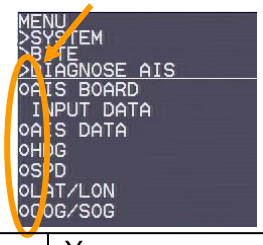
No → Place the cursor on OFF, and push "ENT" key. Then, does the display turn to ON?

No → Check that AIS PCB has been installed and the contacts of connectors are normal.

Yes

Yes

4 minutes after switching ON of AIS, operate as follows:
When the screen below is displayed after selection of MENU > SYSTEM > BITE > "DIAGNOSE AIS", will circle marks (O) be indicated on all items?



No → Is x AIS BOARD? Yes → AIS PCB failure

No → Is x AIS DATA? Yes → Check AIS connection.

No → Is x HDG? Yes

No → Is x SPD? Yes

No → Is x LAT/LON? Yes

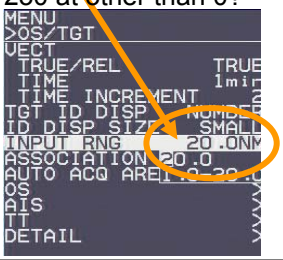
No → Is x COG/SOG? Yes

→ Go to [4.3.2.7 No display of ship's bearing, speed and lat/lon] in page 4-14

Yes

Is the position of 230 in AIS 230/254 below at other than 0?

No → Setting RNG at 20.0NM in MENU > OS/TGT > INPUT RNG, is the position of 230 at other than 0?

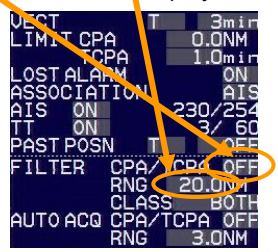


No → No ship equipped with AIS device is within 20.0NM, confirm when a ship equipped has approached.

Yes

Yes

When the filter CPA/TCPA is set at OFF and RNG at 64NM in the below picture, is AIS displayed?

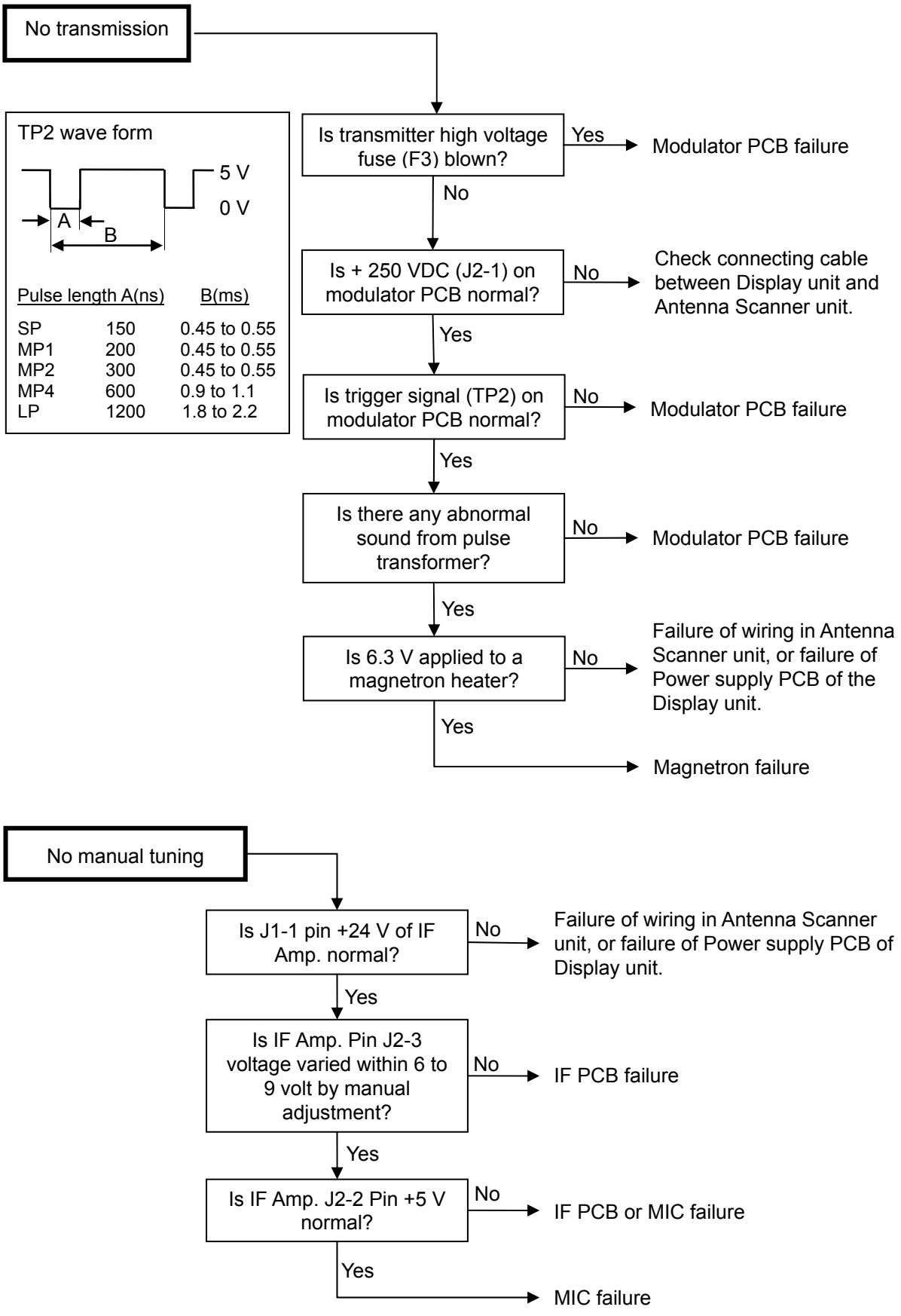


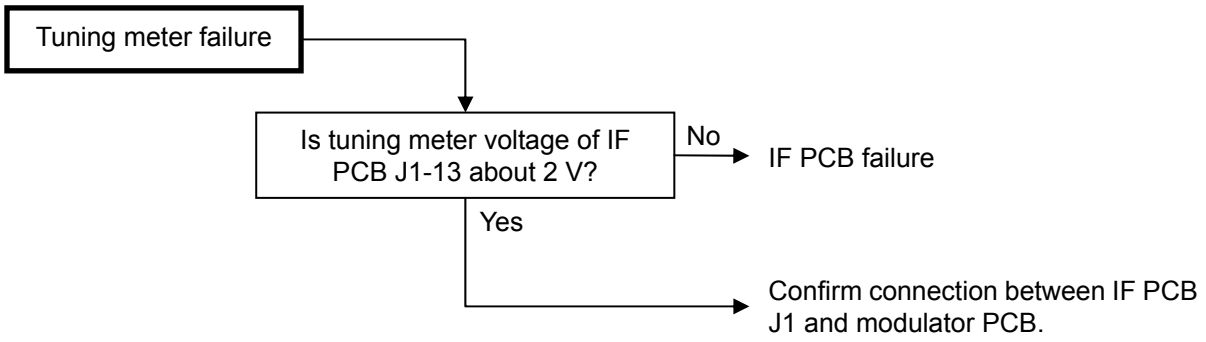
No → VDM sentence is wrong. Check at AIS device side.

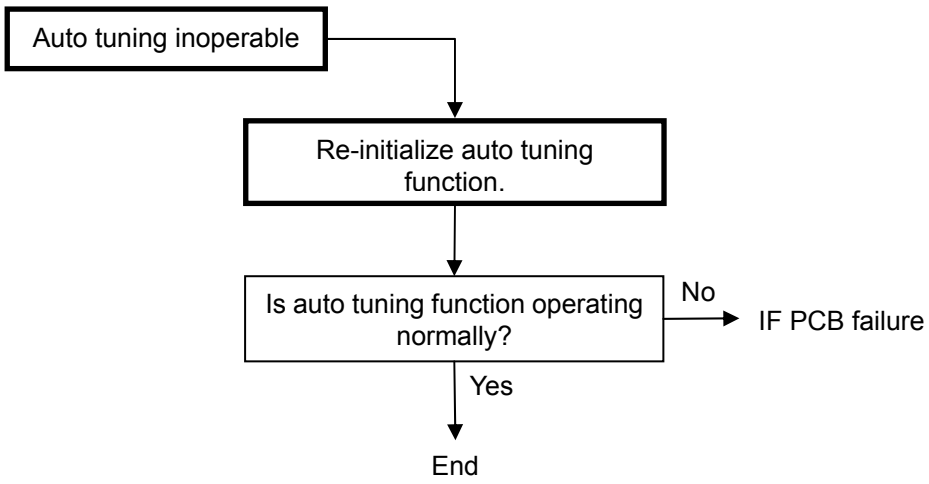
Yes

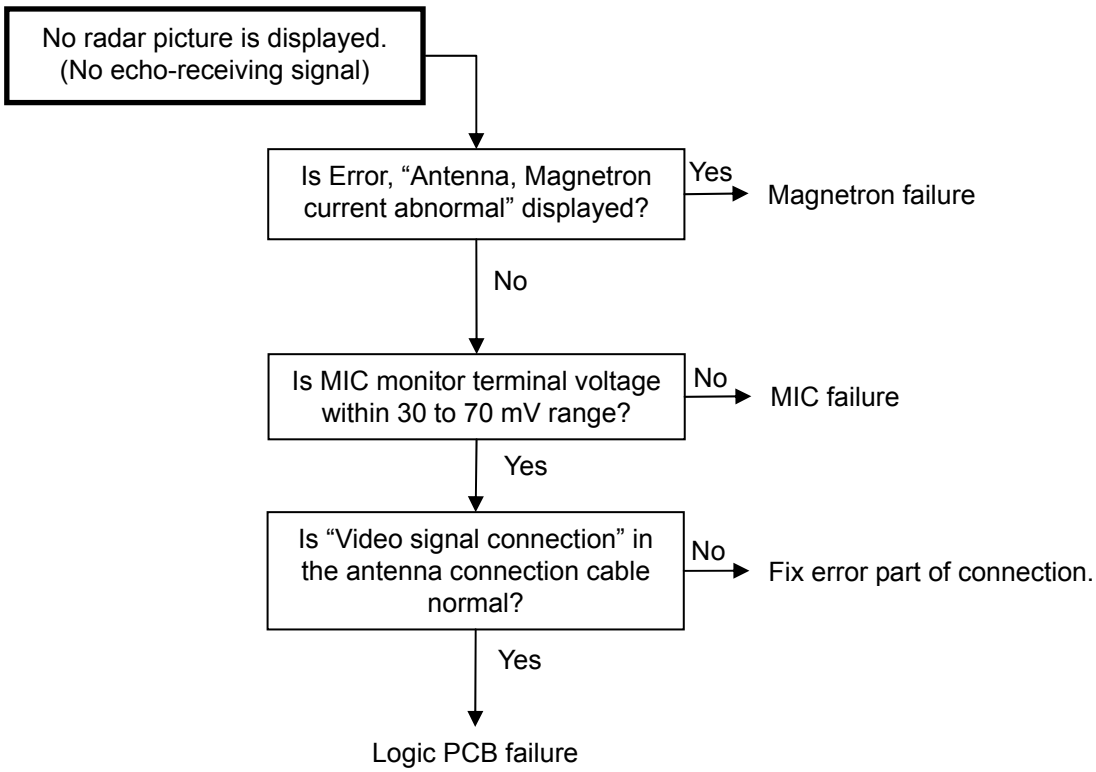
Normal

4.3.2.18 Other faults (Antenna Scanner unit)




Tuning meter failure
Is tuning meter voltage of IF PCB J1-13 about 2 V?
No
IF PCB failure
Yes
Confirm connection between IF PCB J1 and modulator PCB.


Auto tuning inoperable
Re-initialize auto tuning function.
Is auto tuning function operating normally?
No
IF PCB failure
Yes
End


No radar picture is displayed. (No echo-receiving signal)
Is Error, “Antenna, Magnetron current abnormal” displayed?
Yes
Magnetron failure
No
Is MIC monitor terminal voltage within 30 to 70 mV range?
No
MIC failure
Yes
Is “Video signal connection” in the antenna connection cable normal?
No
Fix error part of connection.
Yes
Logic PCB failure

4.4 Repair

4.4.1 Replacement of fuse

The location of the fuses is on the back panel of Display unit.

Fuse type and rating

Application	Type, dimension (mm)	Fuse characteristic	Rating
Main power	Tubular (φ6.4 x 30)	Normal blow	15 A
Modulator high voltage	Tubular (φ5.2 x 20)	Normal blow	0.5 A
Antenna drive motor	Tubular (φ5.2 x 20)	Normal blow	5 A

Fuse location

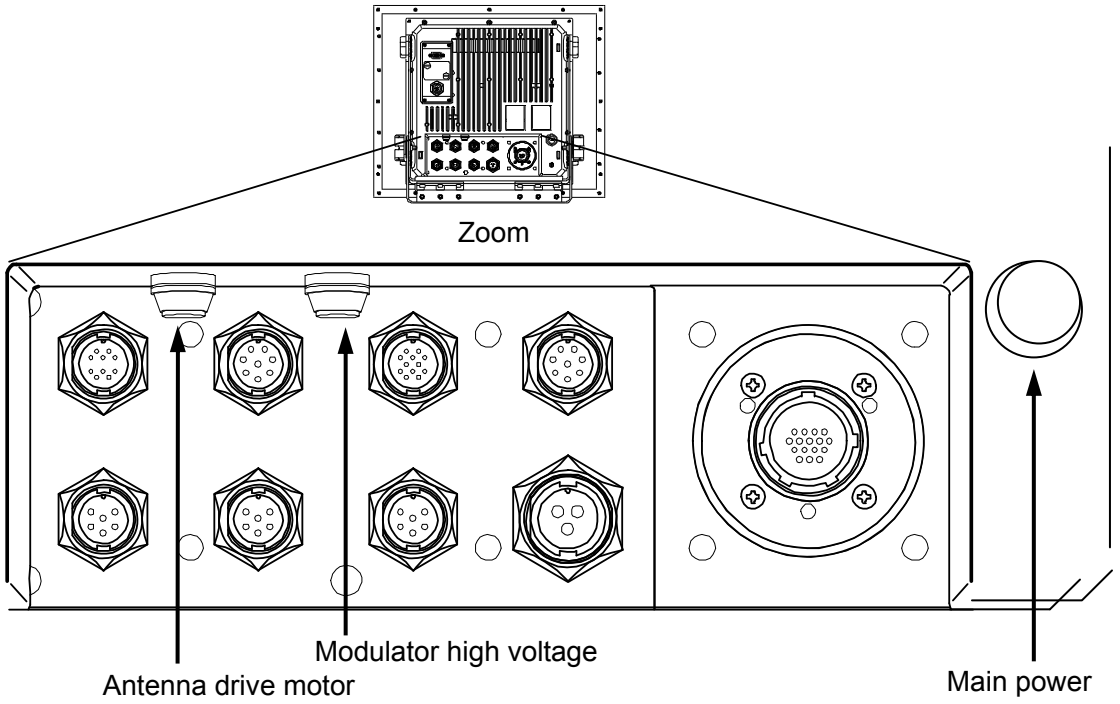


Figure 4.3 Fuse locations on display unit back panel

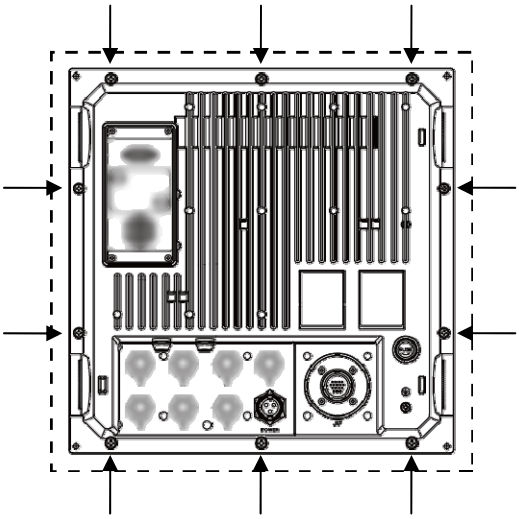
4.4.2 Replacement of Internal Battery

Internal Battery is used for settings backup.

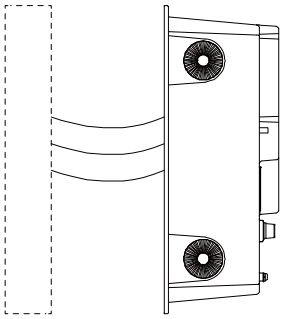
When the battery runs low, all initial settings must be re-setup every time the power is turned on.

Exchange method of the internal battery is explained as below.

1. Remove 10 fixed screws on the back side of the display unit.



2. Remove the front panel from the main chassis by disconnecting the internal cable.



3. Exchange the internal battery on the Logic PCB.
   Battery type name: CR2032

Chapter 5 Maintenance

5.1 Regular service and cleaning up

Periodic inspection and cleaning is essential to keep the radar system in the good working order for the life of the radar.

5.1.1 Monthly inspection

(1) Check whether there is any dirt or soot on the radiating part of the Antenna unit. If any, wipe it with soft cloth soaked in water or soap detergent. Also make sure no cracks or coating material is on the front radiation part of Antenna unit.

> Never turn on the power of radar system under inspection.

(2) Wipe the radar screen with cloth soaked in static electricity inhibitor if dirty. Avoid using a dry cloth since it will generate static electricity resulting in the accumulation of dust.

5.1.2 Annual inspection

Inspect the Antenna motor brushes in the Scanner unit every 2,000 operating hours. Replace with a new brush if the brush length is less than 6 mm.

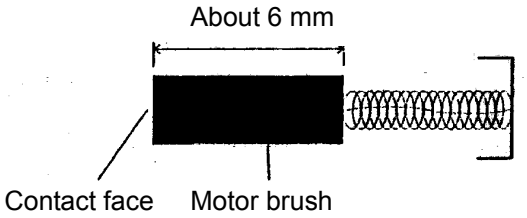
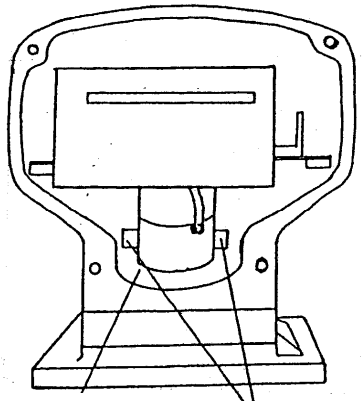


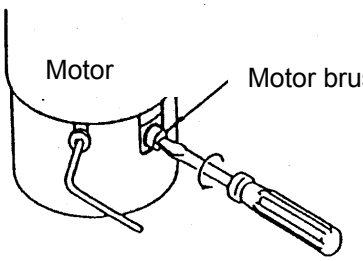
Figure 5.1 instructions for changing the motor brushes

(1) Remove the cover at the forward side of the Antenna unit by unscrewing the mounting screw. The Antenna drive motor is located inside the lower side of the housing.
(2) Remove the old motor brush using the slotted screwdriver. (Refer to Figure 5.2).
(3) Fit the screw to the slot and rotate slowly to counterclockwise. Both of the brushes should be changed simultaneously.
(4) Insert new brushes and rig them with a reverse sequence.

> **Warning:** To prevent electric shock, be sure to turn off the radar system power before opening the cover of the antenna unit.

Internal structure of the antenna housing





Turn the screw slowly to counterclockwise using a screwdriver to remove an old motor brush.

Figure 5.2 Changing the motor brushes

Chapter 6 Input/output data

6.1 Input data

6.1.1 Details of the data input format

Check sum: All the data from $ to the check sum position * is calculated by exclusive-OR operation and used as checksum.

ACK	Acknowledge alarm

$ - - ACK, xxx * hh<CR><LF>

- Check sum
- Unique alarm number (identifier) at alarm source
- Formatter
- Talker device
- Start of sentence

ALR	Set alarm state

$ - - ALR, xxxxxx.xx, xxx, A, A, c- -c*hh <CR><LF>

- UTC
- Check sum
- Alarm' s description text
- Alarm' s acknowledge state
  A : acknowledged
  V : unacknowledged
- Alarm' s condition
  A : threshold exceede
  V : not exceeded
- Local alarm number
- Formatter
- Talker device
- Start of sentence

BWC	Bearing and distance to waypoint

$ - - BWC, , xxxx.xxx, N/S, xxxxx.xxx, E/W, x.x, T, x.x, M, x.x, N, xxx, a*hh <CR><LF>

- Way point latitude, N/S
- Way point longitude, N/S
- Bearing, degrees true
- Bearing, degrees magnetic
- Distance (nm)
  xx.xx : 00.00 ~ 09.99nm
  xxx.x : 010.0 ~ 999.9nm
- Way point ID
- Mode indicator
- Check sum
- Formatter
- Talker device
- Start of sentence
- This field is not used

DBT	Depth below transducer

$ - - DBT, xxxx.x, f, xxxx.x, M, xxxx.x F*hh <CR><LF>

- Check sum
- Water depth, fathoms
- Water depth, m
- Water depth, feet
- Formatter
- Talker device
- Start of sentence

DPT	Depth

$ - - DPT, xxxx.x, xx.x, x.x*hh <CR><LF>

- Check sum
- Maximum range scale in use
- Offset trom tansducer, im meters
- Water depth relative to the transducer, in meters
- Formatter
- Talker device
- Start of sentence

DTM — Datum reference

$ - - DTM, ccc, a, x.x, a, x.x, a, x.x, ccc*hh <CR><LF>

- $: Start of sentence
- - : Talker device
- DTM : Formatter
- ccc : Local datum
- a : Local datum subdivision code
- x.x : Lat offset, min, N/S
- a : Lat offset, min, N/S
- x.x : Lon offset, min, E/W
- a : Lon offset, min, E/W
- x.x : Altitude offset, m
- ccc : Reference datum
  - W84 : WGS84
  - W72 : WGS72
  - S85 : SGS85
  - P90 : PE90
  - 999 : user
- *hh : Check sum
- <CR><LF>

GGA — Global positioning system (GPS) fix data

$ - - GGA, hhmmss.ss, xxxx.xxx, N/S, xxxx.xxx, E/W, x, ... *hh <CR><LF>

- $: Start of sentence
- - : Talker device
- GGA : Formatter
- hhmmss.ss : UTC
- xxxx.xxx, N/S : Latitude, N/S
- xxxx.xxx, E/W : Longitude, N/S
- x : GPS quality indicator
  - 0 : fix not available or invalid
  - 1 : GPS SPS mode, fix valid
  - 2 : DGPS,SPS mode, fix valid
  - 3 - 8 : Not accepted in
- . . . . . : These fields are not used
- *hh : Check sum
- <CR><LF>

Note for Talker device identifer :
Only GP(GPS) is accepted

GLC — Geographic position, LORAN C

$ - - GLC, , , , x.x,a,x.x,a,x.x,a,x.x,a,x.x,a *hh <CR><LF>

- $: Start of sentence
- - : Talker device
- GLC : Formatter
- , , , : This field is not used
- x.x,a,x.x,a,x.x,a,x.x,a,x.x,a : TD1 TD2 TD3 TD4 TD5
  - These fields are valid as far as the data are entered in 2 out of 5 TD fields;
  - Otherwise the fields will void
- *hh : Check sum
- <CR><LF>

GLL — Geographic position Latitude/Longitude

$ - - GLL, xxxx.xxx, N/S, xxxx.xxx, E/W, , A, a*hh <CR><LF>

- $: Start of sentence
- - : Talker device
- GLL : Formatter
- xxxx.xxx, N/S : Latitude, N/S
- xxxx.xxx, E/W : Longitude, E/W
- , : This field is not used
- A : Status :
  - A = Data valid
  - V = Data invalid
- a : Mode indicator
- *hh : Check sum
- <CR><LF>

GNS — GNSS fix data

$ - - GNS, , xxxx.xxx, N/S, xxxx.xxx, E/W, a, ... *hh <CR><LF>

- $: Start of sentence
- - : Talker device
- GNS : Formatter
- , : This field is not used
- xxxx.xxx, N/S : Latitude, N/S
- xxxx.xxx, E/W : Longitude, E/W
- a : Mode indicator
- . . . . : These fields are not used
- *hh : Check sum
- <CR><LF>

HDG — Heading, deviation and variation

$ - - HDG, x.x, x.x, E/W, x.x, E/W*hh <CR><LF>

- $: Start of sentence
- - : Talker device
- HDG : Formatter
- x.x : Magnetic sensor heading, degrees
- x.x, E/W : Magnetic deviation, degrees E/W
- x.x, E/W : Magnetic variation, degrees E/W
- *hh : Check sum
- <CR><LF>

HDT — Heading true

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

- $: Start of sentence
- - : Talker device
- HDT : Formatter
- xxx.x : Heading, degrees true
- T : Fixed
- hh : Check sum

Note for Talker device identifer :
Only HE and HN are accepted

MTW — Water temperature

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

- $: Start of sentence
- - : Talker device
- MTW : Formatter
- x.x : Temperature, degrees C
- C : Fixed
- hh : Check sum

RMA — Recommended minimum specific LORAN-C data

$ - - RMA, A, xxxx.xxx, N/S, xxxxx.xxx, E/W, , x.x, x.x, , , a*hh <CR><LF>

- $: Start of sentence
- - : Talker device
- RMA : Formatter
- A : Status (A : Data valid, V : Data invalid)
- xxxx.xxx, N/S : Latitude, degrees N/S
- xxxxx.xxx, E/W : Longitude, degrees E/W
- , : These fields are not used
- x.x : Speed over ground, knots
- x.x : Course over ground, degrees true
- , , : These fields are not used
- a : Mode indicator
- hh : Check sum

RMB — Recommended minimum navigation information

$ - - RMB, A, , , c-c, xxxx.xxx, N/S, xxxxx.xxx, E/W, xxx.x, xxx.x, , , a*hh <CR><LF>

- $: Start of sentence
- - : Talker device
- RMB : Formatter
- A : Status : A = Data valid, V = Data invalid
- , , : These fields are not used
- c-c : Destination waypoint ID
- xxxx.xxx, N/S : Destination waypoint latitude, N/S
- xxxxx.xxx, E/W : Destination waypoint longiitude, E/W
- xxx.x : Range of destination（NM）
  xx.xx : 00.00 to 09.99nm
  xxx.x : 010.0 to 999.9nm
- xxx.x : Bearing to destination, degrees true
- , , : These fields are not used
- a : Mode indicator
- hh : Check sum

RMC — Recommended minimum specific GNSS data

$ - - RMC, hhmmss.ss , A, xxxx.xxx, N/S , xxxxx.xxx, E/W , x.x, x.x, xxxxxx, , , a*hh <CR><LF>

- $: Start of sentence
- - : Talker device
- RMC : Formatter
- hhmmss.ss : UTC
- A : Status : A = Data valid, V = Data invalid
- xxxx.xxx, N/S : Latitude, N/S
- xxxxx.xxx, E/W : Longiitude, E/W
- x.x : Speed over ground, knots
- x.x : Course over ground, degrees true
- xxxxxx : Date : dd/mm/yy
- , , : These fields are not used
- a : Mode indicator
- hh : Check sum

ROT — Rate of turn

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

- $: Start of sentence
- - : Talker device
- ROT : Formatter
- x.x : Rate of turn (°/min)
- A : Status : A = Data valid, V = Data invalid
- hh : Check sum

RTE — Routes

$ - - RTE, , x, W, , c-c, c-c, c-c, c-c*hh <CR><LF>

- Start of sentence: $
- Talker device: - -
- Formatter: RTE
- Message number. Only one message is selectable: x
- This field is not used: ,
- Message mode: W
- This field is not used: ,
- Current waypoint: c-c
- Waypoint ID : The first 4 digits are valid to designate Waypoint ID, which can be assigned up to 8 kinds maximum. Only a working routes is displayed.: c-c, c-c, c-c
- Check sum: *hh
- <CR><LF>

THS — Heading true

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

- Start of sentence: $
- Talker device: - -
- Formatter: THS
- Heading, degrees true: x.x
- Mode indicator: a
- Check sum: hh
- <CR><LF>

VBW — Dual ground/water speed

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

- Start of sentence: $
- Talker device: - -
- Formatter: VBW
- Longitudinal water speed, knots: xx.x
- This field is not used: ,
- Status water speed : A = Data valid, V = Data invalid: A
- Longitudinal ground speed, knots: xx.x
- Transverse ground speed, knots: xx.x
- Status ground speed : A = Data valid, V = Data invalid: A
- These fields are not used: , , ,
- Check sum: *hh
- <CR><LF>

Note for talker device identifier:
Only VD(Doppler speed log) is accepted

VHW — Water speed and heading

$ - - VHW, , , , , xx.x, N, , *hh <CR><LF>

- Start of sentence: $
- Talker device: - -
- Formatter: VHW
- These fields are not used: , , , ,
- Speed, knots: xx.x
- These fields are not used: N, ,
- Check sum: *hh
- <CR><LF>

Note 1 :
In case the speed data in knots is not available, then the metric speed data fields will be recovered used for alternative metric data.

Note 2 :
Talker Device : Only VD (Doppler speed log), VM (Magnetic water speed log) and VW (Mechanical water speed log) are accepted.

VDR — Set and drift

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

- Start of sentence: $
- Talker device: - -
- Formatter: VDR
- Direction, degrees true: x.x
- These fields are not used: T , ,
- Current speed, knots: x.x
- These fields are not used: N
- Check sum: *hh
- <CR><LF>

VTG — Course and ground speed

$ - - VTG, xxx.x, T, , , xxx.x, N, xxx.x, K, a*hh <CR><LF>

- Start of sentence: $
- Talker device: - -
- Formatter: VTG
- Course over ground, degrees true: xxx.x
- These fields are not used: T, , ,
- Speed over ground, knots: xxx.x
- Speed over ground, km/h: xxx.x
- Mode indicator: a
- Check sum: *hh
- <CR><LF>

WPL — Waypoint location

$ - - WPL, xxxx.xxx, N/S, xxxxx.xxx, E/W, c-c*hh <CR><LF>

- $: Start of sentence
- - : Talker device
- WPL : Formatter
- xxxx.xxx, N/S : Waypoint latitude, N/S
- xxxxx.xxx, E/W : Waypoint longitude, E/W
- c-c : Waypoint identifier : The first 4 digits are valid to designate waypoint identifier, which can be assigned up to 8 kinds as maximum
- hh : Check sum

XTE — Cross-track error, measured

$ - - XTE, A, A, x.x, a, N, a*hh <CR><LF>

- $: Start of sentence
- - : Talker device
- XTE : Formatter
- A : Status : A = data valid, V = data not valid, D = differential mode
- A : Status : A = data valid, V = LORAN-C cycle lock warning flag
- x.x : Magnitude of cross-track error
- a : Direction of steer, L/R
- N : Units, nautical miles
- a : Mode indicator
- hh : Check sum

ZDA — Time and date

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

- $: State of sentence
- - : Talker device
- ZDA : Formatter
- hhmmss.ss : UTC
- xx : Day, 01 to 31(UTC)
- xx : Month, 01 to 12(UTC)
- xxxx : Year, (UTC)
- xx : Local zone hour
- xx : Local zone hour
- hh : Check sum

VDM — AIS other ship data

! AI VDM, x, x, x, x, xxxxx・・・・・・・・・・・・・・・・・・・xxxx, N*hh <CR><LF>

- ! : Start of sentence
- AI : Talker device
- VDM : Formatter
- x : Total of sentence
- x : Sentence number
- x : Message number
- x : Channel number
- xxxxx・・・・・・・・・・・・・・・・・・・xxxx : Message part (6bit field)
- N : Fill bit
- hh : Check sum

VDO — AIS own ship data

! AI VDO, x, x, x, x, xxxxx・・・・・・・・・・・・・・・・・・・xxxx, N*hh <CR><LF>

- ! : Start of sentence
- AI : Talker device
- VDO : Formatter
- x : Total of sentence
- x : Sentence number
- x : Message number
- x : Channel number
- xxxxx・・・・・・・・・・・・・・・・・・・xxxx : Message part (6bit field)
- N : Fill bit
- hh : Check sum

6.1.2 Priority of received data

Receiving item	
Ship's bearing information (HDG)	HDT > HDM > VTG (True) > VTG (Magnetic) > RMC
Speed against water (SPD)	VHW > VBW (Speed against water in axis direction)
Speed against ground (SOG)	VBW (2-axis against ground) > VTG > RMC
Course (COG)	VTG (True) > VTG (Magnetic) > RMC
Own ship's position LOP	GLC
Own ship's position L/L	GNS > GGA > GLL > RMC
Destination bearing, distance	RMB > BWC (Magnetic direction of destination is invalid)
Destination position L/L	RMB>BWC>RTE/WPL
Error in destination course	RMB> XTE
Route	RTE
Latitude/longitude of destination of route	WPL
Water depth	DPT>DBT
Water temperature	MTW
Geodetic system	DTM
Date, time	ZDA>RMC>GGA

6.2 Details of TT(ARPA) tracking data output

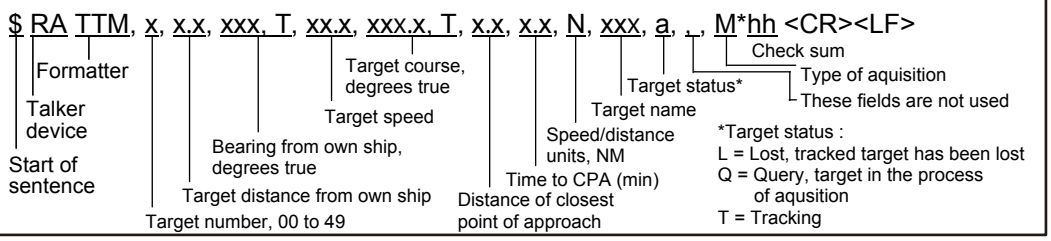
Data standard name: IEC61162-1 or IEC61162-2

Target data of the automatic tracking unit is provided via data connectors (J4/J5) on the back panel.

TLB	Target label
	$ RA TLB, x.x, c - - c, x.x, c - - c, . . . x.x, c - - c * hh<CR><LF> Check sum Additional label pairs Label assigned to target 'n' Target number 'n' reported by the device Formatter Talker device Radar Start of sentence

TTD	Tracked target data
	! RA TTD, hh, hh, x, s - - s, x * hh<CR><LF> Check sum Sequential message identifier, 0 to 9 Hex sentence number, 1 to FF Total hex number of sentences needed to transfer the message, 1 to FF Formatter Talker device radar Start of sentence

TTM	Tracked target message

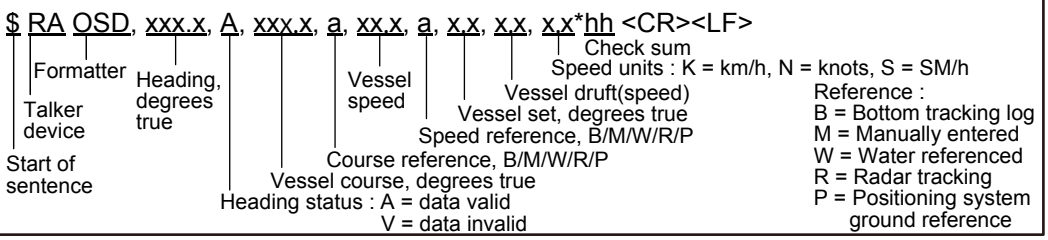


6.3 Details of the radar data output

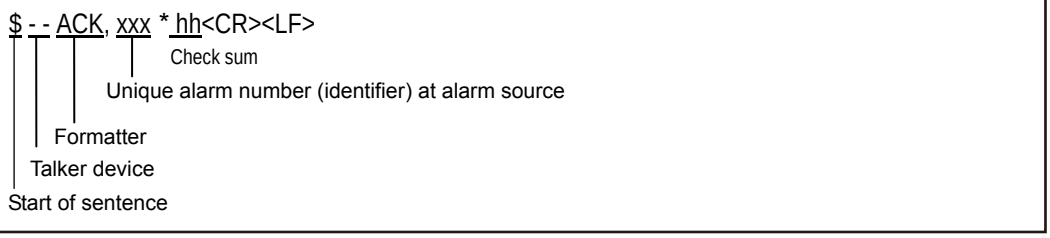
Data standard name: IEC61162-1 or IEC61162-2

Own ship data and radar system data are provided via data connectors (J4/J5) on the back panel.

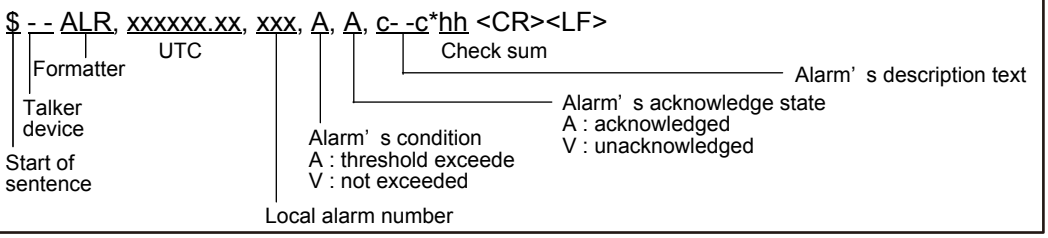
OSD	Own ship data



ACK	Acknowledge alarm

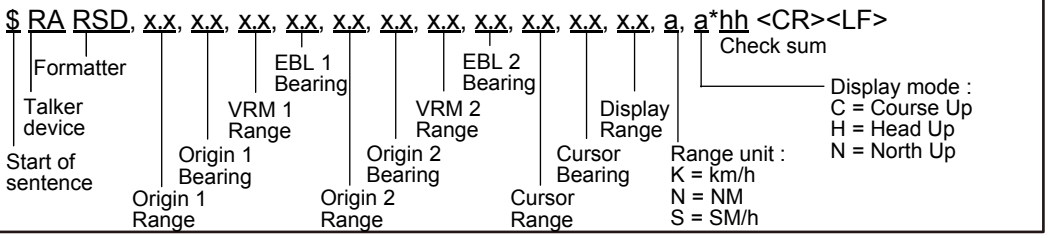


ALR	Set alarm state



6.3.1 Radar system data

RSD	Radar system data



6.4 Interface specification

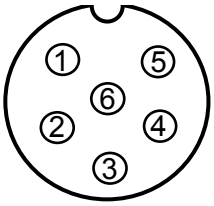
6.4.1 NAV (J4), EPFS (J5) and SDME (J6) serial data input/output specification

Input connector: J4, J5 and J6

Connector used: LTWD-06PMMP-LC

Connector acceptable: LTWD-06BFFA-L180

J4-J6 Data connector pin assignment
(Display unit upper view)



Data connector pin assignment

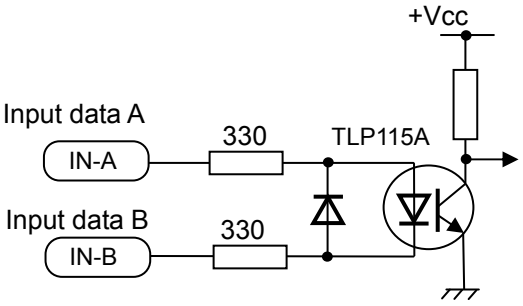
J4, J5 & J6	
Pin number	Signal name
1	Shield
2	OUT-A
3	OUT-B
4	IN-A
5	IN-B
6	Ground

Serial data input (Listener):

Standard-type signal conforming to IEC 61162-1 or IEC 61162-2 is acceptable.

Input load: 330 + 330 Ohm

Circuit configuration: Photo coupler
Type TLP115A (Toshiba)

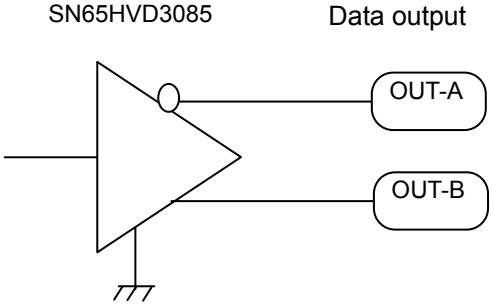


Serial data input circuit

Serial data output (Talker):

Standard-type signal conforming to IEC 61162-1or IEC 61162-2 is transmittable.

Circuit configuration: RS422 driver IC
Type SN65HVD3085 (TI）



Serial data output circuit

6.4.2 VDR (external monitor) and Alarm output signal specification

Output connector name: VDR & Alarm

Connector used: LTWBU-10PMMP-LC

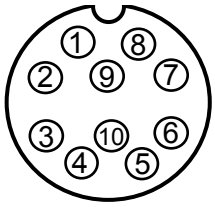
Connector acceptable: LTWBU-10BFFA-L180

Pin location is shown below.

VDR & External Alarm connector pin assignment

Pin number	Signal name
1	RVD
2	R-GND
3	GVD
4	G-GND
5	BVD
6	B-GND
7	H-SYNC
8	V-SYNC
9	BZ (+)
10	BZ (-)

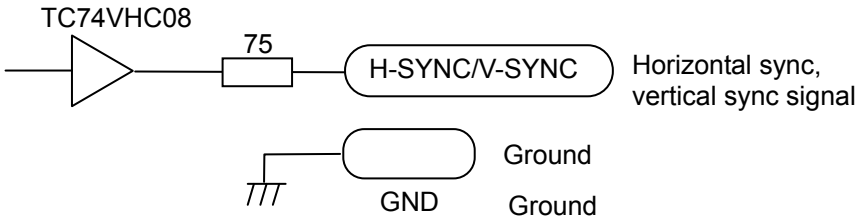
VDR & External Alarm connector pin assignment
(Display unit upper view)



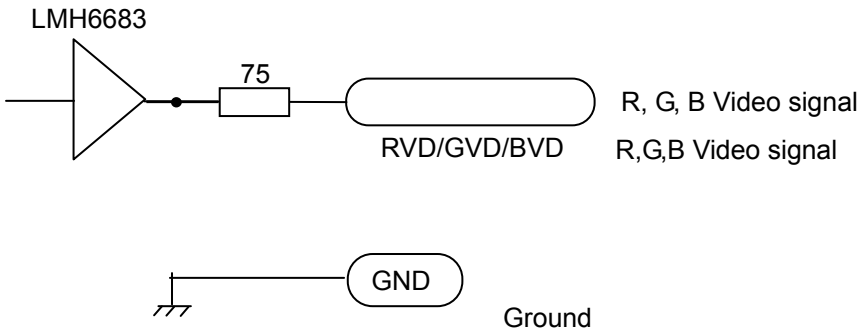
Signal specification

Signal name	Frequency	Polarity	Signal width	Level	Impedance
Horizontal sync signal (H-SYNC)	63.981kHz	Negative	1.037us	TTL	200 Ω
Vertical sync signal (V-SYNC)	60.0Hz	Negative	47 us	TTL	200 Ω
R, G, B Video signal	-	Positive	—	0.7 V p-p	75 Ω

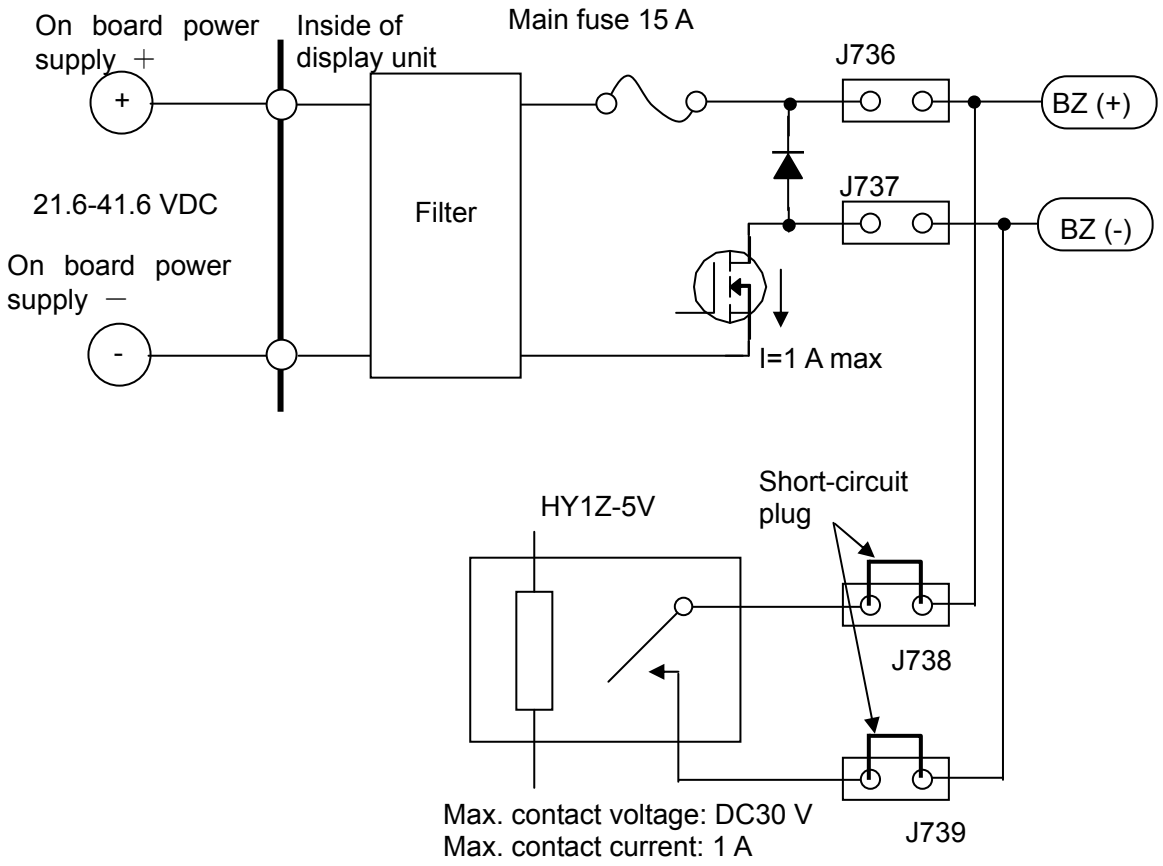
Circuit for horizontal sync, vertical sync signal output



Circuit for R, G, B video signal output



Alarm Output specification



Alarm contact closed in case of failure.
When voltage is to be output at buzzer terminals, remove the short-circuited plug from short-circuit connectors J738 and J739 on the logic board E59-700* in the display unit and insert them into J736 and J737. Then, on board power supply voltage will be output as alarming voltage when an alarm is generated.

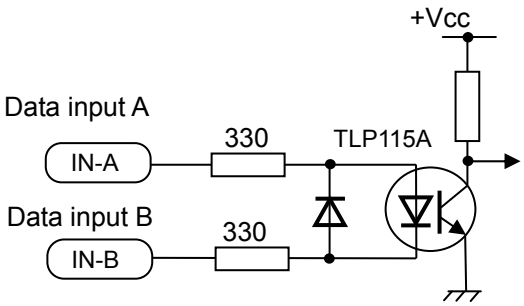
*Subject to version change

6.4.3 AIS input/output specification (J2)

I/O connector AIS (J2)

Connector used: LTWD-08PMMP-LC

Connector acceptable: LTWBD-08BFFA-L180



Serial data input circuit

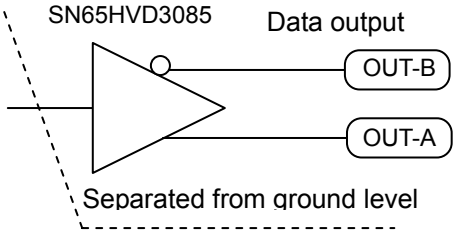
Serial data input (Listener):

Standard signals conforming to IEC61162-2 is acceptable.

Input load 330+330 Ohm

Circuit configuration: Photo coupler

Type TLP115A (Toshiba)



Serial data output circuit

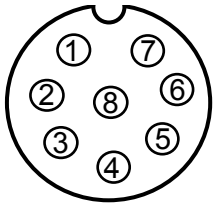
Serial data output circuit (Talker):

Standard signals conforming to IEC61162-2 can be output.

Circuit configuration: RS422 Driver/Receiver IC

Type SN65HVD3085 (TI)

J2 Data connector pin assignment
(Display unit upper view)



AIS connector pin assignment

Pin number	Signal name
1	Shield
2	IN-A
3	IN-B
4	OUT-B
5	OUT-A
6	GND
7	ALARM+ IN
8	ALARM- IN

Note: Pin 7 and pin 8 are used for error detection input signal for AIS system.

It denotes [Short: Normal, Open: Error]. Please short #7 and #8 pin at AIS normal state.

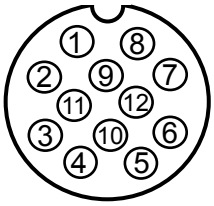
6.4.4 Radar input/output signal specification

I/O connector: J3 Inter Switch

Connector used: LTWU-12PMMP-LC

Connector acceptable: LTWBU-12BFFA-L180

J3 Remote connector pin assignment
(Display unit upper view)



Inter Switch connector pin assignment

Pin number	Signal name
1	VIDEO OUT
2	TRIG OUT
3	GND
4	AZIP OUT
5	SHF OUT
6	GND
7	VIDEO IN
8	TRIG IN
9	GND
10	AZIP IN
11	SHF IN
12	+12VDC

6.4.5 Gyro input signal specification

Gyro data connector

Connector used: LTWD-08PMMP-LC

Connector acceptable: LTWBD-08BFFA-L180

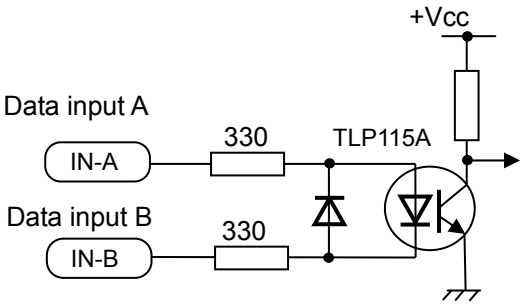
Serial data input (Listener):

Standard signals conforming to IEC 61162-2 or IEC 61162-1 is acceptable.

Input load 330+330 Ohm

Circuit configuration: Photo coupler

Type TLP115A (Toshiba)



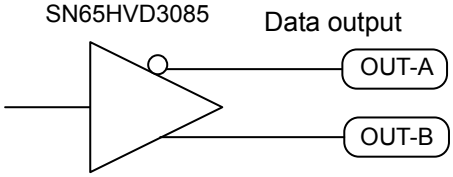
Serial data input circuit

Serial data output circuit (Talker):

Standard signals conforming to IEC 61162-2 or IEC 61162-1 can be output.

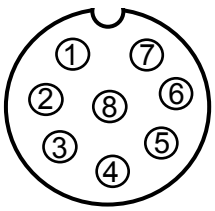
Circuit configuration: RS422 Driver IC

Type SN65HVD3085 (TI)



Serial data output circuit

Gyro data connector pin assignment
(Display unit upper view)



Gyro data connector pin assignment

Pin number	Signal name
1	OUT-A
2	OUT-B
3	IN-A
4	IN-B
5	GND
6	NC
7	NC
8	DC+12V

6.4.6 Talker device code of the data output devices

The device code displayed as talker is shown in the table below.

Data output device	Talker device code	Displayed code
Decca navigator device	DE	DEC
Global positioning system (GPS)	GP	GPS (See below)
Differential GPS (DGPS)	GP	DGPS (See below)
GLONASS receiver	GL	GLO
Global Navigation Satellite System	GN	GNSS
Integrated navigation system	IN	INS
Loran-C	LC	LOR
Electronic Position Finding System	SN	EPFS
True north tracking Gyro	HE	GYRO
Non-true north tracking Gyro	HN	GYRO
Magnetic compass	HC	MAG
Doppler Log and Generic Log	VD	DO LOG
Electromagnetic Log	VM	LOG
Mechanical Log	VW	LOG
Other devices		Display of talker device

Notice

The change between GPS and DGPS of the device name displayed on the screen is based on the operational status display in the GGA sentence. Refer to “Further description of the sentence” of Chapter 6.

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