FURUNO

OPERATOR'S MANUAL

MARINE RADAR

MODEL FR-8300DS

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·Your Local Agent/Dealer

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PUB. No. OME-33230
(ITAM) FR-8300DS

0008067200

CONTENTS

SPECIFICATIONS OF FR-8300DS

1. SCANNER UNIT

1. Radiator: Slotted Waveguide Array

2. Radiator Length:	250cm	270cm
3. Radiator Type:	SN-4A	SN-5A
4. Horizontal Beamwidth:	2.6°	2.3°
5. Vertical Beamwidth:	25°	25°

6. Polarization: Horizontal
7. Antenna Rotation: 24 rpm nominal (no wind load)
8. Wind Load: Relative wind 51.5 m/s (100kts)

2. TX MODULE & RECEIVER CIRCUIT (contained in the scanner housing)

1. Transmitting Tube: Magnetron MG5223F
2. Frequency and Modulation: 3050MHz ± 30MHz (S-band), PON
3. Peak Output Power: 30kW nominal
4. Pulselength & Pulse Repetition Rate:

Pulselength	Pulse Rep. Rate (Hz) (*1)	Range (nm)									
		0.25	0.5	0.75	1.5	3	6	12	24	48	96
Short (SP) 0.08us	approx. 2100Hz	0.08us									
Middle 1 (M1P) 0.3us	approx. 2100Hz				0.3us						
Middle 2 (M2P) 0.6us	approx. 1200Hz					0.6us					
Long (LP) 1.2us	approx. 600Hz(*2)						1.2us				

*1: PRR is changed to approx. 500Hz on all ranges when "Second-trace Echo Rejection Mode" is selected.
*2: Approx. 500Hz on 96nm range.

5. Modulator: SCR line type pulse modulator
6. IF Amplifier:
   I.F. ---------- 60MHz
   Bandwidth ------- 28MHz (short)
   3MHz (mid./long)
   Characteristics --- Logarithmic
7. Tuning: Manual, with tuning marker
8. Receiver Front End: MIC (Microwave IC)
9. Duplexer: Circulator and Diode Limiter

3. DISPLAY UNIT

1. Indication System: PPI, daylight display

2. Picture Tube: 12" rectangular CRT

3. Range (nm):	0.25	0.5	0.75	1.5	3	6	12	24	48	96
4. Range Ring Interval (nm):	0.05	0.1	0.25	0.25	0.5	1	2	4	8	12
5. Number of Rings:	5	5	3	6	6	6	6	6	6	6

6. Display Mode:
   1) Head-up
   2) North-up *
   3) Course-up *
   4) Head Set **

   * gyrocompass required
   ** when no gyro is connected

7. Bearing Resolution: better than 3.5°; radiator SN-4A
   3.0°; radiator SN-5A
8. Bearing Accuracy: better than ± 1.0°
9. Range Discrimination: better than 44m (1.5nm range)
10. Minimum Range: better than 27m (0.25nm range)
11. VRM/Range Ring Accuracy: better than 0.9%

12. Marks: Heading Mark, North Mark*, Bearing Scale, Range Ring, VRM1 & VRM2, EBL1 and EBL2, Tuning Marker, Guard Zone

    * gyrocompass required

13. Numeral/Character Indication: Range in Use, Range Ring Interval, Display Mode (HU, NU*, CU*, HS**), Pulselength (SP, MP1, MP2, LP) Interference Rejector (IR), Alarm (GUARD), GYRO*, Echo Stretch (ES), EBL, EBL Bearing Mode (R, T*), VRM, Echo Average (EAV1, EAV2, EAV3), ZOOM, Protting Time.

    * gyrocompass required
    ** when no gyro is connected

14. Echo Trail: Continuous (max. 99min 59sec), 30sec, 1min, 3min or 6min
15. Interference Rejector: Built-in
16. Off-center Display: Built-in
17. Zoom Function: Selected area is doubled in size (not activated when off-centering)
18. Echo Average: Correlates echo scan-to-scan.
19. Echo Stretch: Enhances echo on mid./long ranges.
20. Floating EBL: Measures range and bearing between any two targets.
21. Alarm Function: built in

4. ENVIRONMENTAL CONDITIONS

1. Vibration:

Total Amplitude	Vibration Cycle
± 1.6mm	1 to 12.5Hz
± 0.38mm	12.5 to 25Hz
± 0.10mm	25 to 50Hz

2. Ambient Temperature:

Scanner Unit ------ -25°C to +70°C
Display Unit ------ -15°C to +55°C

3. Humidity:

Relative Humidity 95% at +40°C

5. POWER REQUIREMENTS

24VDC, 150W
100/110/115/220/230VAC, 250VA (100VAC), 50/60Hz, 1ø (rectifier required)

6. COLOR

Scanner Unit: Munsell N9.5
Display Unit: 2.5GY5/1.5 Embossed T25 (Cabinet)
N3.0 Newtone No.5 (Control Panel)

SPARE PARTS

No.	Name	Type	Q'ty	Weight	Remarks
1	Scanner Unit	SN4A-RSB-0023	1	77kg	250cm radiator
		SN5A-RSB-0023		79kg	270cm radiator
2	Display Unit	RDP-073	1	19kg	
3	Accessories	FP03-03000	1 set		
4	Installation Materials *	CP03-04000	1 set		W/15m sig. cable
		CP03-04010			W/20m sig. cable
		CP03-04020			W/30m sig. cable
		CP03-04030			W/60m sig. cable
5	Spare Parts	SP03-04900	1 set		

*: Installation materrials for display unit (CP03-02501),
for scanner unit (CP03-02502) and
signal cable RW-6895

OPTIONS

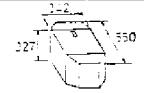
No.	Name	Type	Code No.	Remarks	
1	Rectifier Unit	RU-3424	000-030-441	for 110VAC	
			000-030-442	for 220VAC	
2	Transformer Unit	RU-3305	000-030-448	for de-icer 110/220VAC	
3	Power Cable	CVV-S 8x2C	000-560-634	15m	
4	Video Plotter	RP-3			
5	Memory Card (RAM)	OP03-02	008-105-140	for RP-3	
6	Chart Card (ROM)			for RP-3	
7	Auto plotter	APR-3			
8	Performance Monitor	PM-50			
9	A-D Converter	AD-10S		for gyro data	
10	External Buzzer	OP03-21	000-030-097	W/1.5m cord	
11	Radar Color Display	CD-140/141			
12	Radar Slave Display	FMD-800/8000			
13	Signal Cable Assy.	S03-15-5	008-100-360	CO-SPEVV-SB-C 0.2x5P 5m, For nav. data	
14	Signal Cable Assy. (Antenna Cable)	S03-27-15	008-377-820	15m	RW-3839-2 without armor
		S03-27-20	008-377-830	20m	
		S03-27-30	008-377-840	30m	
		S03-27-60	008-377-850	60m	

FURUNO

CODE No.	000-080-903	03CS-X-9502
TYPE	FP03-03000	

付属品表
ACCESSORIES

FR-8050D(DA) FR-8100DS レーダー
FR-8100D(DA) FR-8300DS
FR-8250D(DA) FMD-8000 RADAR

番号 No.	名称 NAME	略図 OUTLINE	型名／規格 DESCRIPTIONS	数量 Q'TY	用途／備考 REMARKS
1	フード組品 HOOD ASSY.		FP03-02910 CODE No. 008-223-520	1	
2	ビニールカバー VINYL COVER		03-034-0401-0 CODE No. 000-801-657	1	
3	フィルタ FILTER		03-034-9601 CODE No. 100-101-680	1	
			CODE No.		
			CODE No.		
			CODE No.		
			CODE No.		
			CODE No.		
			CODE No.		
			CODE No.		

貿易用
FOR EXPORT

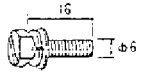
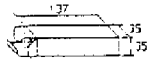
図番 DWG. No. C3314-015-A
検図 CHECKED

FURUNO

CODE No.		
TYPE		

工事材料表
INSTALLATION MATERIALS

レーダー空中線部組立材料
RADAR ANTENNA ASSEMBLING MATERIALS

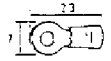
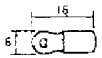
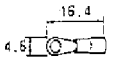
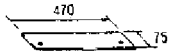
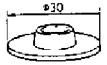
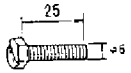
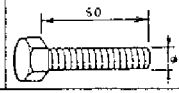
番号 No.	名称 NAME	略図 OUTLINE	型名／規格 DESCRIPTIONS	数量 Q'TY	用途／備考 REMARKS
1	六角ボルト HEX. BOLT		M10X20 SUS304 CODE No. 000-862-158	8	
2	六角セムスBC(スリ割付) HEX. BOLT (SLOTTED, WASHER HEAD)		M6X16 SUS304 CODE No. 000-862-061	8	
3	バネ座金 SPRING WASHER		M10 SUS304 CODE No. 000-864-261	8	
4	ミガキ平座金 FLAT WASHER		M10 SUS304 CODE No. 000-864-137	8	
5	スペースリーボンド ADHESIVE		1211 50g CODE No. 000-854-118	1	
6	Oーリング O-RING		WP-20 1115-70 CODE No. 000-851-714	2	
			CODE No.		
			CODE No.		
			CODE No.		
			CODE No.		

図番 DWG. No. C3291-013-A 1/1
検図 CHECKED

FURUNO

CODE No.	008-206-860	03BY-X-9402-5
TYPE	CP03-02501	

工事材料表 INSTALLATION MATERIALS	FR-8050S/8100S(M2)/8300S FR-15100S/15300S FR-81000S/83000S	レーダー RADAR (空中線部用 FOR SCANNER UNIT)

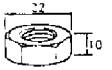
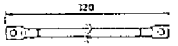
番号 No.	名称 NAME	略図 OUTLINE	型名／規格 DESCRIPTIONS	数量 Q'TY	用途／備考 REMARKS
1	圧着端子 CRIMP-ON LUG		FV5.5-4	8	
			CODE No. 000-538-123		
2	圧着端子 CRIMP-ON LUG		FV1.25-3, アカ RED	29	
			CODE No. 000-538-113		
3	圧着端子 CRIMP-ON LUG		320882	1	
			CODE No. 000-537-110		
4	防蝕ゴム CORROSION-PROOF RUBBER MAT		03-017-0301-1	2	
			CODE No. 100-050-931		
5	シールワッシャー SEAL WASHER		03-001-3002-0	4	
			CODE No. 300-130-020		
6	六角ボルト HEX. BOLT		M6X25 SUS304	1	
			CODE No. 000-862-180		
7	六角ナット HEX. NUT		M6 1種 SUS304	1	
			CODE No. 000-863-109		
8	ミガキ平座金 FLAT WASHER		M6 SUS304	3	
			CODE No. 000-864-129		
9	バネ座金 SPRING WASHER		M6 SUS304	1	
			CODE No. 000-864-260		
10	六角ボルト HEX. BOLT		M12X60 SUS304	4	
			CODE No. 000-862-191		

図番 DWG. No.	C3291-009-F	1/2
検図 CHECKED		

FURUNO

CODE No.	008-206-860	03BY-X-9403-3
TYPE	CP03-02501	

工事材料表 INSTALLATION MATERIALS	FR-8050S/8100S FR-8100S MARK-II FR-8300S FR-81000S/83000S	レーダー RADAR (空中線部 FOR SCANNER UNIT)

番号 No.	名称 NAME	略図 OUTLINE	型名／規格 DESCRIPTIONS	数量 Q'TY	用途／備考 REMARKS
11	六角ナット 1種 HEX. NUT		M12 1種 SUS304	4	
			CODE No. 000-863-112		
12	ミガキ平座金 FLAT WASHER		M12 SUS304	4	
			CODE No. 000-864-132		
13	バネ座金 SPRING WASHER		M12 SUS304	4	
			CODE No. 000-864-263		
14	アース線 GROUNDING WIRE		RW-4747	1	
			CODE No. 000-566-000		
			CODE No.		
			CODE No.		
			CODE No.		
			CODE No.		
			CODE No.		
			CODE No.		

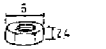
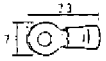
図番 DWG. No.	C3291-010-D	2/2
検図 CHECKED		

FURUNO

CODE No.	008-206-900	03BY-X-9401-5
TYPE	CP03-02502	

工事材料表
INSTALLATION MATERIALS

FR-8050S/8100S(M2)/8300S　レーダー
FR-1510DS/1530DS　RADAR
FR-8100DS/8300DS　(指示部用 FOR DISPLAY UNIT)

番号 No.	名称 NAME	略図 OUTLINE	型名／規格 DESCRIPTIONS	数量 Q'TY	用途／備考 REMARKS
1	NHコネクタ組品 NH CONNECTOR ASSY.		03-302(4P) CODE No. 008-300-570	1	
2	六角ナット 1種 HEX. NUT		M3 C2700W M3NI2 CODE No. 000-863-204	2	
3	ミガキ平座金 FLAT WASHER		M3 C2600P M3NI2 CODE No. 000-864-104	2	
4	バネ座金 SPRING WASHER		M3 C5191W M3NI2 CODE No. 000-864-204	2	
5	圧着端子 CRIMP-ON LUG		8NK4 CODE No. 000-538-180	4	
6	圧着端子 CRIMP-ON LUG		FV5.5-4 CODE No. 000-538-123	3	
			CODE No.		
			CODE No.		
			CODE No.		
			CODE No.		

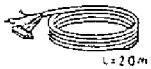
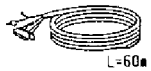
図番 DWG. No. C3291-008-E　1/1
検図 CHECKED　中野　柄　三好

FURUNO

CODE No.		03CE-X-9401-2
TYPE		

工事材料表
INSTALLATION MATERIALS

FR-8300S
FR-1510DS/1530DS
FR-8100DS/8300DS
FMD-8000
レーダー
RADAR
(信号ケーブル SIGNAL CABLE)

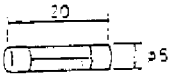
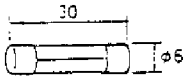
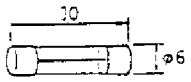
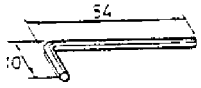
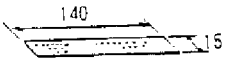
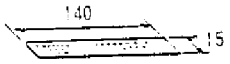
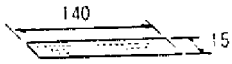
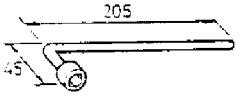
番号 No.	名称 NAME	略図 OUTLINE	型名／規格 DESCRIPTIONS	数量 Q'TY	用途／備考 REMARKS
1	信号ケーブル組品 SIGNAL CABLE ASSY.		S03-13-15 (RW-6895 *15M#) CODE No. 008-224-500	1	選択 To Be Selected
2	信号ケーブル組品 SIGNAL CABLE ASSY.		S03-13-20 (RW-6895 *20M#) CODE No. 008-224-510		
3	信号ケーブル組品 SIGNAL CABLE ASSY.		S03-13-30 (RW-6895 *30M#) CODE No. 008-224-520		
4	信号ケーブル組品 SIGNAL CABLE ASSY.		S03-13-60 (RW-6895 *60M#) CODE No. 008-224-530		30kWのみ選択可。 Selectable only for 30kW radar.
			CODE No.		
			CODE No.		
			CODE No.		
			CODE No.		
			CODE No.		

図番 DWG. No. C3303-001-0　1/1
検図 CHECKED　中野　柄　三好

FURUNO

CODE No.	000-080-904	BOX No.	P
TYPE	SP03-04900		

SHIP No.	SPARE PARTS LIST FOR	U S E	SETS PER VESSEL
	レーダー FR-8100DS/8300DS RADAR		

ITEM No.	NAME OF PART	OUTLINE	DWG. No. OR TYPE No.	QUANTITY WORKING PER SET	QUANTITY WORKING PER VES.	QUANTITY SPARE	REMARKS/CODE No.
1	ヒ ュ ー ズ FUSE		UL-TSC 125V 2A	1		3	000-101-132
2	管入りヒューズ GLASS TUBE FUSE		FGBO 0.5A AC125V	1		2	000-549-060
3	管入りヒューズ GLASS TUBE FUSE		FGBO 10A AC125V	2		4	000-549-065
4	六 角 レ ン チ HEX. WRENCH		対辺 1.5MM		1		000-830-112
5	貼りマーク 18 LABEL (18)		03-011-1068		1		100-043-630
6	貼りマーク 19 LABEL (19)		03-011-1069		1		100-043-640
7	貼りマーク 1 LABEL (1)		03-011-1051		1		301-110-510
8	貼りマーク 2 LABEL (2)		03-011-1052		1		301-110-520
9	カーボンブラシ CARBON BRUSH		T-A01297B	4		4	000-115-023
10	キセル型レンチ L-HANDLE SOCKET WRENCH		M8用 対辺 13MM		1		000-830-110

MFR'S NAME	FURUNO ELECTRIC CO., LTD.	DWG. No.	C3322-001-A

CHAPTER 1 OPERATION

GENERAL

This radar is equipped with numerous functions which help the operator assess marine traffic and fishing conditions (location of floats, etc.) These functions are, however, easy to access. If you change a control setting you will see the associated reaction almost immediately on the screen. Key entry is confirmed by a beep tone, while three beeps in succession alert wrong use of key. The location of each control and touchpad and the arrangement of legends, markers, etc. on the screen are given on page 1-15.

CAUTION

1. **Prior to switching on the radar, make sure that no person nor obstacle is in the vicinity of the scanner unit.**
2. **Because of hazardous radar energy, NEVER look into the beam of a transmitting scanner radiator at close distance.**

BASIC OPERATION

Turning the Power On / Transmitting the Radar

POWER-SW ON/OFF, SCANNER-SW ON/OFF, STBY/TX

After having confirmed that there are no obstructions around the scanner, turn the POWER and SCANNER switches to ON. DIP switch settings, program no., results of the ROM & RAM checks, total on time, total TX time, and the 3-minute timer are displayed. The 3-minute timer (magnetron warming up time) begins counting down from 3:00 to 0:00, whereupon it changes to "ST-BY," indicating the radar is ready to transmit.

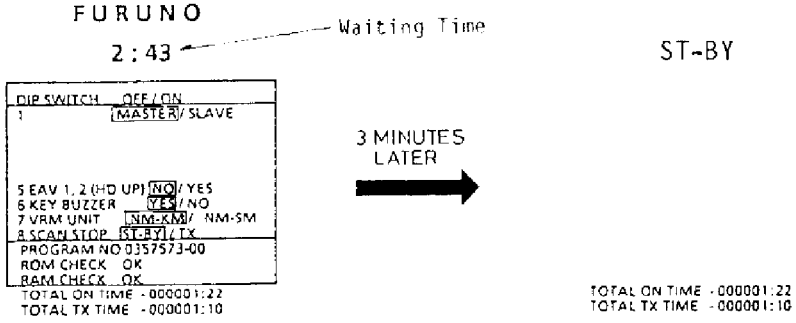


Fig.1-1

When the message ST-BY appears on the screen, press the STBY/TX touchpad to begin transmission. The display screen lights up, and any echoes received from targets are displayed on the screen. (If the STBY/TX touchpad is pressed during the 3-minute warm up period, TX appears below the timer indication and the radar will begin transmitting immediately at 0:00.)

To temporarily suspend transmission, press the STBY/TX touchpad to display ST-BY on the screen.

NOTE: Whenever the STBY/TX touchpad is pressed to begin transmission, or the RANGE +, RANGE -, PULSE, SHIFT, MODE, or X2 ZOOM touchpad is pressed, the cross hair cursor is displayed for reference on the screen for 3 seconds before being erased.

Pulselength Selection 

The PULSE touchpad is used to select the pulselength. At the "short pulselength" position, picture definition in the 1.5 to 24 nm ranges is improved, while at the "long pulselength" position, the detection of echoes is improved. The pulselength selected is indicated at the upper left-hand corner of the screen: SP, short pulse; MP1, middle pulse 1; MP2, middle pulse 2; or LP, long pulse.

The pulselength and pulse repetition rate on the specifications shows the pulselength selectable in each range.

Range Selection 

The RANGE touchpads are used to select the RANGE. The range selected determines automatically the fixed range ring interval. Press the + touchpad to increase the range, or press the - touchpad to lower the range. The range selected and the fixed range interval are indicated at the upper left-hand corner of the screen.

TUNE Control Adjustment 

The TUNE control is used to tune the receiver to the exact frequency of the transmitter. For the first 10 minutes of operation the tuning should be checked periodically because the transmitter has not stabilized yet. Readjustment after the first 10 minutes is normally not required.

Tuning is made easy by the use of the tuning bar provided at the upper right-hand side of the display screen. The TUNE control is so adjusted to display the longest tuning bar.

To tune the receiver, first turn the A/C SEA control fully counterclockwise and set the range to 24 nm. Turn the TUNE control between its extremes until the longest tuning bar (between 4 and 5 tuning markers) is obtained.

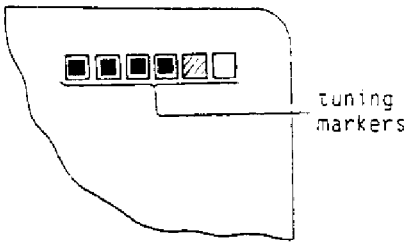


Fig.1-2 Tuning Bar

GAIN Control Adjustment 

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

To properly set the gain, first select one of the long ranges--the speckled background noise is more apparent. Turn the GAIN control clockwise slowly until you can see feeble speckled background noise. If you set up for too little gain, weak echoes may be missed. If you turn the control too far clockwise, yielding too much speckled noise background, targets may be missed because of the poor contrast between desired echoes and the background noise on the screen.

A/C SEA Control Adjustment 

In rough seas, sea clutter appears on the screen as a large number of small echoes (see Fig.1-3) which might impair radar performance in close ranges. The action of the A/C SEA (Anti Clutter Sea) circuit is to reduce the amplification of echoes at short ranges (where clutter is the greatest) and progressively increase amplification as the range increases, so that amplification will be normal at those ranges where sea clutter is not experienced. The control is effective to a maximum of about 6 miles.

The proper setting of the A/C SEA control is so that the clutter is broken up into small dots, and small targets become distinguishable. If the control is not sufficiently advanced, other targets will be hidden in the clutter, while if it is set too high, sea clutter and targets will both disappear from the screen. As a general rule of thumb, turn the control clockwise until the clutter has disappeared leeward, but a little is still visible windward. Always leave a little clutter visible on the screen, this ensures weak echoes will not be suppressed. If no clutter is visible on the screen, leave the control in the fully counterclockwise position.

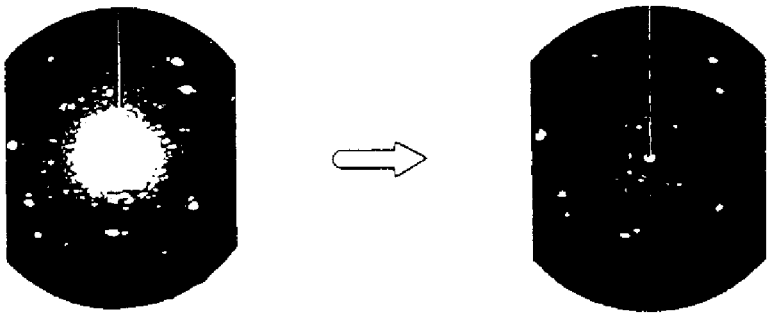


Fig.1-3 Adjusting the A/C SEA Control

Brightness/Illumination Adjustment

CRT Brightness 

The BRILL (Brilliance) control adjusts the brightness of the CRT. Turn it clockwise to increase the intensity of the radar echoes blips, legends and markers. Adjust it so that radar echo blips may be observed clearly.

Mark Brilliance 

The MARK BRILL touchpad is used to adjust the brilliance of the various marks and legends displayed on the screen; i.e., VRMs, EBLs, range rings, north mark (if gyro connected), heading mark and guard zone. There are four levels of brilliance: low, medium, medium high and high. Each time the touchpad is pressed the brilliance changes in the above sequence.

Panel Illumination 

The PANEL DIM (panel dimmer) control adjusts the illumination for both the touchpad and control panels.

Mode Selection

The MODE touchpad is used to select the presentation mode. There are either two or three modes selectable, Head-Up (HU), Course-Up (CU), North-Up (NU) or Head Set (HS), depending on whether a gyrocompass is connected or not. Each time the touchpad is pressed the mode changes in the following sequence, and the mode selected is indicated at the top left-hand side of the screen.

with gyro : HU → CU → NU

without gyro : HU → HS

Head-Up Mode

The picture is orientated so that the heading mark appears at the top of the screen. This mode is most suitable for navigation in congested areas or narrow channels.

Note that the north mark appears only when a gyrocompass is connected.

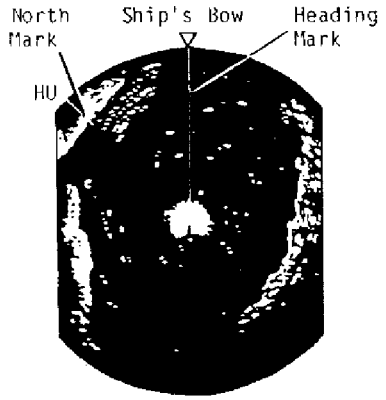


Fig.1-4 Heading-Up Mode Display

North-Up Mode

The radar picture is stabilized so that the north is at the top of the screen and the heading mark changes its position according to the orientation of the ship's heading. This mode is suitable for radar fixing of own ship's position in reference to the navigation chart. The picture is stabilized against yaw of the vessel, reducing the smearing of target echoes.

This mode is available only when a gyrocompass is connected.

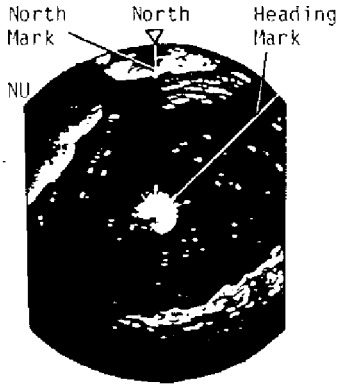


Fig.1-5 North-Up Mode Display

Course-Up Mode

Press the MODE touchpad for the CU mode at the moment the ship's bow is oriented to the desired direction (ship's course to port, waypoint, etc), and the picture is stabilized with the desired direction at the top of the screen. The heading mark changes according to the orientation of ship's heading. The picture is stabilized against yaw of the vessel.

This mode is available only when a gyrocompass is connected.

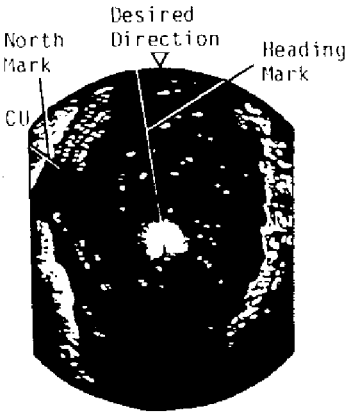
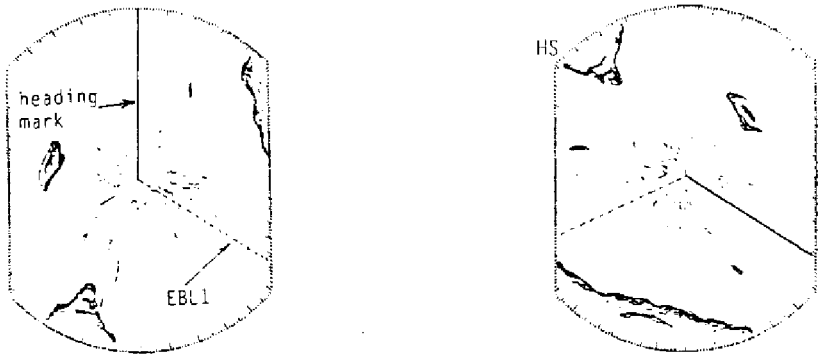


Fig.1-6 Course-Up Mode Display

Head Set Mode

The heading mark may be moved to the desired direction by using EBL and its rotary knob control.

Select the Head-up Mode; press the EBL ON touchpad to display EBL (EBL1 or EBL2); set EBL to the dresird direction by rotating the rotary knob (1-7a). Then select the Head Set Mode, and the heading mark will move to where the EBL is located as shown in Fig.1-7b. Note that this mode is available only when a gyrocompass is not connected.

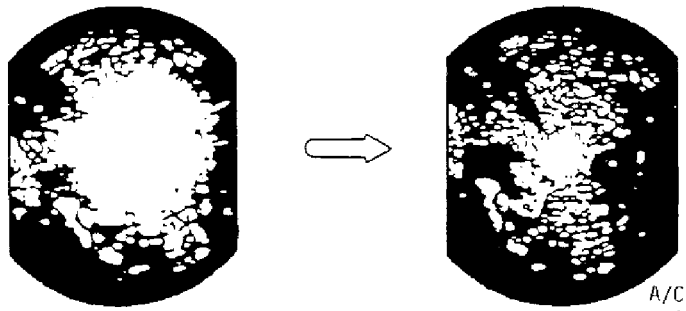


(a) Fig.1-7 Head Set Mode Display (b)

A/C RAIN Control Adjustment

The echoes of ships operating inside rain, hail, or snowstorms may be hidden by on-screen rain clutter. Rain clutter is easily recognizable by its wool-like appearance on-screen. When this type of interference obscures a large area of the screen, you would use the A/C RAIN control to reduce the clutter.

When solid clutter caused by heavy precipitation is visible on the screen, turn the control clockwise to distinguish targets from the clutter. This control may also be used in clear weather to separate groups of echoes on a congested short range picture. In all cases use discretion when adjusting the control. Advancing it too far clockwise may erase targets from the screen.



rain clutter,
A/C RAIN control CCW

A/C RAIN control adjusted,
rain clutter reduced

Fig.1-8 Effect of the A/C RAIN Control

Reducing Radar Interference

Radar interference may occur when in the vicinity of another shipborne radar operating in the same frequency band. It appears on the screen often as a large number of bright dots either scattered at random or in the form of "curved spokes" (Fig.1-9). This type of interference can be reduced by activating the Interference Rejector circuit. Press the IR touchpad to activate the circuit. The indicator "IR" appears at the upper right-hand corner of the screen. Press the touchpad again to switch it off when no interference exists, otherwise weak targets may be missed. Note that this function should be turned off to receive a radar beacon (racon) signal.

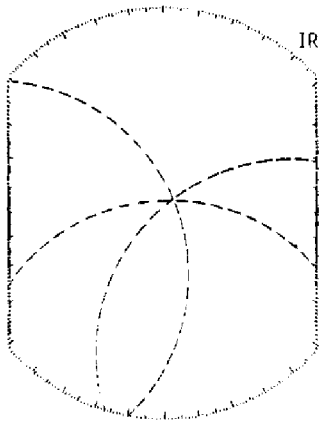


Fig.1-9 Radar Interference

Erasing the Heading Mark/North Mark

When the radar is turned on, the heading mark is displayed. The north mark is also displayed if a gyrocompass is connected. When the heading mark or north mark masks or hinders recognition of a small target echo, press and hold the HM OFF touchpad to temporarily erase them. Release hold to redisplay them.

In addition to erasing the heading mark/north mark, this touchpad can alternate between NM and KM units for the VRM(s) or select true or relative bearing readout for the EBL(s) in HU mode if a gyrocompass is connected. For further details, see the following "RANGE AND BEARING MEASUREMENT."

RANGE AND BEARING MEASUREMENT

The range to a target may be measured with the fixed range rings, erased/displayed by pressing the RING touchpad, or a Variable Range Marker (VRM). The bearing of a target may be measured by an Electronic Bearing Line (EBL).

Selection and operation of the markers used to measure range and bearing are simple. At each bottom corner of the display unit there is a touchpad control, EBL ON/OFF on the left corner and VRM ON/OFF on the right corner, and a rotary knob. The ON and OFF touchpads on each touchpad control are used to display and erase a marker and its readout from the screen. If two alike markers are displayed when the OFF portion is pressed, the readout not circumscribed is erased. Each rotary knob operates two markers, VRM1/VRM2 or EBL1/EBL2. The marker whose readout is circumscribed is currently operable by a rotary knob. To transfer control to the other marker, press the ON portion of the touchpad.

Range Measurement  , 

The range to a target is roughly measured with the range rings, which are displayed/erased by pressing the RING touchpad.

For more accurate measurement of the range to a target you would activate the VRM. Press the VRM ON touchpad until the VRM readout you want to operate is circumscribed. Next, rotate the VRM control until the circle described by the VRM just touches the inside edge of the target blip (see Fig.1-10). The range to the target is shown at the lower right-hand corner of the screen; VRM1 readout on top and VRM2 readout below it.

Note that the lengths of the dash and space on VRM1 and VRM2 are different as shown in Fig.1-10.

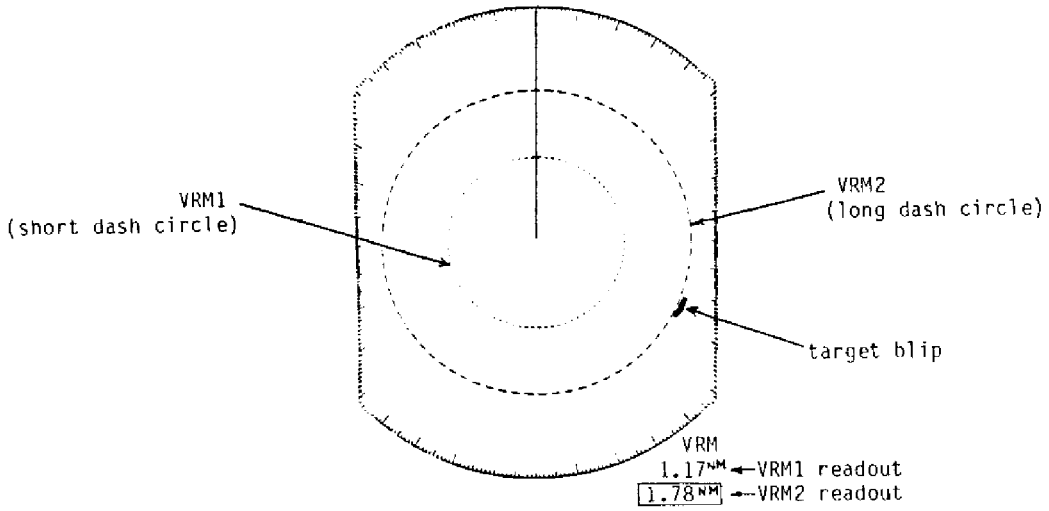


Fig.1-10 Measuring Range With a VRM

VRM Unit Selection  , 

The unit of measurement for the VRM1/VRM2 can be changed from NM to KM (and vice versa). Press the VRM ON touchpad to select valid VRM you want to change, and then press the VRM ON touchpad while pressing and holding the HM OFF touchpad.

Note: Change from NM to SM (statute mile) is possible by changing the setting of a DIP switch. Refer to appendix B on page B-1.

Bearing Measurement 

Press the EBL ON touchpad until the EBL readout you want to operate is circumscribed. Then, rotate the EBL control until the EBL bisects the target blip (see Fig.1-11). The relative or true bearing is shown at the lower left-hand corner of the display screen; EBL1 readout on top and EBL2 readout below it. (Ship's heading is displayed just above the EBL indicator when a gyrocompass is connected.)

Note that the lengths of the dash and space on EBL1 and EBL2 are different as shown in Fig.1-11.

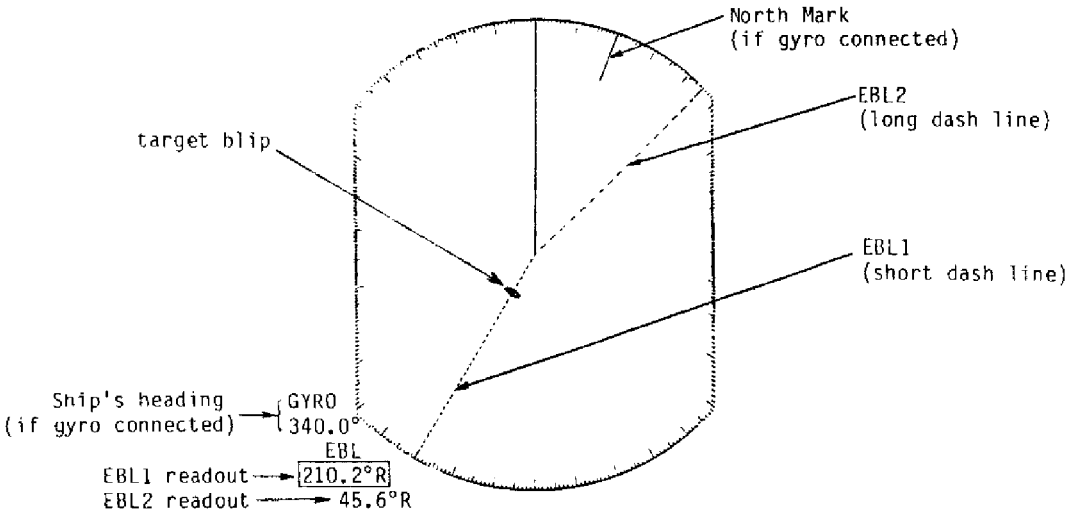
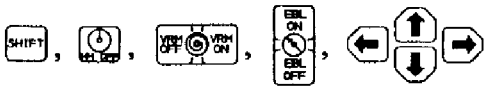


Fig.1-11 Measuring Bearing With an EBL

True Bearing Indication 

EBL readouts are relative to own ship's heading in the Head-Up mode, while true (relative to north) on North-Up or Course-Up modes. When the gyro is in use, however, Head-Up mode permits EBL readout in either relative to heading or true north. Press the EBL ON touchpad to select a desired EBL. Then, press the EBL ON touchpad while pressing and holding the HM OFF touchpad, and the EBL readout alternately changes between "R(relative)" and "T(true)".

Range & Bearing Between Two Targets (Floating EBL) 

The EBL1 origin and VRM1 center can be offset to measure the range and bearing between any two targets on the screen, or predict movement of another ship.

1. Move the cross hair cursor "+" to one of the two targets selected with four cursor shift touchpads.

2. Press the SHIFT touchpad while keeping the HM OFF touchpad pressed, and the EBL1 origin and the VRM1 center are offset to the cross hair cursor intersection marked by "x".

3. Adjust the EBL control so that EBL1 bisects the other target in concern, and adjust the VRM control so that VRM1 rests on the inner edge of the target. Now, the range and bearing between the two are given by VRM1 and EBL1 readouts.

4. To predict another ship's course, place EBL1 over the target after passing several minutes. If EBL1 bisects own ship, the possibility of collision exists. Refer to Fig.1-14 on page 1-11.

SHIFTING THE DISPLAY SHIFT ,

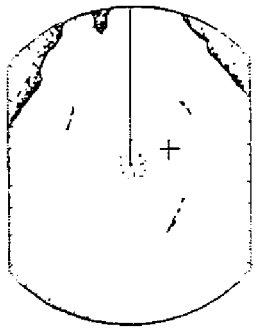
The own ship's position can be shifted to any position on the radar screen. The primary advantage of the shifted (off-center) display is that for any particular range setting the view ahead, behind or on the sides of own ship can be extended without changing the range in use.

The cross hair cursor "+", which may be maneuvered by the four cursor shift touchpads, is used to select the area to be shifted.

Note that the maximum range of the shifted display function is limited to 1.6 times for 0.25 to 48 nm ranges and 1.33 times for 96 nm range.

Procedure

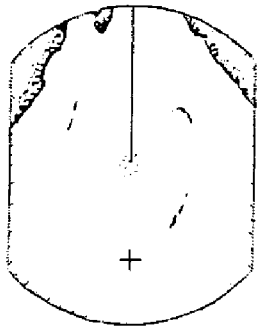
1. Press a cursor shift touchpad to present the cross hair cursor on the screen (a). Set the cursor on the area desired (b). After releasing hold of the touchpad, the cursor will flash 3 seconds before being erased.



(a)

NOTE 1: The cursor can be returned to the center of the screen by pressing the ⬆ and ⬇ touchpads simultaneously.

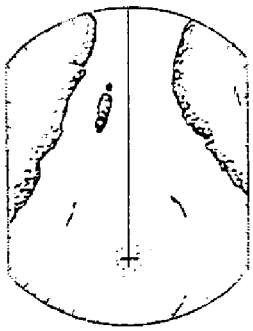
NOTE 2: When continuously pressing a cursor shift touchpad, the cursor moves close to the bearing scale, and a series of beep tones will be generated, telling you that the cursor cannot be moved farther outward.



(b)

2. Press the SHIFT touchpad, and the own ship's position is off-centered (c). The heading mark is shifted to where the cursor was last positioned, and the cursor is redisplayed 3 seconds before being erased.

3. To cancel the shift function, press the SHIFT touchpad again.



(c)

Fig.1-12 Shifting the Display

ZOOM FUNCTION [X2 ZOOM], [↑↓←→]

The area between own ship and an arbitrary location can be doubled with the zoom function. This function lets you take a closer look at an area of interest without changing the range in use.

Note that this function is not available when the shift function is on. If you attempt to activate it when the shift function is on, successive beep tones will be generated, informing you of unacceptable key entry.

Procedure

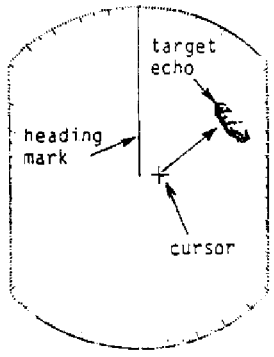
1. Press any cursor shift touchpad to display the cross hair cursor "+" (a); operate four cursor shift touchpads until the cursor is near the target (b). After releasing hold of a cursor shift touchpad, the cursor flashes 3 seconds before being erased from the screen.

   NOTE 1: The cursor can be returned to the center of the screen by pressing the [↑] and [↓] touchpads simultaneously.

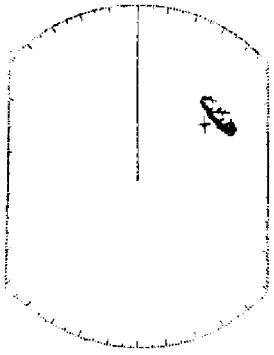
   NOTE 2: When continuously pressing a cursor shift touchpad the cursor moves close to the bearing scale, a series of beep tones will be generated, telling you that the cursor cannot be moved farther outward.

2. Press the X2 ZOOM touchpad to activate the zoom function. The own ship will shift to an opposite position to the cursor in reference to the screen center, thereby producing a doubled screen size for the same range between the own ship and the target (c). The message "ZOOM" flashes at the lower right-hand side of the screen.

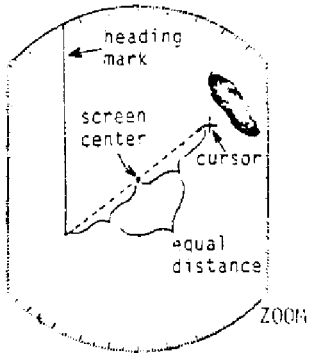
3. To cancel the zoom function, press the X2 ZOOM touchpad. The zoom function can also be cancelled by pressing the SHIFT touchpad or changing the range.



(a)



(b)



(c)

Fig.1-13 Using the Zoom Function

TRAILING TARGET ECHOES ECHO TRAIL

The ECHO TRAIL touchpad is used to plot the relative movement of all targets to own ship in a lower intensity. (True motion plotting is available when connected to the RP-3 Video Plotter and gyrocompass.) This feature helps the operator to evaluate traffic situations of all targets. Each time the ECHO TRAIL touchpad is pressed, the plotting time changes in the following sequence.

30 sec. → 1 min. → 3 min. → 6 min. → continuous → off

When the plotting function is turned on, e.g., 30 sec. is selected, "30S" (plotting time) is indicated at the upper right on the screen, the timer shown to the left of "30S" starts counting up and the trail of every target starts extending. As soon as the timer counts 30 sec., the timer indication disappears and thereafter only plotting is continued. The trail of the target is erased from its oldest tip and only the last 30 sec. remains on the screen. The faster the relative speed of the target, the longer the trail of the target.

NOTE: If continuous plotting is selected, the timer continuously stays on the screen, and it counts up from 0:00 to 99:59 and the trail extends continuously without being erased.

If the range is changed while plotting is being performed, the indication "ECHO TRAIL" is displayed in inverse video (black characters, green background), informing the operator that the plotting mode is suspended. Return to the previous range setting to resume plotting.

To erase the traces, press the ECHO TRAIL touchpad 10 seconds after the previous press.

Collision Course?

To ascertain another ship as a hazardous target place the EBL on it. If the extension of its latest tracks is on the EBL, it can be a hazardous one. In Fig.1-14, ship A can be on collision course and ship B will pass clear to starboard.

"Floating EBL" (page 1-8) is another method to predict other ship's course. Suppose that ship C (initial position) goes to C' after several minutes. Since the floating EBL1 passes through own ship, possibility of collision exists.

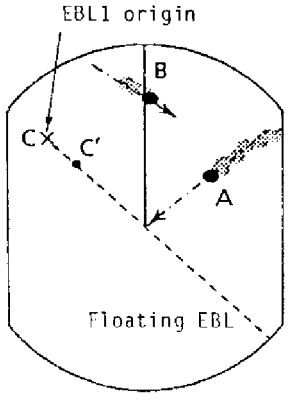


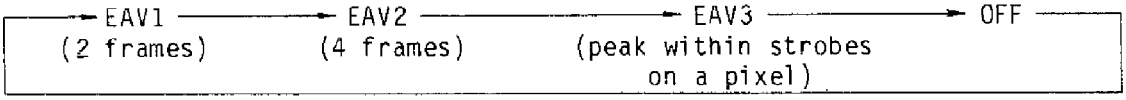
Fig.1-14

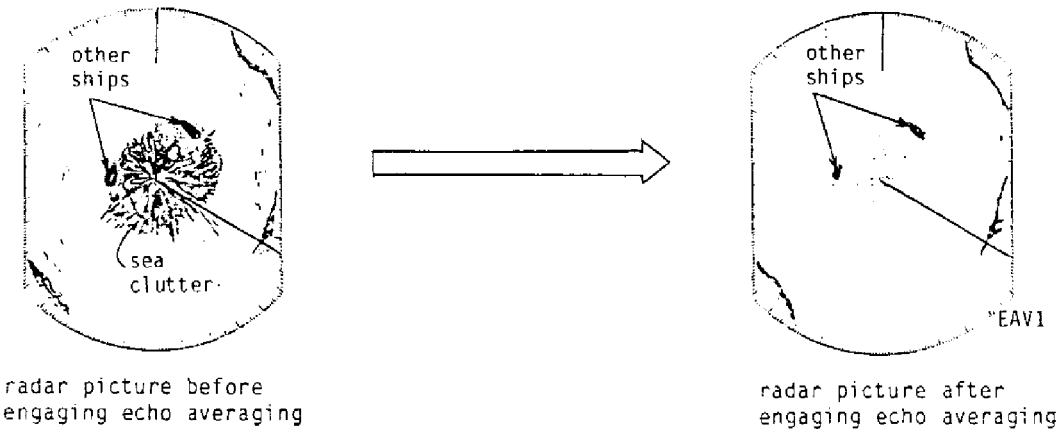
ECHO AVERAGING 

Echo averaging function is turned on or off by pressing the ECHO AVG touchpad, and its basic idea is to paint stable targets in normal intensity and unstable echoes in lower intensity.

Echoes received from stable targets such as other ships (moving at the slower relative speed to own ship) appear on the screen at almost the same position for every sweep, while unstable echoes such as sea clutter appear at random. To distinguish target echoes from sea clutter, this radar uses the scan-to-scan correlation method, which stores and averages successive two or four picture frames. If the echo is stable it is presented in its actual strength level. To the contrary, if it is unstable it is suppressed in intensity, allowing you to discriminate targets from sea clutter.

To properly use the echo averaging function, first suppress sea clutter with the A/C RAIN control (A/C SEA control: fully CCW). Then, press the ECHO AVG touchpad. Each time the touchpad is depressed the level of correlation changes in the following sequence, and annunciator appears at the lower right-hand corner of the screen. EAV3 does not provide correlation but picks up the peak level among several strobes in a frame. This is useful to track target masked by short range sea clutter.





radar picture before engaging echo averaging

radar picture after engaging echo averaging

Fig.1-15 Echo Averaging Function

Echo average 1 & 2 should not be used when speed difference between own ship and other ships is large or when own ship is being subjected to heavy pitching or rolling.

Note: In Head-Up mode, EAV1 and EAV2 cannot be used. (EAV3 may be used in this mode.) It, however, is possible to make EAV1 and EAV2 work in Head-Up mode. Change the setting of DIP switch S1 #5, referring to Appendix B.

SETTING THE ALARM  ,  , 

An alarm may be set to visually (flashing) and audibly (beep sound) alert you should targets (ships, landmasses, etc.) above a certain signal level enter into a preset guard zone. A guard zone is defined as an area where you do not want targets to enter in. The size of the guard zone may be set between 0 and maximum range for distance and between 0° and 360° in bearing.

This alarm is very effective as an anti-collision aid when using an autopilot or navigating in narrow channels. However, it does not relieve the operator of the responsibility to watch out for possible collision situations. It should never be used as a primary means to detect possible collision situations.

The procedure to set the guard zone and alarm is as follows.

Range Setting

1. Press the VRM ON touchpad to display VRM1; and then rotate the VRM control until VRM1 is at the range desired for the inner limit of the alarm.

2. Press the VRM ON touchpad again to display VRM2; rotate the VRM control until VRM2 is at the range desired for the outer limit of the alarm.

Sector Setting

3. Press the EBL ON touchpad to display EBL1; rotate the EBL control until EBL1 is at the bearing desired for the counterclockwise limit of the alarm.

4. Press the EBL ON touchpad again to display EBL2; rotate the EBL control until EBL2 is at the bearing desired for the clockwise limit of the alarm.

Alarm Setting

5. Press the GUARD ALARM touchpad, and the indication "GUARD" will appear at the top right-hand side of the screen. Any targets entering the guard zone will trigger the alarm. The EBLs and VRMs may be operated without disturbing the settings of the alarm.

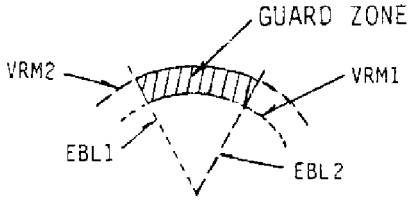


Fig.1-16 Guard Zone

To suspend the alarm sound, press the GUARD ALARM touchpad once. The message "GUARD" will be reversed. Press the GUARD ALARM touchpad again to restore sound. To cancel the alarm function, press and hold the touchpad for more than one second.

NOTE 1: When the range in use is lower than the range of the guard zone, the indication "GUARD UP RANGE" appears on the screen, replacing the indication "GUARD."

NOTE 2: The alarm sounds when targets having a certain level of strength enter the guard zone. This level includes not only ships and landmasses, but also returns from seaface or precipitation. Since the level is changeable with the environment, the operator is required to properly adjust the gain and anti-clutter controls. It should be noted that excessively high settings of A/C controls can fail in alerting small targets.

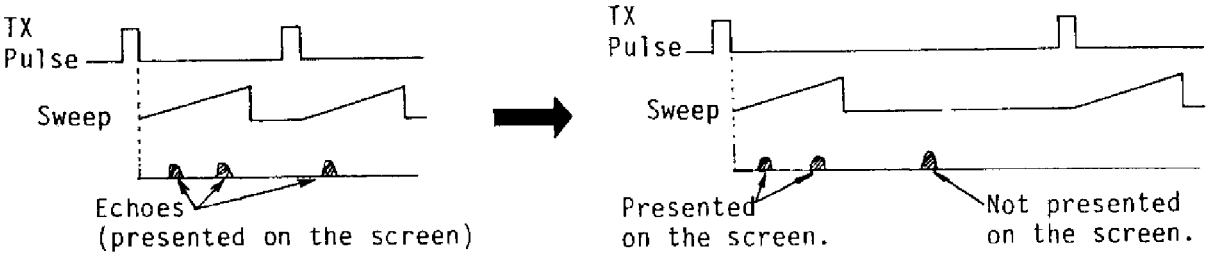
MAGNIFYING TARGET ECHOES [ECHO STRETCH]

As a general rule of thumb, the reflected echoes from long distance targets are displayed on the screen as weaker and smaller blips even though they are compensated by the radar's internal circuitry.

The echo stretch function is provided to magnify small targets in middle and long ranges, i.e., 1.5 nm range or higher. Press the ECHO STRETCH touchpad, and the indicator "ES" is displayed at the upper right-hand corner of the screen and the echoes are doubled lengthwise. Note that this function is inactive in short ranges; "ES" is indicated in inverse video.

SECOND-TRACE ECHO REJECTION MODE [STBY/TX] & [HM OFF]

Since the propagation loss of radio wave is minimal in the S-band radar, echoes from very distant targets may appear as false echoes (second-trace echoes) on the screen, returning after the next transmission pulse has been transmitted.



Second-trace Echo Rejection mode inactive

Second-trace Echo Rejection mode active

Fig.1-17

To erase the second-trace echoes, depress the [STBY/TX] touchpad while depressing and holding the [HM OFF] touchpad. The indication of pulselength appears at the top left-hand side of the screen in inverse video to inform you that the second-trace echo rejection mode is active. Note that the second-trace echo rejection is ineffective on 0.25, 0.5 and 0.75 nm ranges even if the operation mentioned above is performed. (The indication of pulselength appears in inverse video, however the rejection circuit is inactive.)

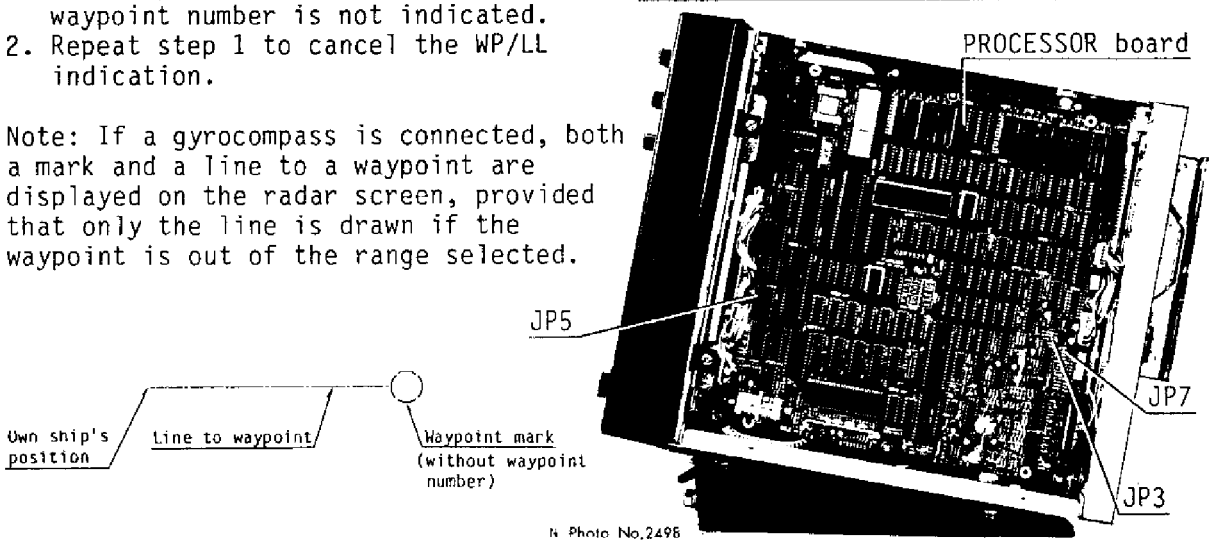
DISPLAYING OWN SHIP'S POSITION & WAYPOINT (OPTION)

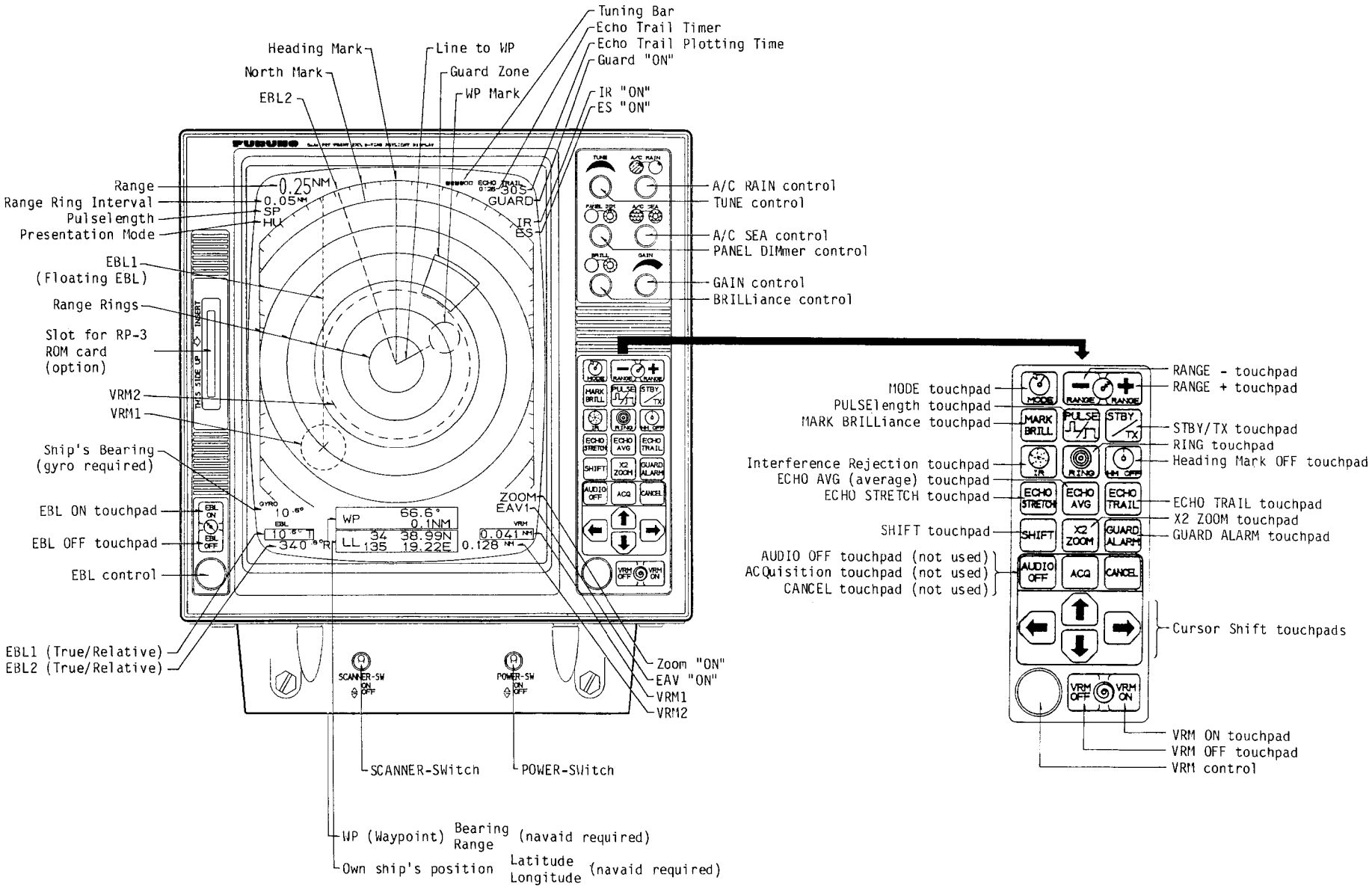
Own ship's position in latitude/longitude, and range/bearing to a waypoint selected on the nav aid may be displayed at the lower center of the screen if an external navigator having NMEA0183 or FURUNO CIF format is connected. Cut jumper wire(s) JP3, JP5 or JP7 on the PROCESSOR board according to its format.

1. Press the MODE touchpad while keeping the HM OFF touchpad pressed, and WP (Waypoint) and LL (Latitude/Longitude) are displayed, provided that the waypoint number is not indicated.
2. Repeat step 1 to cancel the WP/LL indication.

	JP3	JP5	JP7
NMEA0183	cut	short	short
FURUNO CIF	short	cut	cut
Factory setting	short	short	short

Note: If a gyrocompass is connected, both a mark and a line to a waypoint are displayed on the radar screen, provided that only the line is drawn if the waypoint is out of the range selected.




Tuning Bar
Echo Trail Timer
Echo Trail Plotting Time
Guard "ON"
IR "ON"
ES "ON"
Heading Mark
Line to WP
North Mark
Guard Zone
EBL2
WP Mark
Range
Range Ring Interval
Pulselength
Presentation Mode
EBL1
(Floating EBL)
Range Rings
Slot for RP-3
ROM card
(option)
VRM2
VRM1
Ship's Bearing
(gyro required)
EBL ON touchpad
EBL OFF touchpad
EBL control
EBL1 (True/Relative)
EBL2 (True/Relative)
A/C RAIN control
TUNE control
A/C SEA control
PANEL DIMmer control
GAIN control
BRILLiance control
Zoom "ON"
EAV "ON"
VRM1
VRM2
SCANNER-SWitch
POWER-SWitch
WP (Waypoint) Bearing Range (navaid required)
Own ship's position Latitude Longitude (navaid required)
MODE touchpad
PULSElength touchpad
MARK BRILLiance touchpad
Interference Rejection touchpad
ECHO AVG (average) touchpad
ECHO STRETCH touchpad
SHIFT touchpad
AUDIO OFF touchpad (not used)
ACQuisition touchpad (not used)
CANCEL touchpad (not used)
RANGE - touchpad
RANGE + touchpad
STBY/TX touchpad
RING touchpad
Heading Mark OFF touchpad
ECHO TRAIL touchpad
X2 ZOOM touchpad
GUARD ALARM touchpad
Cursor Shift touchpads
VRM ON touchpad
VRM OFF touchpad
VRM control

CHAPTER 2 APPLICATION

In this chapter, minimum and maximum ranges, radar resolution, range measurement, false echoes and radar plotting will be discussed.

MINIMUM AND MAXIMUM RANGES

Minimum Range

When the radar is used as a collision avoidance aid, the minimum detection range is of urgent concern. It is very dangerous for a target to disappear when it approaches the ship. The minimum range is primarily determined by the height of the antenna (vertical beam width of antenna) above the waterline.

Maximum Range

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

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

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

where Rmax: radar horizon (nm)
h1 : antenna height (m)
h2 : target height (m)

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

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

RADAR RESOLUTION

Bearing Resolution

Bearing resolution is the ability to display as separate pips the echoes received from two targets which are at the same range and close together. It is proportional to the antenna length and reciprocally proportional to the wavelength. The length of the antenna radiator should be chosen for a bearing resolution better than 2.5° (International Maritime Organization (IMO) Resolution). This condition is normally satisfied with a radiator larger than 1.2 m (4 ft).

Range Resolution

Range resolution is the ability to display as separate pips the echoes received from two targets which are on the same bearing and close to each other. This is determined by pulselength only. The usual discrimination range is 22.8 m (25 yd) on a 0.08 microsecond pulse.

BEARING ACCURACY

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

RANGE MEASUREMENT

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

FALSE ECHOES

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

Multiple Echoes

Multiple echoes occur when a short range, strong echo is received from a ship, bridge, or breakwater. A second, a third or more echoes may be observed on the display at double, triple or other multiples of the actual range of the target as shown in Fig. 2-1. Multiple reflection echoes can be reduced and often removed by decreasing the gain or properly adjusting the A/C SEA control.

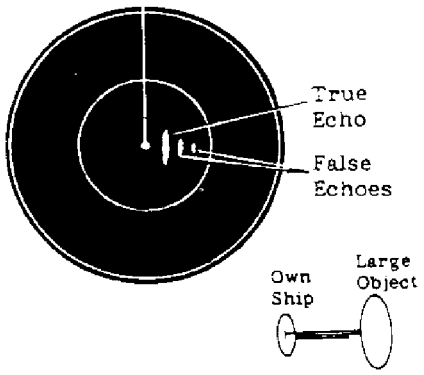


Fig.2-1 Multiple Echoes

Side-lobe Echoes

Every time the radar pulse is transmitted, some radiation escapes on each side of the beam--called "side-lobes." If a target exists where it can be detected by the side lobes as well as the main lobe, the side echoes may be represented on both sides of the true echo at the same range, as shown in Fig. 2-2. Side lobes show usually only on short ranges and from strong targets. They can be reduced through careful reduction of the gain or proper adjustment of the A/C SEA control.

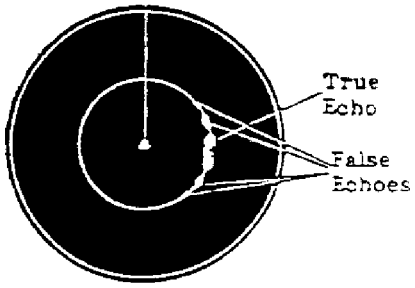


Fig.2-2 Side-Lobe Echoes

Blind and Shadow Sectors

Funnels, stacks, masts, or derricks in the path of antenna may reduce the intensity of the radar beam. If the angle subtended at the scanner is more than a few degrees, a blind sector may be produced. Within the blind sector small targets at close and long ranges may not be detected. See Fig. 2-3.

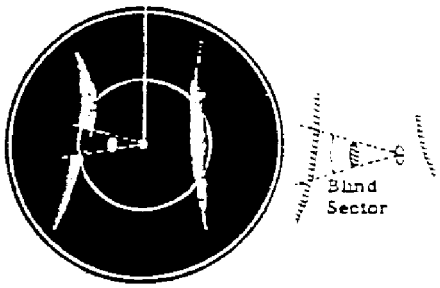


Fig.2-3 Blind and Shadow Sectors

Virtual Image

A relatively large target close to your ship may be represented at two positions on the screen. One of them is the true echo directly reflected by the target and the other is a false echo which is caused by the mirror effect of a large object on or close to your ship as shown in Fig. 2-4. If your ship comes close to a large metallic bridge, for example, such a false echo may temporarily be seen on the screen.

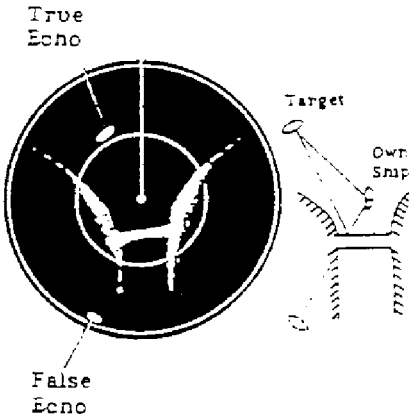


Fig.2-4 Virtual Image

POSITION FIXING WITH RADAR

Radar Range

The simultaneous measurement of the ranges to two or more fixed objects is normally the most accurate method of obtaining a fix with radar alone. Preferably at least three ranges should be used. However the use of more than three range arcs may introduce excessive error because of the time lag between measurements, i.e., you will be moving as you take successive measurements.

When obtaining a fix, it is best to measure the most rapidly changing range last because of a smaller time lag in the radar plot from the ship's actual position. For greater accuracy, the objects selected should provide arcs with angles of cut as close to 90° as possible. Small, isolated, radar-conspicuous fixed objects whose associated range arcs intersect at angles approaching 90° provide the most reliable and accurate position fixes. Objects at longer ranges are less accurate for position fixing because they may be below the radar horizon and because the width of the radar beam increases with range.

To fix your position, first measure the range to two or more prominent navigational marks which you can identify on the chart. (The method for measuring range is given on page 1-8.) Next, with a compass sweep out the ranges from the charted positions. The point of intersection of the arcs is your estimated position. The method to obtain a position fix using radar range is illustrated in Fig. 2-5.

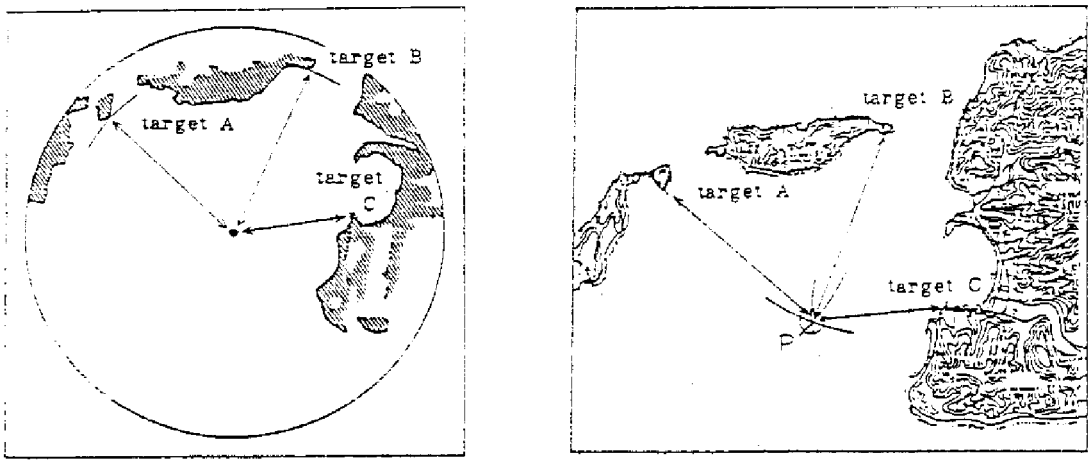


Fig.2-5 Position Fixing Using Range

Range and Bearing

The advantage of position fixing by range and bearing is the speed with which a fix can be obtained. A distinct disadvantage however is that this method is based upon only two intersecting position lines, a bearing line and range, obtained from two points of land. If possible, the object used should be small, isolated and identified with reasonable certainty. To fix

your position using range and radar bearing, measure the relative bearing of the target with the EBL, noting the exact direction of the ship's heading when doing so. Next, make allowance for compass deviation (true or magnetic) and find the true bearing of the target. Sweep out the range to the target with a compass on the chart and plot the true bearing of the target. The point of intersection is your approximate position. Fig. 2-6 illustrates how to obtain a position fix using range and bearing.

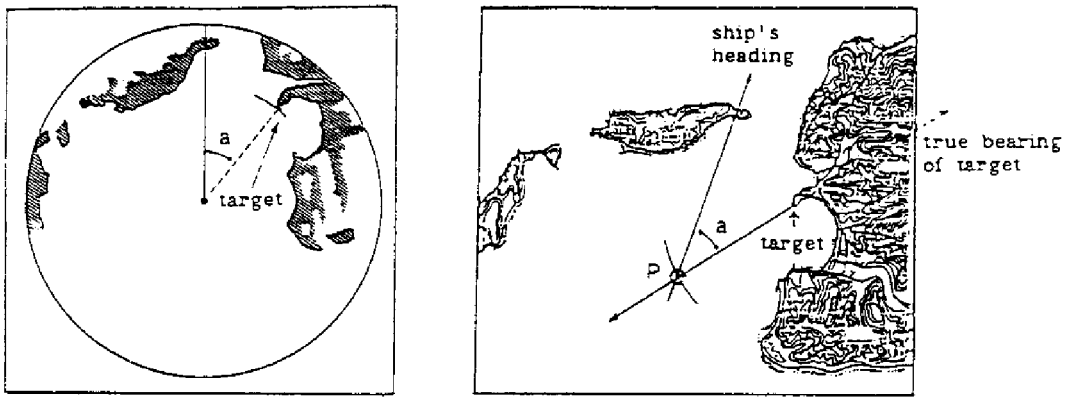


Fig.2-6 Position Fixing Using Range and Bearing

Two Bearings

Generally, fixes obtained from radar bearing are less accurate than those obtained from intersecting range arcs. The accuracy of fixing by this method is greater when the center bearings of small, isolated radar-conspicuous objects can be observed. Similar to position fixing using range and bearing, this method affords a quick means for initially determining approximate position. The position should then be checked against other means to confirm reliability.

Position fixing using two bearings is determined by measuring the relative bearings for the two targets and then determining their true bearings. Plot the two bearings on the chart; the point of intersection of the two bearings is your approximate position. Fig. 2-7 illustrates how to obtain a position fix using two bearings.

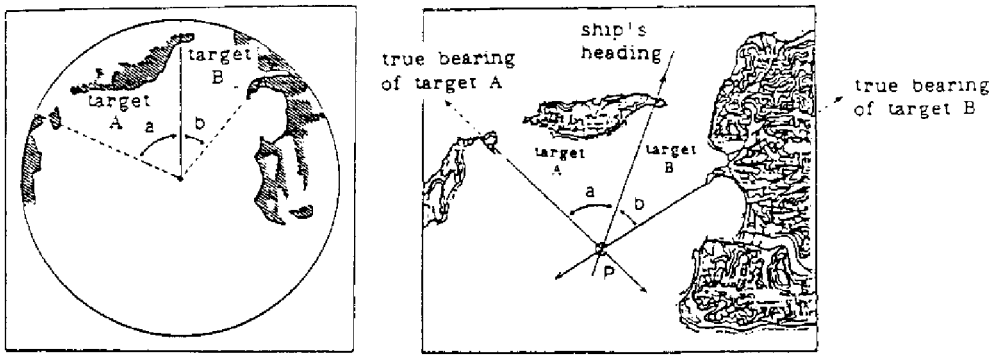


Fig.2-7 Position Fixing Using Two Bearings

CHAPTER 3 MAINTENANCE

This radar is designed and constructed to give the user many years of trouble-free operation. However, to maintain optimum performance maintenance must be performed at regular intervals. Recommended maintenance intervals and check points are given in the table below.

"CAUTION"

Before beginning maintenance work, be sure to switch off the radar at the main switchboard. When checking inside the units, wait for a few minutes until the high voltage components (CRT or HV capacitors) can discharge the residual charge.

Interval	Check Point	Check/Measures	Remarks
3 to 6 months	Exposed nuts and bolts on scanner unit	Check for corroded or loosened nuts/bolts. If necessary, clean them and repaint thickly. Replace them if heavily corroded.	*Sealing compound may be used instead of paint. *Put a slight amount of grease if nuts and bolts are replaced.
	Scanner radiator	Check for dirt or cracks on the radiator surface. Thick dirt should be wiped off by using a soft cloth immersed in fresh water. If a crack is found, apply a slight amount of sealing compound or adhesive as first-aid treatment, then call for repair.	*Do NOT use plastic solvent (thinners or acetone) for cleaning. *When removing ice on the scanner unit, use a wooden hammer or plastic-head hammer. Crack on the scanner unit may allow water to penetrate inside, causing permanent damage to the internal circuitry.
	Terminal boards and plugs in scanner unit	Open scanner cover to check terminal board/plug connections inside. Also, check if the rubber packing of the scanner cover is in good order.	*When putting cover back in position, be careful not to catch flying wires between cover and unit.
	CRT screen	Dirt on this creates symptoms identical to poor sensitivity. Clean CRT surface carefully, using care not to scratch it.	*Use a soft cloth with a slight amount of anti-static-charge spray. Never apply plastic solvent.

Interval	Check Item	Check/Measures	Remarks
6 months to 1 year	Scanner motor	Check and clean carbon brushes and commutator. If brushes have worn out to 6mm or less, replace them with new one (15mm long) supplied as spare parts.	*Under normal use, the carbon brush will last approximately 6000 hours.
	CRT anode	High tension on CRT attracts dust in environment, and moist dust will cause poor insulation.	*If any crack is found on rubber cap or wire sheath, call for service to replace damaged part. Do not touch these parts since high voltage may exist.
	Terminal boards, sockets and plugs	Check for loose connections. Clean contacts or replace plug, if necessary.	
	Scanner turning gear	Check that the scanner turning gear is greased. If not, apply a generous amount of grease to the turning gear.	*Never apply grease to the drive gear, since it is closely located beside the timing disc.

NOTE: Refer to Chapter 5 PARTS LOCATION for the positions of relevant parts.

CHAPTER 4 TROUBLESHOOTING

Whenever you suspect the radar is not functioning properly, turn it off and check plug connections on p.c. boards, then proceed to the Trouble Finding List on the next page, if necessary. If a p.c. board is found to be faulty, replace it or call for service. Do not attempt further component check in any p.c. board. Careless handling may damage the board.

"CAUTION"

There are many high tension points in the radar system. Take special care when approaching the following parts.

1. Power supply circuit (Display Unit)
2. CRT circuit (Display Unit)
3. Modulator circuit (Scanner Unit)
4. Magnetron (Scanner Unit)

Service Call

Please provide the following information when requesting service.

1. Name of the vessel
2. Vessel's location (port/berth)
3. Sailing Schedule
4. Radar model (Serial number/Date manufactured)
5. Description of the problem (include results of the troubleshooting checks)
6. Previous service

Trouble Finding List

Operation	Symptom	Check Point	Remarks
Turn Power on and adjust PANEL DIMMER control.	Illumination lamps for front panel do not come on with PANEL DIMMER turned fully CW.	1. Main fuse F1351 (10A) 2. Mains voltage/ polarity 3. POWER SUPPLY board 4. Illumi. lamps	*Measure mains voltage at DTB-1 #1(+) and #2(-). It should be 20.4 to 30.0VDC.
	Scanner does not rotate.	1. Scanner fuse F1352 (10A) 2. Scanner motor carbon brushes 3. Scanner rotating mechanism jammed 4. Scanner motor relay K1351	*If bearing pulse is not being sent from scanner, "NO BP" is displayed at ST-BY mode. *If worn, replace it with new one supplied as spare parts.
Adjust BRILLIANCE control.	Nothing appears on CRT.	1. CRT 2. CRT H.T. 3. DEFLECTION board 4. PROCESSOR board	*Visually check that CRT heater is lit. *Adjust CONTRAST pot. (RV101) and BRIGHT pot. (RV204) on DEFLECTION board. If picture appears, CRT assembly is OK.
	Picture synchronization is abnormal.	1. CRT assembly (DEFLECTION board, etc.) 2. PROCESSOR board	*Adjust H-HOLD pot. (RV202) and V-HOLD pot. (RV401) on DEFLECTION board. If synchronization is not achieved, DEFLECTION board is defective.

Operation	Symptom	Check Point	Remarks
After "ST-BY" message, hit STBY/TX key.	Marks and legends appear abnormally.	1. PROCESSOR board	
Adjust GAIN control with A/C SEA control set at minimum.	Marks and legends appear but no noise nor echo.	1. IF amplifier 2. Multicore cable between scanner and displa units 3. PROCESSOR board 4. GSC board	*Check continuity and isolation of coax. cable. (Note: Disconnect the plug and lugs at the both ends of coax. cable before checking it by ohmmeter.
	Marks, legends and noise appear but no echo. (No transmission leak appears.)	1. TX fuse F1 (0.5A) 2. Magnetron MG5223F 3. MODULATOR board 4. MODULATOR TRIGGER board 5. Modulator SCR 6. PROCESSOR board	*If fuse is blown, replace it. If it blows again, the magnetron or modulator's components may be faulty. *Connect a multimeter between test points "MAG. CUR"(+) and "TP.GND"(-) on INTERFACE board and transmit radar on 96 nm range. If the voltage is 5.5 to 7.5VDC, check points 2 to 5 shown left may be OK. *Connect a multimeter set at 10VAC range, between test points TP5 TX-TRIG (+) and TP3 GND (-) on PROCESSOR board. If the voltage varies when changing the range, the PROCESSOR board is operating normally.

Operation	Symptom	Check Point	Remarks
	Sweep line on the screen is out of synchronization with the antenna.	1. BEARING SIGNAL GEN. board (Scanner Unit) 2. PROCESSOR board	
	Poor bearing accuracy	1. Adjustment of heading SW S1 on PANEL board. 2. PROCESSOR board	*The message "NO HD" blinks on the screen when heading pulse is not received.
Adjust TUNE control.	Poor sensitivity	1. Deteriorated magnetron 2. Detuned MIC 3. Dirt on radiator face	*Set range to 96 nm and measure voltage between test points "MAG.CUR"(+) and "TP.GND"(-) on INTERFACE board. It should be 5.5 to 7.5 VDC.
Adjust A/C RAIN control.	No A/C RAIN effect.	1. PANEL board 2. GSC board	
Change range.	Radar picture does not change.	1. Poor contact of touchpad key 2. PROCESSOR board	
Hit each touchpad key.	Prescribed function is not carried out.	1. Poor contact of touchpad key 2. PROCESSOR board	

NOTE: When the gyro signal is lost, the presentation mode automatically becomes Head-Up, the legend "GYRO" flashes and the gyro readout disappears. If this happens, check connection between J20 on the INTERFACE board and A-D Converter AD-10S/100 or between the gyrocompass and AD-10S/100. When the gyro signal is restored, the readout reappears on screen but "GYRO" continues to flash to warn the operator that the readout is unreliable. To remedy this situation, check the on-screen gyro indication. If it is wrong, reset AD-10S/100, and then hit the MODE key to stop the flashing of the legend "GYRO."

CHAPTER 5 PARTS LOCATION

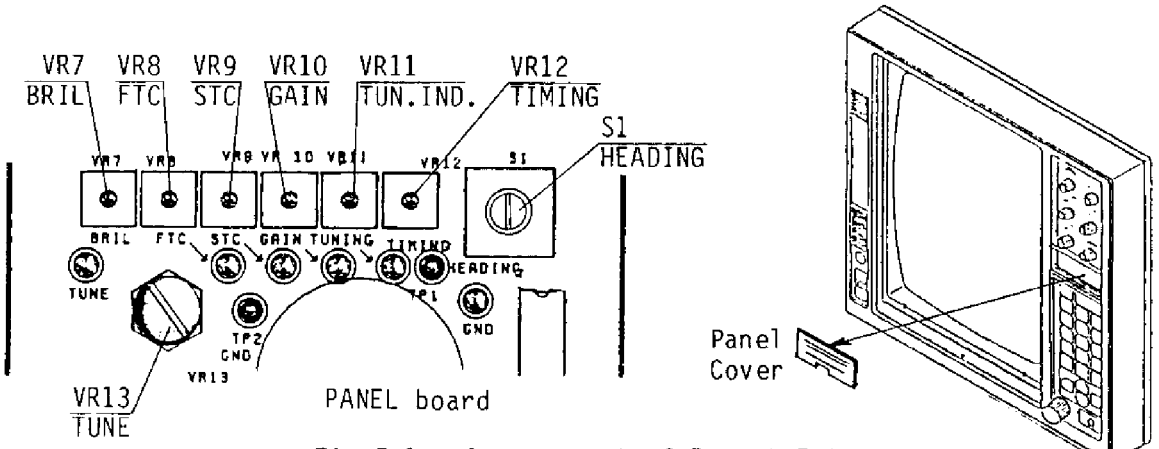


Fig.5-1 Arrangement of Preset Pot.

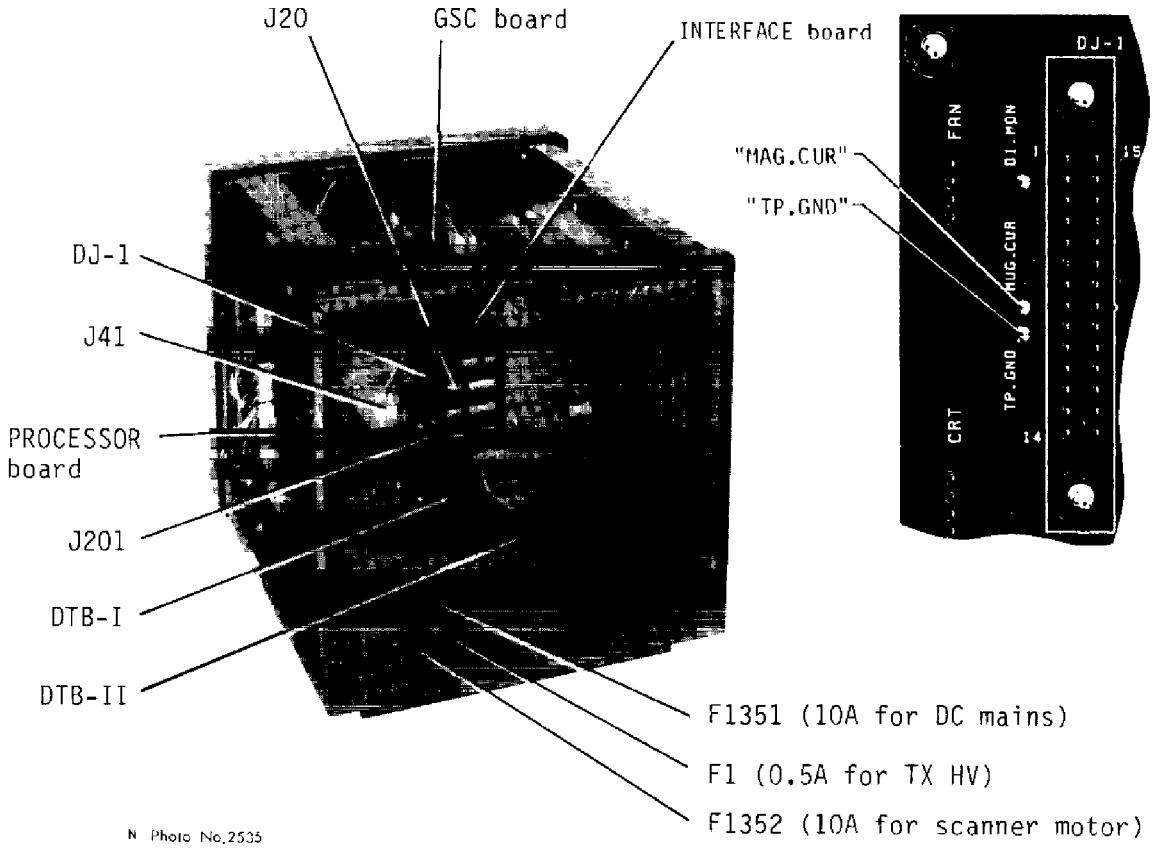


Fig.5-2 Display Unit (Rear View)

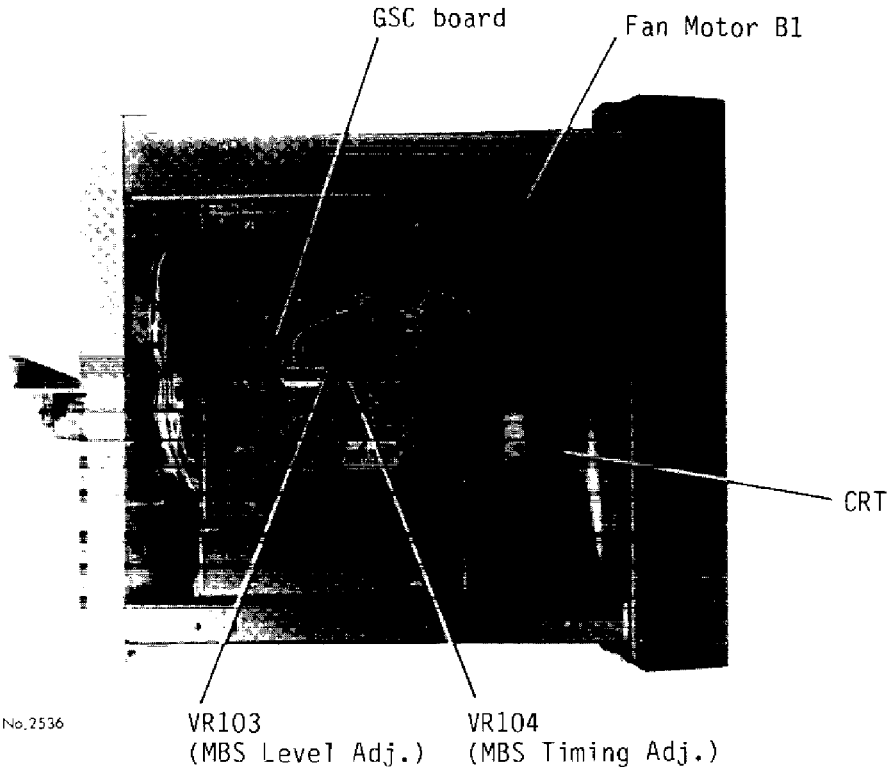


Fig.5-3 Display Unit (Top View)

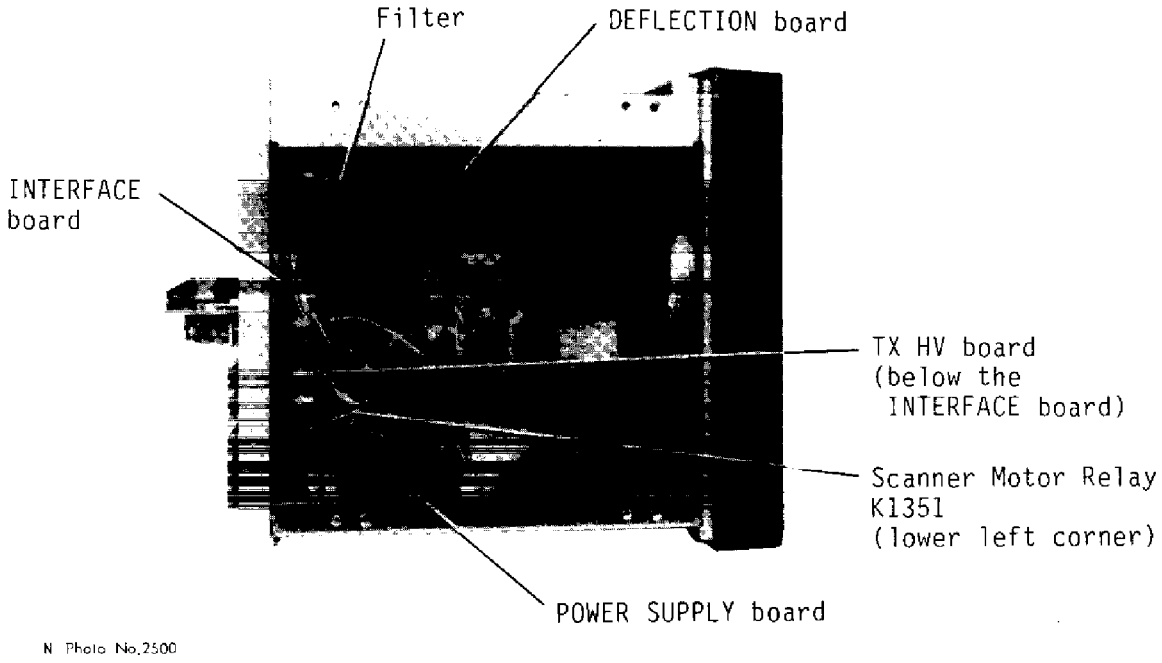


Fig.5-4 Display Unit (GSC board fixing plate removed)

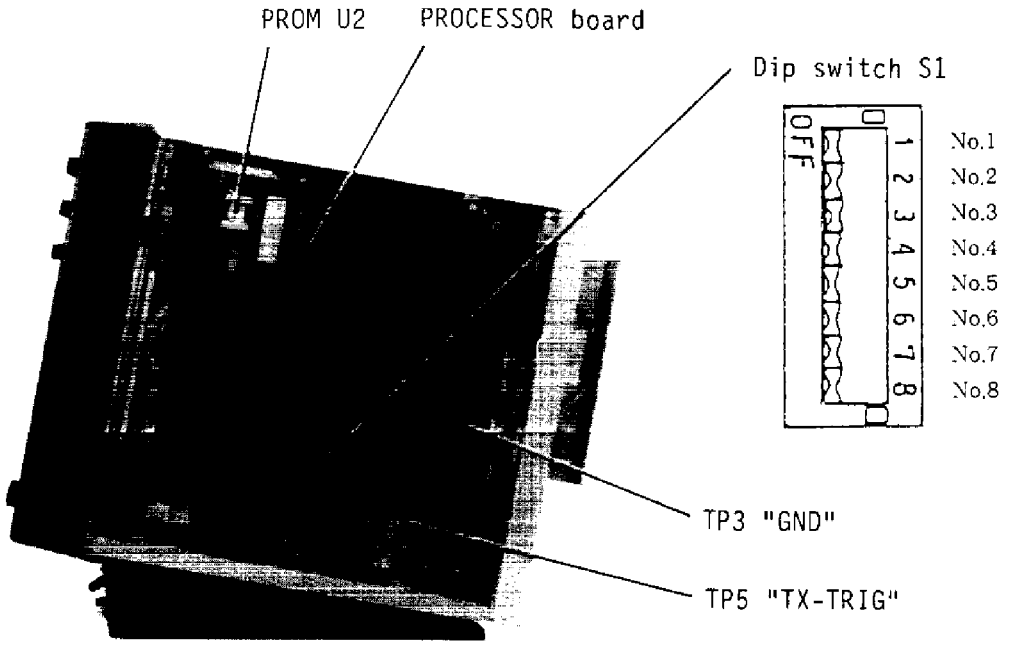


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Fig.5-5 Display Unit
(Side View, cover removed)

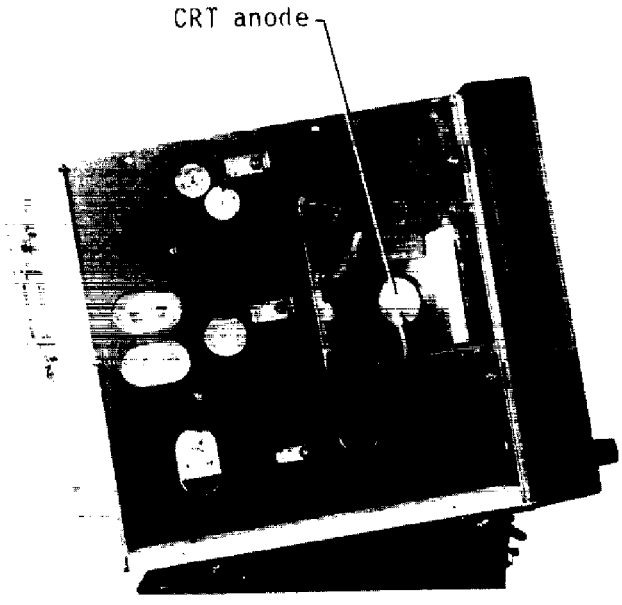

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Fig.5-6 Display Unit
(Side view, cover removed)

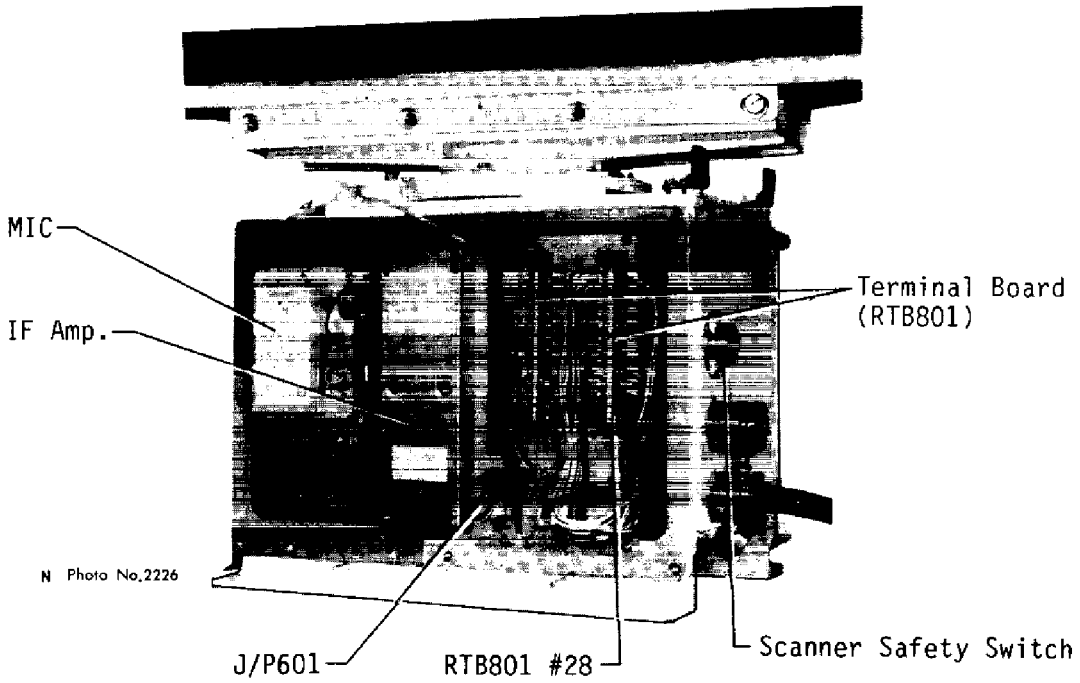


Fig.5-7 Scanner Unit (Port view)

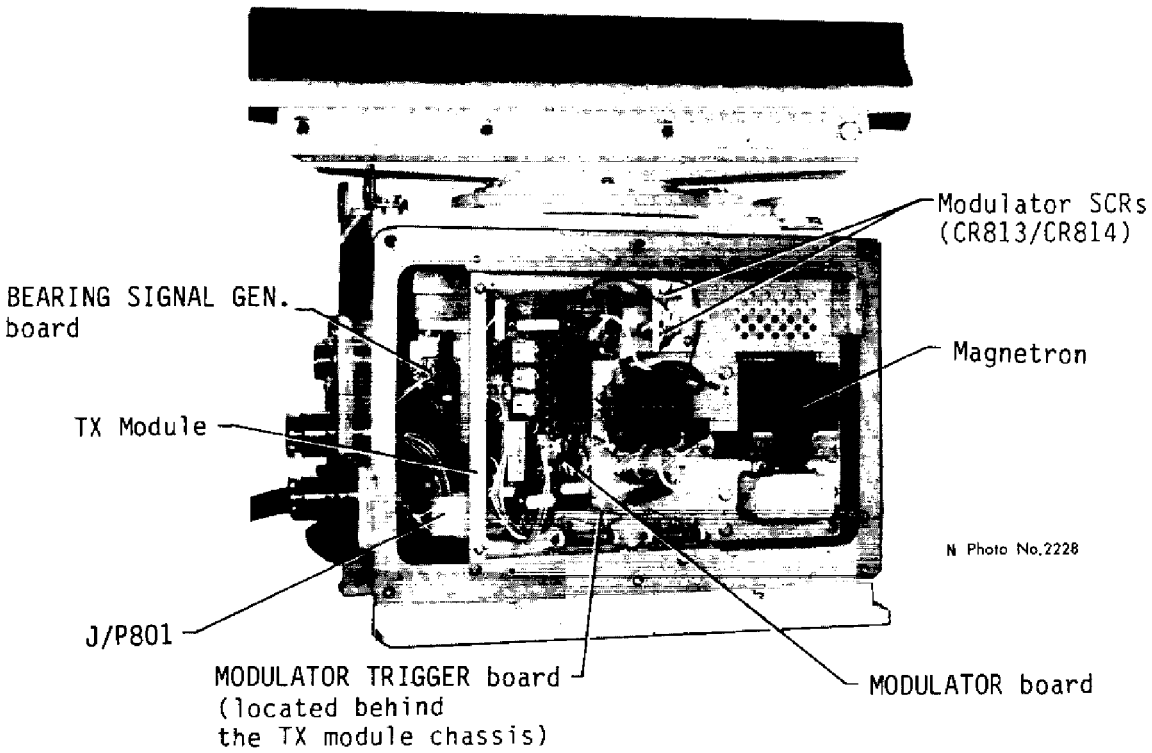


Fig. 5-8 Scanner Unit (Starboard view)

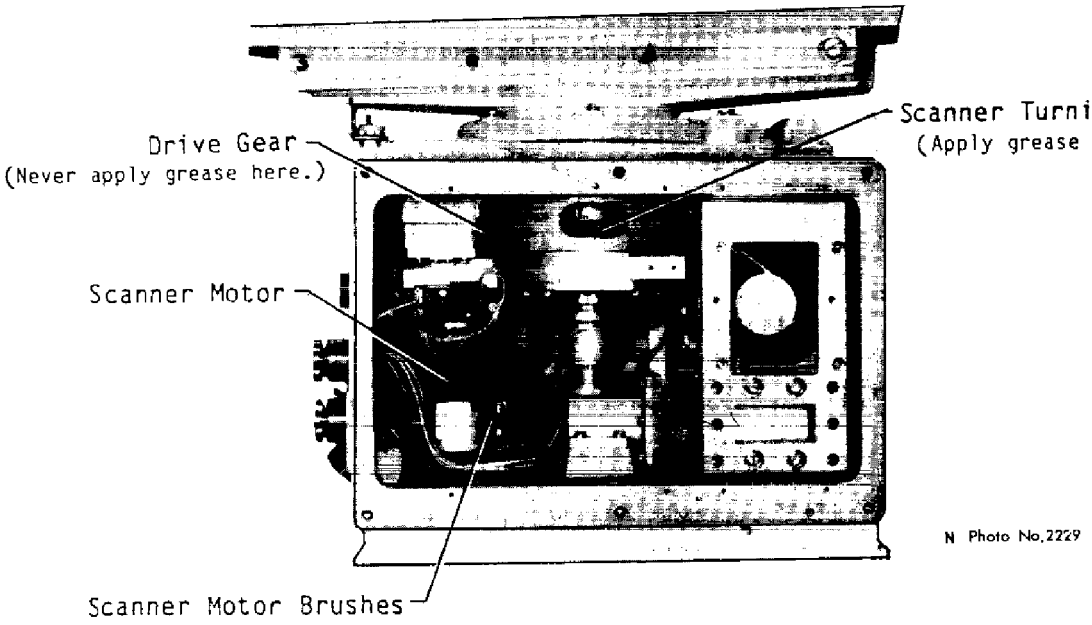


Fig.5-9 Starboard View of Scanner Unit without TX Module

CHAPTER 6 INSTALLATION

GENERAL

This radar system is mainly composed of two units, the display unit and the scanner unit, and operates directly from the ship's mains of 24VDC. For operation from 100, 110, 115, 220 or 230VAC, a rectifier unit is required.

When the radar is first unpacked, check that all units, parts and materials are contained, referring to the complete set, installation materials, spare parts and accessories lists. All steel and wood works should be arranged locally.

SCANNER UNIT INSTALLATION

Siting Considerations

The scanner unit is generally installed on top of the wheelhouse or on the radar mast on an appropriate platform. When siting the unit, consideration must be given to the following points.

1) The standard supply interconnecting cable RW-6895 run between the scanner unit and the display unit is 15m long. If additional cable is required for a particular installation an unbroken length must be used (i.e., no splices allowed), and the maximum length is 60 meters.

2) A funnel, mast or derrick post in line of sight of the radiator may cause blind sectors on the radar picture. A shadow sector between 355 and 5 degrees must be avoided by carefully planning the installation site.

3) Deposits and fumes from the funnel or other exhaust vent can adversely affect the aerial performance and hot gas tends to distort the radiator portion. The scanner unit must not be mounted in a place where it may be subjected to temperature in excess of 70°C.

4) The unit must not be positioned in close proximity to a direction finder aerial; separation of more than 2 meters is recommended.

5) The compass safe distance; 4.8 meters, standard compass, 3.6 meters, steering compass, should be observed.

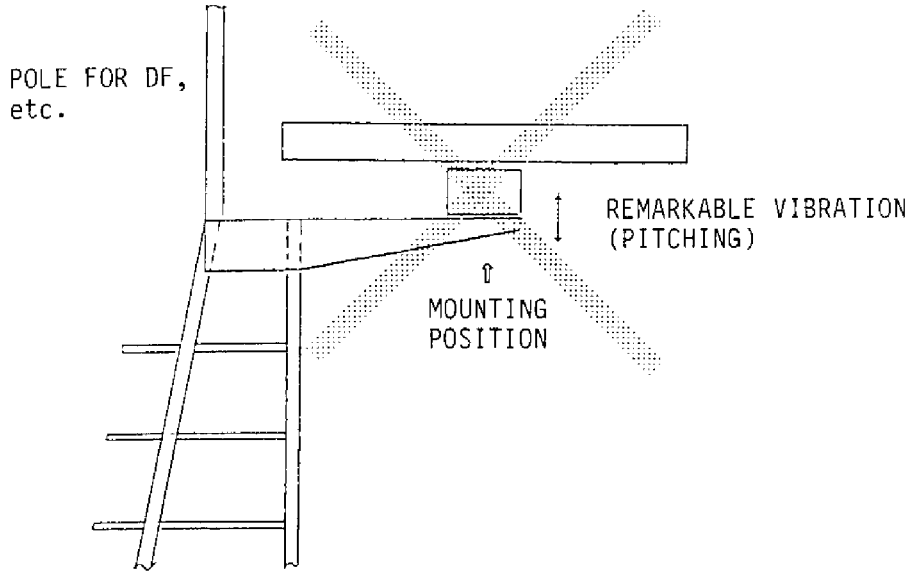
6) Sufficient clearance should be allowed around the unit for checking and service.

Mounting

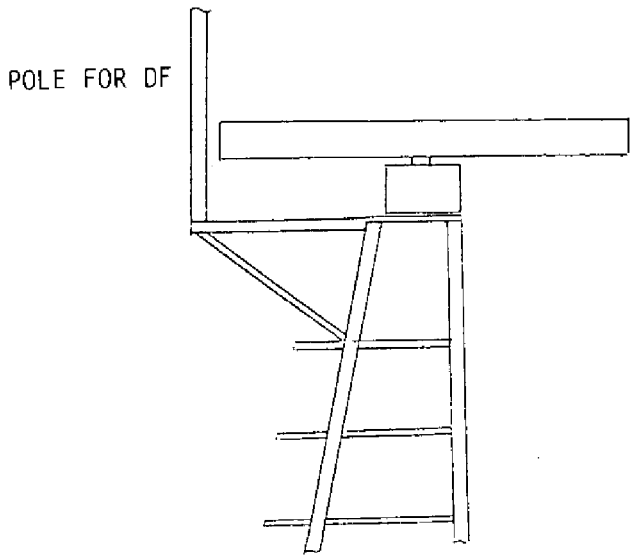
The antenna radiator and the scanner housing are shipped in separate packages and must be assembled at installation. Use the following procedure for mounting the scanner unit.

INSTALLATION PRECAUTION FOR S-BAND SCANNER UNIT

If an S-band scanner unit is mounted near the end of a platform to provide sufficient rotation clearance for the radiator (see figure), the scanner unit, because of its weight, swings up and down by ship's vibration and rolling, exterting excessive levels of stress at the base of the radiator, which can damage the radiator. To prevent this, relocate the scanner unit, or if relocation is not possible reinforce the platform.



EXAMPLE



Mount the scanner unit directly on the mast or on the platform as near as possible to the center of the mast.

CAUTIONS:

1) Follow the safety rule and use safety devices for dangerous work on the radar mast.

2) The scanner base is made of aluminium cast. To prevent the scanner base from electrolytic corrosion, use the seal washers and corrosion-proof rubber mat and ground the unit with the grounding wire, supplied as the installation materials. Refer to page 6-5.

3) Be sure to apply the adhesive (Non-acid type silicone sealant) supplied as the installation materials to bolts, nuts and washers. Do not use other type of sealant which may contain acetic acid.

4) Do not paint the radiator aperture.

5) Do not lift the scanner unit by the radiator. (Use lifting hooks.)

6) When assembling the antenna radiator, apply the adhesive (coat of waterproof compound) between mating surfaces of rotary joint flange. Do not apply it to the O-ring and the groove for O-ring.

Scanner Unit Assembling

It is recommended to install the antenna radiator on the scanner base before mounting the scanner unit on the radar mast. Refer to the scanner unit assembling drawing on next page.

1) Remove two protection caps from the radiator flange and rotary joint flange.

2) Place the O-ring in the groove of the rotary joint flange. Make sure the O-ring is fully greased. Make very sure the O-ring is not pinched during assembling.

3) Secure the feeder waveguide on the rotary joint flange with four M6x16 hex bolts.

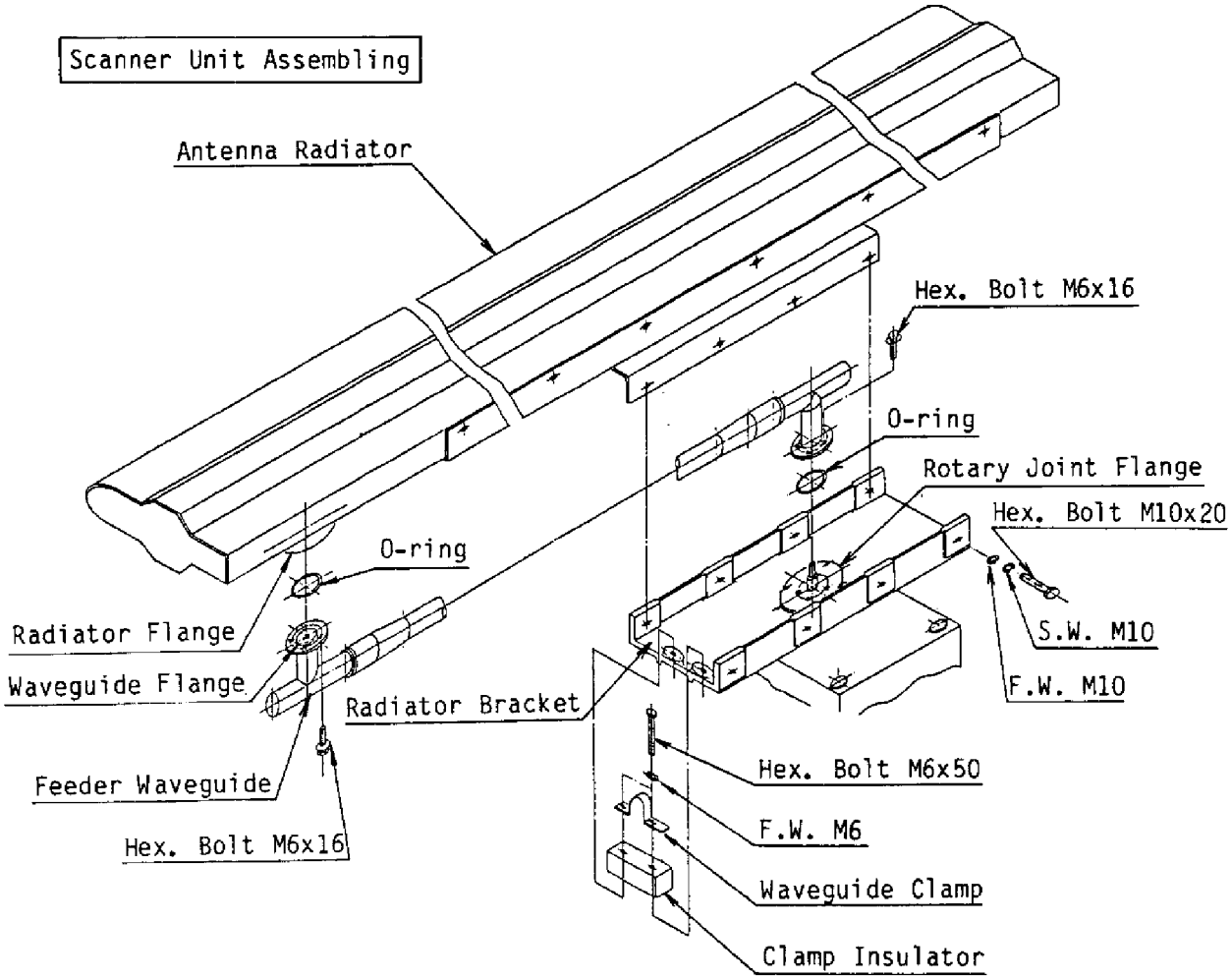
4) Fix the feeder waveguide on the radiator bracket with a waveguide clamp, a clamp insulator, two flat washers and two M6x50 hex bolts.

5) Place the greased O-ring in the groove of the radiator flange.

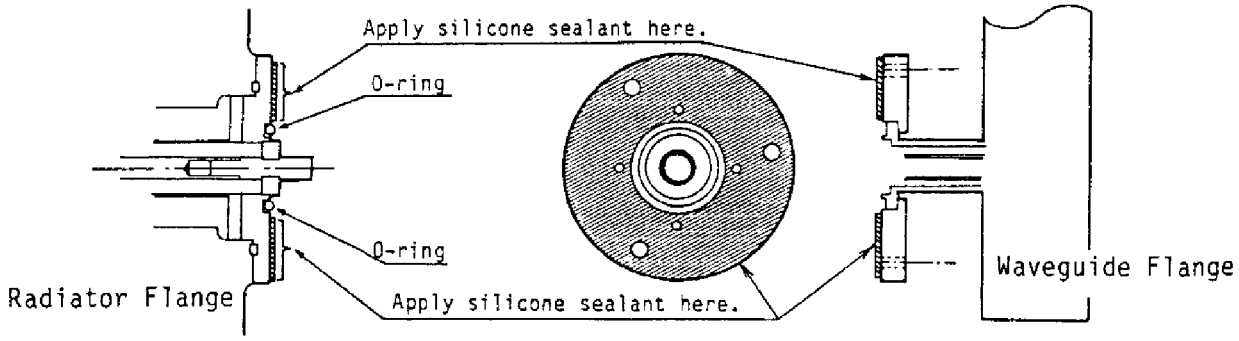
6) Put the antenna radiator on the bracket and fix it temporarily with eight M10x20 hex bolts, spring washers and flat washers.

7) Secure the feeder waveguide to the radiator flange with four M6x16 hex bolts.

8) Tighten the antenna radiator on the bracket with eight M10x20 bolts.



NOTE 1. Apply silicone sealant (supplied, non-acid type) on bolts, nuts, washers and waveguide flanges outside O-ring grooves to aviod electrolytic corrosion. (Do not apply sealant to O-rings and O-ring grooves.)



2. Do not pinch O-ring and keep it clean.

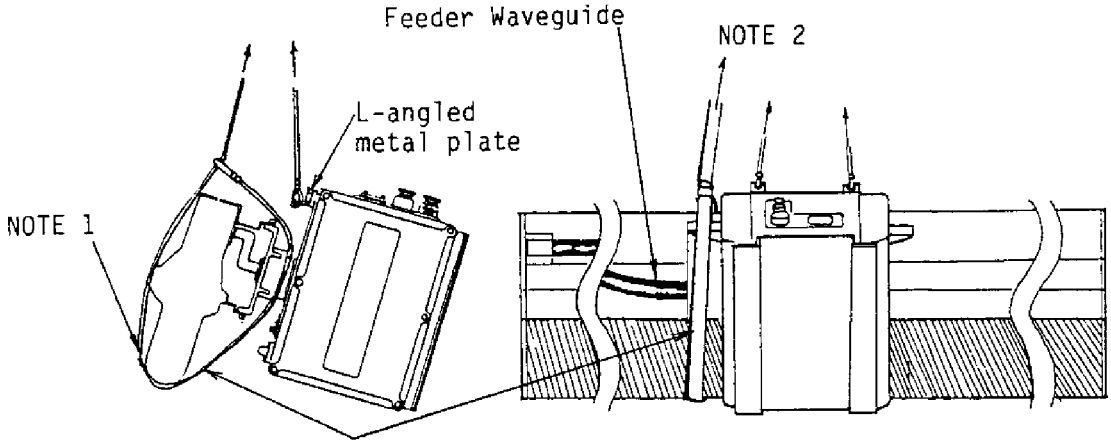
3. For packings of scanner covers and O-rings, do not use silicone sealant, but rather use grease.

How to Mount Scanner Unit

1) Drill four bolt holes (15mm dia.) in the radar mast platform or the deck, referring to the scanner outline drawing.

2) Place the corrosion-proof rubber mats supplied as the installation materials on the mounting platform where the scanner base will be positioned. This is to prevent the scanner base made of aluminum cast from the electrolytic corrosion. See page 6-5.

3) Using two L-angled metal plates on the scanner top, lift the scanner base with the antenna radiator and place the scanner unit on the rubber mats so that the cable glands face the ship's stern.



Put the rope around antenna radiator (feeder waveguide side) to prevent antenna from rotating when lifting up the antenna base.

NOTE 1. Take care not to damage antenna surface by the rope.
2. Tensile load should not be applied to antenna radiator.

Fig.6-2

4) Fix the scanner base to the mounting platform by using four M12x60 hex bolts, nuts, washers and seal washers supplied as the installation materials.

5) Arrange the grounding terminal at the nearest grounding spot using an M6x25 hex bolt, nut and washers supplied as the installation materials. Then fix a grounding wire (RW-4747, 320mm long) to the terminal.

6) Connect the other end of the grounding wire to the grounding terminal of the scanner unit.

7) Apply silicone sealant supplied as the installation materials to the grounding terminal and the fixing bolts.

REMARKS ON INSTALLATION OF SCANNER UNIT

The scanner base is made of aluminum cast. To prevent the scanner base from electrolytic corrosion, place the seal washer and corrosion-proof rubber mat, and run the grounding wire between the grounding terminal fitted on the scanner body and the nearest grounding spot as illustrated below. (These parts are supplied as the installation materials.)

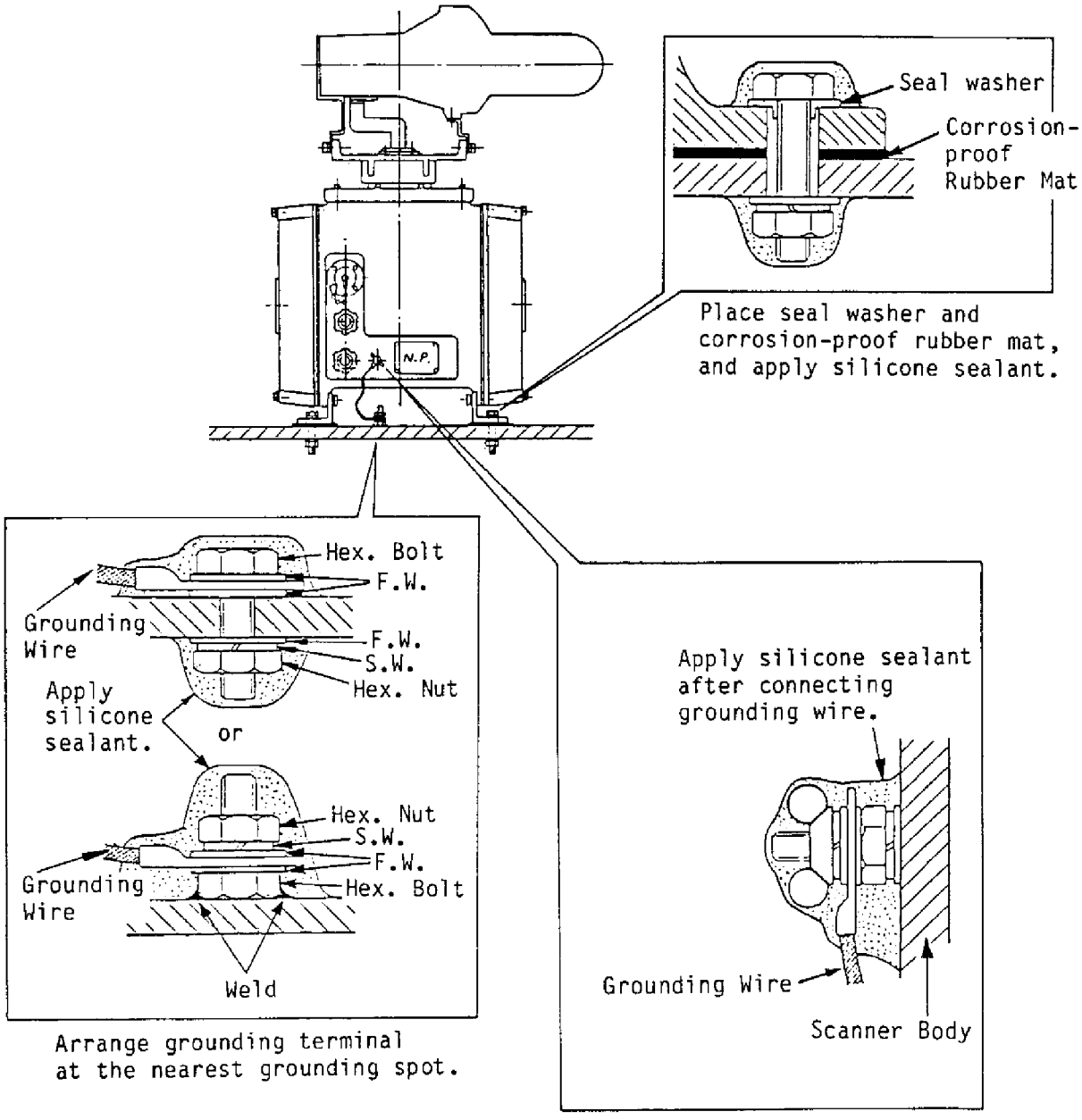


Fig.6-3

DISPLAY UNIT INSTALLATION

Siting Considerations

Locate the display unit in a place where it can be viewed and operated conveniently but where there is no danger of salt or fresh water spray or immersion.

The magnetic compass may be affected if the display unit is placed too close to it, because of the magnetic fields generated in the radar. The compass safe distance; 1.0 meters for standard compass, 0.75 meters for steering compass, must not be disregarded.

The orientation of the display unit should be so that the radar screen is viewed while the operator is facing the bow. This makes determination of position much easier.

The mount can be installed either on a tabletop or on a bulkhead. The mounting dimensions for this unit are shown in outline drawing on page D-1. You can use the mounting cradle itself as a template for marking the mounting bolt holes. Since the unit weights 19 kg reinforce the mounting place, if necessary.

Make sure you allow enough clearance to get to the connectors behind the unit. Leave at least a foot or so of "service loop" of cables behind the unit so that it can be pulled forward for servicing or easy removal of the connectors. The recommended clearances for servicing ease are given in outline drawing.

Mounting

Tabletop

1. Remove the two bolts (M8x40) fixing the display unit to the mounting cradle.
2. Drill four mounting holes (12mm dia.) through the tabletop.
3. Secure the mounting cradle to the tabletop by using M10 bolts, nuts and washers. 9mm radius coach screws may be substituted for the M10 bolts.
4. Place the display unit on the mounting cradle and secure them at the front of the display unit with the two bolts removed at step 1.

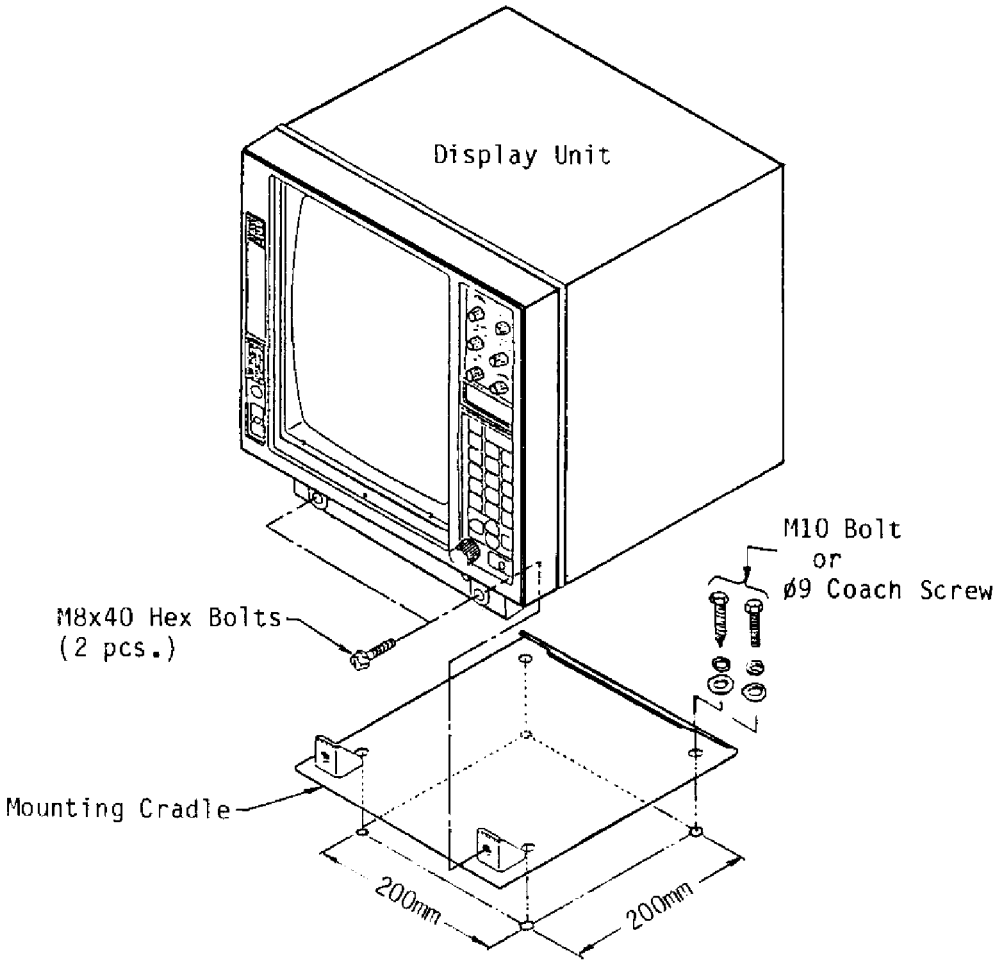


Fig.6-4 Tabletop Mounting

Bulkhead

1. Take the top cover off by loosening six M4x10 cosmetic screws.
2. Loosen two M8x40 hex bolts at the front of the display unit, and the mounting cradle comes free. Secure the mounting cradle to the bulkhead.
3. After disconnecting flying connector P/J1351, loosen four M6x20 hex bolts and separate the ramp base with the bottom plate from the display unit.
4. Loosen four M3x6 screws to separate the bottom plate from the ramp base.
5. Loosen the lock nuts for the POWER and SCANNER switches on the ramp base and turn them upside down, and secure the lock nuts. Attach the label (2) supplied as the spare parts to the ramp base.
6. Refix the bottom plate to the ramp base.
7. Connect the flying connector, and fix the ramp base to the top of the display unit with four M6x20 hex bolts removed in step 3.
8. Fix the top cover to the bottom of the display unit.
9. Fix the unit to the mounting cradle.

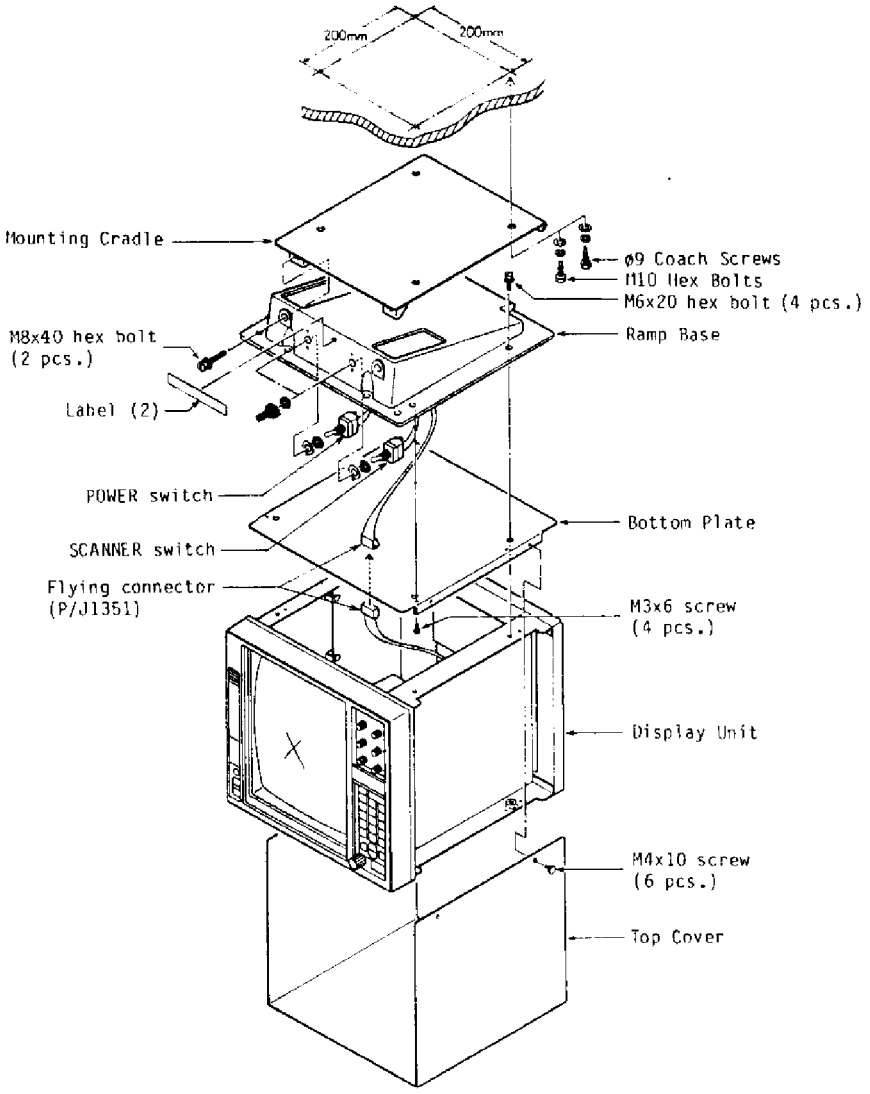


Fig.6-5 Bulkhead Mounting

CONNECTIONS

Connections to Display Unit

Two cables run to the display unit, the multicore cable from the scanner unit and the power cable from the ship's mains or rectifier. The multicore cable is terminated with factory-wired connectors at the display side. Fabricate the power cable (optional supply) as follows.

Fabricating the Power Cable

5. Remove 200mm of the vinyl sheath, taking care not to nick the braided shield.
6. Unwind the cloth tape and cut it off.
7. Take out about 40mm of the inner core of the braided shield; cut off the jute.
8. Remove about 10mm of the insulators from the cores and fix the supplied crimp-on lugs to the cores.
9. Wrap the braided shield with vinyl tape, leaving space for clamping.

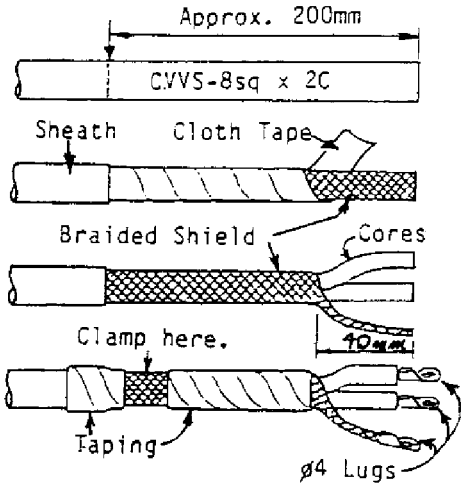


Fig.6-6 Fabricating the Power Cable

Connecting the Multicore Cable

10. Expose the copper shield of the multicore cable by removing the vinyl tape at the point shown below.

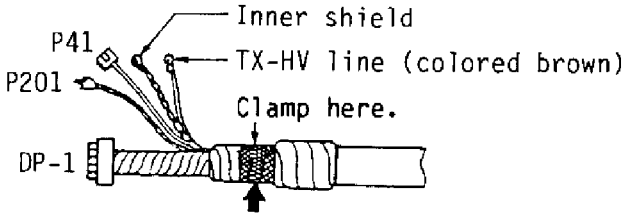


Fig.6-7 Multicore Cable (Display Unit side)

11. Take off the rear cover by loosening five M4x8 fixing screws.
12. Separate the clamp plate from the cable clamp by loosening two M4x10 fixing screws. Then secure the multicore cable and power cable so that the cable shield is completely grounded thru the clamp.
13. Cables of optional equipment(s) should be secured by the cable clamp after loosening two M6x35 hex bolts.
14. Dress the end of the multicore cable through the cutout in the rear panel; and then connect the coaxial cable plug P201, multicore cable connector DP-1 and P41, TX-HV line and inner shield of the multicore cable.

15. Ground the inner shield of the multicore cable to the chassis through a screw beside the terminal board DTB-II.

16. Connect the power cable to the terminal board DTB-I; positive core to #1 and negative core to #2. Ground the shield of the power cable to the chassis through a screw beside the terminal board DTB-I.

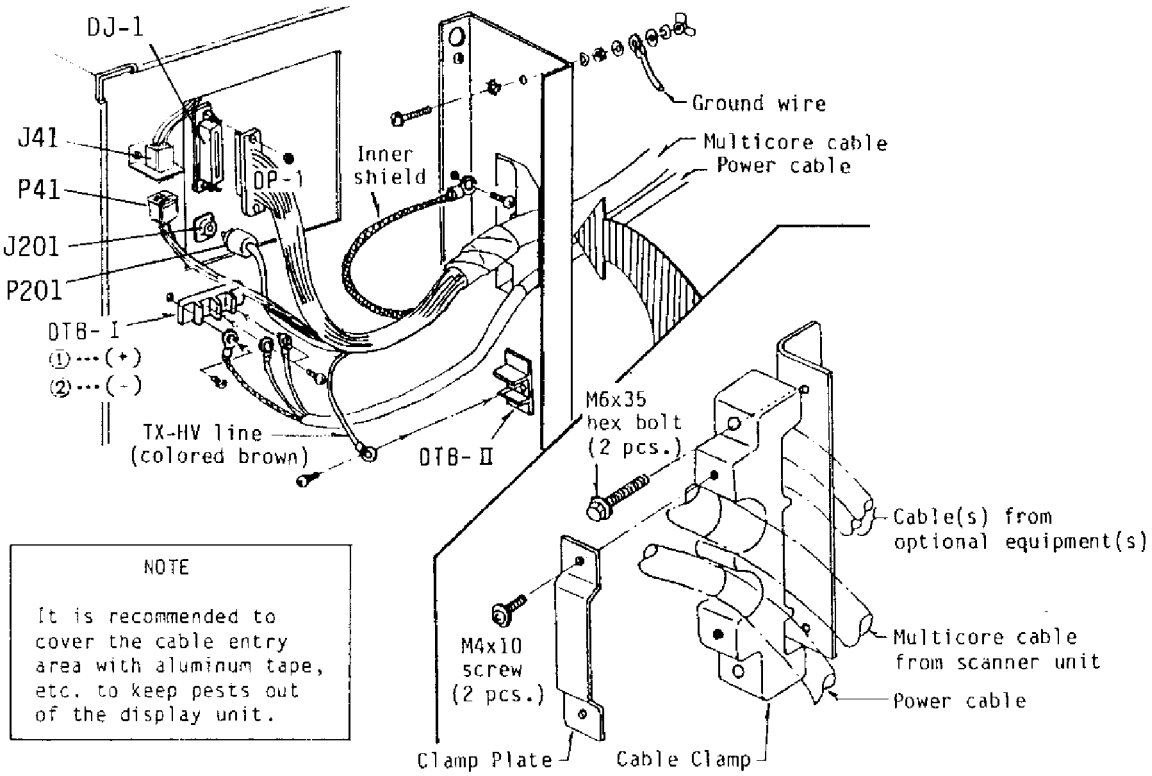


Fig.6-8 Display Unit (Rear cover removed)

Confirmation on the POWER SUPPLY Board

There are some jumper wires which must be changed with respect to the ship's mains. The POWER SUPPLY board is located on the left side of the display unit and the jumpers are accessible when the display cover is removed.

Jumper	24VDC mains
JP-1	without jumper
JP-2	Common - H
JP-3	Common - H
JP-4	Common - H
JP-5	Common - H

Connections to Scanner Unit

The multicore cable (RW-6895 or RW-3839-2) and power cable (250V-DPYC-1.25) for de-icer (option) should be connected to the scanner unit. The procedure for connecting the cables to the scanner unit is as follows.

NOTE: Care should be taken not to bring a screwdriver into contact with the magnetron to prevent demagnetization of magnetron.

1) Open the scanner housing cover of the port side by loosening six fixing bolts.

2) Remove the terminal board assembly from the chassis by loosening four fixing screws in order to facilitate the wirings.

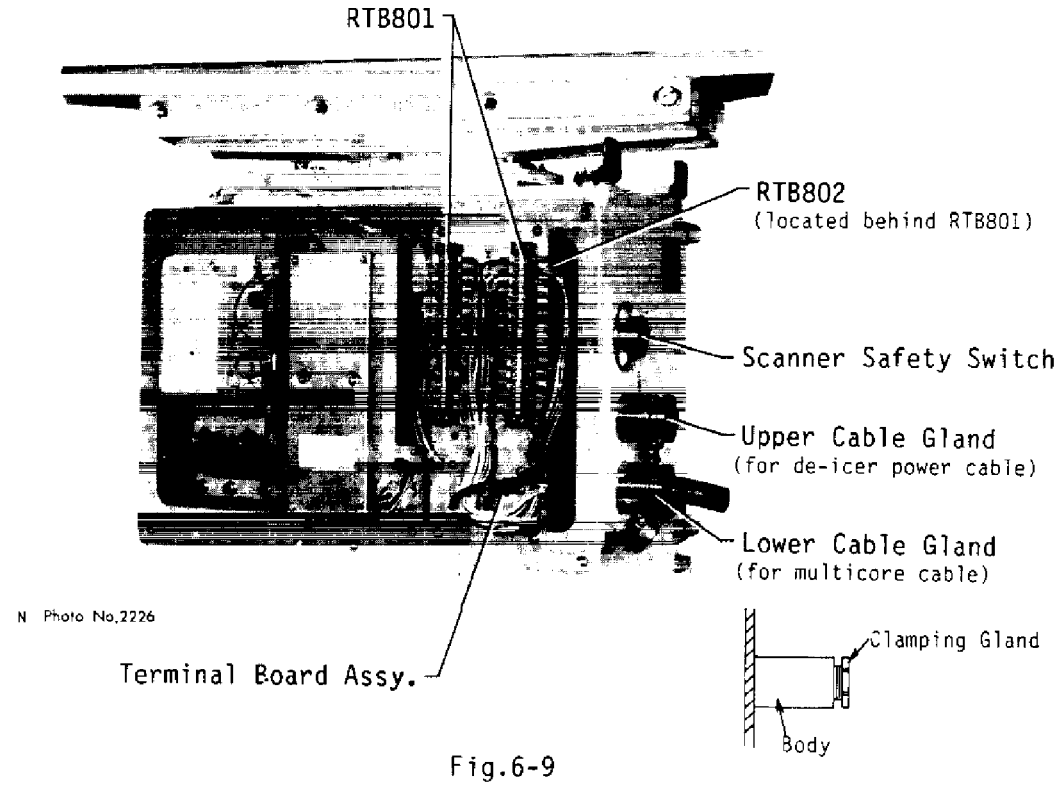


Fig.6-9

3) If de-icer is optionally installed, the power cable for de-icer should be connected to the scanner unit as follows. If not installed, skip to step 4).

   1. Loosen the clamping gland of the upper cable gland and remove the rubber packing and flat washers from the body.

   2. Cut the power cable, leaving approx. 600mm from the cable gland entry.

3. Remove the vinyl sheath for approx. 600mm and the armor for approx. 590mm with care not to damage the cable cores.

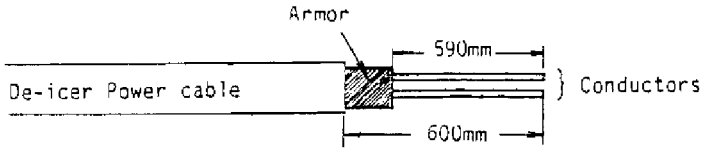


Fig.6-10

4. Slide the clamping gland, flat washers and rubber packing over the cable, and fold back the armor by 5mm, then put it between the flat washer and the cable gland body as below.

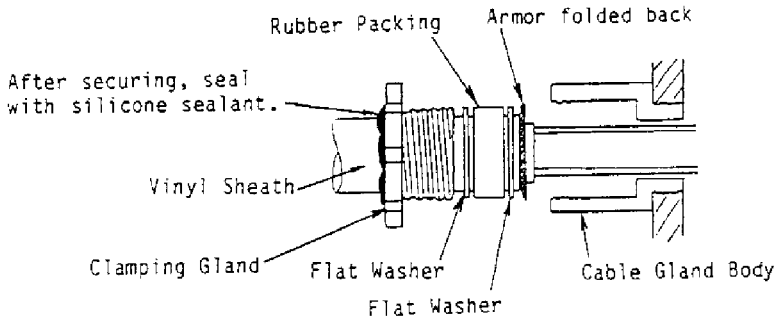


Fig.6-11

5. Cut the conductors to the appropriate lengths, taking into consideration the distance to RTB802 located behind RTB801.

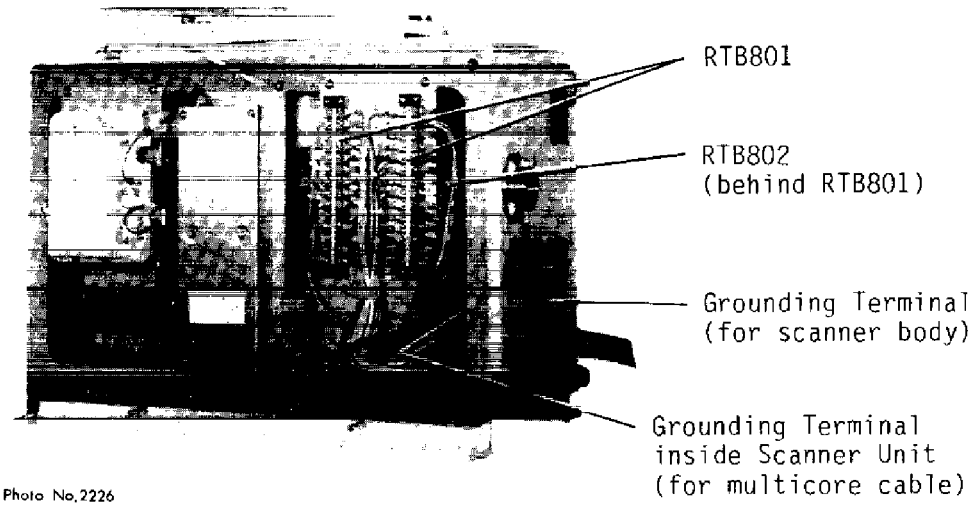


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Fig.6-12

6. Remove approx. 6mm of the vinyl insulation from the end of each wire, then fix the supplied crimp-on lugs (FV5.5-4) on each wire by using a crimping tool. Make sure each connection is secure both electrically and mechanically.

7. Secure the clamping gland to the body, then seal with the silicon sealant.

8. Connect the conductors to RTB802, referring to the interconnection diagram.

4) Loosen the clamping gland of the lower cable gland and take the rubber packing and flat washers out of the body.

When using RW-6895 cable

5) Remove the vinyl sheath/armor/inner vinyl sheath of the multicore cable for approx. 600mm with care not to damage the outer shield, and take the outer layer wires and inner shield out of the outer shield as shown in Fig.6-13.

6) Take the inner layer wires and coaxial cable out of the inner shield and mark the inner layer wires properly for identification. Then, cut the outer vinyl sheath and the armor as shown below, and wrap the vinyl tape for insulation.

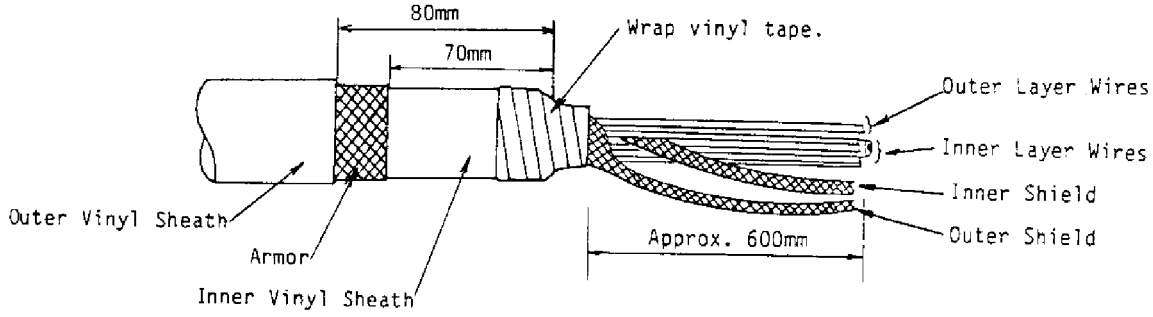


Fig.6-13a

7) Slide the clamping gland, flat washers and rubber packing over the cable. Note that the armor is grounded with two washers as below.

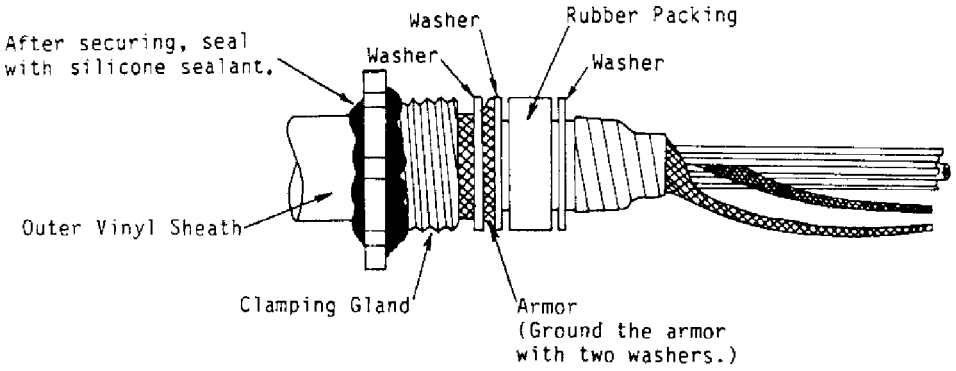


Fig.6-13b

When using RW-3839-2 Cable

5) Cut the cable to a suitable length, extending the length actually required by 600mm. Strip off about 600mm of the vinyl sheath, being careful not to nick the copper shield tape. Then cut off the copper tape leaving about 10mm from the vinyl sheath.

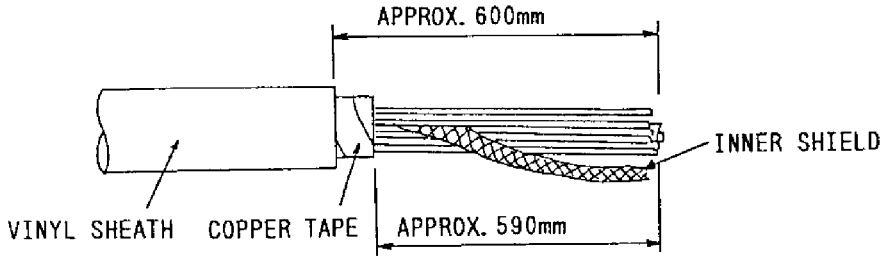


Fig.6-14a Fabricating the Signal Cable RW-3839-2

6) Untwine the braided shield with a screwdiver, etc. to expose the inner cores. Appropriately mark the inner cores for future identification.

7) Slide the clamping gland, rubber packing and washers into the cable. Fold back the copper tape by 5mm between two washers.

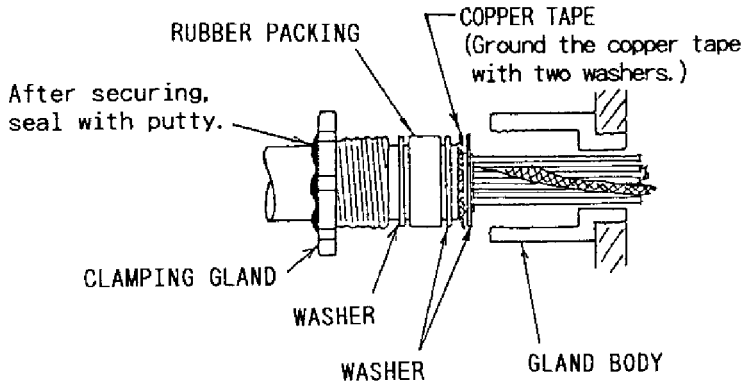


Fig.6-14b Fabricating the Signal Cable RW-3839-2

8) Cut each lead wire to the proper length, taking into consideration the distance to their respective terminals on RTB801.

9) Peel off the vinyl sheath of the coaxial cable (2C-2V) for approx. 75mm and take out the inner core. Then remove approx. 24mm of insulator from the end of the inner core and fold back the conductor as below, then put the crimp-on lug (320882) on the conductor. Cut the shield leaving approx. 45mm and put the crimp-on lug (FV1.25-3) on the shield. Put the cloth tape over the shield and core. Be careful not to nick the inner conductor when stripping off the insulation, since it is fragile.

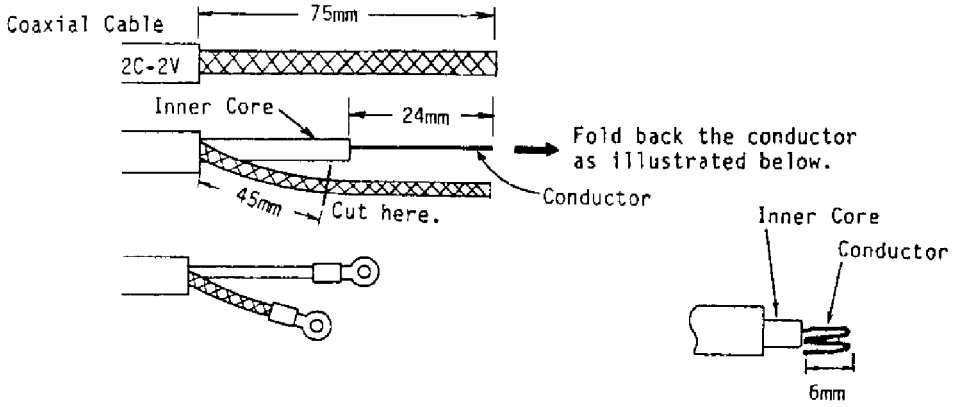


Fig.6-15

10) Remove approx. 6mm of the vinyl insulation from the end of each wire, and fix the crimp-on lugs (FV1.25-3) on each wire. Together, put the crimp-on lugs (FV5.5-4) on outer/inner shields by using a crimping tool. Make sure each connection is secure both mechanically and electrically.

11) Secure the clamping gland to the body, then seal with the silicone sealant. See Fig.6-14.

12) Connect each lead wire and outer/inner shields to RTB801 and the grounding terminal inside the scanner unit (Fig.6-12) respectively, referring to the interconnection diagram.

NOTE: Do not forget to ground the scanner body with grounding wire RW-4747 supplied thru the grounding terminal shown in Fig.6-12.

13) Put the terminal board assembly back in position.

14) Close the scanner housing covers, making sure that the packing surface of the scanner cover is properly greased and is free of dirt.

RECTIFIER UNIT INSTALLATION AND CONNECTION (OPTION)

For the set driven by 100/110/115/220/230VAC ship's mains a rectifier unit is required. The unit can be mounted in any dry, well-ventilated place. The mounting dimensions are shown in the outline drawing.
The compass safe distance, 2.5 meters, standard compass, and 1.5 meters, steering compass, should be observed.

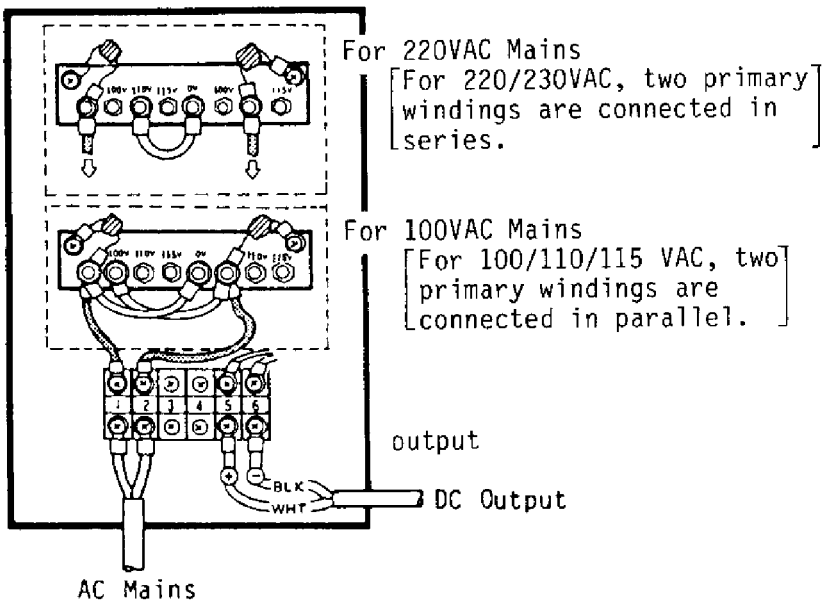


Fig.6-16 Connections to the Rectifier Unit

POST INSTALLATION ADJUSTMENT

Preoperation Checks

After completion of all wiring and interconnections, check that there is no wrong nor loose connection on the terminal boards. Check that the connectors and circuit boards are firmly connected to corresponding jacks and plugs. Then, apply the power and check radar functions item by item according to the following procedure.

1. Set the controls as follows.

   POWER switch ---------- OFF
   SCANNER switch ---------- OFF
   BRILLIANCE control ------ fully counterclockwise
   A/C RAIN control -------- fully counterclockwise
   A/C SEA control --------- fully counterclockwise
   GAIN control ------------ fully counterclockwise
   TUNE control ------------ mid-travel

   Turn the power on and confirm that the input voltage at the terminals #1(+) and #2(-) of DTB-I is 20.4 to 30.0VDC. (If the power is supplied through a rectifier, change of tap connection at the rectifier unit may be required.)

2. In about 3 minutes after switching on the radar, turn the CRT BRILL control clockwise and the indication ST-BY is displayed on the screen. Turn the SCANNER switch to ON and check that the antenna rotates at a speed between 20 and 25 rpm.

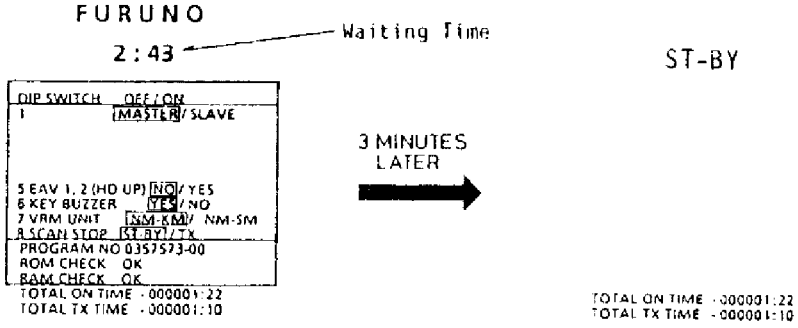


Fig.6-17

3. Press the STBY/TX touchpad to begin transmitting.

4. Gradually turn the GAIN control clockwise, and confirm that noise and/or echoes appear on the screen.

5. Adjust the TUNE control to obtain best tuning.

6. Check the function of other controls, switches and touchpads by operating them one by one.

Adjustments

The location of the preset potentiometers on the PANEL board is shown below. Pry off the panel cover with a small screwdriver.

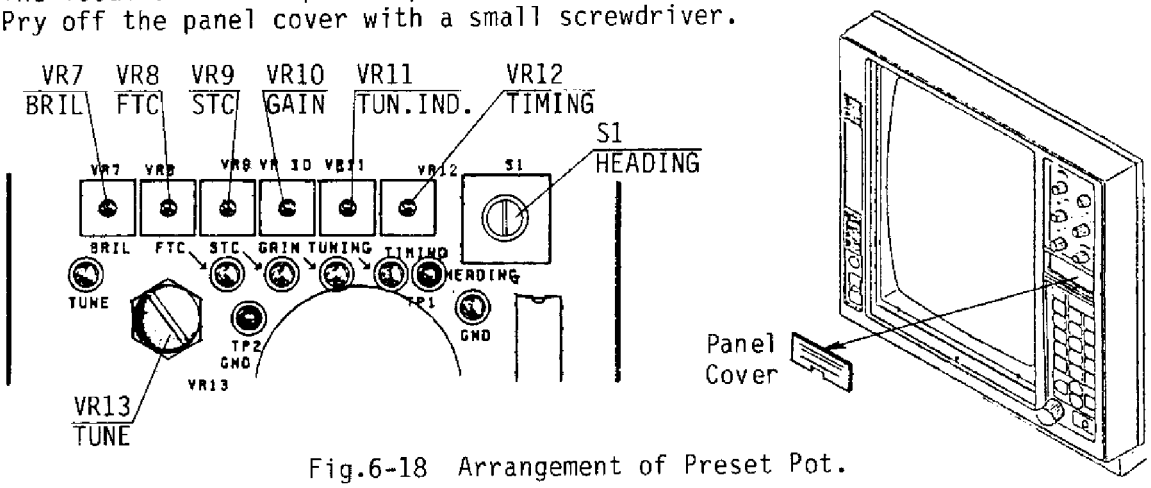


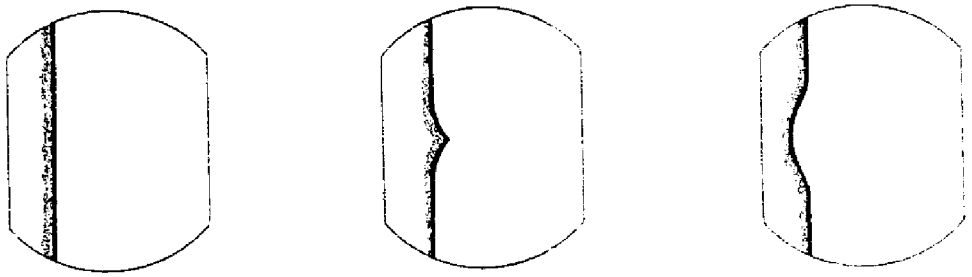
Fig.6-18 Arrangement of Preset Pot.

Transmission Timing

Transmission timing differs with respect to the length of the multicore cable between the display and the scanner units. Even if the standard cable of 15m in length is used, the adjustment must be performed. The following problems may occur if the adjustment is not made.

* Straight wharf or breakwater appears bent inward or outward at the center of the screen on 0.25 nm range.
* Range error is found on short range.
* Dark area appears at the center of the screen.

The adjustment is made with VR12 (TIMING) while observing the radar screen.



a. PROPER SETTING
Straight target appears as a straight line on the screen.

b. TURN VR12 CCW TO CORRECT.
Straight target is pulled inward.

c. TURN VR12 CW TO CORRECT.
Straight target is pushed outward.

Fig.6-19 Transmission Timing

Heading Alignment

The scanner unit has been installed to face straight ahead in the direction of the bow. Some small error, however, may be observed on the display for most installations because of the difficulty in achieving accurate initial positioning of the scanner unit. The following adjustment will compensate for this error.

1. Set the range to 3 nm; select the head-up mode; and operate the radar to obtain a normal picture on the screen.
2. Select a suitable target echo (small island, end of quay, etc.) located on or around the heading mark and near the edge of the screen.
3. Press the EBL ON touchpad to present an EBL on the screen.
4. Operate the rotary knob control until the EBL bisects the target and read the relative bearing "A" to the target.
5. On a navigational chart find the relative bearing "B" of the target from the ship's heading.

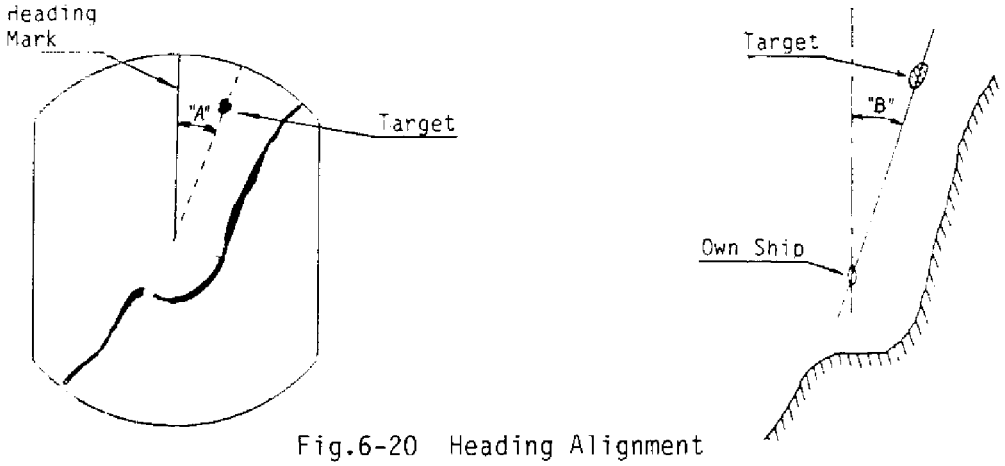


Fig.6-20 Heading Alignment

6. Both the bearings "A" and "B" should be same. If the difference is within ±5°, adjust rotary code switch S1 (HEADING, working range ±5° in steps of 0.7°. Clockwise rotation shifts the picture CW.) See Fig.5-17 for the location of S1.
7. If the difference is more than ±5°, set S1 to "0" and then adjust the position of reed switch S801 located inside the scanner unit. When the bearing "A" is greater than "B", slightly turn the adjusting screw CCW. To the contrary, when "A" is smaller than "B", slightly turn it CW. Secondly adjust S1 at the display as in step 6.

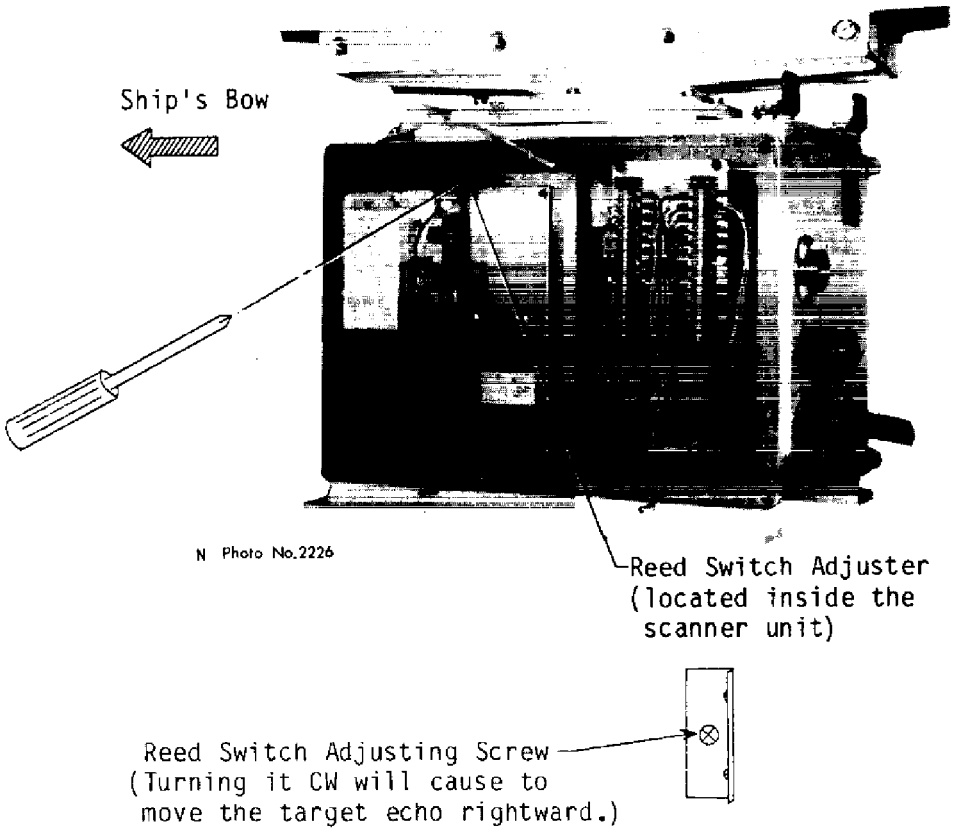


Fig.6-21

Tuning & Tuning Indicator Sensitivity

Optimum tuning should be obtained with the maximum number of tuning markers displayed. If not, take the following procedure.

1) Set the controls and switches as follows.

   RANGE: maximum range, GAIN: properly adjusted, A/C SEA & A/C RAIN: fully CCW, ECHO STRETCH & IR: OFF, TUNE: mid-travel

2) Transmit the radar and wait for 10 minutes approx. for magnetron oscillation to stabilize.

3) Adjust VR13 (TUNE) so that a comparatively weak long range echo is discerned with maximum definition. See Fig.6-18 for the location of VR13.

4) Adjust VR11 (TUN.IND) so that four tuning markers of the tuning bar light up with the fifth marker blinking. See Fig.6-18 for the location of VR11.

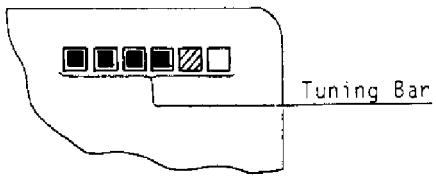


Fig.6-22 Tuning Bar

Main Bang Suppression (MBS)

This adjustment is already made at factory. But if the main bang appears on the screen, perform the following procedure after Transmission Timing adjustment is done.

1) Transmit the radar on 0.25 nm range and adjust the GAIN and A/C SEA controls for the best picture definition.

2) Turn VR103 (MBS Level pot.) and VR104 (MBS Timing pot.) on the GSC board (03P6571) fully CW.

3) Turn VR104 CCW little by little until the main bang disappears.

4) Turn VR103 CCW little by little until the main bang ring becomes faintly visible on the screen.

5) Turn VR104 CCW little by little until the main bang ring disappears.

NOTE: Too high a setting of MBS (VR103 & VR104) will cause the target echo in close ranges to disappear.

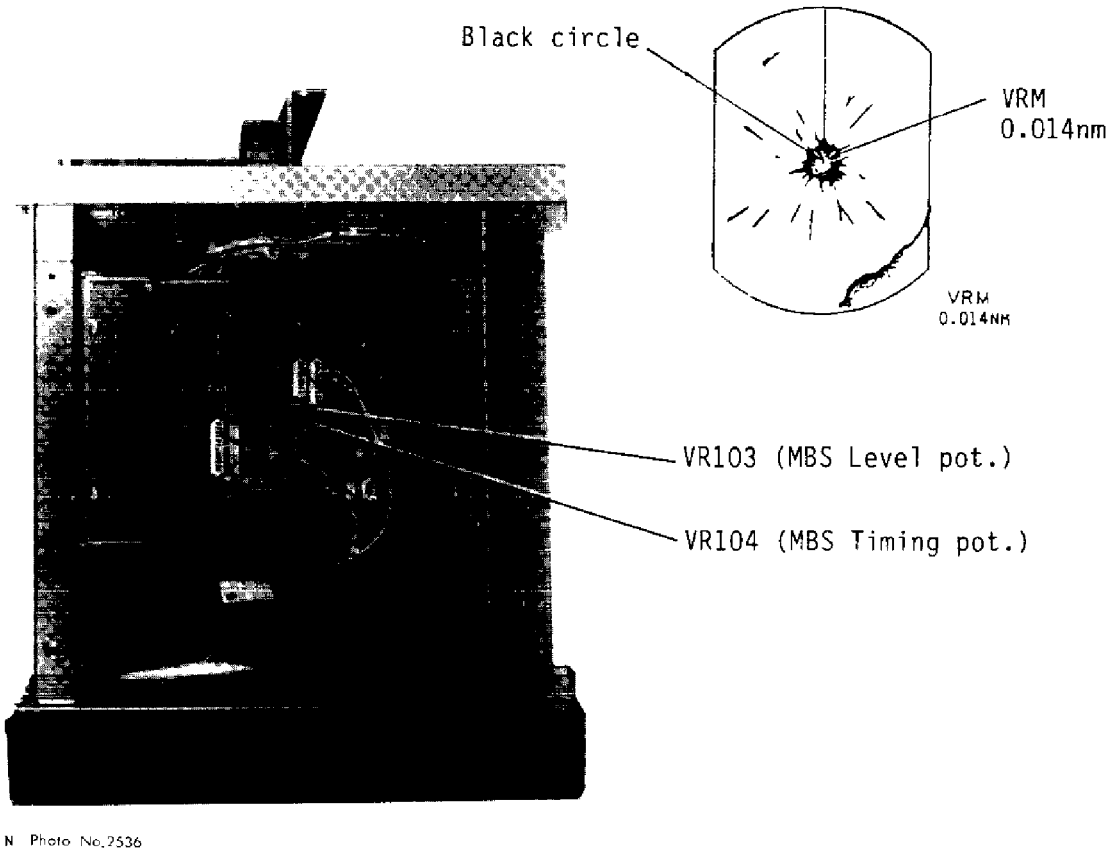


Fig.6-23 Suppressing the Main Bang

Magnetron Heater Voltage

If the length of the multicore cable is different from the standard one (15m), the Magnetron Heater Voltage should be adjusted as follows. The location of test points is shown in the figure below.

The radar must be set to "transmitting status" with scanner rotation suspended to perform this adjustment. Scanner rotation may be suspended by turning the SCANNER switch to OFF; however, no radar waves are transmitted. To achieve this, set #8 of DIP switch S1 to ON at the PROCESSOR board (03P7529). Never fail to reset the DIP switch to OFF after completing this adjustment.

1) Remove the transmission fuse F1 (0.5A) to cut TX high voltage, and set #8 of DIP switch S1 on the PROCESSOR board to ON.

2) Turn off the SCANNER switch and turn on the POWER switch.

3) Operate the radar in stand-by, 0.25nm range; set the BRILL control fully counterclockwise.

4) Connect a multimeter, set to the range of 10VDC, between pins #4(+) and #6(-) of the pulse transformer. See the figure below.

5) Adjust the position of the sliding contact of R812 to obtain the multimeter reading of 6.3VDC.

6) Press the STBY/TX touchpad to transmit, and then set the range to 48nm. Adjust the position of sliding contact of R811 for the multimeter reading of 5.3VDC. Set the range to 3nm and confirm that the reading is also 5.3VDC. If not, readjust R811.

7) Replace the transmission fuse F1, and reset #8 of DIP switch S1 to OFF.

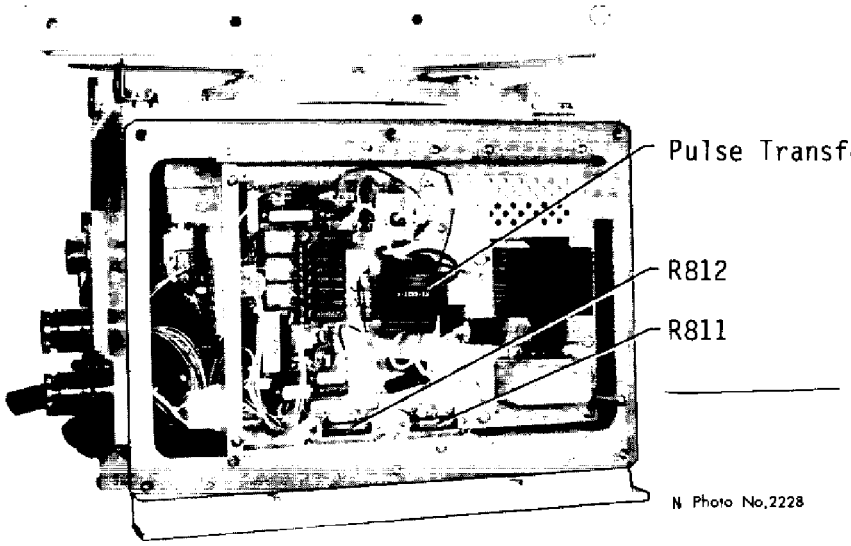


Fig.6-24 Scanner Unit (Starboard view)

CRT Brilliance

The minimum brightness of the CRT can be adjusted to suit operator's needs, by adjusting VR7 (BRIL). See Fig.6-18 for its location.

Others

Adjustments of preset gain, A/C sea and A/C rain are shown in this section. If the radar does not meet the following conditions, adjust corresponding preset potentiometers VR10 (GAIN), VR9 (STC) and VR8 (FTC). See Fig.6-18 for its location. Set the controls as below.

A/C SEA -------- fully CCW (min.)
A/C RAIN ------- fully CCW (min.)
IR ------------ on
ECHO STRETCH --- off
ECHO AVG ------- off
ECHO TRAIL ----- off

for Preset Gain

1. Transmit and tune the radar on the range of 48 nm.
2. Gradually turn the GAIN control clockwise and confirm that a little background noise appears when the control is within the 12 to 3 o'clock range. If not, adjust VR10.

for A/C Sea

1. Transmit and tune the radar on the range of 24 nm.
2. Set the GAIN control to a position where a little background noise appears on the screen.
3. Turn the A/C SEA control fully CW and confirm that no background noise appears in the range of 0 to 7 nm (min.) or 0 to 14 nm (max.) If not, adjust VR9.

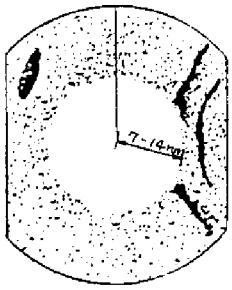


Fig.6-25

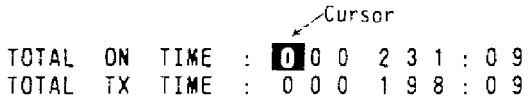
APPENDIX 1 SETTING TOTAL ON TIME & TOTAL TX TIME

The total on time (no. of hours the power has been applied) and the total TX time (no. of hours radar has been transmitted) are displayed during ST-BY period.

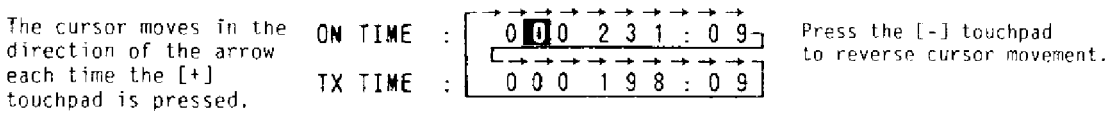
These times can be set or readjusted as desired to keep track of maintenance intervals, magnetron life, etc.

Procedure

1. Turn the power on and set the radar to stand-by.
2. While pressing and holding down the HM OFF touchpad, alternately press the + and - touchpads five times each.
3. Release hold of the HM OFF touchpad. The total on time and total TX time are displayed and a cursor circumscribes the first numeral on the "TOTAL ON TIME" line.



4. Press the + and - touchpads to set the cursor on the desired position; press the + touchpad to advance the cursor, or press the - touchpad to move the cursor reversely.



5. After placing the cursor on the desired numeral, press and hold the HM OFF touchpad and then press the + or - touchpad to count the numeral (0-9) upward or downward, respectively.
6. Repeat steps 4 and 5 to change other numerals.
7. Press the STBY/TX touchpad to return to the normal operating mode.

APPENDIX 2 DIP SWITCH

The specifications of this radar can be changed by switching the settings of DIP switch S1 on the PROCESSOR board. The specifications of each switch are given in the table below.

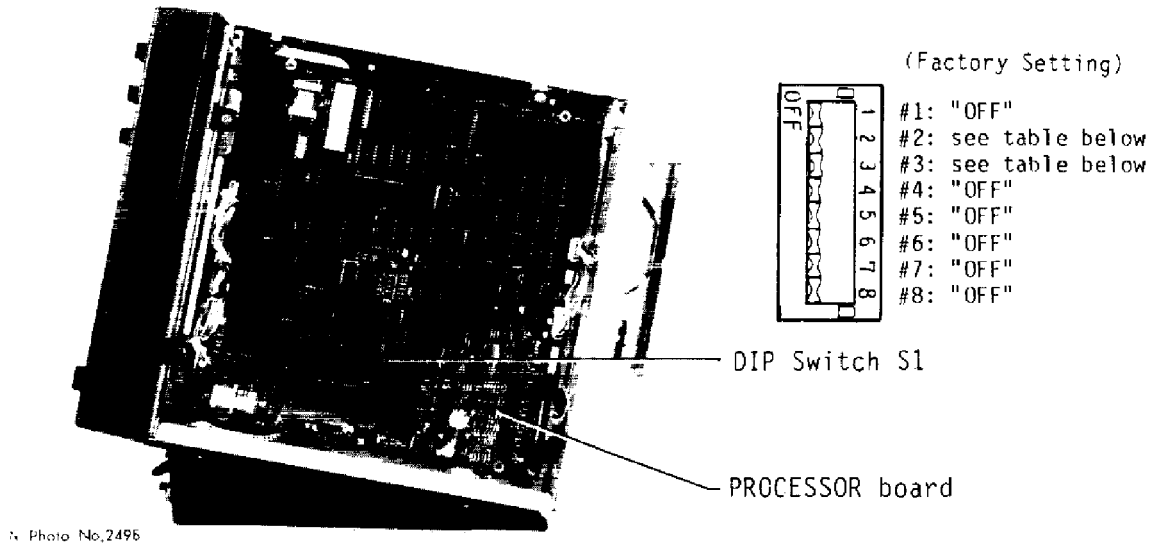


Fig.1 Display Unit (cover removed)

No.	Specification		OFF	ON
1	Radar Selection		Main Radar	Sub Radar
2	Model Selection	FR-8100DS	No.2 ON	No.3 OFF
3		FR-8300DS	No.2 OFF	No.3 ON
4	WP & L/L Indication (if nav aid connected)		Nav Data	
5	Use of Echo Averaging Levels 1 & 2 in the Head-up Mode		NO	YES
6	Key Operation Confirmation (beep tone)		YES	NO
7	Unit of Variable Range Marker		NM/KM	NM/SM
8	Transmit or no when scanner rotation is suspended.		NO (ST-BY)	YES (TX)

The settings of the DIP switch are displayed for 3 minutes after the power is turned on. Active settings are circumscribed.

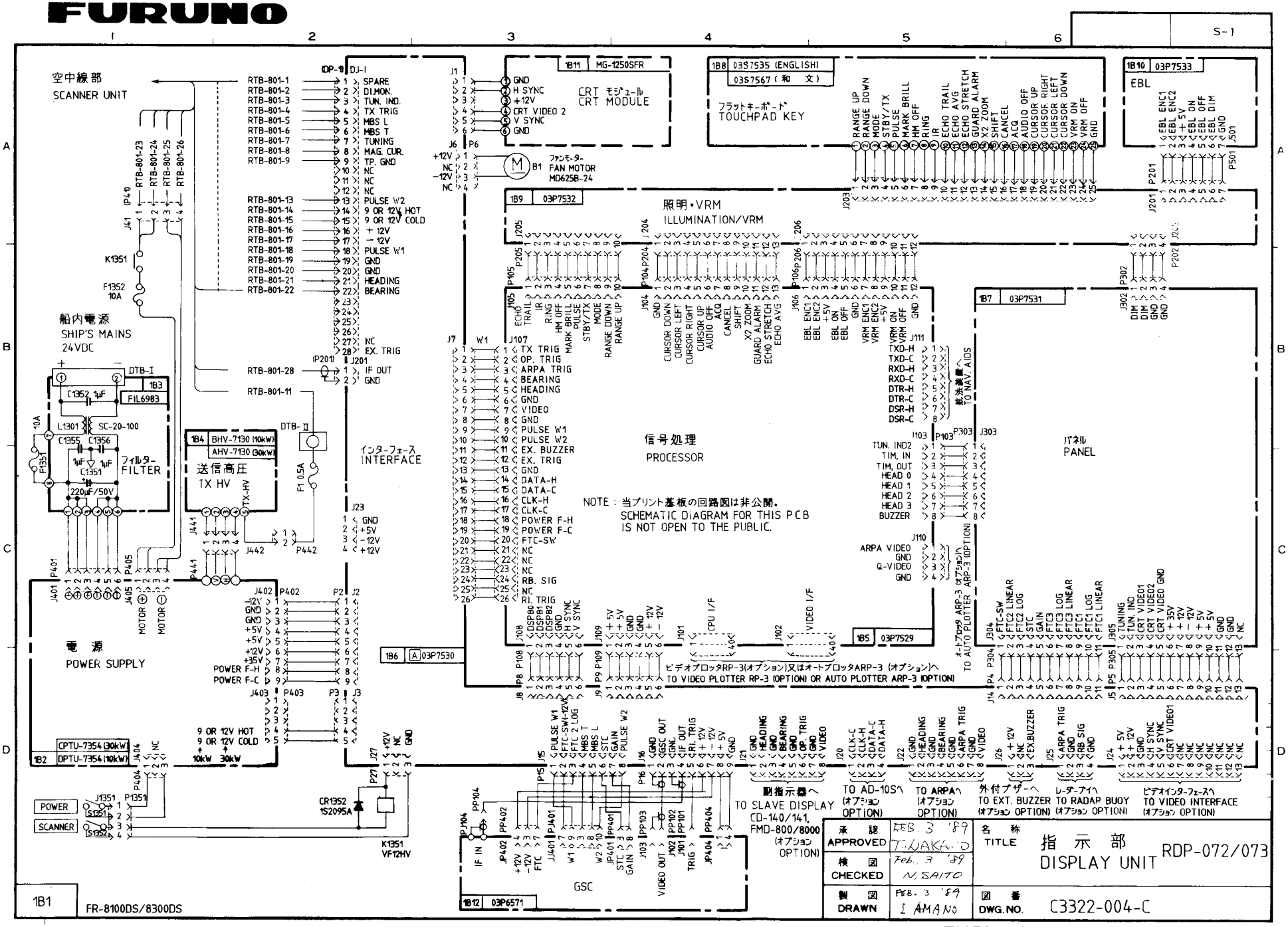
DIP SWITCH	OFF / ON
1	[MASTER] / SLAVE
5 EAV1,2 (HD UP)	[NO] / YES
6 KEY BUZZER	[YES] / NO
7 VRM UNIT	[NM↔KM] / NM↔SM
8 SCAN STOP	[ST-BY] / TX

PROGRAM NO : 0357573-00
ROM CHECK OK
RAM CHECK OK

TOTAL ON TIME=000019 : 55

TOTAL TX TIME=000010 : 09

FURUNO



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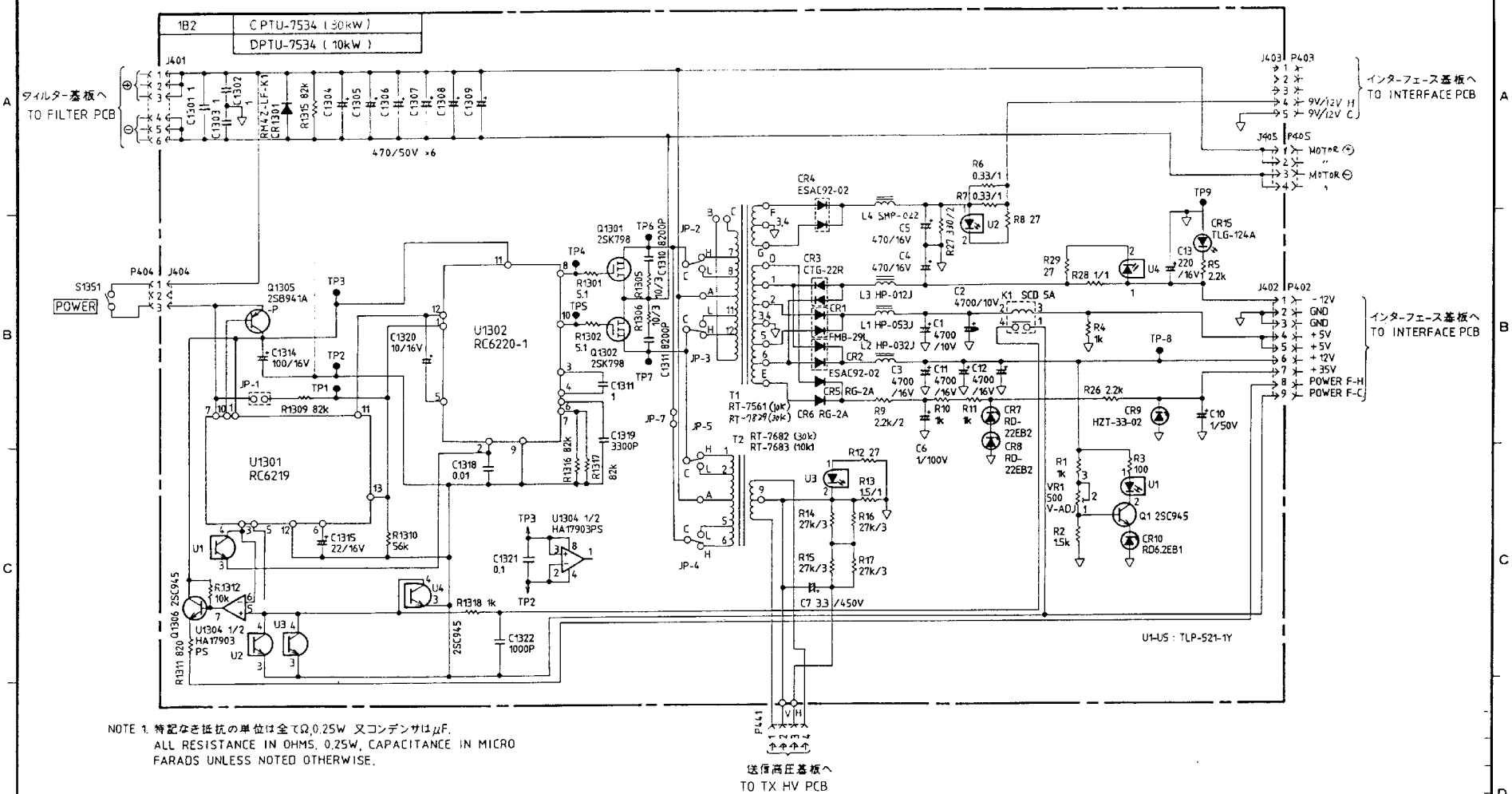
FURUNO



NOTE 1. 特記なき抵抗の単位は全てΩ,0.25W 又コンデンサはμF.
ALL RESISTANCE IN OHMS, 0.25W, CAPACITANCE IN MICRO FARADS UNLESS NOTED OTHERWISE.

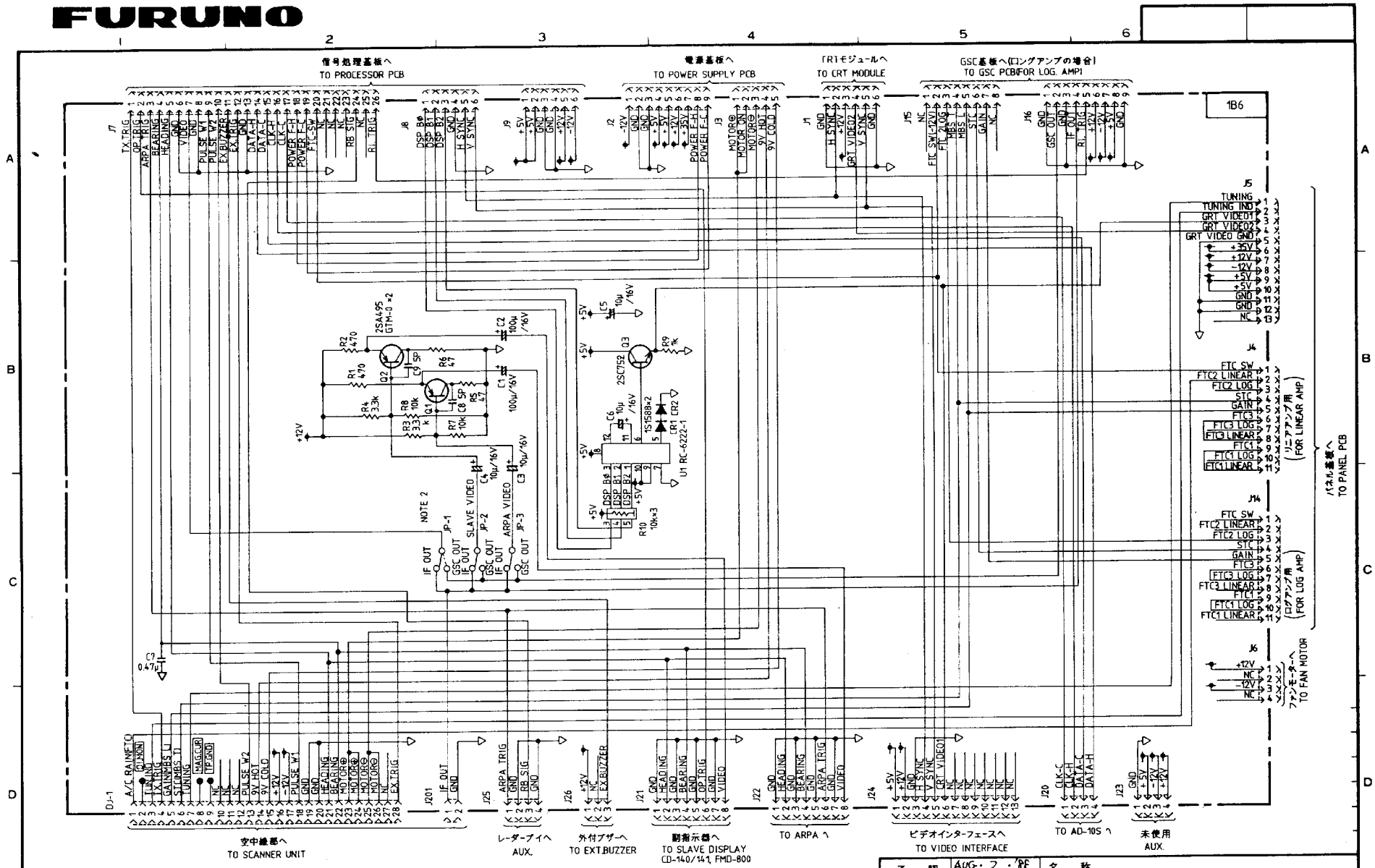
承認 APPROVED	AUG. 2. '88 T. NAKANO	名称 TITLE	PTU-7534 電源基板 (CPTU/DPTU) POWER SUPPLY
検図 CHECKED	AUG. 1. '88 T. NAKANO		
製図 DRAWN	1ST. Aug. '88 T. HATAI	図番 DWG. NO.	CB322-C05-A

FS-2100DS/8300DS

FURUNO ELECTRIC CO., LTD.

S-2

FURUNO



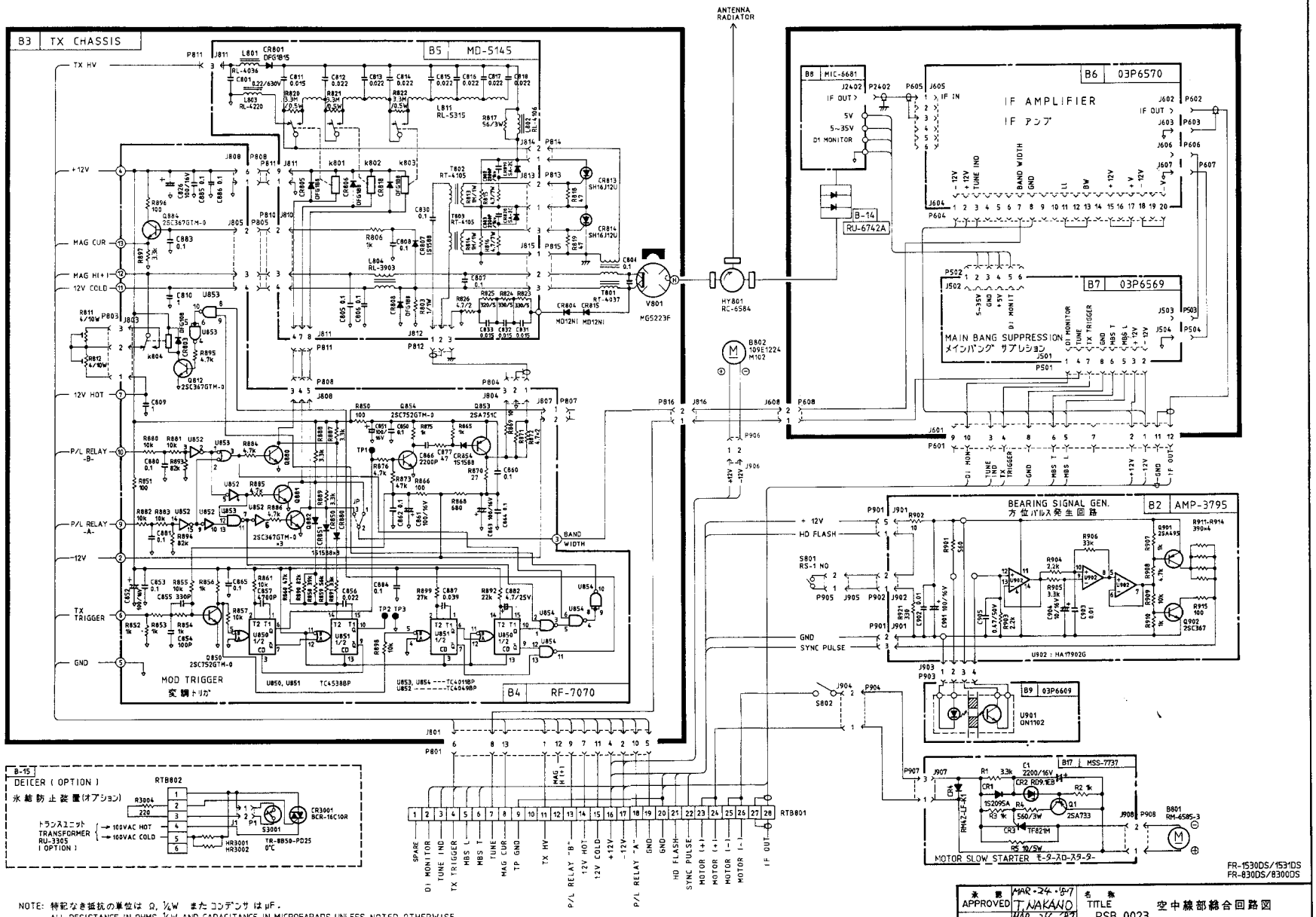
NOTE 1: 特記なき抵抗の単位は全てΩ, 0.25W 又 コンデンサはF.
ALL RESISTANCE IN OHMS, 0.25W, CAPACITANCE IN FARADS UNLESS NOTED OTHERWISE.
2: JP-1の設定は03P7530の場合 ----- IF OUT側, A03P7530の場合 ----- GSC OUT側.
CONNECTIONS OF JP-1: FOR 03P7530 ----- IF OUT, FOR A03P7530 ----- GSC OUT.
3: JP-2, JP-3の設定はそれぞれ接続する副指示器, ARPAの仕様に合わせる. IF OUT-----リニア, GSC OUT-----ログ
SET JP-2 & JP-3 RESPECTIVELY FOR CONNECTED SLAVE DISPLAY & ARPA. IF OUT---LINEAR, GSC OUT---LOG.

FMD-8000
FR-8100DS/8300DS
FR-8050D(A)/8100D(A)/8250D(A)

承認 APPROVED	Aug. 2. '88 T. NAKAJO	名称 TITLE	03P7530 インターフェース基板 INTERFACE PCB
検図 CHECKED	Aug. 1. '88 I. AMANO		
製図 DRAWN	1st. Aug. '88 Y. HATAI	図番 DWG. NO.	C3314-011-C

FURUNO ELECTRIC CO., LTD.

S-3

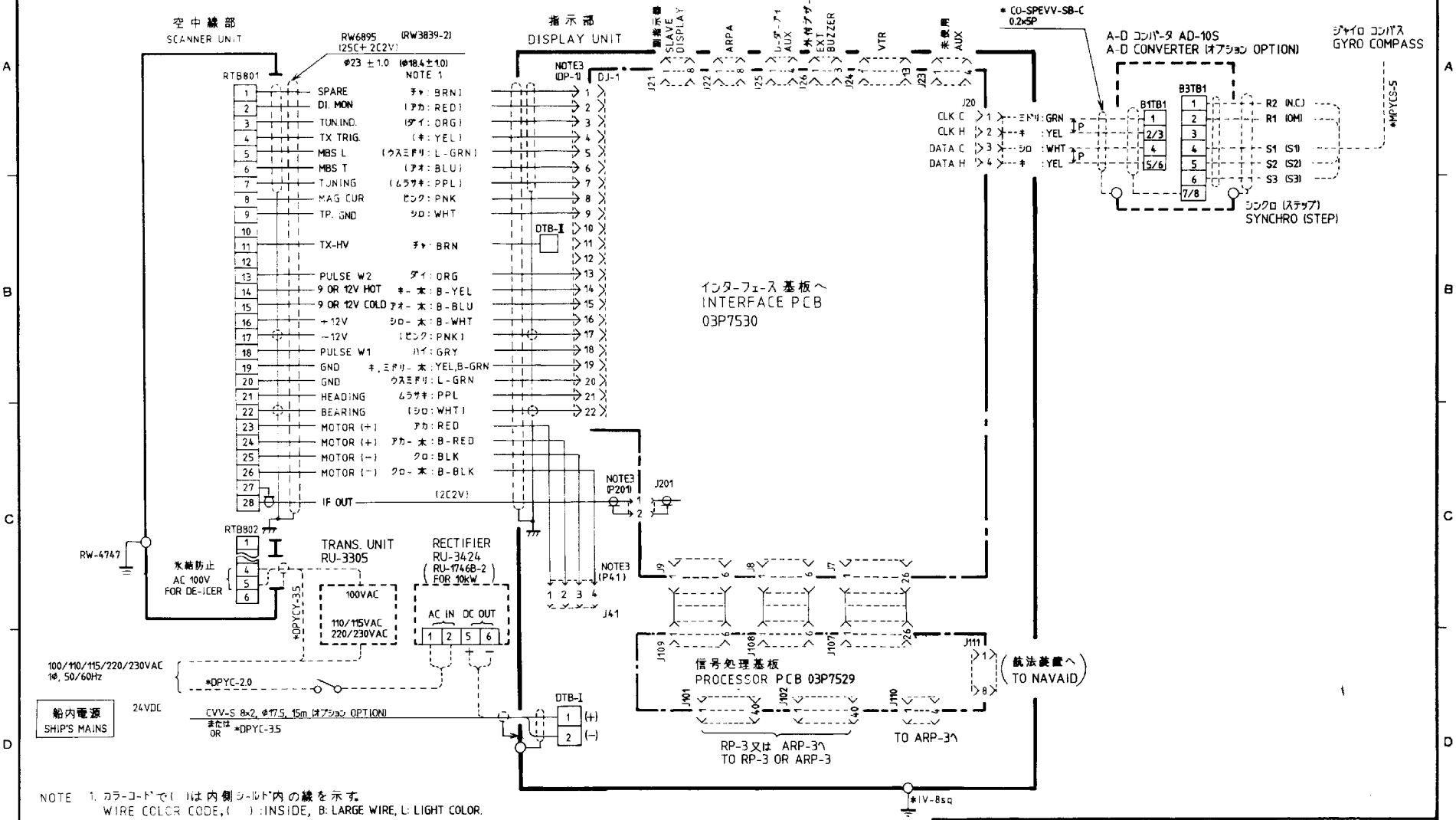


NOTE: 特記なき抵抗の単位は Ω, ¼W またコンデンサ は μF.
ALL RESISTANCE IN OHMS, ¼W AND CAPACITANCE IN MICROFARADS UNLESS NOTED OTHERWISE.

FR-1530DS/1531DS
FR-8300DS/8300DS

承認 APPROVED	MAR.24.'87 T.NAKANO	名称 TITLE	空中線部総合回路図
検図 CHECKED	MAR.24.'87 SAITOH	RSB-0023	SCANNER UNIT
製図 DRAWN	MAR.17.'87 I.Amano	図番 DWG.NO.	C3303-002-G

FURUNO



NOTE
1. カラーコードで( )は内側シールド内の線を示す。
WIRE COLOR CODE,( ) :INSIDE, B: LARGE WIRE, L: LIGHT COLOR.
2. シールドは両ユニット側で完全にアースすること。
SHIELD SHOULD BE EFFECTIVELY GROUNDED AT BOTH UNIT ENDS.
3. コネクタプラグ取付済。CONNECTOR PLUG FACTORY-WIRED.(DP-1, P201, P41)
4. *：造船所支給。SHIPYARD SUPPLY.

承認 APPROVED	Feb. 3, '89 T.NAKANO	名称 TITLE	FR-8100DS/8300DS/1531DS 相互結線図 INTERCONNECTION DIAGRAM
検図 CHECKED	Feb. 3, '89 N. SAITO		
製図 DRAWN	FEB. 3 '89 I. AMANO	図番 DWG.NO.	C3322-003-B

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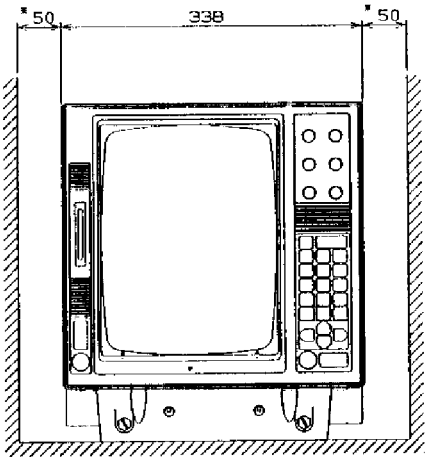
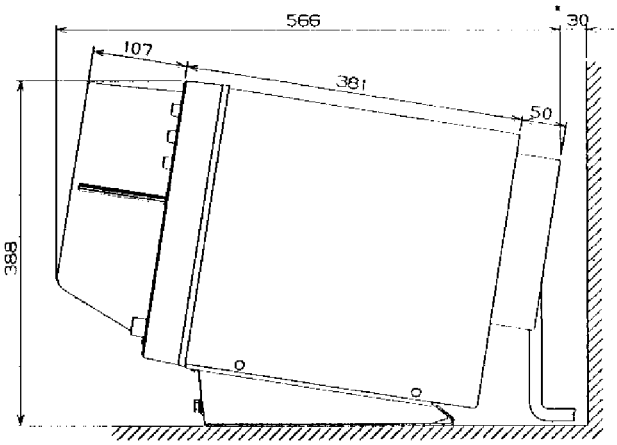
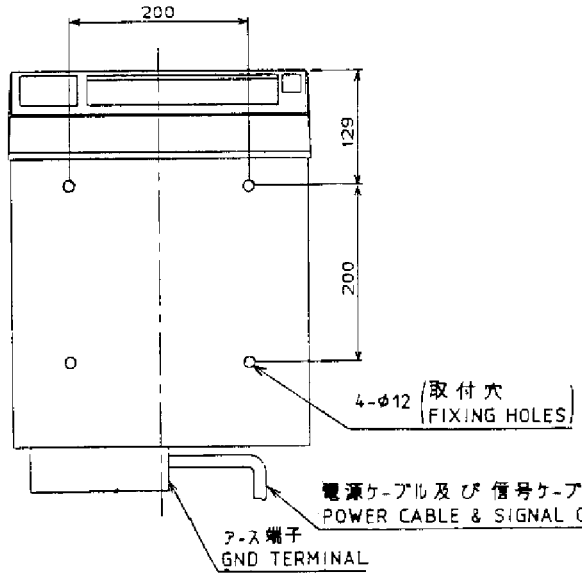
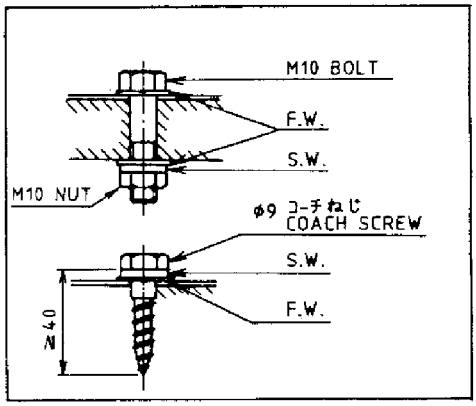
FURUNO

D-1









NOTE 1 * : 推奨サービス空間。
RECOMMENDED SERVICING CLEARANCE.

NOTE 2 : 装備ケーブルはサービス時、指示部を前方に十分引き出せるよう余裕をもたせること。
SUFFICIENT EXTRA CABLINGS SHOULD BE ALLOWED AT THE BACK OF THE UNIT SO THAT THE UNIT CAN BE DRAWN OUT WITH THE CABLES CONNECTED FOR MAINTENANCE.

コンパス安全距離
COMPASS SAFE DISTANCE

標準コンパス STANDARD COMPASS	1.0m
操舵コンパス STEERING COMPASS	0.75m

FR-8050D(A)/8100D(A)
8250D(A)

品番 ITEM	品名 NAME	材質 MATERIAL	数量 Q'TY	図番 DWG.NO.	摘要 REMARKS

承認 APPROVED	June·21·'88 M.Tokata	三角法 THIRD ANGLE PROJECTION		名称 TITLE	レーダー指示部外寸図 RADAR DISPLAY UNIT
検図 CHECKED	June·21·'88 I. AMANO	尺度 SCALE	1/8		
製図 DRAWN	14TH·June·'88 T. HATAI	重量 WEIGHT	19 kg	図番 DWG.NO.	C3314-007-A

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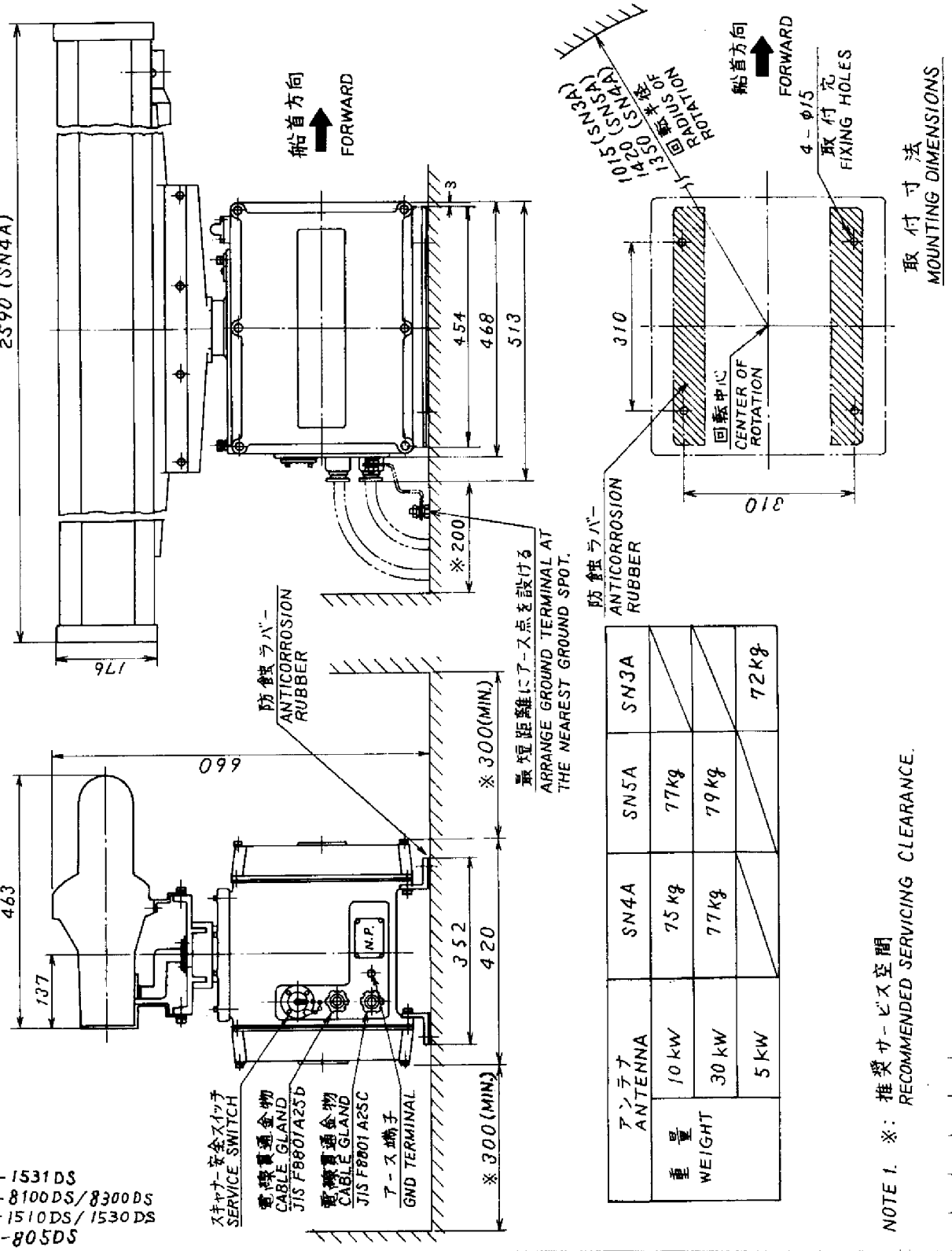
FURUNO

D-2



アンテナ ANTENNA	SN4A	SN5A	SN3A
10 kW	75 kg	77kg	
30 kW	77kg	79 kg	
5 kW			72kg
重量 WEIGHT			

NOTE 1. ※: 推奨サービス空間
RECOMMENDED SERVICING CLEARANCE.

FR-1531DS
FR-8100DS/8300DS
FR-1510DS/1530DS
FR-805DS
FR-830DS
FR-810DS (MARK-II)

品番 ITEM	品名 NAME	材質 MATERIAL	数量 Q'TY	図番 DWG.NO.	摘要 REMARKS

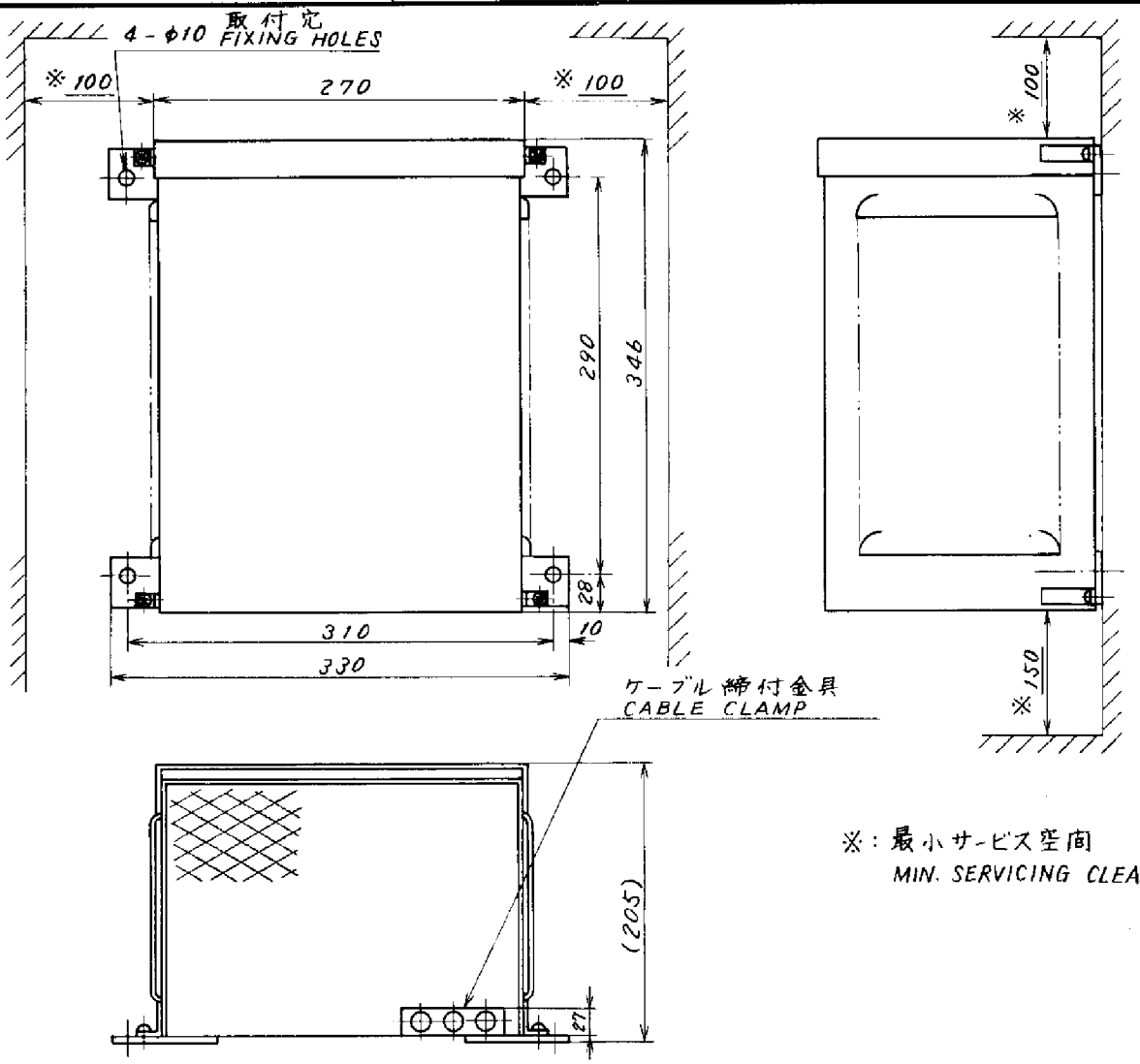
承認 APPROVED	MAR. 19. '86	三角法 THIRD ANGLE PROJECTION		名称 TITLE	レーダー空中線部外観図 RADAR SCANNER UNIT
検図 CHECKED	Mar. 19. '86	尺度 SCALE	1/10		
製図 DRAWN	MAR. 19. '86	重量 WEIGHT	kg	図番 DWG.NO.	C3291-004-H

REV.: 5/86, 12/86, 10/87

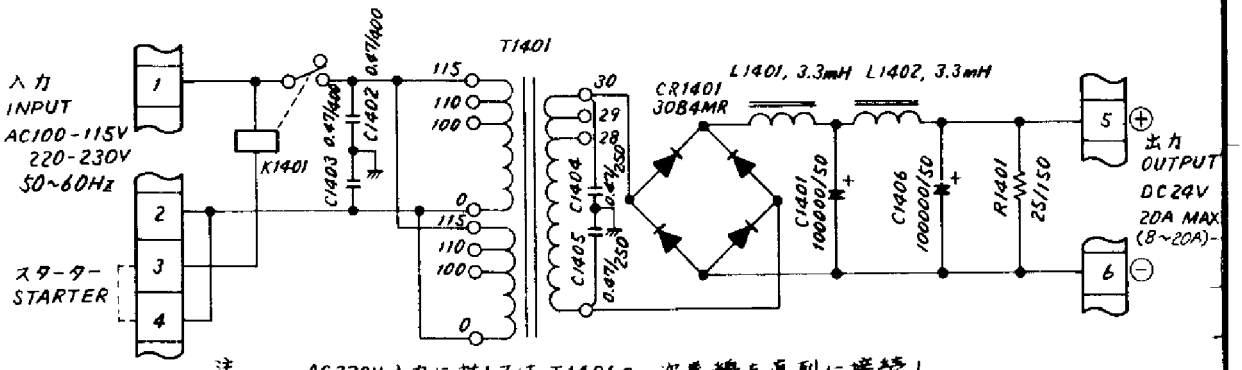
FURUNO ELECTRIC CO., LTD.

FURUNO

D - 3



※：最小サービス空間
MIN. SERVICING CLEARANCE



注 NOTE

AC220V入力に対しては T1401 の一次巻線を直列に接続し、リレー K1401 を MM2X AC100V から MM2X AC220V に変更する。

FOR 220VAC INPUT, CONNECT T1401 PRIMARY WINDINGS IN SERIES AND CHANGE RELAY K1401 FROM MM2X AC100V TO MM2X AC220V.

品番 ITEM	品名 NAME	材質 MATERIAL	数量 Q'TY	図番 DWG.NO.	摘要 REMARKS

承認 APPROVED	OCT. 11. '78	三角法 THIRD ANGLE PROJECTION		名称 TITLE	整流器 RECTIFIER UNIT
検図 CHECKED	OCT. 11. '78	尺度 SCALE	1/5	RU-3424	
製図 DRAWN	11. 10. '78	重量 WEIGHT	25 kg	図番 DWG.NO.	C3002 - 004 - E

FURUNO ELECTRIC CO., LTD.