

FURUNO

OPERATOR'S MANUAL

COLOR RADAR

MODEL FCR-1411/1411A



FURUNO ELECTRIC CO., LTD.
NISHINOMIYA, JAPAN

FURUNO

Information

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Addenda No.23 to FR-700/1000 Series Service Manual SM-E3237
Addenda No.15 to FR-1200 Series Service Manual SM-E3249
Addenda No.13 to FCR-1400 Series Service Manual SM-E3259
Addenda No.12 to CD-140 Service Manual SM-E3252

TYPE OF INVERTER BOARD CHANGED IN CD-140, FR-700/1000/1200 SERIES & FCR-1400 SERIES RADARS

In the above equipments, the type of the INVERTER board is changed from "INV-3810" to "INV-6022". The INV-6022 board can be used instead of the INV-3810 board, while the INV-3810 board can not be used instead of the INV-6022 board.

Factory Modification: Production in May, 1985
(Production of INV-3810 board is discontinued from May, 1985.)

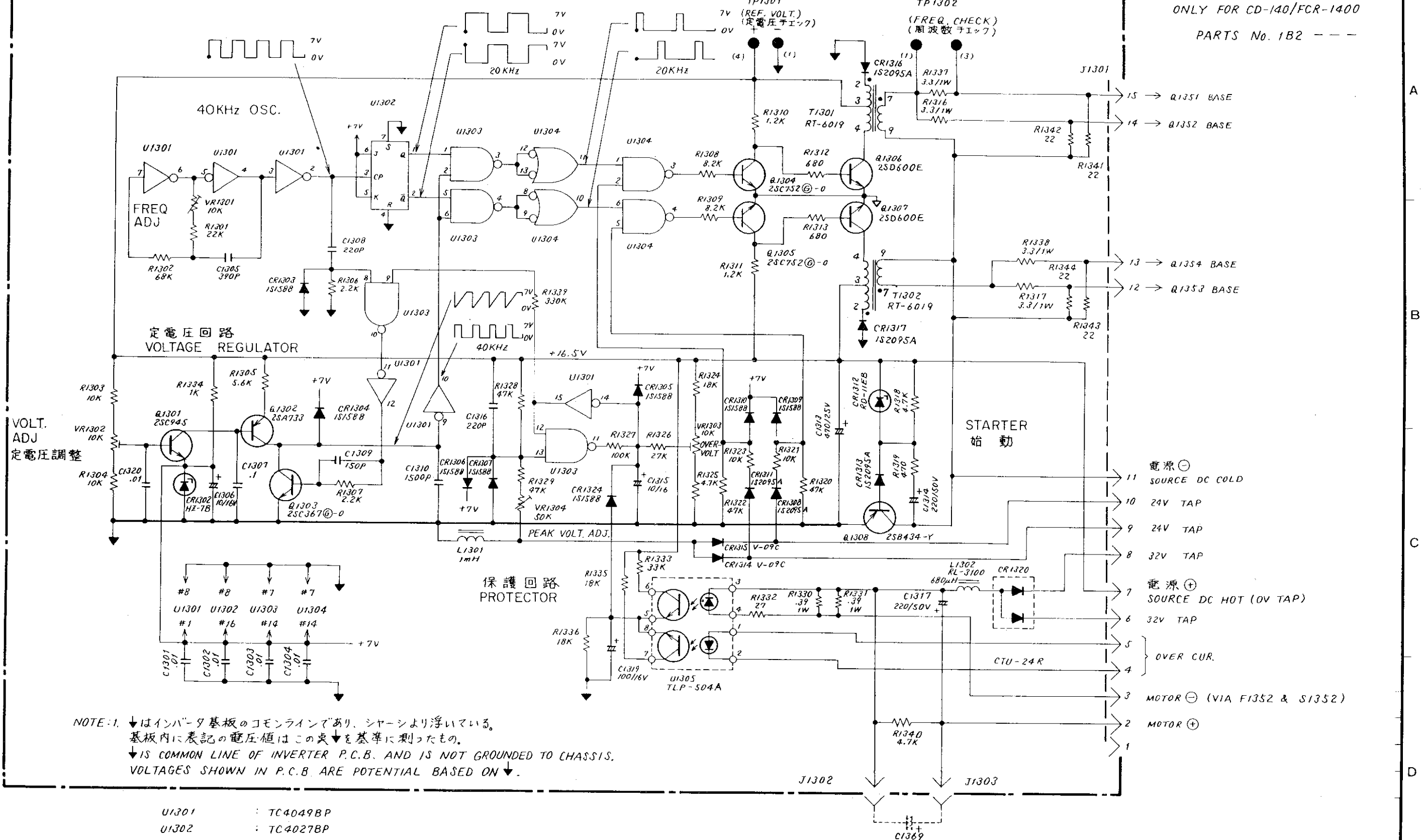
<u>Model</u>	<u>Serial Number</u>
FR-701:	863-0252 and after
701N:	875-0388 and after
701NA:	851-0041 and after
711:	865-8979 and after
711N:	876-0237 and after
721:	867-0915 and after
1011:	866-3650 and after
1011A:	824-0011 and after
1011N:	877-0369 and after
1011NA:	853-0011 and after
1012:	880-0533 and after
1021:	868-1073 and after
1022:	881-0521 and after
FR-1201:	884-0251 and after
1211:	882-0356 and after
1221:	883-0163 and after
1221A:	810-0013 and after
FCR-1401:	888-0252 and after
1411:	889-2232 and after
1421:	890-0291 and after
1401A:	818-0116 and after
1411A:	819-0226 and after
1421A:	820-0056 and after
CD-140:	887-0741 and after

Use the circuit diagram of the INV-6022 board attached in place of that of the INV-3810 board. The adjustment method on the INV-6022 board is the same as that on the INV-3810 board.

(INV-6022)

CD-140/FCR-1400 の場合のみ
ONLY FOR CD-140/FCR-1400

PARTS No. 1B2



NOTE: 1. ↓はインバータ基板のコモンラインであり、シャーシより浮いている。
基板内に表記の電圧値はこの点↓を基準に測ったもの。
↓IS COMMON LINE OF INVERTER P.C.B. AND IS NOT GROUNDED TO CHASSIS.
VOLTAGES SHOWN IN P.C.B. ARE POTENTIAL BASED ON ↓.

承認 APPROVED	検図 CHECKED	製図 DRAWN	承認 APPROVED	検図 CHECKED	製図 DRAWN	三角法 THIRD ANGLE PROJECTION	度 SCALE	重量 WEIGHT	kg	名称 TITLE	インバータ回路 INV-6022 INVERTER	図番 DWG. NO.	C3278-005-B
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SPECIFICATIONS OF FCR-1411/1411A RADAR

SCANNER UNIT

1. Radiator:	Slotted Waveguide Array			
2. Radiator Length:	123cm(4ft) (XN-2)	200cm(6.5ft) (XN-3)	200cm(6.5ft) (XN-3A)	240cm(8ft) (XN-4A)(*)
3. Horizontal Beamwidth:	1.80°	1.23°	1.23°	0.95°
4. Vertical Beamwidth:	25°	25°	20°	20°
5. Sidelobe attenuation:				
Within $\pm 10^\circ$ of main lobe;	24dB	24dB	24dB	28dB
Outside $\pm 10^\circ$ of main lobe;	30dB	30dB	30dB	32dB
(*) : 240cm radiator can be available only for 24VDC ship's mains.				
6. Polarization:	Horizontal			
7. Antenna Drive:	24VDC motor irrespective of ship's mains			
8. Antenna Rotation:	24 r.p.m. nominal (without wind load)			
9. Wind Load:	Relative wind 100 knots			
10. Ambient Temperature:	-25°C to +70°C			
11. Compass Safe Distance:	Standard: 3.80m, Steering: 2.40m			

TRANSCEIVER MODULE (Contained in the scanner housing)

1. Frequency Range:	9410MHz \pm 30MHz
2. Peak Output Power:	10kW nominal
3. Pulselength and Pulse Repetition Rate:	

FUNCTION SW	RANGE	1/4	1/2	3/4	1.5	3	6	12	24	48	72	n.m.
Ⓛ "SP"	P/L	0.08				0.6				1.0		u sec
	P.R.R.	2685				1493				792	641	Hz
Ⓛ "LP"	P/L	0.08				0.6				1.0		u sec
	P.R.R.	2685				1493				792	641	Hz

4. Modulator:	Solid state by SCR
5. Transmitting Tube:	Magnetron 9M602
6. Local Oscillator:	Gunn diode oscillator

7. Mixer: Balanced Type
8. I.F.: 40MHz (Logarithmic Characteristic) for FCR-1411
60MHz (Linear Characteristic) for FCR-1411A
9. Bandwidth: 30MHz/2.6MHz for FCR-1411
7MHz/3MHz for FCR-1411A
10. Tuning: Manual, with LED tuning indicator
11. Duplexer: Circulator and T/R limiter

DISPLAY UNIT

1. Picture Tube: 14 inch Color CRT
2. Color Assignment: Echoes: Red/Yellow/Green
*Background: (Black) (Blue) (Black) (Blue)
*Legends/Markers: (White) (White) (L-Blue) or (L-Blue)
*Plotted echoes: (Blue), (Black), (Blue) (Black)
* Color combination selectable.
3. Range: 1/4, 1/2, 3/4, 1.5, 3, 6, 12, 24, 48, 72 n.m.
4. Range Ring Interval: 1/16, 1/8, 1/4, 1/2, 1, 2, 4, 8, 12 n.m.
5. Range Discrimination: Better than 33m on 1/4 n.m. range
6. Minimum Range: Better than 30m on 1/4 n.m. range
7. Range Accuracy: Within 1.5% or 70m whichever is greater.
8. Bearing discrimination: 2.0°(XN-2), 1.4°(XN-3), 1.4°(XN-3A) 1.0°(XN-4A)
9. Bearing Accuracy: Cursor Accuracy, +1° or better.
EBL Resolution, 0.5°
10. Off-centering: 1/3 of sweep radius for forward range extension
11. Display Mode: Heading-up, North-up*, Course-up*, Plot (*Gyro signal required)
12. Plotting Mode: Plotting at selected interval; 15sec., 30sec., 1min., 3min. and 6min.
Continuous plotting; max. 99min. and 59sec.
13. Ambient Temperature: -15°C to +55°C
14. Coating Color: N3.0 Newton No.5(Front Panel), 2.5GY5/1.5(Cover)
15. Compass Safe Distance: Standard: 1.30m, Steering: 0.75m

POWER SUPPLY

12/24/32VDC (for 1230/2000mm Antenna) +25%
-15%, directly,
24VDC (for 2400mm Antenna), approx. 200W (12VDC) or 170W (24/32VDC)
100/110/115/220VAC, 50Hz to 60Hz, 1φ, approx. 230VA, with extra rectifier.

COMPLETE SET

No.	Name	Type	Q'ty	Weight	Remarks
1	Scanner Unit	123cm	1	33 kg	
		200cm		37.5 kg	
		200cm		36.5 kg	
		240cm		38.5 kg	
2	Display Unit		1	30 kg	
3	Rectifier Unit	RU-1746B-2	1	17.0 kg	
4	Accessory		1 set		
5	Installation Materials		1 set		
6	Standard Spare Parts		1 set		

OPTIONAL EQUIPMENT LIST

No.	Name	Type	Remarks
1	Gyro Interface	AD-10S	
2	FSI Rejector	RI-3 (*)	
3	Radar Alarm	RA-24	
4	Interswitch Unit	RJ-2	
5	Radar Color Display	CD-140	
6	Video Plotter Control Unit	GD-2000	

(*): RI-3 can not be combined with A type radar.

STANDARD ACCESSORIES

No.	Name	Type	Code No.	Q'ty	Remarks
1	Plastic Cover	14-011-2087-0	000-879-623	1	For display unit
2	L-Handle Socket Wrench	13mm for M8	000-830-110	1	For opening scanner unit cover

STANDARD SPARE PARTS

No.	Name	Type	Code No.	Q'ty	Remarks
1	Fuse	FGB0, 0.5A	000-549-060	2	
2	Fuse	FGB01, 10A	000-549-082	2	For 24/32V DC ship's mains
3	Fuse	FGB01, 25A	000-549-085	2	For 12V DC ship's mains
4	Fuse	FGB0, 10A	000-549-065	2	For scanner motor
5	Winker Lamp	T3.8C 8V 60mA	000-540-180	2	For panel illumination
6	Motor Brush	For D-8G-516	000-430-482	2	For scanner motor

INSTALLATION MATERIALS

No.	Name	Type	Code No.	Q'ty			Remarks
				*1	*2	*3	
1	Hex Bolt	M8x30(SUS304)	000-862-151	4	6	4	For antenna assembling
2	Hex Bolt	M8x25(SUS304)	000-862-149	4	-	4	
3	W.H.Screw(A)	M6x25(SUS304)	000-881-923	-	6	-	
4	Hex Bolt	M4x16(SUS304)	000-862-113	8	-	-	
5	W.H.Screw(B)	M4x16(SUS304)	000-882-042	-	8	8	
6	W.H.Screw(B)	M4x25(SUS304)	000-882-043	-	2	-	
7	Hex Bolt	M4x30(SUS304)	000-862-116	-	-	2	
8	Hex Nut	M8(SUS304)	000-863-110	4	6	4	
9	Spring Washer	For M8(SUS304)	000-864-262	8	6	8	
10	Spring Washer	For M4(SUS304)	000-864-256	8	-	2	
11	Flat Washer	For M8(SUS304)	000-864-130	12	12	12	
12	Washer	RSG-1002-0	360-710-020	-	6	-	
13	Flat Washer	For M4(SUS304)	000-864-126	8	-	2	
14	W/G Clamp (E type)	RSB-2006-1	360-220-061	-	1	1	
15	W/G Clamp Packing	RSB-2008-0 03-003-4003-0	360-220-080 300-340-030	-	1	-	
16	O-ring	AS568-125	000-851-840	2	2	2	
17	Adhesive	Super Three Bond 1211	000-854-118	1(50g)			
18	Hex Bolt	M12x60(SUS304)	000-862-191	4			
19	Flat Washer	For M12(SUS304)	000-864-132	4			
20	Spring Washer	For M12(SUS304)	000-863-263	4			
21	Hex Nut	For M12(SUS304)	000-863-112	4			
22	Multicore Cable	RW-3839-2 (FR-721-C)	008-299-230	15m			With connectors at one end
23	2C Shielded Cable	CVV-S-8 x2C	000-560-634	15m			For Power Supply
24	Crimp-on Lug	171512-5(φ4)	000-537-009	4			For grounding shield of cable
25	Crimp-on Lug	171510-2(φ3)	000-537-097	29			For scanner unit connection
26	Crimp-on Lug	320882	000-537-110	1			For center core of coax cable
27	Soldering Lug	8NK4 (φ4)	000-538-180	10			For Power Supply
28	4P Connector w/15mm wires	H4P-SHF-AA	008-300-570	1			For Bearing Data Input
29	Corrosion-proof Rubber (1)						For preventing the scanner unit from electrolytic corrosion.
30	Seal Washer	03-001-3001-0	300-130-010	1			
31	Ground wire	03-001-3002-0	300-130-020	4			
32	Hex Bolt	RW-4747 (30cm)	000-566-000	1			
33	Hex Bolt	M6x25(SUS304)	000-862-133	1			
34	Hex Nut	M6	000-863-109	1			
35	Flat Washer	for M6	000-864-129	3			
	Spring Washer	for M6	000-864-260	1			

Note: *1 For 123cm radiator
 *2 For 200cm radiator (XN-3)
 *3 For 200cm radiator (XN-3A)/ 240cm radiator (XN-4A)

CHAPTER 1. INSTALLATION INSTRUCTIONS

1-1. 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 12V, 24V or 32V d.c. (24V d.c. only for 2400mm antenna). For operation from 100V, 110V, 115V or 220V a.c., the rectifier unit is additionally used.

When the radar is unpacked, check that all necessary units, parts and materials are contained referring to the equipment list, the installation materials list and the spare parts list. The steel and wood works should be arranged locally.

1-2. Unit Installation

Scanner Unit

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

- 1) The interconnecting cable type RW-3839-2 between the scanner unit and the display unit is supplied 15m long. The scanner unit must be sited in consideration of this matter. (Additional interconnect cable for longer runs is available up to a maximum of 100m. Consult with Furuno dealer.)
- 2) A funnel, mast or derrick post in line of sight of the radiator may causes blind sectors on the radar picture. The shadow sector between 355 degs and 5 degs 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 position where it is subjected to temperature in excess of 70°C.
- 4) The unit must not be positioned in close proximity to a direction finder (DF) aerial; separation of more than 2m is required.

Scanner Unit Mounting

The following procedure must be followed when mounting the scanner unit.

Cautions: 1. 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 ground wire, supplied as installation materials. Refer to page 1-17.

2. Be sure to apply the special silicone sealant supplied to bolts, nuts and washers to make future removal easier.
3. Do not paint the radiator aperture.
4. Do not lift the scanner unit by the radiator.

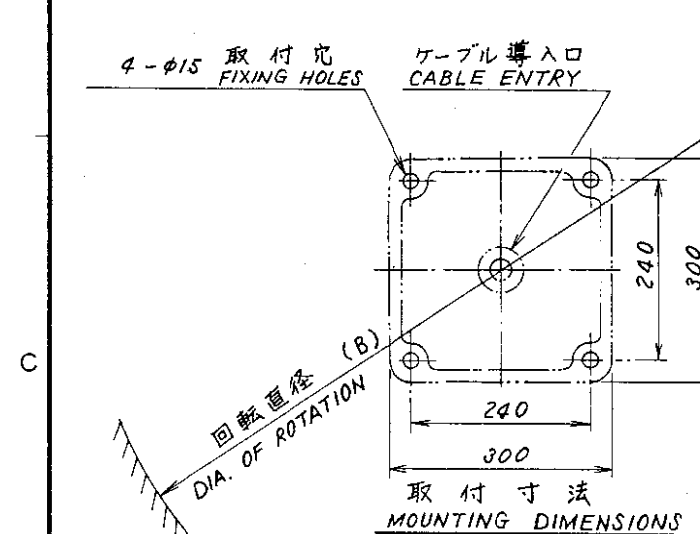
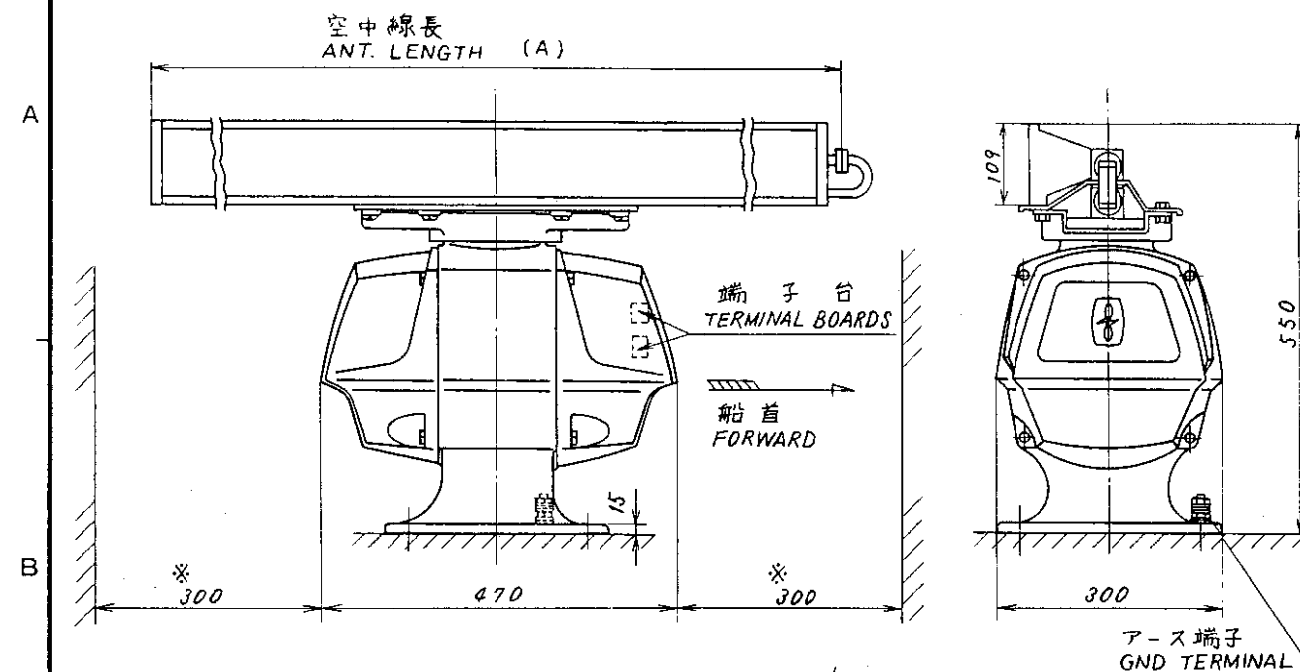
- 1) Drill four bolt holes (15mm dia.) and one cable entry hole (approx. 50mm dia.) in the radar mast platform or the deck. See the scanner outline Dwg. on pages 1-3 and 1-4.
- 2) Place the scanner housing in the chosen position so that the forward mark on the scanner base points towards ship's bow.
- 3) Apply silicone sealant to the M12x60 hex bolts, nuts and washers supplied as installation materials for corrosion protection, and then mount the scanner base with them.

Antenna Radiator Assembling (Ref. Dwg. No. C3237-025 on page 1-5 and C3249-017 on page 1-6)

Fit the feeder waveguide on the radiator before mounting the radiator on the bracket.

- 1) Place the O-ring in the groove of the radiator flange. Make sure the O-ring is fully greased. Make very sure the O-ring is not pinched during assembly!
- 2) Secure the feeder waveguide on the radiator flange with the M4x16 bolts* and washers* supplied.
- 3) For 2000mm (6.5ft) or 2400mm (8ft) radiator, fix the feeder waveguide on the bottom of the radiator with the waveguide clamp, clamp insulator, M4x25 (for 2000mm radiator), M4x30 (For 2400mm radiator), bolts* and washers*.
- 4) Place the greased O-ring in the groove of the rotary waveguide flange before mounting the radiator with the feeder waveguide on the bracket.
- 5) Secure the feeder waveguide to the rotary waveguide with four M4x16 bolts* and washers*.
- 6) Tighten the radiator on the bracket with four M8x30 bolts*, four M8x25 bolts* and washers* (for 1230mm XN-2 type, 2000mm XN-3A type, and 2400mm XN-4A type radiators) or six M8x30 bolts*, six M6x25 bolts* and washers* (for 2000mm XN-3 type radiator).

* Apply the silicone sealant supplied to them beforehand for anticorrosion. (Use only this non-acid type of silicone sealant. Acetic acid contained in other types of sealants will cause damage!)



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

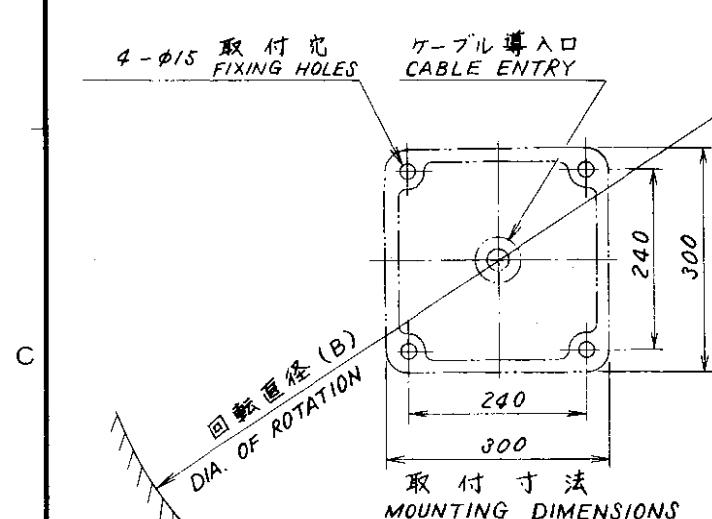
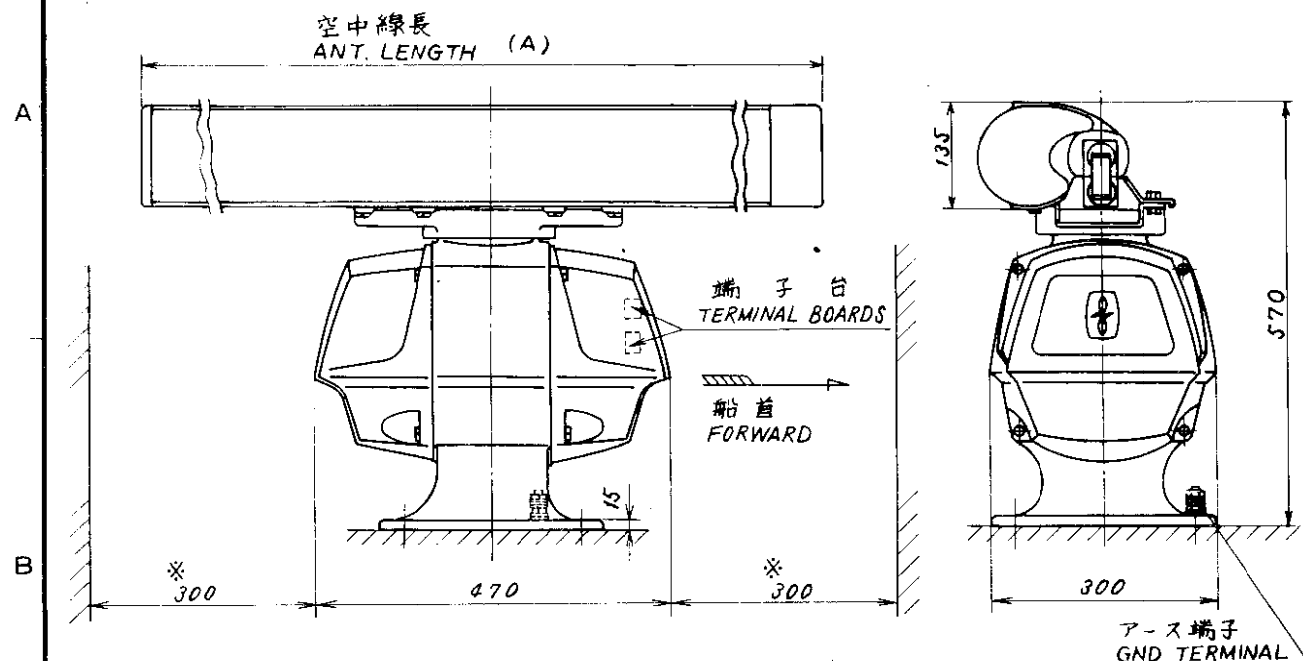
種 類 ※ ANT. TYPE	90cm 型 TYPE	123cm 型 TYPE	200cm 型 TYPE
空中線長 (A) ANT. LENGTH	910mm	1250mm	2000mm
回転直径 DIA. OF (B) ROTATION	1100mm	1400mm	2200mm
重 量 WEIGHT	32kg	33kg	37.5kg

※※ 選択可能な空中線部種類は、レーダー型式により異なる。各仕様を参照のこと。
SELECTABLE ANTENNA TYPE DEPENDS ON RADAR MODEL. SEE INDIVIDUAL SPECIFICATIONS.

承認 APPROVED	JAN. 12. '79	品番 ITEM	品名 NAME	材質 MATERIAL	数量 Q'TY	図番 DWG. NO.	摘要 REMARKS
検図 CHECKED	JAN. 17. '79	尺 度 SCALE	1/10	名 称 TITLE	レーダー空中線部外觀図 RADAR SCANNER UNIT		
製図 DRAWN	JAN. 16. '79	重 量 WEIGHT	kg	図 番 DWG. NO.	C3237-001-L		

REV. : 3/83

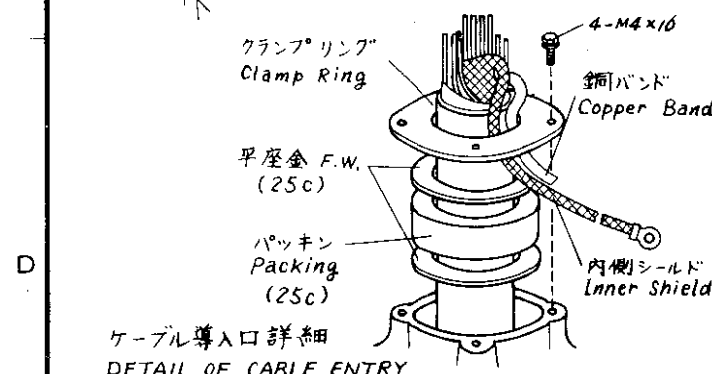
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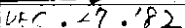
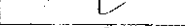


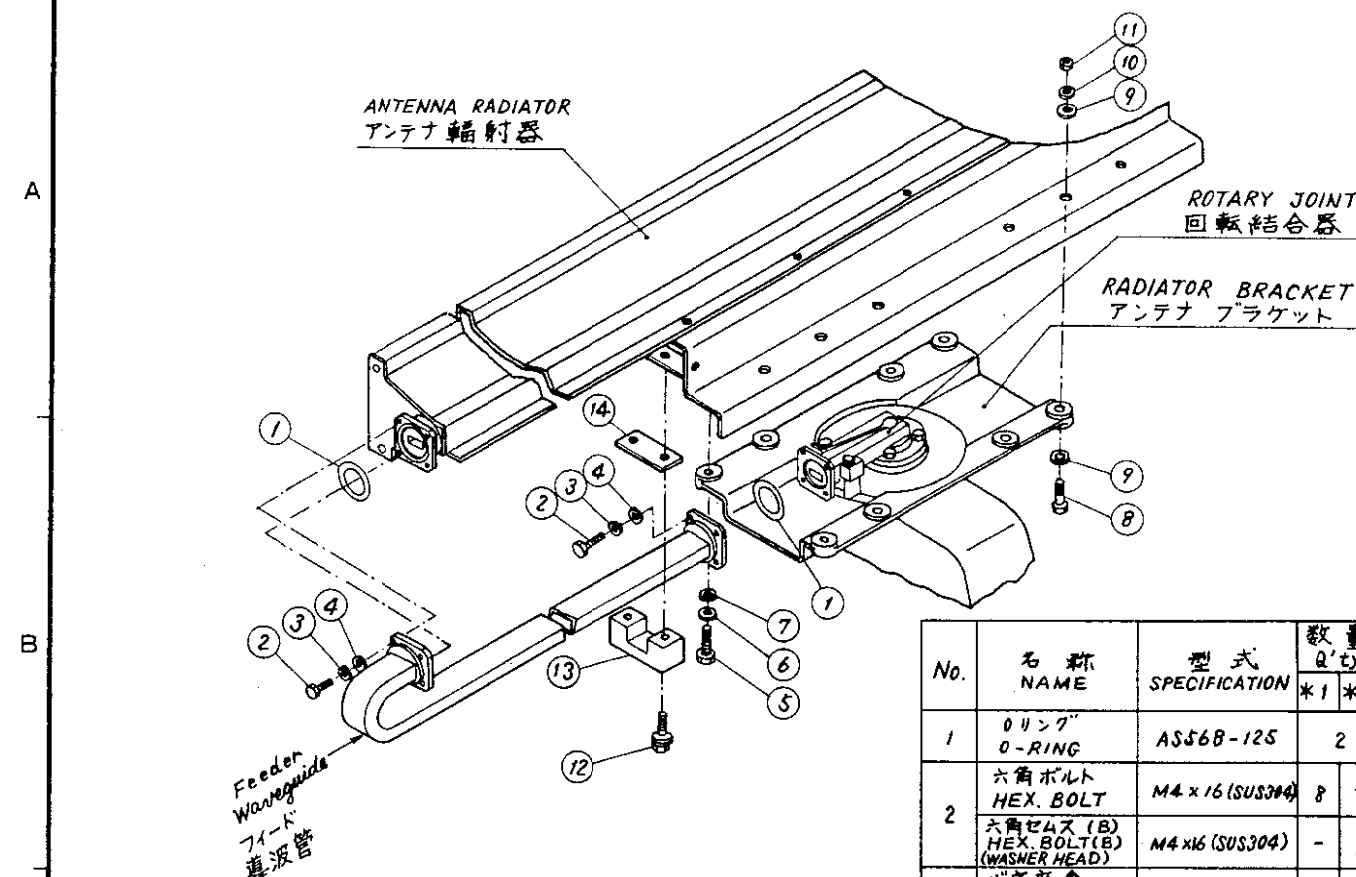
NOTE 1. ※: 推奨サービス空間
RECOMMENDED SERVICING CLEARANCE.

種類 ※	200cm型TYPE (XN-3A)	240cm型TYPE (XN-4A)
空中線長 (A) ANT. LENGTH	2070mm	2570mm
回転直径 DIA. OF ROTATION (B)	2200mm	2700mm
重量 WEIGHT	36.5kg	38.5kg

※※ 選択可能な空中線部種類は、レーダー型式により異なる。各仕様を参照のこと。
SELECTABLE ANTENNA TYPE DEPENDS ON RADAR MODEL. SEE INDIVIDUAL SPECIFICATIONS.



FCR-1400 FR-700/1000/1200 SERIES		品番 ITEM	品名 NAME	材質 MATERIAL	数量 Q'TY	図番 DWG. NO.	摘要 REMARKS
承認 APPROVED	DEC. 27. '82 	三角法 THIRD ANGLE PROJECTION		名称 TITLE	レーダー-空中線部外観図 RADAR SCANNER UNIT		
検 CHECKED	DEC. 27. '82 	尺 SCALE	1/10				
製 DRAWN	Dec. 27. '82 	重量 WEIGHT	kg	図番 DWG. NO.	C3249-011-D		



NOTE 1. 電蝕防止のため、組立時にボルト、ナット、ワッシャー及びフランジ面のOリング溝外側の部分に支給のシリコンシーラント(無酸性)を塗布する。Oリング及びOリング溝には塗布しないこと。
APPLY SILICONE SEALANT (SUPPLIED, NON-ACID TYPE) ON BOLTS, NUTS, WASHER AND WAVEGUIDE FLANGE OUTSIDE O-RING GROOVE TO AVOID ELECTRICAL CORROSION. (DO NOT APPLY SEALANT TO O-RINGS AND O-RING GROOVES.)

2. Oリングにきずをつけない。ごみを付着させないように注意の事。
DO NOT PINCH O-RING AND KEEP IT CLEAN.

3. Oリング及びスキャナカバーのパッキンにはグリスを使用すること。シリコンシーラントは使用不可。
FOR PACKINGS OF SCANNER COVERS AND O-RINGS, DO NOT USE SILICONE SEALANT, BUT RATHER USE GREASE.

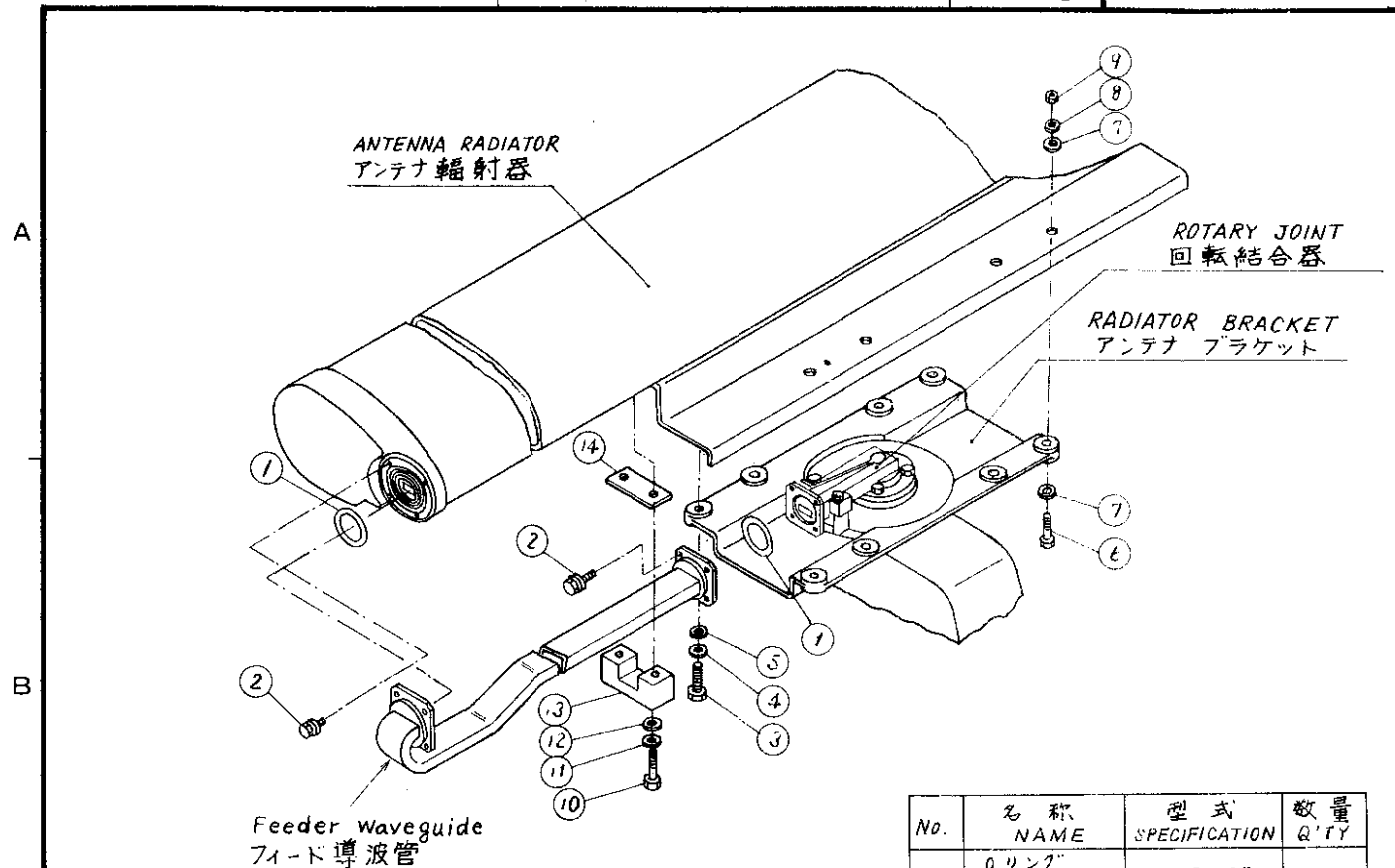
No.	名称 NAME	型式 SPECIFICATION	数量 QTY
			*1 *2
1	Oリング O-RING	AS568-125	2
2	六角ボルト HEX. BOLT	M4 x 16 (SUS304)	8
	六角ワッシャー (B) HEX. BOLT (B) (WASHER HEAD)	M4 x 16 (SUS304)	- 8
3	平座金 FLAT WASHER	FOR M4用(SUS304)	8
4	平座金 FLAT WASHER	FOR M4用(SUS304)	8
5	六角ボルト HEX. BOLT	M8 x 25 (SUS304)	4
	六角ワッシャー (A) HEX. BOLT (A) (WASHER HEAD)	M6 x 25	- 6
6	平座金 FLAT WASHER	FOR M8用(SUS304)	4
7	平座金 FLAT WASHER	FOR M8用(SUS304)	4
8	六角ボルト HEX. BOLT	M8 x 30 (SUS304)	4
9	平座金 FLAT WASHER	FOR M8用(SUS304)	8
10	平座金 FLAT WASHER	FOR M8用(SUS304)	8
11	六角ナット HEX. NUT	M8 (SUS304)	4
12	六角ワッシャー (B) HEX. BOLT (B) (WASHER HEAD)	M4 x 25	- 2
13	導波管押え WIG CLAMP	RSB-2006-1	- 1
14	導波管パッキン WIG PACKING	RSB-2008-0	- 1

*1: 900/1230mm アンテナ用
FOR 900/1230mm. RADIATOR

*2: 2000mm アンテナ (XN-3) 用
FOR 2000mm RADIATOR (XN-3)

FR-700/1000/1200 シリーズ SERIES
FCR-1400 シリーズ SERIES
FR-1223

承認 APPROVED		品番 ITEM		品名 NAME		材質 MATERIAL		数量 Q'TY		図番 DWG. NO.		摘要 REMARK	
MAY. 25. '77		三角法 THIRD ANGLE PROJECTION		名称 TITLE		空中線部組立図 SCANNER UNIT ASSEMBLING							
検図 CHECKED		MAY. 25. '77		尺 度 SCALE		空中線長 ANT. LENGTH: 900, 1230 & 2000mm (XN-3)							
製図 DRAWN		25. 5. 77		重 量 WEIGHT		kg		図番 DWG. NO.		C3237-025-G			



- NOTE 1. 電蝕防止のため、組立時にボルト、ナット、ワッシャー及びフランジ面のOリング溝外側の部分に支給のシリコンシーラント(無酸性)を塗布する。Oリング及びOリング溝には塗布しないこと。
APPLY SILICONE SEALANT (SUPPLIED, NON-ACID TYPE) ON BOLTS, NUTS, WASHER AND WAVEGUIDE FLANGE OUTSIDE O-RING GROOVE TO AVOID ELECTRICAL CORROSION. (DO NOT APPLY SEALANT TO O-RINGS AND O-RING GROOVES.)
2. Oリングにきずをつけない、ごみを付着させないように注意の事。
DO NOT PINCH O-RING AND KEEP IT CLEAN.
3. Oリング及び「スキャナカバー」のパッキンにはグリスを使用すること。シリコンシーラントは使用不可。
FOR PACKINGS OF SCANNER COVERS AND O-RINGS DO NOT USE SILICONE SEALANT, BUT RATHER USE GREASE.

No.	名称 NAME	型式 SPECIFICATION	数量 Q'TY
1	Oリング O-RING	ASS68-125	2
2	六角ボルト(B) HEX. BOLT(B) (WASHER HEAD)	M4x16 (SUS304)	8
3	六角ボルト HEX. BOLT	M8x25 (SUS304)	4
4	バネ座金 SPRING WASHER	FOR M8用(SUS304)	4
5	平座金 FLAT WASHER	FOR M8用(SUS304)	4
6	六角ボルト HEX. BOLT	M8x30 (SUS304)	4
7	平座金 FLAT WASHER	FOR M8用(SUS304)	8
8	バネ座金 SPRING WASHER	FOR M8用(SUS304)	4
9	六角ナット HEX. NUT	M8 (SUS304)	4
10	六角ボルト HEX. BOLT	M4x30 (SUS304)	2
11	バネ座金 SPRING WASHER	FOR M4用(SUS304)	2
12	平座金 FLAT WASHER	FOR M4用(SUS304)	2
13	導波管押え W/G CLAMP	RSB-2006-1	1
14	導波管間座 W/G PACKING	03-003-4003-0	1

品番 ITEM	品名 NAME	材質 MATERIAL	数量 Q'TY	図番 DWG. NO.	摘要 REMARKS
承認 APPROVED	MAY. 25. '77	三角法 THIRD ANGLE PROJECTION	名称 TITLE	空中線部組立図 SCANNER UNIT ASSEMBLING	
検図 CHECKED	MAY. 25. '77	尺度 SCALE	空中線長 ANT. LENGTH: 2000mm(XN-3A)/2400mm(XN-4A)		
製図 DRAWN	25. 5. 79	重量 WEIGHT	kg	図番 DWG. NO.	C3249-017-D

Display Unit

When siting the display unit, select a waterproof site suitable for navigational and operational convenience, where the radar screen is not in the direct path of bright sunshine or overhead lighting. The cable length to the scanner unit (15m cable supplied) must be taken into account.

Display Unit Mounting — Note: Overhead Mounting is Not Possible.

Mount the display unit as follows:

- 1) Remove the mounting base from the display main body by undoing two bolts at the front bottom of the display unit. See Fig.1-1.
- 2) Drill four bolt holes of 14mm dia. through the tabletop to correspond to the fixing holes on the mounting bracket. See Fig.1-1 and outline drawing on page 1-8.
- 3) Secure the mounting base on the table by using M12 bolts, nuts and washers.
- 4) Place the display main body on the mounting base and secure it with the two bolts on the front bottom.

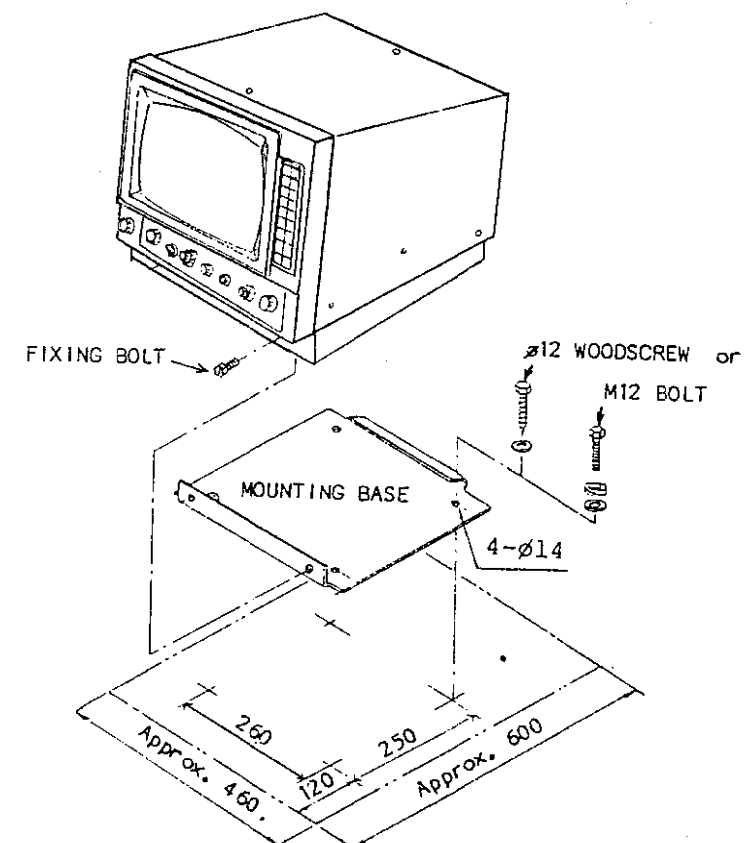
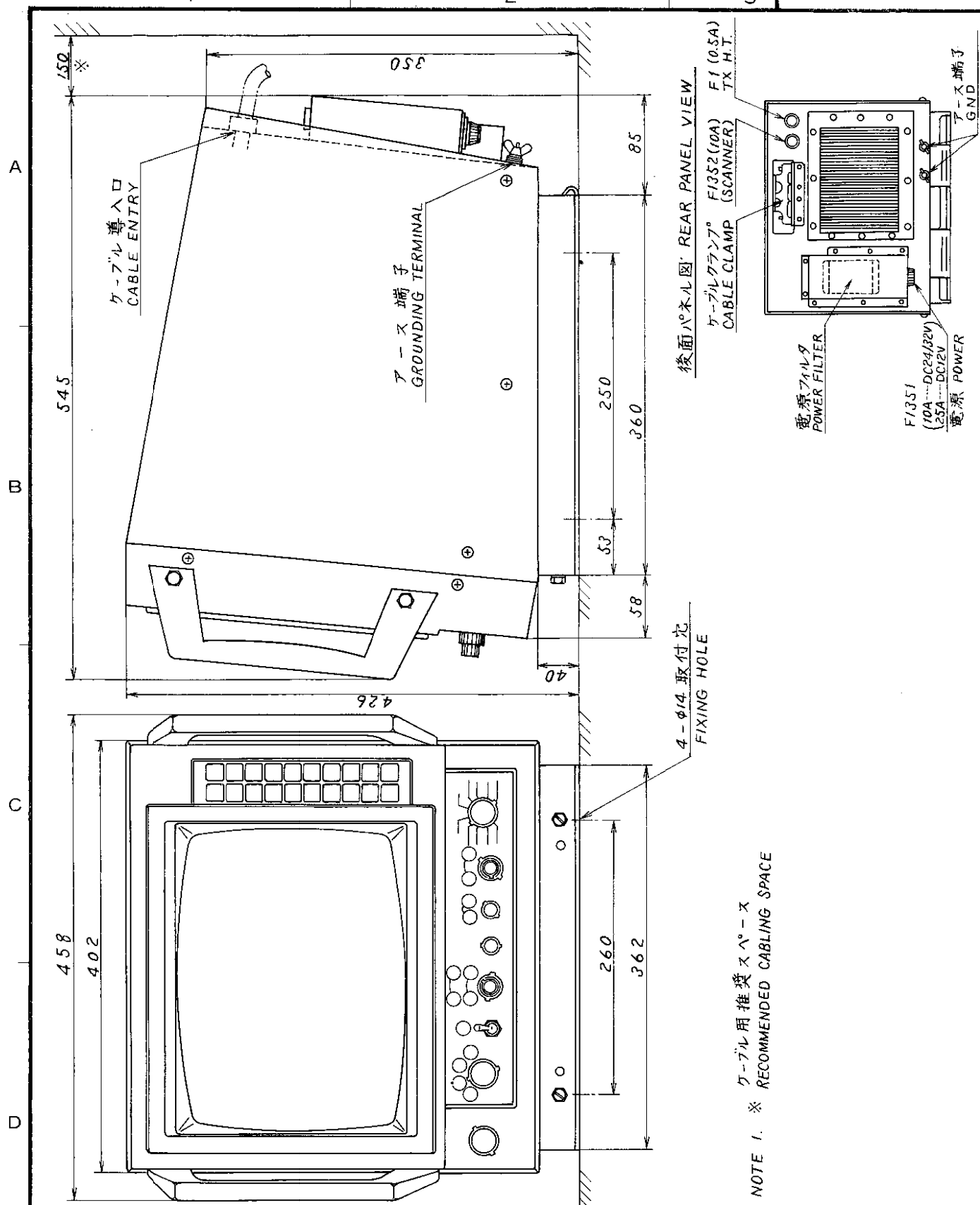


Fig. 1-1 Display Unit Mounting

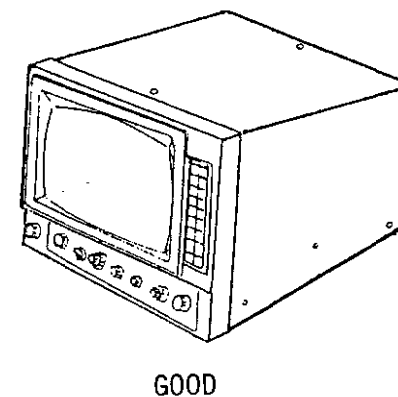


FCR-1400 MARK II SERIES FCR-1401/1411/1421		品番 ITEM	品名 NAME	材質 MATERIAL	数量 QTY	図番 DWG. NO.	摘要 REMARKS
承認 APPROVED	AUG. 26. '83		三角法 THIRD ANGLE PROJECTION	名称 TITLE			
検図 CHECKED	AUG. 26. '83		尺度 SCALE	カラーレーダー指示部寸法図 COLOR RADAR DISPLAY UNIT			
製図 DRAWN	AUG. 26. '83		重量 WEIGHT	30 kg		図番 DWG. NO.	C3259-001-B

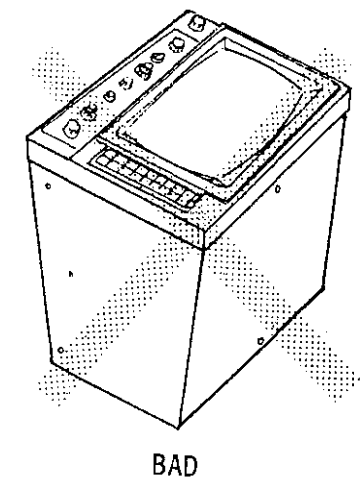
Proper Installation of Display Unit

The display unit must not be bulkhead mounted. It must be mounted such that the CRT face is vertical, not horizontal. A tilt angle of 30° is the absolute maximum that is allowed. The reason for this is that small bits of phosphor will fall off the face of the CRT during normal operation. If the CRT face is mounted horizontally, these small bits may fall down into the guns and cause arcing. The arcing will destroy the CRT and may damage the display chassis also.

CRT face is vertical.



CRT face is horizontal.


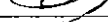



Rectifier Unit

For the set driven by 100/110/115/220V AC 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 rectifier outline drawing on page 1-10.

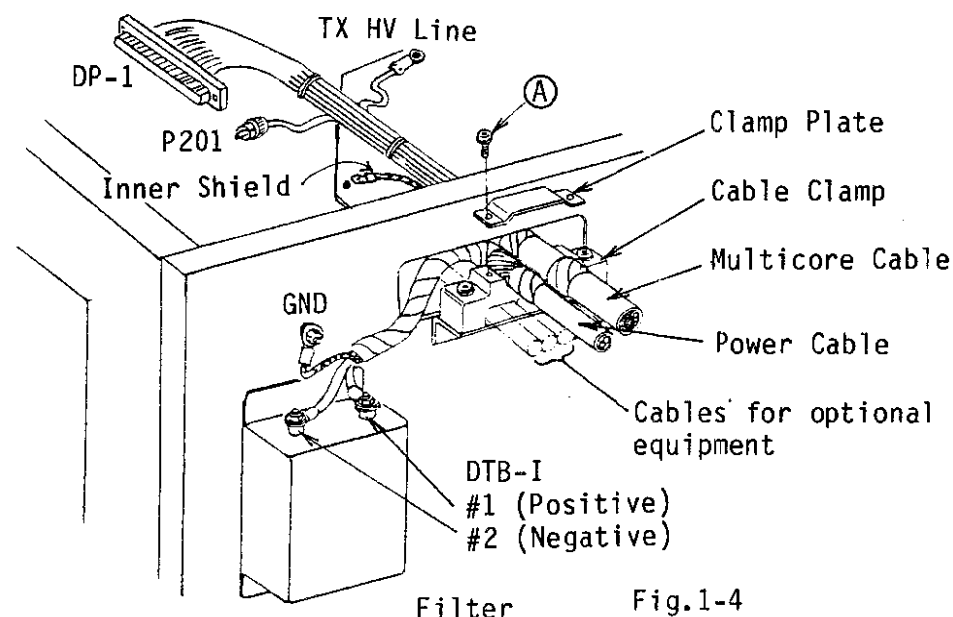


スタンダード STANDARD	2.1M
ステアリング STEERING	1.5M

		品番 ITEM	品名 NAME	材質 MATERIAL	數量 Q'TY	圖番 DWG.NO.	摘要 REMARKS
承認 APPROVED	OCT. 17. '78 	三角法 THIRD ANGLE PROJECTION		名稱 TITLE RU-1746B-2 整流器 RECTIFIER UNIT			
檢閱 CHECKED	OCT. 17. '78 	尺度 SCALE	1/5				
製圖 DRAWN	OCT. 17. '78 	重量 WEIGHT	17 kg	圖番 DWG.NO.	C3002-002-J		

- 4) Separate the clamp plate from the cable clamp by loosening two panhead screws (A). Then secure the multicore cable and power cable to the cable clamp with the clamping plate so that the cable shield is completely grounded thru the cable clamp. See Fig.1-4.
(Note: Interference to other nearby equipment may result unless grounding is adequate.)

- 5) When optional units are installed, remove the cable clamp by loosening two hex. bolts and then secure the cables with the cable clamp to the display chassis.



- 6) Dress the end of the multicore cable through the cutout in the rear panel, and connect 28P plug (DP-1), coax plug (P201) and the flying lead HV wire with crimp-on lug to 28P jack (DJ-1), coax jack (J201) on the interface board, and terminal #5 of DTB-II. See Fig.1-5.

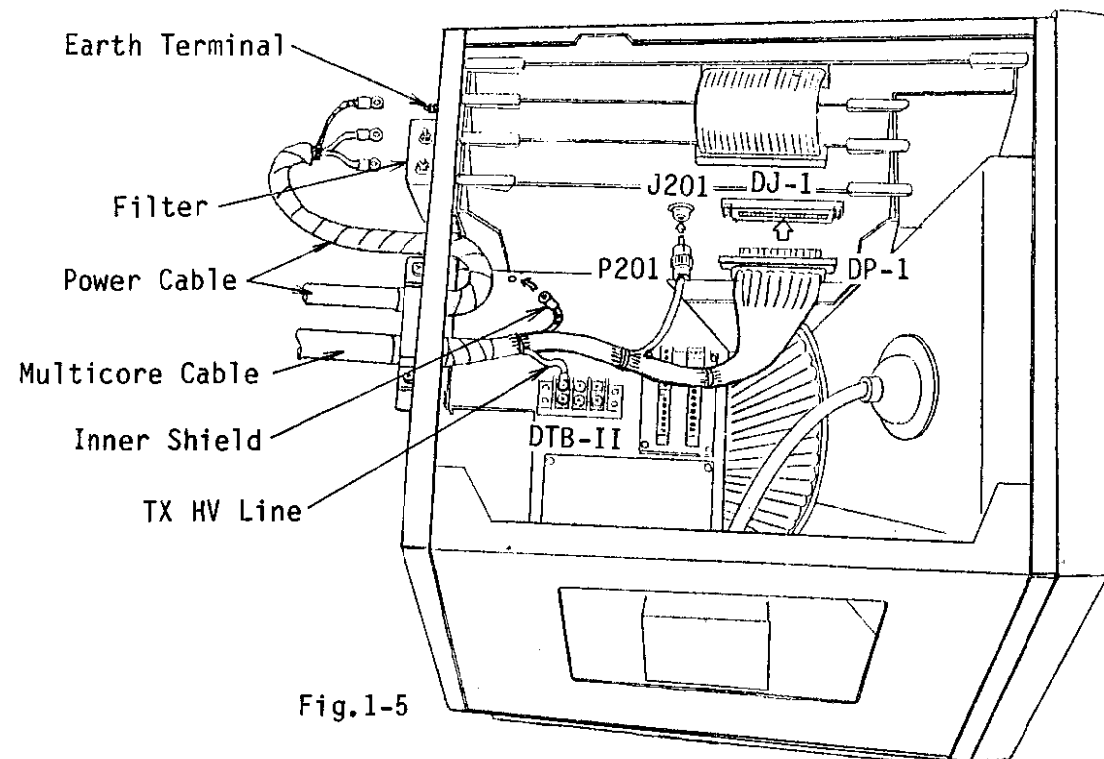


Fig.1-5

- 7) Ground the inner shield of the multicore cable to the display chassis as shown in Fig.1-5.
- 8) Connect the power cable to the terminals DTB-I on the line filter; positive core to #1 and negative core to #2. Connect the shield of the power cable to the earth terminal above the filter. See Fig.1-4 and Fig.1-5.

Connection to Scanner Unit

Only the multicore cable goes to the scanner unit. The procedure for connecting the multicore cable to the scanner unit is as follows.

- 1) Pass the open end of the cable through a pipe or waterproof cable gland fitted through the wheelhouse top or bulkhead toward the scanner unit.
- 2) Open the scanner housing covers by removing the four bolts. Remove the RF transceiver module by unscrewing the two bolts shown in Fig.1-6 and disconnecting two plugs, P801 and P601.

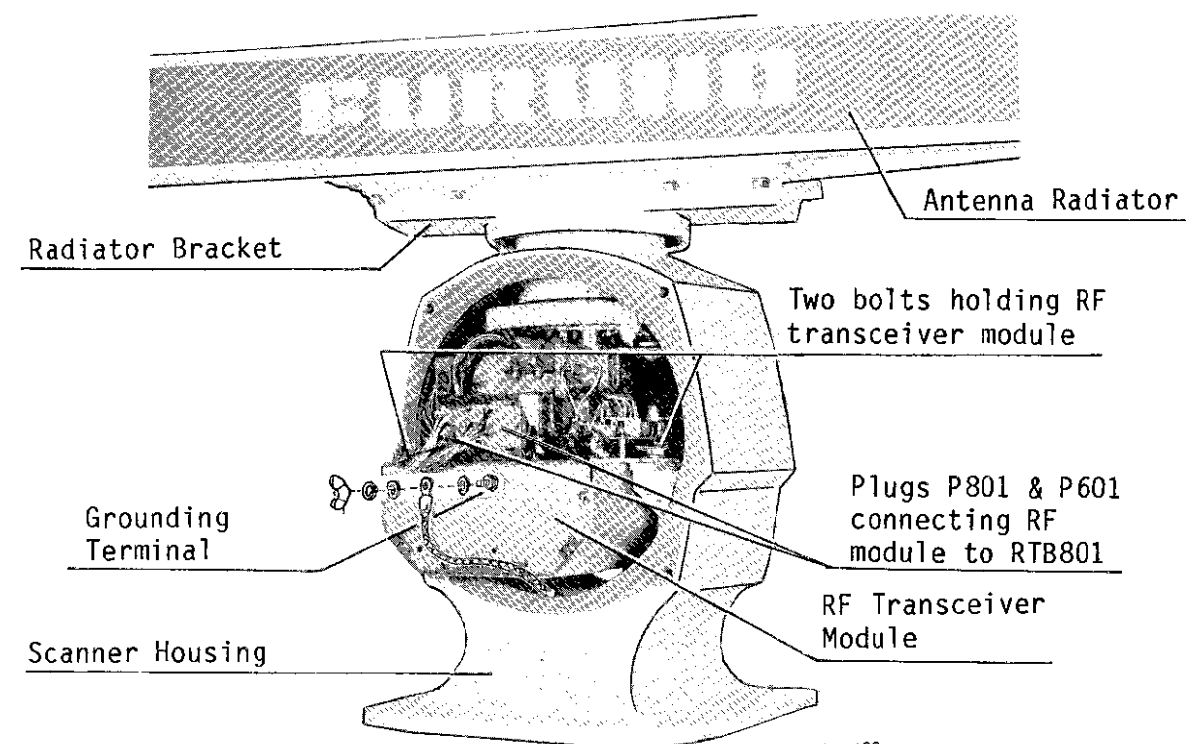


Fig.1-6

N Photo No. 638

- 3) Remove the cable gland located on the bottom in the scanner housing as shown in Fig.1-7.
- 4) Pass the multicore cable through the scanner base and the cable gland just removed. Refer to Fig.1-7.

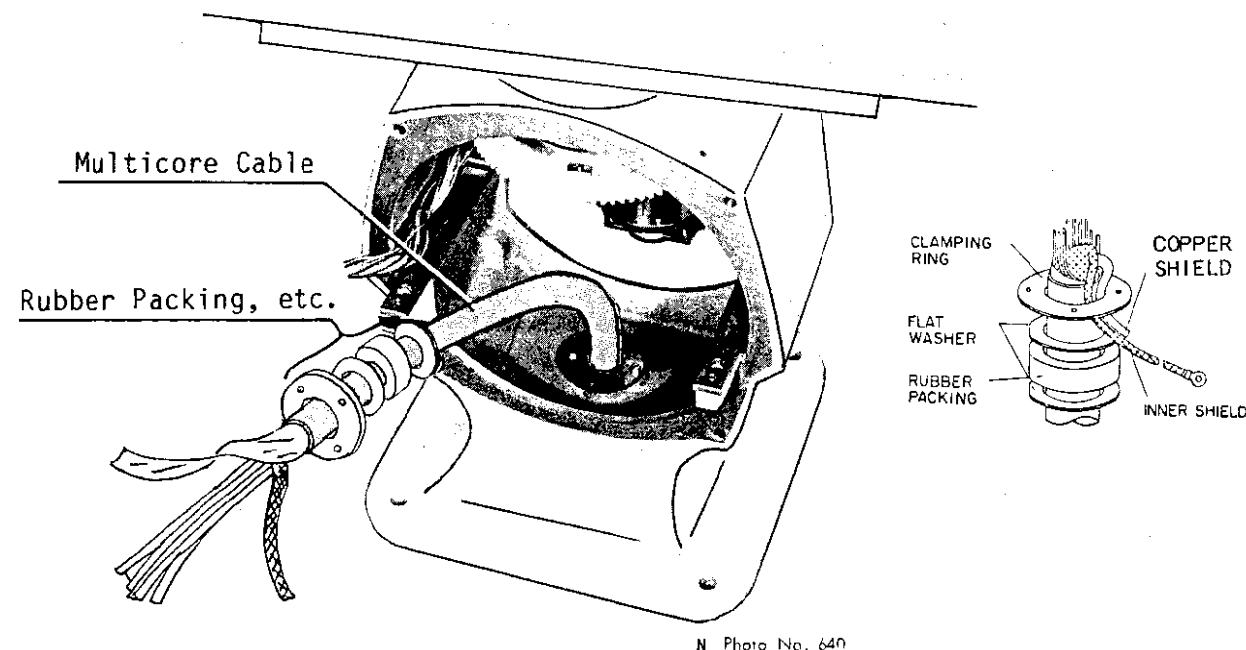


Fig.1-7

- 5) Cut the cable to appropriate length, and fabricate the cable end referring to "Fabrication of Multicore Cable (Scanner Side)" on page 1-15.

Note: After putting crimp-on lugs on the lead wires, confirm that the electrical connection is good and tight electrically and mechanically. Take special care with the coaxial cable center conductor since this is fragile.

- 6) Tighten the cable gland to the scanner base. Ground the copper shield of the multicore cable with the clamping ring as shown in Fig.1-7.
- 7) Connect the lead wires with crimp-on lugs to terminal board RTB801 shown in Fig.1-9, referring to the interconnection diagram on page 1-19.

Note: The inner shield of the multicore cable should be connected to the grounding terminal on the RF transceiver module. See Fig.1-6.

- 8) Dress the lead wires so that they will not be caught by the scanner cover when closing it.
- 9) Replace the RF module and secure it with two bolts; then connect two plugs P801 and P601.
- 10) Close the scanner housing covers, making sure that the scanner cover packing ring is set correctly in position (as shown in Fig.1-10) and that its surface is properly greased and is free of dirt.

FABRICATION OF MULTICORE CABLE (SCANNER SIDE)

1. Remove vinyl sheath for a length of 450mm, taking care not to cut the copper shield.
2. Slide washer, rubber packing, washer and clamping ring of the cable gland over the cable as shown in Fig.1-7.
3. Straighten the copper shield and separate outer layer wires from those in the braided shield (inner wires).
4. Take out the wires and coax. wire (2C-2V) from inside layer.
5. Mark the wires properly for identification.
6. Cut each leadwire to the proper length taking into consideration the distance to their respective terminals on RTB801.
7. Remove about 6mm of the vinyl insulation from the end of each wire, and fix a crimp-on lug on each wire using a crimping tool. Make sure each connection is secure both mechanically and electrically.
8. Spread out the inner shield of multicore cable and cut it off leaving about 500mm. Put vinyl tube or taping over the braided shield and solder a 4mm lug at the end of the shield.
9. Pull each crimp-on lug holding the wire with other hand to assure the connection is tight.

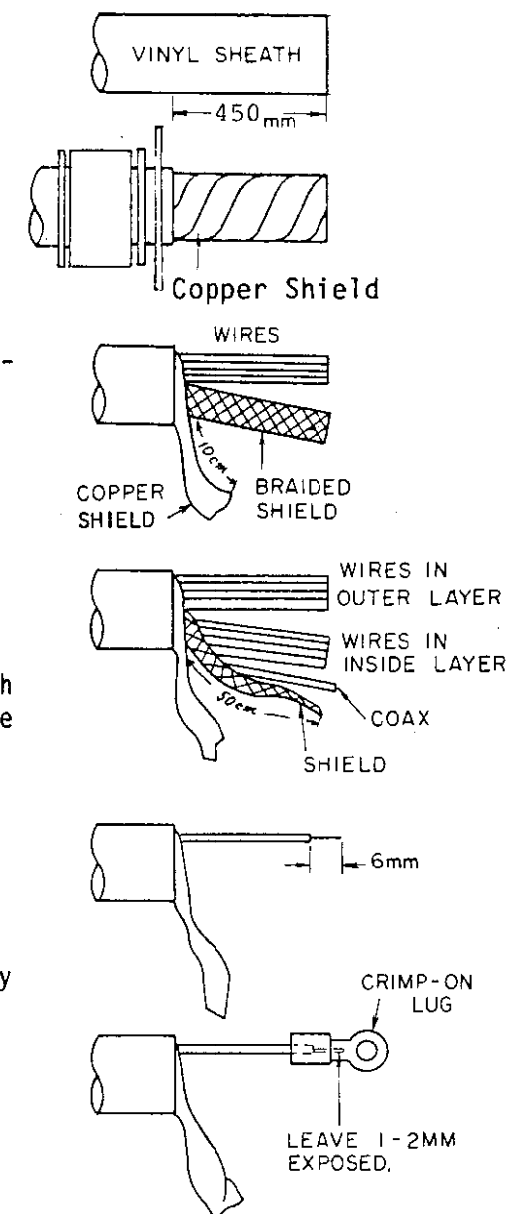


Fig.1-8(a)

10. Peel vinyl sheath of the coax cable (2C-2V) for about 50mm and take out the inner core, then put crimp-on lug (ø3) on the inner core and crimp-on lug (ø4) on the shield. Put cloth tape over the shield and core. The wire in the inner conductor is fragile: BE CAREFUL not to nick it when stripping off the insulation.

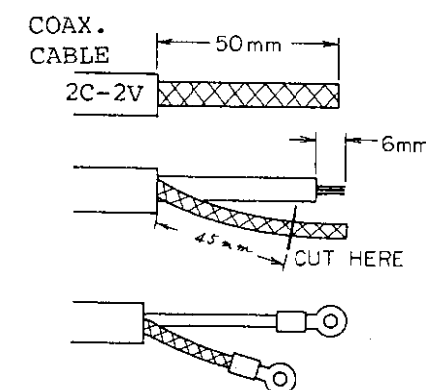


Fig.1-8(b)

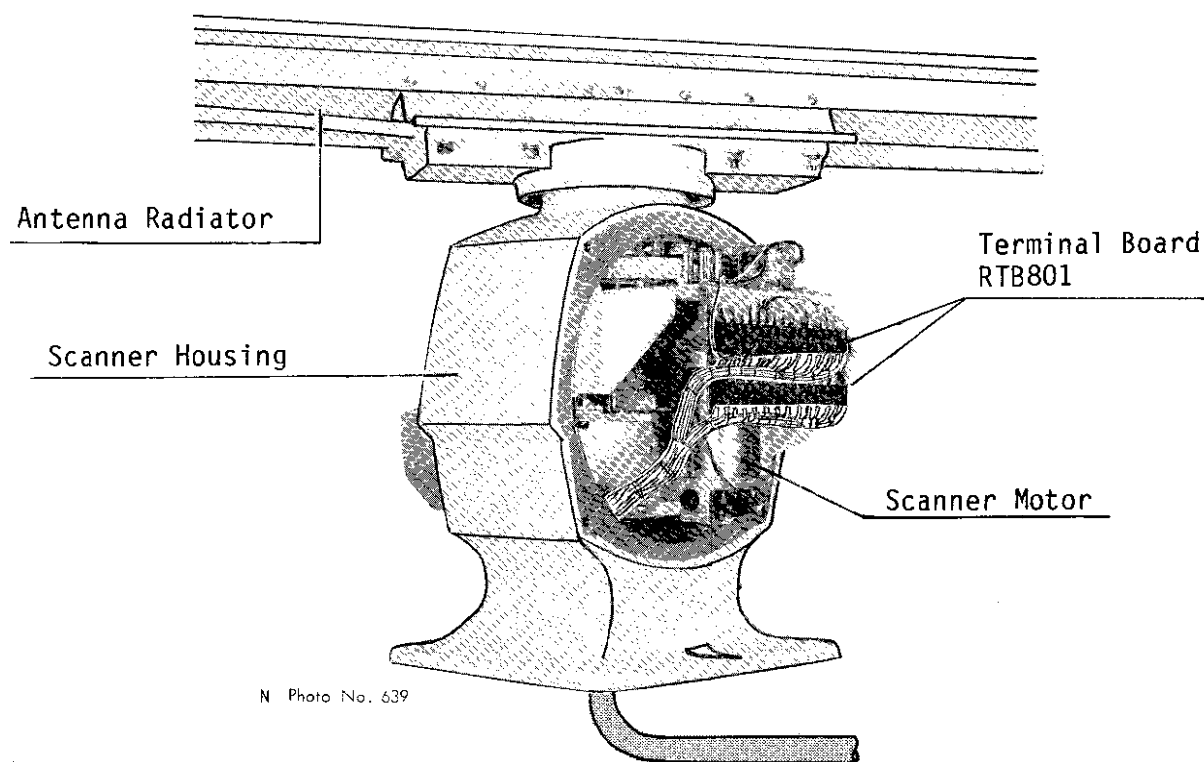


Fig.1-9

Remarks for handling Scanner Unit Packings (O-rings)

The packings for the scanner unit covers have a rectangular cross section. Care should be taken in the orientation when fitting the packing into the groove. (A) in the following figure shows correct fitting while (B) is wrong, and sufficient watertightness will not be obtained.

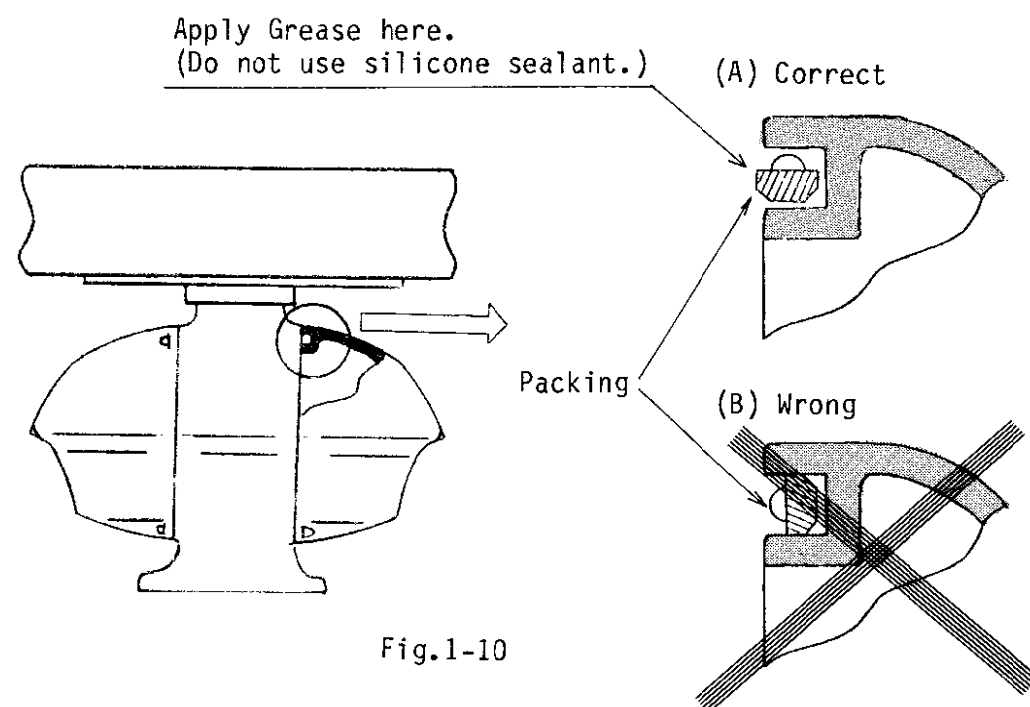


Fig.1-10

Remarks on Installation of Scanner Unit

To prevent electrolytic corrosion at the scanner base, use the seal washers and the corrosion-proof rubber mat, and run a ground wire between the ground terminal fitted on the scanner base and the nearest ground spot as illustrated below (These parts are supplied as installation materials.).

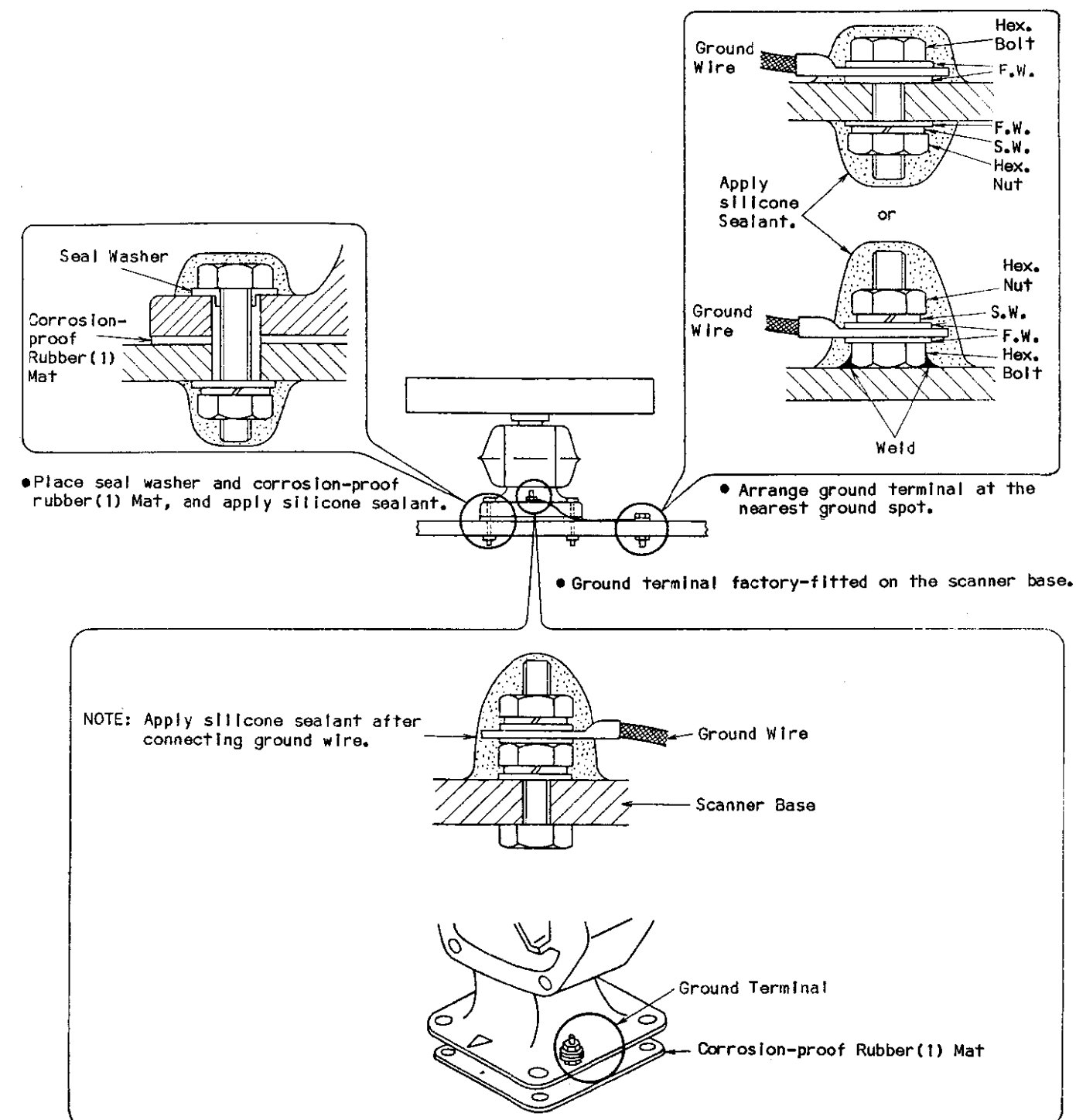
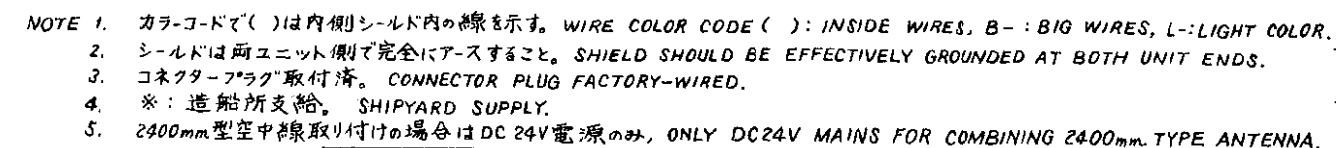


Fig. 1-12



FCR-1401/1411/1421		品番 ITEM	品名 NAME	材質 MATERIAL	數量 Q'TY	圖番 DWG.NO.	摘要 REMARKS
承認 APPROVED	SEP. 1 '82 <i>[Signature]</i>	三角法 THIRD ANGLE PROJECTION		名稱 TITLE			
檢 CHECKED	AUG. 30 '82 <i>[Signature]</i>	尺 SCALE	度 /	相互結線圖 INTERCONNECTION DIAGRAM			
製 DRAWN	AUG. 30 '82 <i>[Signature]</i>	重 WEIGHT	量 kg	圖番 DWG.NO. C3259-002-G			

1-4. Preoperation Checks and Adjustment

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

- 1) Set controls and switches on the display front panel as shown below.

Switches and Controls	Settings
FUNCTION & SCANNER switch	"OFF"
RANGE switch	48 n.m.
BRILLIANCE, GAIN, STC controls	Fully CCW
TUNING control	Mid-travel
Others	Any positions

Refer to chapter 2. OPERATION INSTRUCTIONS for location of controls and switches.

- 2) Confirm that the radar input is within -10% to +25% of the specified voltage.

Specified Voltage	Allowance
12V DC	10.8V DC to 15.0V DC
24V DC	21.6V DC to 30.0V DC
32V DC	28.8V DC to 40.0V DC

- 3) Turn the FUNCTION switch to "STAND-BY" position and check the input voltage again at the terminals #1 (+) and #2 (-) of DTB-I on the filter FL1. (If the power is supplied through a rectifier, change of tap connection on transformer may be required. See page 1-10.)
- 4) Turn the SCANNER switch upward (ON) and check that the antenna is rotating at a speed between 20 rpm to 25 rpm.
- 5) Turn the BRILLIANCE control clockwise. Confirm that marks and legends appear on the screen. 3 minute timer starts counting down from 3:00 to 0:01 on the screen. At 0:00 the timer indication is changed to "ST-BY" to indicate the radar is ready to transmit.

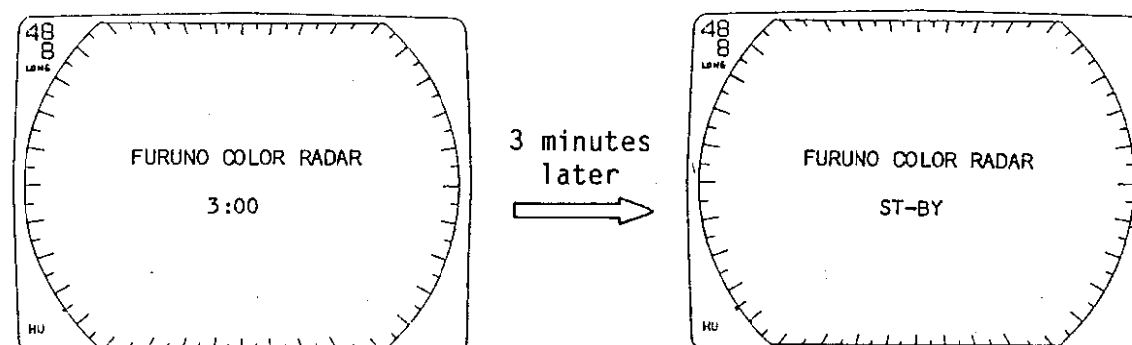


Fig.1-13

- 6) Turn the FUNCTION switch to the "TRANSMIT" position.
- 8) Gradually turn the GAIN control clockwise, and confirm that noise and/or echoes appear on the CRT.
- 9) Adjust the TUNING control for the best tuning condition so that the max. number of tuning marks may appear on the right-top on the screen.

When the best tuned condition is not obtained with the control placed around the mid-point of its travel, adjust the gunn oscillator, referring to page 1-25.

- 10) Check the function of other controls and switches such as STC, FTC, touchpad keys, etc., by operating them one by one.

Adjustment of Transmission Timing

Transmission timing will change depending on the length of the multi-core cable between the display and the scanner units. It has been adjusted for a nominal cable length of 10m at the factory. (Supplied cable length is 15m.)

Readjustment of transmission timing is required if the cable length is altered at installation or the following symptoms are observed on the radar screen.

- * Straight wharf or breakwater appears bent inward or outward at the screen center on 1/4 n.m. range as shown in Fig.1-14(b) and (c).
- * Range error is found on short range.
- * Dark area appears at the screen center.

The adjustment is made with 1B5VR101 (Fig.1-15) on the interface p.c.b. (13P4754) in order to remedy the above symptoms while observing the radar screen.

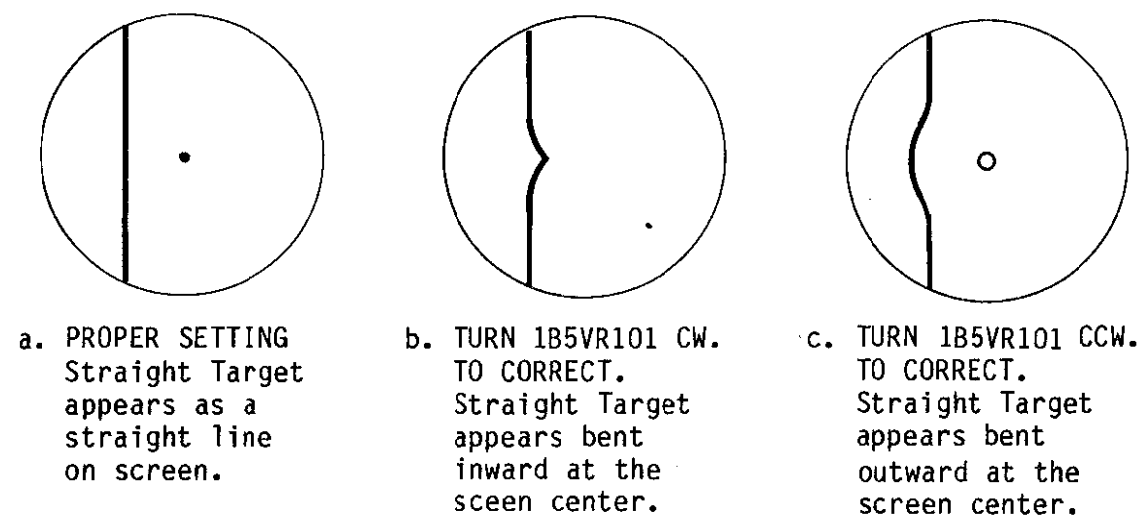


Fig.1-14

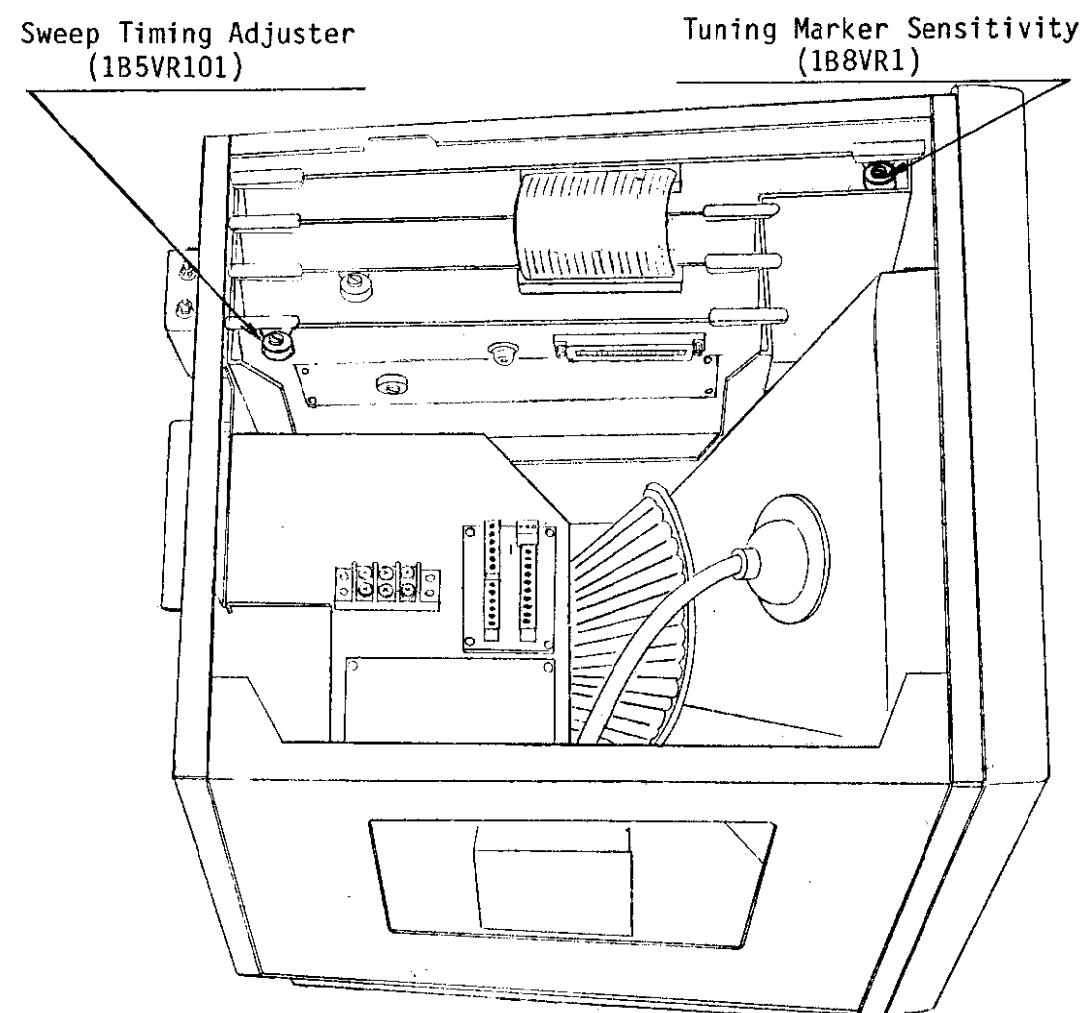


Fig.1-15

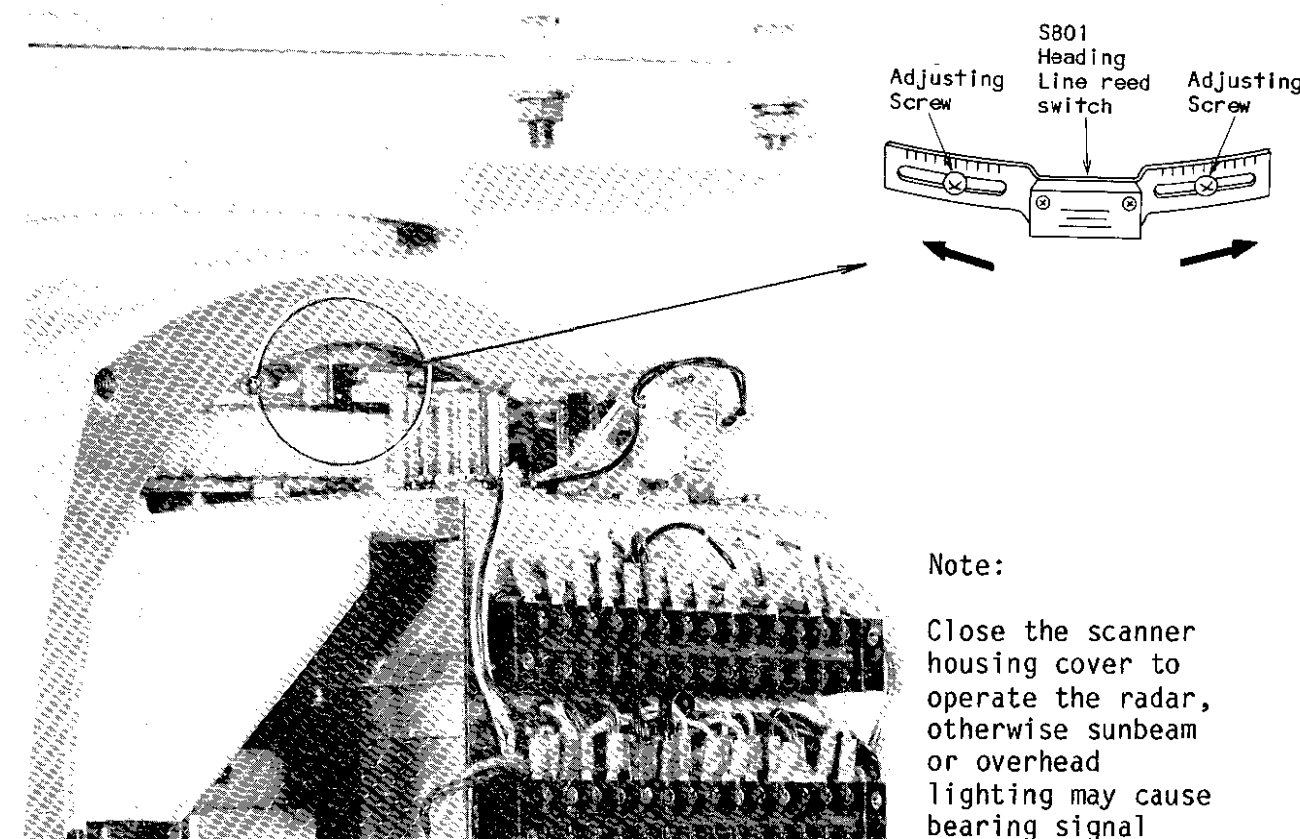
Heading Alignment

The heading flash should appear on the screen at the instant the radar beam passes the ship's bow. This adjustment should be made by observing the picture on the screen rather than being done mechanically because the direction of the emitted radar beam is not perpendicular to the radiator aperture but deviates by a certain amount --- the squint angle. At the operating frequency of this radar system, the squint angle is about 2.5 degrees advanced in the turning direction of radiator.

To do this job efficiently, two persons are usually needed, one at the display and the other at the scanner. Use of handheld transceivers makes adjustment easier by establishing communication between them.

The procedure for heading alignment is shown below.

- 1) Open the forward cover of the scanner unit after switching off the radar.
- 2) Turn the radiator aperture toward the ship's heading by hand, taking into consideration the squint angle (approx. 2.5 degrees).
- 3) Connect an ohmmeter between #20 and #21 of RTB801.

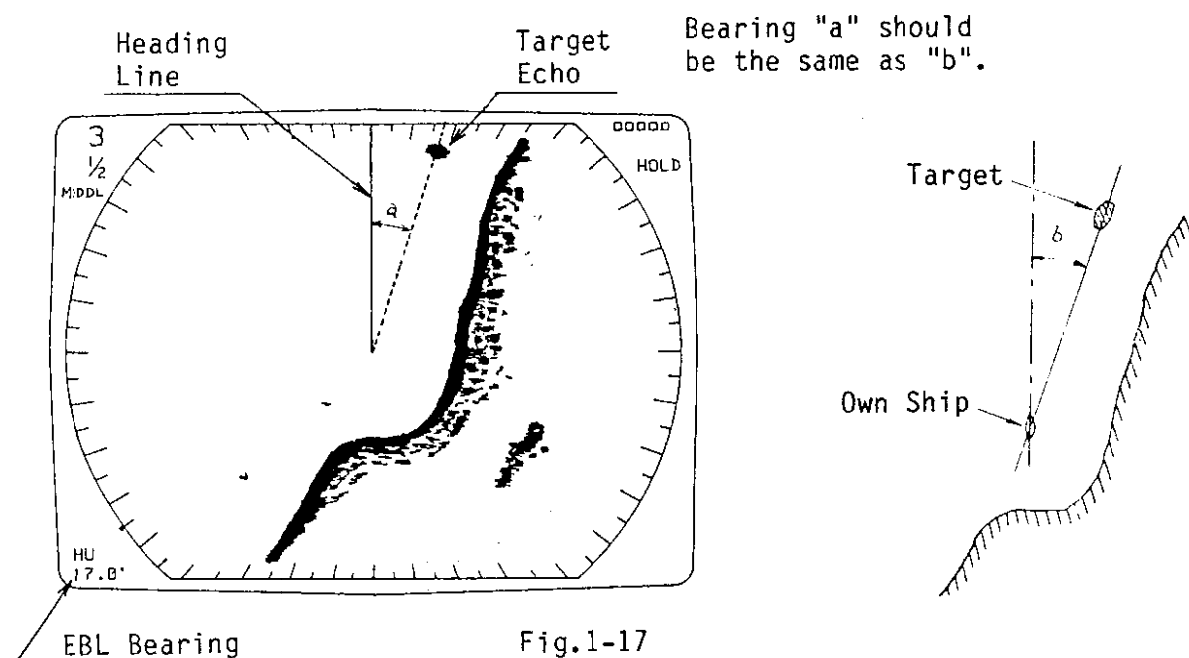


Note:

Close the scanner housing cover to operate the radar, otherwise sunbeam or overhead lighting may cause bearing signal generator to malfunction.

Fig.1-16

- 4) Loosen two screws fixing the heading flash reed switch S801, and move it fully leftward. Then, slowly move it rightward until the ohmmeter swings to indicate 330 ohms (point where the heading flash switch is closed). Secure the heading flash key by two screws.
- 5) Close the scanner housing cover temporarily. Then, stand clear of the scanner unit.
- 6) Operate the radar for normal picture on the screen.
- 7) Set the **RANGE** switch at 1 1/2 or 3 mile range and select a proper target echo (small island, end of quay, etc.) located on or around heading flash and near the edge of the CRT screen. Measure the bearing of the target by turning **EBL** control.
- 8) Alternatively, read out the ship's bearing on the ship's compass, and find the relative bearing of the target from the ship's heading on the navigational chart. This can also be done by visually measuring the direction of the target from the ship's bow. See Fig.1-17.
- 9) The bearing of the target echo on the screen should be the same as that on the navigational chart or visually measured. If there is a difference between them, turn off the **SCANNER** switch and adjust the position of the heading flash key S801 to compensate for the error.
- 10) Repeat the above procedure until the bearing of the target on the screen coincides with one confirmed visually or on the chart. After the adjustment has been completed, don't forget to tighten the heading flash reed switch.
- 11) No further adjustment is required at the scanner unit at installation. Close the scanner housing covers and tighten down the bolts, making sure that the O-ring is still in place and that no wires are pinched.



Gunn Oscillator Tuning

The radar should be optimally tuned with the front panel **TUNING** control at mid-travel. If not, adjust the frequency of the gunn oscillator by turning its tuning screw (Fig.1-18) as below.

- 1) Stop antenna rotation by turning the **SCANNER** switch downward with **BRILLIANCE** control set at minimum.
 - 2) Set the **TUNING** control on the display front panel at the mid-travel. Set the **RANGE** switch to 48 n.m. range.
 - 3) Set the **FUNCTION** switch to "TRANSMIT" and wait for about 10 minutes for the magnetron to stabilize fully.
 - 4) Connect a multimeter, set to the DC10V range, between pins #3 (pos.) and #8 (neg.) of P601 (Fig.1-18).
 - 5) Loosen the lock nut of the gunn oscillator tuning screw and adjust the screw for maximum multimeter deflection.
- Note: Two tuning points exist while turning tuning screw. Select the mode at the point where tuning screw is out farthest.
- 6) After above adjustment, look at the picture on the screen, and confirm that maximum targets are obtained with the **TUNING** control set at mid travel.

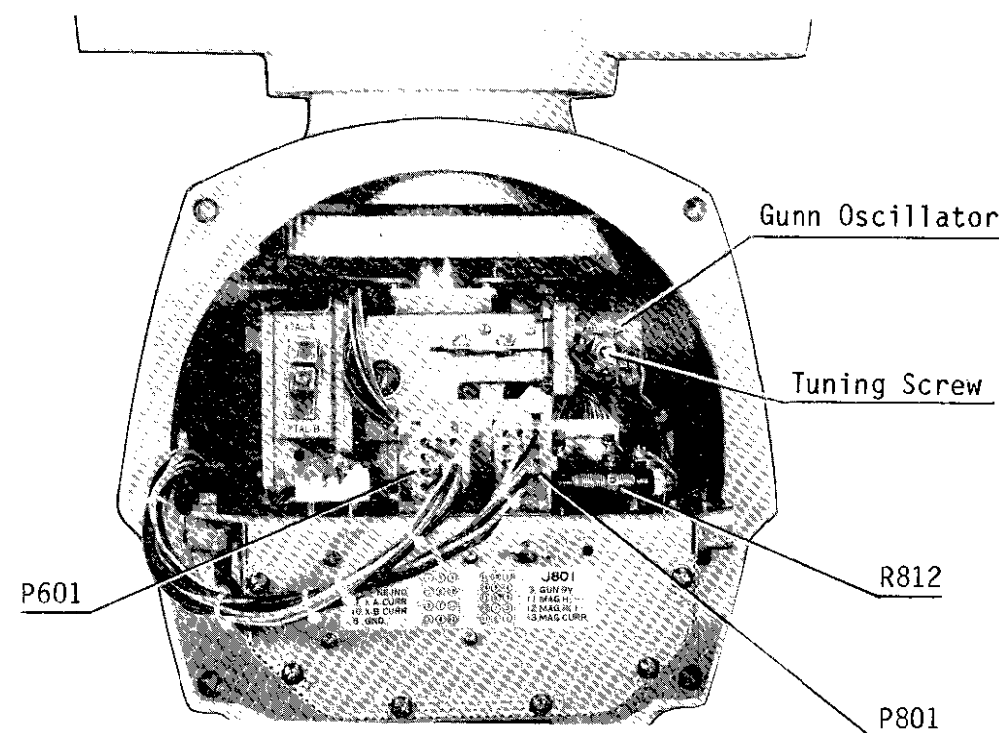


Fig.1-18

Tuning Indicator Sensitivity

In long range with the best tuning condition, adjust 1B8VR1 (Fig.1-15) on the CPU p.c.b. (03P4757) so that four marks of tuning indicator (Fig.1-19) appear and the fifth mark is just starting to flicker.

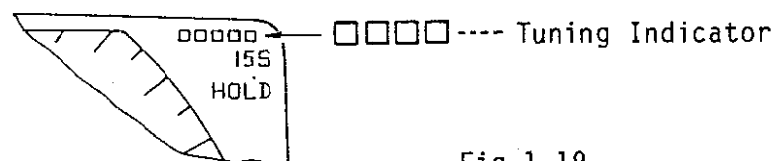


Fig.1-19

Magnetron Heater Voltage Adjustment

If the length of multicore cable is different from standard one (15m), the Magnetron Heater Voltage should be adjusted as follows:

1. Operate the radar in the condition of Stand-by, 1/4n.m. range, scanner rotation suspended and minimum CRT brilliance.
2. Connect the multimeter set to the 10V DC range, between P801 #12(positive) and #11(negative). See Fig.1-18.
3. Adjust the position of the sliding contact of R812(Fig.1-18) for multimeter reading of 7.0V to 7.6V.

1-5. Alteration of Power Supply

By changing the main fuse, terminal connections and transistors (Q4 thru Q7) on the RECTIFIER board (03P4764) in the display unit, this radar can be operated from 12V, 24V or 32VDC. See Fig.1-20.

Power Input	Main Fuse	Change connection to	Transistors Q4 to Q7
12V DC	25A	12V Terminals	2SC2750(Do not use 2SC3220)
24V DC & AC	10A	24V Terminals	2SC3220
32V DC	10A	32V Terminals	2SC3220

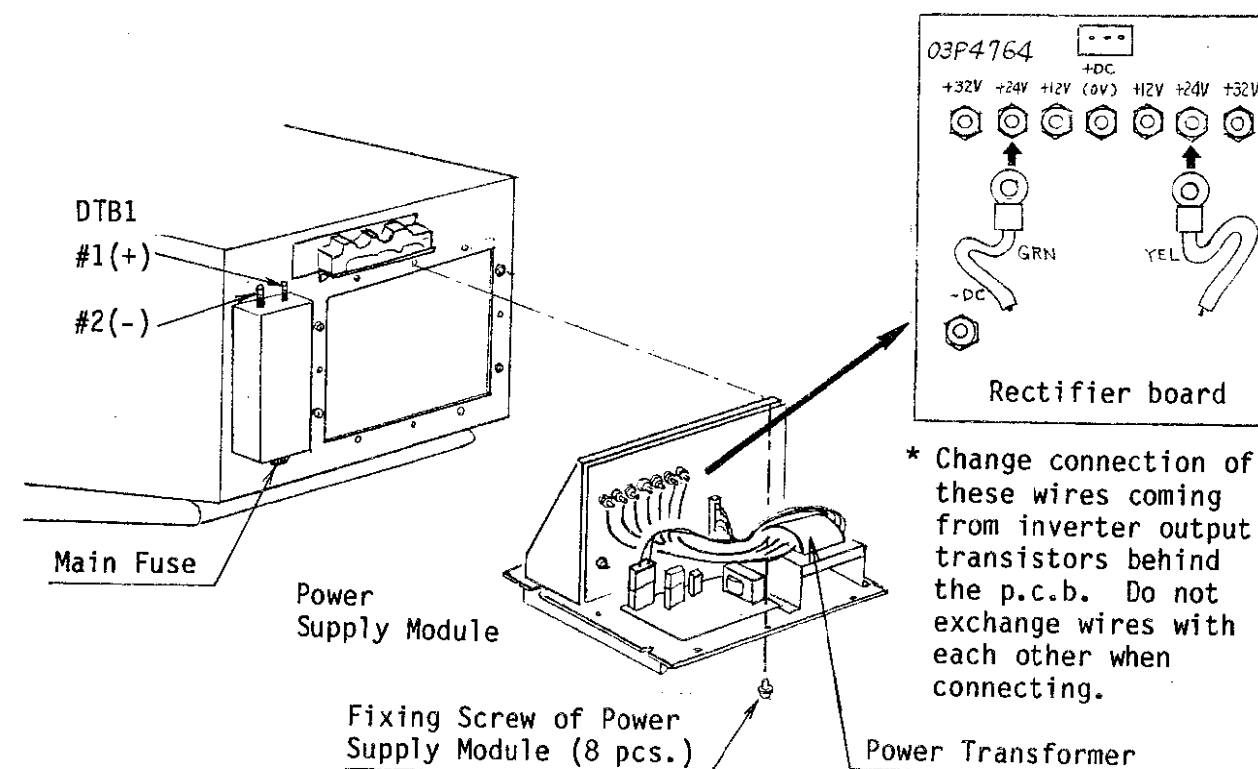


Fig.1-20 Alteration of Power Supply

Adjustment after alteration of power supply

After alteration of power supply, "Over-voltage (Mains input) protector adjustment" and "Reference voltage adjustment (*)" are required on the INVERTER board.

(*): For the 12V sets having the RT-4727-6 (and after) type of the pulse transformer (Fig.1-20), the inverter reference voltage is adjusted for +16.0V at factory.

Necessary Test Instruments:

- (1) Multimeter
- (2) Variable Power Supply
(Output voltage to be 65% to 140% of rated input of radar)

Condition: Stand-by, 1/4 n.m. range, scanner rotating, minimum CRT bril.

Ratings:

Rated Voltage	Peak Voltage	Absolute Max. Ratings	Ref. Voltage
12VDC set	15.6V to 16.4V	17.5V	16.0V
24VDC set	31.3V to 32.7V	35.0V	16.5V
32VDC set	42.1V to 43.9V	45.0V	16.5V

Procedure:

- 1) Connect a multimeter, set to 50VDC range, across DTB1 #1(+) and #2(-). See Fig.1-20.
- 2) Confirm that the radar stops operation at the moment the supply voltage reaches the peak voltage shown above.

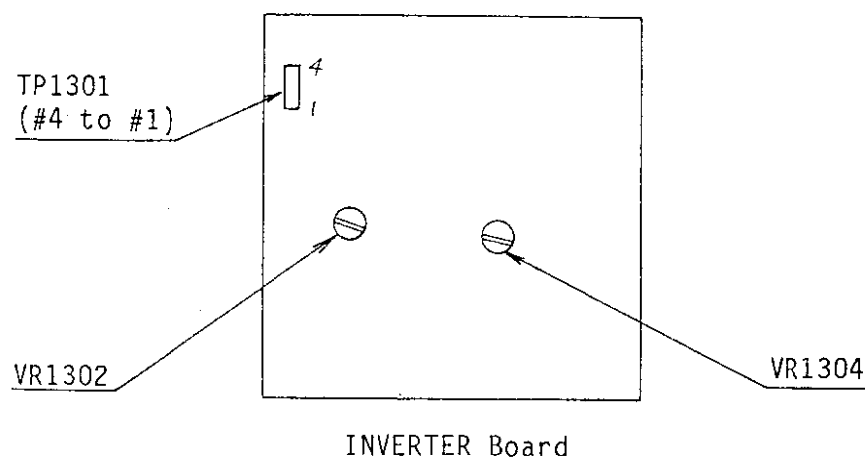
NOTE: Do NOT increase the supply voltage beyond absolute max. ratings

- 3) If not so, "Over-voltage (Mains input) protector adj." is required by turning VR1304 on the INVERTER board.

When the power supply is changed between 12VDC and 24/32VDC, take the following procedure.

- 4) Connect the multimeter, set to 30VDC range, between #4(+) and #1(-) of TP1301 on the INVERTER board.
- 5) Operate the radar with the rated power supply voltage.
- 6) Adjust VR1302 on the INVERTER board so that the meter indicates the ratings.

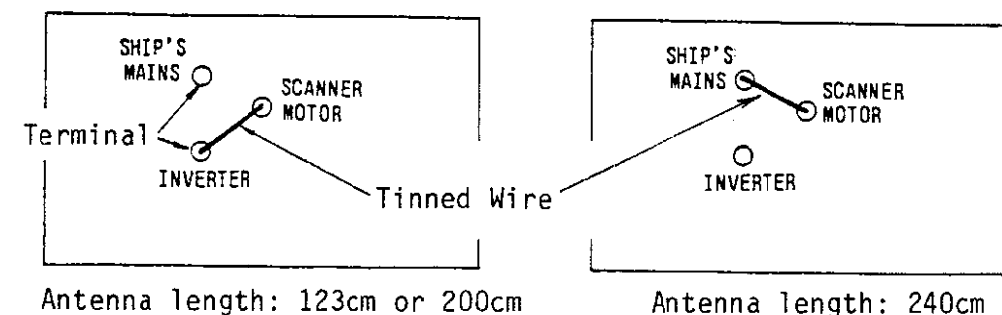
12VDC set ----- 16.0V
24/32VDC set ----- 16.5V



1-6. Modification to change the Antenna in Length

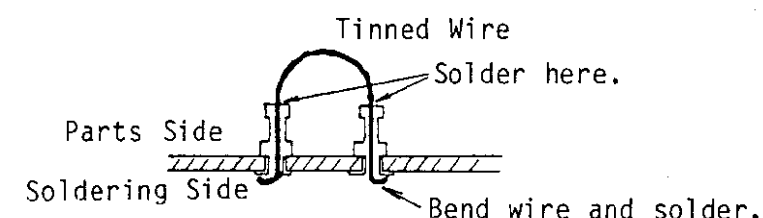
The radar is designed so that 123cm and 200cm antenna are driven by the inverter unit, while the 240cm antenna is driven directly by 24V DC mains. The following modification is required in the display unit in order to change the antenna in length from 123cm or 200cm type to 240cm type, or vice-versa.

- 1) Remove the power supply module as shown in Fig.1-20.
- 2) Remove the plate fixing the inverter output transistors to the heat sink by loosening four screws, taking care not to damage the leads of the transistors (especially when they are stuck to the rubber cushion of the plate).
- 3) Remove the RECTIFIER board (03P4764) from the power supply module by loosening six screws.
- 4) Change the jumper wire connection as below according to the antenna length.

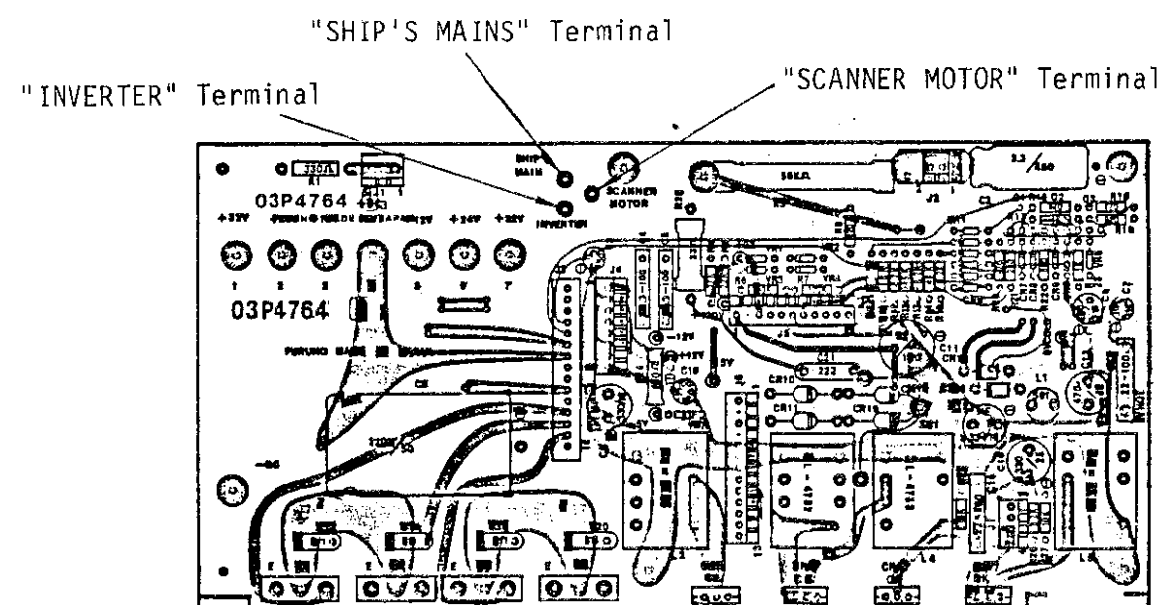


RECTIFIER Board (03P4764-33) Parts Side

NOTE 1: Fixing of Jumper Wire



NOTE 2: RECTIFIER Board (03P4764-33) Parts Side



- 5) Put the PCB back on the power supply module, then return the module to the display unit chassis.

NOTE: There is no difference in cabling between 123/200cm and 240cm antenna type scanner unit.

CHAPTER 2. OPERATION INSTRUCTIONS

Adjustment of and the function of the various operating controls will be discussed in this chapter. The operating personnel should familiarize himself with all the operating controls in order to make the best possible use of the equipment.

2-1. Function of Front Panel Controls and Switches (See page 2-16.)

FUNCTION switch

This switch has four operating modes :

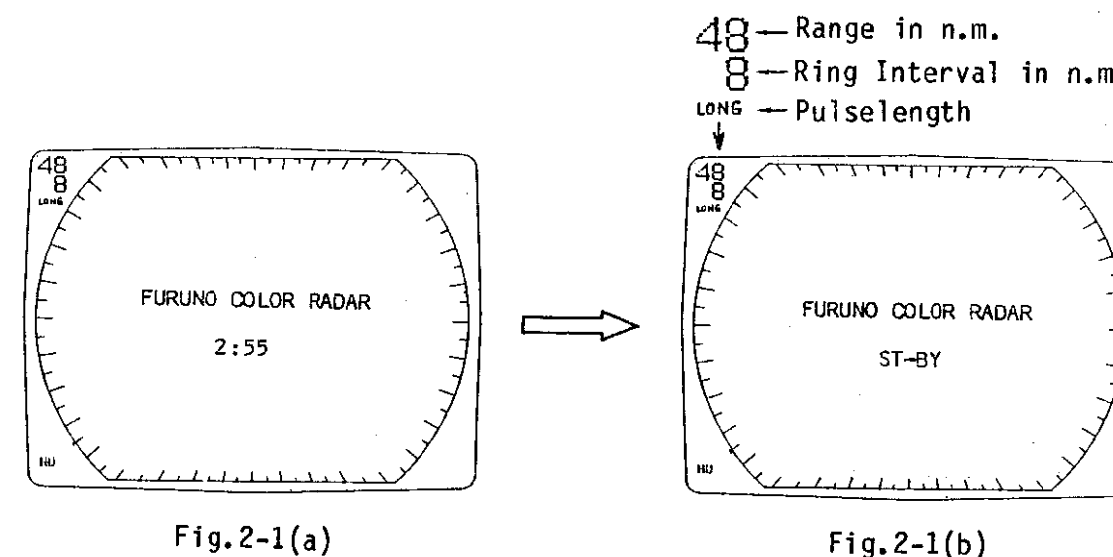
○ -- "OFF"

There is no power supplied to the radar system.

○ -- "STAND-BY"

Radar pulses are not being transmitted but the radar is in a state of immediate readiness for use. This position is utilized when the radar use is temporarily suspended.

Shortly after the FUNCTION switch is turned from ○ (OFF) to ○ (STAND-BY), the 3 minute timer indication on the screen center will be shown as in Fig.2-1(a). It will start counting down from "3:00" to "0:01", whereon it changes to the "ST-BY" indication, showing that the radar is ready to transmit.



- ⌚ -- "TRANSMIT (Short Pulse)"
- ⌚ -- "TRANSMIT (Long Pulse)"

At these settings, radar pulses are being transmitted and any echoes reflected from targets are received and displayed on the radar screen.

The pulselength and pulse repetition rate are determined by the combination of this switch and **RANGE** switch as shown in Table 2-1. At the "Short Pulse" position, the picture definition in the 1.5 and 3 mile ranges is improved. In the "Long Pulse" position, the detection of echoes is improved.



SCANNER switch ⌚

The scanner motor is driven by 24Vd.c. output of the inverter irrespective of the ship's mains voltage. This switch turns on/off the antenna rotation. Confirm that there is no obstruction around the antenna before turning on this switch.

RANGE switch

This 10 position range switch selects the maximum range as shown in Table 2-1. The range selected determines automatically the range ring interval, pulselength, pulse repetition rate and the characteristics of the receiver circuit for better detection in long ranges and better definition in short ranges. The range selected, range ring interval and pulselength are indicated at the left-top on the screen.

Table 2-1

FUNCTION	Range Setting	$\frac{1}{4}$	$\frac{1}{2}$	$\frac{3}{4}$	1.5	3	6	12	24	48	72	n.m.
	Ring Interval	$\frac{1}{16}$	$\frac{1}{8}$	$\frac{1}{8}$	$\frac{1}{4}$	$\frac{1}{2}$	1	2	4	8	12	n.m.
	No. of Rings	4	4	6	6	6	6	6	6	6	6	
	Pulse-Length	0.08					0.6		1.0			u sec
	P.R.R.	2700					1500		800		640	Hz
	Pulse-length	0.08			0.6		1.0					u sec
	P.R.R.	2700			1500		800				640	Hz

TUNING control ⌚

This control allows the receiver to be tuned in the transmitter. At a long range setting (48 or 72 miles), rotate the control slowly between extremes so that the maximum number of the tuning markers appear at the right-top of the screen. See Fig.2-2. The best tuning is usually found at the mid-point of its travel.

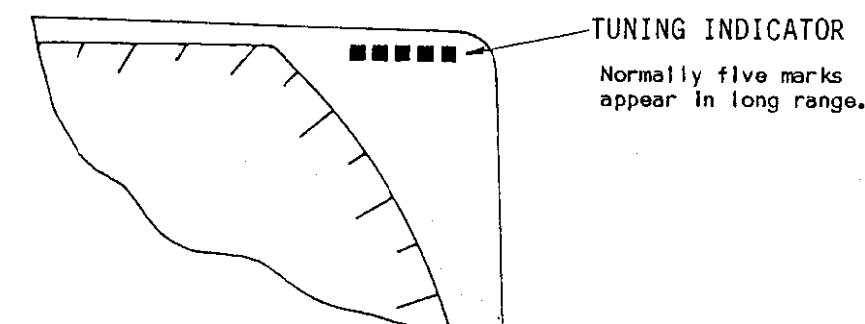


Fig.2-2

GAIN control ⌚

This control adjusts the sensitivity of receiver amplifier. The correct setting is where slight green background speckles are just visible on the screen. Too high a setting causes blurring and loss of definition while too low a setting reduces the detection range.

STC control (Sensitivity Time Control or Sea-Clutter) ⌚

This control reduces the amplification of echoes at short range, progressively increasing it as the range increases so that sea clutter (i.e. multiple random echoes from waves) near the ship is diminished. STC is fully variable and setting of this control depends on the sea and weather conditions and the range in use. The control should be kept adjusted in such a way that a little clutter to windward is left visible on the screen, as this ensures pick-up weak target echoes.

FTC control (Fast Time Constant or Rain/Snow Clutter)



The solid clutter caused by heavy precipitation is gradually reduced by turning this control clockwise, and the definition of picture is improved.

The **FTC** control can also be used with advantage to separate groups of echoes on a congested short range picture, and further this control is useful to diminish the sea clutter, using **GAIN** control together with **STC** control. It should be kept in mind that if the **FTC** control is turned clockwise, change will be expected in the characteristics of even a precipitation-free picture. Keep this control off unless its use is mandated by precipitation conditions because weak targets may otherwise be missed.

BRILLIANCE control



This controls the brightness of the picture. Turn this control clockwise to increase the intensity of the radar echo blips, legends and markers. Adjust it so that radar echo blips may be observed clearly.

ILLUMINATION control



Turning this control clockwise increases the brightness of the illumination on the control panel.

EBL/ No.1 EVRM/ No.2 EVRM control



This rotary knob controls the Electronic Bearing Line (EBL), No.1 EVRM or No.2 EVRM. Turning it CW rotates the EBL CW or enlarges the EVRM range. Of three markers, the following marker is controlled by this knob.

1. The marker, which has been lastly turned on by the marker switches (**EBL on/off** , **No.1 EVRM on/off** and **No.2 EVRM on/off**) on the touchpad panel, is controlled.
2. The marker, for which touchpad (, , or) is pressed, is controlled when two or more markers are turned on.
3. When the marker being controlled by this rotary knob is turned off, another marker which has been turned on is controlled.

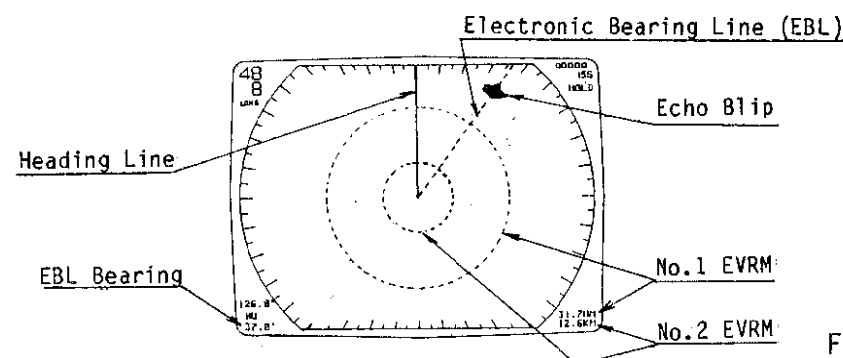


Fig.2-3

2-2. Functions of the Touchpad Keys

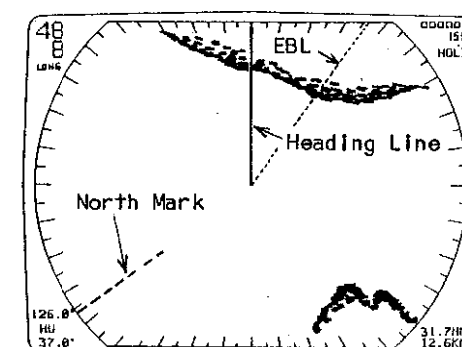
The Touchpad keys, covered with laminate film for splashproofing, function as described below. A distinct "beep" sound is made to confirm that the key has been pressed.

Heading Alignment (Heading-up, North-up, Course-up and Heading set)

HEADING UP (Normal mode)



The picture is orientated so that the heading line appears at the screen top. Bearings measured are relative to the ship's bow. This type of indication is most suitable on crowded seas or narrow channels. Legend "HU" is displayed at the lower left of the display.

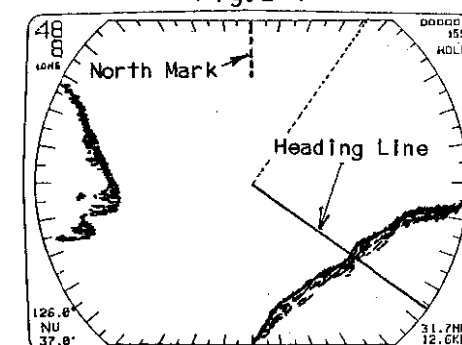


126.0° Gyro Reading
HU HU: Heading-up Mode
37.0° EBL Bearing
Fig.2-4

NORTH UP



The radar presentation is stabilized so that North is at the screen top and the heading line wanders according to the orientation of ship's heading. The picture is stabilized against yaw of the vessel which reduces movement of targets. Bearings measured are with respect to true North and may be easily plotted on a chart. Legend "NU" is displayed at the lower left of the display.



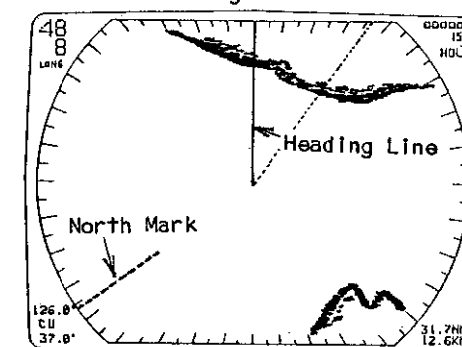
126.0° Gyro Reading
NU NU: North-up Mode
37.0° EBL Bearing
Fig.2-5

This type of presentation is often preferred on the high seas. Note that a gyro must be connected for this mode.

COURSE UP




Press this key at the moment when the ship's bow is headed in the desired direction (Ship's course to port, waypoints, etc). The picture is stabilized so that the desired direction is at the screen top. The heading line wanders according to the orientation of ship's heading. The picture is stabilized against yaw of the vessel, which reduces movement of targets. Note that a gyro must be connected for this mode.



126.0° Gyro Reading
CU CU: Course-up Mode
37.0° EBL Bearing
Fig.2-6


When it is necessary to change course, press either HU or NU key, and then press this key again. The picture is now oriented in the new direction. Legend "CU" appears at the lower left of the display while this mode is selected.

HEADING SET 

This touchpad operates in different way depending on whether a gyrocompass is connected or not.

When a gyrocompass is not connected:

The heading line may be moved to a direction determined by the **EBL** control or touchpads.

- 1) Set the EBL to the desired direction by using **EBL** control or touchpads.
- 2) Press the  touchpad. The heading line will move to the EBL direction as shown in Fig.2-7.

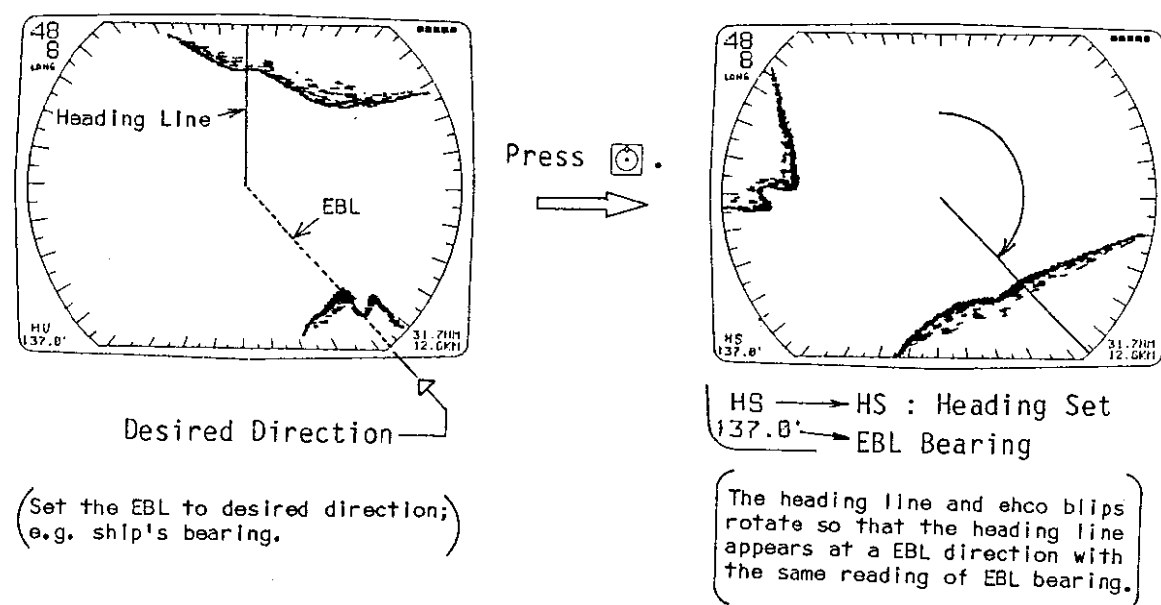



Fig.2-7 Heading-set Mode (Gyrocompass not connected)

When a gyrocompass is connected:

The direction set by the EBL can be moved to the screen top as below.

- 1) Move the EBL to the desired direction by using the **EBL** control or touchpads.
- 2) Press the  touchpad. The picture will turn so that the bearing of the EBL is at the top of the screen as shown in Fig.2-8.

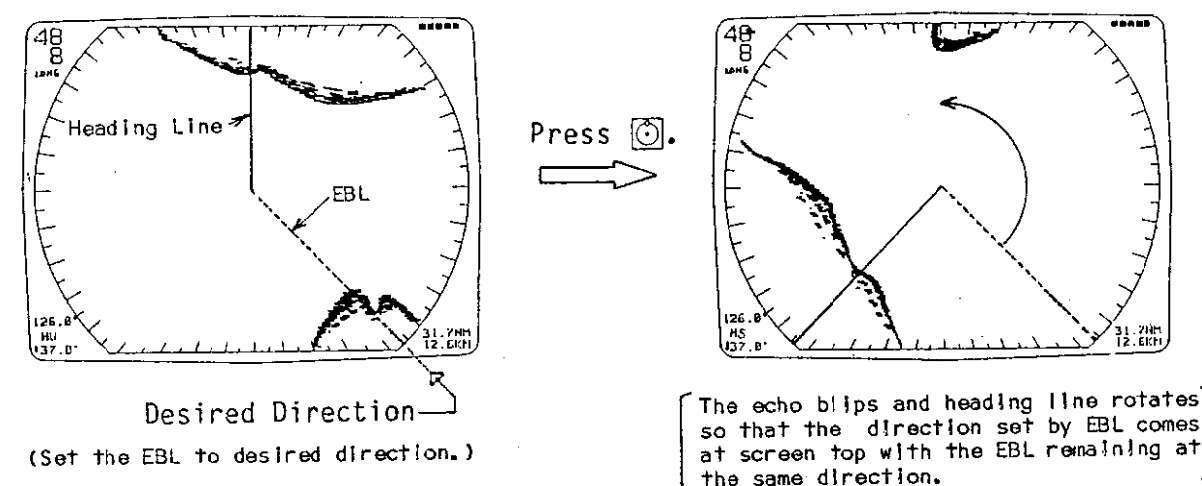



Fig.2-8 Heading-set Mode (With Gyrocompass connected)

Heading Line and North Mark

HEADING OFF 

The heading line disappears while this key is pressed. Should a small desired target be under the heading line, use this key.

NORTH MARK on/off 

The "North Mark", which is available when a gyrocompass is connected, is turned on or off by this key. To turn the North mark off, press the key. Pressing the key once again turns on the North mark.

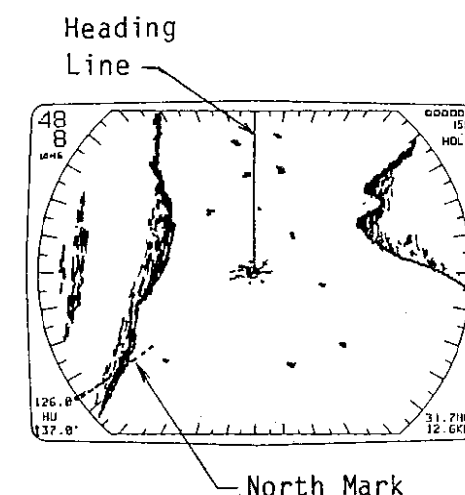



Fig.2-9

Off-center & Hold (Picture Freeze)

OFF-CENTER 

Allows the sweep center (origin) to be off-centered by 1/3 of sweep radius for forward range extension. By pressing this key again, the origin is returned to the center of the screen.

HOLD (Picture Freeze) 

Freezes the picture displayed on the screen for one minute when pressed. "HOLD" appears at the upper right of the screen to warn that the picture is frozen. In this condition, all the controls and keys on the control panel are disabled.

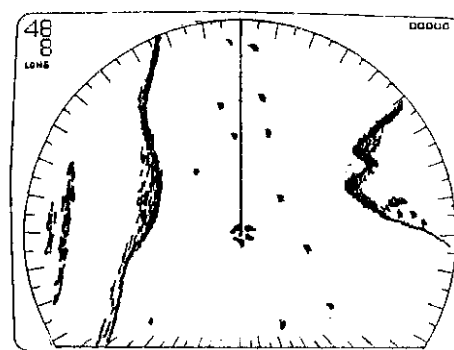


Fig. 2-10

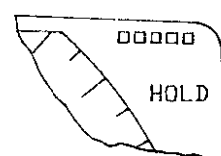




Fig. 2-11


Electronic Bearing Scale (EBL)

EBL on/off 

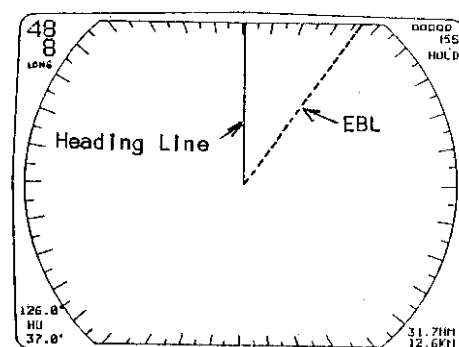
When this key is pressed, the EBL appears as a dotted line and its bearing (relative to ship's heading in the heading-up mode "HU" or true bearing to north in north-up mode "NU") is indicated at the lower left of the display. To remove the EBL, press the key again.

EBL Control (CW) 

Rotates the EBL clockwise in 0.5° step when pressed. For continuous clockwise rotation of EBL, keep this key pressed.

EBL Control (CCW) 

Rotates the EBL counterclockwise in 0.5° step when pressed. For continuous counter clockwise rotation of EBL, keep this key pressed. The rotary knob at the lower left of the panel will rotate the EBL manually in 1° steps.



126.0° → Gyro Reading
HU → Display Mode
37.0° → EBL Bearing


Fig. 2-12

Range Ring and Variable Range Mark


RANGE RING 

Turns the range rings off when pressed. Press again to turn them on.


The following three keys are provided for both the 1st and 2nd EVRM's.

EVRM on/off 


The EVRM is displayed as a dotted circle on the CRT when pressed. The EVRM range is displayed at the lower right of the CRT. (The readout of "n.m." or "km" may be selected by means of a dip switch on the CPU board inside. Ask your local agent if you want to use EVRM calibrated in "km". Refer to page AP2-1.)

EVRM (Increase) 

Enlarges EVRM range. To increase the range rapidly, press the key continuously.

EVRM (Decrease) 

Decrease the EVRM range. To decrease the range rapidly, press the key continuously.

PLOT (Picture Memory) 

Two plotting modes can be selected depending on the internal dip switch setting (Refer to page AP2-1); one is "plotting at selected interval" and the other is "continuous plotting". In the former plotting mode, successively pressing the PLOT key determines plot interval of target echoes so that the track of a target may be observed overtime.

48 → Range
8 → Ring Interval
LONG → Pulse Length

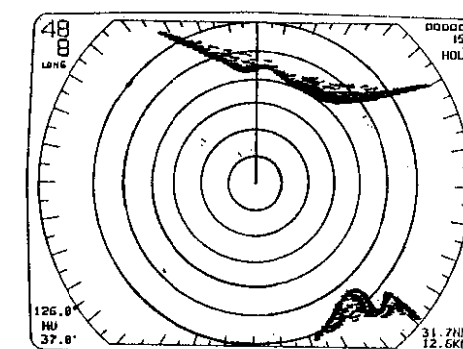
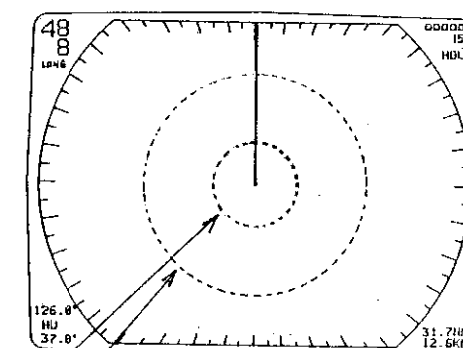


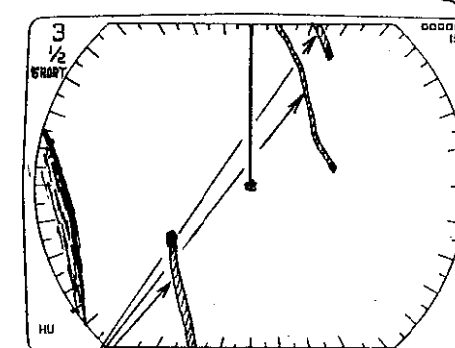
Fig. 2-13 Range Ring



No.1 EVRM ← 31.7NM
No.2 EVRM ← 12.6KM

Fig. 2-14 EVRM

Plot interval or plotting time elapsed → 15S



Course Plot (Blue)

Fig. 2-15

The interval is set for 15 seconds, 30 seconds, 1 minute, 3 minutes, 6 minutes or OFF. The plot interval is indicated at the upper right position on the CRT.

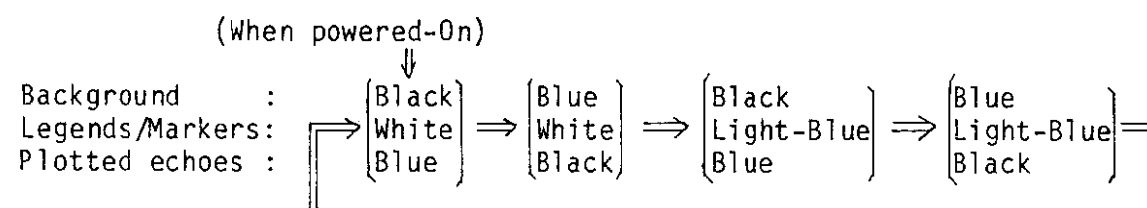
In the latter plotting mode, continuous course plotting takes place by pressing the PLOT key and the time elapsed after starting the plot operation is indicated at the upper right position on the CRT, counting up to 99 minutes and 59 seconds. The PLOT key turns on/off plotting repeatedly by every depression. Plotted echoes are displayed in a dark blue color on the CRT. The relative movement and speed of targeted can be ascertained. This key is also used to stop from self-test sequence.

TEST / COLOR CHANGE / SOUND ☐

Pressing this key within 5 seconds after turning on the POWER switch performs the self-test sequence. See "2-5. Self-test" on page 2-17 for details of self-test. Press the PLOT key to escape from self-test mode.

Every time this touchpad key is pressed during normal operation, the colors corresponding to background, legends/markers and plotted echoes (picture memory) are changed as below. This picture color combination can be set to observed most clearly.

NOTE: Whether the "beep" sound is produced or not when any touchpad key is pressed depends on #3 setting position of the dip switch on the CPU board 03P4757. See "APPENDIX 2 INTERNAL PRE-SET SWITCH"















2-3. Operating Procedure

SUMMARY OF PREOPERATION CHECKS AND INITIAL SETTING		
1) Confirm that the input power is within -10% to +25% of the specified voltage.	Switch & Control	Initial Setting
	FUNCTION	○ (OFF)
12VDC --- 10.8VDC to 15.0VDC 24VDC --- 21.6VDC to 30.0VDC 32VDC --- 28.8VDC to 40.0VDC	SCANNER	Downward (OFF)
	BRILLANCE	Fully CCW
	GAIN & STC	Fully CCW
2) Check that there is no wrong or loose connection among the units.	FTC	Fully CCW
	TUNINN	Mid-travel
3) Confirm that there is no person or obstacle around the antenna radiator	Others	Any Position
4) Confirm that the controls and switches on the display front panel are set as shown in Table 2-2.		

Table 2.2

No.	Operation	Remarks
1	Turn the FUNCTION switch to ○ (ST-BY) and the BRILLIANCE control clockwise.	"FURUNO COLOR RADAR" and 3 min. delay time for transmission appear on the screen.
2	Turn the SCANNER switch upward (ON).	The antenna radiator rotates at approx. 24 r.p.m.
3	Allow about 3 minutes.	The waiting time indication changes to "ST-BY" indication. The radar is ready to transmit.
4	Turn the FUNCTION switch to ① or ② with the GAIN set at 70% of max. travel.	The radar transmits microwave pulses and any echoes reflected by targets are received, giving echo blips on the screen.
5	Adjust the TUNING control so that maximum number of tuning markers appear on the right-top of screen.	The receiver circuit is tuned to transmitter frequency.
6	Select the desired range with RANGE switch.	The range selected, range ring interval and pulselength are indicated at the left-top of the screen.
7	Press the RANGE RING touchpad.	Range rings appear on the screen at constant interval indicated at the left-top of the screen.
8	Select the pulselength in middle ranges by FUNCTION switch.	Set to ① for better detection of weak echo and to ② for better definition in narrow channel or crowded sea.
9	Adjust the GAIN and STC.	Increase the gain (and decrease the STC) on long ranges so that small weak signals may be detected. Reduce the gain and adjust the STC carefully on short ranges so that sea clutter is suppressed, with desired targets remaining.

No.	Operation	Remarks
10	Press the HEADING OFF touchpad to remove the heading line.	So long as the touchpad is depressed, the heading line disappears and echo blips under the heading line are easily observed.
11	Press the OFF-CENTER touchpad.	The sweep center (Own ship position) shifts downward and forward watching area is expanded. Press again to return the sweep to the screen center.
12	Press the EBL on/off touchpad for bearing measurement.	The EBL appears as a dotted line on the screen, and the bearing of the EBL is read at the left bottom of the screen.
13	Place the EBL on target by operating EBL/No.1 EVRM/No.2 EVRM or touchpad;  ,  or  .	The relative bearing of target is indicated on the left bottom of the screen.
14*	Press the NORTH MARK touchpad.	The north mark appears on the screen.
15*	Press the NORTH UP touchpad to obtain true bearing picture (north-up).	The north mark comes to the screen top, and the heading line and echo blips rotate as the ship moves.
16*	To measure the true bearing of target, move the EBL over the target by EBL/No.1 EVRM/No.2 EVRM or touchpad.	The true bearing of target is indicated on left bottom of screen.
17*	To obtain a stable picture so that the present ship's heading (course) is fixed at screen top, press the COURSE UP touchpad.	The echo blips are stable on the screen even if the ship's heading fluctuates.
18	To measure the range to the target, press the EVRM on/off touchpad;  .	A dotted circle line appears on the screen and the range of the circle is indicated at the right bottom of screen.

No.	Operation	Remarks
19	Place the circle line at the inner edge of the target by operating EBL/No.1 EVRM/No.2 EVRM or touchpad;  ,  or  .	The range to the target is indicated in n.m. at the right bottom of the screen.
20	To plot the movement of the targets, press the PLOT touchpad  .	On the mode of "Plotting at selected interval", the plot interval (15sec.) is indicated on the right top of the screen, and the movement of the target relative to own ship is plotted in blue at selected interval; 15sec. On the mode of "Continuous plotting", continuous course plotting takes place and the time elapsed after starting the plot operation is indicated on the right top of the screen.
21	On the mode of "Plotting at selected interval", press the PLOT touchpad  repeatedly to change the plot interval.	The plot interval is changed to 30 sec, 1 min, 3 min and 6 min successively.
22	To stop the plot indication, press the PLOT touchpad until the interval indication or plotting time elapsed is erased on the screen.	The plot interval indication or plotting time elapsed is erased and the plotting picture disappears.
23	On plot mode, press the TEST/COLOR CHANGE/SOUND touchpad  repeatedly.	The colors corresponding to background, legends/markers and plotted echoes are changed. Set the colors so as to be observed most clearly.
24	To stop the radar, turn the FUNCTION switch to OFF  . To stop transmitting, set the FUNCTION switch to ST-BY  .	

* ---Functions available when gyrocompass is connected.

2-4. Effective Suppression Method for Sea Clutter and Rain Clutter

(1) How to discriminate small target from sea clutter

As sea clutter varies depending on size or shape of wave, sea or weather condition or height of scanner antenna from sea surface, the discrimination of a small target from sea clutter should be made by using not only **STC** control but also both **FTC** and **GAIN** controls.

Operation Method using **FTC**, **GAIN** and **STC** Controls

- 1) Turn **STC** control fully CCW.
- 2) Set **GAIN** control at maximum.
- 3) Adjust **FTC** control so that sea clutter near the ship appears with the same strength as that around middle of sea clutter range on the screen.
Note: Too high a setting of **FTC** control will make the target echo small in size.
- 4) Turn **GAIN** control CCW gradually to reduce sea clutter over the screen, and further turn it CCW to emphasize the target echo from sea clutter.
Note: The weaker target than sea clutter will also disappear on the screen.
- 5) If sea clutter near the ship still stays on the screen, turn **STC** control slightly CW to eliminate it.

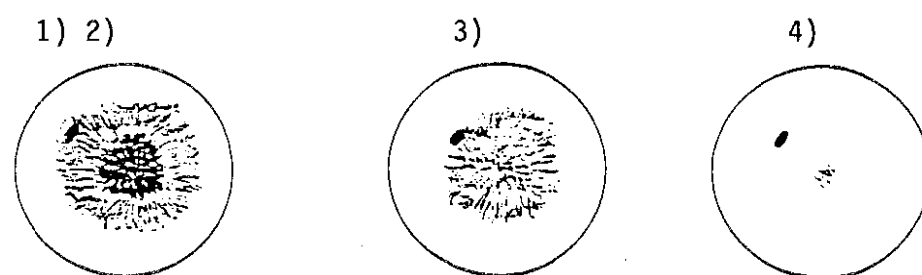


Fig.2-16

The following shows the difference in target recognition.

(Example 1): Sea clutter is strong on the windward side. (Sea clutter does not appear symmetrically on the screen.)

- * Both the target echoes A and B become small in size as below when the sea clutter is suppressed by using only **STC** control.

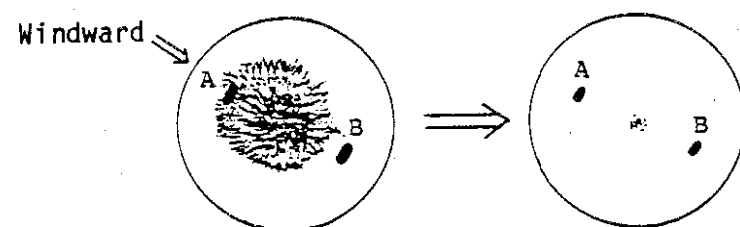


Fig.2-17

- * When **FTC** and **GAIN** controls are used effectively, target echo B that exists outside sea clutter does not become small in size.

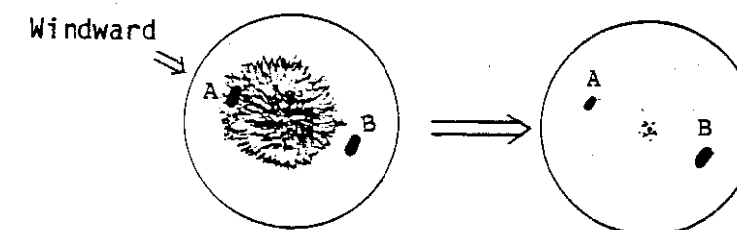


Fig.2-18

(Example 2): When strong sea clutter near the ship is eliminated completely, the target echo becomes small in size as it approaches near the ship.

- * Of the target echoes A and B which are same in size, only the target echo B becomes small in size when **STC** control is turned CW.

Note: Too high a setting of **STC** control will cause the target echo to completely fade out.

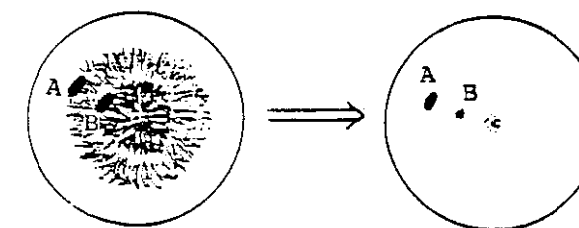


Fig.2-19

- * When both **FTC** and **GAIN** controls are used effectively, the target echo near the ship does not become small in size. (The target echoes A and B appear with the same size on the screen as below.)

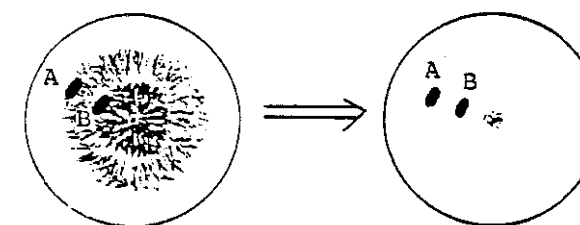


Fig.2-20

- (2) How to discriminate targets from solid rain clutter caused by heavy precipitation.

Solid clutter caused by heavy precipitation appears over a wider area than sea clutter and makes the discrimination of long range target difficult. However since it is usually not so strong as sea clutter, the target echo in solid clutter can be emphasized with proper use of **FTC** and **GAIN** controls. The following shows examples of proper **GAIN** and **FTC** settings in different conditions.

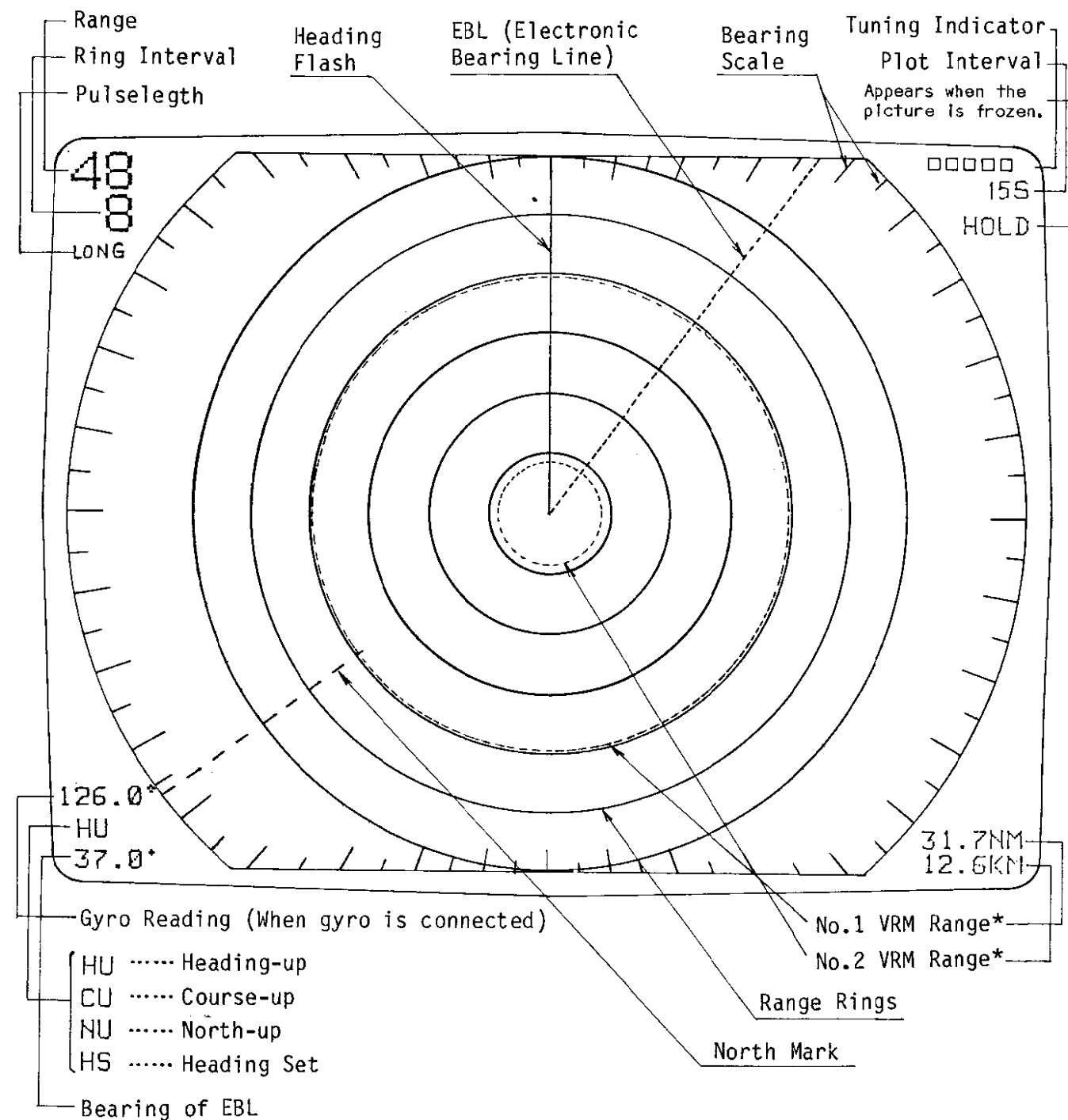
(Example 1): It drizzles over a wide area uniformly.

Use only **GAIN** control, and the target echo on the screen does not become small in size. (If **FTC** control is used, the target echo becomes small in size.)

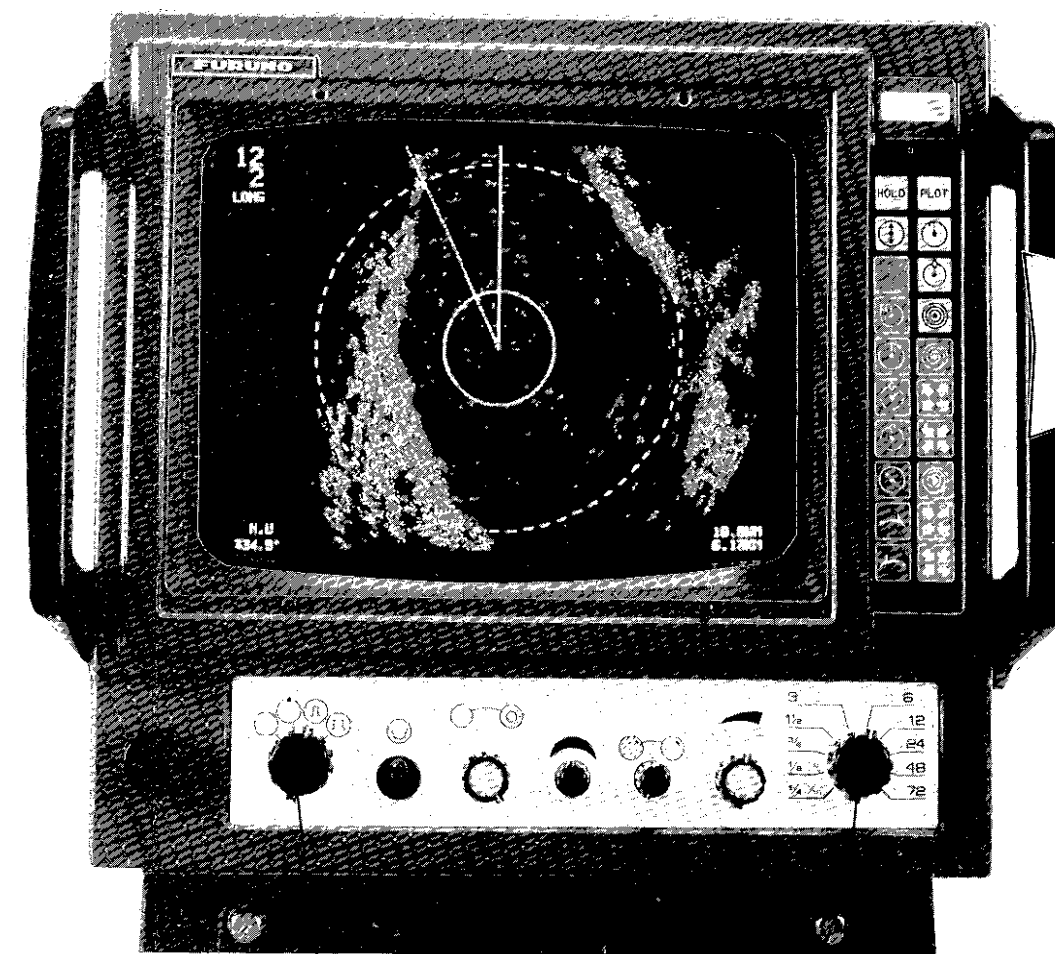
(Example 2): Heaviness of rain is different from area to area.

Both **GAIN** and **FTC** controls should be used. When only **GAIN** control is used to eliminate rain clutter in the heavy rain area, a small target echo in the light rain area will be lost.

- 1) Set **GAIN** control at maximum.
- 2) Adjust **FTC** control so that rain clutters both in the light and heavy rain areas appear in the same level on the screen.
Too high a setting of **FTC** will make the target echo small in size.
- 3) Turn **GAIN** control CCW to reduce rain clutter, and the target echo is emphasized from rain clutter.



Note: The unit of VRM range is selectable between n.m. and km by the setting of inner preset switches.



FUNCTION

RANGE SWITCH

FUNCTION	OFF-ST/BY-TRANSMIT_TRANSMIT (SHORT) (LONG)
	SCANNER
	BRILLIANCE
	ILLUMINATION
	EBL/ No.1 EVRM/ No.2 EVRM

	GAIN
	STC (Anti-clutter Sea)
	FTC (Anti-clutter Rain & Snow)
	TUNING

	HOLD (Picture Freeze)
	OFF-CENTER
	TEST/SOUND
	COURSE-UP
	HEADING-UP
	NORTH-UP
	HEADING-SET
	EBL ON/OFF
	EBL CONTROL (CW)
	EBL CONTROL (CCW)
	PLOT (Picture Memory)
	HEADING OFF
	NORTH MARK
	RANGE RING (FIXED)
	NO.1 EVRM ON/OFF
	INCREASE
	DECREASE
	NO.2 EVRM ON/OFF
	INCREASE
	DECREASE

CHAPTER 3. REMARKS ON VIEWING PICTURE

3-1. Minimum and Maximum Ranges

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 sea, the height of the target above the sea, the size, shape and material of the target, and the atmospheric conditions.

Under normal atmospheric condition, the maximum range, Rmax, 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 pulse. Rmax is given by the following equation.

$$R_{max} = 2.2 \times (\sqrt{h_1} + \sqrt{h_2})$$

where Rmax: Radar horizon (n. mile)
 h1 : Antenna height (meter)
 h2 : Target height (meter)

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

$$\begin{aligned} R_{max} &= 2.2 \times (\sqrt{9} + \sqrt{16}) = 2.2 \times (3 + 4) \\ &= 15.4 \text{ (n. miles)} \\ &= \text{approx. } 8.56 \text{ (km)} \end{aligned}$$



Fig.3-1 Radar Wave Propagation

Minimum Range

When the radar is used as a collision avoidance aid, the minimum range is of urgent concern. It is very dangerous for a target to disappear when it approaches the ship. The minimum range is determined by the transmission pulse width and the height of the antenna (vertical beam width of antenna). The minimum range of the radar is usually approximately 10 meters.

3-2. Radar Resolution

Bearing Resolution

The bearing resolution is an ability to discriminate two targets which are located at the same range and close in azimuth to each other. Usual bearing resolution is on the order of 1 degree. The horizontal beamwidth of the antenna is the primary factor in bearing resolution.

Range Discrimination

The range discrimination is the ability to distinguish two targets which are in the same direction and close each other. This is determined by pulselength only.

3-3. 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 the 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, the adjustment of heading marker at installation is an important factor in determining the bearing accuracy. When measuring the bearing of a target, put the target echo at the edge of the screen by selecting the proper range so as to minimize measuring error.

3-4. Range Measurement

Measurement of the range to the target is also a very important function of the radar. Generally, there are two means for measuring range: fixed range rings which appear on the screen with a predetermined interval as a reference for the range measurement, and the variable range marker which can be moved inwards and outwards so that it will touch the target. The range to the target can be read out by a digital display.

3-5. 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 can occur. Typical false echoes are shown below.

Multiple Reflections

When a wide and flat target such as the sideboard of the ship, bridge, building on the pier or breakwater exists near the ship, radar pulses are multi-reflected between your ship and the target. This results in the appearance of multiple echoes on the screen. The multiple echoes appear at equal intervals after the true echo as shown in Fig.3-2. They can be reduced or often removed by decreasing the gain or properly adjusting the STC control.

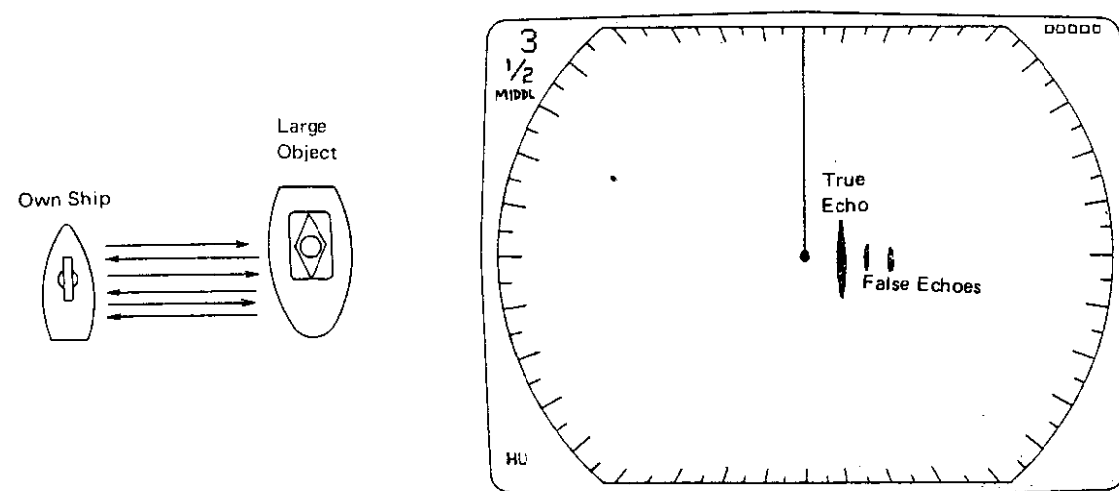


Fig.3-2

Side Echoes

When a radar pulse is emitted from the antenna radiator, some of the total energy escapes on each side of the main beam --- in side-lobes. A large strong target might be detected by the sidelobes as well as main lobe. The side echoes appear at both sides of true echo at the same range as shown in Fig.3-3. Side echoes can also be removed by adjusting the gain and STC controls.

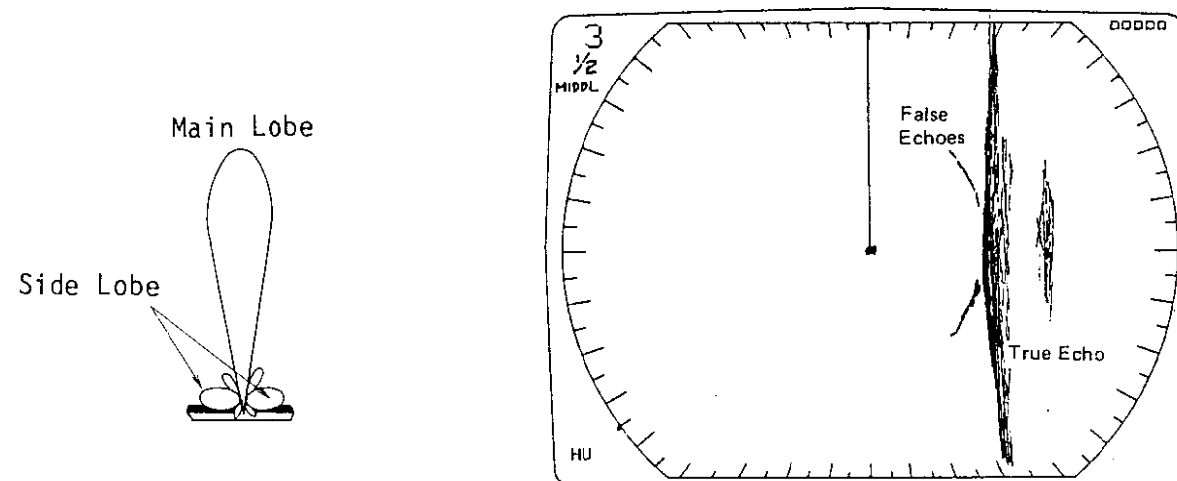


Fig.3-3

Second-trace Echoes

In some cases radar wave propagation is abnormal, and echoes from long distant targets may appear on the screen. Sometimes they may be returned after the next pulse has been emitted and appear on the next sweep as false echoes along with the true echoes of the nearer targets.

Virtual (Mirror) Images

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 the false echo which is caused by the mirror effect of a huge object on or close to your ship as shown in Fig.3-4. If your ship comes close to a big metallic bridge, for example, such a false echo may temporarily be seen on the scope.

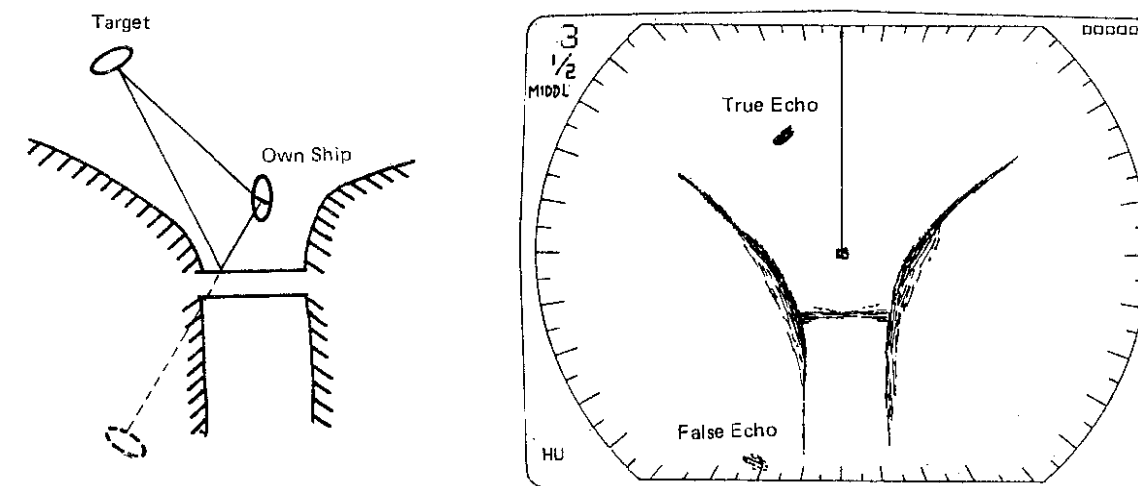


Fig.3-4

Dead Angle (Blind Sector)

A funnel, mast or derrick post near the radar antenna may intercept the radar beam. In that case, no target can be detected in that direction the "dead angle". A huge object close to your ship may cause a similar blockage of signals.

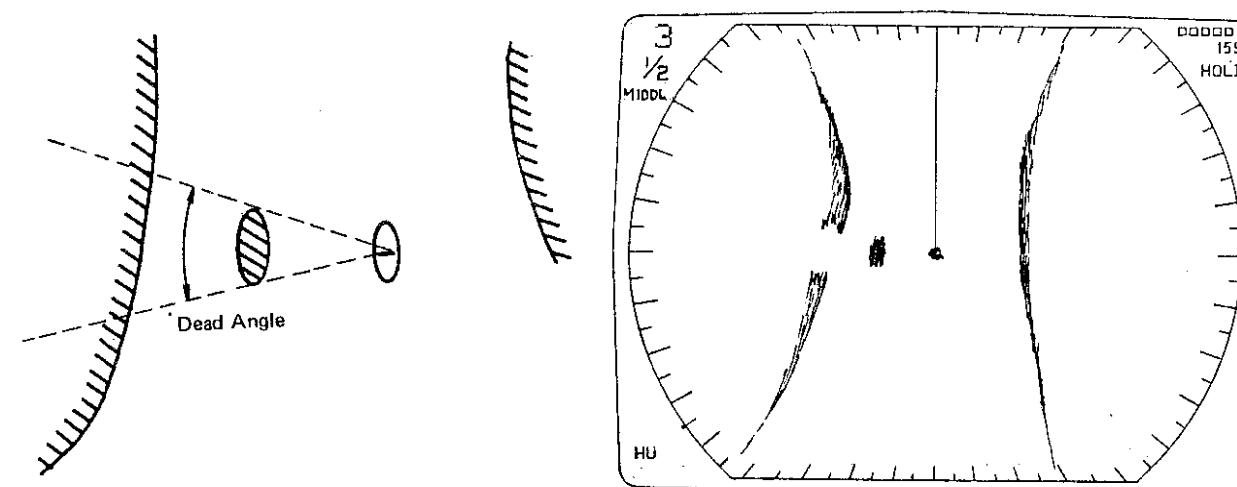


Fig.3-5

Radar Interference

When another ship radar is using the same frequency as your radar, the pulses emitted from the other ship are received and appear on your radar screen as curved spokes ("rabbit tracks") as shown in Fig.3-6.

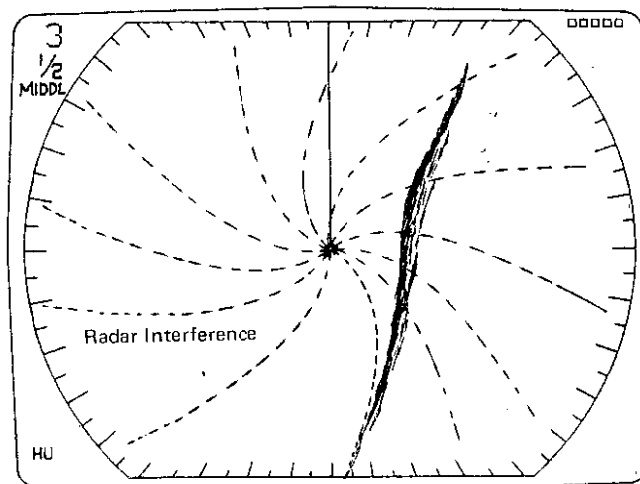


Fig.3-6

CHAPTER 4 MAINTENANCE

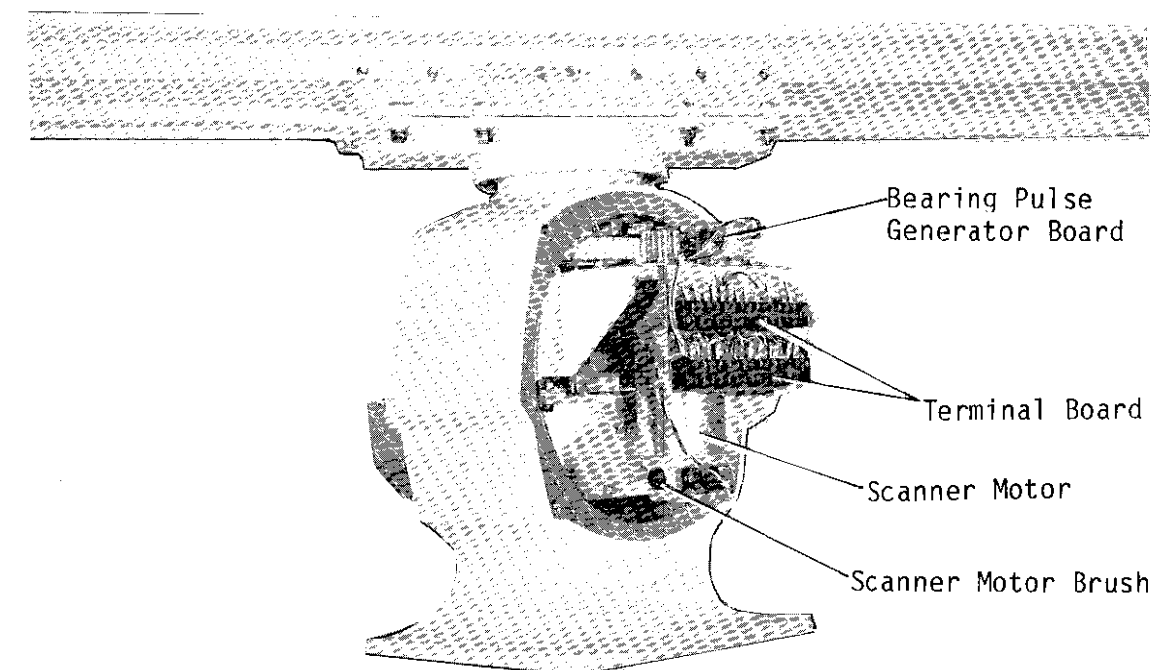
To maintain optimum performance of the equipment for extended period, general check and maintenance should be made periodically.

"CAUTION"

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

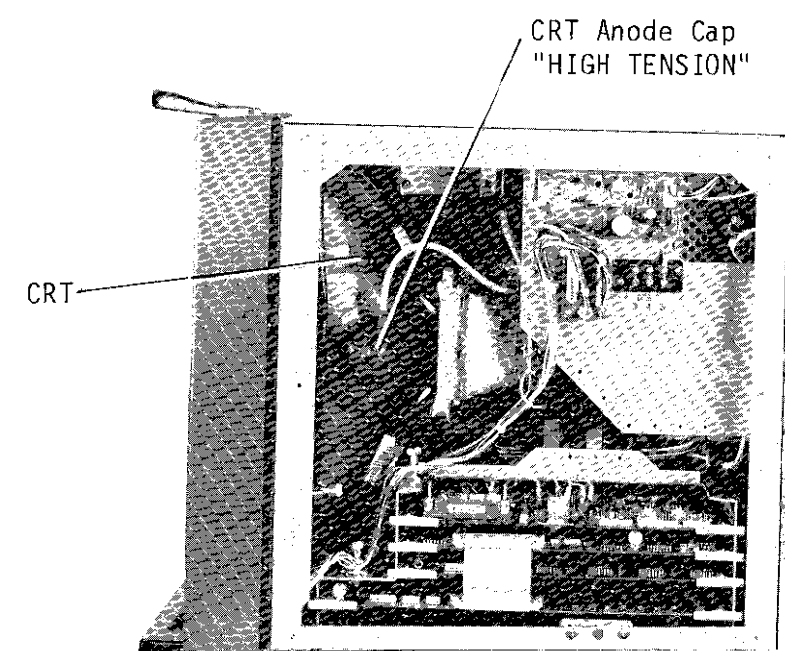
Interval	Item	Check/Measures	Remarks
3 to 6 months	Exposed bolts and nuts on scanner unit	Check for corroded or loosened bolts/nuts. If necessary, clean them up and repaint thickly. Replace them with new ones if heavily corroded.	*Sealing compound may be used instead of paint. *Put slight amount of grease if bolts and nuts are replaced.
	Scanner radiator	Check for dirt or crack on the radiator surface. Thick dirt should be wiped off by using a soft cloth immersed in fresh water. If any crack is found, apply 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 wooden hammer or plastic-head hammer. Crack on the scanner unit will cause permanent damage to the internal circuitry due to water leakage.
	Terminal boards and plugs in scanner unit (See Fig.4-1.)	Remove scanner covers to check terminal board/plug connections inside. Also check if the O-ring on each cover is in good order.	*When putting covers back in positions, do not pinch flying wires.
	CRT screen	Dirt on this creates symptom identical to poor sensitivity. Clean up CRT surface using special care not to scratch them.	*Use soft cloth with slight amount of anti-static-charge spray. Never apply plastic solvent.

Interval	Item	Check/Measures	Remarks
6 months to 1 year	Scanner motor (See Fig.4-1.)	Check and clean up carbon brushes and commutator. If brushes have worn out to 6mm or less, replace them with new ones. (New brush is 11mm long.)	*Under normal use, the carbon brush will last approximately 2000 hours.
	CRT anode and approach (See Fig.4-2.)	High tension on CRT attracts dust in environment, and moist dust will cause poor insulation. Clean up high voltage parts as follows. 1. Turn off radar. 2. Pull out anode cap and touch its nipple to chassis (discharging). 3. Clean up CRT side and anode cap/lead by using soft dry cloth.	*If any crack is found on rubber cap or wire sheath, replace it with new one. *Always make sure to put anode cap back on CRT after cleaning.
	Terminal boards, sockets and plugs	Check for loose connections. Polish up contacts or replace plug, if necessary.	



N Photo No. 639

Fig.4-1



N Photo No.1355

Fig.4-2

CHAPTER 5 TROUBLESHOOTING

Whenever an unusual symptom is encountered, perform the Self-Test described on the next page, and check the plug connections on p.c. boards and the lead connections on terminal boards, then proceed to individual function check along with the Trouble Finding List on the following pages. If some board is found to be faulty, replace it with new one or call for service. Do not attempt further component check in the p.c. board. Careless handling may cause more serious trouble.

"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)

Notes on Service Call

To allow effective service job, the following information should be given at a service call.

1. Name of the vessel
2. Vessel's position (port/berth)
3. Sailing Schedule
4. Radar model
5. Serial number/Date manufactured
6. Symptom of trouble
(Results of checks along with the Trouble Finding List)
7. Previous service

5-1. Self-Test

A check of memory devices (ROM/RAM) is done by pressing the blank touchpad  within 5 seconds after turning on the unit. "ROM/RAM OK" is displayed on the screen for normal ROM/RAM operation. If abnormal operation is detected, and error message such as "ROM 1 ERROR" appears.

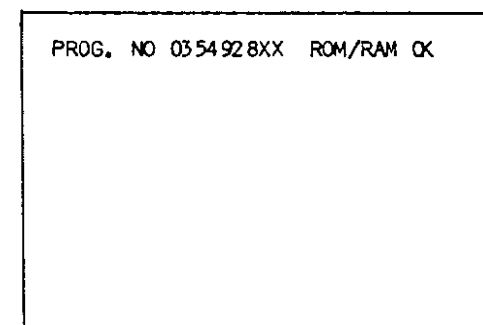


Fig.5-1 Normal Memory Circuit

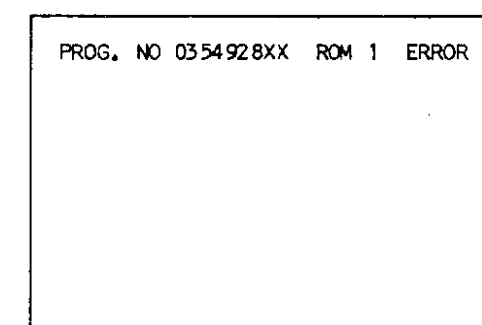


Fig.5-2 Faulty Memory Circuit

After ROM/RAM check, press the **[HOLD]** touchpad for the check of key function and also preset condition and the function of the dip switch on the CPU board appears. The displayed number changes from "0" to "1" when each key is pressed to confirm normal key function. The reading of the gyrocompass is displayed as shown below when it is connected. To escape from the self-test sequence, press the **[PLOT]** touchpad.

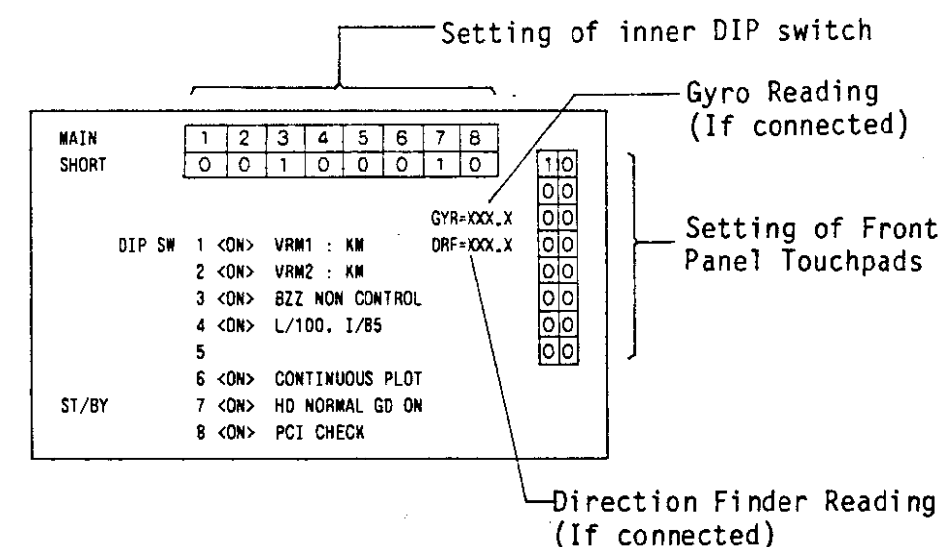
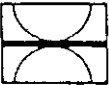
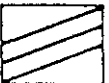

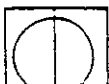



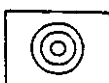


Fig.5-3 Touchpad Checks

Operation	Symptom	Possible Cause	Remarks
	Nothing appears on CRT.	1. CRT assembly 2. INTERFACE board 3. COORDINATE CONVERSION board 4. MEMORY board	<p>*Turn low light pots. (R338/R348/R358) on CRT board fully CW (Fig.5-5). If some picture appears, CRT assembly is OK.</p> <p>*Visually check that CRT heater is lit.</p> <p>*Turn FUNCTION switch to "OFF" and pull out CRT anode cap with special care, then move it close to chassis (approx. 8mm apart). If normal, sparking will occur.</p> <p>*If CR12 not blinking on INTERFACE board, INTERFACE or COORDINATE CONVERSION board defective.</p>
	ST-BY indication does not appear after 3 min.	1. INTERFACE board 2. COORDINATE CONVERSION board	
Turn SCANNER switch to "ON".	Scanner does not rotate.	1. Scanner fuse F1352 (10A) (Display rear) 2. Scanner Motor brushes 3. Scanner motor mechanism jammed 4. Power supply circuit for scanner motor	

Operation	Symptom	Possible Cause	Remarks
Perform Self-Test. (See page 5-2)	Error indication appears.	1. CPU board 2. MEMORY board	*If "ROM ERROR" appears, ROM IC(s) on CPU board defective. If "RAM ERROR" appears, CPU or MEMORY board defective.
	Abnormal touch-pad operation.	1. touchpad panel 2. CPU board	
After ST-BY indication appears, turn FUNCTION switch to "TRANSMIT" position and adjust BRILLIANCE control.	Picture synchronization abnormal.  	1. CRT assembly 2. MEMORY board 3. COORDINATE CONVERSION board	*Adjust H-HOLD pot. (R516) and V-HOLD pot. (R407) on DEFLECTION board (Fig.5-6). If synchronization is not achieved, DEFLECTION board defective.
	Horizontal or vertical scanning line appears on CRT.  	1. CRT assembly 2. COORDINATE CONVERSION board	
	Doubled picture appears.  	1. COORDINATE CONVERSION board	
	Legends appear abnormally.	1. CPU board	
	Legends do not appear in white but in color.	1. CRT assembly 2. MEMORY board	
	No range ring.	1. MEMORY board 2. INTERFACE board	*If EVRM does not appear, MEMORY board defective.

Operation	Symptom	Possible Cause	Remarks
Adjust GAIN control.	Noise but no echo.	1. TX fuse F1 (0.5A) (Display rear) 2. TX trigger circuit on INTERFACE board 3. MOD TRIG board 4. Modulator circuit 5. Magnetron 6. Gunn oscillator 7. Mixer diodes 8. IF AMP block (Scanner Unit) 9. VIDEO AMP board 10. INTERFACE board 11. MEMORY board	*Set RANGE switch to 48 mile detecting range, and measure voltage between pins #4(+) and #1(-) of TP103 on INTERFACE board. (MAG CURR) If the voltage is within 2.8 to 4.0V DC, circuits and parts of "possible cause" items 2 to 5 are OK. (Fig.5-3). *Set RANGE switch to 48 mile detecting range, and measure voltage between pins #2(+) and #1(-), #1(+) and #3(-) of TP103 on INTERFACE board. (X'TAL CURR) If the voltage is within 0.047 to 0.075V DC, gunn ocs. and mixer diodes are OK. (Fig.5-3). *If CR13 blinks on INTERFACE board, MEMORY board defective. (Fig.5-3)
	Radar picture is shrunk or expanded.  	1. COORDINATE CONVERSION board	
	Picture resolution is poor.	1. INTERFACE board 2. COORDINATE CONVERSION board	

Operation	Symptom	Possible Cause	Remarks
	Sweep rotation is not synchronized with antenna rotation.	1. BEARING SIGNAL GEN. board (Scanner unit) 2. Heading flash circuit 3. COORDINATE CONVERSION board	
	Abnormal bearing of picture.	1. COORDINATE CONVERSION board 2. CPU board 3. AD Converter (Option)	
Adjust TUNE control.	Poor sensitivity.	1. Deteriorated mixer diodes 2. Deteriorated magnetron 3. Detuned Gunn oscillator 4. Dirt on Radiator face 5. Water leak on waveguide	*Set RANGE switch to 48 mile detecting range, and measure voltage between pins #4(+) and #1(-) of TP103 on INTERFACE board. (MAG CURR) If the voltage is too low. Magnetron has deteriorated.
Adjust STC, FTC control.	No STC or FTC effect.	1. VIDEO AMP board	

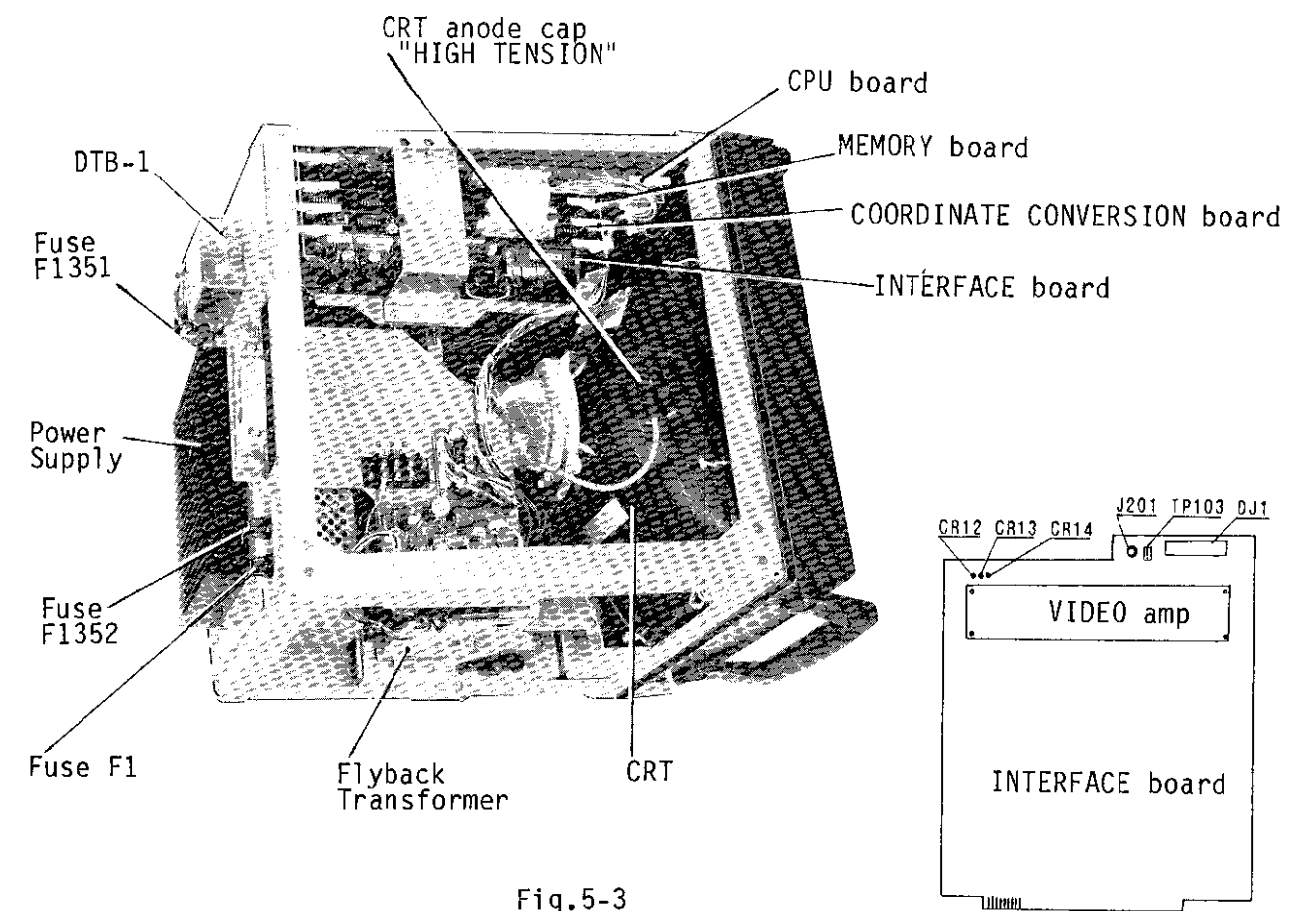
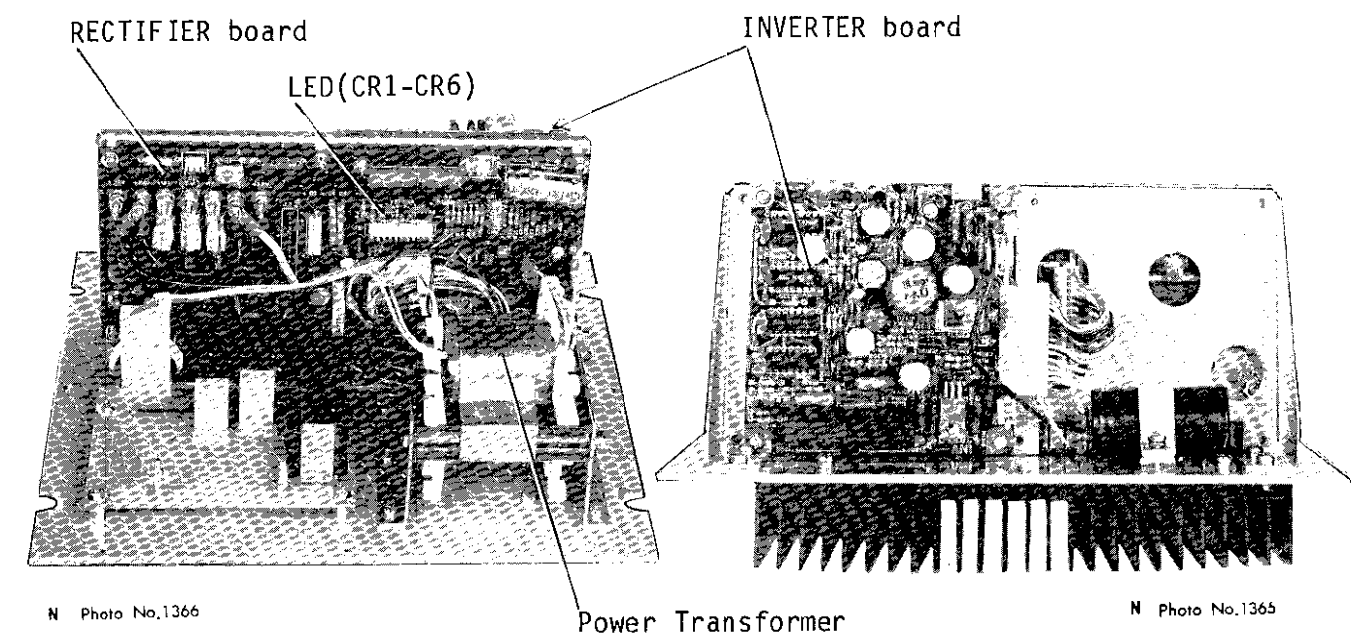


Fig.5-3

N Photo No.1353



N Photo No.1366

N Photo No.1365

Fig.5-4 Power Supply

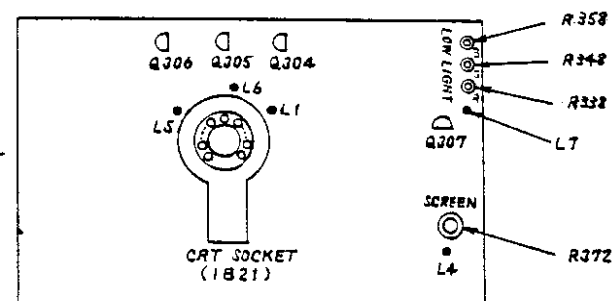


Fig.5-5 CRT board

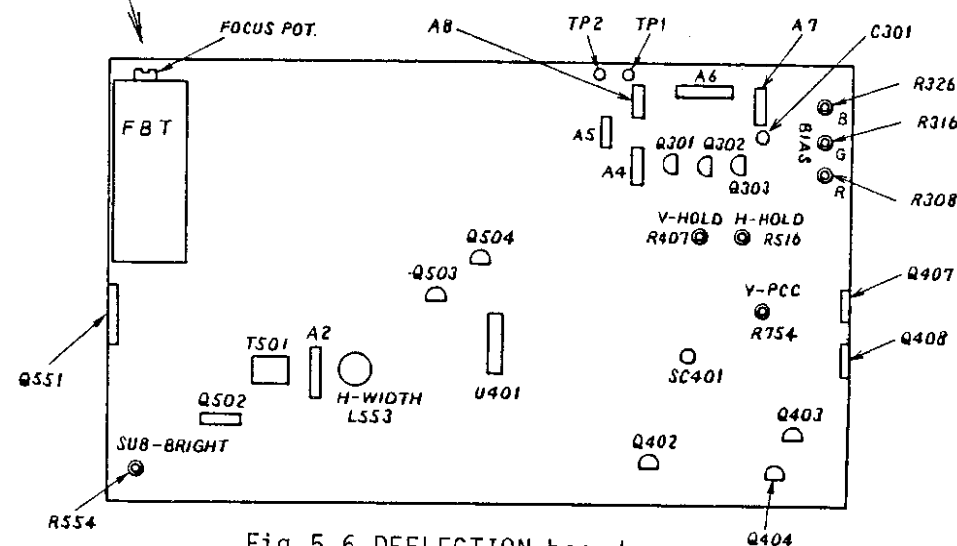


Fig.5-6 DEFLECTION board

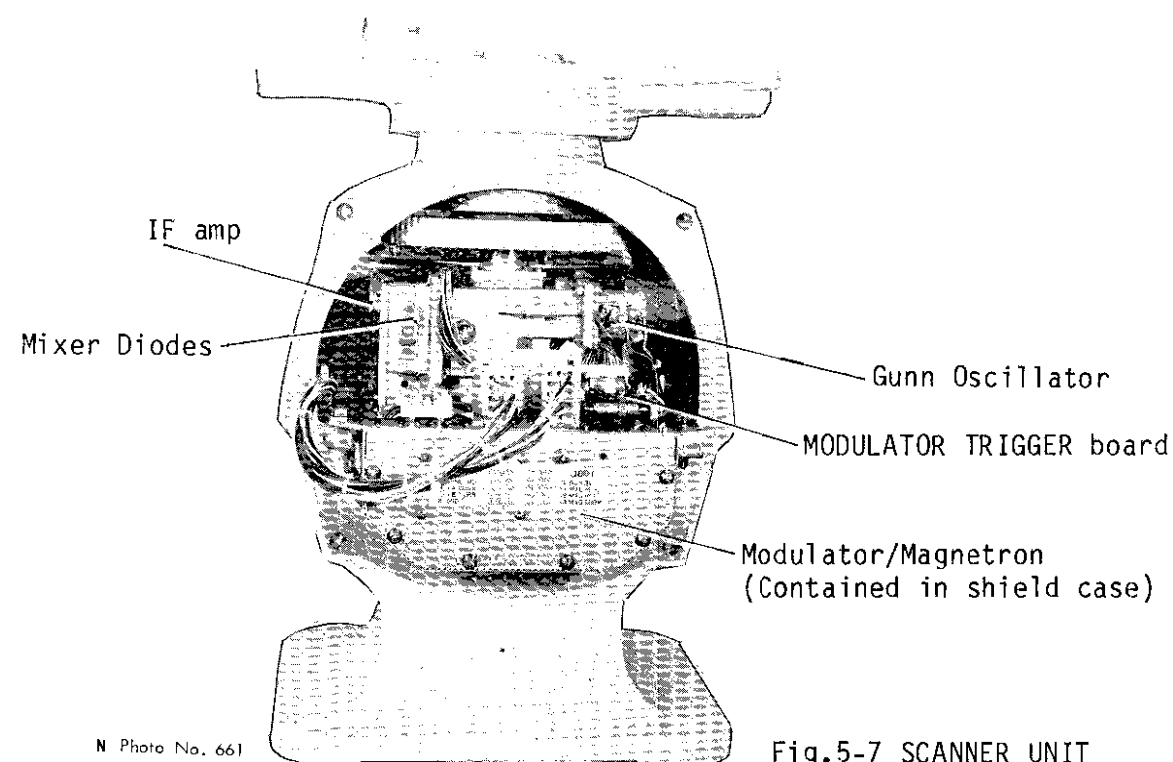


Fig.5-7 SCANNER UNIT

APPENDIX 1.

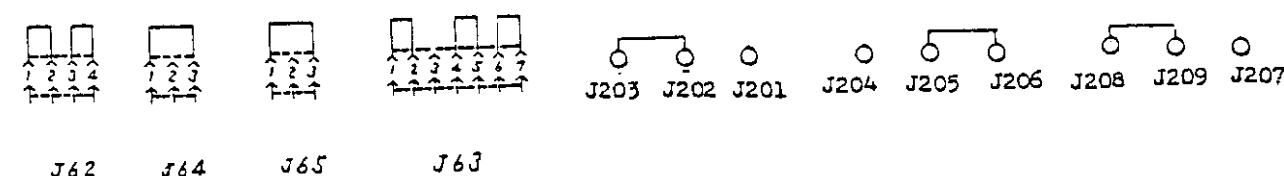
HOW TO COMBINE RI-3 WITH COLOR RADAR

1. Connection

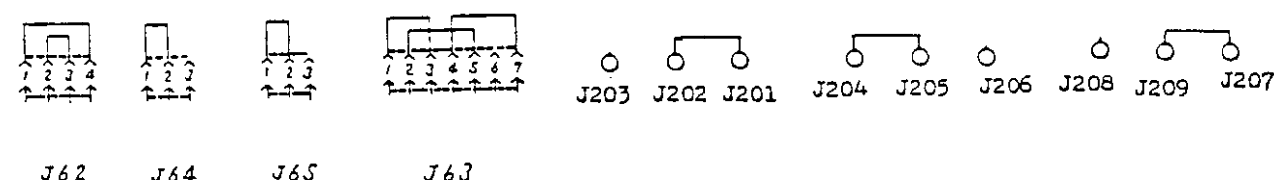
- 1) Connect the cable (RW-4848) from RI-3 to J20 on INTERFACE Board 03P4754.
- 2) Connect the power cable from RI-3; the BLK wire to "-DC" and the RED wire to "+DC" on RECTIFIER board 03P4764. Refer to Page AP1-3.

2. Modification

- 1) Change the jumper wires on J62 thin J63 and J201 thin J209 on INTERFACE board 03P4754 and VINEO AMP board 03P5080

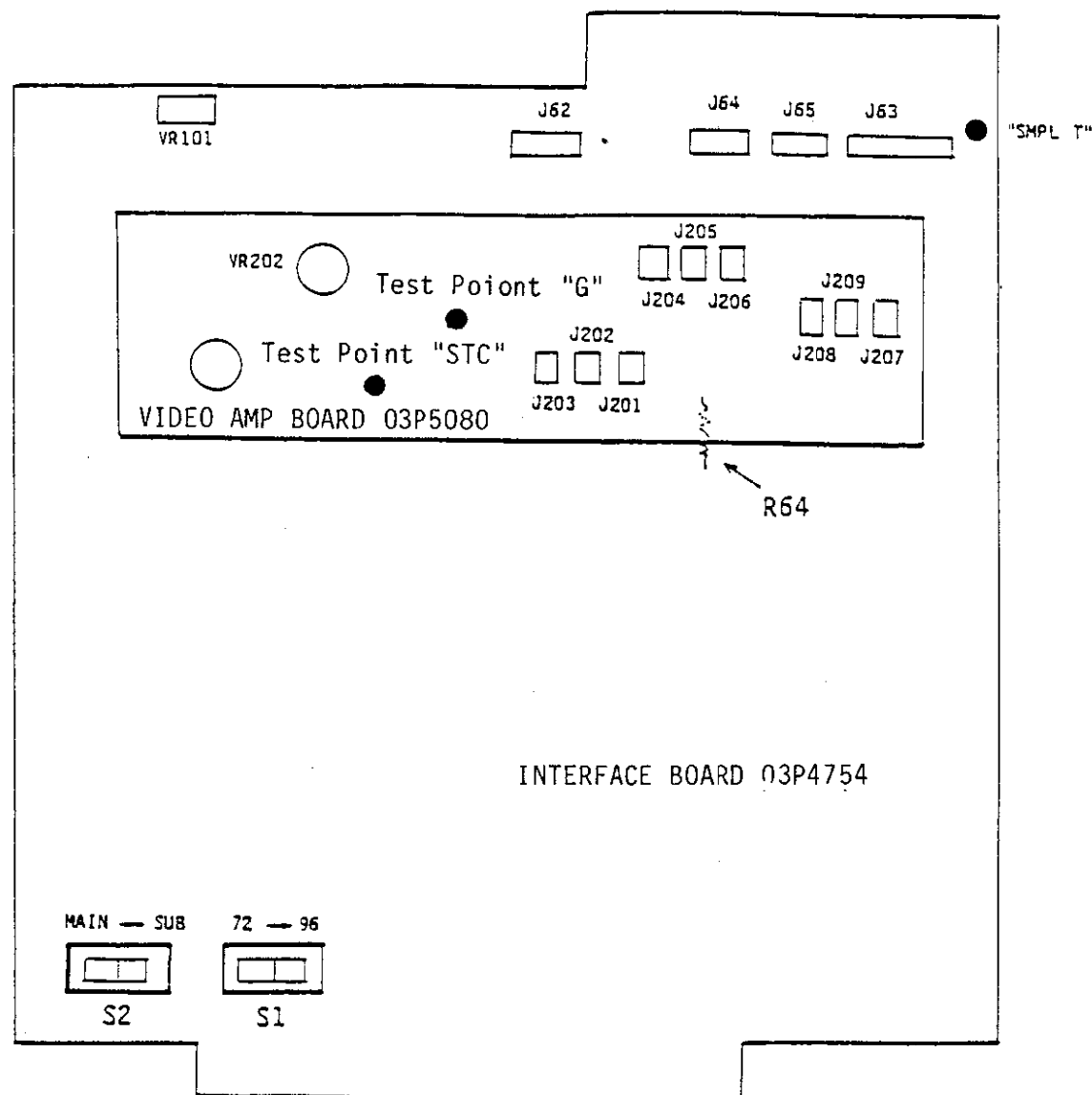


With RI3

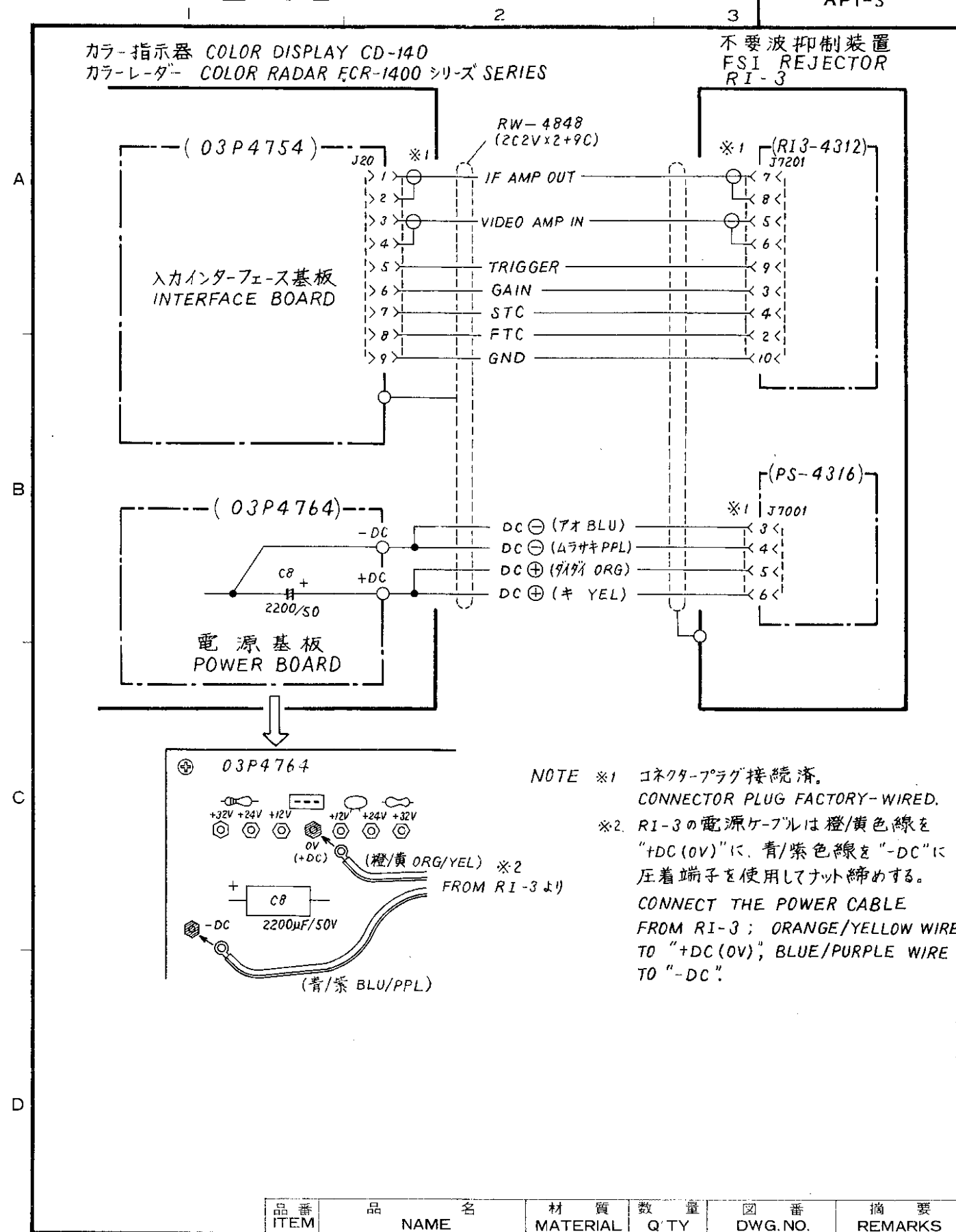


Without RI-3

- 2) Change the resistor of R64 from 10K ohms, 1/4W to 4.7K ohms, 1/4W or add a resistor 10K ohms, 1/4W across R64.



INTERFACE BOARD (C) 03P4754



承認 APPROVED	品番 ITEM	品名 NAME	材質 MATERIAL	数量 QTY	図番 DWG. NO.	摘要 REMARKS
APR. 30. 83 K. Kato		三 角 法 THIRD ANGLE PROJECTION				名 称 TITLE RI-3 不要波抑制装置相互結線図 FSI REJECTOR
検 図 CHECKED	APR. 30. 83	尺 度 SCALE				
製 図 DRAWN	Apr. 30. 83 Banda	重 量 WEIGHT	kg		図 番 DWG. NO.	C3245-004-A

APPENDIX 2

INTERNAL PRE-SET SWITCH

An internal pre-set switch comprises 8 dip switches and is located on the CPU board 03P4754 as shown on the next page. No.3 and No.7 switches are factory-set to "ON" and other switches, to "OFF".

No.1 switch

"OFF": No.1 EVRM is indicated in nautical mile (NM).

"ON" : No.1 EVRM is indicated in kilometer (KM).

No.2 switch

"OFF": No.2 EVRM is indicated in nautical mile (NM).

"ON" : No.2 EVRM is indicated in kilometer (KM).

No.3 switch

"ON" : The "beep" sound is heard whenever any touchpad key is pressed.

"OFF": Whether "beep" sound is given with touchpad key operations or not changes alternately by every pressing the TEST/COLOR CHANGE/SOUND touchpad ☐.

(Initially when powered-on, "beep" sound is given.)

No.4 switch

In CD-140, this switch is set to "ON" when FURUNO radar FRL-100 or FRI-85 is connected as main radar.

In color radar FCR-1400 series, this switch is not used.

No.5 switch

Not used.

No.6 switch

"OFF": "Plotting at selected interval" mode is selected.

"ON" : "Continuous course plotting" mode is selected.

No.7 switch

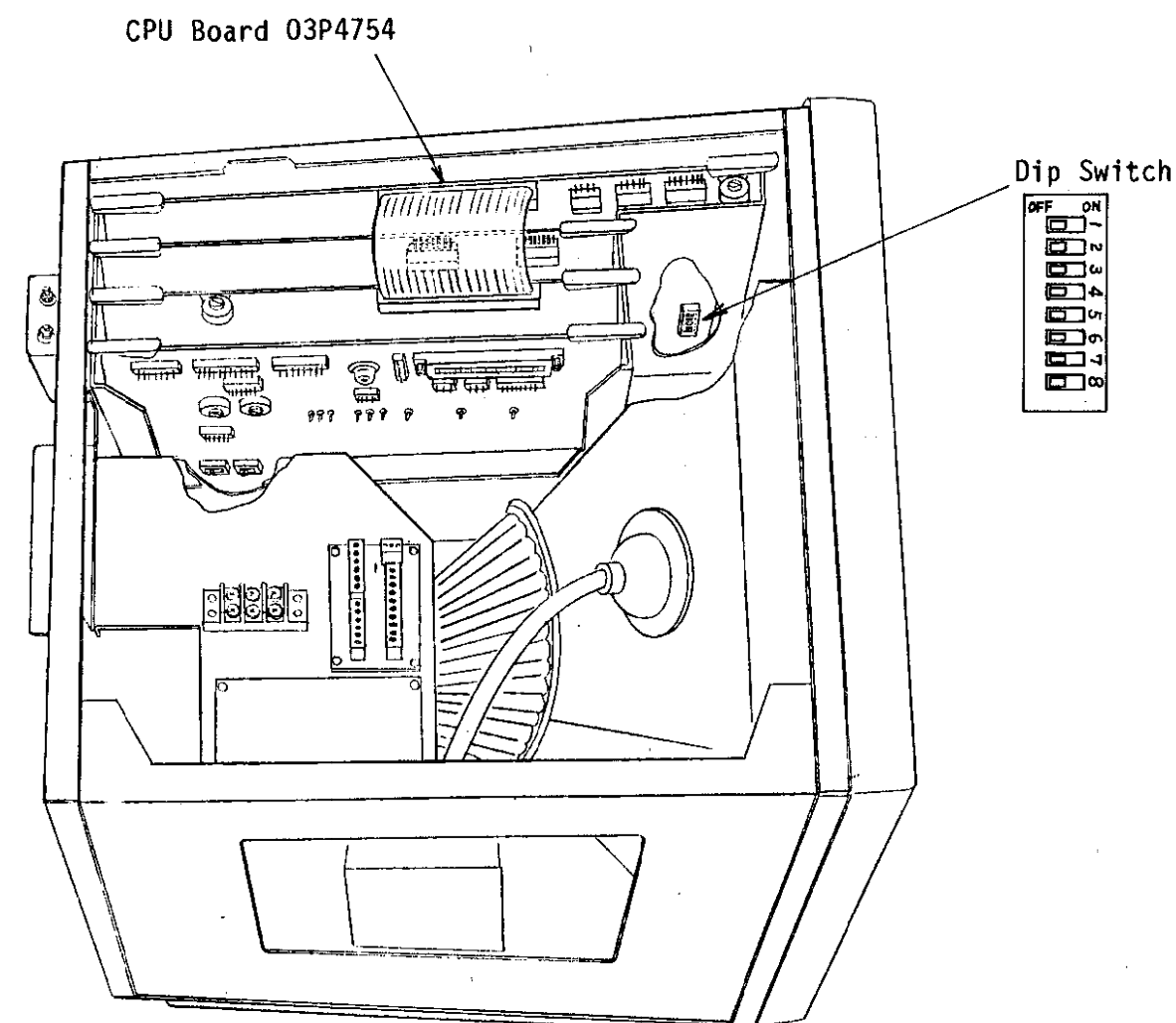
"OFF": The heading flash appears or disappears repeatedly every time ☐ (Heading off) key is pressed in combination mode with GD-2000.

"ON" : The heading flash disappears while ☐ (Heading off) key is pressed in combination mode with GD-2000.

No. 8 switch

Normally set to "OFF".

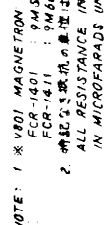
When this switch is set to "ON", the communication interface IC for Color Video Plotter Control Unit GD-2000 can be checked with "Dummy Connector" connected to J30 on the CPU board 03P4754.



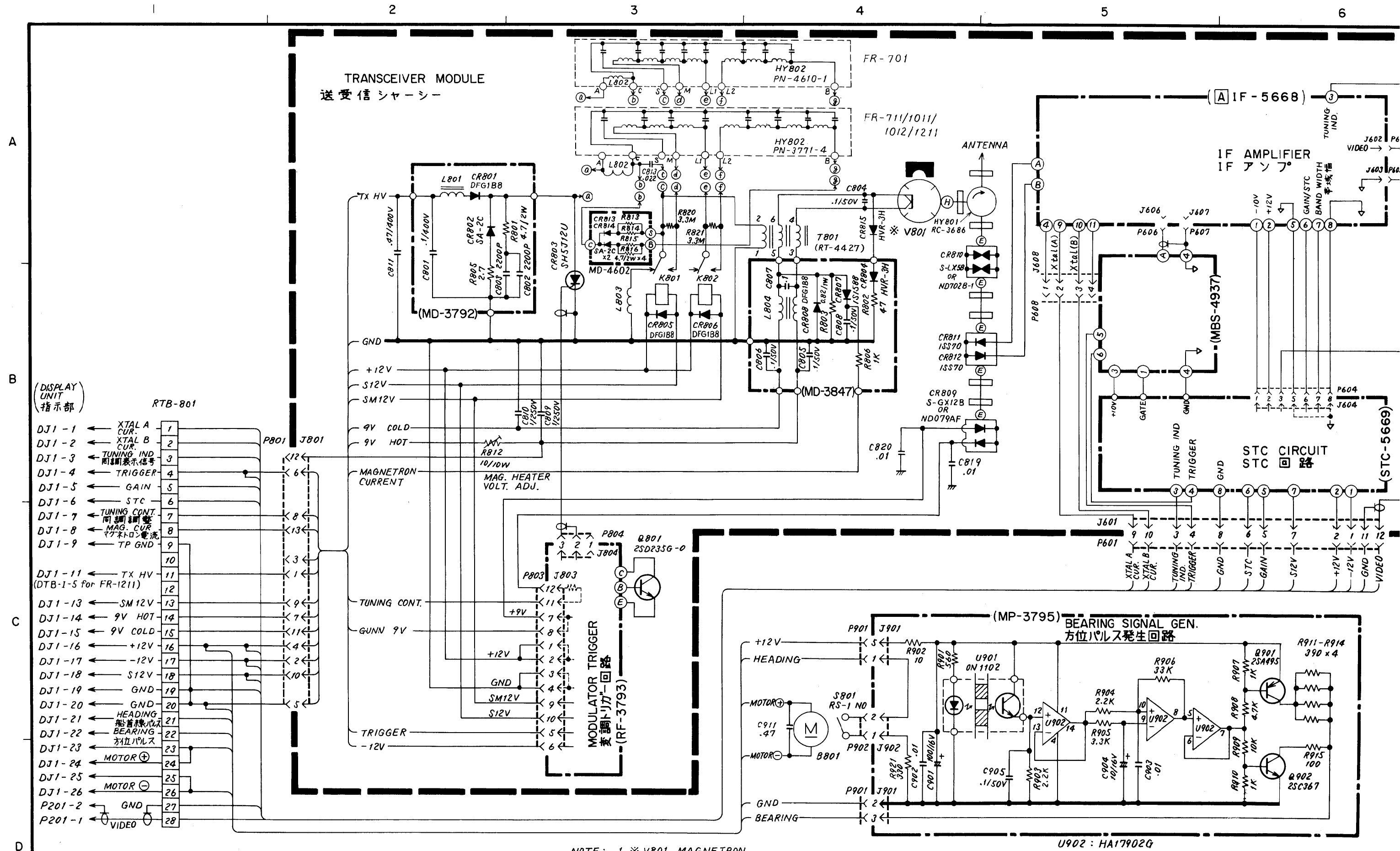
CONTENTS OF SCHEMATIC DIAGRAMS

The following is a complete set of schematic diagrams for the FCR-1411 and FCR-1411A color radars.

No.	Items	FCR-1411 Radar			FCR-1411A Radar		
		Type	Dwg. No.	Page	Type	Dwg. No.	Page
1	Scanner Unit		C3259-006	S-1		C3237-035	S-1A
2	Modulator Trigger Board	RF-3793	C3237-013	S-2	RF-3793	C3237-013	S-2
3	IF Amplifier	IF-4366	C3259-011	S-3	AIF-5668	C3237-037	S-3A
4	STC Circuit Board				STC-5669	C3237-036	S-3B
5	Display Unit		C3259-005	S-4		C3259-005	S-4
6	Mother Board	03P4758	C3259-007	S-5	03P4758	C3259-007	S-5
7	Inverter Board	INV-6022	C3278-005	S-6	INV-6022	C3278-005	S-6
8	Rectifier Board	B03P4764	C3259-013	S-7	B03P4764	C3259-013	S-7
9	TX H.V. Board	BHV-4119	C3259-010	S-8	BHV-4119	C3259-010	S-8
10	Control Panel Board	C03P4759	C3259-008	S-9	C03P4759	C3259-008	S-9
11	Touchpad Panel Board	03P4760	C3259-009	S-10	03P4760	C3259-009	S-10
12	CRT Display	TX-1403KA	C3259-012	S-11	TX-1403KA	C3259-012	S-11



FCR-1401 MARK-I
FCR-1411 MARK-II
FCR-1401
FCR-1411



NOTE: 1. * V801 MAGNETRON

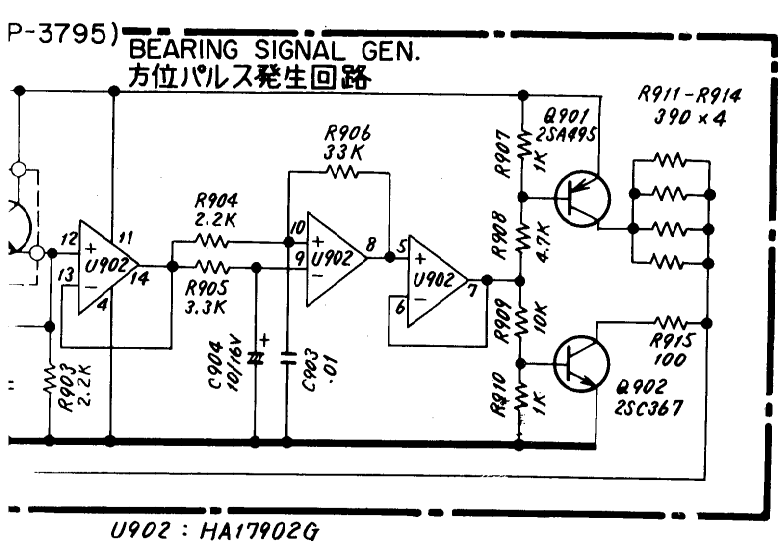
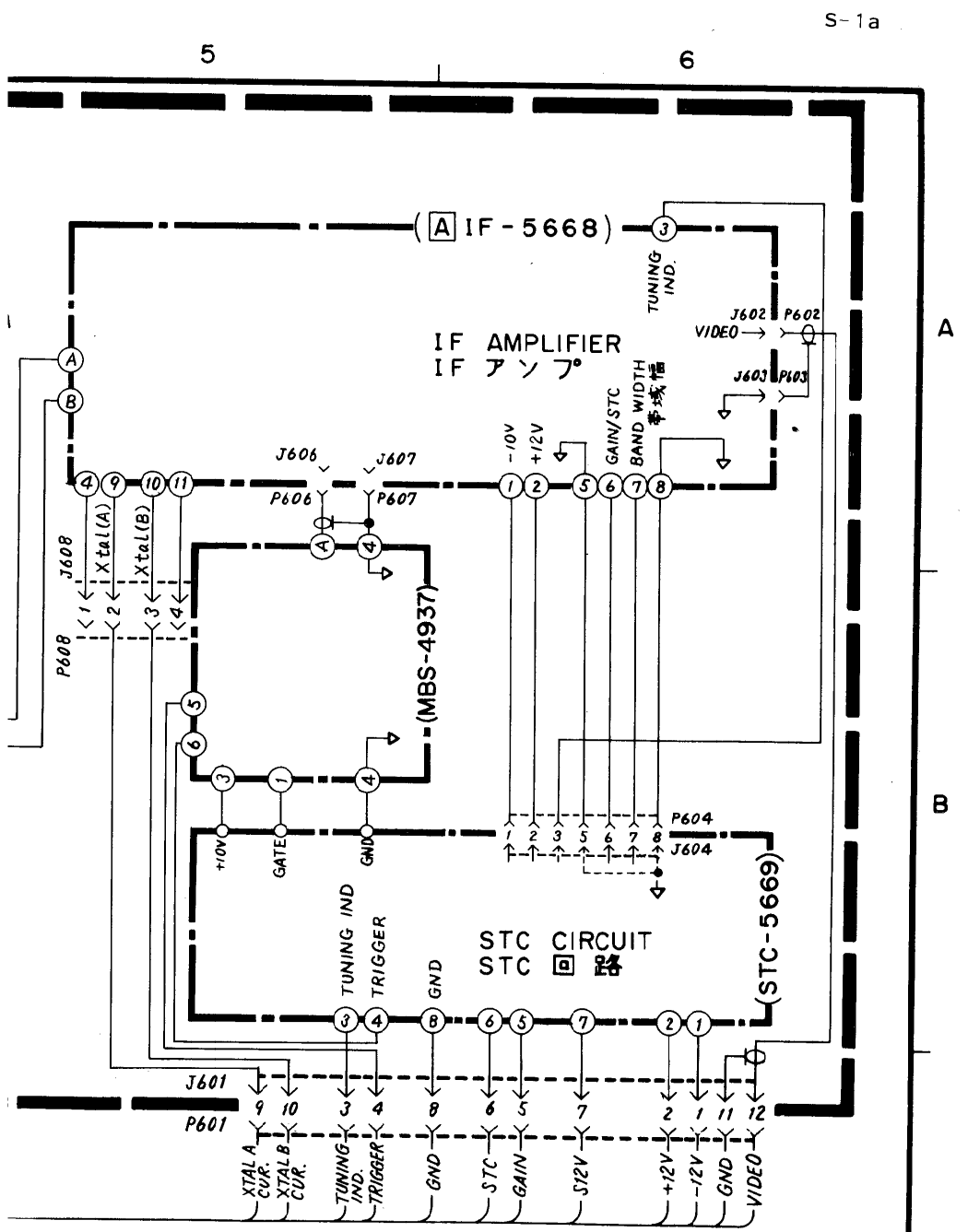
FR-701 : 9M502/E3526

FR-711/1011/1012 : 9M602 OR M597, FR-1211: 9M602 OR MG5241

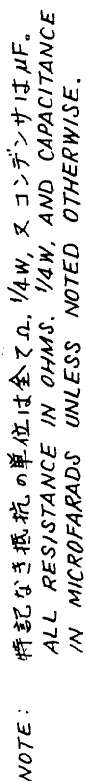
2. 特記なき抵抗の単位は全てΩ, 1/4W, X コンデンサはμF.
ALL RESISTANCE IN OHMS, 1/4W, AND CAPACITANCE
IN MICROFARADS UNLESS NOTED OTHERWISE.

FR-701A/711A
FR-1011A
FR-1012A
FR-1211A
FCR-1401A/1411A

承認 APPROVED	検 CHECKED	製 DRAWN	名称 TITLE
			SCANNER UNIT 空中線部
			製番 DWG. No. C3237-035



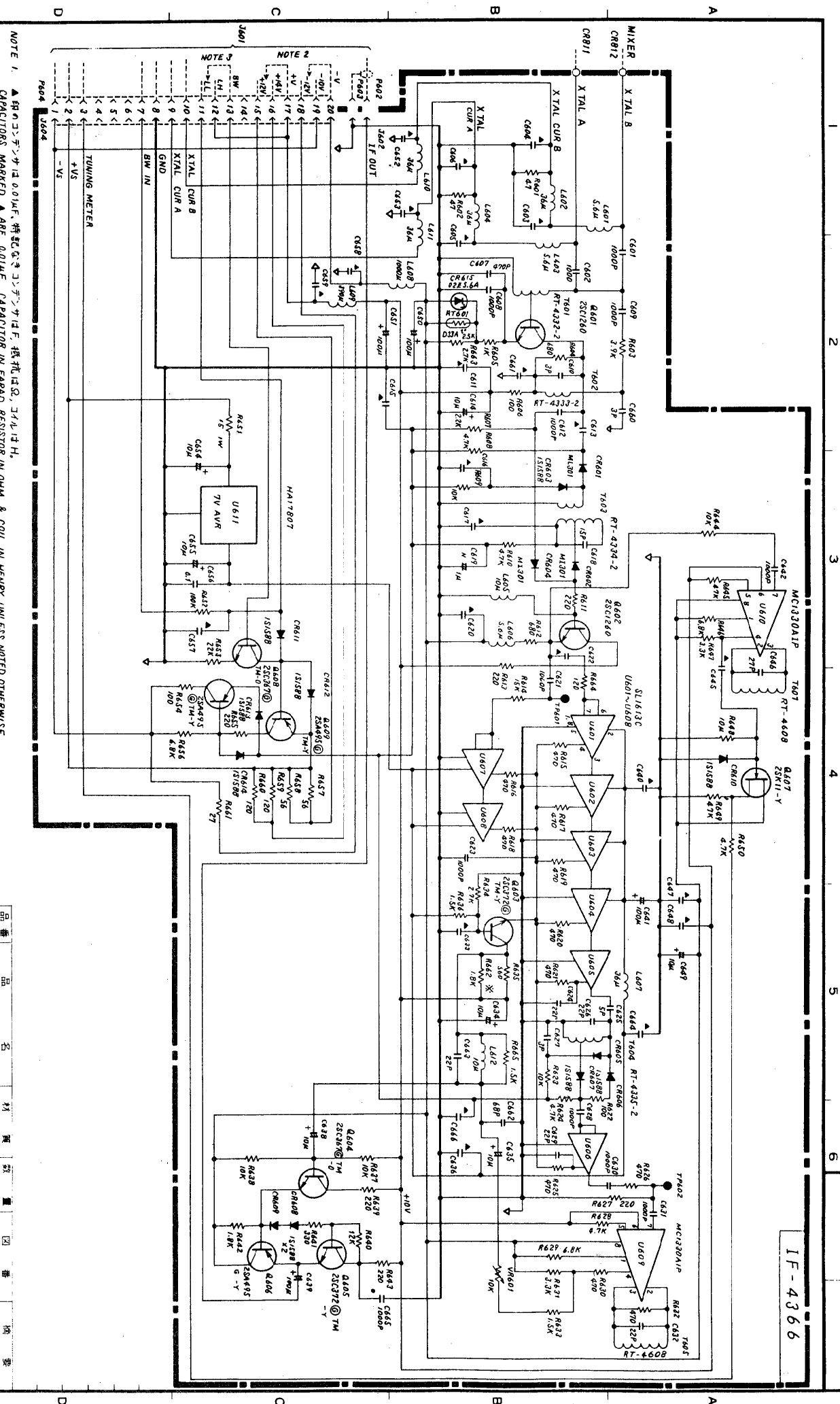
承認 APPROVED	検図 CHECKED	製図 DRAWN	名称 TITLE SCANNER UNIT 空中線部
101A/111A 1011A 1012A 1211A 1401A/1411A	Oct. 23, '84	Oct. 17 '84 K. Kusunagi	図番 DWG. No. C3237-035-B



FURUNO ELECTRIC CO., LTD.

承認 APPROVED	検査 CHECKED	製図 DRAWN	1983.11.23 1983.11.23 1983.11.23 1983.11.23
品番 ITEM	品名 NAME	材料 MATERIAL	数量 QTY
第三角法 THIRD ANGLE PROJECTION	名称 TITLE	図番 DWG. NO.	検査 CHECKED
尺度 SCALE	IF 7.7 回路 IF-4366 IF AMPLIFIER		検査 CHECKED
重量 WEIGHT	kg	図番 DWG. NO.	検査 CHECKED
		C3259-011-A	

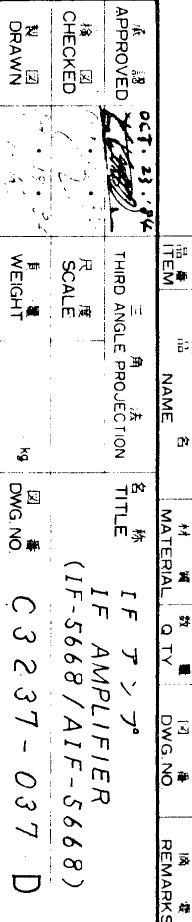
FURUNO ELECTRIC CO., LTD.





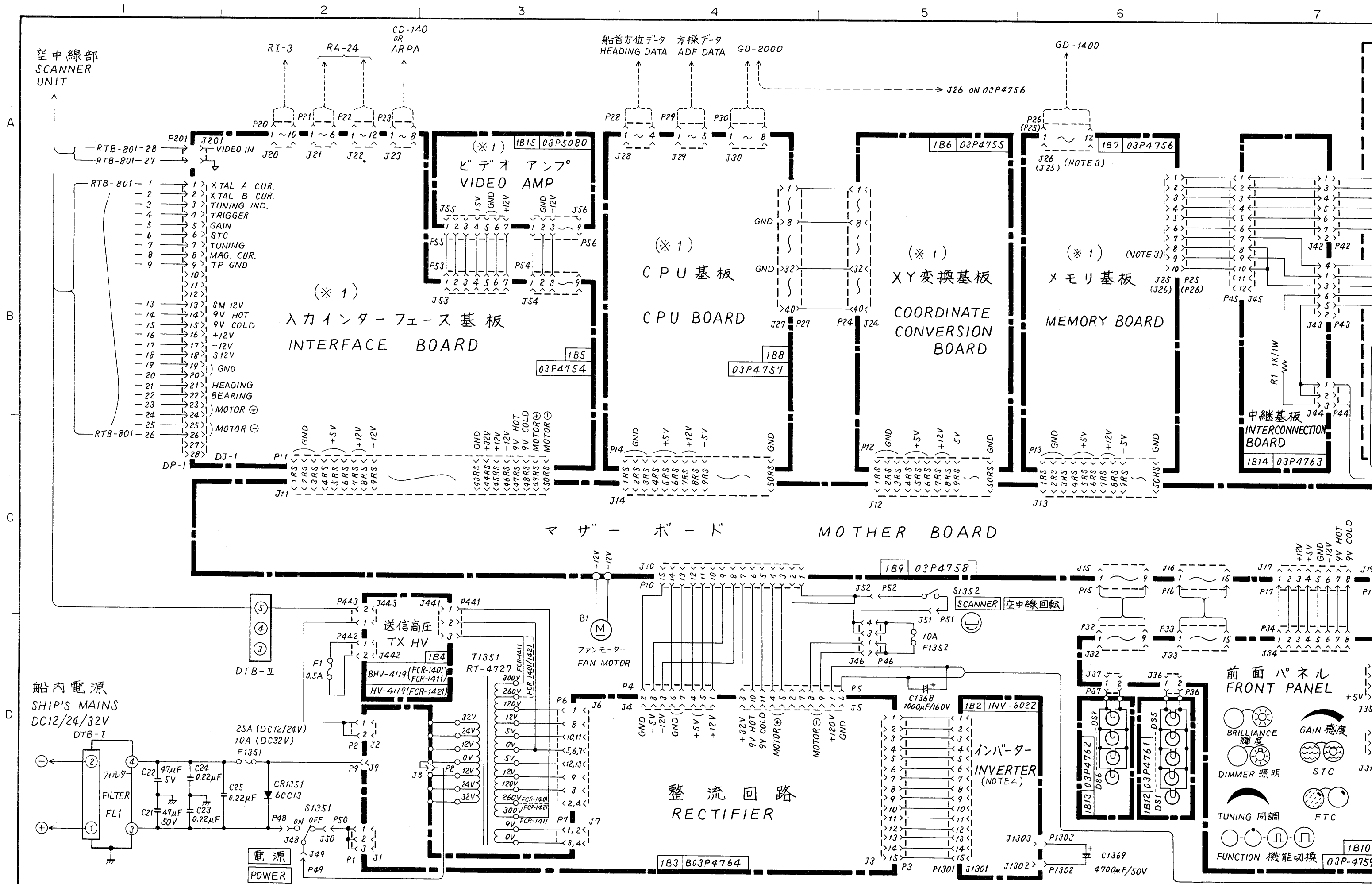
FCR-1400 MARK II A SERIES
FR-80SDA/810DA/82CDA
FR701A/711A/721A
FR1011A/1012A/1021A/1022A
FR1211A/1221A
FCR-1401A/1411A/1421A
FR-701/711/721 MARK II-A
FR-1001/1011/1021 MARK II-A
FR-1002/1012/1022 MARK II-A

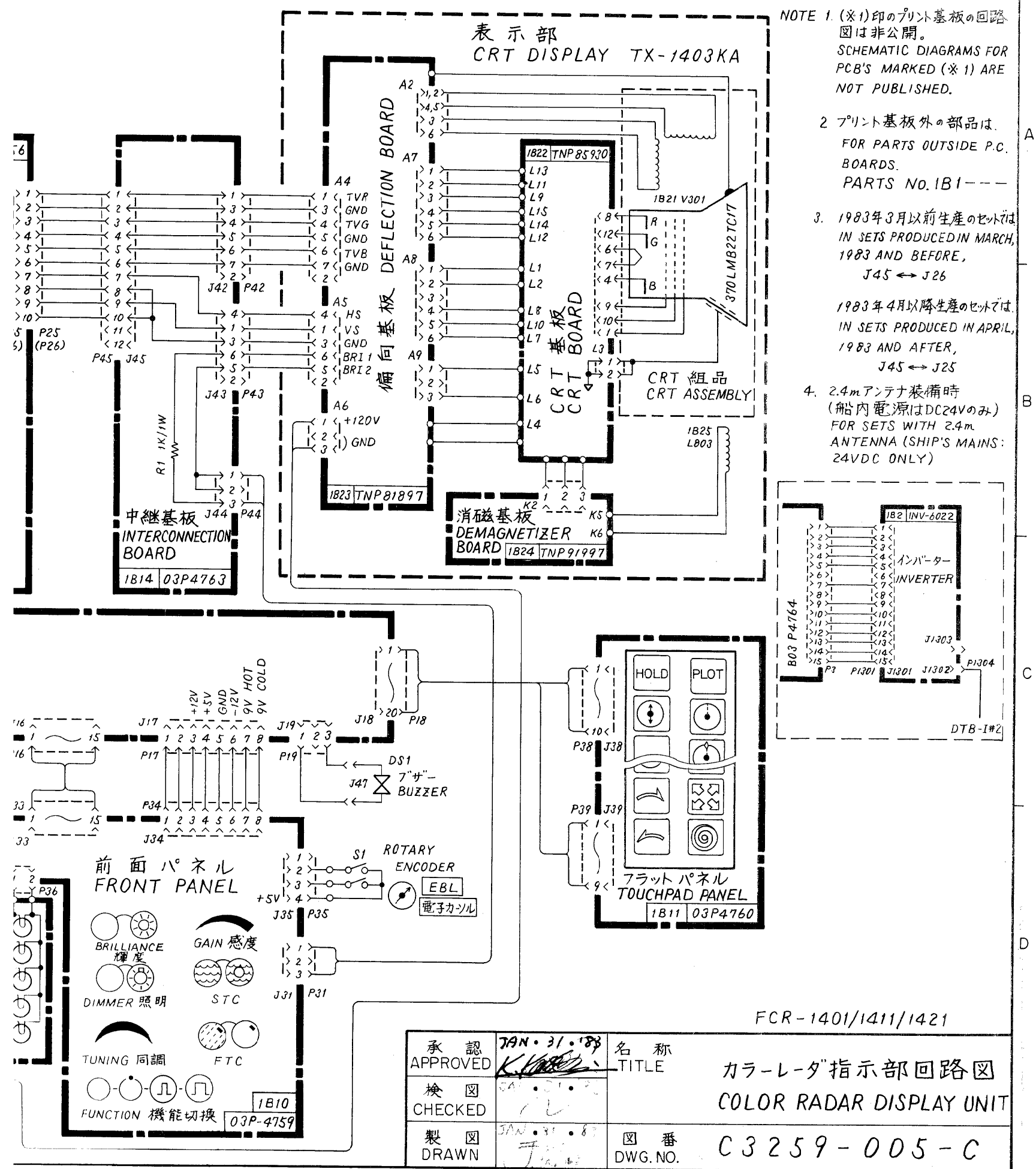
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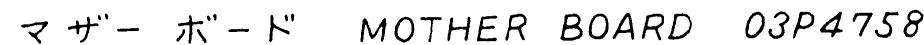


2. $\blacktriangle: 0.01\mu F, 50V$

FURUNO ELECTRIC CO., LTD

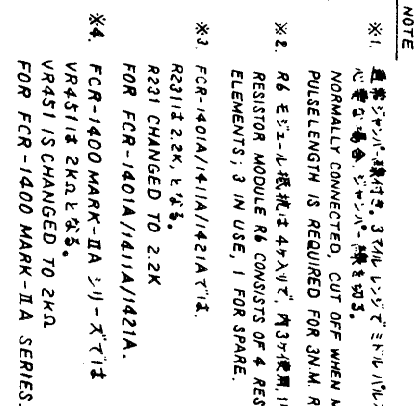






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機型	MODEL	基板型名	PRINT TYPE
FGR-1401	(MARK-II)	B03P-4759	
FGR-1411/1421	(MARK-II)	C03P-4759	
FGR-1401A		D03P-4759	
FGR-1411/1421A		E03P-4759	
FGR-1401 MARK-IIA		F03P-4759	
FGR-1411/1421 MARK-IIA		G03P-4759	

FRONT PANEL BOARD
前面パネル基板
03P-4759

FCR-1400 MARK-II (A) SERIES
FCR-1400 (A)

REV. 10/85

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