No. : OM-E3275-2D

FURUNO

OPERATOR'S MANUAL

MARINE RADAR

MODEL FR-802D

FURUNO ELECTRIC CO., LTD.
NISHINOMIYA, JAPAN

880410KY(8804, yoha)
PRINTED IN JAPAN

CONTENTS

FURUNO

SPECIFICATIONS OF FR-802D RADAR

SCANNER UNIT

1. Radiator:	80cm center-fed slotted waveguide array, enclosed in radome
2. Radiator Rotation:	24 r.p.m.
3. Wind Load:	Relative wind 100 knots
4. Horizontal Beamwidth:	2.7°
5. Vertical Beamwidth:	25°
6. Sidelobe Attenuation:	Within ±20° of main lobe; 21 dB Outside ±20° of main lobe; 25 dB
7. Polarization:	Horizontal

TRANSCEIVER MODULE

1. Transmitting Tube:	Magnetron 9M302/E3513
2. Frequency & Modulation:	9410MHz ± 30MHz, PON
3. Peak Output Power:	3kW nominal
4. Pulselength & Pulse Repetition Rate:	

Pulselength	Pulse Repetition Rate(Hz)	Range (N.M.)
Short (S) 0.08us	Approx. 3300	0.25 to 1.5
Long (L) 0.5us	Approx. 840	3 to 36

5. Modulator:	SCR Line Type Pulse Modulator
6. I.F.:	40MHz
7. Tuning:	Manual
8. Receiver Front End:	MIC (Microwave IC)
9. Bandwidth:	7MHz/3MHz
10. Duplexer:	Circulator and Limiter

DISPLAY UNIT

1. Indication System:	PPI, Daylight Display
2. Picture Tube:	12 inch rectangular CRT

3. Range:
4. Range Ring Interval:
5. Number of Rings:

0.25	0.5	0.75	1.5	3	6	12	24	36	n.m.
0.05*	0.1*	0.25	0.25	0.5	1	2	4	6	n.m.
5	5	3	6	6	6	6	6	6	pcs.

* Kilometer unit 0.1km and 0.2km available for 0.25 and 0.5 n.m. ranges respectively with internal dip switch.

6. Display Mode: 1) Head-up
*2) Course-up
*3) North-up
*: Only when a gyro interface (option) is connected.

7. Bearing Resolution: Better than 2.7°
8. Bearing Accuracy: Better than 1°
9. Range Discrimination: Better than 31m
10. Minimum Range: Better than 36m
11. Range Ring Accuracy: 0.2%
12. VRM Accuracy: 0.5% or 10m, whichever is the greater.
13. Mark Indication: Heading Mark, North Mark, Bearing Scale, Range Ring, No.1/No.2 VRM's, No.1/No.2 EBL's and Alarm Zone Mark
14. Numeral/Character Indication: Range, Range Ring Interval, Display Mode (HU,CU,NU), Pulselength (S,L), Plot Interval, Interference Rejection (IR), Radar Alarm (ALM), Ship's Bearing, EBL Bearings (No.1/No.2 EBLs), VRM Ranges (No.1/No.2 VRMs) and Echo Stretch (ES), Bearing Mode (R for relative, T for true)
15. Plotting Mode: Continuous or selected interval; 15sec, 30sec, 1min, 3min and 6min
16. Interference Rejector: Built in
17. Radar Alarm: Built in
18. Echo Stretch: Bulit in

ENVIRONMENT CONDITION

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

2. Ambient Temperature: Scanner Unit -------- -25°C to +70°C
Display Unit -------- -15°C to +55°C
3. Humidity: Relative humidity, 95% at +40°C

POWER SUPPLY & POWER CONSUMPTION

12Vdc (10.2-15Vdc) or 24/32Vdc (20.4-40Vdc) directly by changing jumper connections, 95W at 12VDC. 100/110/115/220/240Vac, 50/60Hz, 1ø, with extra rectifier (RU-3423, option), 155VA

COATING COLOR

1. Display Unit ---- Munsell 2.5GY5/1.5 Embossed T25 (Light gray) for Cabinet, Munsell N3.0 Newtone No.5 (Dark gray) for Control Panel
2. Scanner Unit ---- Munsell N9.5 for Radome, Munsell 2.5PG3.5/10 for Radome Mounting Base
3. Rectifier Unit -- Munsell 2.5GY5/1.5 Newtone No.5 (Light gray)

EQUIPMENT LIST

No.	Name	Type	Q'ty	Weight	Remarks
1	Scanner Unit		1	19 kg	
2	Display Unit	RDP-006T(Tabletop) or RDP-006B(Bulkhead)	1	20 kg	
3	Rectifier Unit	RU-3423	1	16.5kg	Option
4	Accessories	FP03-00100	1 set		
5	Installation Materials	CP03-01600	1 set		
6	Standard Spare Parts	SP03-02000	1 set		

OPTIONAL SUPPLY

No.	Name	Type	Code No.	Remarks
1	Gyro Interface Unit	AD-10S		
2	Power Cable	VV-S 2x2C	000-564-559	3.5m
3	Filter Assy.		008-290-100	
4	Hood w/Magnifying Lens	MFL-800	008-203-120	

STANDARD SPARE PARTS (Type: SP03-02000, Code No.: 000-081-027)

No.	Name	Type	Code No.	Q'ty	Remarks
1	Lamp	T3.8C 8V 60mA	000-540-180	2	Panel Illumi.
2	Fuse	FGBO, 20A	000-549-015	2	12VDC Mains
3	Fuse	FGBO, 10A	000-549-065	2	24/32VDC Mains
4	Fuse	FGBO, 0.5A	000-549-060	2	High Voltage
5	Fuse	FGBO-A, 1A	000-549-061	2	Scanner Motor
6	Fuse	UL-TSC125V2A	000-101-132	3	CRT Display
7	Label (1)	03-011-1051-0	301-110-510	1	POWER & SCANNER sw.
8	Label (2)	03-011-1052-0	301-110-520	1	POWER & SCANNER sw.
9	Socket Wrench	Hex. 1.5mm	000-830-112	1	
10	Spare Parts Box	F710 type	000-831-610	1	

ACCESSORIES (Type: FP03-00100, Code No.: 000-081-105)

No.	Name	Type	Code No.	Q'ty	Remarks
1	Vinyl Cover	03-011-0401	000-879-490	1	Display Unit
2	Hood Assembly	FP03-00110	008-111-640	1	

INSTALLATION MATERIALS (Type: CP03-01600, Code No.: 000-082-902)

No.	Name	Type	Code No.	Q'ty
1	Multicore Cable	RW-4160	003-152-100	10m
2	NH Connector Assy.	03-302 (4P)	008-300-570	1
3	Connector	16P2B	000-500-346	1
4	Lug	ø4	000-536-100	4
5	Cable Clamp (1)	03-011-1222-0	100-016-300	1
6	Cable Clamp (2)	03-011-1223-0	100-016-310	1
7	Hex. Bolt	M12 x 60	000-862-191	4
8	Hex. Nut	M12	000-863-112	4
9	Flat Washer	M12	000-864-132	4
10	Spring Washer	M12	000-864-263	4
11	Crimp-on Lug	FV5.5-4 (ø4)	000-538-123	1
12	Crimp-on Lug	FV1.25-3 (ø3)	000-538-113	20
13	Seal Washer	CW1053DX	300-850-021	4
14	Drain Tube	03-003-3001-0	300-330-010	1
15	Safety Lanyard	03-003-3002-0	300-330-020	1
16	Fitting Metal	ML	000-570-342	1
17	Label (7)	03-004-0207-0	300-402-070	1

* Note: Items 1 thru 6 are used for display unit and items 7 thru 17 for scanner unit.

CHAPTER 1 OPERATION INSTRUCTIONS

Adjustment and function for the respective operating controls is 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.

1.1 Function of Each Control (See page 1-18.)

POWER Switch

This switch turns on/off the power supplied to the radar system. Turn it to ON (OFF) to initiate (or cease) the radar operation.

Shortly after the unit is turned on, the 3 minute timer and internal dip switch setting (See page AP2-1.) will appear on the screen as shown in Fig.1-1. The timer will count down from "3:00" to "0:00", and the display will change to the "ST-BY" indication, showing that the radar is ready to transmit.

NOTE: The self-check for memory devices (ROM/RAM) is carried out automatically at every power-up. Confirm that the ROM1, ROM2 and RAM are indicated by "OK" at the bottom of the display. See Fig.1-1. If the self-check sequence detects a failure of some block, the message "ERROR" is displayed such as "ROM1 ERROR". Refer to Section 4.1 Self-check for Memory Device on page 4-1 for more details.

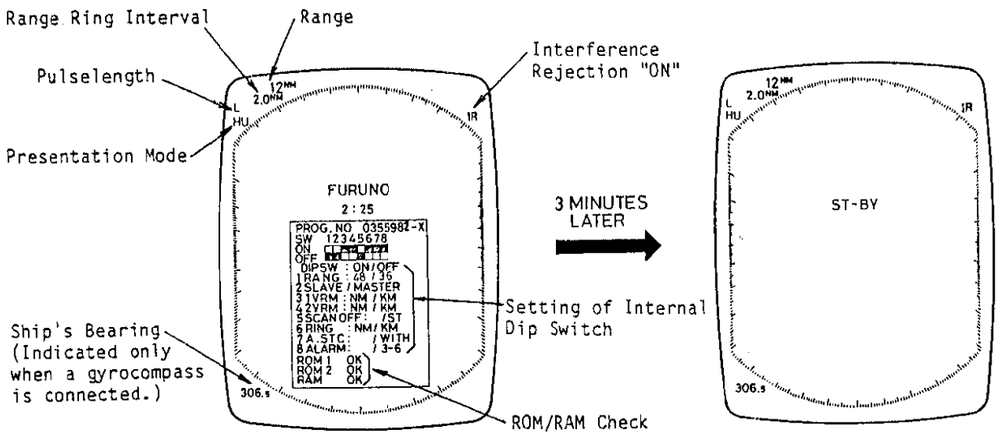


Fig.1-1 Fig.1-2

SCANNER Switch

When this switch is turned to ON with the **POWER** switch turned on, the antenna begins to rotate.

When this switch is turned to OFF, the radar is put in standby condition irrespective of **TX** touchpad setting.

TX (Transmit) Touchpad

Press this touchpad while the indication of the "ST-BY" is displayed on the screen as shown in Fig.1-2, and the radar pulses are transmitted and then any echoes reflected from the targets are received and displayed on the screen. - TRANSMIT Condition.

The pulselength and pulse repetition rate are automatically determined by means of the range settings as shown in Table 1-1.

The pulselength selected is indicated as "S" (0.08us), and "L" (0.5us) at the top left on the screen. See Fig.1-3.

Table 1-1

Pulselength	Pulse Repetition Rate(Hz)	Range (N.M.)
Short (S) 0.08us	Approx. 3300	0.25 to 1.5
Long (L) 0.5us	Approx. 840	3 to 36

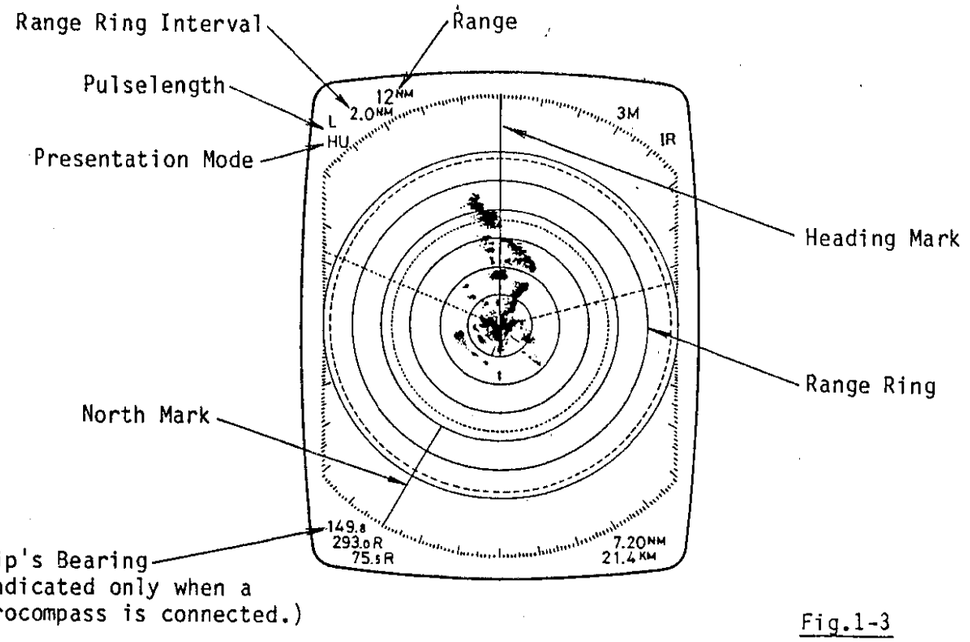


Fig.1-3

ST-BY Touchpad 

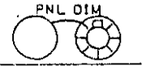
Pressing this touchpad stops the transmission. Press the TX touchpad again to present the radar picture on the screen. This touchpad is utilized when the use of the radar is temporarily suspended.

RANGE Switch

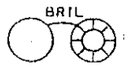
This 9 position range switch selects the detection range. See Table 1-2. The range selected determines automatically the range ring interval.

Table 1-2 Range and Range Ring Interval

Range	0.25	0.5	0.75	1.5	3	6	12	24	36	n.m.
Range Ring Interval	0.05	0.1	0.25	0.25	0.5	1	2	4	6	
Number of Rings	5	5	3	6	6	6	6	6	6	pcs.

PANEL DIMMER Control 

This adjusts the illumination of the control panel. Turning it CW increases the brightness of the illumination.

BRILLIANCE Control 

This adjusts the brightness of the picture. Turning it CW increases the intensity of the radar echo blips.

MARK BRIL Touchpad 

This touchpad changes the brightness of the characters, numerals and marks (range rings, EVRM and EBL) presented on the screen in 4 steps. Every depression of touchpad changes the brightness stepwise.

ECHO STRETCH Touchpad 

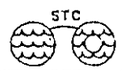
This magnifies small blips in long pulselength setting for better distinction of echoes. The "ES" is indicated at the top right on the screen when this touchpad is turned on. If this is pressed in short pulselength setting, the indication of the "ES" is presented in black with green background to inform the operator that ECHO STRETCH mode is inactive.

TUNE Control 

This control is used to tune the receiver in the transmitter. The tuning is made by moving the control slowly through the limits of its travel to find the position where a comparatively weak long range echo is discerned on the screen with maximum definition. The best tuning position is usually found at a point where the control is advanced 50% of its travel.

GAIN Control 

This control adjusts the sensitivity of the receiver amplifier. Turning it CW increases the receiver gain. Normal setting for this control around 60% of its travel produces slight background speckles (white noise) on the screen. On short ranges, it is recommended that the **GAIN** control is set almost fully CW and the **STC** control for best picture presentation.

STC (anti-clutter sea) Control 

This control reduces the gain at close range to reduce sea clutter caused by multiple random echoes from waves. Since this control is effective over the screen on short ranges, it is recommended to use this control in place of the **GAIN** control to adjust gain in short ranges. In this case, combined use of the **FTC** and **STC** controls is effective to obtain a quality picture, reducing sea clutter.

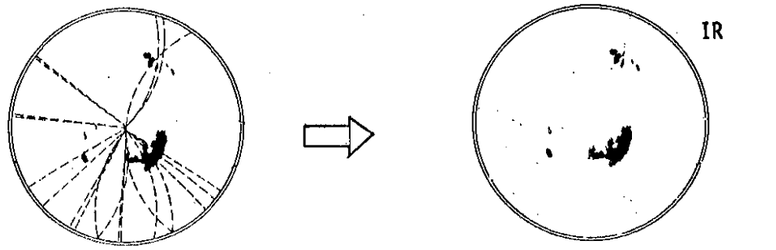
FTC Control 

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

This control can also be used advantageous to separate groups of echoes on a congested short range picture, and further this is useful to diminish the sea clutter, using the **GAIN** control as well as the **STC** control. Too high a setting of the **FTC** control makes the target echo small in size or causes it to disappear.

IR (Interference Rejection on/off) Touchpad 

When radar interference from other radars operating in the vicinity is observed on the screen, press this touchpad to eliminate it. The indication of the "IR" appears at the top right on the screen when the interference rejector circuit is activated. See Fig.1-4.



Interference Rejector OFF Interference Rejector ON

Fig.1-4

RING (Range Ring on/off) Touchpad

This touchpad turns on/off the fixed range rings. The number and interval of rings vary depending on the range setting as shown in Table 1-2. The range ring interval is indicated at the top left on the screen as shown in Fig.1-3.

Only for 0.25 n.m. and 0.5 n.m. ranges, the range ring interval can be indicated in kilometers instead of n. miles by changing the internal dip switch setting. See page AP2-1.

HM OFF (Heading Mark off) Touchpad

The heading mark disappears while this touchpad is depressed. Should a small desired target be under the heading mark, use this touchpad.

NM (North Mark on/off) Touchpad

The North Mark, which is available when a gyrocompass is connected, is turned on or off by this touchpad. The ship's bearing is always indicated at the bottom left on the screen as long as a gyrocompass is connected. See Fig.1-3.

MODE Touchpad

The following three modes ("HU"/"CU"/"NU") can be selected in order by pressing this touchpad successively. When a gyrocompass is not connected, neither "CU" nor "NU" mode is available (Only "HU" mode is available). One of "HU","CU" and "NU" is indicated at the top left on the screen corresponding to the mode setting as shown in Fig.1-3.

"HU" (Head-up)

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

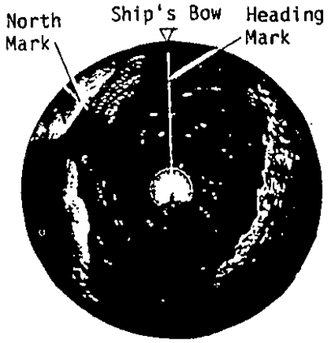


Fig.1-5 Head-up Mode

"CU" (Course-up)

Press the **MODE** touchpad for "CU" mode at the moment the ship's bow is faced in the desired direction (ship's course to port, waypoints, etc.), and the picture is stabilized so that the desired direction is at the top of the screen. The heading mark wanders according to the orientation of ship's heading. The picture is stabilized against yaw of the vessel.

Note that a gyrocompass must be connected for this mode.

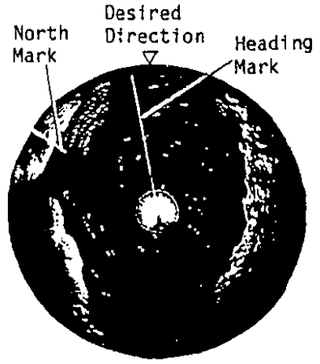


Fig.1-6 Course-up Mode

"NU" (North-up)

The radar picture is stabilized so that North is at the top of the screen and the heading mark wanders according to the orientation of ship's heading. Therefore, this mode is available for measurement of ship's position and as a navigation monitor on the navigational chart. The picture is stabilized against yaw of the vessel, reducing shift of target echoes.

Note that a gyrocompass must be connected for this mode.

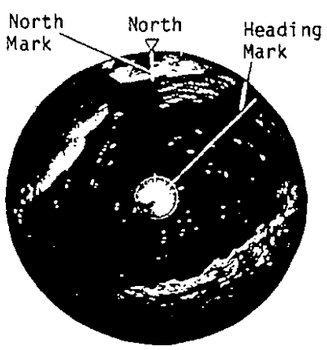


Fig.1-7 North-up Mode

PLOT (Picture Memory) Touchpad [PLOT]

This is to present the movement of other ships relative to your own ship on the screen. Press this touchpad, and continuous plotting of moving targets takes place and the time elapsed after starting the plot operation is indicated at the top right on the screen, counting up to 99 minutes and 59 seconds. Plot echoes blink every second indicating that the PLOT mode is taking place. If the touchpad is pressed again within 10 seconds, the plot interval of target echoes changes to 15 seconds. Further, pressing it successively within 10 seconds changes the plot interval as follows: 30 seconds, 1 minute, 3 minutes, 6 minutes. If the plot interval is set at 1 minute, the target echoes are memorized repeatedly every minute. The plot interval is indicated at the top right on the screen instead of the continuous plotting time elapsed. To erase the plot picture, press this touchpad 10 seconds after the previous press.

When the **RANGE** switch is turned while the PLOT operation is performed, the plotting time elapsed or the plot interval on the screen is presented in black figure with green background to inform the operator that the PLOT mode is inactive as shown in Fig.1-8. To continue the PLOT operation, turn the **RANGE** switch to its original position.

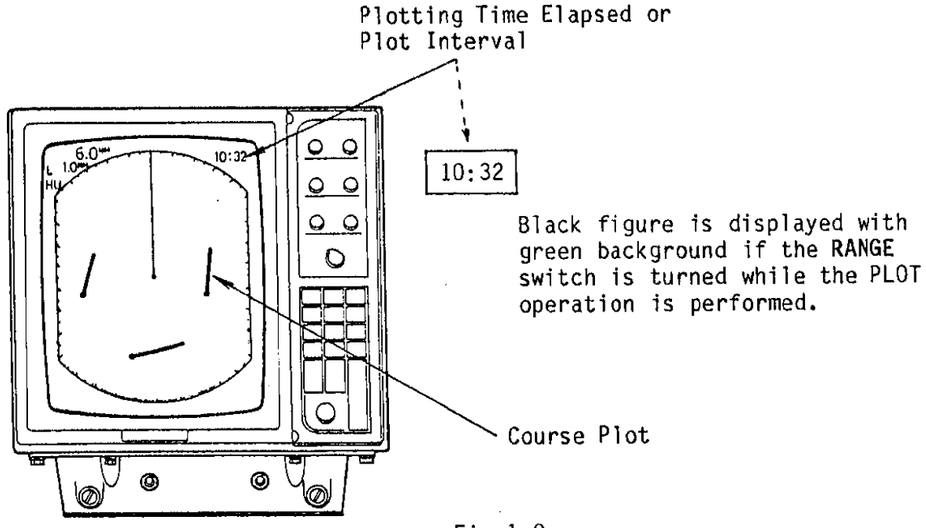


Fig.1-8

ALARM (Radar Alarm on/off) Touchpad [ALARM]

Radar alarm function is turned on and off by pressing this touchpad. When any targets fall into the guard zone selected by **VRM** and **EBL** touchpads, the alarm sound is released. Refer to Section 1.5 for the alarm setting. To silence it, press the **ALARM** pad again. The message "ALM" appears at the top right on the screen to indicate that the alarm function is activated. If the alarm mode is inactive due to improper setting of alarm zone, etc., the indication of the "ALM" is inverted, i.e., it appears in black letters with green background.

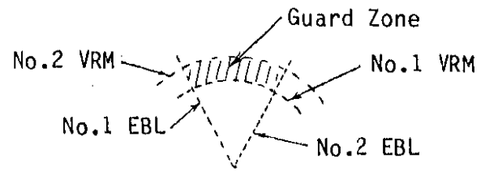
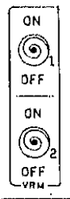


Fig.1-9

NOTE: By changing the internal dip switch setting, the range of the guard zone can be limited between 3 and 6n.m. for the regulation in some countries. See page AP2-2.



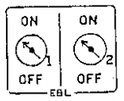
VRM-1 (No.1 VRM on/off) & VRM-2 (No.2 VRM on/off) Touchpads

Pressing the "ON" portion (upper half) of each touchpad presents the No.1 or No.2 VRM on the screen as a dotted ring. The distance can be digitally read out at the bottom right on the screen in the unit of nautical miles. (It can be indicated in kilometers by changing the internal setting. See page AP2-2.) To adjust VRM, first press "ON" portion of desired touchpad, **VRM-1** or **VRM-2**, then rotate the **No.1/No.2 VRMs & EBLs control**.

To distinguish the No.2 VRM from No.1, the length of the dash and space is different as shown in Fig.1-10.

Press the "OFF" portion (lower half) of the touchpad to erase the VRM.

EBL-1 (No.1 EBL on/off) & EBL-2 (No.2 EBL on/off) Touchpads



Pressing the "ON" portion (upper half) of the EBL touchpad presents the EBL on the screen as a dotted line. The bearing of the EBL is displayed at the bottom left on the screen. See Fig.1-10. It is indicated in relative bearing for the "HU" mode ("R" added) and in true bearing for the "NU" mode ("T" displayed instead of "R"). To adjust EBL, first, press the "ON" portion of the touchpad, **EBL-1** or **EBL-2**, then rotate the **No.1/No.2 VRMs & EBLs** control.

To distinguish between the No.1 and No.2 EBLs, the length of the dash and space is different as shown in Fig.1-10.

Press the "OFF" portion (lower half) of the touchpad to erase the EBL.

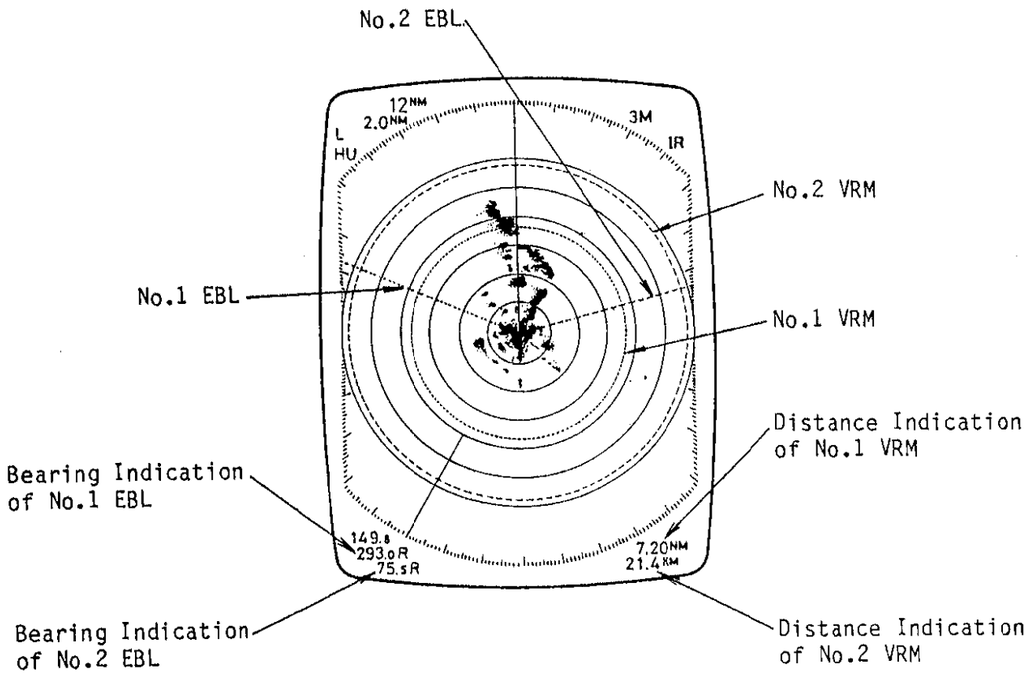


Fig.1-10

No.1/No.2 VRMs & EBLs Control

This control is used to adjust VRMs and EBLs. First, press the "ON" portion (upper half) of either one of touchpads, **VRM-1**, **VRM-2**, **EBL-1** or **EBL-2**, then rotate this control.

1.2 Operating Procedure

Confirm that the power supply is within the rating, and the controls and switches on the control panel are set as below before switching on the radar.

Controls & Switches	Settings
POWER & SCANNER	"OFF"
GAIN, STC, FTC, BRILLIANCE	Fully CCW
TUNE	Center
Others	Any positions

Starting

Start		Remarks
Turn **POWER** switch to ON and turn **BRILLIANCE** control CW.	-------	Power is supplied to radar system and 3 minute timer starts to count-down on the screen. See Fig.1-1
Wait for 3 minutes.	----------	Indication of "ST-BY" is displayed, showing that radar is ready to transmit. See Fig.1-2.
Turn **SCANNER** switch to ON.	----------	Antenna begins to rotate.
Press **TX** key.	----------	Transmission begins and range rings are observed on the screen.
Set **RANGE** switch at maximum range and adjust **TUNE** control.	----------	Adjustment should be made so that a comparatively weak long range echo is discerned on the screen with maximum definition.
Adjust **GAIN** control.	----------	Target echoes appear.

Continued

Remarks

Set **RANGE** switch at a desired position.

Adjust **GAIN, STC & FTC** controls according to sea condition. -------- See page 1-15.

To measure range to a target, use VRM or fixed range rings. -------- See page 1-12.

To measure the bearing of a target, use EBL and **MODE** touchpad. ---- See page 1-13.

Press **ALARM** touchpad if radar alarm function is desired. ---- See page 1-14.

Press **ST-BY** (Standby) touchpad to cease radar operation temporarily. ---- It is recommended to turn the radar in standby unless observation of picture is necessary for longer life of the magnetron.

Stopping

After turning **GAIN & BRILLIANCE** controls fully CCW, turn **SCANNER** switch to OFF and then turn **POWER** switch to OFF.

1.3 Range Measurement

1. Measurement with fixed range rings

The distance to a target is roughly measured with fixed range rings which are presented by pressing the **RING** touchpad. The range ring interval is indicated at the top left on the screen.

The ring intervals of 0.1 Km and 0.2 Km are available for 0.25 n.m. and 0.5 n.m. ranges respectively. Refer to page AP2-2.

2. Measurement with variable range marker

For precise measurement of the distance to a target, use the following procedure.

1) Press the "ON" portion (upper half) of either of the **VRM-1** or **VRM-2** touchpad to present the No.1 or No.2 VRM (dotted ring) on the screen.

2) Locate the VRM with the **No.1/No.2 VRMs & EBLs** control at the inner edge of the target.

3) The distance to the target is readily indicated at the bottom right on the screen.

Note: The distance can be indicated in nautical miles or kilometers according to the settings of the internal dip switch. Refer to page AP2-1.

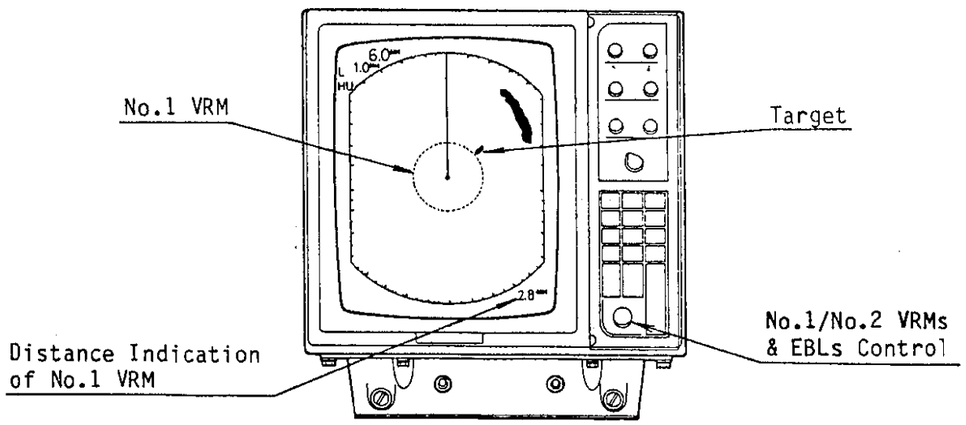


Fig.1-11

1.4 Bearing Measurement

The relative or true bearing to the selected target can be measured as follows.

1. Relative Bearing (See Fig.1-12.)

   1) Set the presentation mode to "HU" (Head-up) by pressing the **MODE** touchpad.

   2) Press the "ON" portion (upper half) of either of the **EBL-1** or **EBL-2** touchpad to present the EBL on the screen.

   3) Rotate the **No.1/No.2 VRMs & EBLs** control until the EBL intersects over the center of the target.

   4) The bearing of the target is readily indicated at the bottom left on the screen.

2. True Bearing (See Fig.1-13.)

   This method is available when a gyrocompass is connected.

   1) Set the presentation mode to "NU" (North-up) by pressing the **MODE** touchpad.

   2) Perform the same procedure as steps 2 thru 4 of "Relative Bearing" mentioned above.

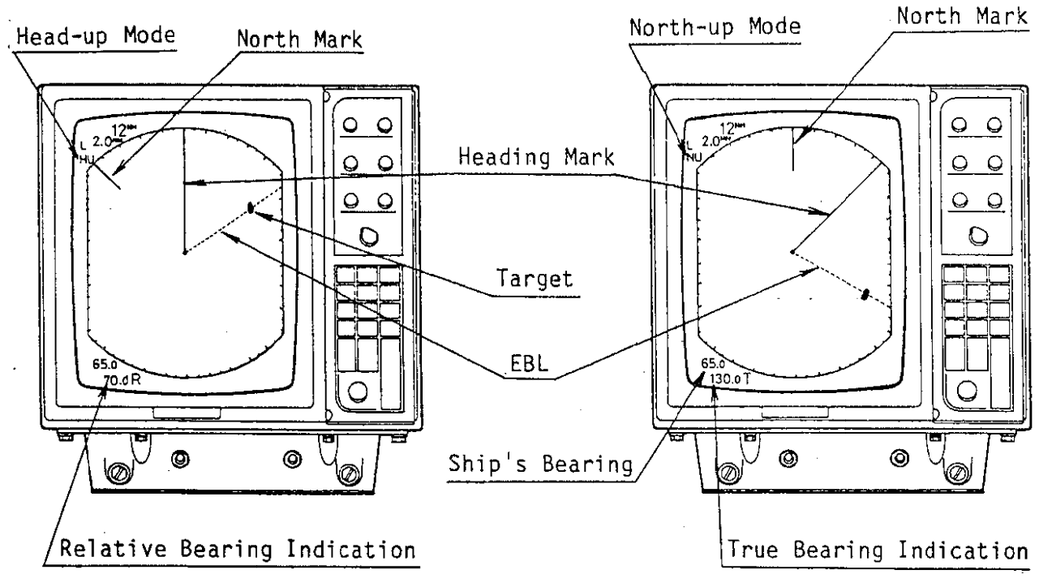


Fig.1-12

Fig.1-13

1.5 Radar Alarm Setting

The guard zone for the alarm can be selected between 0 and 36 n.m. for distance (between 3 and 6 n.m. when preset by the internal dip switch. See page AP2-2.) and between 0 and 360° in bearing. The alarm sound is released when any targets, ships or land mass on the screen fall into the preset guard zone. Use the following procedure to set the guard zone.

- RANGE SETTING -

1) Press the "ON" portion (upper half) of the **VRM-1** touchpad and rotate the **No.1/No.2 VRMs & EBLs** control to set the range of the inner edge of the guard zone.

2) Press the "ON" portion (upper half) of the **VRM-2** touchpad and rotate the **No.1/No.2 VRMs & EBLs** control to set the range of the outer edge of the guard zone.

- SECTOR SETTING -

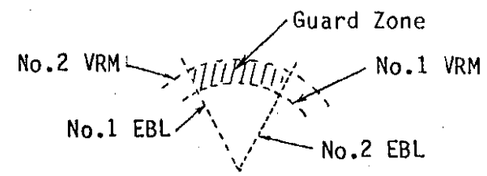
3) Press the "ON" portion (upper half) of the **EBL-1** touchpad and rotate the **No.1/No.2 VRMs & EBLs** control to set the CCW limit of the alarm sector.

4) Press the "ON" portion (upper half) of the **EBL-2** touchpad and rotate the **No.1/No.2 VRMs & EBLs** control to set the CW limit of the alarm sector.

- ALARM SETTING -

5) Press the **ALARM** touchpad, and the letters "ALM" mark will appear at the top right on the screen.

6) The alarm sound is released when any targets on the screen fall into the guard zone selected above.



1.6 How to get quality picture, suppressing Sea and Rain Clutters

1. How to discriminate small targets from the sea clutter

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

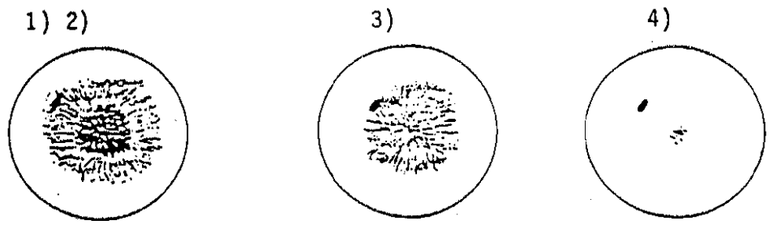
1) Turn **STC** control fully CCW.
2) Set **GAIN** control at maximum.
3) Adjust **FTC** control so that sea clutter near the ship appears equal in strength with that around the middle of the sea clutter range on the screen.

   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: A target weaker than the sea clutter will also disappear on the screen.

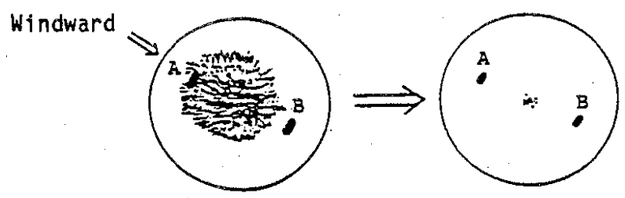
5) If sea clutter near the screen center still stays on the screen, turn **STC** control slightly CW to eliminate it.



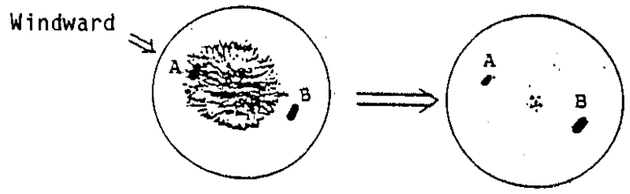
The following shows the difference in target recognition with respect to the way of adjustment.

(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.



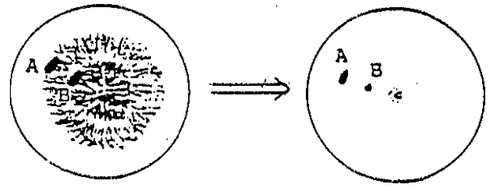
* When **FTC** and **GAIN** controls are used effectively, target echo B that exists outside sea clutter does not become small in size.



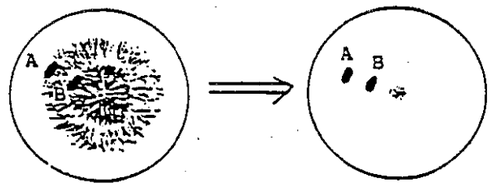
(Example 2): When strong sea clutter around the screen center is eliminated completely, the target echo becomes small in size as the ship approaches the target.

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

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



* When both **FTC** and **GAIN** controls are used properly, the size of target echo does not change. (The target echoes A and B appear equal in size on the screen as shown below.)



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

The solid clutter caused by heavy precipitation appears over the area wider than the sea clutter and makes the discrimination of long range targets difficult. However, since it is usually not so strong in comparison with the sea clutter, the target echo in the rain 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 the wide area uniformly.

Use only **GAIN** control, and the size of target echo on the screen does not become small. (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 at 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 distinguishable from rain clutter.

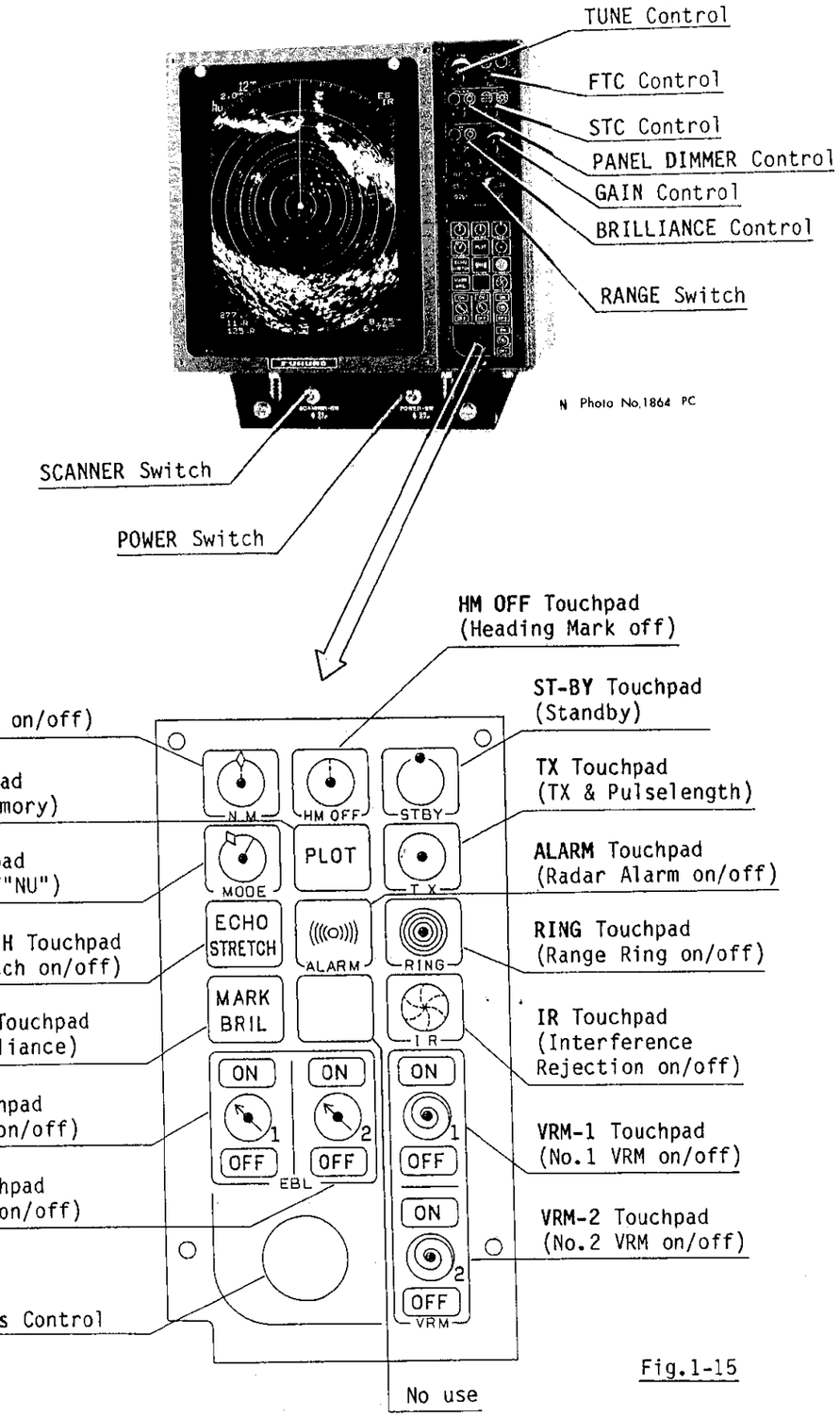


Fig.1-15

CHAPTER 2 REMARKS ON VIEWING PICTURE

2.1 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 the 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 signal. The Rmax is given in the following equation.

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

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;

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

Minimum Range

When the radar is used as a collision avoidance aid, the minimum range is of urgent concern. It is very dangerous for the 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).

2.2 Radar Resolution

Bearing Resolution

The bearing resolution is an ability to discriminate two targets which are located at the same range and close each other. It is proportional to the antenna length and reciprocally proportional to the wave length. The usual bearing resolution is 1 to 3 degrees.

Range Discrimination

The range discrimination is an ability to distinguish two targets which are in the same direction and close each other. This is determined by pulselength only. The usual discrimination is 25 yards on 0.08 microsecond pulse.

2.3 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 to determine the bearing accuracy. When measuring the bearing of a target, put the target echo at the extreme position on the screen by selecting proper range to minimize the measuring error.

2.4 Range Measurement

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

2.5 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 are represented. Typical false echoes are shown below.

Multiple Reflection

When a wide and plane target such as the sideboard of the ship, bridge, building on the pier and breakwater exists near the ship, the radar pulses are multi-reflected between your ship and the target. This results in presentation of multiple echoes on the screen. The multiple echoes appear at equal intervals after the true echo as shown in Fig.2-1.

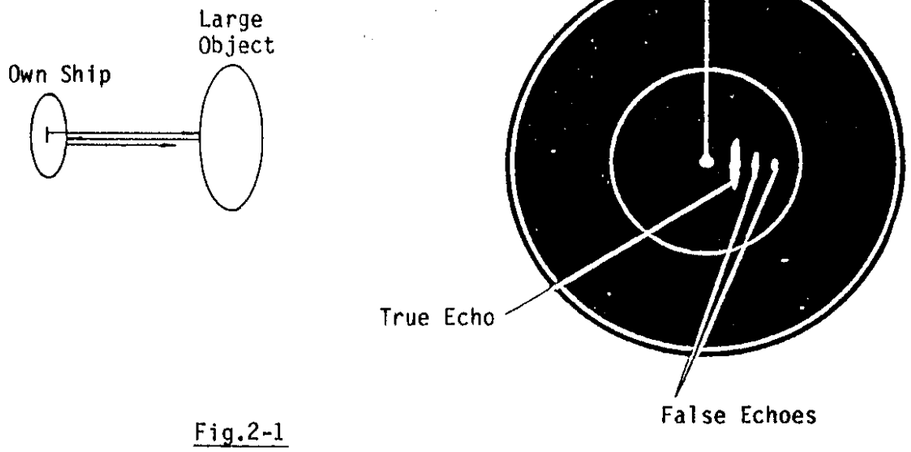


Fig.2-1

Spurious Echoes

When the radar pulse is emitted from the antenna radiator, some of the emitted total energy escapes on each side of the main beam --- side-lobes. If the target is strong, it can be detected by the sidelobes as well as main lobe, the spurious echoes may be represented at both sides of true echo with the same range as shown in Fig.2-2. The spurious echoes can also be removed by adjusting the **GAIN** and **STC** controls.

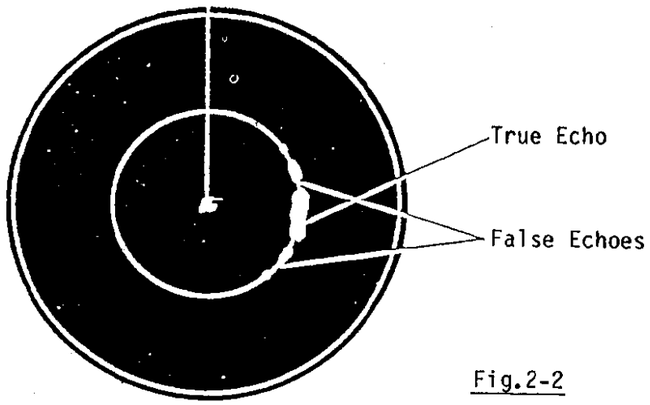


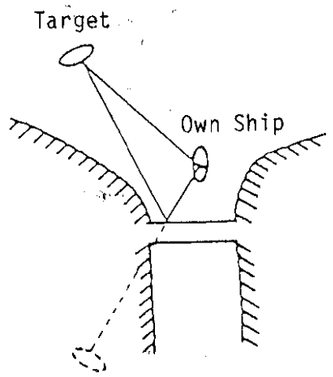
Fig.2-2

Second-trace Echoes

If the radio wave propagation is extraordinary, the echoes from very distant targets may appear on the screen. In this case, they may return after the echoes from the next transmission pulse have appeared. Thus the false echoes appear together with the true echoes of the near distant targets.

Virtual Image

A relatively large target, close to your ship, may be represented at two positions on the screen. One of them is the true echo directly reflected by the target and the other is the false echo which is caused by the mirror effect of a huge object on or close to your ship as shown in Fig.2-3. If your ship comes close to a big metallic bridge, for example, such a false echo may temporarily be seen on the scope.



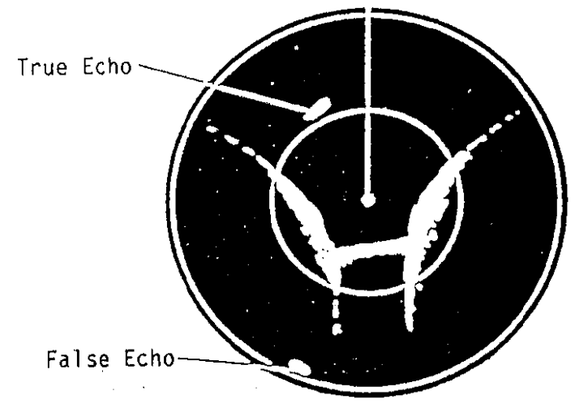
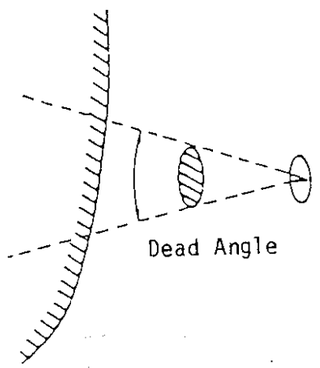


Fig.2-3

Dead Angle (Blind Sector)

A funnel, mast or derrick post near the radar antenna may intercept the radar beam. In that case, no target is detected within a certain angle, and it is called "dead angle". The huge object close to your ship may cause the similar result.



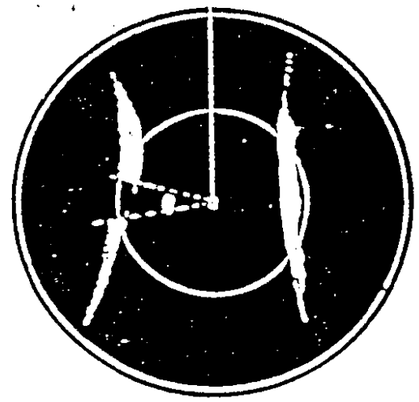


Fig.2-4

Radar Interference

When another ship is using the same frequency as your ship, the radar pulses emitted from another ship are received and appear on your radar screen as the curved spokes as shown in Fig.2-5.

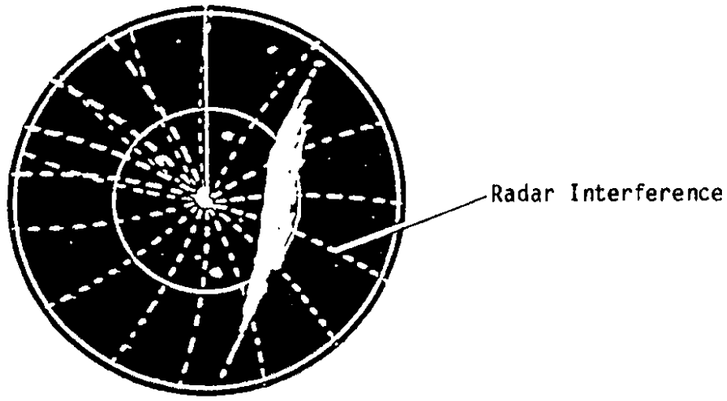


Fig.2-5

FURUNO

CHAPTER 3 MAINTENANCE

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

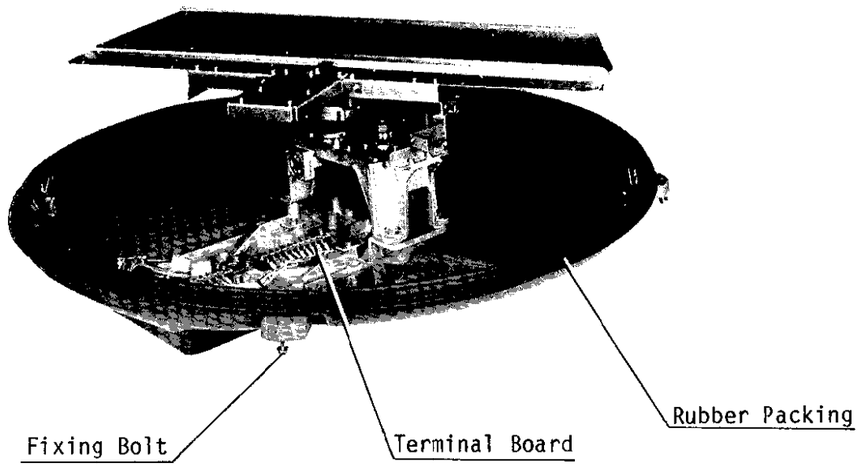
"CAUTION"

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

Interval	Item	Check/Measures	Remarks
3 to 6 months	Radome	Check for dirt or crack on the radome surface. Thick dirt should be wiped off by using wet soft cloth or alcohol. 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.
		Check the rubber packing for deterioration and replace it if necessary. (See Fig.3-1.)	*Deterioration of the rubber packing leads to permanent damage of the internal circuitry due to water immersion. It should be replaced at its earlier stage of deterioration.
	Exposed bolts and nuts	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.
	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.

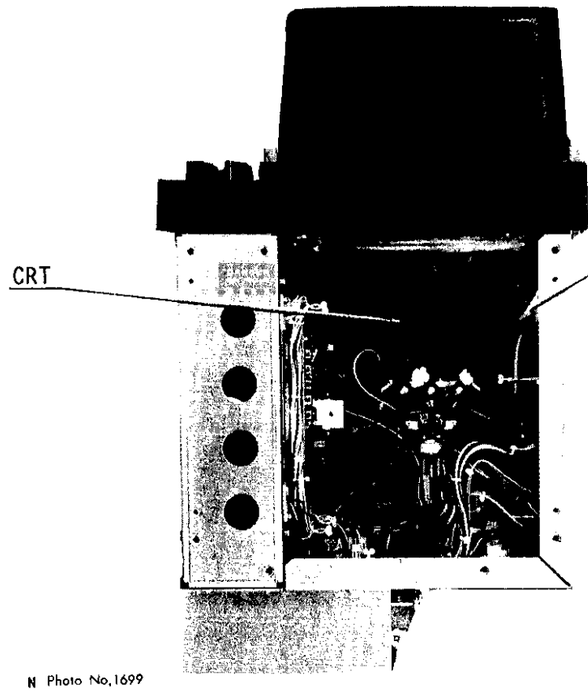
Continued

Interval	Item	Check/Measures	Remarks
6 months to 1 year	CRT anode and approach (See Fig.3-2.)	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.
	Plugs, connectors and terminal boards(Display & scanner unit)	Check for loose connections. Polish up contacts or replace plug, if necessary.	



N Photo No.1129

Fig.3-1 Scanner Unit with Transceiver Unit removed



N Photo No.1699

Fig.3-2 Display Unit Top View

CHAPTER 4 TROUBLESHOOTING

4.1 Self-check for Memory Device

Whenever an unusual symptom is encountered, check ROM/RAM operation on the CPU board (03P5550). Upon turning on the radar, the check result of the ROM/RAM is displayed at the bottom of the screen. See Fig.4-1. If abnormal operation is detected, an error message such as "ROM 1 ERROR" appears. Replace a chip indicated by "ERROR" with new one. See Fig.4-2 for parts location. If ROM/RAM operation is OK, 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 page 4-3. 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.

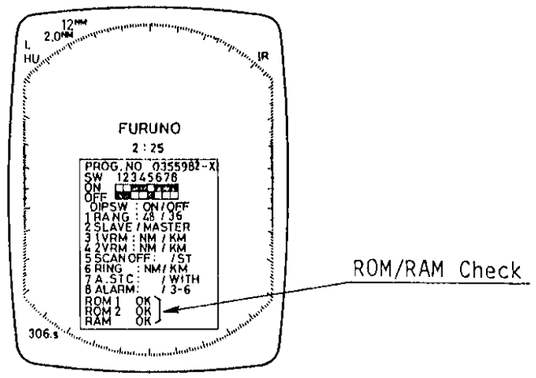
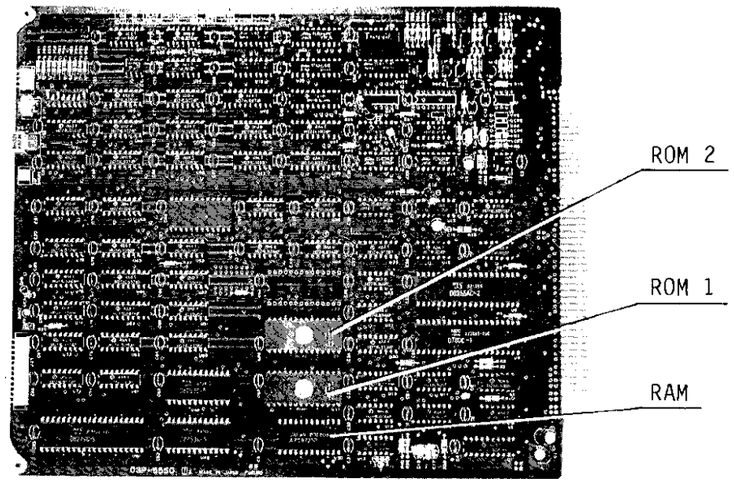


Fig.4-1



N Photo No.1703

Fig.4-2 CPU Board (03P5550)

"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

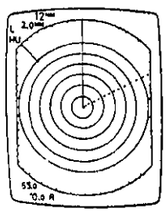
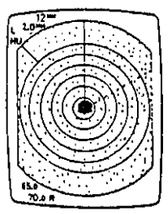
4.2 Trouble Finding List

Operation	Symptom	Check Point	Remarks
Turn on **POWER** switch and adjust **PANEL DIMMER** control.	Illumination lamps for front panel do not come on with **PANEL DIMMER** turned fully CW.	1. Main fuse F1351 (Display rear) See Fig.4-3.	
		2. Mains voltage/ polarity	*Measure mains voltage at the filter (FL-1). See Fig.4-3. The voltage should be: 10.2 to 15.0VDC (12VDC set) 20.4 to 40.0VDC (24/32VDC set)
		3. Overload on some voltage line(s)	*If some voltage line is overloaded (or shorted), inverter oscillation stops (CR12 thru CR16 on POWER SUPPLY board go off.) and CR10 on the board keeps lighting. See Fig.4-4. Turn off the radar and turn it on again observing CR12 thru CR16 (LEDs). The LEDs for normal lines light up momentarily before inverter oscillation stops. Check the line corresponding to the LED which is not lit up.
		4. POWER SUPPLY board	
		5. Illumination lamps	

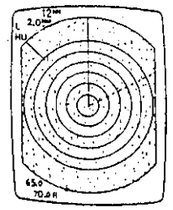
Continued

Operation	Symptom	Check Point	Remarks
Adjust **BRILLIANCE** control.	Nothing appears on CRT.	1. CRT	*Visually check that CRT heater is lit.
		2. CRT H.T.	*Turn off POWER switch and pull out CRT anode cap with special care for H.V. charged, then move it close to chassis (approx. 8mm apart). If normal, sparking will occur.
		3. DEFLECTION board	*Adjust CONTRAST pot. (RV101) and BRIGHT pot. (RV204) on DEFLECTION board. See Fig.4-5. If some picture appears, CRT assembly is OK.
		4. CPU board	*If CR9 on CPU board lights up, CPU (Z80) is in good order. See Fig.4-6.
		5. MEMORY board	
	Picture synchronization is abnormal.	1. CRT assembly (DEFLECTION board, etc.)	*Adjust V-HOLD pot. (RV202) and H-HOLD pot.(RV401) on DEFLECTION board. See Fig.4-5. If synchronization is not achieved, DEFLECTION board is defective.
		2. CPU board	* If CR9 on CPU board lights up, CPU (Z80) is in good order. See Fig.4-6.
		3. MEMORY board	

Continued

Operation	Symptom	Check Point	Remarks
Turn on **SCANNER** switch.	Scanner does not rotate.	1. Scanner fuse F1352 (1A) See Fig.4-3. 2. Scanner rotating mechanism jammed 3. Power supply circuit for scanner motor	
After ST-BY message appears, press **TX** touchpad.	Marks and legends appear abnormally.	1. CPU board 2. MEMORY board	*If CR9 on CPU board lights up, CPU (Z80) is in good order.
Adjust **GAIN** control with **STC** set at minimum.	Marks and Legends appear but no noise nor echo. 	1. IF amplifier (See Fig.4-7) 2. Multicore cable between the scanner and display 3. INTERFACE board 4. MEMORY board	*Check continuity and isolation of the cables. *If CR16 does not blink on INTERFACE board, INTERFACE board is faulty. If it blinks, MEMORY board is faulty. See Fig.4-6.
	Marks, legends and noise appear but no echo. (The transmission leak appears as below.) 	1. MIC (See Fig.4-7)	*Set **RANGE** switch at 0.25 n.m., and turn **GAIN** control fully CW (max.). If the center spot (transmission leak) appears on the screen, the transmitter may be operating normally.

Continued

Operation	Symptom	Check Point	Remarks
	Marks, legends and noise appear but no echo. (No transmission leak appears.) 	1. TX fuse F1 (0.5A) See Fig.4-3. 2. Magnetron 3. MODULATOR board 4. Modulator SCR 5. CPU board 6. INTERFACE board	*Replace fuse with new one. If the fuse blows off again, the magnetron or modulator's components may be faulty. *In the scanner unit, with the **RANGE** switch set to 36 n.m. range, measure the magnetron current (voltage) between #3(+) and #5(-) of J801. If the voltage is 1.8 to 2.4V, the items 2 to 4 of "Check Point" are OK. See Fig.4-8. *Connect a multimeter set at 10VAC range between test points TX-TRIG (+) and GND (-) on INTERFACE board. See Fig.4-6(a). If the voltage reading changes with turning **RANGE** switch, the CPU and INTERFACE boards in the display unit are operating normally.
	Sweep rotation is not synchronized with antenna rotation.	1. MOTOR CONTROL board in the scanner unit 2. INTERFACE board 3. CPU board	*If CR15 on INTERFACE board (Fig.4-6) lights up every 2 to 3 sec., heading flash circuit on INTERFACE board is normal.
	Abnormal bearing of picture	1. Adjustment of the heading SW on CPU board. See page AP1-20. 2. CPU board 3. Gyro Interface board	

Continued

Operation	Symptom	Check Point	Remarks
Adjust **TUNE** control.	Poor sensitivity	1. Deteriorated Magnetron	*Set **RANGE** switch to 36 n.mile detecting range, and measure the magnetron current (voltage) as mentioned in "Remarks" on page 4-6. If the voltage is too low, magnetron is deteriorated.
		2. Detuned MIC	
	Poor sensitivity (Bright circle appears on 0.25 n.mile range.)	1. Water leakage into receiving circuit.	
Adjust FTC control.	No FTC effect	1. INTERFACE board	
Change **RANGE** switch to another position.	Radar picture is not changed.	1. CONTROL PANEL board (Fig.4-6)	
		2. CPU board	*If CR9 on CPU board lights up, CPU (Z80) is in good order.
		3. INTERFACE board	
Press **IR** touchpad.	Interference Rejection is not performed. (No IR legend appears.)	1. Bad contact of touchpad key	
		2. CPU board	*If CR9 on CPU board lights up, CPU (Z80) is in good order.
		3. INTERFACE board	
Press **ECHO STRETCH** touchpad.	No Echo Stretch function	1. Bad contact of touchpad key	
		2. CPU board	*If CR9 on CPU board lights up, CPU (Z80) is in good order.
		3. INTERFACE board	

Continued

FURUNO

Operation	Symptom	Check Point	Remarks
Press **RING** touchpad.	No range ring	1. Bad contact of touchpad key	
		2. CPU board	*If CR9 on CPU board lights up, CPU (Z80) is in good order.
		3. MEMORY board	

NOTE: If the touchpad keys other than mentioned above malfunction, first check the contact of the corresponding touchpad. If it is OK, CPU or MEMORY board may be faulty.

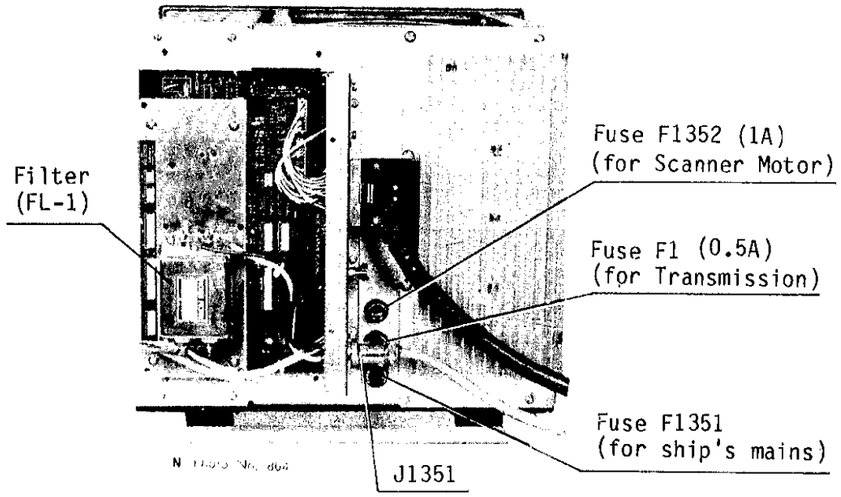
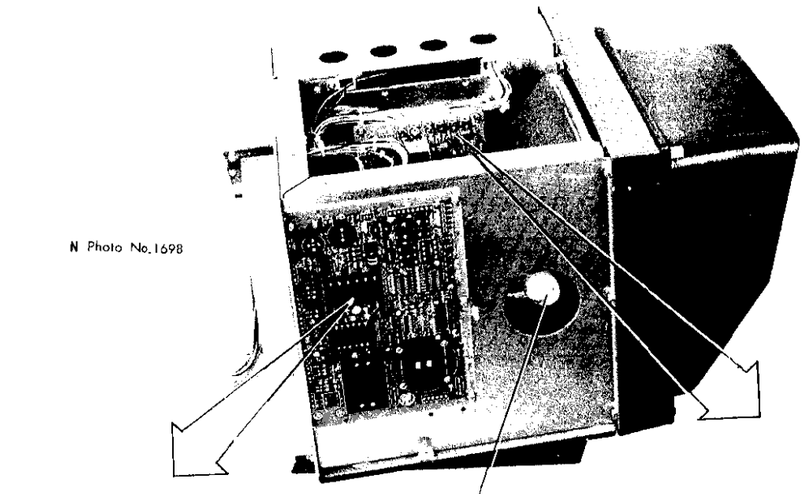


Fig.4-3 Display Rear View



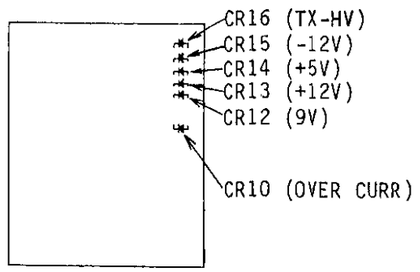


Fig.4-4 POWER SUPPLY Board
Soldering Side (03P5900)

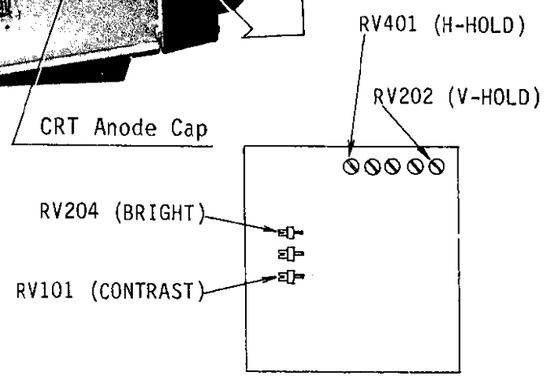


Fig.4-5 DEFLECTION Board

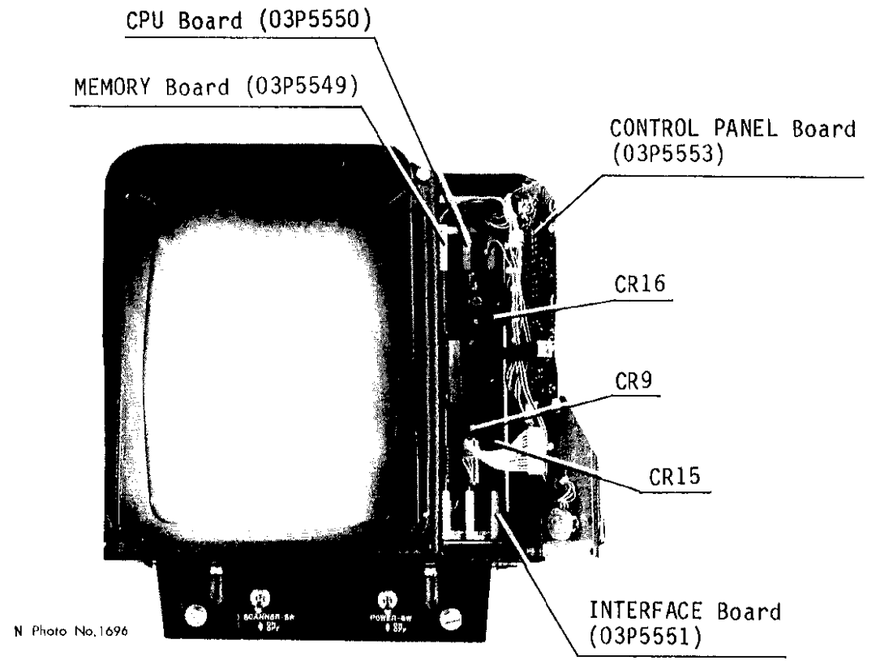


Fig.4-6

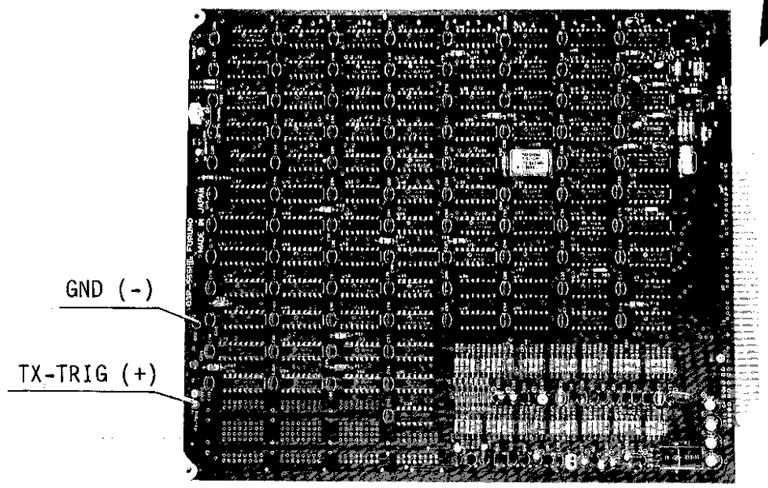
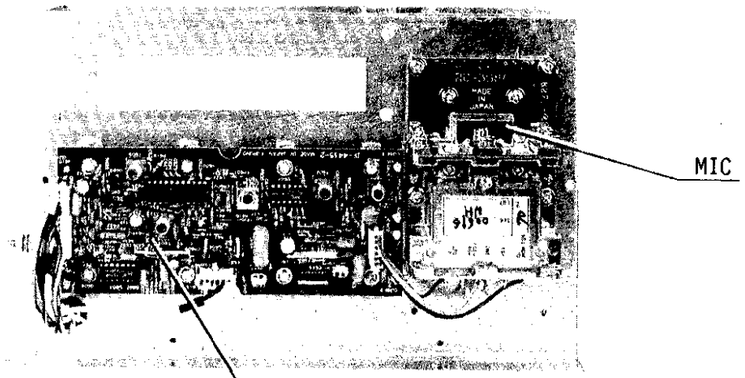
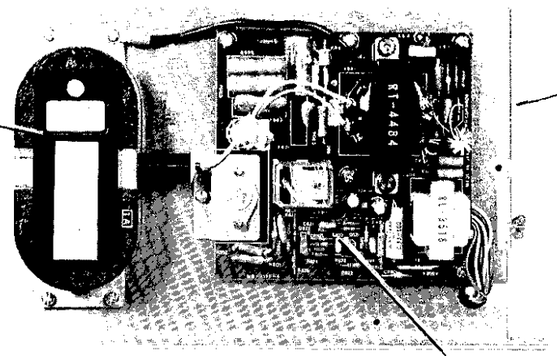


Fig.4-6(a)



N Photo No.1083

Fig.4-7 Transceiver Module Side View



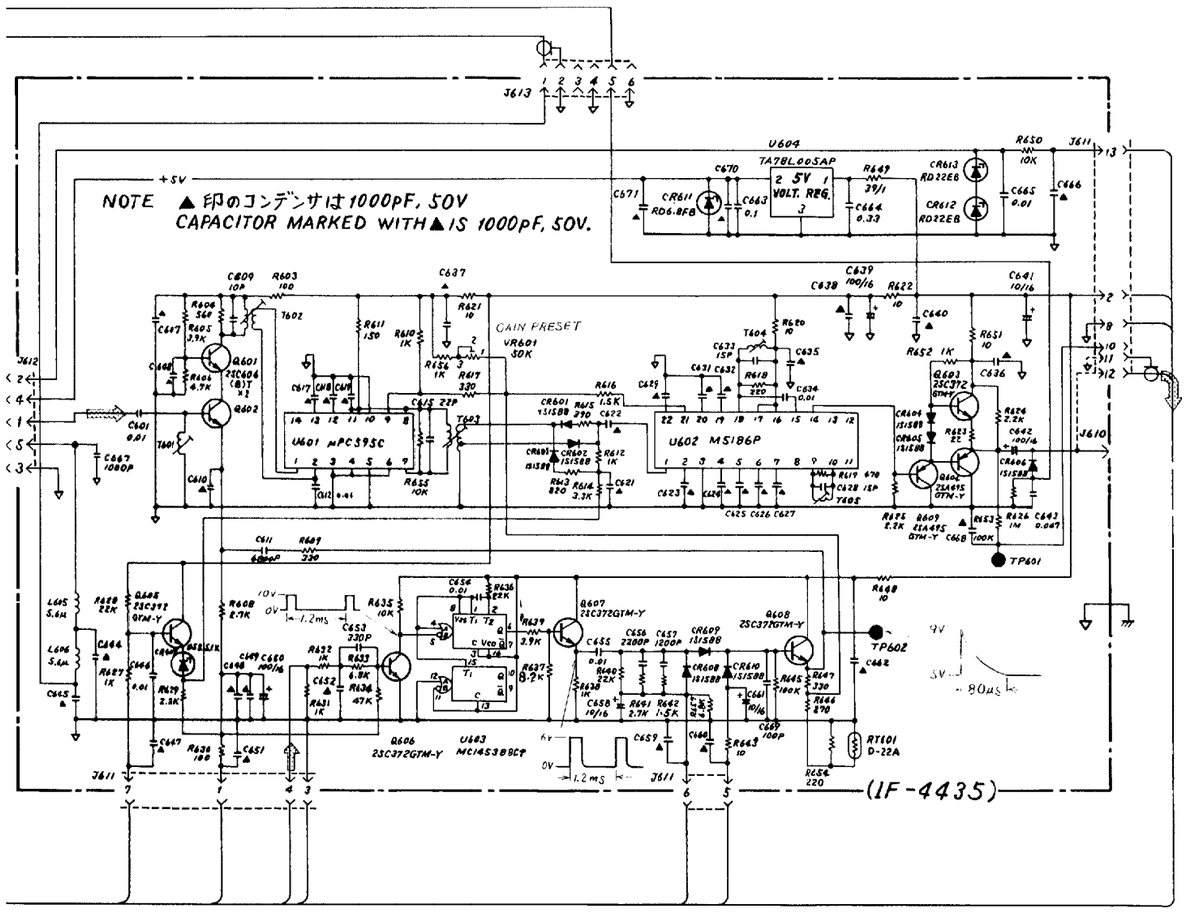
N Photo No.1084

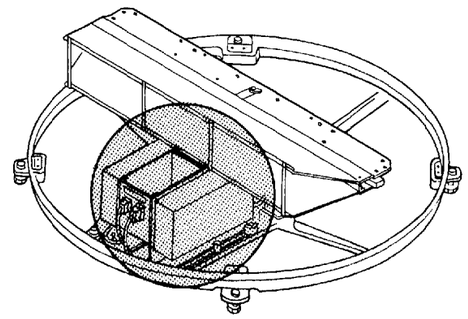
Fig.4-8 Transceiver Module Side View

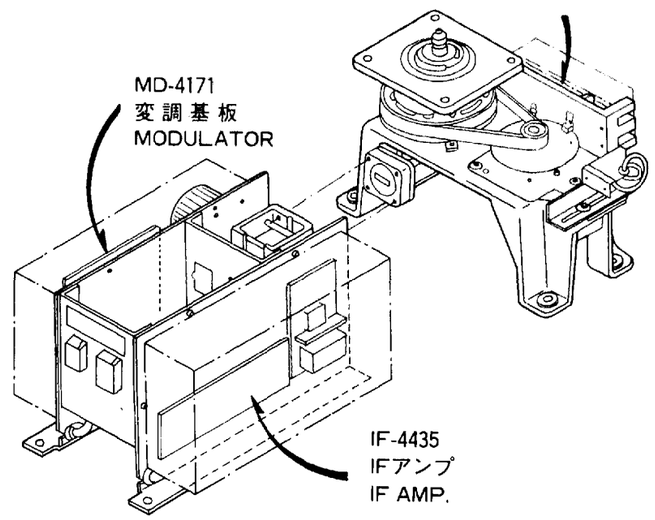
CONTENTS OF SCHEMATIC DRAWINGS

5 6 7 8 9

LE







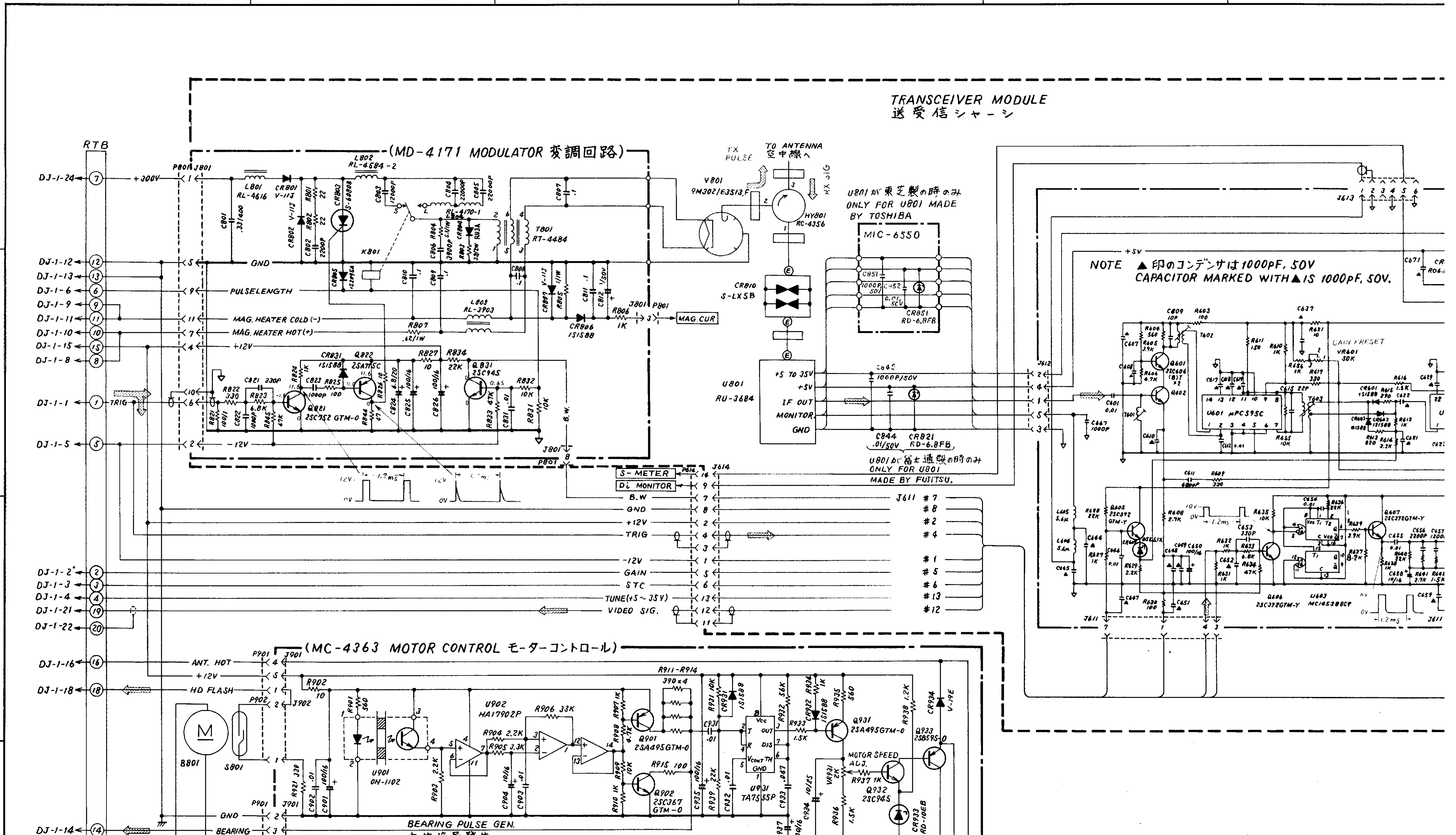
NOTE 1. 特記無き抵抗の単位は全てΩ, 1/4W 又コンデンサはμF.
ALL RESISTANCE IN OHMS, 1/4W AND CAPACITANCE IN MICROFARADS UNLESS NOTED OTHERWISE.
2. DC電圧値はGAIN, STC共に最大, ST-BY/ショートレンジで測定。
DC VOLTAGES ARE MEASURED WITH GAIN MAX & STC MAX ON ST-BY/SHORT RANGE.
3. 波形図はGAIN, STC共に最大、送信/3マイルレンジで測定。
WAVEFORMS ARE MEASURED WITH GAIN MAX & STC MAX ON TX/3 MILE RANGE.

FCR-902
FR-602D
FR-802D
MODEL 2400

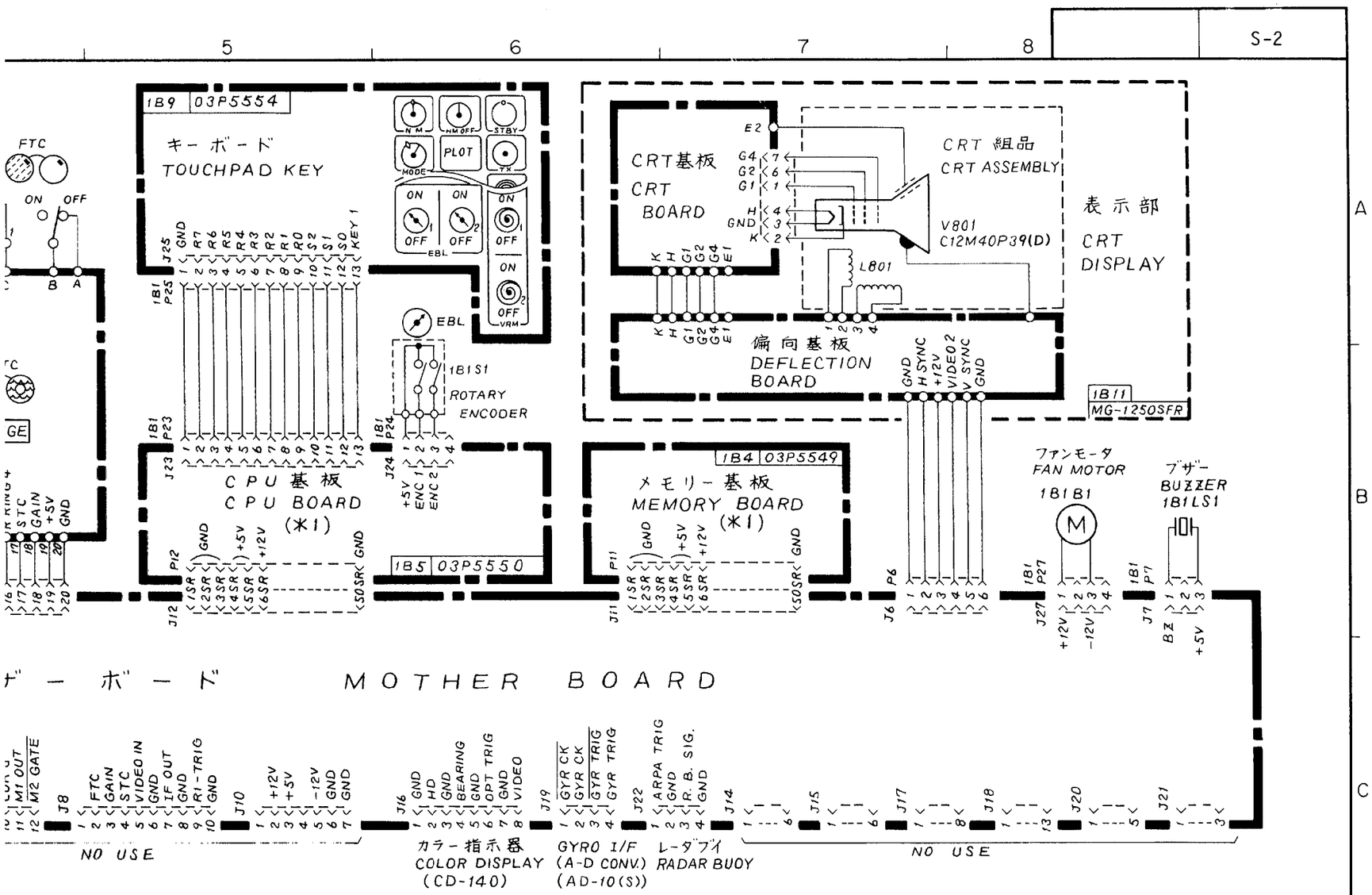
名称 TITLE	空中線部回路図 SCANNER UNIT
図番 DWG. NO.	C3255-008-G

Rev.: 5/84, 3/85, 9 11/85, 9/86

5 6 7 8



NOTE 1. 特記無き抵抗の単位は全てΩ, 1/4W ヌコンデンサは
ALL RESISTANCE IN OHMS, 1/4W AND CAPACITANCE
2. DC 電圧値は GAIN, STC 共に最大, ST-BY/ショート
DC VOLTAGES ARE MEASURED WITH GAIN MA
3. 波形図は GAIN. STC 共に最大、送信/3マイルレ
WAVEFORMS ARE MEASURED WITH GAIN MA



NOTE 1. (*1)印のプリント基板の回路図は非公開。
SCHEMATIC DIAGRAMS FOR PCB'S MARKED (*1) ARE NOT PUBLISHED.

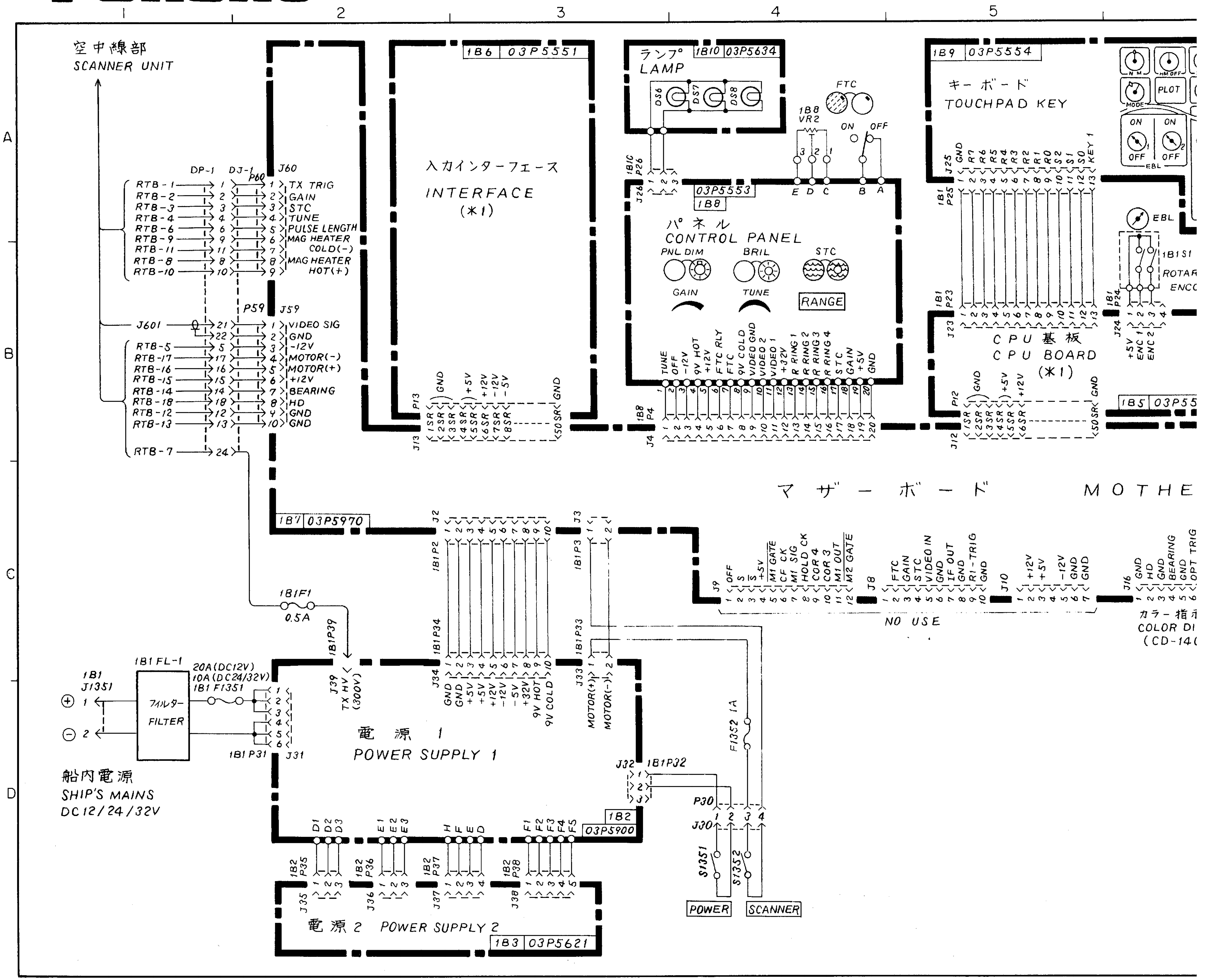
承認 APPROVED	DEC. 11 '84	名称 TITLE	指示部回路図 DISPLAY UNIT
検図 CHECKED	Dec. 11 '84		
製図 DRAWN	Dec. 11 '84	図番 DWG.NO.	C3275-004-D

FR-801D
FR-802D
FR-803D

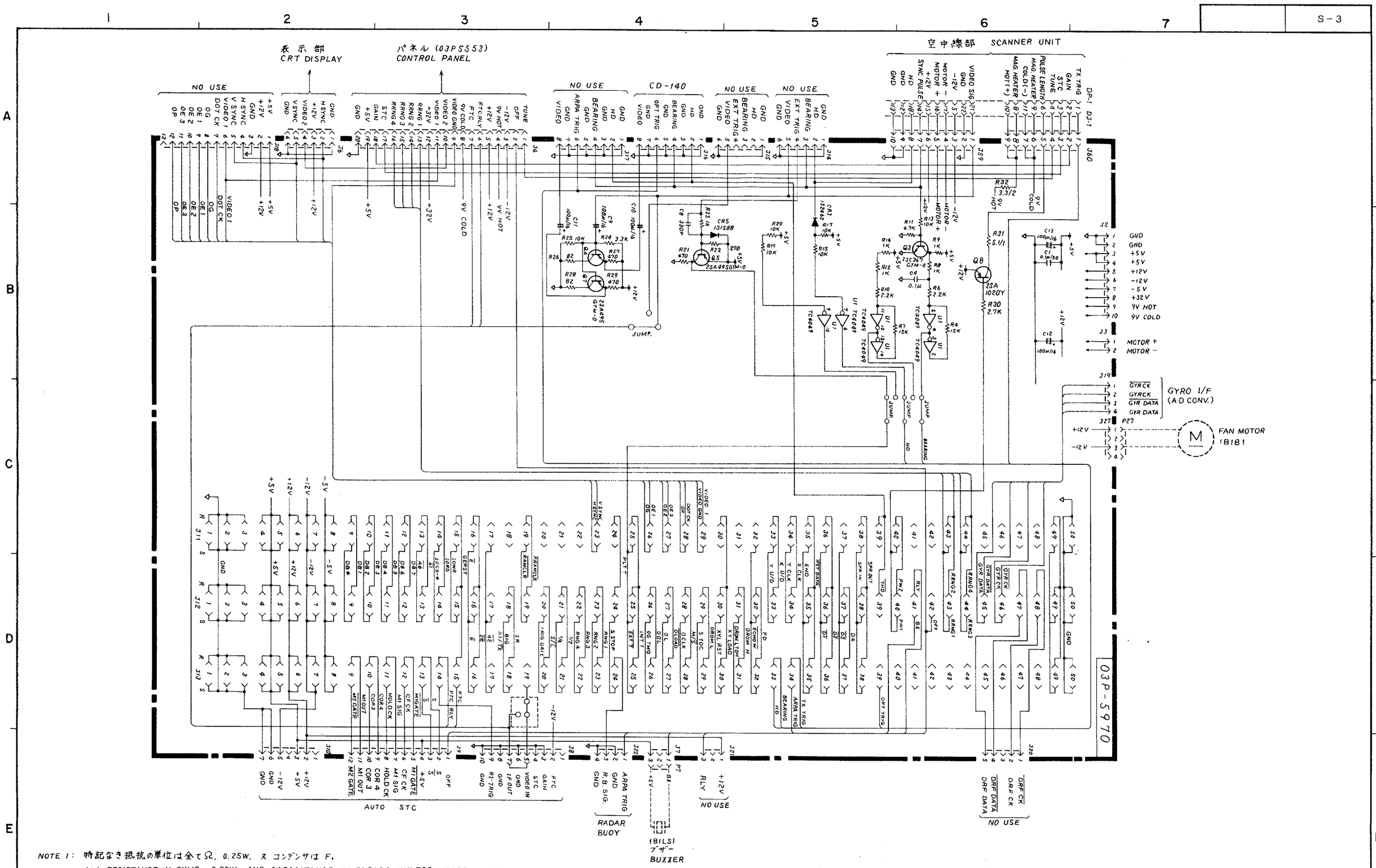
REV. : 5/85, 7/85

FURUNO ELECTRIC CO., LTD.

FURUNO



空中線部
SCANNER UNIT
1B6 03P5551
入カインターフェース
INTERFACE
(*1)
ランプ
LAMP
1B10 03P5634
DS6 DS7 DS8
FTC
1B8 VR2
ON OFF
03P5553
1B8
パネル
CONTROL PANEL
PNL DIM
BRIL
STC
GAIN
TUNE
RANGE
1B9 03P5554
キーボード
TOUCHPAD KEY
EBL
1B1S1
ROTAR
ENCO
CPU 基板
CPU BOARD
(*1)
1B5 03P55
DP-1 DJ-1 P60 J60
RTB-1 RTB-2 RTB-3 RTB-4 RTB-6 RTB-9 RTB-11 RTB-8 RTB-10
TX TRIG
GAIN
STC
TUNE
PULSE LENGTH
MAG HEATER COLD(-)
MAG HEATER HOT(+)
J601
P59 J59
VIDEO SIG
GND
-12V
MOTOR(-)
MOTOR(+)
+12V
BEARING
HD
GND
GND
RTB-5 RTB-17 RTB-16 RTB-15 RTB-14 RTB-18 RTB-12 RTB-13
RTB-7
マザーボード
MOTHE
1B7 03P5970
NO USE
カラー指示
COLOR DI
(CD-14
1B1F1
0.5A
1B1 FL-1
フィルター
FILTER
20A(DC12V)
10A(DC24/32V)
1B1 F1351
1B1 J1351
1B1P31 J31
J39 TX HV (300V)
電源 1
POWER SUPPLY 1
GND GND +5V +5V +12V +12V -12V -5V +32V 9V HOT 9V COLD
MOTOR(+) MOTOR(-)
F1352 1A
J32 1B1P32
P30 J30
S1351 S1352
POWER
SCANNER
1B2 03P5900
船内電源
SHIP'S MAINS
DC12/24/32V
電源 2
POWER SUPPLY 2
1B3 03P5621



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

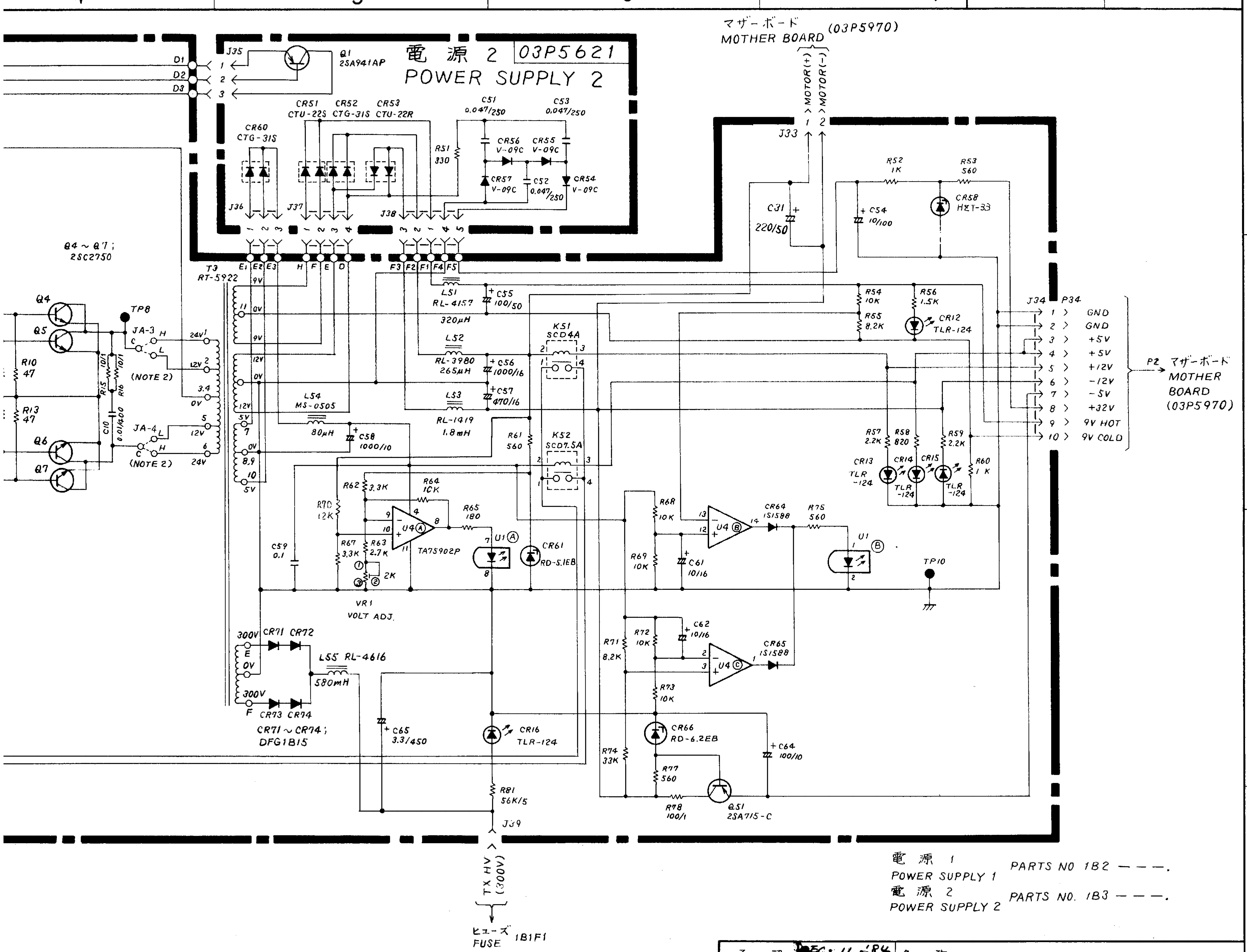
PARTS NO. 1B7 ---

承認 APPROVED	DEC・6・'84	名称 TITLE	マザーボード MOTHER BOARD
検図 CHECKED	Dec・5・'84 K.Kuwata		
製図 DRAWN	DEC・5・'84	図番 DWG.NO.	C3275-006-D

FR-801D
FR-802D
FR-803D

REV.: 5/85, 7/85, 10/85

S-4



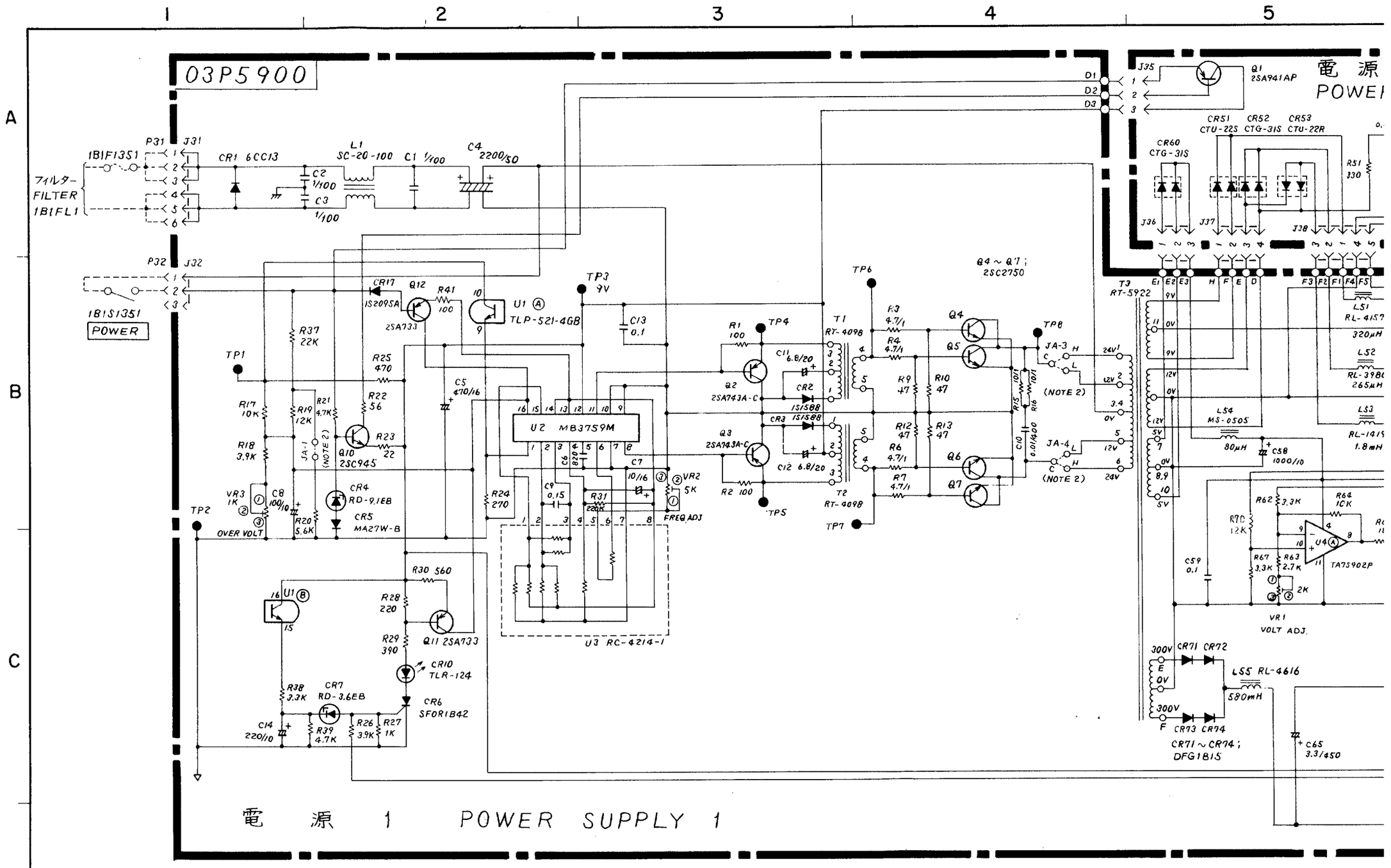
電源 1 POWER SUPPLY 1 PARTS NO 1B2 ———.

電源 2 POWER SUPPLY 2 PARTS NO. 1B3 ———.

承認 APPROVED	Dec. 11 '84	名称 TITLE	電源部 POWER SUPPLY
検図 CHECKED	Dec. 11 '84		
製図 DRAWN	Dec. 10 '84	図番 DWG. NO.	C3275-005-F

FR-801D
FR-802D
FR-803D

REV. : 5/85, 7/85, 10/85, 1/86, 9/86

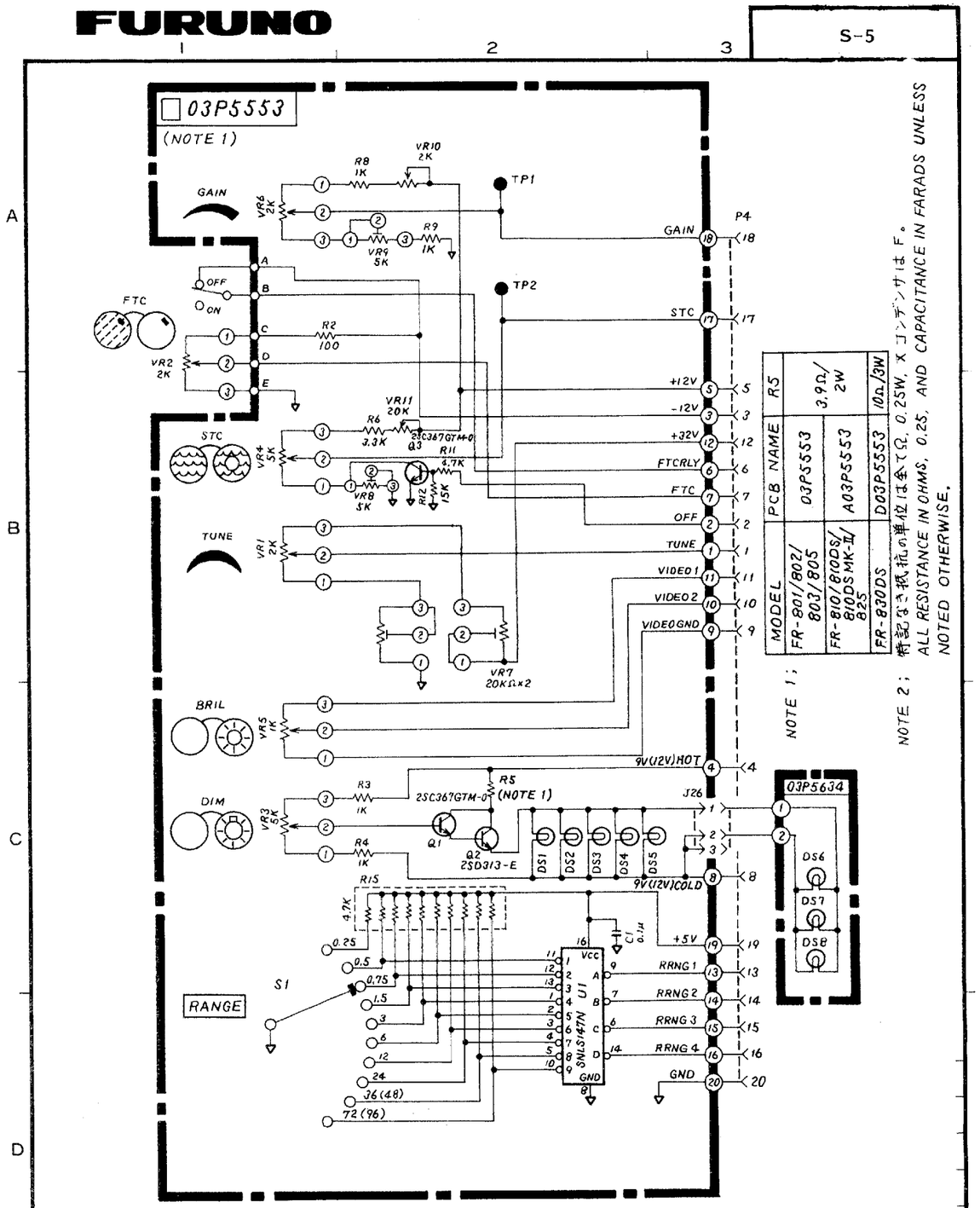


電　源　1　POWER SUPPLY 1

NOTE 1 ; 特記なき抵抗の単位は全てΩ, 0.25W ヌ コンデンサは μF。
ALL REGISTANCE IN OHMS. 0.25W, CAPACITANCE IN MICROFARADS UNLESS NOTED OTHERWISE.

NOTE 2 ; 電源仕様により 右の様に ジャンパする。
CHANGE CONNECTIONS WITH SHIP'S MAINS VOLTAGE.

MAINS VTG.	JA-1	JA-3	JA-4
10.4 ~ 15VDC		C–H, L	C–L, H
20.4 ~ 40VDC		C–H, L	C–L, H



MODEL	PCB NAME	R5
FR-801/802/803/805	03P5553	3.9Ω/2W
FR-810/810DS/810DS MK-II/825	A03P5553	
FR-830DS	D03P5553	10Ω/3W

NOTE 1; 特記なき抵抗の単位は全てΩ, 0.25W, Xコンデンサは F。

NOTE 2; ALL RESISTANCE IN OHMS, 0.25, AND CAPACITANCE IN FARADS UNLESS NOTED OTHERWISE.

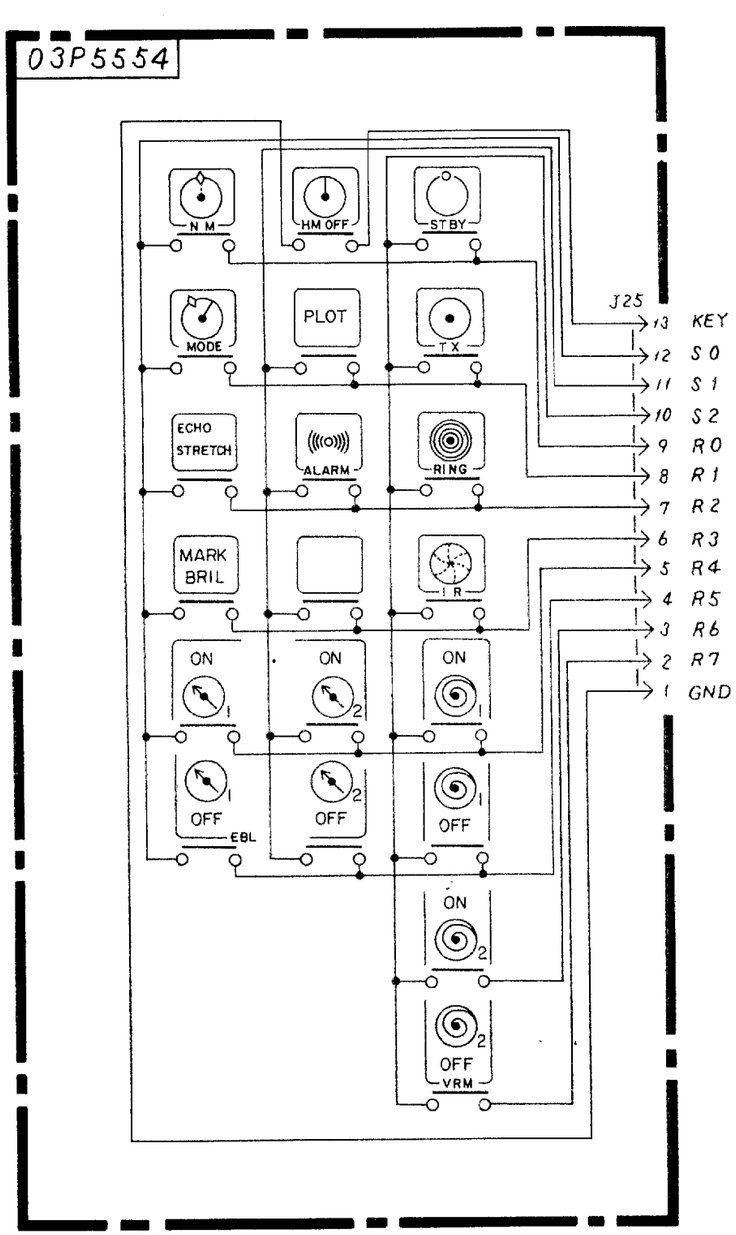
FR-800

ITEM	NAME	MATERIAL	Q'TY	DWG.NO.	REMARKS

承認 APPROVED	DEC. 13 '84	三角法 THIRD ANGLE PROJECTION	名称 TITLE パネル基板 CONTROL PANEL (□03P5553)
検図 CHECKED	Dec. 13 '84	尺度 SCALE /	
製図 DRAWN	Dec. 13 '84	重量 WEIGHT kg	図番 DWG.NO. C3276-004-G

REV.: 5/85, 10/85, 2/87

FURUNO ELECTRIC CO., LTD.



FR-810DS
FR-825D(A)
FR-801D/802D
FR-803D/805D(A)/810D(A)

FR-825D(A)/805D(A)/810D(A)の時 FOR FR-825DA/805D(A)/810D(A) PARTS NO. 1B9---.

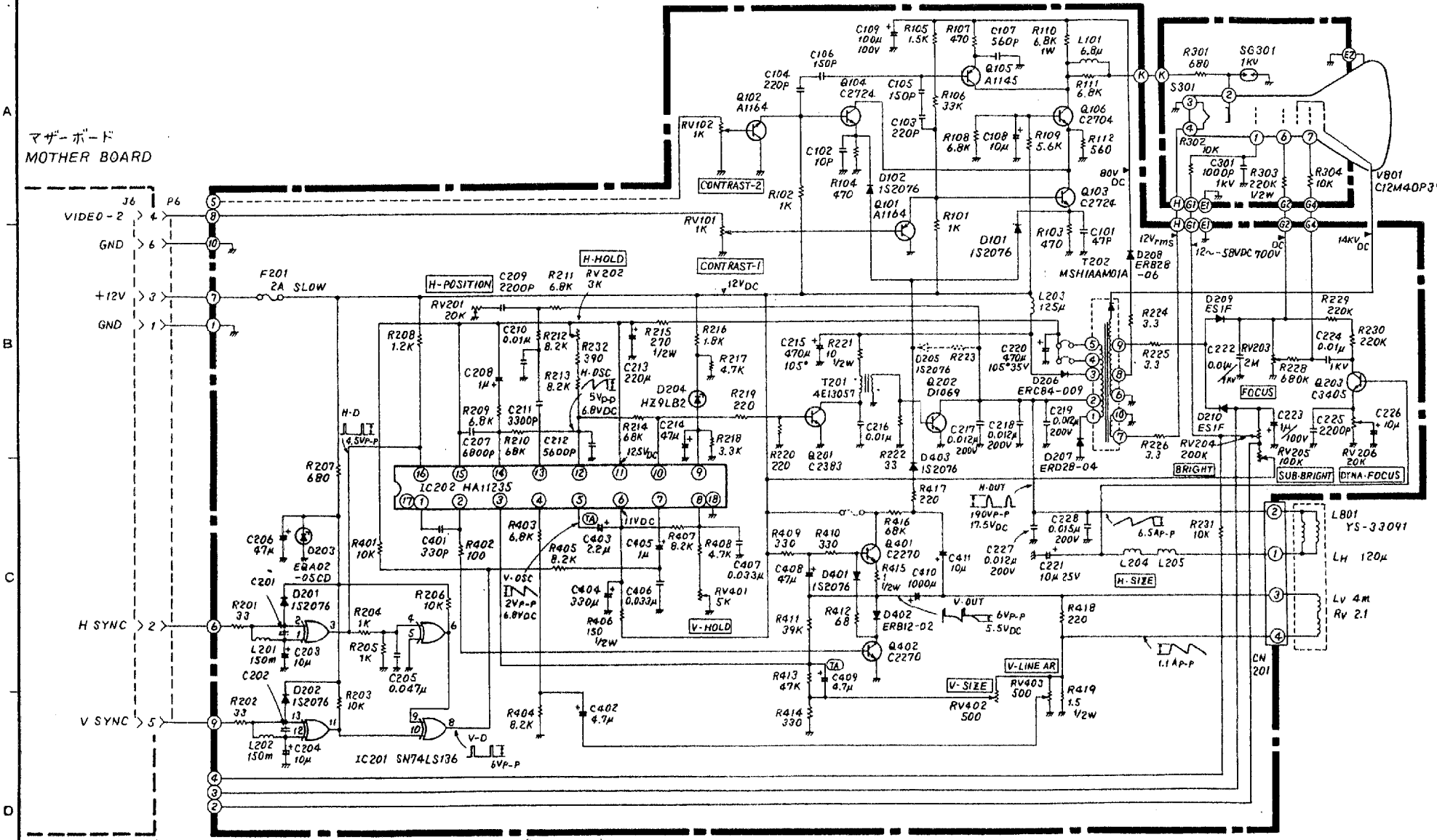
FR-801D/802D/803Dの時 FOR FR-801D/802D/803D PARTS NO. 1B8---.

ITEM	NAME	MATERIAL	Q'TY	DWG.NO.	REMARKS

承認 APPROVED	DEC. 11 '84	三角法 THIRD ANGLE PROJECTION	名称 TITLE キーボード基板 TOUCHPAD KEY BOARD
検図 CHECKED	Dec. 11 '84 K. Kuroyanagi	尺度 SCALE /	
製図 DRAWN	Dec. 10 '84	重量 WEIGHT kg	図番 DWG.NO. C3276-003-D

FURUNO ELECTRIC CO., LTD.

FURUNO



ITEM	NAME	MATERIAL	Q'TY	DWG.NO.	REMARKS

承認 APPROVED	Dec.-19-'84	三角法 THIRD ANGLE PROJECTION	名称 TITLE: 表示部 CRT DISPLAY (MG-1250SFR)
検図 CHECKED	Dec.-17-'84 K. Kuwahara	R度 SCALE	
製図 DRAWN	Dec.-17-'84	重量 WEIGHT kg	図番 DWG.NO. C3276-008-J

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

FR-800

REV. : 5/85, 7/85, 2/87

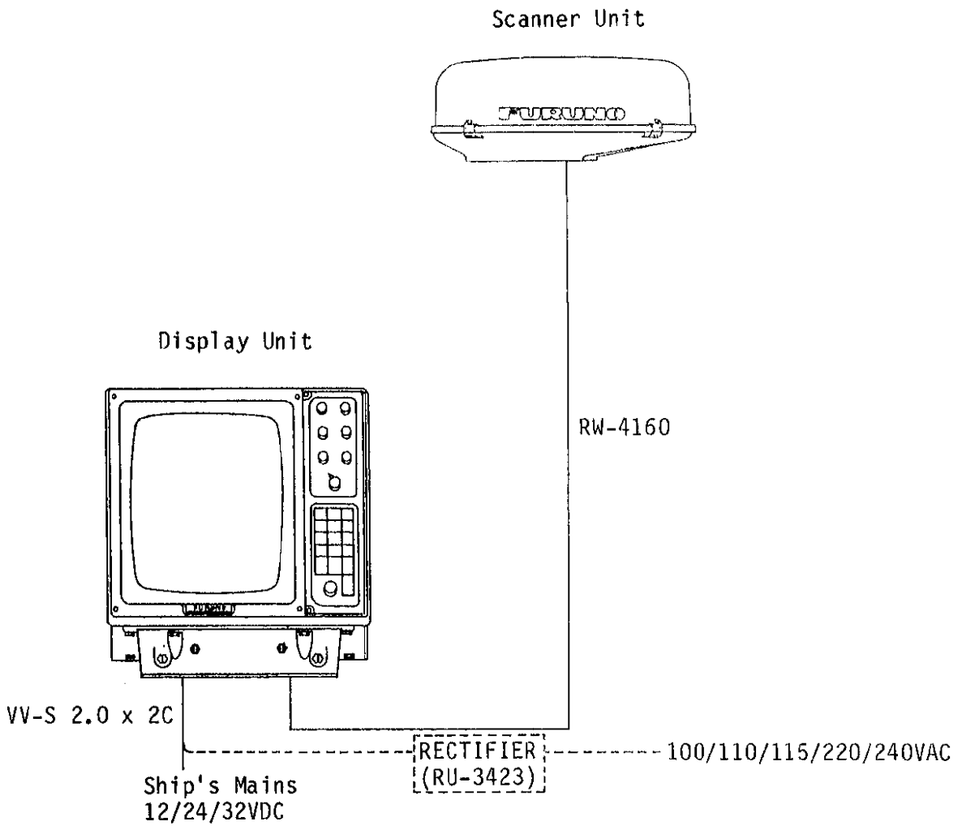
FURUNO ELECTRIC CO., LTD.

S-7

APPENDIX 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 dc. For operation from 100V, 110V, 115V or 220V ac, an optional rectifier unit is required. When the radar is first 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 Display Unit

1.2.1 Installation

As supplied, the display unit is provided for tabletop mounting, but it can be easily converted for bulkhead/overhead mounting. See next page. Choose a location to mount the unit that allows:

* Accessibility to front panel controls.
* Connection to a power source and the scanner unit.
* Compass safe distance of 1.3m standard and 0.75m steering.
* Protection from sea spray, rain and temperature in excess of 50°C.
* Convenience for observing picture on the screen. The direct path of bright sunshine or overhead lighting will disturb observation.

Mount the display unit as follows:

1) Remove the mounting cradle from the display main body by undoing two bolts at the front bottom of the display unit. See Fig.1.
2) Drill four bolt holes of 12mm dia. through the tabletop to correspond to the fixing holes on the mounting cradle. See Fig.1 and the outline drawing of the display unit.
3) Secure the mounting cradle on the table by using M10 bolts, nuts and washers or coach screws and washers.
4) Place the display main body on the mounting cradle and secure it with the two bolts at the front bottom.

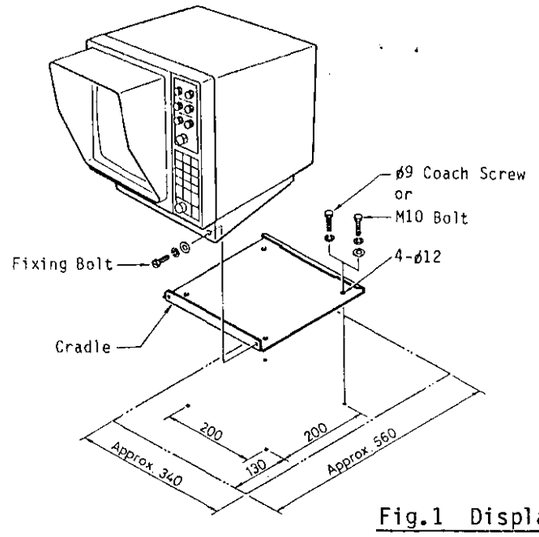


Fig.1 Display Unit Mounting

Conversion from Tabletop Mount to Bulkhead/Overhead Mount

The tabletop mount type display can be converted to the bulkhead or overhead mount type by the following method.

1) Take off the top cover ① by loosening eight M4 x 10 screws ②. See Fig.2.

2) Remove the fixing plate ③ by loosening four M4 x 8 washerhead screws ④.

3) Loosen two M8 x 40 hex. bolts ⑥ and remove the mounting cradle ⑦ from the ramp base ⑧.

4) Take off the ramp base ⑧ from the display main body ⑤ after removing seven M6 x 16 hex. bolts ⑨ and disconnecting a flying connector ⑩.

5) Loosen the lock nuts of the toggle switches ⑪ (POWER & SCANNER) on the ramp base ⑧ and turn them upside down, and secure the lock nuts.

6) Replace the label with one supplied as the spare parts.

Fig.2 Tabletop Mount

7) Connect a flying connector ⑩. Then, secure the ramp base ⑧ on the top of the display main body ⑤ with seven hex. bolts ⑨. See Fig.3.

8) Secure the fixing plate ③ with four washerhead screws ④ at the place shown in Fig.3.

9) Fit the top cover ① on the bottom of the display main body ⑤ and secure it with eight screws ②.

10) To install the unit, secure the mounting cradle ⑦ on the bulkhead or ceiling before assembling it with the ramp base ⑧.

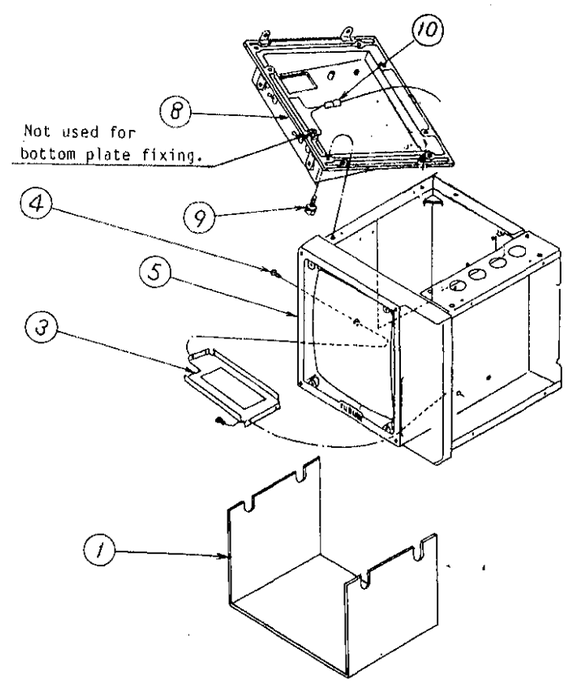
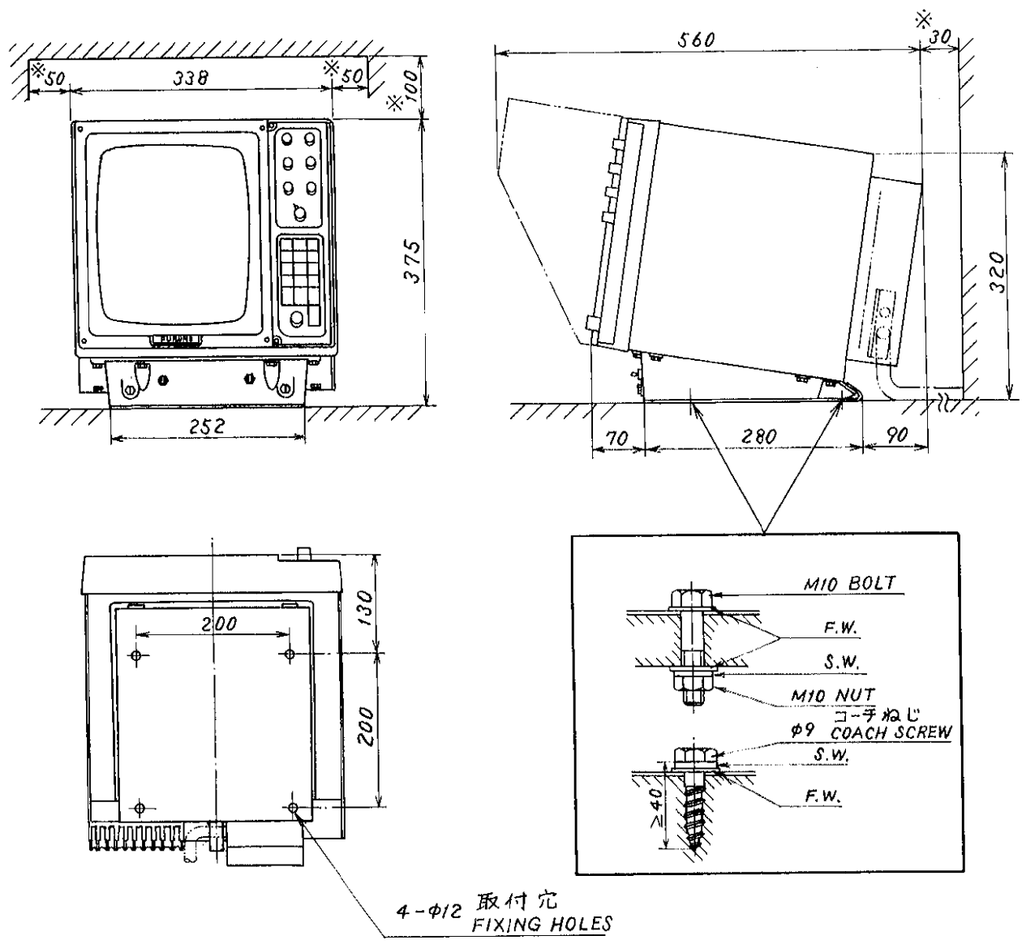


Fig.3 Bulkhead/Overhead Mount



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

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

FR-810DS(M-II)/830DS/805DS
FR-825D(A)
FR-801D/802D/803D
FR-805D/810D

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

承認 APPROVED	Aug.15.'84	三角法 THIRD ANGLE PROJECTION		名称 TITLE	レーダー指示部寸法図 RADAR DISPLAY UNIT
検図 CHECKED	Aug.13.'84.	尺度 SCALE	1/8		
製図 DRAWN	Aug.13.'84	重量 WEIGHT	20 kg	図番 DWG.NO.	C3276-001-G

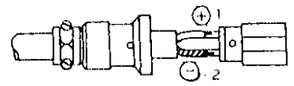
FURUNO ELECTRIC CO., LTD.

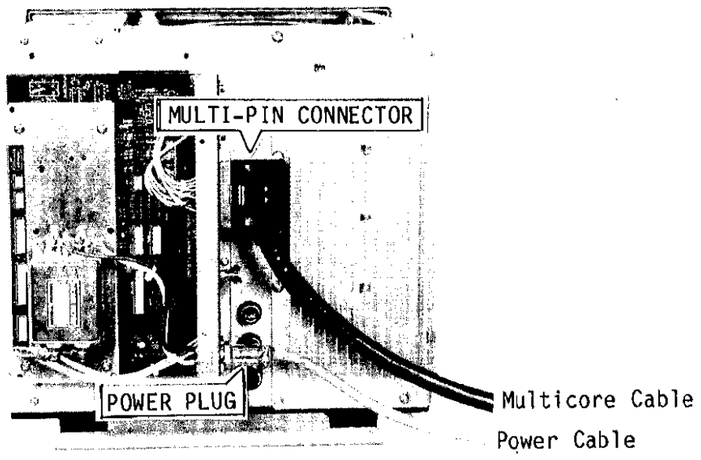
1.2.2 Connecting the Cables

Two cables run to the display unit. These are;

a. the multicore cable from the scanner unit and
b. the power cable from the ship's mains or rectifier.

The multi-pin connector (24P) is factory-wired, however, the 2P power plug is supplied as installation material and fitted to the power cable at installation. The positive lead(+) should be connected to pin #1 of the power plug and the negative lead(-) to pin #2 of that.



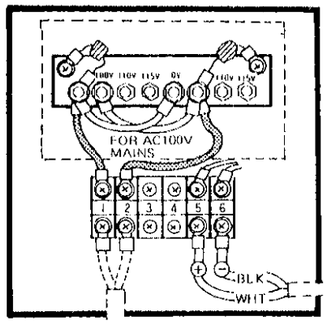


N Photo No. 804

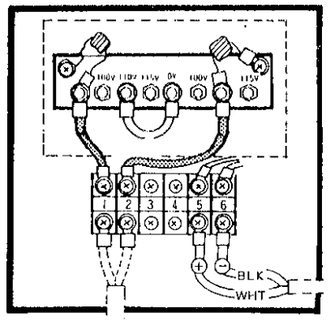
Fig.4 Rear View of Display Unit

1.3 Rectifier Unit (Option)

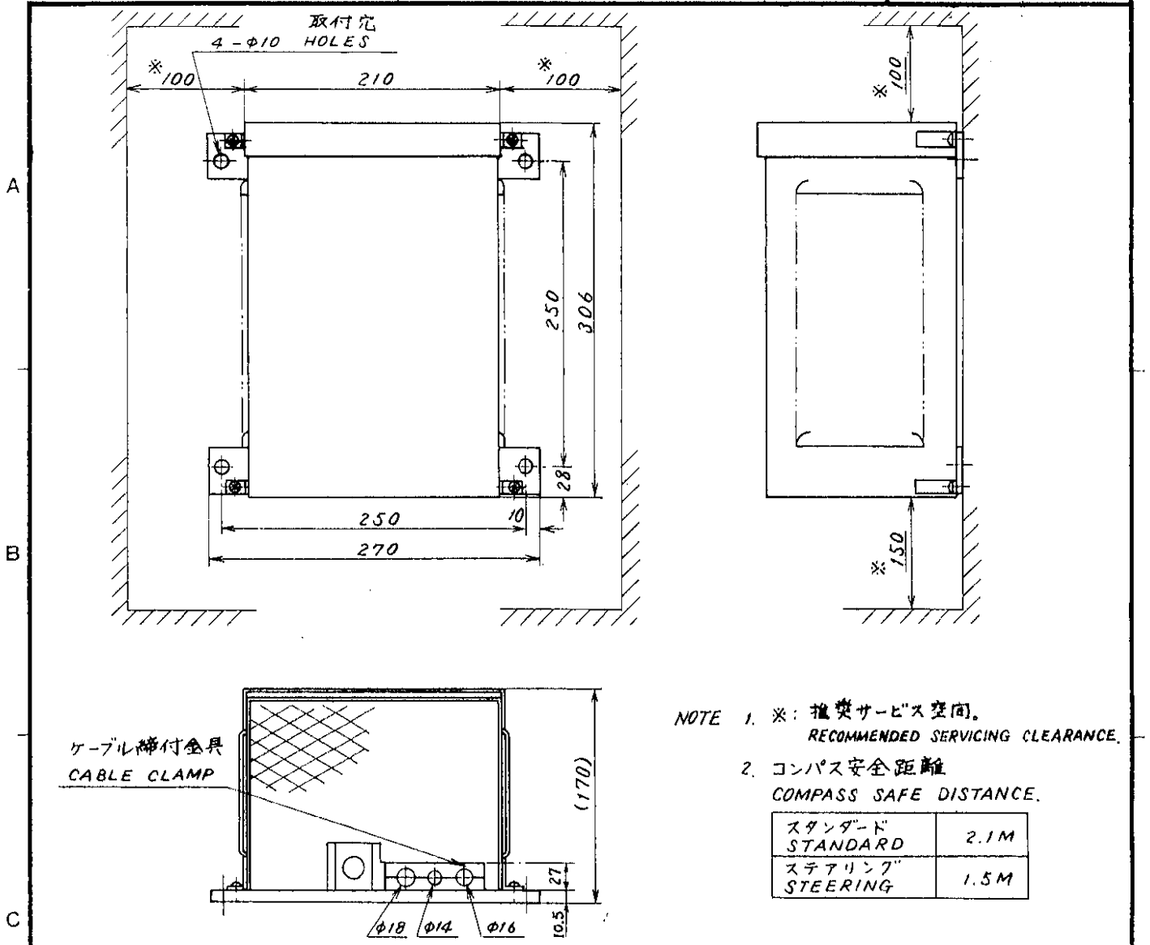
For the set driven by 100/110/115/220Vac ship's mains, a rectifier unit is required. Note that the jumper connection on the rectifier unit differs with the ship's mains. The unit can be mounted in any dry, well ventilated place. The compass safe distance of 2.1m standard and 1.5m steering should be observed.



Jumper connection for 100Vac



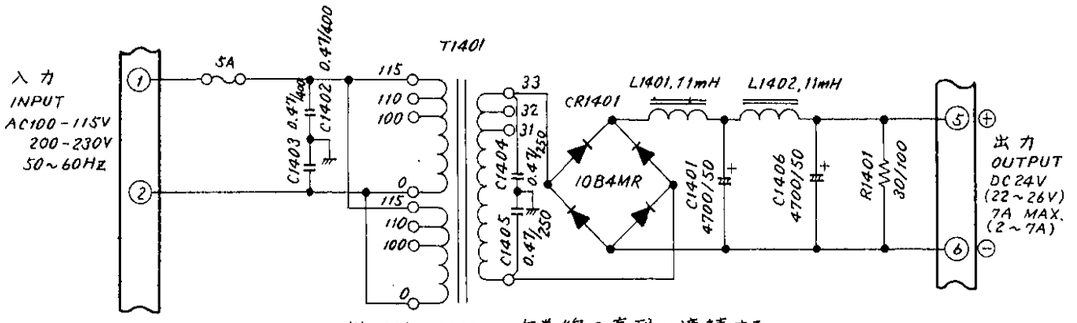
Jumper connection for 220Vac



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

2. コンパス安全距離
COMPASS SAFE DISTANCE.

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



注 AC220V 入力に対しては T1401の一次巻線を直列に接続する。

NOTE FOR 220VAC INPUT, CONNECT T1401 PRIMARY WINDINGS IN SERIES.

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

承認 APPROVED	JAN 18 '79	三角法 THIRD ANGLE PROJECTION		名称 TITLE	RU-3423 整流器 RECTIFIER UNIT
検図 CHECKED	JAN. 17. '79	尺度 SCALE	1/5		
製図 DRAWN	Jan 16 79	重量 WEIGHT	16.5kg	図番 DWG.NO.	C3002-005-H

REV.: 8/85

FURUNO ELECTRIC CO., LTD.

1.4 Scanner Unit

Scanner Unit Siting Considerations

The scanner unit is generally installed either on the wheelhouse top or on a radar mast on an appropriate platform. When siting the unit, take care to consider the following points.

1) The interconnecting cable, type RW-4160, is run between the scanner and the display, and is 10 meters long. If additional interconnect cable is required for a particular installation, an unbroken length of cable must be used (i.e., no splices allowed!), and the maximum length of the interconnect cable is 30 meters.

2) Any large metallic objects such as funnels, masts or derrick posts around the radar scanner may well block its line of sight, causing blind sectors in the radar picture. The sector directly ahead is obviously most important to the radar operator, so carefully plan the site of the scanner so the forward area is clear of obstructions.

3) Deposits and fumes from a funnel or other exhaust vent can adversely affect the performance of the antenna, since hot gases may distort the radome. The scanner unit must not be mounted in a position where it may be subjected to temperatures in excess of 70° C.

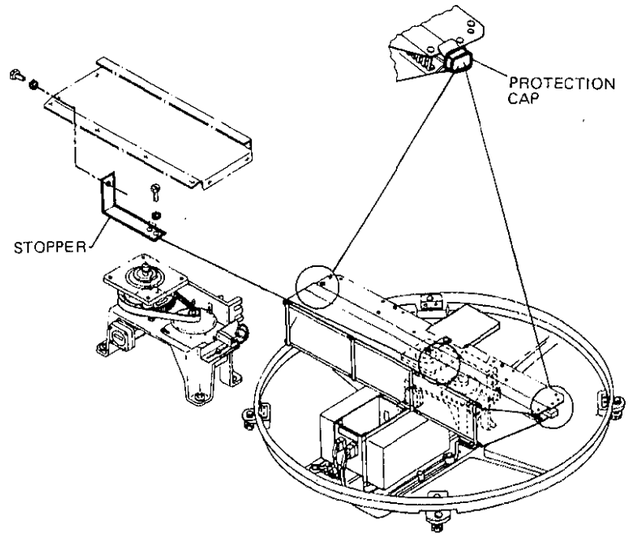
4) The compass safe distance, 3.10m standard compass and 1.75m steering compass, should be observed.

5) The unit must not be positioned in close proximity to a radio direction finder antenna, since the DF would be adversely affected. A separation of more than 2 meters is recommended.

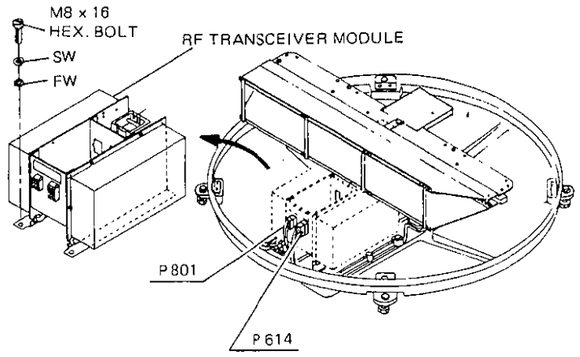
Scanner Unit Preparation and Unpacking

1) Open the radome package carefully. Unbolt the four screws used to hold the white radome to the blue mounting base, and carefully lift the radome up over the insides of the dome.

2) Remove the protection caps from the end of the scanner, and remove the two bolts securing the stopper bracket to the scanner. This will release the scanner from its shipping preparation position, and allow it to rotate freely, as well as to allow access to the transceiver assembly.

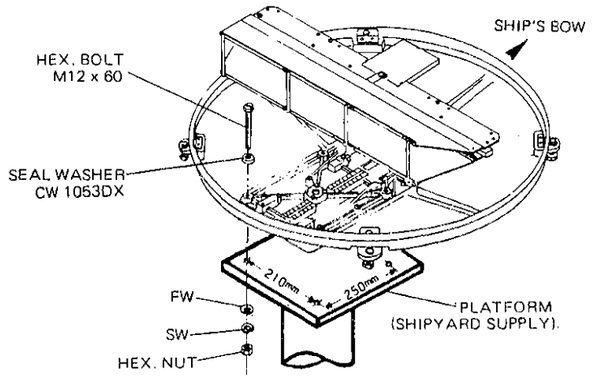


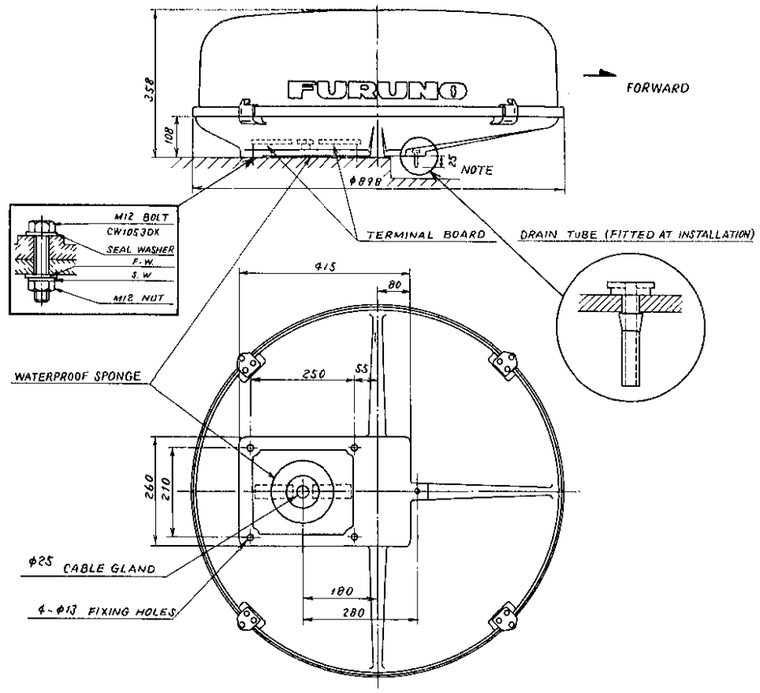
3) Unplug connectors P614 and P801 going into the transceiver, and then undo the two M8 x 16 hex. bolts securing the transceiver to the mounting plate. The transceiver assembly may then be slid out from under the scanner and placed in a safe location temporarily while the radome base is secured to the radar mounting platform.



Scanner Unit Mounting

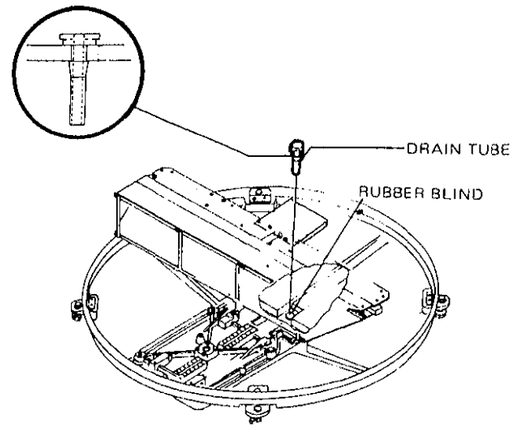
4) Now install the bottom mounting base of the radome on the radar platform using four M12 x 60 bolts, paying attention to the orientation of the unit.





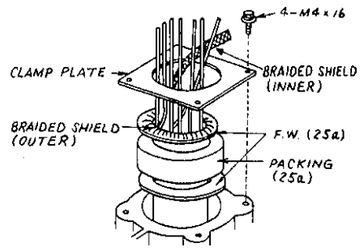
NOTE PROVIDE A SPACE OF 80MM AROUND AND 50MM BELOW THE DRAIN HOLE TO INSTALL THE DRAIN TUBE.

5) Remove the black rubber blind to expose the hole for installation of the drain tube. Make sure that the drain tube is fully inserted into the hole. It is important that there is sufficient free space beneath the bottom of the drain tube for it to "breathe", thereby allowing the radome cover to expand and contract as necessary during ambient temperature variations. DO NOT allow the bottom of the drain tube to contact the mounting platform surface, since this could allow water to be drawn up by capillary action into the dome.



Wiring and Final Preparation of Scanner Unit

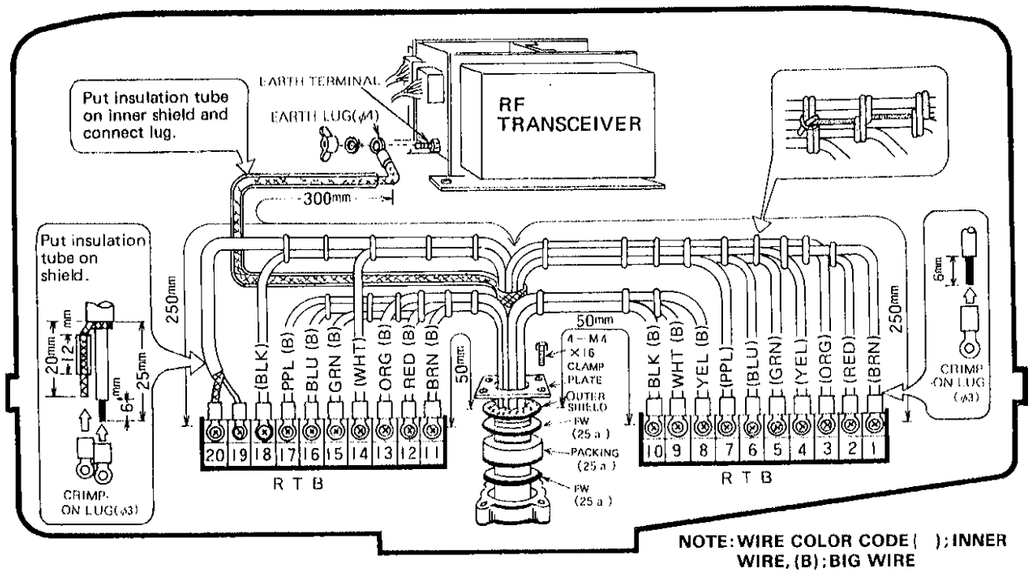
6) Run the interconnect cable from the display unit into the scanner base, taking special precaution to make sure that the cable grand is properly installed to prevent water leakage into the dome around the cable. See the drawing below.



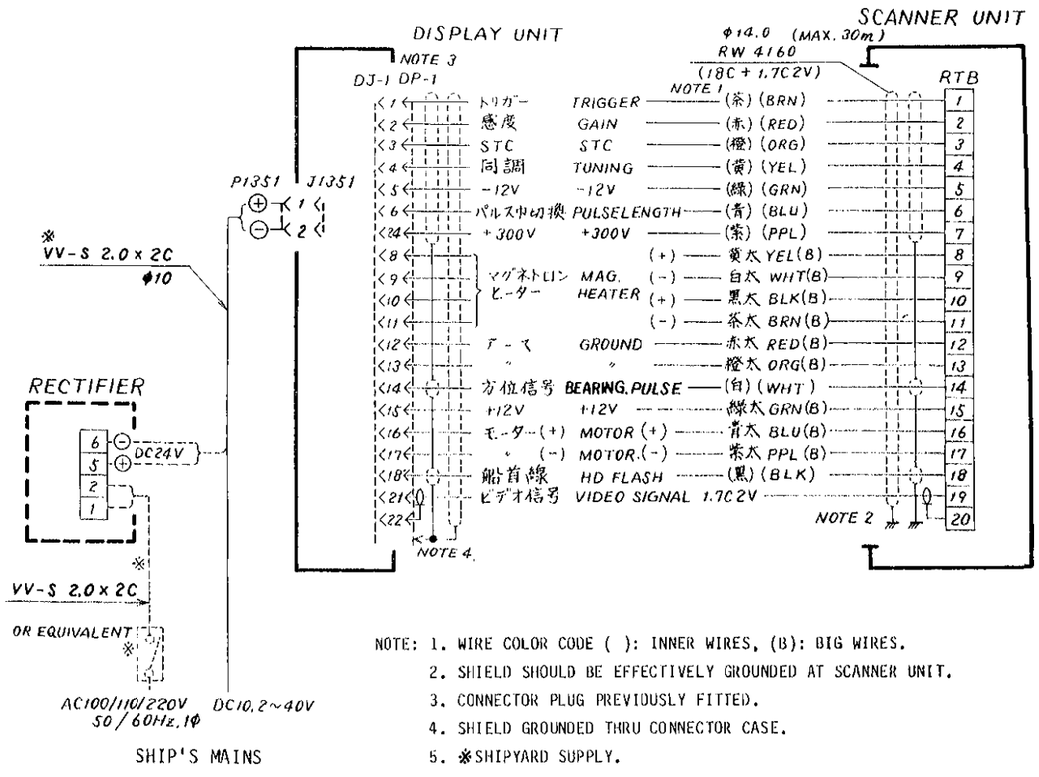
DETAIL OF CABLE ENTRY

7) Dress the interconnect cable wires neatly and terminate each wire with a crimp-on lug. The harness thus formed should be laced with lacing twine or plastic "tie-wraps". Make sure that each wire is prepared so that there is some insulation crimped at the back end of the crimp-on lug in order to provide mechanical integrity for the connection. Make sure that there is enough bare wire in the forward end of the crimp-on lug to ensure the integrity of the electrical connection.

Scanner Unit

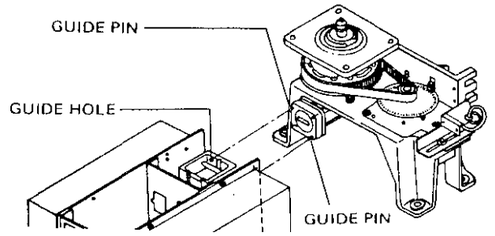


NOTE: WIRE COLOR CODE ( ); INNER WIRE, (B); BIG WIRE

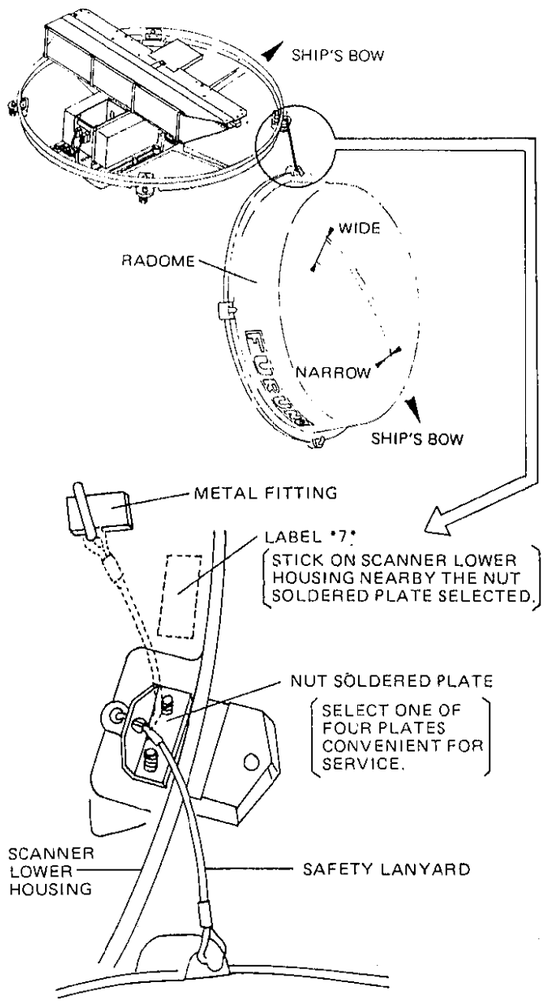


NOTE: 1. WIRE COLOR CODE ( ): INNER WIRES, (B): BIG WIRES.
2. SHIELD SHOULD BE EFFECTIVELY GROUNDED AT SCANNER UNIT.
3. CONNECTOR PLUG PREVIOUSLY FITTED).
4. SHIELD GROUNDED THRU CONNECTOR CASE.
5. ※SHIPYARD SUPPLY.

8) After the wiring has been completed and has been inspected by another person to verify accuracy, reinstall the transceiver assembly. Make sure that the guide holes on the waveguide flange of the transceiver are mated properly with the guide pins on the transceiver waveguide output.



9) Set up the safety lanyard on the blue radome mounting base by running the end of the lanyard through the hole in the securing plate which will allow the white radome cover to hang most conveniently when the radar is being serviced at a later date. Put the sticker showing where the safety lanyard is stowed under the blue mounting base so that the servicing technician may easily locate it before actually reopening the radome at a later date. Replace the radome cover, making sure that it is oriented properly; i.e., with the narrow part of the groove on the top of the cover pointed forwards.



1.5 Alteration of Power Supply

By changing the main fuse and jumper connections on the POWER SUPPLY board (03P5900) in the display unit, the radar can be operated from either 12Vdc or 24/32Vdc.

Mains Input	Main Fuse	POWER SUPPLY Board (03P5900)	
		JA-1	JA-3/JA-4
12Vdc (10.2-15V)	25A	Cut jumper wire.	Select "L" marks.
24/32Vdc (20.4-40V)	10A	Put jumper wire.	Select "H" marks.

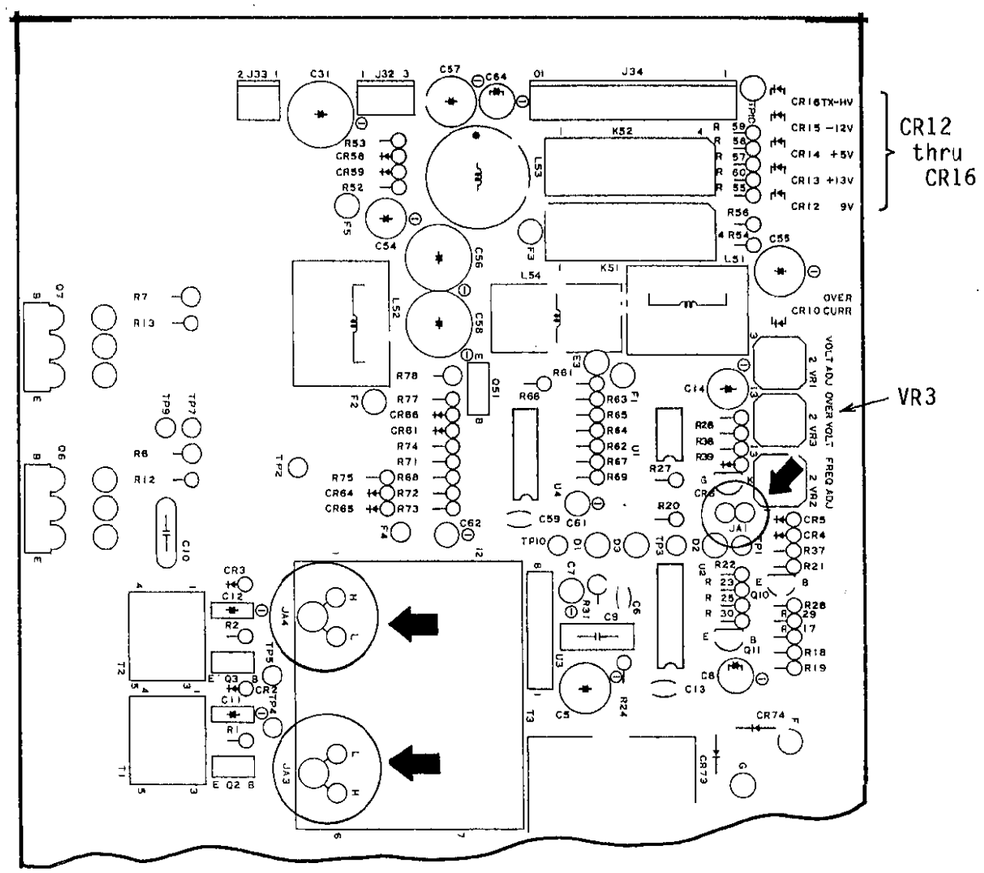


Fig.5 POWER SUPPLY Board (03P5900, Soldering Side)

Adjustment after modification

When the above modification is done, confirm that the over-voltage protector functions normally, i.e., the radar stops operation at the moment the supply voltage increases up to the voltage shown below, using variable-voltage dc power supply.

Power Supply Setting	Operating Voltage of Over-voltage Protector
12Vdc	16 ± 0.4Vdc (15.6 to 16.4Vdc)
24/32Vdc	43 ± 0.9Vdc (42.1 to 43.9Vdc)

If not, over-voltage (mains input) protector adjustment should be made as follows.

Procedure:

1) Turn VR3 on the POWER SUPPLY board (03P5900) fully CW. See Fig.5.

2) Set the output voltage of the dc power supply to 16Vdc (12Vdc set) or 43Vdc (24/32Vdc set).

3) Turn VR3 CCW little by little until the inverter stops oscillation, and switch off the radar. (CR12 thru CR16 on the POWER SUPPLY board go off at the moment the inverter oscillation stops. See Fig.5.)

4) Decrease the output voltage of the dc power supply below the operating voltage of the protector, and switch on the radar.

5) Increase the output voltage of the dc power supply and confirm the inverter stops oscillation at the moment the output voltage of the dc power supply reaches 16Vdc (12Vdc set) or 43Vdc (24/32Vdc set).

6) Switch off the radar and adjust the output voltage of the dc power supply to the rated value, then switch on the radar again.

1.6 Preoperation Checks and Adjustment

After completion of all wirings 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) Turn the **POWER** switch to "ON" and confirm that the input voltage at the filter (FL-1) is as below.

Specified Voltage	Allowance
12Vdc	10.2Vdc to 15.0Vdc
24Vdc & 32Vdc	20.4Vdc to 40.0Vdc

2) In about 3 minutes after switching on the radar, the indication of the "ST-BY" is presented on the screen to indicate the radar is ready to transmit.

3) Turn the **SCANNER** switch to ON and press the **TX** touchpad.

4) Check the function of controls and touchpad keys by operating them one by one.

Adjustment of Transmission Timing

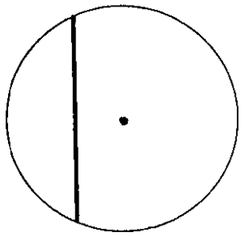
Transmission timing differs with respect to the length of the multicore cable between the display and the scanner units. Perform this adjustment at installation without fail, otherwise the following symptoms will appear. See Fig.6.

* Straight quay or breakwater appears bent inward or outward near the center spot on 0.25 n.m. range.

* Range error is found on short range.

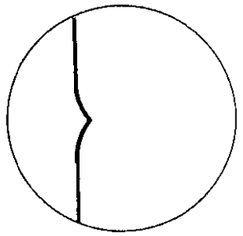
* Wide ring appears at the screen center.

The adjustment is made with VR1 on the INTERFACE board (03P5551) in order to reject the above symptoms while observing a proper target echo on the screen. See Fig.7.



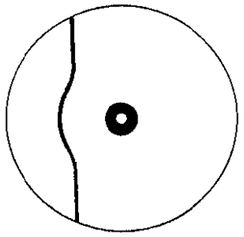
a. PROPER SETTING
Straight Target appears as a straight line on the screen.

Fig.6(a)



b. TURN VR1 CW TO CORRECT. Straight Target appears bent inward at the screen center.

Fig.6(b)



c. TURN VR1 CCW TO CORRECT. Straight Target appears bent outward at the screen center.

Fig.6(c)

N Photo No.1696

Fig.7

Heading Alignment

Procedure:

1) Select the Head-up mode by pressing the **MODE** touchpad.

2) With the **RANGE** switch set at 3 n.m., select a proper target echo (small island, end of quay, etc.) located on or around the heading flash and near the edge of the screen.

3) Press the **EBL-1** touchpad to present the No.1 EBL on the screen.

4) Rotate the **No.1/No.2 VRMs & EBLs** control until the EBL positions over the center of a target.

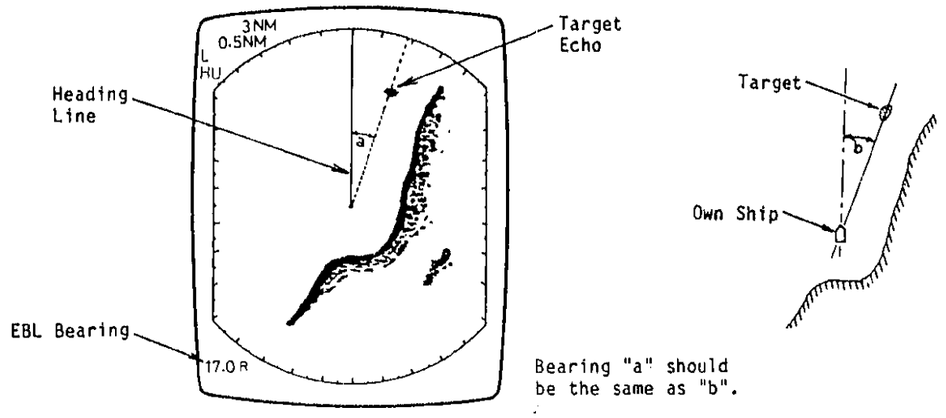
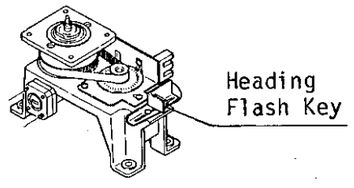


Fig.8

5) Read the EBL bearing at the bottom left on the screen. On the other hand, find the relative bearing of the target from the ship's heading on the navigation chart by referring to the ship's compass. The relative bearing can also be given by visually measuring the direction of the target from the ship's bow using the dumb card.

6) Adjust S2 on the CPU board (03P5550) so that the bearing of the target on the screen is the same as that on the navigation chart or visually measured. See Fig.7 for the location of S2.

NOTE: When the adjustment cannot be completed with S2, change the position of the heading flash key in the scanner unit and readjust S2. This should be made when the scanner unit is installed with large error in direction.



Tuning Adjustment

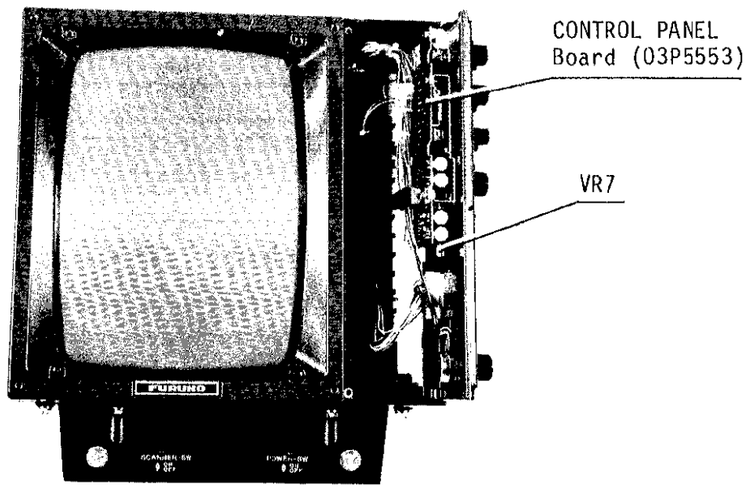
This adjustment is already made at factory. But if the best tuning condition is not obtained with the **TUNE** control set around mid-travel, use the following procedure.

Procedure:

1) Transmit the radar on long range with the **TUNE** control set around mid-travel and wait for approx. 10 minutes to stabilize the oscillation of the magnetron.

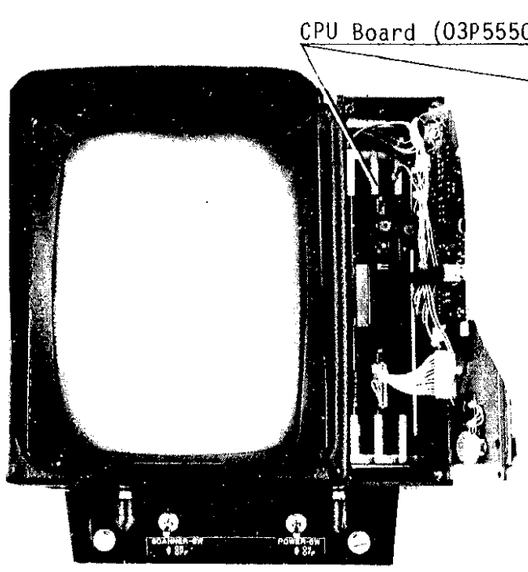
2) Turn VR7 on the CONTROL PANEL board (03P5553) fully CW and turn it CCW gradually to detect the tuning point where a weak long range echo is discerned with maximum sensitivity.

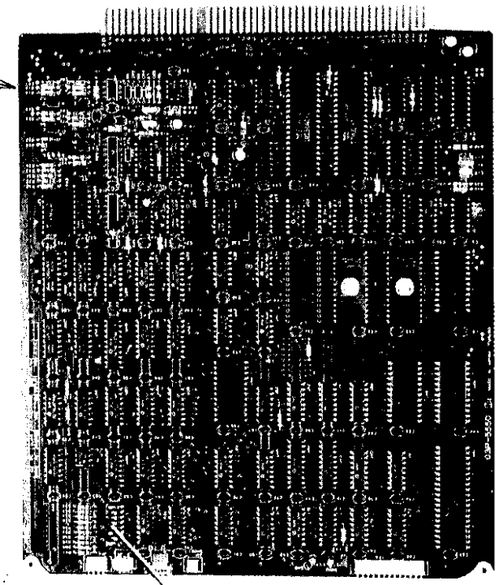
3) If there are two tuning points, set VR7 at the first tuning point.



APPENDIX 2 SETTING OF INTERNAL DIP SWITCH

An internal dip switch (S1) is located on the CPU board (03P5550) as shown below. Note that #1, #2 and #7 of S1 are factory-use only.





Switch #3
"ON" : No.1 VRM is calibrated in nautical miles(NM).--- Factory-setting
"OFF": No.1 VRM is calibrated in kilometers(KM).

Switch #4
"ON" : No.2 VRM is calibrated in nautical miles(NM).--- Factory-setting
"OFF": No.2 VRM is calibrated in kilometers(KM).

Switch #5
With this switch set to "OFF", the radar is put in standby condition irrespective of the **TX** touchpad setting when the **SCANNER** switch is turned to "OFF". --------Factory setting

Switch #6
"ON" : Range ring interval is calibrated in nautical miles(NM).
----- Factory-setting
"OFF": The range ring intervals of 0.1 Km and 0.2 Km are selected on 0.25 n.m. and 0.5 n.m. ranges respectively.

Range	Range Ring Interval
0.25 n.m.	0.1 Km
0.5 n.m.	0.2 Km

Switch #8
"ON" : Guard zone of the alarm is selected between 0 and 36 n.m.
----- Factory-setting
"OFF": Guard zone setting is limited between 3 and 6 n.m.