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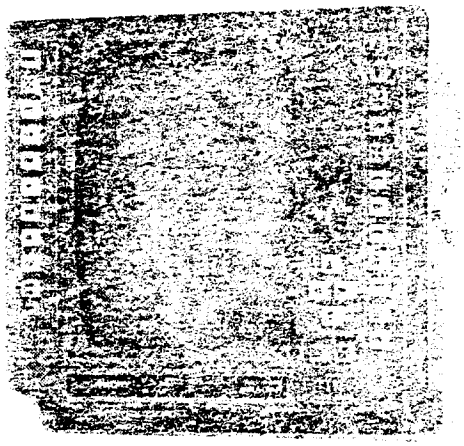
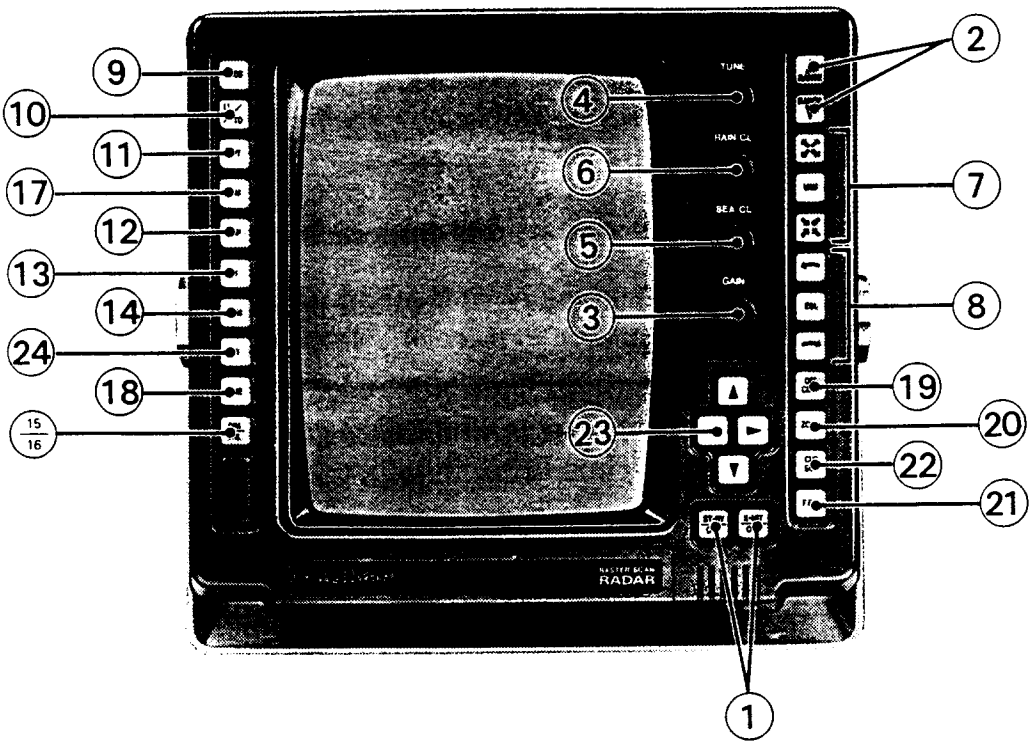


Models R40X and R41X
Raster Scan Radar Systems

RAD - 176

Raytheon

OPERATION REFERENCE GUIDE
FOR
R40X/R41X



MODEL R40X/41X CONTROLS AND PANEL LAYOUT

OPERATIONS:

1. **POWER:**
   To turn the radar "ON": Press the [ST-BY/OFF] key.
   To transmit: Press the [X-MIT/OFF] key (Warm-up period 90 sec.).
   To turn the radar "OFF": Press [ST-BY/OFF] and [X-MIT/OFF] keys together.
2. **RANGE:** Press the [Range ▲] key to increase the range scale. Press the [Range ▼] key to decrease the range scale.
3. **GAIN:** To adjust the gain, rotate the **GAIN** control knob clockwise to increase the gain and counterclockwise to decrease the gain.
4. **TUNE:** To adjust the tuning, rotate the **TUNE** control knob to maximize the target echoes on the display and/or peak indication of the tune bar indicators.
5. **SEA CLUTTER (STC):** To adjust the the Sea Clutter (STC), rotate the **SEA CL** control knob CW to increase the STC and decrease the clutter or CCW to decrease the STC.
6. **RAIN CLUTTER (FTC):** To adjust the Rain Clutter (FTC), rotate the **RAIN CL** control knob CW to increase the FTC and CCW to reduce the FTC.

7. **VRM:** To turn ON/OFF the VRM: Press the [VRM] key.
To change from VRM #1 to VRM #2: Press and hold the [VRM] key until buzzer sounds.
To increase or decrease the VRM distance (slowly): Press the  or the  key.
To increase or decrease the VRM (faster): Press the [VRM] key while pressing the  or the  key.

8. **EBL:** To turn ON/OFF the EBL: Press the [EBL] key.
To change from EBL #1 to EBL #2: Press and hold the [EBL] key until buzzer sounds.
To rotate the EBL (slowly): Press the  or the  key.
To rotate the EBL (faster): Press the [EBL] key while pressing the  or the  key.

9. [MODE]: Each press changes the bearing readout in the following sequence: RELATIVE → TRUE → MAGNETIC → RELATIVE...

10. [LL/TD]: Each press changes the loran data in the following sequence: OFF → L/L → TD → OFF...

11. **WAYPOINT:** Press the [WPT] key.
The waypoint mark, bearing and distance, and time-to-go to the waypoint are displayed.
If the [LL/TD] key and the [WPT] key are pressed together, the waypoint Lat/Long position will be displayed in place of own ship's position.

12. [EXP]: When pressed, alternately turns "ON" and "OFF" target expansion.

13. [IR]: When pressed, either enables or disables the interference rejection circuit.

14. [SHM]: When pressed, the Ship's Heading Mark will be "momentarily" removed from the display. If pressed and held, the ship's heading mark will be removed until the key is released.

15. **CRT BRILLIANCE:** Press the [DIM/BRIL] key. The "BRIL" menu appears on the display. Press the [Range ▲] key to increase the brilliance or the [Range ▼] key to decrease the brilliance. The range of brilliance is from 1–8 steps.

16. **PANEL BACKLIGHTING:** Press the [DIM/BRIL] key twice. The "DIM" menu appears on the display. Press the [Range ▲] key to increase the backlighting or the [Range ▼] key to decrease the backlighting. The range is from 0–7.

17. ALARM: Press the [ALM] key, and "MAKE ZONE PRESS ALM" is displayed. Set the desired alarm zone using VRM #1 and VRM #2. (Use EBL #1 and EBL #2 to make sector zone.)
Press the [ALM] key again, and "SET LEVEL PRESS ALM" is displayed. Use the Range ▲/▼ keys to change the target desired level for the audible alarm if desired.
Press the [ALM] key again to set the "IN" Alarm. If the [ALM] key is held depressed, the described zone will be memorized.
Press the [ALM] key again, and the "IN" Alarm is changed to an "OUT" Alarm.
Press the [ALM] key again, and the Alarm mode is turned "OFF".
A memorized alarm zone can be recalled by pressing and holding the [ALM] key. The characters for **ALM** will be in reverse characters.

18. TIME (TIMED TX MODE):
This feature allows the operator to program the radar to automatically Transmit for a specific programmed period and to return to Standby for a prescribed period.
To set the TX Time: Press the [TIME] key. "SET TX PERIOD", "10, 20, 30 SCANS" menu will be displayed. Use the RANGE ▲/▼ keys to make your selection. Your selection will be displayed in reverse characters.
Press the [TIME] key again. A new menu "SET STBY PERIOD", "3, 5, 10, 15, MIN" will be displayed. Use the RANGE ▲/▼ keys to make your selection. Your selection will be displayed in reverse characters.
To turn the Timed TX mode ON: Press and hold the [TIME] key until the buzzer sounds.
To turn the Timed TX mode OFF: Press and hold the [TIME] key until the buzzer sounds.

19. OFF CENTER:
To turn "ON" the Off Center mode: Press the [OFF CENT] key. The Off Center cursor "–┼–" appears on the display along with "SET ORIGIN, PRESS OFF CENT" menu and the mode indicator will change to "O". Use the [SHIFT] keys to position the cursor. Press [OFF CENT] again and Off Center Mode is activated. The menu disappears from the display.
To establish a new Off Center origin, use the [SHIFT] keys to re-position the cursor. Then press the [OFF CENT] key and the origin will be shifted to the new position.
To turn "OFF" the Off Center mode, press the [OFF CENT] key again.

20. ZOOM: To turn "ON" the Zoom mode: Press the [ZOOM] key. The zoom cursor mark "–┼–" will appear on the display along with the "SET ORIGIN, PRESS ZOOM" menu and the mode indicator will be changed to "Z".
Use the [SHIFT] keys to position the cursor to the area to be magnified. Then press the [ZOOM] key to activate the Zoom Mode. The menu is removed from the screen, and the display is magnified 2 times. A " ⊕ " Symbol marks the cursor position.
To turn "OFF" the ZOOM mode: Press the [ZOOM] key again.

21. FLOATING EBL:
The EBL #2 is assigned as the Floating EBL, and VRM #2 is used for range measurements from the Floating EBL line.
To turn "ON" the Floating EBL mode: Press the [F.EBL] key. The cursor "–┼–" will appear on the display along with the "SET ORIGIN, PRESS F.EBL" menu. The mode indicator is changed to an "F".
Use the [SHIFT] kedys to position the cursor to the desired origin. Press the [F.EBL] key again. The EBL #2 and VRM #2 will be centered at the new origin. The origin can be changed at anytime while in this mode by using the [SHIFT] keys to re-position the cursor and by repressing the [F.EBL] key.
To turn the F.EBL mode "OFF": Press the [F.EBL] key again.

22. CURSOR: To turn "ON" the Cursor mode: Press the [CURSOR] key.
The cursor mark "–+–" will appear on the display and the mode indicator will be changed to a "C".
The cursor can be positioned using the [SHIFT] keys to obtain the Range, Bearing and Time-To-Go information for any point on the display. The Time-To-Go display will disappear after 8–10 seconds.
To turn "OFF" the CURSOR mode: Press the [CURSOR] key again.
Each of the cursors in OFF CENTER, ZOOM, F.EBL, and CURSOR modes has its own origin point which will be "MEMORIZED" when the mode is turned "OFF".

23. SHIFT KEY:

Four cursor direction control keys shift the cursor position on the display. Press ▲/▼, or ◀/▶ to shift the cursor to the desired location. You can press ▲/▼ and ◀/▶ together to move at angles as necessary.

24. RANGE RINGS [RR]:

The [RR] turns the Fixed Range Rings "ON" or "OFF" alternately.
Press [RR]=Range Ring "ON"; Press [RR]=Range Rings "OFF".

PURPOSE

THIS MANUAL CONTAINS IMPORTANT INFORMATION OF
THE INSTALLATION, OPERATION AND MAINTENANCE OF
YOUR EQUIPMENT

RAYTHEON MARINE COMPANY products are supported by a network of Authorized Service Representatives. For product information, you may contact the following regional centers:

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Phone: 603-881-5200

Europe .....Raytheon Marine Sales & Service Co.
Siljangade 6
KD2300 Copenhagen S
Phone: 45-31-57 06 11

HIGH VOLTAGE WARNING

Do not open any of the units when the radar is ON; high voltages within the Scanner and Display Unit could be fatal to anyone coming in direct contact with them.

Disconnect ship's power from the Scanner and Display Unit before attempting any maintenance; otherwise, ship's power will be present at terminals inside the Scanner and Display Unit.

RADIATION HAZARD

Care should be taken to avoid possible harmful effects (particularly to the eyes) of radiation from radar transmissions.

To avoid harmful radiation, the Display OPERATE switch should be turned to the ST-BY or OFF position when working on the Scanner.

"IMPORTANT NOTICE"

THIS DEVICE IS ONLY AN AID TO BOATING SAFETY AND NAVIGATION. ITS PERFORMANCE CAN BE AFFECTED BY MANY FACTORS INCLUDING EQUIPMENT FAILURE OR DEFECT, ENVIRONMENTAL CONDITIONS, AND IMPROPER HANDLING OR USE. IT IS THE USER'S RESPONSIBILITY TO EXERCISE COMMON PRUDENCE AND NAVIGATIONAL JUDGEMENT. THIS DEVICE SHOULD NOT BE RELIED ON AS A SUBSTITUTE FOR SUCH PRUDENCE AND JUDGEMENT.

CONTENTS

RADAR GLOSSARY

The following is a list of abbreviations and acronyms which may be used in the text of the manual.

A/D	–	Analog to Digital Conversion
ALM IN	–	Alarm In, also known as the approach alarm. For targets approaching a set area or own ship.
ALM OUT	–	Alarm Out, also known as the exit alarm. For targets exiting or leaving a set area.
CPU	–	Central Processing Unit
CRT	–	Cathode Ray Tube
D/A	–	Digital to Analog Conversion
DEL	–	Delete
DISP	–	Display
EBL	–	Electronic Bearing Line
EXP	–	Expansion
FET	–	Field Effect Transistor
FTC	–	Fast Time Constant, also known as Anti-Clutter Rain
IR	–	Interference Rejection
KM	–	Kilometer
LL	–	Latitude/Longitude
MH	–	Modulator High Voltage
MN	–	Modulator High Voltage Return
NM	–	Nautical Mile
NSK	–	North Stabilizing Kit
PCB	–	Printed Circuit Board
PPI	–	Plan Position Indicator
P-S	–	Parallel to Serial Conversion
PW	–	Pulse Width (Length)
PWS	–	Pulse Width (Length) Selection
RR	–	Range Rings (Fixed)
MC	–	Motor Control
SHM	–	Ship's Heading Marker
ST-BY	–	Standby
STC	–	Sensitivity Time Constant, also known as Anti-Clutter Sea
TB	–	Terminal Board
TD	–	Time Difference
TI	–	Trigger
VD	–	Video
VRM	–	Variable Range Marker
WPT	–	Waypoint
X-MIT	–	Transmit

SECTION 1

GENERAL DESCRIPTION

1.1 INTRODUCTION

Congratulations on selecting the Raytheon X Series Raster Scan Radar for your radar navigation needs.

Whether you purchased this radar because of its compactness or power economy, ease of installation, or long term reliability, one thing is certain; the moment you turn on your R40X or R41X Display you will know you are seeing a revolutionary new concept in radar technology at work.

Radar signals are "stored" on a 10-inch diagonal TV-type picture with chart like clarity and detail. A single glance at your Display will give you a complete and accurate 360° radar picture of other vessels, buoys and land fall surrounding your vessel.

The new 1/8 NM range scale together with the Offset mode makes navigating tight channels, rivers, or waterways at night a pleasure instead of a problem.

The Zoom mode gives you a fast 2 times enlargement of the radar presentation in the zone you have designated. A new "Timed Tx" mode lets the radar automatically turn its transmitter "on" and "off" for scans of the area around your vessel. Set the target alarm zone to alert you of any radar contacts that have entered your zone, including any that might have escaped your notice.

Dual Electronic Bearing Line's (EBL) and Variable Range Markers (VRM) allow rapid high accuracy target bearing and range measurements. When connected to a Loran-C Navigator with proper output data format for full function operation, the radar can display your destination waypoint on the screen at its bearing and range from your vessel. The Waypoint feature provides steering reference information to the destination, and can be used to help locate specific buoys or waypoint landmarks.

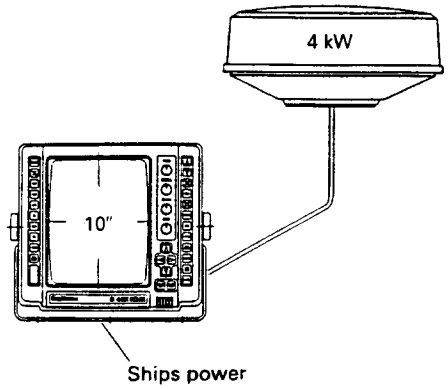
With all of these electronic features and the thoughtful compact and efficient design of this radar, it soon becomes apparent that human engineering and operational simplicity have been foremost considerations in the R40X/R41X product design.

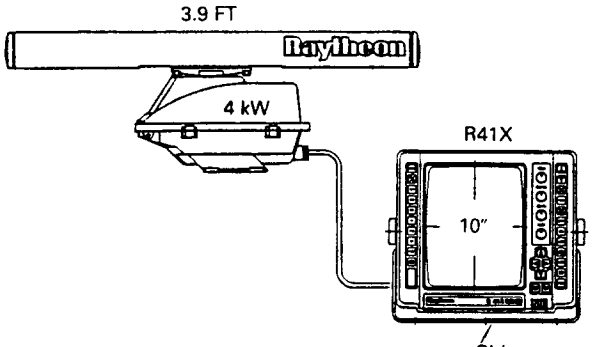
We trust that you will enjoy many years of excellent performance, reliability, and smooth sailing with your new X series radar system.

1.2 SYSTEM DESCRIPTION

The X Series Model configurations are:

R40X A two-piece system consisting of a compact 10″ monochrome raster scan display unit and a 4 kW X-band transceiver housed in a 24″ radome housing.





R41X A two-piece system consisting of the same compact 10″ monochrome raster scan display unit as above, with the same 4 kW X-band transceiver housed in a pedestal unit and driving a 3.9′ open array.

1.2.1 Display Units

The R40X and R41X display units use a 10″ green monochrome monitor enclosed in a compact, rugged, and weather-resistant cabinet.

The front panel contains all of the operating controls for the radar system organized in a combination of rotary controls for precise settings of the Gain, Tuning, Sea-clatter, and Rain-clatter adjustments for clear and detailed radar presentations. Two groups of silicone rubber covered keys assure fast and accurate selections of ancillary operating functions. These keys are logically arranged for the operators convenience and well backlit for night-time use with bold alphanumerics on-screen.

The display unit is designed to be tabletop mounted and can be mounted on a bulkhead or overhead. An optional console mounting kit is available to provide a professional look to custom installations into consoles or panels.

All system set-up adjustments are made at the display front panel, negating any requirements to enter the display units during a standard installation.

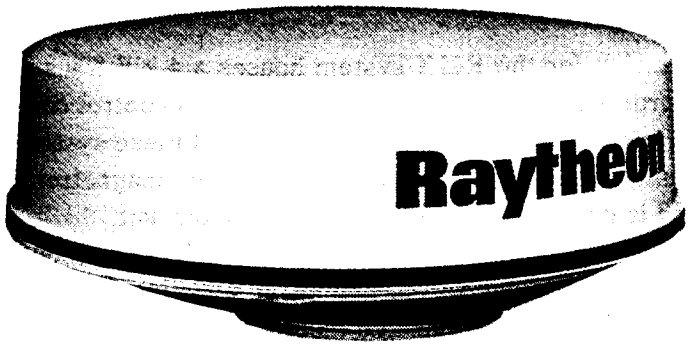
The compact design of the display units is made possible by the use of a custom LSI component (Large Scale Integrated circuit device). This "chip" contains, in one package, the equivalent of up to 20 integrated circuits. Thus, compact size, power efficiency, yet with full features at an economical price are all standard with the X series radar systems.

1.2.2 Cable Requirements

The basic cables in the X series radar systems are the Interunit cable assembly and the Power cable assembly. Other cables associated with interface to optional external equipment are discussed in the installation section of this manual. A brief description of the interunit cable follows:

Interunit Cable

The Antenna and display units are interconnected with a single multiconductor cable using 16 wires. The Transmit trigger conductor is individually shielded and terminated at each end. The video signals from the receiver are coupled via a 50 ohm coax cable also properly terminated at each unit. The cable is wrapped with braided shield material with provisions for grounding the shield at the transceiver and display units. A ground terminal is available at the display rear panel for connection to the ship's RF ground system.



R40X SCANER UNIT

1.2.3 Scanner Unit R40X

The antenna and transceiver are combined within the 24½ inch radome which is made of AES plastic and has a single-flange mounting. A small, flexible interunit cable connects the Scanner Unit to the Display Unit.

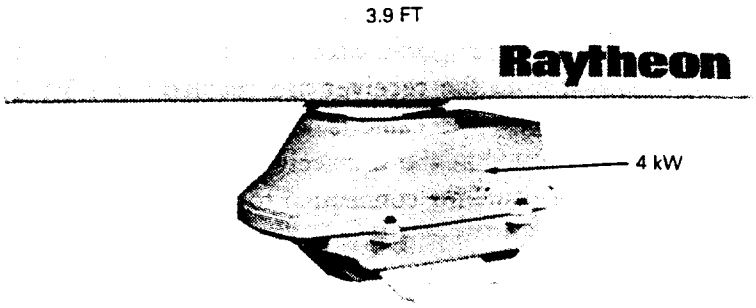
The radome cover is secured to the scanner pan base by four clamping bolts and is provided with a rubber gasket to seal the unit from the weather and salt spray.

Inside, the radome features a printed-circuit card array. This technically innovative antenna provides a narrow 4° beamwidth for excellent short range resolution and high gain in a very compact antenna package.

The internal X-band transmitter operates at a powerful 4 kW peak power with a sensitive micro-integrated circuit frontend at the receiver.

The construction of the antenna unit is modulized. So repairs, should they be required, can be made quickly and cost-effectively.

1.2.4 Scanner Unit R41X



The Scanner Unit for the R41X system houses a 4 kW transmitter, a linear receiver with a low-noise frontend, the array drive motor and its control circuitry.

The X-band transmitter, which is common in all of these systems, operates with three different pulse lengths and three different PRF's. The magnetron type is a MSF1421B, rated at 4 kW and is driven by the solid state modulator unit.

The open array contains a 3.9 foot end-fed slotted array producing 2.2° horizontal and 30° vertical beamwidths for high resolution, super sensitive target pick up and display. The open array is driven by a speed-regulated motor at 24 RPM.

The receiver section consists of a passive diode limiter, low noise MIC frontend (NJT 1946), coupled to a 60 MHz dual bandwidth IF amplifier. The bandwidth of the receiver switches between 10 and 3 MHz at the designated pulsewidth changeovers during range scale selections to provide optimum sensitivity with less noise.

A power supply pcb assembly provides the operating supply voltages for the transmitter/receiver and for the motor control circuitry.

1.2.5 Basic System Components

A. R40X

The R40X Radar System consists of the following items:

	Item	Raytheon Product Code
1 ea.	Display Unit	M89957
1 ea.	Scanner Unit	M89950
1 ea.	Cable Assembly (15 Meters)	M89951
1 ea.	Sunshield	MTV003554

B. R41X

The R41X Radar System consists of the following items:

	Item	Raytheon Product Code
1 ea.	Display Unit	M89959
1 ea.	Scanner Unit	M89954
1 ea.	Cable Assembly (15 Meters)	M89951
1 ea.	Sunshield	MTV003554
1 ea.	3.9 foot Array	M89955

C. Options

Other Optional Items

Universal Mast Mount (R40X)	M88374
Console Mounting Kit (R40X/R41X)	M89977

1.3 SPECIFICATIONS

1.3.1 General

1) Maximum range: 32 nautical miles (R40X).
48 nautical miles (R41X).

2) Minimum range: Better than 35 m on 0.25 n.m.

3) Range Scales:

	Range	Range ring interval	Number of rings
	0.125 nm	0.0625 nm	2
	0.25 nm	0.125 nm	2
	0.5 nm	0.25 nm	2
	0.75 nm	0.25 nm	3
	1.5 nm	0.25 nm	6
	3 nm	0.5 nm	6
	6 nm	1 nm	6
	12 nm	2 nm	6
	24 nm	4 nm	6
(R40X)	32 nm	8 nm	4
(R41X)	48 nm	8 nm	6

4) Range discrimination: Better than 30 m.

5) Range ring accuracy: Better than ±1.5% of maximum range of the scale in use, or 22 m, whichever is the greater.

6) Bearing accuracy: Better than ±1 degree.

7) Cathode-ray tube: 7 in. tube.
Effective diameter 132 mm

8) Environmental conditions:

Scanner Units:	Temperature −15°C to +50°C (under nominal input voltage)	
	Humidity	Up to 95% at 35°C
Display Units:	Temperature	−10°C to +50°C
	Humidity	Up to 95% at 35°C

9) Input power requirements: 11~42V dc

10) Power Consumption: 50W (R40X): 65 W (R41X)

1.3.2 Scanner Unit R40X

1) Dimensions:

Diameter of radome	620 mm
Height	275 mm

2) Weight Approx. 9.5 kg

3) Polarization: Horizontal

4) Beam width:

Horizontal	4°
Vertical	25°

5) Sidelobes: Better than −21 dB

6) Rotation: Approx. 24 RPM

7) Drive motor input voltage: DC 10V

8) Transmitter frequency: 9410±30 MHz

9) Peak power output:	4 kW	
10) Transmitter tube:	Magnetron (MSF1421B)	
11) Pulse length/Pulse repetition frequency:	0.08 μs/2250 Hz (0.125, 0.25, 0.5, 0.75, 1.5 nm) 0.25 μs/1500 Hz (3, 6 nm) 0.5 μs/750 Hz (12, 24, 32 nm)	
12) Modulator:	Solidstate modulator driving magnetron	
13) Duplexer:	Circulator	
14) Mixer protector:	Diode Limiter	
15) Mixer:	MIC Frontend	
16) IF amplifier:	Center frequency	60 MHz
	Bandwidth	10/3 MHz
17) Overall noise figure:	Less than 6 dB	

1.3.3 Scanner Unit R41X

1) Dimensions:	411 (H)×swing circle	1220 mm
2) Weight	Approx.	24 kg (52 lbs)
3) Polarization:	Horizontal	
4) Beam width:	Horizontal	2.2°
	Vertical	30°
5) Side lobe level:	−23 dB or less (within ±10°) −26 dB or less (more than ±10°)	
6) Rotation:	Approx. 24 rpm	
7) Wind velocity:	35 m/s (70 knots), relative	
8) Transmitter frequency:	9410±30 MHz	
9) Peak power:	4 kW	
10) Transmitter tube:	Magnetron (MSF1421B)	
11) Pulse length/RPF:	0.08 μs/2250 Hz (0.125, 0.25, 0.5, 0.75, 1.5 nm) 0.25 μs/1500 Hz (3, 6 nm) 0.5 μs/750 Hz (12, 24, 48 nm)	
12) Modulator:	Solid state modulator	
13) Duplexer:	Circulator+diode limiter	
14) Radar front end module:	MIC (microwave integrated circuit)	
15) IF Amplifier:	Center frequency	60 MHz
	Bandwidth	10 MHz/3 MHz
	Characteristic	Linear
16) Overall noise figure:	Less than 6 dB	

1.3.4 Display Unit

1) Dimensions:	Width	302 mm
	Depth	370 mm
	Height	265 mm
2) Mounting:	Table, overhead or bulkhead mounting	
3) Weight:	Approx. 6 kg (Approx. 13 lbs)	
4) Cathode-ray tube:	E2728B39-SDHT (Green) 10″ Monitor	
5) Video	8 levels quantitized	

6)	Range scales:	0.125, 0.25, 0.5, 0.75, 1.5, 3, 6, 12, 24, 32 (R40X), 48 (R41X) nautical miles
7)	Range rings:	0.0625, 0.125, 0.25, 0.25, 0.25, 0.5, 1, 2, 4, 8 nautical miles
8)	Display Resolution:	610×496 lines
9)	Bearing synchronizing system:	Motor Encoder
10)	Tuning:	Manual
11)	Bearing scale:	360° scale graduated at intervals of 5°
12)	Ship's heading marker:	Electrical
13)	VRM:	Digital readout on CRT in the range of 0.00 to 32.0 nm (R40X), 48.0 nm (R41X), 3 digit Digital-On-Screen-Display
14)	In/Out connections:	Type
	A. Inter-unit	16-pin Connector
	B. Power DC input	3-pin Connector
	C. Loran C	BNC Connector, isolated
	D. Magnetic sensor	BNC Connector
	E. External alarm output	2-pin Connector (RCA)
15)	Interface:	NMEA0182/JRC NMEA0183: Must include GLL, GTD, VTG, BWC or RMA and RMB
16)	EBL:	Digital readout on CRT in the bearing of 0° to 360°, 3 digit Digital-On-Screen-Display
17)	EBL Resolution:	1°
18)	Alarm:	Audible alarm and zone mark on PPI
19)	Off Center	Up to 66% radius (except max. range scale)
20)	Zoom	0.25 nm to max. range
21)	Timed TX	Rotation Period Select 10, 20 or 30 Scans Repetition Period Select 3, 5, 10 or 15 Minutes
22)	Features	Two (2) VRM's, Two (2) EBL's, Interference Rejection, Target Expansion, Target Alarms, LAT/LONG or TD Readouts Waypoint Mode, Off Center, Zoom, Timed Transmit, Ship's Heading Line with Momentary Off Key, Cursor, F. EBL
23)	Controls	Standby Key, ST-BY/OFF Transmit Key, X-MIT/OFF Range UP Key, △ Range DOWN Key, ▽ Variable Range Marker (VRM) Select or ON/OFF Key, VRM VRM Increase Key, VRM Decrease Key, Electric Bearing Line (EBL) Select or ON/OFF Key, EBL EBL CCW Key, EBL CW Key, Off Center Key, OFF CENT

23) Controls (Continued)	Zoom Key, ZOOM Cursor Key, CURSOR Floating EBL Key, F. EBL Numerical Bearing Display Select Key, MODE LL/TD Select Key, LL/TD Waypoint Key, WAY Alarm Key, ALM Target Expansion Key, EXP Interference Rejection Key, IR Ship's Heading Marker OFF Key, SHM Range Rings OFF Key, RR Timed Transmit Key, TIME CRT Brilliance/Panel Illumination Key, DIM/BRIL Tuning Control, TUNE Anti-Rain Clutter Control, RAIN CL Anti-Sea Clutter Control, SEA CL Gain Control, GAIN
24) Inputs:	
Loran-C	NMEA 0182, JRC Format, or NMEA 0183. (NMEA 0183 must include "GLL", "GTD", "VTG", "BWC", or "RMA" and "RMB" sentences for full function.)
Magnetic sensor	NMEA 0183 "HDM" or "HSC". Sentences.
25) Outputs	External Alarm- Contact Closure Limits: 24 VDC maximum 100 mA maximum

1.3.5 Cable Information

The standard interunit cable is 15 m (49 feet) as supplied with the radar. If additional cable is required to complete the installation specific lengths of pre-made cable assemblies are available.

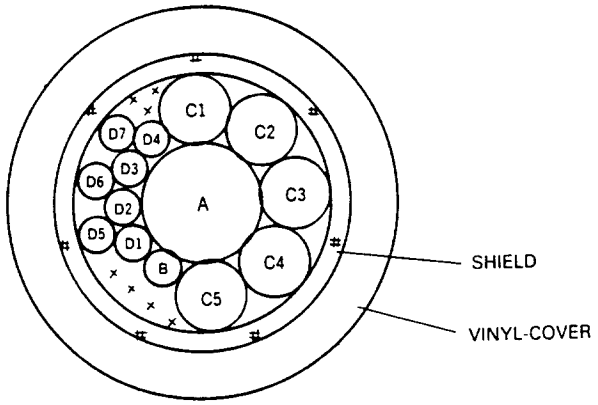
Use	Type of Cable	Standard Length	Maximum Length
Scanner-Display	H-2695110045	15 m	20 m

Cable assemblies are available from Raytheon as follows:

	Length	Product Code
Standard	15 m	M89951
Option	20 m	M89961

SPECIFICATION OF COMPOSITE CABLE

This cable is vinyl-covered, shielded, 14 conductor cable connecting the Scanner Unit with the Display Unit. Specification of this cable is as follows:



Conductor	Cross Section (mm^2)	Conductor Type mm.	Color	Remarks
A	0.5	7/0.26		Coaxial
B	0.3	7/0.20		Shielded
C 1	1.25	50/0.18	Blue	
C 2	1.25	50/0.18	Yellow	
C 3	1.25	50/0.18	Green	
C 4	1.25	50/0.18	Red	
C 5	1.25	50/0.18	Purple	
D 1	0.3	7/0.20	Blue	
D 2	0.3	7/0.20	Yellow	
D 3	0.3	7/0.20	Green	
D 4	0.3	7/0.20	Red	
D 5	0.3	7/0.20	Purple	
D 6	0.3	7/0.20	White	
D 7	0.3	7/0.20	Brown	

FIG. 1-1 COMPOSITE CABLE

SECTION 2

INSTALLATION

Although your X series radar is designed to the highest levels of quality and performance, it can best attain those standards when a proper installation of the equipment has been achieved.

This section provides the user with practical guidelines to assist in the planning and installation of the R40X or R41X aboard your vessel.

2.1 UNPACKING AND INSPECTION

Do use care when unpacking the unit from shipping carton to prevent damage to the contents. It is also good practice to save the carton and the interior packing material until the unit has been satisfactorily installed on the vessel. The original packing material should be used in the unlikely event that it is necessary to return the unit to the factory.

2.1.1 Equipment Supplied

Table 2.1 indicates a listing of items that are included with your New radar system.

TABLE 2.1 Equipment Supplied

No.	Description	Type	Q'ty	Remark
1	Interunit Cable	M89951	49 feet	(15 M)
2	Power Cable Ass'y	CFQ-2646	1	
3	Sunshield	MTV003534	1	
4	Instruction Manual	7ZPRD0257	1	
5	Bridge Card	7ZPRD0258	1	
6	Standard Spares	(see table)	1	

If you are missing any of the items. Please notify your dealer immediately.

TABLE SPARE PARTS

Name of Parts	Type	Quantity	Description	Part Number
Fuse	Glass tube 6.3A	2	F401 Display unit	5ZFAD00336
Fuse	Glass tube 5A	2	F402 Display unit	5ZFAD00045
Fuse	Glass tube 3.15A	4	F401, F402 Display unit	5ZFAD00382
Lamp	AS90140	3	PL1~3 Display unit	5WAAB00258

2.1.2 Planning

The layout for installing the R40X/R41X Radars should be planned to give the best operation and service aboard your particular vessel. In general, the Scanner Unit should be mounted as high as possible above the waterline. The Display Unit should be installed in a convenient viewing position for the helm.

A 15 meter length of Vinyl-covered, shielded, 14 conductor cable is furnished for interconnecting the two main units (Scanner and Display).

This length of cable should be sufficient to complete the cable run required on most small vessels. The maximum length of cable from the Scanner Unit to the Display Unit should not exceed 20 meters.

A General System diagram for the R40X/R41X is shown below.

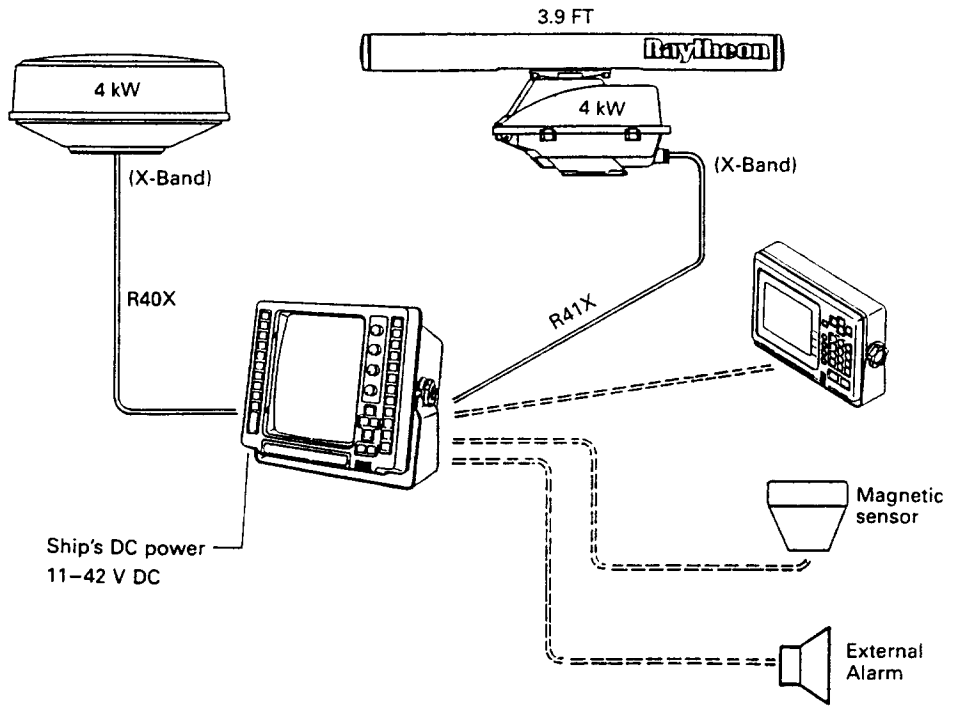


FIG. 2-1 GENERAL SYSTEM DIAGRAM

2.2 INSTALLATION OF SCANNER UNIT

2.2.1 Selecting the Location

Selecting an adequate location for the Scanner Unit requires careful consideration. On many small vessels, the unit can be installed onto a mast platform on an arch or bridge structure or onto a mast. Since radar basically operates at line-of-sight, the unit should be mounted as high as possible on the ship to ensure best performance at the maximum range.

The scanning beam should not be obstructed by surrounding large objects. Try to locate the unit where large structures such as superstructures, searchlights, horns, or masts are not in the same horizontal plane. Otherwise, blind areas and false targets can appear on the radar screen. Installation near the top of exhaust stacks must be avoided as damage could result due to excessive heat and the corrosive effects of stack gases.

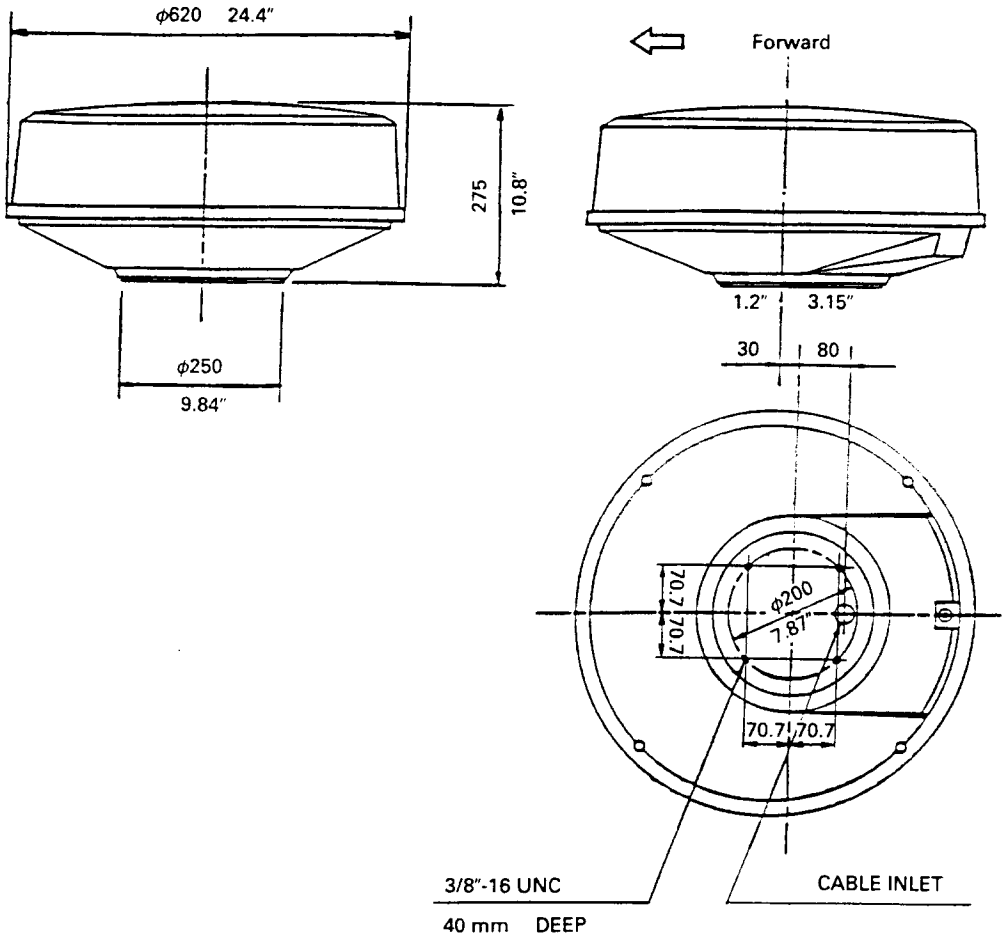
2.2.2 Mounting the Scanner Units General

Using the outline drawing of the Scanner bases as a guide prepare the mounting surface with the four mounting holes as required. Install the Scanner and secure it to the mounting surface. The Scanner should be parallel to the ship's waterline oriented so the cable inlet and safety switch are pointed AFT.

When mounting the Scanner to a platform attached to a fly bridge superstructure avoid placing the Scanner Unit at eye level. Although the radar transmits a 4 kW peak power pulse the average power radiated is less than 2 watts. Generally the known RF radiation level can be considered to be safe beyond 3 feet from the Scanner Units.

However, due to the extreme sensitivity of the human eye, it is recommended and prudent to install the Scanner in a plane above or well below the passengers line of sight.

2.3 INSTALLING THE RADOME SCANNER



COLOR	WHITE
WEIGHT	APPROX. 9.5 kg (20.9 lbs)

FIG. 2-2 OUTLINE DRAWING OF SCANNER UNIT

Sail Boat Mast Mounting

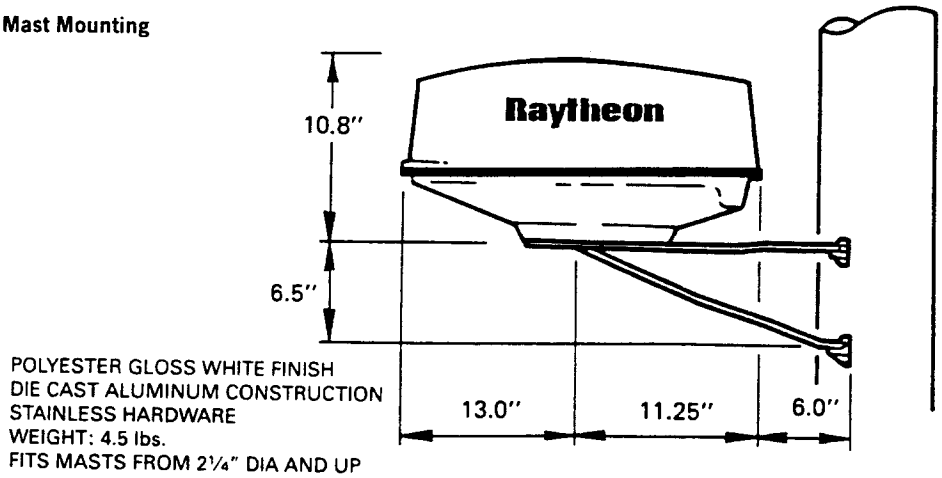


FIG. 2-3 UNIVERSAL MAST MOUNT

For sailboat installations Raytheon offers a universal mast mount kit (Product Code M89374). This optional mount fits masts with diameters from 2 ¼" and larger. When using the mast mount kit appropriate hardware should be used for the type and style of mast aboard the vessel.

If there is doubt concerning the proper type of hardware, consult with your boat dealer or representative for proper recommendations.

Depending on the type of sailboat, a radar antenna guard should be installed if the sails tend to contact the antenna platform. Without a proper radar guard serious damage can result to the mounting platform and radar antenna.

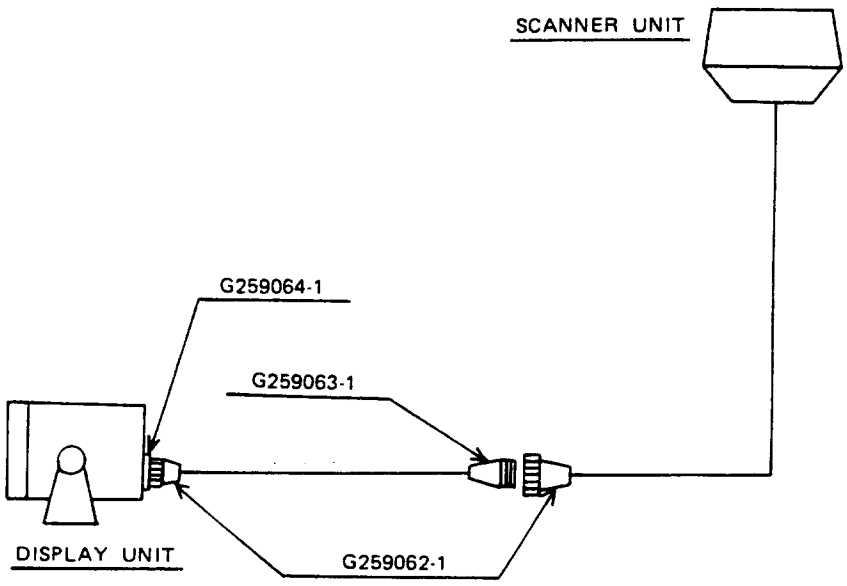
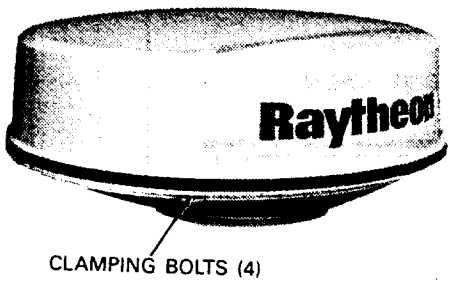
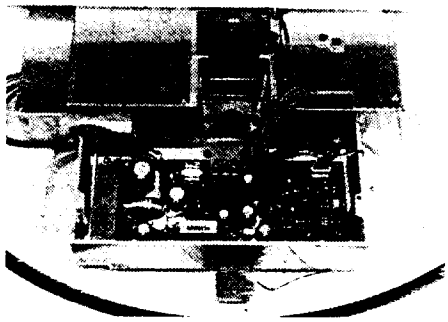


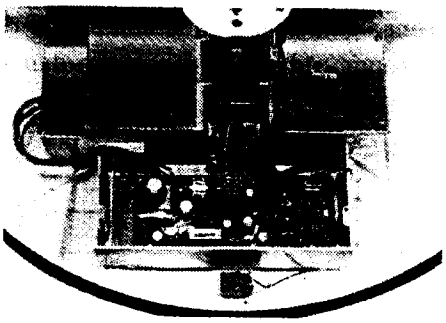
FIG. 2-4 TYPICAL INSTALLATION FOR SAILBOAT SHOWING INLINE CONNECTION AT MAST BASE



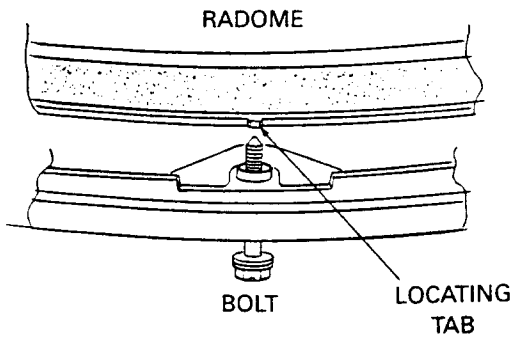
LOOSEN FOUR CLAMPING BOLTS



REMOVE THE RADOME FROM THE BASE, THE CABLE GROMMET, AND PLATE HARDWARE FROM THE CABLE GLAND, (TWO SCREWS). INSERT THE CONNECTING CABLE INTO THE CABLE INLET. ADD THE RUBBER GROMMET, AND SECURE THE CLAMPING PLATE.



CONNECT THE CABLE LEADS WITH TERMINAL BOARDS TB101 AND CONNECTOR J101. GROUND THE SHIELD WITH THE LUG. DRESS THE WIRE HARNESS WITH CABLE CLAMPS OR TIE-RAPS AS NECESSARY TO AVOID LEADS TOUCHING THE ROTATING ARRAY.



WHEN REASSEMBLING THE RADOME COVER NOTE THAT THE BOLT HOLE POSITIONS HAVE A TAB ON THE RADOME COVER TO ASSIST YOU IN PLACING THE RADOME FOR REINSTALLATION.

FIG. 2-5 CONNECTING PROCEDURE FOR RADOME SCANNER UNIT

2.3.1 Connecting the Cable in the Radome Antenna

The cable entrance is provided in the base of the Scanner Unit.

If the unit is mounted on a hollow mast, the cable may be run inside the mast and then be fed through the center entrance hole.

Connect the cable leads onto terminal board TB101 and connector J101 as shown in below.

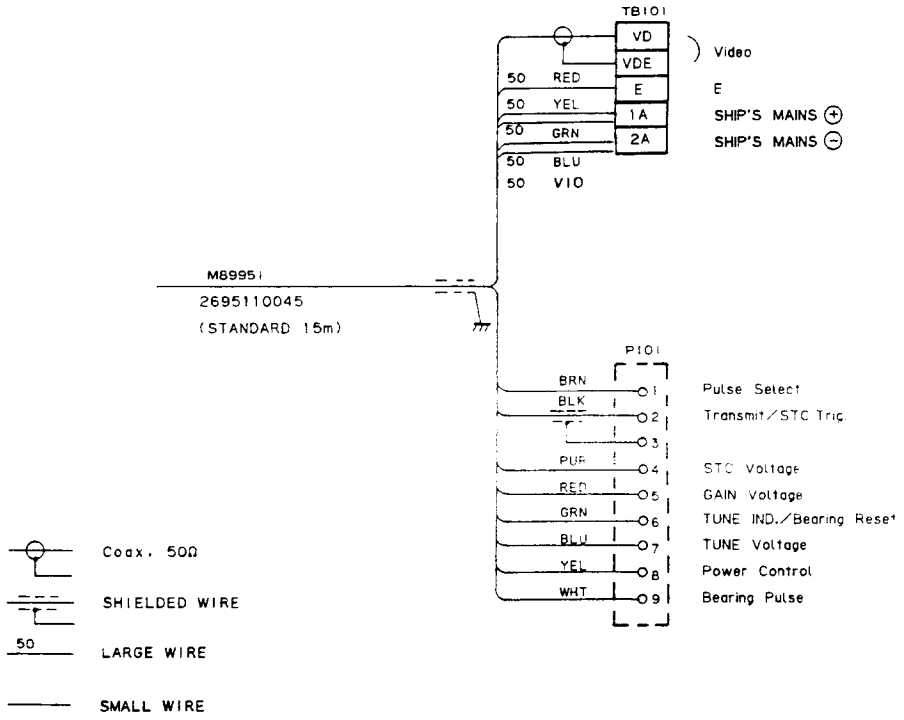


FIG. 2-6 TYPICAL WIRING AT RADOME SCANNER

2.4 SCANNER UNIT ASSEMBLY

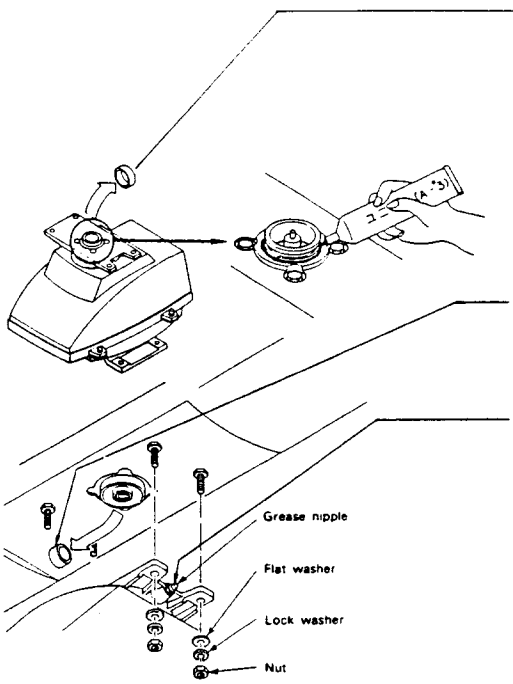
The open array scanner/pedestal are shipped as two separated units, the pedestal and the array. The following procedure should be followed in assembling the Scanner and Array Units.

2.4.1 Array/Scanner Unit Assembly Procedure

The following assembly materials are shipped with the array:

1) Seal Material 1 tube
2) M10 Nuts 4 each
3) M10 Lock Washers 4 each
4) M10 Flat Washers 4 each
5) Assembly Instructions Procedure

A. Assembling Procedure



SCANNER UNIT ASSEMBLY 1/2

1) Remove the cap from the pedestal.

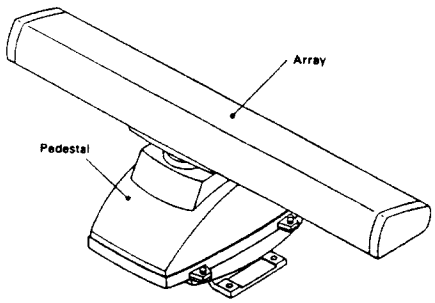
2) Apply the seal material as illustrated with a thickness of about 1/8".

3) Remove the cap from the array.

4) Position the array support so the grease fitting is on the right side of the pedestal (looking from the front) place the array on the pedestal, lettered face forward.

5) Install a flat washer, lock washer, and nut to each stud and tighten with a wrench.

B. The Completely Assembled Scanner Unit



SCANNER UNIT ASSEMBLY 2/2

2.4.2 Mounting the Open Array Scanner Unit

Using the appropriate mounting dimension of Fig. 2-7 as a guide prepare a mounting platform surface on which to mount the radar pedestal unit. Assure that the platform has sufficient strength to support the scanners' weight under the most adverse conditions the vessel is likely to encounter. Also ensure that the platform is parallel with the vessel's water line to maintain the proper plane of radiation for the radar antenna.

Install the scanner unit onto the mounting platform with the cable entry and safety switch facing "AFT". Secure the scanner with the proper Stainless Steel hardware to the platform.

If mounting directly to a deck top does not give sufficient height or clearance, a radar mast or pedestal may be used to elevate the unit. Refer to Fig. 2.8.

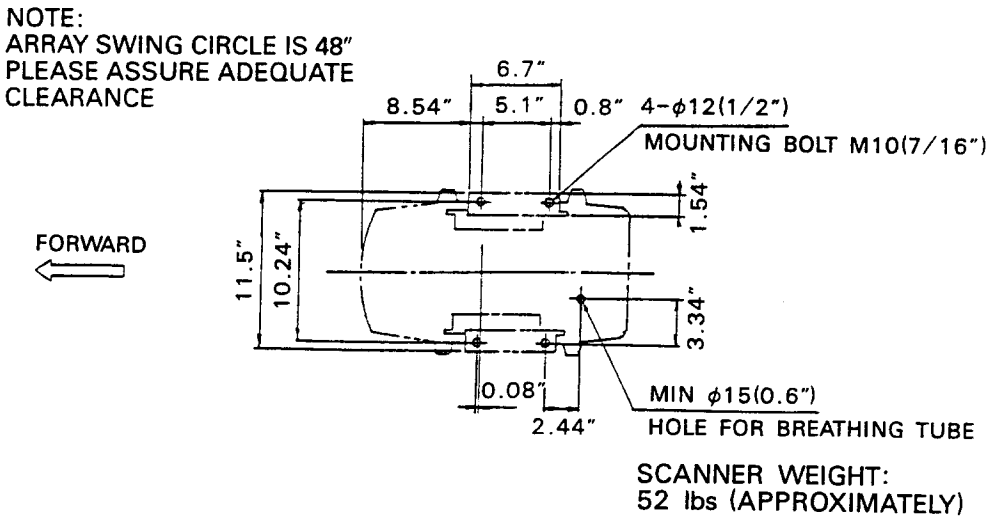


FIG. 2-7 MOUNTING DIMENSIONS

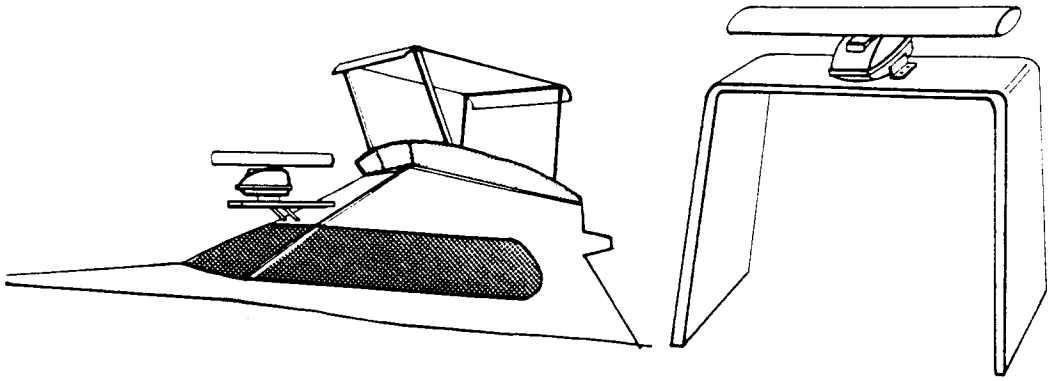
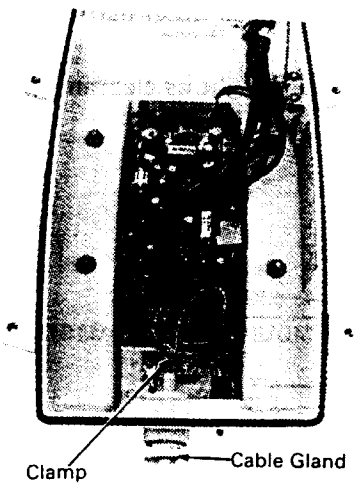


FIG. 2-8 TYPICAL MOUNTING LOCATIONS

2.4.3 Cabling the Scanner Unit

The cable inlet of the scanner unit is located at the rear of the pedestal base assembly (see Fig. 2-9).



Loosen 4 bolts and open the cover.
Remove the blind plate from the gland assembly and discard.
Insert the washers and rubber gasket on the cable as shown in Fig. 2-10. Remove the 2 screws and remove the cable clamp. Insert the cable into the pedestal approximately 12". Prepare each wire for termination by cutting it to the proper length and attaching a terminal lug. Follow the wiring diagram in Fig. 2-11. Tighten each terminal. Reinstall the spring clamp to insure the shield is grounded, pull the excess cable from the pedestal. Tie spare wires to cable harness. Insert the washers and rubber gasket into the gland and tighten the gland nut.

FIG. 2-9 SCANNER UNIT CABLE CONNECTION PROCEDURE

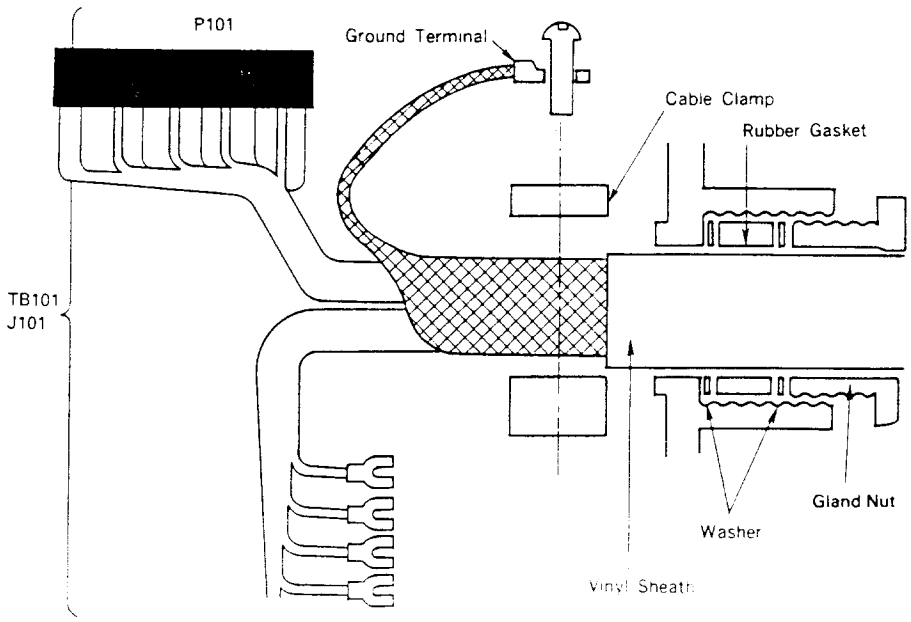


FIG. 2-10 SCANNER UNIT CABLE CONNECTION PROCEDURE

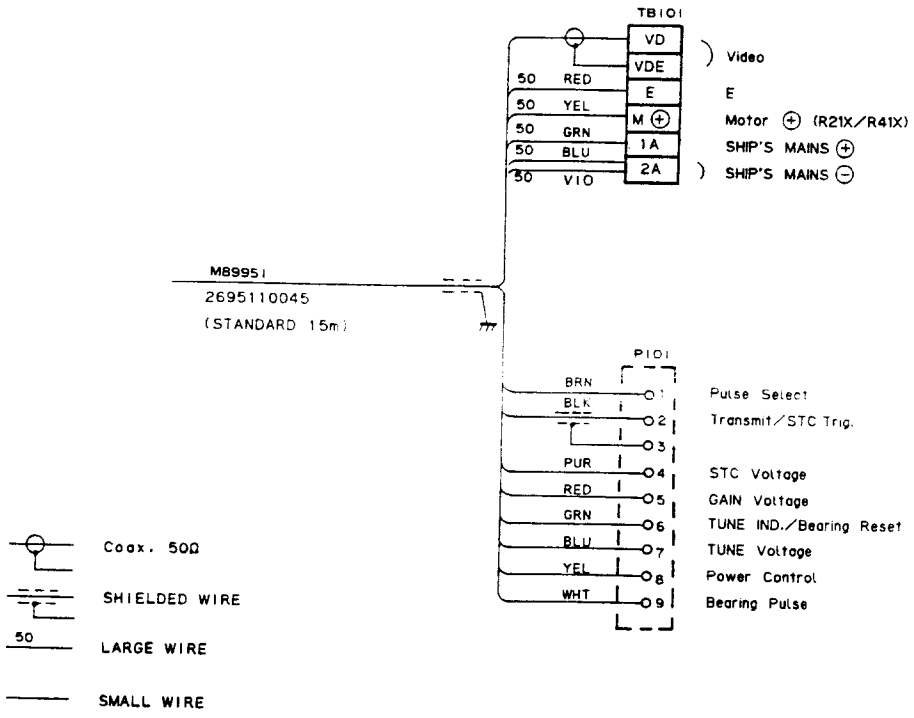


FIG. 2-11 WIRING DIAGRAM FOR X SERIES OPEN ARRAY SCANNER UNIT

2.5 INSTALLATION OF DISPLAY UNIT

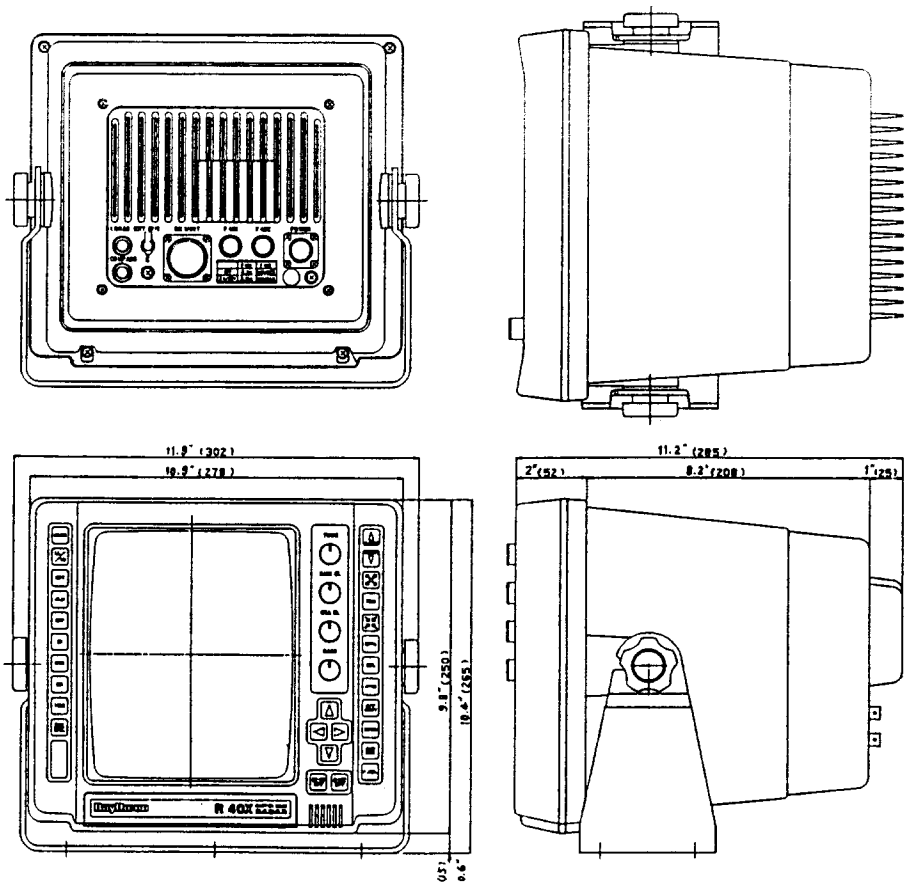
2.5.1 Selecting the Location

Ideally, the Display Unit should be located in the wheelhouse so the radar screen can be viewed when looking forward from the wheel. The Display Unit can be mounted on top of the chart table hung from the overhead, or installed against a bulkhead.

To minimize interference the location chosen should be at least 1 meter (3 feet) away from the ship's compass and the Loran C receiver.

2.5.2 Mounting the Display Unit

Using the dimensions from the outline drawing for the Display Unit (page 2-13) as a guide, install the Display Unit to the desired mounting surface. Note that the yoke of the Display Unit can be attached above or below the unit.



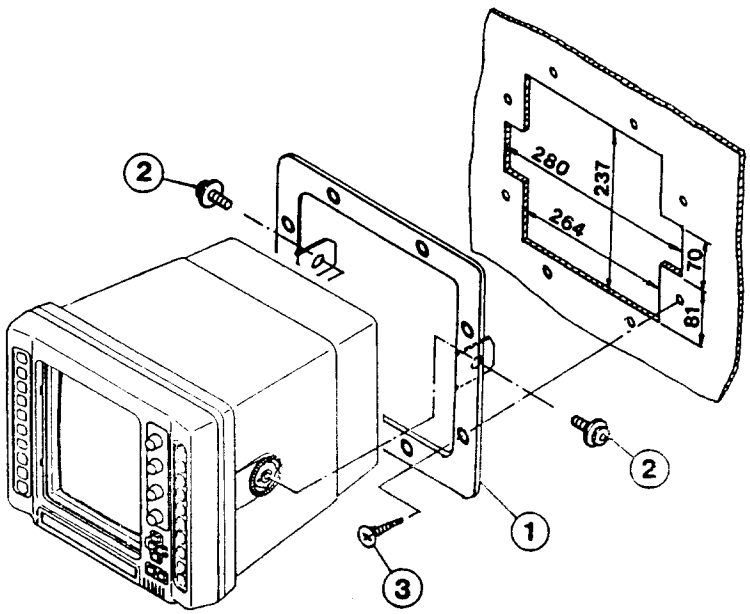
Dimensions are shown in inches (millimeters)

OUTLINE DIMENSIONS

CONSOLE MOUNTING THE DISPLAY UNIT

Mounting instructions For
the R40X/R41X console
mount kit M89977.

PARTS LIST
1. TRIMRING MTB191051 1ps
2. SCREW BRTGO1387 2pcs
3. TAPPING SCREW 4 mm 8pcs



1. Locate a clear flat area at least 12″ (H)×12″ (W)×15″ (deep). Make sure the area behind the cutout is clear of wires or other obstructions before proceeding.
2. Use TRIMRING to trace cutout hole. Drill a pilot hole inside the cutout area. Using a proper saw, cut along the inside of the cutout line.
3. Still using TRIMRING mark 8 holes for the frame mounting screws. Using a 2/16″ bit, drill clearance holes at the 8 locations around the cutout area.
4. Remove the yoke knobs and mounting bracket from the radar.
5. Slide the TRIMRING over the radar as shown in the diagram. Use 6 mm screws (provided) to attach frame at yoke screw mounting holes.
6. Attach power, antenna cables, option cables and ground to the radar and insert the radar into the cutout secure the console frame using the eight #3 screws provided onto the panel.

2.5.3 DC Power Connection

A 2 m (6 ft.) power cable assembly is furnished for connecting the DC power to the radar. Longer cable runs may require larger wire sizes to minimize any voltage drop in the cable.

If the distance between the ship's main DC power source and the radar equipment is greater than 10 feet it may be necessary to move the source of the ship's power closer to the radar. In order to properly determine the supply cable wiring size to use, a graph is upplied in Table 2-1 for recommending an appropriate cable diameter. Begin by estimating the length of cable you will require between the ship's main power source and the radar. Select the wire size indicated by the distance and input voltage.

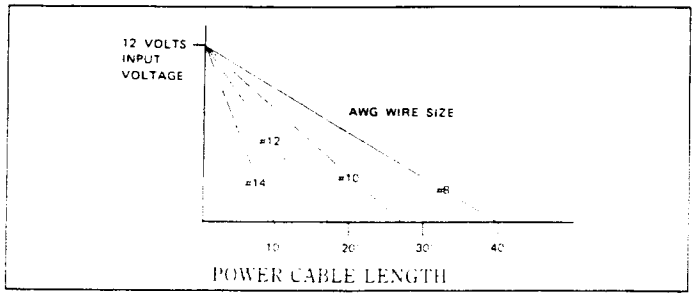


TABLE 2-1 POWER CABLE SIZE VERSUS LENGTH

Table 2-1 is a recommended guide for selecting power cable wire sizes based on the length of the cable to the ships' power connection point.

The Connections should be made at a power distribution panel, isolation switch, or to the battery. Check that all connections are clean and bright. The white wire must be connected to (+) positive battery terminal and the black wire to (−) negative battery terminal. The shielded wire should be connected to the ships RF ground.

Should the power connections be accidently reversed, protective fuse F1 (6.3A), located on the rear panel, will blow. Make sure that the input power leads are connected for correct polarity with a VOM. Replace the fuse.

Note: *If ships input power is 24 or 32 V dc, F1 should be changed to a 3 amp fuse.*

GROUNDING THE RADAR SYSTEM

It is important for proper operation that an effective RF ground be connected to the rader system. You may elect to ground the radar by connection of the power cable assembly shield to the RF ground system on your vessel or by connecting a 10 or 12 gauge wire to the ground on the rear of the display to be connected to the nearest ground point of the ship's RF ground system.

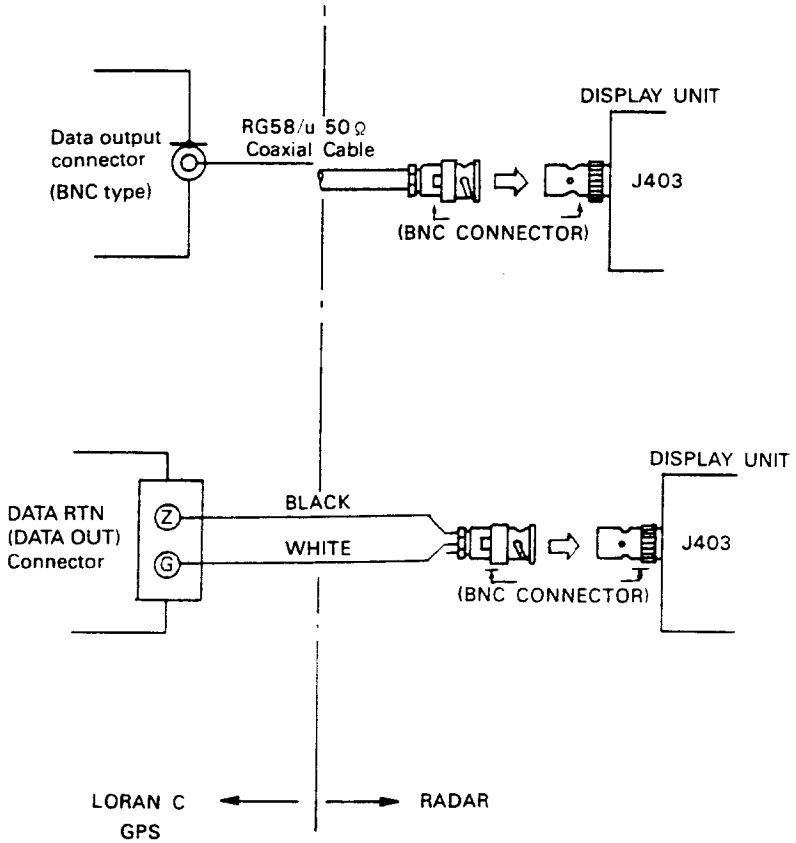


FIG. 2-12 SAMPLE NAVIGATOR CONNECTIONS

2.5.4 Connection to Loran C Receivers

The R40X/R41X display can show your latitude and longitude position (L/L) or time differences (TD's) when connected to a Loran C with the proper data output format.

The display is programmed to accept data from the Loran in the N.M.E.A. 0182, N.M.E.A. 0183 formats, or JRC Formats.

The N.M.E.A. 0182 format will only provide a Lat/Long display for the radar. The N.M.E.A. 0183 data standard will, in most cases, provide Lat/Long, TD, Course and Speed data for the radar display.

To display the selected waypoint, the N.M.E.A. format must contain the "BWC" sentence. All of these data are contained in sentences "RMA" and "RMB".

Consult your Loran C manual for directions in obtaining the appropriate data output from the Loran for your radar.

The loran connection to the Display Unit is made with a common BNC connector. RG 58 A/U Coax cable (50Ω) of any length may be used to complete the interconnection to the Loran C. Two wire, shielded cable may be used in place of the RG 58 Coax if necessary.

2.5.4.1 The BNC Connector Assembly Procedures

The following procedure may be helpful to illustrate how the BNC connector should be installed:

1. Strip and remove the coax vinyl cover for about 3/8" (9.6 mm)
2. Slide the BNC connector fastener ① onto the coax. Add the washer ③.
3. Insert the rubber gasket ④ and clamp ⑦ (as shown).

4. Peel back the shield of coax and pull back over the clamp. Trim the excess shield material so that the shield is only covering the clamp.
5. With a knife or other suitable tool, remove 1/8" (3 mm) of dielectric material ⑨. Neatly dress and tin with solder the center conductor of the cable. (Avoid using excessive solder.) Now solder the terminal ⑧ onto the tinned conductor. Again, avoid using any excessive solder.
6. Install the connector shell into the cable and thread the fastener tightly into the connector shell.

   Note: *The shield of the coax should be tightly bonded between the clamp and shell body.*
7. The connection should be checked with a multimeter for possible short circuits and continuity, as a final test.

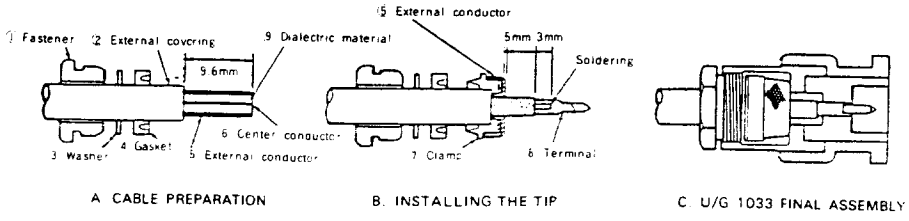


FIG. 2-13 DIAGRAM OF BNC CONNECTOR ASSEMBLY

2.5.5 Installation of the Magnetic Flux Sensor

The sensor should be placed in a location on the vessel where magnetic interference is least and where it will remain undisturbed. The optimum compass location is as close as possible to the vessel's center of pitch and roll. On steel vessels, the sensor may need to be mounted above the deck enclosure on a mast and should be between one meter and three meters from the main structure.

1. Locate a suitable installation area, free from magnetic interference.
2. Fix the sensor to a vertical bulkhead using brass or stainless steel screws.
3. Adjust case of the sensor so the pointer on the top leading edge is in fore and aft direction. Tighten main bracket bolt to lock sensor in place. To re-align through 90 or 180 degrees, remove sensor lid (4 screws), release printed circuit board (PCB) by removal of four pillars and gently rotate PCB assembly until it is fore and aft. Replace pillars and lid with arrow facing forward.
4. The transit screw is located at the base of the sensor. This locks the gimbal during shipment for protection. Ensure transit screw (white nylon screw at center of base) is withdrawn five full turns to allow full mechanical movement of coil assembly. If unit is exposed to the weather remove screw, shorten by 10 mm (3/8"), replace and tighten.
5. Install a terminal strip or junction box (not supplied by Raytheon) in any convenient place to allow system connection.
6. Even though the sensor is internally fused, it is advisable to connect the system through a fused supply. It may be wired either from an existing switch panel or separately. Always connect via the junction box. As the current drain is low, the compass can be left on with very little battery drain. Wiring details are provided in Fig. 2-14.

Minimum Mounting Distances

Radios, RDF, Depth Recorders, etc.	1 meter
Power cables carrying more than 0.5 amp	1 meter
Radar magnetrons	3 meters
Ship's Engines	1 meter

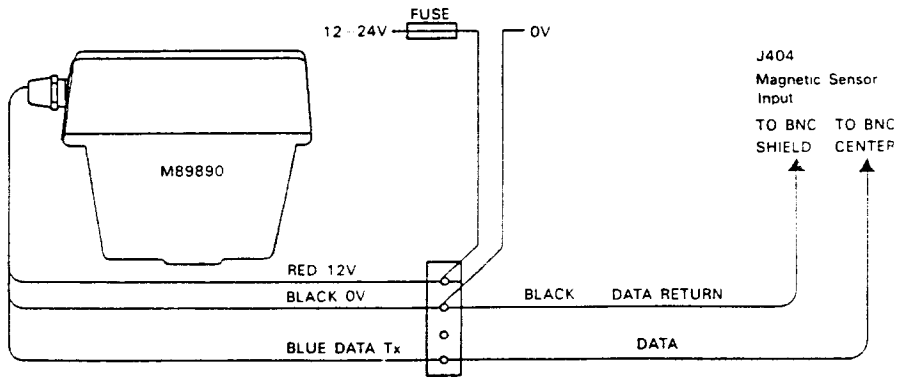
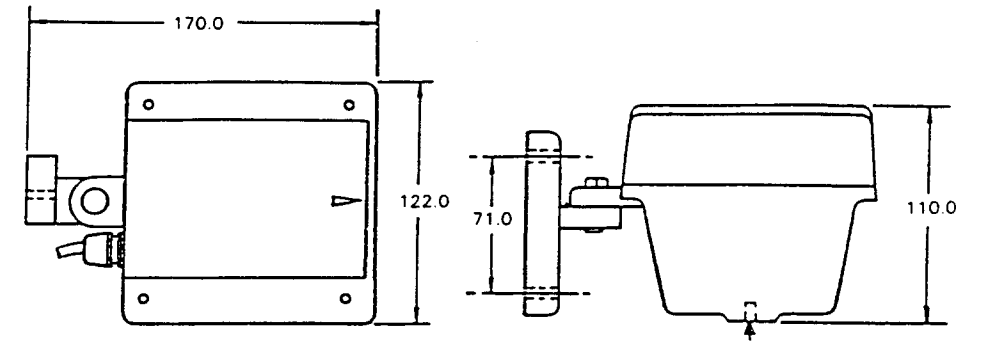
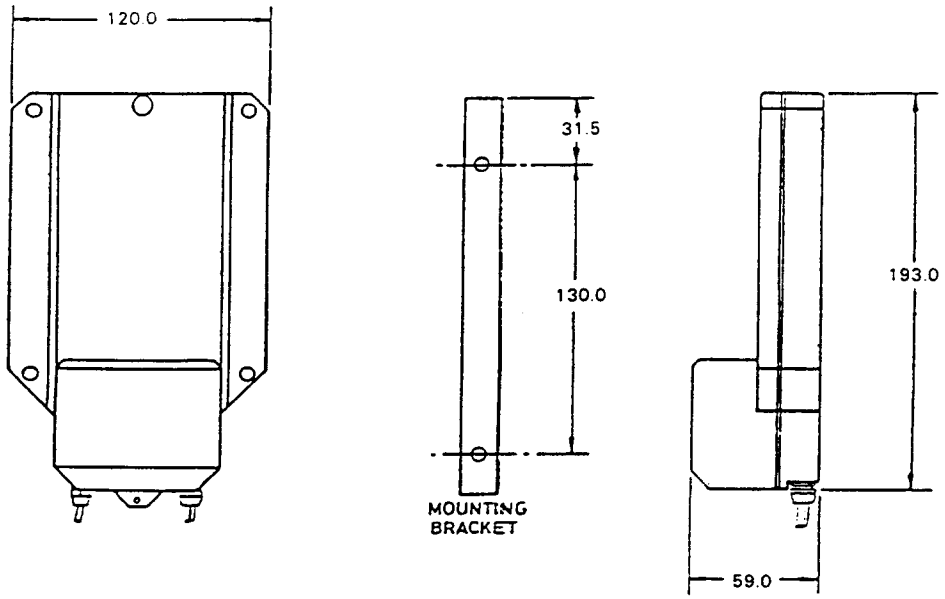


FIG. 2-14 GENERAL MAGNETIC FLUX SENSOR WIRING

The instructions for calibrating the magnetic sensor unit will be included with the magnetic sensor option.

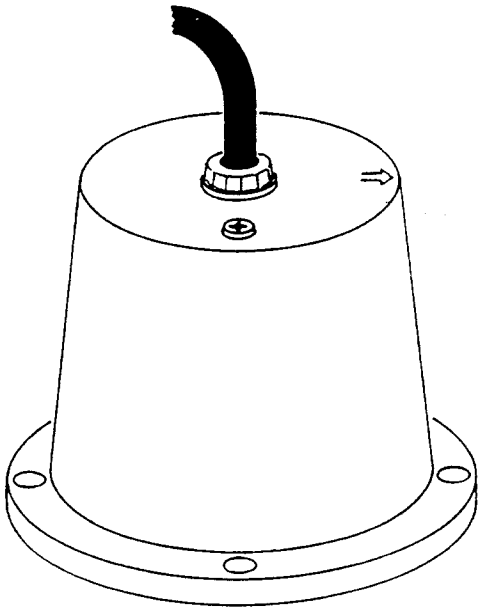


ALLOY HOUSING



PLASTIC HOUSING

FIG. 2-15 TYPICAL MAGNETIC FLUX SENSORS OUTLINE DIAGRAMS

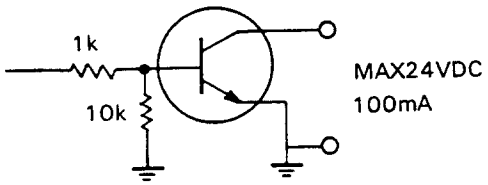


TYPICAL MAGNETIC SENSOR OUTLINE DIAGRAM

2.5.6 External Alarm

The Radar can operate an external alarm device through the connector on the rear panel designated for this purpose. Devices connected to this output are limited to an operating voltage less than 24 VDC and a maximum current of less than 100 mA.

The external alarm drive circuit is shown for reference.



A miniature phono plug is required for inter-connecting to the external alarm connector.

2.6 INITIAL OPERATION AND CHECKOUT

2.6.1 Inspection After the Installation

After completing the installation and prior to energizing the equipment, it's a good idea to recheck that all the steps of the installation are completed in accordance with the instructions.

In particular, inspect to insure that the cables were not accidently crimped or damaged and that the ships input voltage is connected correctly; that the mounting bolts of the scanner unit are tight; the cable gland is tightly sealed at the Scanner Unit, that the antenna connections are correct, and the cable shield is connected properly to RF ground.

2.6.2 Operational Checkout

Activate the power circuits to the radar and switch the radar into standby (STBY). After approximately 90 seconds "READY" will be displayed on the CRT.

If you are unfamiliar with the operating controls of this radar, please take a few moments to familiarize yourself by reviewing the instructions in Chapter 3 Operation.

Press the X-MIT switch to "ON" and observe the presence of radar targets on the screen. Check the operation of the Range, selection keys for each range scale. Observe that the sweep is the correct length and has the proper number of range rings. Observe that the range markers are focused properly.

Operate the [BRIL/DIM] key. Check for multiple picture intensity level operation.

After approximately 10 minutes of operation, check the TUNE control for maximum target returns occuring at the center of the TUNE level range.

If readjustment of the Display Unit is required follow the instructions for alignment in section 5 (pages 1 to 5) adjustment and faultfinding.

2.6.3 Post Installation Set up Adjustments

Following the operational check, two alignments A) and B) are normally required for proper operation.

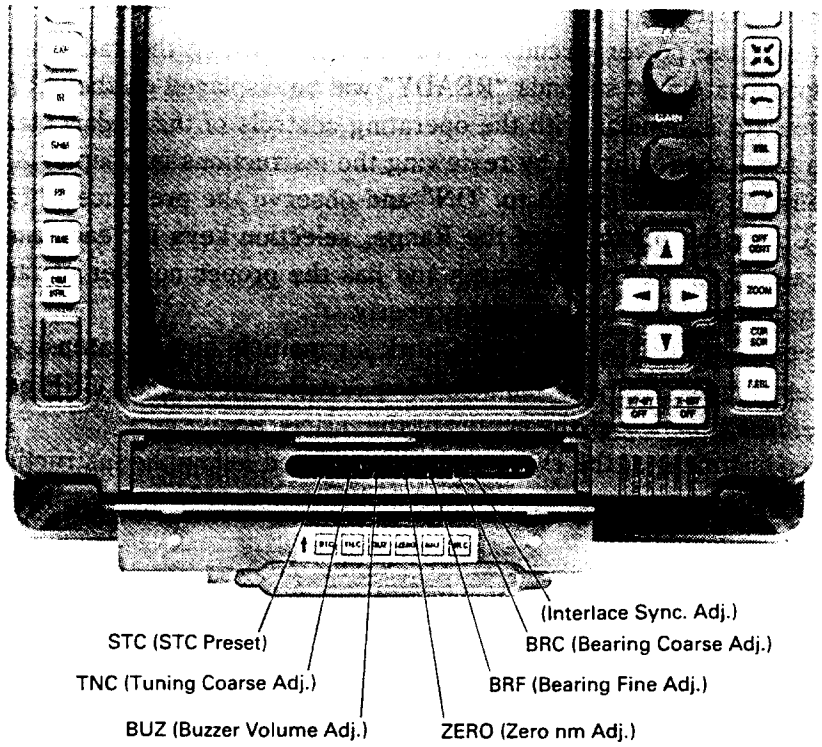
They are: A) Relative Bearing Alignment
B) Display timing (0 nm adjustment)

Other adjustments are:

C) Tuning preset
D) STC (Sea-Clutter preset)
E) Buzzer Volume Adjustment

Access to these adjustments can be made by pressing in lightly on the Logo overlay panel on the display front panel and sliding the panel downward. Remove the rubber protector seal to expose the adjustment controls by grasping the end tab and gently pull the seal from the cutout.

The set-up adjustments will appear as shown on the diagram below.



POST INSTALLATION SET UP ADJUSTMENTS

A) Relative Bearing Alignment [BR.C], [BR.F]

This alignment should be carried out for safety when the installation is complete to ensure that targets on your display appear at their proper bearing with respect to the ship's heading.

Proceed as follows:

① Identify a suitable target (e.g., ship or buoy, etc.) preferably between 1.5 and 3 nm in range on the screen.

② Using an accurate means other than the radar (visual means) establish the relative bearing of the target.

③ Put the first EBL marker on the target.

④ Set BR.F (RV2) at its mid position.

⑤ Press the [EXP] key until the buzzer sounds and the display on the screen reads BEARING ADJUST.

⑥ By turning the coarse bearing adjustment BR.C (RV1), the first EBL marker is rotated. Adjust RV1 until the EBL is on the bearing to the target ±10 degrees, and the beeper sounds continuously.

⑦ Set the fine adjust BR.F (RV2) for the correct bearing to within ±1 degree.
⑧ Press the [EXP] key continuously until the words BEARING ADJUST disappear from the screen to restore the normal display mode.

B) Display Timing (0 nm Adjustment) [ZERO]
This is a radar timing adjustment. It is necessary to ensure targets are at their proper range on the display unit. Incorrect timing is mostly noticed on the 1/8 nm.
① Set the range at 0.125 nm.
② Locate a dock, seawall or bridge on the display. Observe whether the radar target is straight on the display. If not, adjustment is indicated.
③ Adjust [ZERO] (RV3) so that the object appears to be straight on the display.

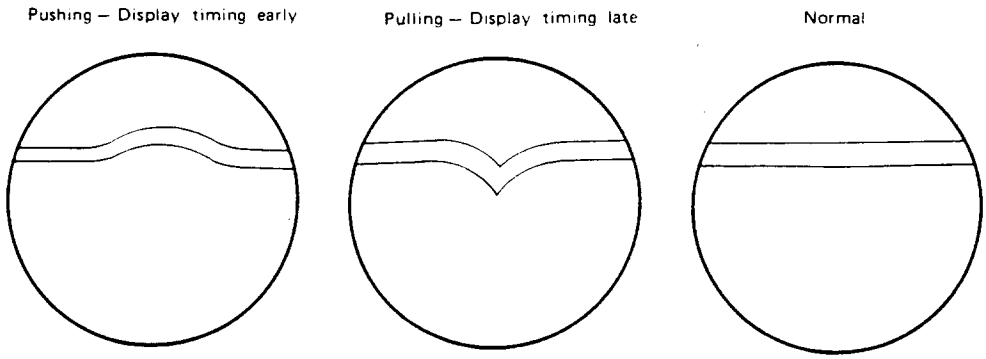


FIG. 2-16 0 NM ADJUSTMENT

The remaining adjustments affect operating conditions that are normally set at the factory and typically will not require any further adjustments. However, these settings should be checked at installation so that optimum operation will be realized.

C) Tuning Preset [TN.C]
Normal tuning of the radar should be indicated on the Radar Display by seeing maximum target returns with the "TUNE" control at its mid scale position.
After about 10 minutes of operation:
① Set radar to 6 nm range scale.
② Set GAIN for normal operation level.
③ Set SEA CLUTTER, RAIN CLUTTER, IR to "OFF".
④ Set TUNE control of the front panel, so that tune control indicator centered in its range. Adjust RV5 (Coarse Tune) very carefully for maximum target on the CRT Display.

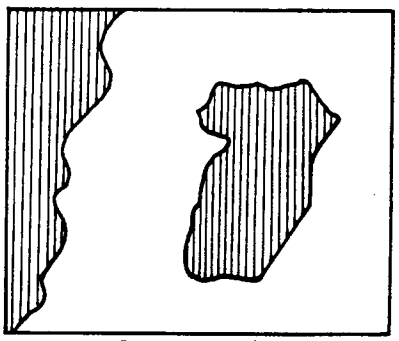
D) STC Preset [STC]
① Set Range to 12 nm.
② Set the Gain Control fully clockwise.
③ Turn the Sea-Clutter control fully clockwise and adjust STC (RV6) so that no back-

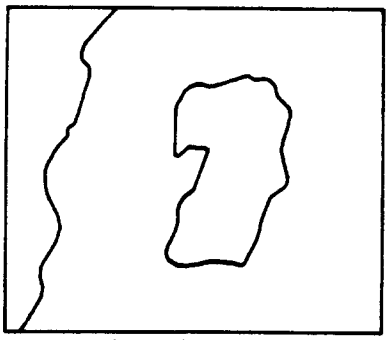
ground noise appears in the range of 0 to 4 nm. In some conditions the STC action range may be extended for severe sea states.

E) Buzzer Volume Adjustment
At the time of shipment, the Buzzer Volume has been adjusted to the maximum position. When it is necessary to lower the volume, adjust BUZ (RV4).

F) AVR Voltage Adjustment
AVR Output Voltage adjustment RV1 in the PC501 (POWER SUPPLY PCB)
Adjust the DC voltage between the TP1 (positive) and GROUND (negative) so that it will be +5 V by RV1 located on the power supply PCB.

G) Interlace Synchronization Adjustment
This adjustment synchronizes the scanning line positions so that they are adjacent to each other. The ideal interlace adjustment occurs when there are no visible lines appearing in the video pattern.
Adjust RV7 on the ADJUSTMENT PCB for proper blending while looking at the video pattern.


Poor Interlace Sync.


Proper Adjustment

H) Comparator level adjustment
① Gain and STC control VR's on the front panel turn counterclockwise.
② Set the range scale to max. range.
③ Set EXP is ON and IR is OFF.
④ Adjust RV2 on CQA-116 so that the noise on the screen just disappear.
⑤ Press EXP switch to OFF.
⑥ Press IR switch to ON.
⑦ Gain control VR on the front panel turn clockwise.
⑧ Adjust RV1 on CQA-116 so that the receiver white noise slightly visible on.

SECTION 3

OPERATION

3.1 OPERATING CONTROLS

Generally the operation of the R40X/R41X is easy and straight forward. However, the navigator who is familiar with the panel layout and understands the functions of the various controls will be able to obtain the best performance from his equipment.

3.1.1 Layout of the Controls

The layout of controls is shown in Figure 3-1.

3.1.2 Functions of the Controls

① POWER, [ST-BY/OFF], [X-MIT/OFF] KEYS

In the "OFF" state no power is applied to the radar system. Upon pressing the [ST-BY/OFF] key, power is applied to the scanner and display units. A countdown timer on the radar display shows the time remaining in the warm up period. During the warm-up period the antenna does not rotate.

After the warm up period (approximately 90 seconds), three beeps will sound and "ST-BY" will be displayed on the screen along with the bearing circle and graphics. The radar is now "ready" and available for operation.

Press the [X-MIT/OFF] key (with the sign ST-BY displayed), puts the radar into the "transmit" mode. The antenna will begin rotation, and targets will be displayed on the screen.

By pressing the [ST-BY/OFF] key again, the radar will return to the "stand-by" condition with the transmitter off and "ST-BY" again appears on the screen.

By pressing the [ST-BY/OFF] and the [X-MIT/OFF] key simultaneously, the radar will be turned off and all alpha-numeric information on-screen will extinguish.

② RANGE SCALE UP AND DOWN KEYS

By pressing the UP [△] or DOWN [▽] key, the desired range scale can be selected. When the radar is turned on, the range displayed will be on the same range scale that was previously in use when the radar was turned off.

During range changes the UP [▲] and DOWN [▼] keys change not only the range scale, but simultaneously change the number and interval of the fixed range rings, the pulse repetition frequency, the transmitter pulse length, and the bandwidth of the IF amplifier. Table 3-1 shows this relationship.

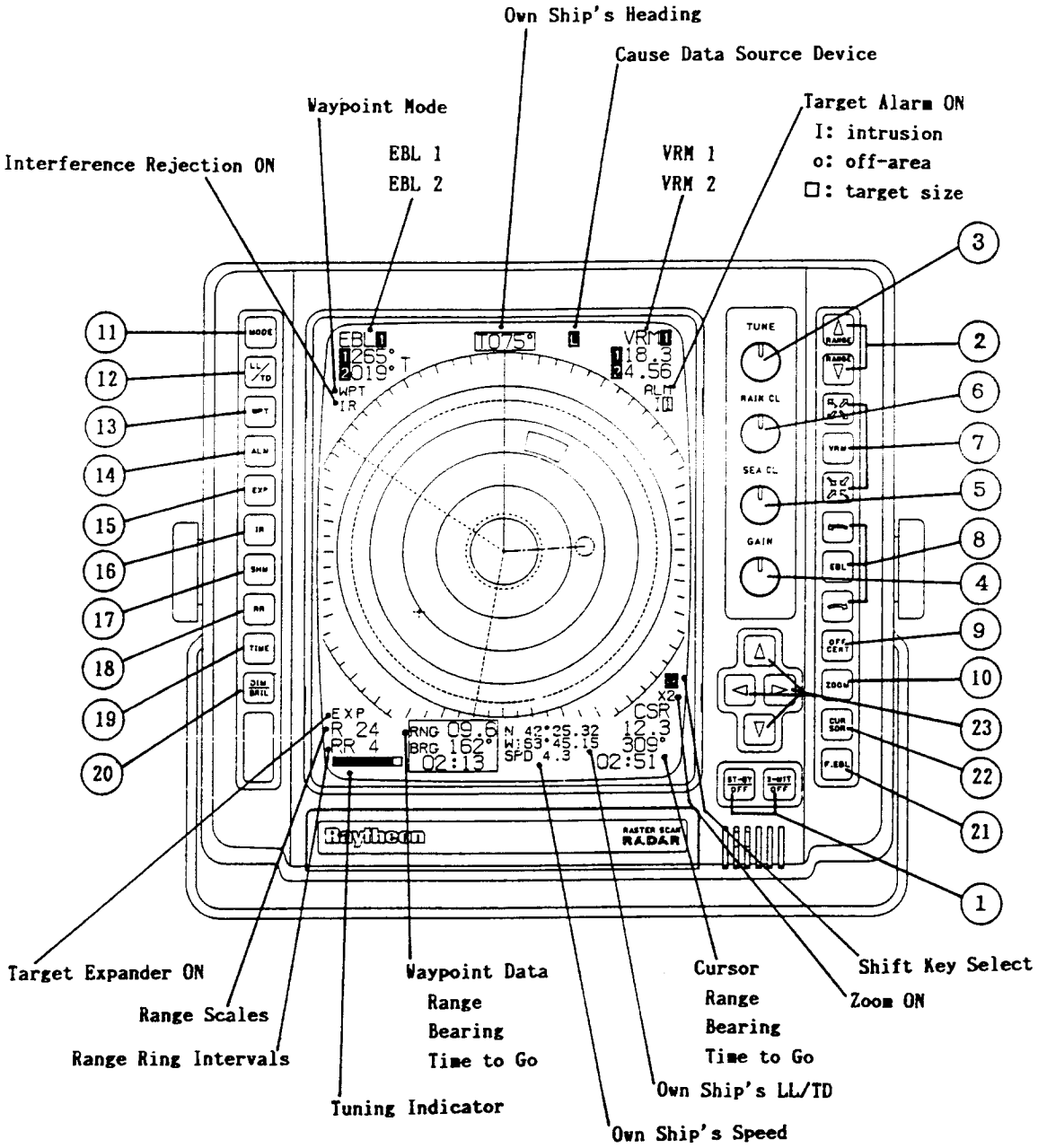


FIG. 3-1 LAYOUT OF CONTROLS

TABLE 3-1 RELATION OF RANGE, RINGS AND PULSE LENGTH

Range (nm)	Range Ring Interval (nm)	Number of Rings	Pulse Repetition Frequency (Hz)	Transmitting Pulse Length (μs)	Bandwidth of IF Amplifier (MHz)
0.125	0.0625	2	2250	0.08	10
0.25	0.125	2	2250	0.08	10
0.5	0.25	2	2250	0.08	10
0.75	0.25	3	2250	0.08	10
1.5	0.25	6	2250	0.08	10
3	0.5	6	1500	0.25	3
6	1	6	1500	0.25	3
12	2	6	750	0.5	3
24	4	6	750	0.5	3
32 (R40X)	8	4	750	0.5	3
48 (R41X)	8	6	750	0.5	3

③ TUNE CONTROL

The tune control is a variable control used to tune the receiver in the antenna unit for maximum targets on the display. If there are no targets available, this control can be used to tune for maximum sea clutter. The on-screen indicator will show the tuning peak condition by displaying a maximum of bars. The tuning adjustment of the radar should be normally performed on the longer range scales from 3 to 24 nm but should always be re-checked for peak indication on the range scale you are using.

④ GAIN CONTROL

The variable gain control adjusts the gain of the receiver, by increasing or decreasing the strength of the incoming video and noise. The gain control level is usually set for the best target presentation on the range scale selected with a slight noise speckle in the background. The gain control level may be reduced slightly on the short ranges for improved clarity, and increased as necessary on the long ranges for more sensitivity. You should use caution when setting the gain level. If the gain is reduced too much, small or weak targets may be missed, and if the gain is set too high, the CRT may be saturated with noise, making target observation difficult.

⑤ SEA CLUTTER CONTROL

The variable sea clutter control, also known as (STC), is used on the short ranges to suppress the effects of sea clutter close to own ship by reducing the nearby gain. The sea clutter should be set to the point where nearby clutter is reduced to small noise dots and small target echoes can still be distinguished. If the STC level is set too high, some small, weak targets may be missed.

The gain and STC should be checked for optimum settings whenever new range scales are selected to assure the best performance in all conditions.

⑥ RAIN CLUTTER CONTROL

The variable rain clutter control, also known as (FTC), is used to reduce large undesirable echoes from clutter such as rain or snow, which may obscure smaller echoes in their vicinity. The rain clutter control is normally adjusted to reduce such echoes so that only the leading edges of the larger echoes are displayed, while the smaller echoes

are only slightly effected. If the rain clutter is advanced too far, some small, weak targets may be suppressed by the controls effect.

⑦ VARIABLE RANGE MARKER (VRM) CONTROLS

The display unit has 2 VRM's which are used individually to obtain accurate range measurements to targets or land masses. When the [VRM] key is pressed for a short time, VRM1 will be displayed as a dashed line on-screen and VRM1 will be displayed in the upper right corner of the display. VRM1 is displayed as a "Dashed" ring. By pressing the "Increase" [▲] or "Decrease" [▼] keys, the VRM range is changed and the VRM distance will be displayed on the CRT, following the VRM1 characters, in nautical miles. If you wish to move the VRM ring more quickly, press the [VRM] key while pressing the "increase" [▲] or "decrease" [▼] key for faster speed of movement of the VRMs on the screen.

If the [VRM] key is depressed again for a short time, the VRM ring will be turned off. The selection of which VRM will be controlled is made by holding the [VRM] key depressed until the buzzer sounds. The second VRM will become activated. VRM2 is displayed as a "DOTTED" ring. The VRM being controlled is displayed with a reversed character [1] or [2] after "VRM" in the upper right corner of the display.

⑧ ELECTRONIC BEARING LINE (EBL) CONTROL

This display unit has 2 EBL's which are used to take accurate bearing measurements to targets or points of land. If the [EBL] key is pressed for a short time, EBL1 will be displayed as a "Dashed" line. The EBL1 bearing can be displayed in Relative, True, or Magnetic degrees depending on the mode selected with the mode key. By pressing the clockwise [↷] or counterclockwise [↶] key, the EBL can be rotated in the corresponding direction, and the bearing of the EBL will be displayed in the window on the screen at the top left side under the EBL characters. If you wish to move the EBL more quickly, press the [EBL] key while still pressing the direction key. The EBL will speed into "overdrive" mode.

The digits of the bearing display will be followed by a "T" when the bearing is "True", an "M" when the bearing is "Magnetic". And, when the bearing is "Relative", will have no letter displayed.

In order to obtain "True" or "Magnetic" bearings, the radar must be connected to a Navaid (Loran C or GPS), or a Magnetic Flux Sensor.

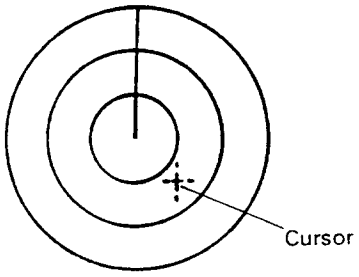
If the [EBL] key is again depressed for a short time, the EBL1 will be turned "off". The selection of which EBL will be controlled is made by holding the [EBL] key depressed until the buzzer sounds. The second EBL will be activated and displayed. EBL2 is displayed as a "DOTTED" line. The EBL being controlled is displayed after the characters "EBL" in the upper left corner of the display by a reversed character [1] or [2].

⑨ OFF CENTER KEY

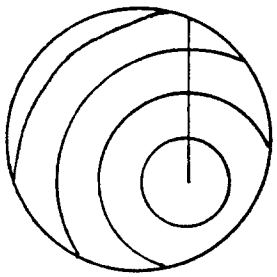
The OFF Center Mode lets you position the radar picture center at another point on the display so you can have a greater view in the direction of interest.

When the [OFF CENT] key is pressed, the position of own ship can be set anywhere on the screen up to 66% of the radius. The Off Center Origin is set using the off-

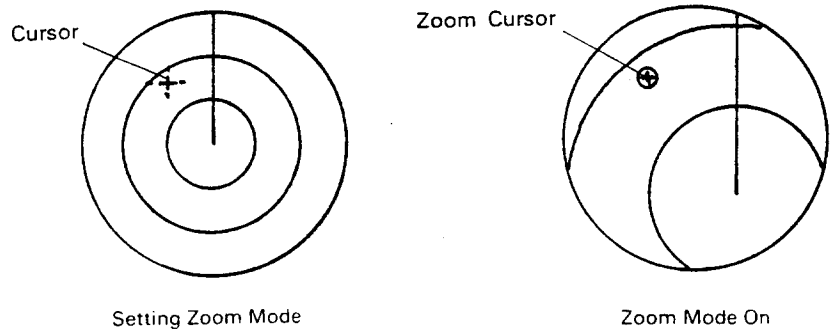
center cursor. Press the [OFF CENT] key. The cursor appears at the sweep origin. Position the cursor to the desired off-center location. Press the [OFF CENT] key to turn "on" the Off Center mode. To turn "off" OFF Center and recenter the sweep, press the [OFF CENT] key again.
The Off Center Mode does not operate on the 32 nm (R40X) or 48 nm (R41X) range and cannot be used together with the zoom mode.



Setting Off Center


Off Center Mode

⑩ ZOOM KEY [ZOOM]
The Zoom mode can be used to magnify any designated area of the display by "two times". When the [ZOOM] key is pressed, "X2" will be displayed on the lower right of the screen. The area between own ship and the designated location can be magnified by a factor of 2 times by using the designated location as the starting point without changing the range in use. The zoom location can be set by using the zoom ⊕ cursor and the shift keys (direction). To operate: Press the [ZOOM] key. The cursor appears at the sweep origin. Use the [SHIFT] keys to position the cursor. Press the [ZOOM] key to turn "on" zoom mode. To assist you in maintaining proper range determination, the fixed range rings are also turned "on" automatically.
Zoom mode can provide a quick means of getting a closer look at a channel entrance, for example, but for navigation purposes it is recommended that you choose the next lower range scale and use the OFF Center feature for the same effect. By alternately pressing the [ZOOM] key, the function can be turned "on" and "off". Zoom does not operate on the 1/8 nm range and cannot be used together with "OFF CENTER".



Setting Zoom Mode　　Zoom Mode On

⑪ MODE KEY [MODE]

When connected to a navigator such as a Loran-C or GPS, the X series radars have three display modes available. They are "Relative", "True" and "Magnetic". The "Relative" mode allows the operator to determine bearing to objects displayed on the radar screen relative to his own heading. These bearings are taken by utilizing the EBL's (Electronic Bearing Lines). All of the bearing data acquired in the relative mode is referenced to the "SHM" (Ship's Heading Marker).

When planning to plot information from the radar display to a chart, it will be helpful to have the bearing information readouts be in True or Magnetic. This data may be obtained directly from the radar by selecting the "True" or "Magnetic" mode. Press the [Mode] key to make the selection of True, Magnetic or Relative by sequential presses of the key.

The "True" and "Magnetic" modes all depend on having a NAVAID with proper data format connected to the radar system. In addition, the vessel must be underway and generally on a constant heading for several minutes, so that the COG (Course Over Ground) information from the loran or GPS will be valid and usable for the radar display modes. Pressing the [MODE] key places the radar in the "True" mode of operation. In this mode, EBL1 and EBL2 bearings are indicated in true bearing as determined by the NAVAID input. The character "T" will be displayed to the right of the EBL bearing characters to indicate the type of bearing input. The ship's COG data from the NAVAID is added to the radar display directly above the SHM and the vessel's speed is shown in the lower right of the display in this mode.

Pressing the [MODE] key again places the radar in the "Magnetic" mode of operation. In this mode, EBL1 and EBL2 bearings are indicated in magnetic bearing as determined by the NAVAID or optional magnetic flux sensor input. The character "M" will be displayed to the right of the EBL characters to indicate the type of bearing input. The ship's COG data from the NAVAID is added to the radar display directly above the SHM and the vessel's speed is shown in the lower right of the display.

When the flux sensor data is available. The "M" character will be displayed in block form [M].

(1) STANDARD MODE

EBL's with on-screen readouts, give relative bearing data.

(2) TRUE MODE

EBL's with on-screen readouts, instantly show true bearings to targets. Own ship's true bearing and own ship's speed are shown.

(3) MAGNETIC MODE

EBL's with on-screen readouts, instantly show magnetic bearings to targets. Own ship's magnetic bearing and own ship's speed are shown. Magnetic bearing data is best when inputted from the optional magnetic flux sensor.

⑫ LL/TD KEY [LL/TD]

The [LL/TD] key is a three position key which selects Latitude/Longitude, Time Difference or OFF for the display. Just press the key for your preference. L/L or TD data can only be displayed if you are connected properly to a Loran C or GPS Receiver.

⑬ WAYPOINT KEY [WPT]

When the [WPT] (waypoint) key is pressed, and the radar is connected to a NAVAID with the necessary data output, a waypoint symbol at the bearing and range to the selected waypoint can be presented on the radar display. Numeric data, showing the waypoint's Latitude/Longitude, bearing and range, and own ship's speed, appears at the bottom of the display. "WPT" characters in the upper right corner of the display indicate that the waypoint mode is ON.

If the radar is receiving course data from the optional magnetic sensor, the waypoint bearing data from the loran must be in "Magneic" to enable the mode.

If the optional magnetic sensor is not used, the loran COG (course) data can be in "True" or "Magnetic" as determined by the Loran-C. The waypoint mode will be enabled when the true or magnetic mode matches the loran course input.

If the waypoint is not within the selected range scale of the radar, only the dashed line indicating the bearing to the waypoint can be displayed. When the waypoint appears on the range scale in use, the waypoint is displayed as a ◌ with the center (own ship) and the waypoint interconnected by a dotted line.

Should data be lost from the heading sensors or from the Loran C, the WPT mode will disabled and the message "NO DATA" will appear on the display.

The Waypoint mode cannot be used if there is no course data from the Loran Navigator, or magnetic sensor or if there is no BWC sentence data available from the Navigator.

When using the WPT mode on higher speed vessels the waypoint symbol will tend to lag behind the actual waypoint. Often this condition is due to the lag in getting data from the Loran and is more noticeable on the shorter range scales.

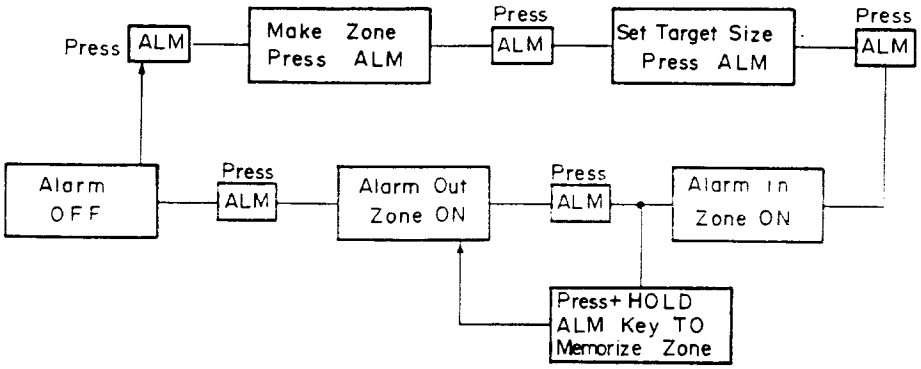
⑭ THE TARGET ALARM KEY [ALM]

This radar has two types of alarm zones; the IN (approach) alarm and the OUT (leave) alarm. The IN alarm is effective for alerting the operator to targets approaching own ship. An "OUT" alarm is an alarm that sounds when the targets leave a prescribed set zone. The OUT alarm is useful for monitoring anchorage conditions, or when pair trawling, or for towing operations.

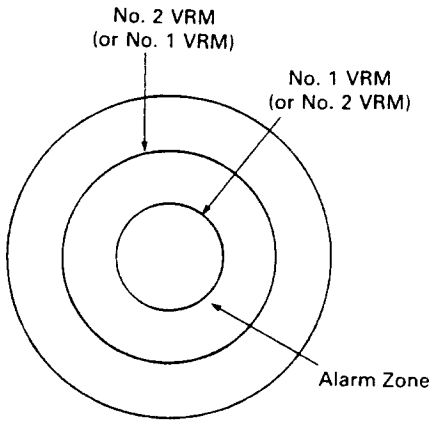
The [ALM] key turns the Alarm mode "ON" or "OFF". When the Alarm mode is ON, "ALM IN" or "ALM OUT" is displayed on the upper right side of the screen.

The alarm is preset to detect radar targets above the noise. If sea clutter or incidental weak echoes trips the alarm, the level of targets can be selected by the operator to avoid false alarming.
The alarm zones are set by positioning VRM1 and VRM2 marks at the desired alarm distances from own ship.
When sector alarms are desired, the sectors are formed by positioning EBL1 and EBL2 to define the borders of the desired alarm zone sector areas.

ALARM KEY OPERATION



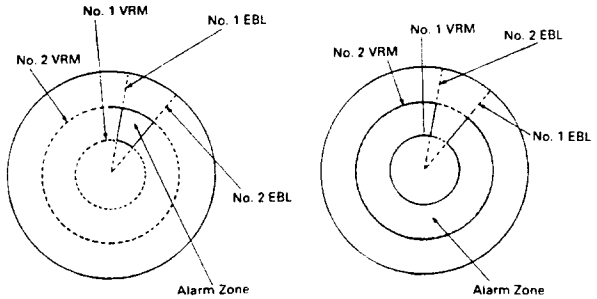
MAKING THE ALARM ZONE:



The most simple and effective alarm zone is made by setting VRM1 close to own ship and VRM2 to the outside desired safety zone distance that you wish to maintain. So, just press the [ALM] key. The "MAKE ZONE" menu appears. Turn on VRM1 and set the desired distance. Turn on VRM2 and set that distance. Press the [ALM] key again. The Alarm Zone will now be displayed as solid rings near the VRM ring positions.
The "SET LEVEL" menu appears. Target level 4 is automatically chosen for you. If you want to select a higher (stronger) level, press the ▲ key to pick target size detection between levels 4 and 7. You can use the ▼ key to choose more sensitive detection levels if you desire. When the selection has been made press the alarm key [ALM] again and the alarm zone is now "on" using the "IN" type of zone. Targets at the programmed level entering into the zone will sound the alarm.

MAKING SPECIAL ZONES (Sectors)

To make sector type zones just turn "on" EBL's 1 and 2 together with VRM's 1 and 2. The only special rule for making sector zones is that the left ege of any sector zone is set by EBL #1. The right side is set by EBL #2. The sector is then the combination of EBL's 1 and 2 and VRM's 1 and 2.
The diagram below demonstrates the area of the alarm zones when EBL1 and EBL2 are reversed.



One use for a sector zone is to draw the zone around an island or fixed target when you plan to anchor. Set the zone for an "OUT" alarm. If the anchor drags, the alarm will sound when the fixed target tries to leave the zone.

ALARM ZONE MEMORY

Most operators prefer to use the same alarm zone most of the time and occasionally will design special alarm zones as the need arises. These radars have a built-in memory to retain the zone that you use most often so that it is not necessary to always remake alarm zones.

MEMORIZING AN ALARM ZONE

To memorize an alarm zone, first make the zone following the normal procedure. After selecting the target size (if desired) and the alarm "IN" is displayed, press and hold the alarm key until the display beeps and the alarm characters on the screen right side turn into block form. At this time the zone will have been memorized for use any time.

To activate the "memorized" alarm zone just press and hold the [ALM] key until the display beeps. Your memorized zone will re-appear. The zone will be displayed as an "IN" type zone. If you want to change to an "OUT" zone, press the [ALM] key one time and "ALM 0" will be displayed on-screen showing the "OUT" alarm is "in use".

⑮ TARGET EXPANDER KEY [EXP]

The [EXP] (target expand) key, allows the operator the ability to make small targets appear larger on the display for better viewing. By alternately pressing the [EXP] key, the function can be turned on and off.

⑯ INTERFERENCE REJECTION KEY [IR]

The [IR] (interference reject) key, when activated, reduces noise on the display caused by other radars operating nearby in the same frequency band. This function is also effective in reducing some background noise. When active, the "IR" characters are displayed below the EBL characters at upper screen left. By pressing the [IR] key again, the IR function is turned off.

If you are navigating in a port area serviced by a "RACON" beacon you should turn off the [IR] mode to see the racon signals.

⑰ SHIP'S HEADING MARKER KEY [SHM]

Normally the ship's heading marker is continuously displayed to show own ship's heading on the radar screen. When the [SHM] (Ship's Heading Marker) key is pressed and held, the ship's heading marker will temporarily not be displayed. When the key is released again, the ship's heading marker will again be displayed. This feature allows small targets, under the Heading Line, to be clearly seen.

⑱ RANGE RINGS KEY [RR]

The [RR] (range rings) key turns on or off the display of the fixed range rings. The fixed range rings are usually used to "estimate" the distances to targets. The interval between the range rings is displayed on the lower left of the screen just below the range scale indicator for your reference.

⑲ TIMED TX KEY [TIME]

The [TIME] key allows the operator to program the radar to automatically transmit for a programmed period and return to standby for a prescribed period. This permits the user to maintain a radar watch while minimizing the power consumption experienced during full transmit operation. To use the Time TX mode, proceed as follows:

(1) Press the [TIME] key
The menu screen displays "SET TX PERIOD 10, 20, 30 SCANS".
(2) Use the range ▲/▼ keys to select the desired number of radar scans during transmit operation. The selected scan period is displayed in block numbers.
(3) Press the [TIME] key again.
The menu screen now displays "SET STBY PERIOD 3, 5, 10, 15 MIN".
(4) Set the standby time using the range ▲ or ▼ key.
The selected standby time is displayed in block numbers.
(5) The menu will disappear after 7 seconds.

TO TURN "TIMED TX" MODE ON

Press and hold the [TIME] key until you hear the beep and the "Timed Tx ON" message is displayed.

TO TURN TIMED TX MODE OFF

Press and hold the [TIME] key until the beep is heard and the "Timed Tx OFF" message is displayed. The [TIME] key needs to pressed for only about 3–5 seconds to turn the mode ON or OFF, and the time mode can be turned off any time the operator desires by pressing and holding the [TIME] key until the OFF message appears.

⑳ BRILLIANCE/DIMMER KEY [DIM/BRILL]

This [DIM/BRIL] (DIMMER/BRILLIANCE) key is used to adjust the brilliance of the screen and also the illumination of the front panel.
To adjust, the brilliance level proceed as follows:

(1) Press the [DIM/BRIL] key.
The menu screen displays "BRIL (1-8) ▲ ▼".
(2) Press the range ▲ or ▼ keys to adjust to the desired brilliance level 1 (Low) to 8 (maximum).
(3) Press the [DIM/BRIL] key again to adjust the key panel backlighting.
The menu screen now displays "DIM (0-7) ▲ ▼".
(4) Press range ▲ or ▼ keys to set the desire illumination level.
The backlighting level is displayed after DIM characters on the screen between 0 (off) to 7 (maximum).
(5) The menus will disappear after 7 seconds.

㉑ FLOATING EBL

The Floating EBL/VRM feature lets you obtain bearing and ranges from points on the display other than from own ships position. To use the Floating EBL, press the [F. EBL] key. A cursor "+" appears at the sweep origin and a message is displayd at the lower right of the display "SET ORIGIN; PRESS F. EBL". An "F" appears on the right side of the screen to show the Floating EBL mode is in use. Use the shift keys to move the cursor to the desired location on the display. Press [F. EBL] to turn "on" the Floating EBL for performing measurements.
The EBL 2 and VRM 2 readouts indicate the Floating EBL/VRM bearing and range.
To turn off the Floating EBL, Press the [F. EBL] key again. The Floating EBL/VRM will be turned "off" from the screen, but the origin position of the EBL will be remembered, in case you want to reuse the Floating EBL in the same location.

㉒ CURSOR

The cursor can be used to find the range and bearings from own ship quickly to any point on the radar picture.
To turn on the cursor mode, just press the [CURSOR] key. The letter "C" appears above the CRS characters to let you know that you are in the "Cursor" control mode.
When the cursor is moved to a position on the display, the range, bearing, and Time-To-Go data will be displayed in the cursor window in the lower right corner of the display screen.
When the mode key is set to "True" bearing mode and a Loran C is connected and supplying true COG data to the radar, the cursor bearings will be "True". If the loran or magnetic sensor is providing "Magnetic" bearings and the magnetic mode is selected, the cursor bearings will be "Magnetic".
The Time-To-Go read out appears for only about 8 to 10 seconds and will disappear After that time.
To turn off the cursor, press the [CURSOR] key again.

㉓ SHIFT KEYS

The shift keys ◀/▶, ▲/◀ are used to position the cursors for the Off Center, Zoom, Floating EBL, and the Cursor modes. If you press combination of ▲/◀ and ◀/▶ keys, the cursors will shift in diagonal directions.

3.2 USING THE CONTROLS

3.2.1 TUNE Control

Radar magnetrons, during their aging process, may take several minutes to completely stabilize on frequency. So, after switching to on and tuning initially, the tuning should be rechecked after the first 10 minutes:

Symptom that the equipment may be out of tune are a lack of distant echoes, or sometimes, the appearance of double echoes (one echo behind the another). Normally it is possible to "fine-tune" the radar by selecting a comparatively weak echo and then set the TUNE control level where the strongest echoes are displayed.

3.2.2 GAIN Control

The correct setting of the GAIN control is for a light background speckle to be just visible on the screen. The equipment is then in its most sensitive condition. Objects will be detected at the greatest possible range. With too little gain, weak targets may be missed and not displayed, with a decrease in detection range. With excessive gain the difference between echoes and background noise will be substantially reduced, making target observation more difficult.

In areas around strong targets (buildings, hills, towers, etc.), the gain might be temporarily reduced to clarify the picture. This should be done with care so important targets will not be missed. With the gain at its normal setting, clutter from rain or snow may obscure the echo from a ship inside a squall or storm. A temporary reduction in gain along with the proper RAIN CL/SEA CL settings will usually permit the stronger and more distinct ship's echo to be distinguished.

Detection of targets beyond the storm may, however, require slightly higher gain than normal, since the storm may have attenuated but not completely obscured the echoes from the targets. The GAIN control should always be reset to the optimum level following range scale changes. In addition, when environmental conditions change, readjustment of the gain may be required.

3.2.3 SEA CLUTTER Control

Whereas the GAIN control affects the strength of echo returns at all ranges, the effect of SEA CLUTTER control is greatest on nearby returns, becoming progressively less as range increases. The SEA CLUTTER control is effective up to a maximum of about three miles.

In particular, the SEA CLUTTER control reduces the strength of the mass of random signals received from waves at short range. The STC level used should be sufficient to reduce the strength of sea clutter while still allowing small nearby targets to be distinguished. The level should never be set so high so as to blank out all nearby returns.

The sensitivity of the SEA CLUTTER control is variable, thus enabling an optimum picture to be obtained under adverse weather conditions.

Maximum reduction in the strength of close-range clutter takes place when the control is set to maximum. When it is set to minimum there is no reduction in the strength of nearby clutter.

The SEA CLUTTER control may be useful to reduce effects from rain or snow clutter in the immediate vicinity of the vessel. A temporary increase in the setting will permit

stronger echoes from ships, and some navigational marks inside storms or squalls, to be distinguished.

At close range in crowded regions the control may be temporarily advanced to clear the picture. This should be done with care, so as to avoid missing important target returns.

The SEA CLUTTER control should be always checked and reset to the minimum required level position after any temporary alteration or when environmental conditions improve.

It is important to remember that both GAIN and SEA CLUTTER levels should be checked and adjusted each time a new range scale is selected. This is important to assure that excessive sea clutter or insufficient gain will not cause important targets to be missed or not displayed.

3.2.4 RAIN CLUTTER Control

During heavy rain or snow storms the RAIN CLUTTER control may be used to improve the detection between echoes and the storm clutter. When operating the RAIN CLUTTER, you will notice the reduction of background returns from land and large targets. This is normal. The rain storm should be minimized and allow targets to be seen within the storm.

3.2.5 [IR] Interference Rejection

When other radars are using the same frequency band as that of your own radar, interference typically appears arranged in curled spokes as shown in Fig. 3-3. The radar interference is most noticeable on longer range scales.

Activating the [IR] feature will eliminate this type of interference as well as affecting reduction of the background noise.

In general, the IR should be set to "ON" for normal operation to allow maximum target presentations on the radar display.

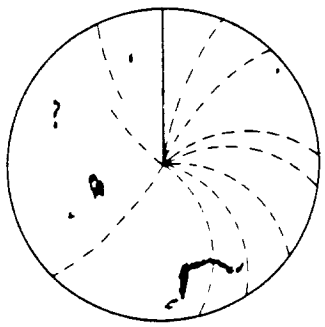


FIG. 3-3 RADAR INTERFERENCE

3.2.6 EXPANSION MODE

From time to time, targets may appear too small in size on the display. In this situation, activating the "expansion" mode will allow the displayed targets to be enlarged on the display, providing greater visibility to the operator.

The expansion mode is activated by the [EXP] key.

3.3 NAVIGATION WITH THE RADAR

3.3.1 Obtaining a Position Fix

The Model R40X/R41X Radar is an accurate and reliable navigational aid for determining your ship's position. Figure 3-4 shows examples of alternative methods of using radar sitings from prominent navigational points which can be identified on a chart. A position fix based on two or more navigational points will furnish an accurate fix, especially when the points are separated by close to 90° from each other relative to your ship.

3.3.2 Collision Avoidance Techniques

The moment a new target appears on the screen, its range and relative bearing should be noted. This is best done by putting the target information directly onto a plotting sheet or chart.

As in visual observation, "a constant bearing indicates a collision course."

As soon as a series of plots taken at intervals of 3 minutes indicates a closing range with no significant change in successive bearings, positive course change action should be considered and "The Regulations for Preventing Collisions at Sea" should be observed.

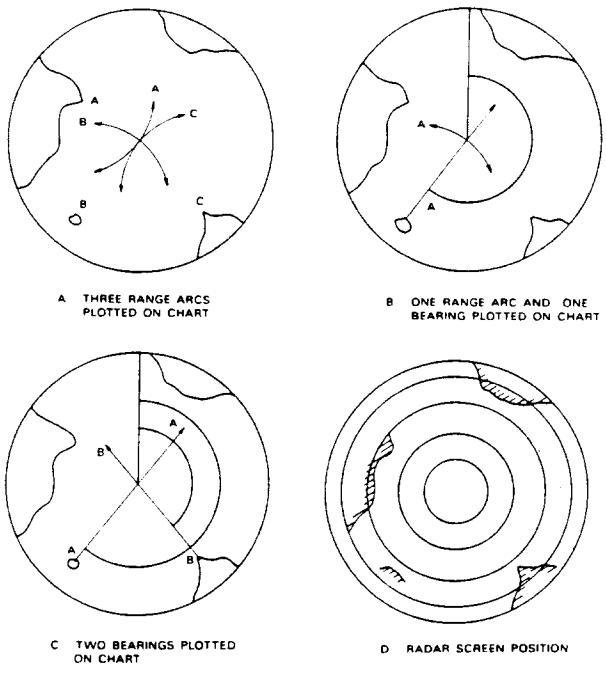


FIG. 3-4 POSITION FIX METHODS

3.3.3 Determining Your Radar Line-of-Sight Range (Target Detection Range)

When searching for distant targets, your radar line-of-sight range to the target can be a limiting factor. Radar waves behave like light waves but they are refracted slightly more, increasing the distance to the radar horizon slightly more than that to the optical horizon (however, displayed range is correct). As Fig. 3-5 shows, the radar line-of-sight range is a combination of the radar horizon of your ship's radar scanner and the radar horizon of the target.

The distance to the radar horizon from radar scanner of height "h" meters, under standard conditions, may be calculated from the formula

$$\text{Distance (nm)} = 2.23\sqrt{h}$$

For example, a scanner at height of 5 meters has a radar horizon of 5 nm.

A 5 meter cliff has a radar horizon of 5 nm. Therefore, under standard conditions, the cliff should begin to appear on the screen when the ship comes nearer than 5+5=10 nm.

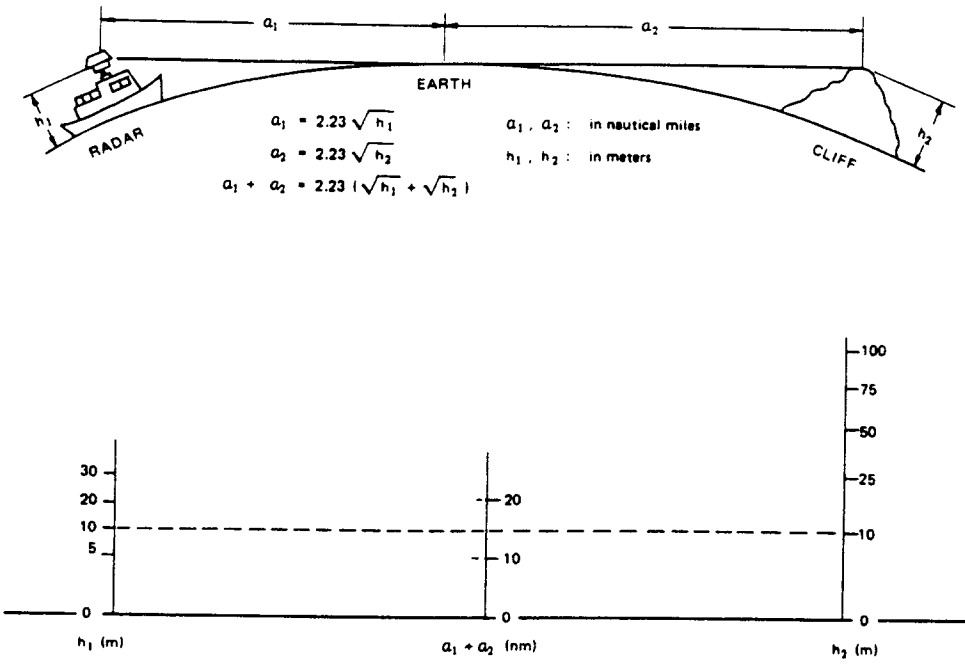


FIG. 3-5 RADAR HORIZON

3.4 FALSE ECHOES

Occasionally, signals appear on the screen at positions where there is no visual target. These targets could be false echoes.
The following conditions are the most common cause of false echoes.

3.4.1 SIDE ECHOES

In your antenna some of the radiation escapes on each side of the main beam of energy and is known as "side lobes". If a large target is very close to your ship, may be reflected by the target and they will be displayed on the screen as an echo. (See Fig. 3-6)
These echoes sometimes appear as arcs, forming echoes at each side of the true echo. Sometimes they are joined together if the side echoes are strong.

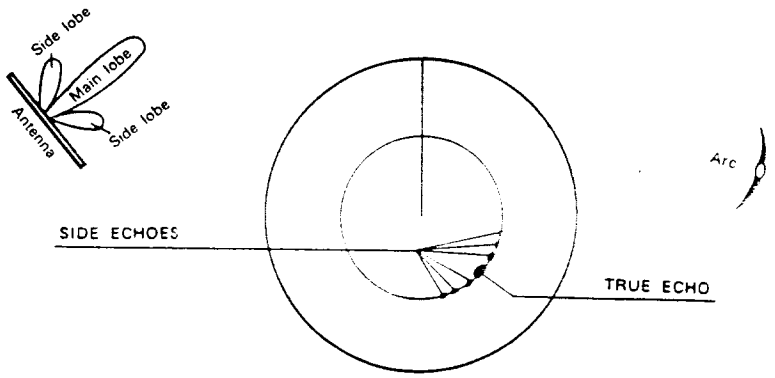


FIG. 3-6 SIDE ECHOES

3.4.2 Indirect Echoes

Indirect echoes may appear when there is a large target, such as a passing ship at a short range, or a reflecting surface, such as a funnel on your own ship in line with the antenna. The signal on first striking the smooth side of the large target, will be reflected, and the echo returns to the antenna and is shown on the display. However, the same reflection hits other masts or obstacles and then gets picked up by the radar antenna with enough strength to appear as a target on the radar screen.

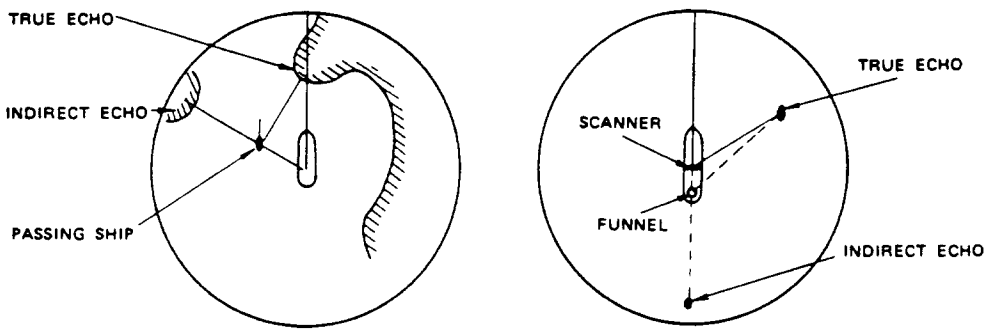


FIG. 3-7 INDIRECT ECHOES

3.4.3 Multiple Echoes

Multiple echoes could appear if there is a large target having a wide vertical surface parallel to your own ship at a comparatively short ranges. The signal will be reflected by the wide vertical surface, then the reflected signal strikes your own ship, and it will return along the same paths to the target. This will be repeated.

Thus, the multiple echoes will appear beyond the true target's echo on the same bearing as shown in Fig. 3-8. This is not very common.

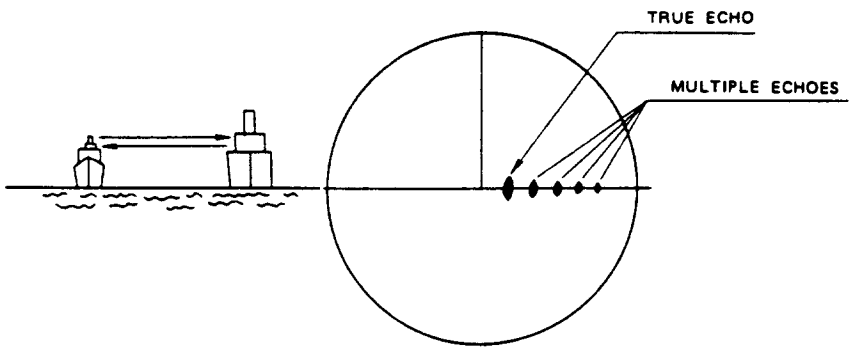


FIG. 3-8 MULTIPLE ECHOES

3.4.4 Ghost Echoes

The ghost echoes may appear if there is a target having a wide smooth surface near your own ship. As shown in Fig. 3-9, the cause of the ghost echoes is similar to that of the indirect echoes.

The ghost echoes appear on the screen as if you saw the target reflected in a mirror.

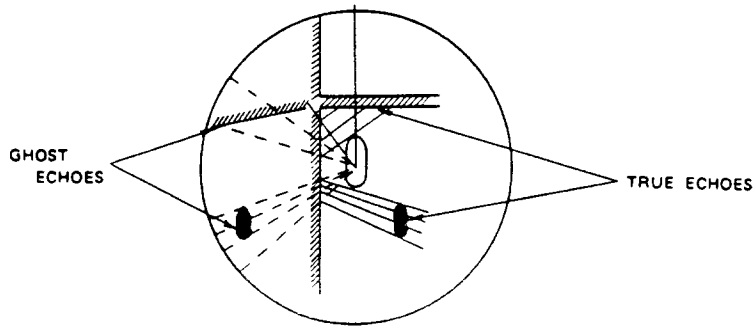


FIG. 3-9 GHOST ECHOES

3.4.5 Shadows

Although the scanner unit should be ideally placed where there is a good all-around view, as far away as possible from any part of the ship's superstructure or rigging to reflect the beam, there may be some obstructions. An obstruction will throw either a complete or partial shadow as shown in Fig. 3-10.

If there are targets in such shadow sector, target's echoes may not be displayed on the screen. Thus, it is important to know the bearings and width of all shadow sectors, and it can be checked by turning the SEA CLUTTER control to zero when light rain clutter covers much of the screen and the sea is calm.

Any shadows will then be shown as dark sectors in the clutter.

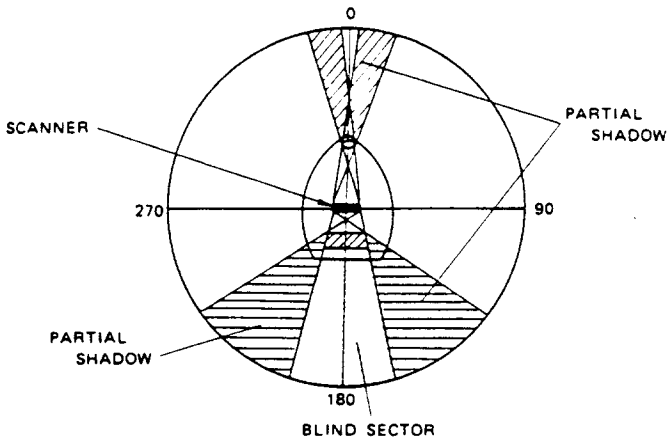


FIG. 3-10 SHADOWS

SECTION 4

MAINTENANCE

4.1 USER PREVENTIVE MAINTENANCE

Continuous satisfactory operation of the radar can depend on how well you take care of your equipment. These simple maintenance tips can save you time and money, and help you avoid premature equipment failure.

1) Always keep the equipment as clean as possible. Remove dirt, dust, or water-spray from the display and scanner during the boat clean up.

2) During routine ships maintenance, make a thorough inspection of the radar system including the following points:
   a. Check all hardware for tightness.
   b. Check for evidence of any corrosion on the scanner unit, display unit, or its cable and connectors. Clean as required.
   c. Check the cable connections and terminal strip connections for cleanliness and tightness. Make sure the wiring is free from chafing or abrasions.

4.2 RADOME SCANNER

Set the safety switch (S101) on the Scanner Unit to OFF before working on the radar scanner.

4.2.1 Radome

Wipe the surface of the Radome with a clean, soft cloth. Remove any paint, dirt, or caked salts. Heavy deposits of dirt or caked salt on the surface of the Radome can cause a considerable drop in the radar's performance. Avoid using chemical cleaners or solvents. Alcohol is preferred or light detergent as a cleaning agent.

4.2.2 Lubrication

Periodic replacement of lubricants is recommended.

Locate the main drive gear, clean away old lubrication residue and dirt. Using an appropriate applicator apply a light coating of grease (MOBILUX Grease No. 2 Mobil Oil Company or equivalent) on the gear of the main shaft and the drive motor.

Cleaning and lubrication should be done approximately every six months.

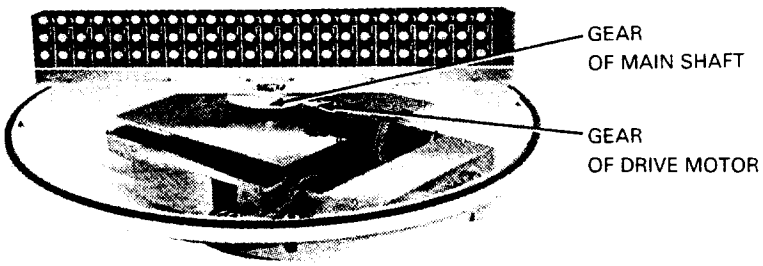


FIG. 4-1 LUBRICATION

4.2.3 Mounting

Check the mounting bolts of the Scanner Unit and tighten if necessary.

4.3 OPEN ARRAY SCANNER

Set the safety switch (S101) of the Scanner Unit to OFF before working on the radar Scanner.

4.3.1 The Antenna Array

The face of the radiator should never be painted, however it should be kept clean from built-ups of dirt, dust, caked salt or soot because deposits of these particles can cause a considerable decrease in the radar's performance.

Use a soft wet cloth or a cloth dampened in alcohol when cleaning the array. Never use solvents such as gasoline, benzine, trichlorethylene, or ketone.

4.3.2 Rotating Drive Unit

1) Oil Seal

To lubricate the rotating drive unit seal, remove the grease cap located on the side of the array base plate, and using a grease gun, add grease until it starts to leak out of the seal. This lubrication is required every 6 months. Use Mobiluxe #2 Grease or equivalent.

2) Drive Motor Brushes

Part of the routine maintenance program should include a periodic inspection of the condition of the motor brushes and commutator segments after every 200 hours of use. The useful life of the brushes is approximately 3000 hours. The brushes should be replaced when they have worn to the groove located at one-half its length.

The commutator should be inspected for wear and cleaned of excess carbon build-up. To clean and polish the commutator segments, use a common pencil eraser.

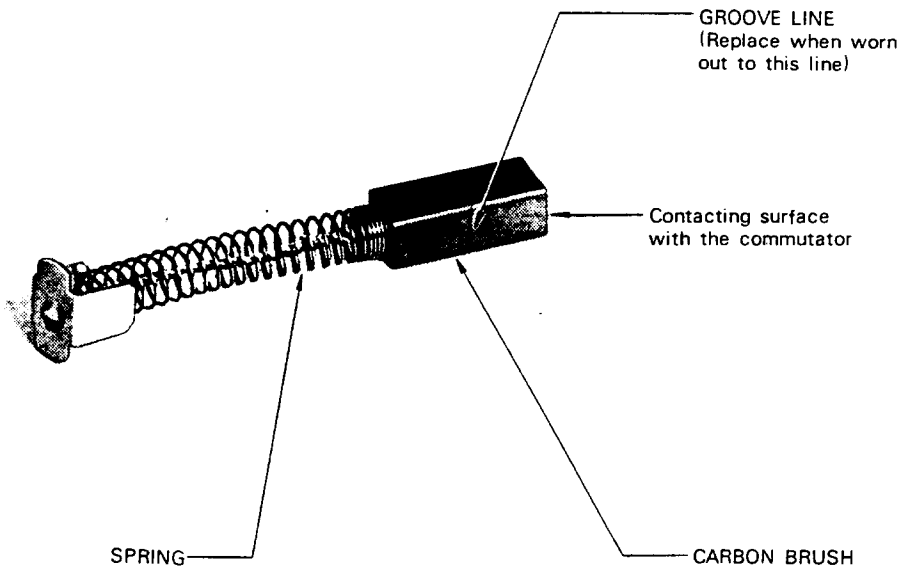


FIG. 4-2 CARBON BRUSH

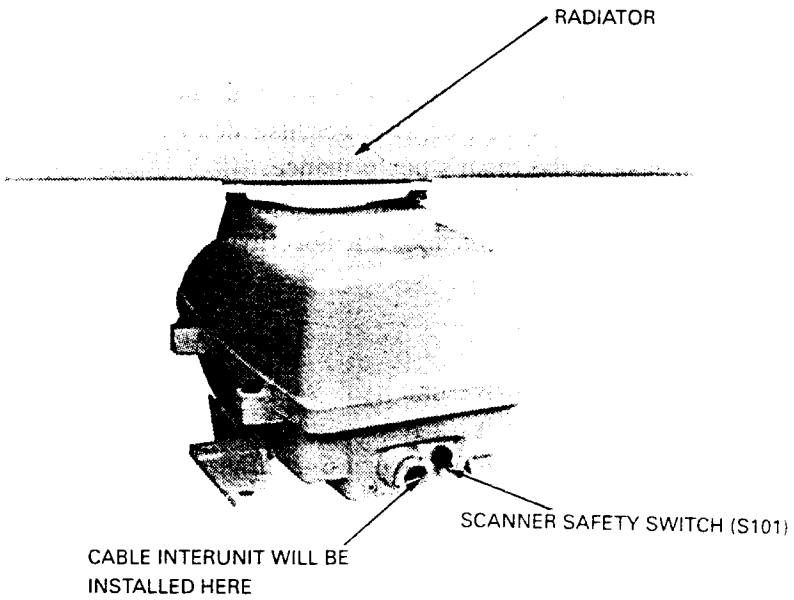


FIG. 4-3 SCANNER UNIT (REAR VIEW)

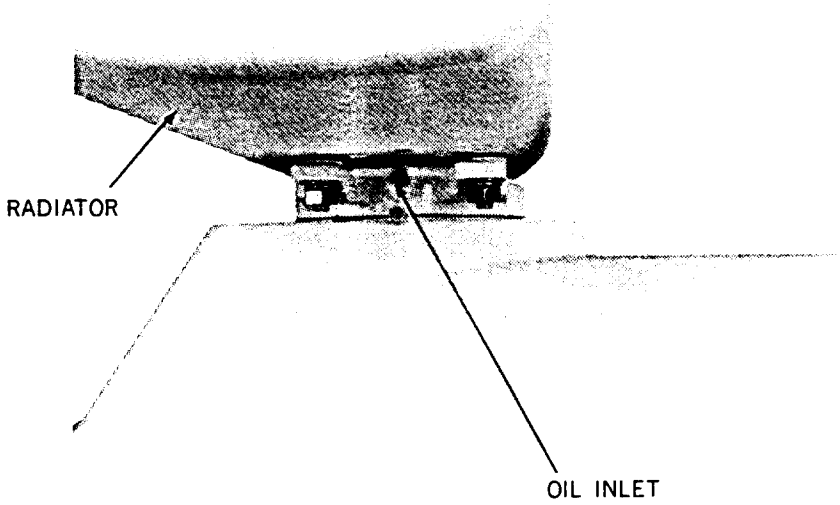


FIG. 4-4 SCANNER OIL SEAL

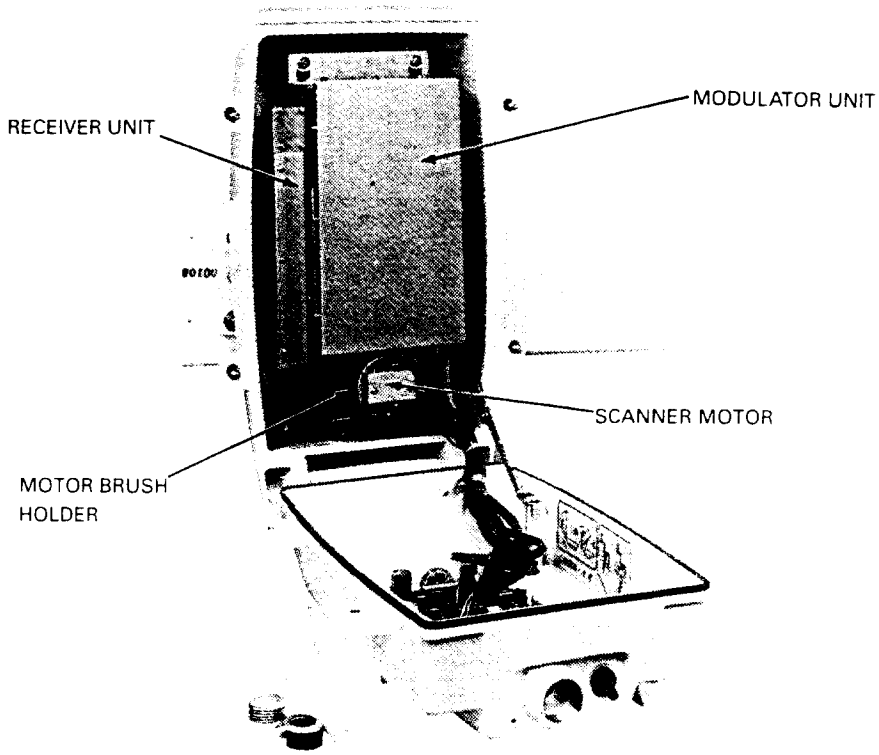


FIG. 4-5 SCANNER UNIT INTERIOR (MODULATOR SIDE)

4.4 DISPLAY UNIT

The face of the cathode-ray tube may, in time, accumulate a film of contaminants which tends to dim the picture.

Be sure Radar is "OFF", use glass cleaner and soft cloth or towels to clean CRT glass, key board, and radar cabinet.

SECTION 5

ADJUSTMENT AND FAULT FINDING

5.1 ADJUSTMENT

5.1.1 Adjustments upon Replacing Components

Although the radar is delivered adjusted for optimum performance, it may be necessary to make adjustments after a major component has been replaced or if a fault is suspected during operation.

NOTE

REPLACEMENT ITEM	ADJUSTMENT REQUIRED	See Sect. #
Magnetron V1	Tuning	2.6.3 c)
MIC Frontend E301	Tuning	2.6.3 c)
Cathode-ray tube V501 Display PCB	Adjusting centering magnet Adjusting intensity Adjusting focus	
SHM Unit S102	Bearing Alignment	2.6.3 A)

5.1.2 Display Unit

1) Intensity adjustment (See Fig. 5-1)
   a. Remove the cover from Display Unit.
   b. Set BRILLIANCE for maximum level.
   c. Adjust RV101 on CRT Monitor PCB, so that PPI is of suitable brightness.

2) Focus adjustment (See Fig. 5-1)
   a. Remove the cover from Display Unit.
   b. Adjust RV151 on CRT Monitor PCB so that the sweep line, rings, and targets on the screen are as small and clear as possible.

3) H. HOLD
   Adjust RV301 on CRT Monitor PCB so that horizontal screen is kept in sync.

4) H. SIZE and V. SIZE
Adjust L301 and RV202 on CRT Monitor PCB so that the rings are round.
Note: *Using a ruler, adjust for equal diameters N/S E/W.*

5) V-LINEAR
Adjust RV203 on CRT Monitor PCB so that the rings are round.

6) Beam Centering adjustment on CRT (See Fig. 5-1)
Rotate the two knobs simultaneously or individually so that the beam center coincides with the center of CRT.

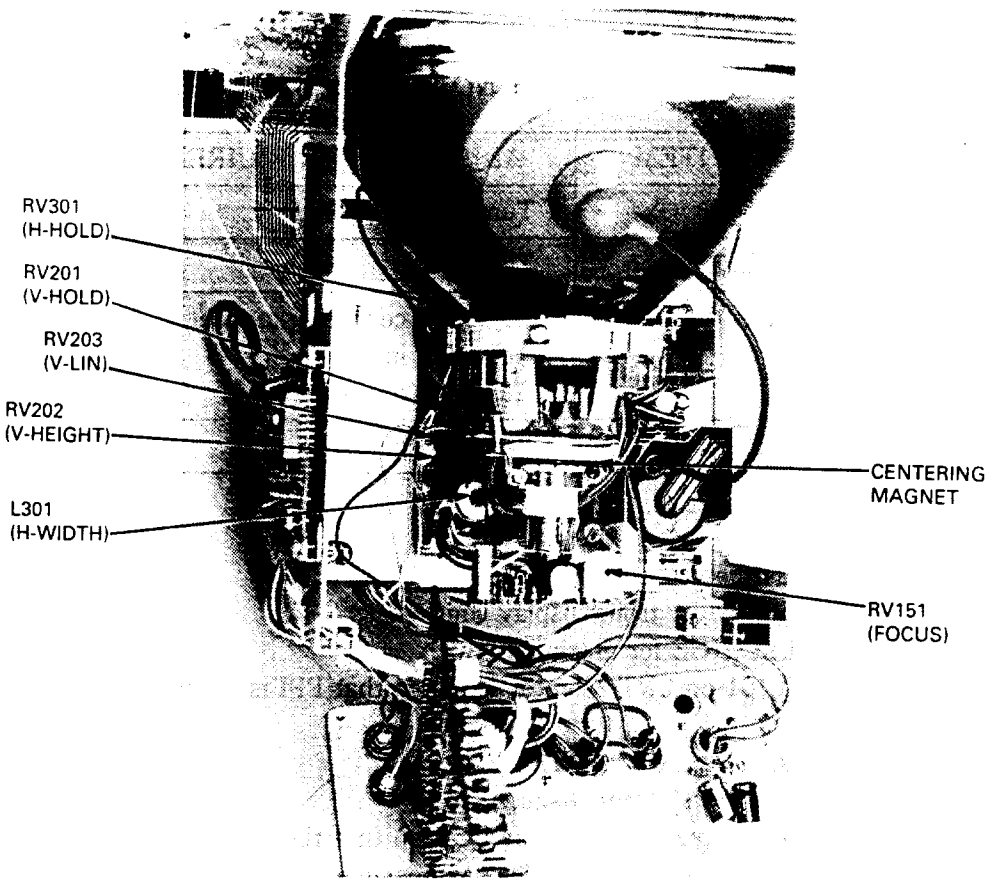


FIG. 5-1 CRT MONITOR PCB ADJUSTMENT

5.1.3 Scanner Uunit

A) AVR voltage adjustment

AVR output voltage adjust RV1 in the PC501 (Power Supply PCB).

Adjust the DC voltage between the CD6-cathode (positive) and ground (negative) so that it will be 7 V.

B) AVR frequency adjustment

AVR frequency adjust RV2 in the PC501 (Power supply PCB;).

Adjust the frequency between the TR5-gate and TB101-2A so that it will be 22.25 kHz.

C) Tune Indicator Adjustment

Note: *This adjustment has been made at the factory at the time of delivery, however, the adjustment may be required when the receiver, MIC, modulator or magnetron is replaced. When the maximum tuning point agrees with the tune indicator, this adjustment is not necessary.*

a) Adjust the Tune Control on the display unit for maximum target echoes.

b) Connect the voltmeter to J301-8 as shown in Fig. 5-4 and Fig. 5-5.

c) Adjust L8 for a minimum voltage reading. If no minimum is found or it is greater than 0.7 V, adjust RV1 for 1 V tune indicator output and then readjust L10 for minimum.

d) Readjust RV1 to get a tune indicator output of 0.7–0.8 V.

e) Recheck that the maximum tuning point and the tune indicator maximum agree.

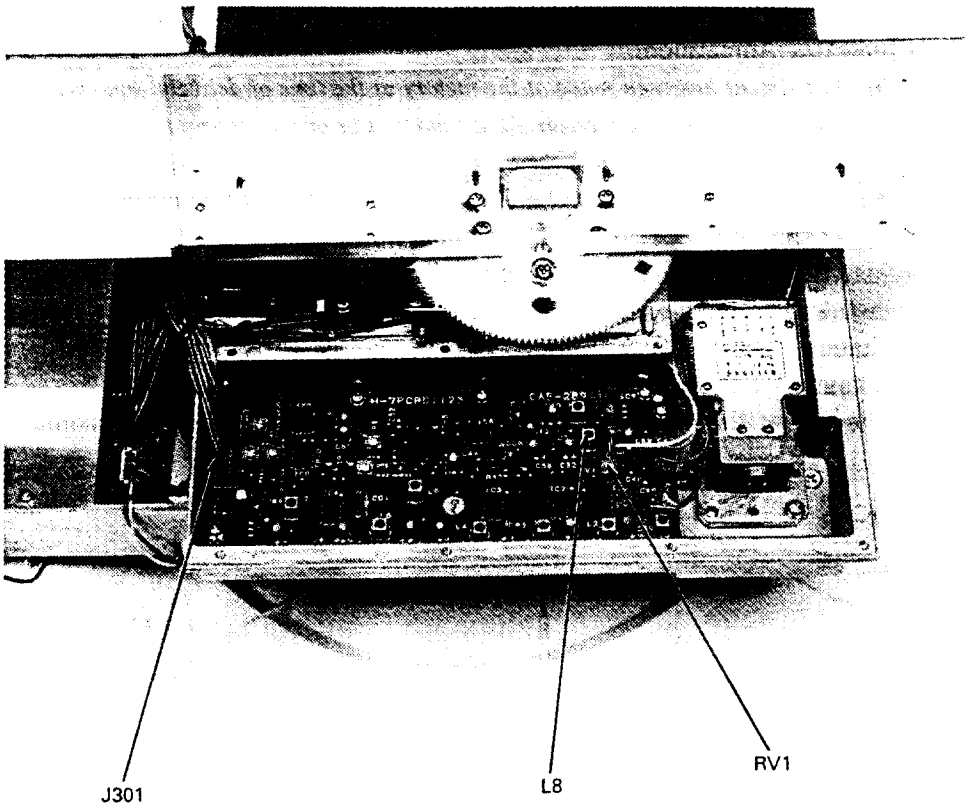


FIG. 5-4 RECEIVER ADJUSTMENT RADOME SCANNER

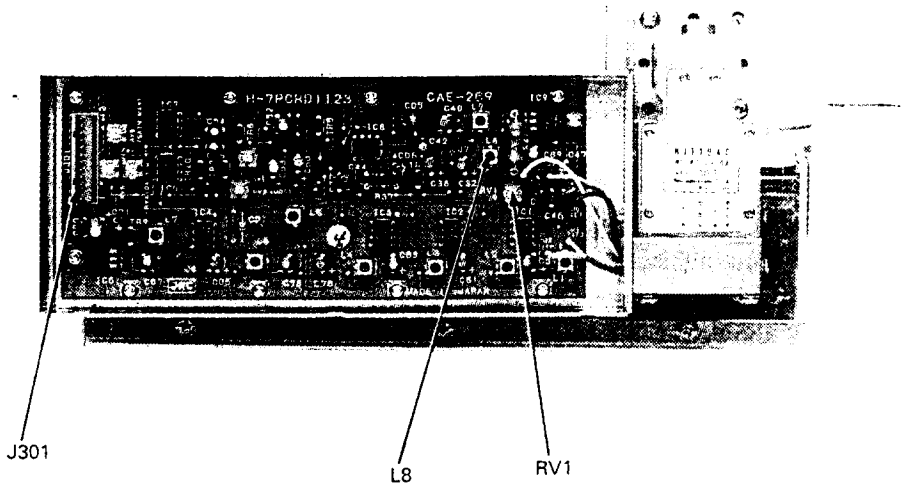


FIG. 5-5 RECEIVER ADJUSTMENT OPEN ARRAY SCANNER

5.2 TROUBLE-SHOOTING

5.2.1 General

While the X-Series Radars are highly reliable systems, early signs and detection of component fatigue can sometimes be spotted during regular operational checks.

When a problem is observed, corrective service should be arranged to avoid failure at critical times at sea.

5.2.2 Fault Finding

(1) Regular operational checks
(preventative maintenance)
The electrical performance of the equipment should be evaluated at periodic intervals by qualified Raytheon Technicians and the results recorded. Changes in test results may indicate an aging or failing component. Table 5.1 provides a check list of items.
Whenever an abnormal result is obtained from a test, appropriate corrective maintenance should be employed to prevent serious damage or failure modes.

CAUTION: In making checks, be alert to the high voltage points existing throughout the equipment.

(2) Fuse
A fuse seldom blows out without some cause. Even if a fuse is merely replaced and does not blow again, it still may be necessary to make further checks of the circuits associated with the fuse.
Table 5.2 shows a table of fuses employed in the equipment.

(3) Fault finding procedure
Often the display on the CRT can help indicate which major circuit is at fault. It may be found quicker to check-out the equipment according to the trouble shooting guide (Table 5.3).
In general, the common causes of trouble frequently encountered include abnormal resistances, intermittent variable resistors, switches and relays.
In the following fault finding procedure, it is assumed that only a VOM is available; the use of an oscilloscope simplifies the procedure, and may prove necessary in some cases.
Table 5-3 is the trouble shooting guide and check-out procedure, Table 5-4 shows typical voltages and resistances at significant points throughout the equipment. The internal resistance of the tester used in measurements was 20 kΩ/V dc, 8 kΩ/V ac.

TABLE 5-1 OPERATION CHECK LIST

Unit to be checked	Check item	Correct condition	Remarks	Measuring point
Scanner Unit	a. Input voltage	Refer to Note		TB1011A ~2A
	b. AVR output voltage	7 V		PC501-CD6-K~ ground
	c. Mag. current	12 V		PC501-TP1~ ground
Display Unit	a. Input voltage	Refer to Note		J401-1~2
	b. AVR output voltage	5 V		TP1~ ground
	c. Observation of screen sensitivity, sweep length, sweep linearity, sweep center, ring and illumination.			
	d. Check of the operating controls			

Note: *Allowable variation of input voltage. DC11 V~42 V*

TABLE 5-2 FUSES USED

Location	Part No.	Rating current	Protective circuit	Type	Remarks
Display unit	F401	6.3 A	All circuit	Glass tube 6.3 A	dc 12 V
	F401	3.15 A	All circuit	Glass tube 3 A	dc 24 V, 32 V
	F402	5 A	Scanner motor	Glass tube 5 A	dc 12 V
	F402	3.15 A	Scanner motor	Glass tube 3.15 A	dc 24 V, 32 V

TABLE 5-3 TROUBLE SHOOTING GUIDE

Trouble	Remedy
1. Does not start at OPERATE switch to STBY.	Check: o Blown fuse F401. o Check input power circuits. o Fault of contact on S401. o Fault of power supply circuit on PC5. o Fault of contact on connector of PC5. o Fault of rectifier diodes on PC5.
2. Scanner fails to rotate.	Check: o Fault of S101. (Safety Switch OFF) o Fault of contact on terminal boards. o Fault of M101/B101. o Fault of drive mechanism.
3. Scanner rotates but rotation of sweep is abnormal	Fault of connection between M101 Check: o Fault of encoder (BP). o Fault of main circuit for the Display Unit.
4. No picture on the screen.	Fault of CRT display unit or its supply voltages. Check: o Open heater of CRT. o Fault of contact on CRT socket. o Fault of contact on CRT cap. o fault of video circuit
5. Only horizontal line screen.	There may be fault in vertical sweep generator, amplifier circuits and deflection coil. Check: o Fault in vertical sweep generator, amplifier circuit
6. Incorrect sweep o Start of sweep is not centered on the screen. o Markers are oval.	o Adjust Centering Magnet. o Adjust horizontal or vertical hold. o Adjust vertical length and linearity. o Adjust height as necessary.

Trouble	Remedy
7. Range rings on the screen but no noise and no echoes:	Fault circuit between IF amplifier of receiver unit and input circuit of display unit video amplifier. Check: ○ Fault of GAIN, STC control settings. ○ Fault of receiver unit. ○ Fault of contact on terminal boards and connector.
8. Noise and range rings on the screen but no echoes.	If no transmission is present, check the modulator and magnetron. Check: If transmission appears to be present as indicated by the correct MAG. I reading on Tester. PC501 TP1 = 12 VDC ○ Failure of Local Oscillator tuning. If transmission appears to be present, carry out the Local Oscillator tuning procedures and check the MIC. ○ Fault of MIC Mixer. If no transmission is present, ○ Whether the lead wire to magnetron is grounded to chassis. ○ Fault of magnetron.
9. Poor sensitivity. Dim echoes.	Check: ○ Reduction of transmitting output power. ○ Fault of magnetron. → Check of MAG. I reading on PC501-TP1. ○ Fault of MIC Frontend. ○ Fault of CRT. ○ Failure of Local Oscillator tuning. ○ Failure of FOCUS adjustment. ○ Failure of INTENSITY ADJ. ○ Fault of video amplifier circuit on PC6. ○ Fault of receiver unit.
10. NO VRM or VRM cannot be controlled.	Check: ○ Fault of S401. ○ Fault of main circui (PC1).

Trouble	Remedy
13. NO EBL or EBL cannot be controlled.	Check: o Fault of S401. o Fault of main circuit (PC1).
14. No alarm zone marker, cannot be controlled or no alarm sound.	Check: o Fault of S401. o Fault of main circuit (PC1). o Fault of Buzzer BZ1.

Table 5.4 shows typical voltage and resistances at significant points throughout the equipment.

TABLE 5.4 TYPICAL VOLTAGES AND RESISTANCES

(A) Inter-unit terminal board

Note: *Resistance measurements shall be made under the following conditions:*
POWER switch-off S101 -ON.
Resistance values shall be measured between measuring point and ground unless otherwise specified, and negative terminal of the tester is grounded as a rule.
The tester used for this measurement is 20 kΩ/V DC, 8 kΩ/V ac.
Voltage measurements shall be made with the following display control conditions:
POWER switch-ON, RAIN CLUTTER -min, GAIN -max, SEA CLUTTER -min.
Ship's power supply is dc 12 V.

STC ..... MIN
FTC ..... MIN

TUNE ..... CENTER
GAIN ..... MAX
P.S. = 12 V (D.C.)

RADOME RADAR

Measuring Point	Resistance (Ω)	Voltage (V)			Remarks
		0.125 ~ 1.5 (nm)	3.6 (nm)	12 (nm)	
TB101 VD	6×10	−0.11	−0.11	−0.11	DC 0.3 V
1 A~2 A	5×10	11.3	11.2	11.2	12 V
J101 1	24×10	0	5.0	10.5	12 V
2	22×10	−0.015	−0.008	−0.005	0.3 V
4	300×10	2.65	2.65	2.65	3 V
5	4×10	12	12	12	12 V
6	20×10	0.25	0.25	0.25	3 V
7	1.5×10k	11.3	11.3	11.3	12 V
8~2 A	140×10	8.7	8.6	8.6	12 V
9	7.5×10	2.4	2.4	2.4	3 V

OPEN ARRAY RADAR

Measuring Point	Resistance (Ω)	Voltage (V)			Remarks
		0.125 ~ 1.5 (nm)	3, 6 (nm)	12 (nm)	
TB101 VD	6×10	−0.11	−0.11	−0.11	DC 0.3 V
M+~2 A	5×10	11.5	11.4	11.4	12 V
1 A~2 A	5×10	11.0	11.0	10.9	12 V
J101 1	24×10	0	5	10.5	12 V
2	22×10	−0.015	−0.008	−0.005	0.3 V
4	300×10	2.7	2.6	2.6	3 V
5	4.3×10	12	12	12	12 V
6	20×10	4.2	4.2	4.2	12 V
7	1.8×10k	11.4	11.3	11.3	12 V
8~2 A	85×10	8.2	8.2	8.2	12 V
9	7.5×10	2.1	2.1	2.1	3 V

(B) Resistances at inter-unit connector without connection of cables.

Note: *Refer to Note given in item (A).*

SCANNER UNIT

Measuring Point	Radome Resistance (Ω)	Open Array Resistance (Ω)
TB101 VD	∞ × 10	∞ × 10
VDE	0 × 10	0 × 10
M+	—	∞ × 10
1A	∞ × 10	∞ × 10
2A	∞ × 10	∞ × 10
J1011 PW	170 × 10	170 × 10
2 TRIG	∞ × 10	∞ × 10
3 E	0 × 10	0 × 10
4 STC	550 × 10	550 × 10
5 GAIN	2K × 10	2K × 10
6 TUNI/BR	21 × 10	21 × 10
7 TUNV	∞ × 10	∞ × 10
8 1B	∞ × 10	∞ × 10
9 BP	8 × 10	8 × 10

DISPLAY UNIT

Measuring Point	R40X Resistance (Ω)
J402 1	∞ × 10
2	∞ × 10
3	23 × 10
4	0 × 10
5	0 × 10
6	5.6 × 10
7	∞ × 10
8	∞ × 10
9	∞ × 10
10	23 × 10
11	4 × 10
12	600 × 10
13	8 × 10
14	0 × 10
15	∞ × 10
16	26 × 10

TABLE 5-5 OF TRANSISTORS USED

TYPE	KIND, USE	SUPPLIER	V_{cbo} (V)	V_{ceo} (V)	V_{beo} (V)	I_c	P_c	h_{fe} min.	h_{fe} max.	ft (MHz)	V_{ce}(V) sat.
2SA495GTM-Y	PNP HF Amp	TOSHIBA	−50	−50	−5	−150 mA	400 mW	120	240	200	−0.4
2SA1010-K	PNP High Speed High Voltage Switching	NEC	−100	−100	−7	−3.5 A	40 W	100	200		−0.6
2SA1015-Y	PNP AF Amp	TOSHIBA	−50	−50	−5	−150 mA	400 mW	120	240	80	−0.3
2SA1145-Y	PNP AF Amp	TOSHIBA	−150	−150	−5	−50 mA	800 mW	120	240	200	−1.0
2SA1244-Y	PNP Switching	TOSHIBA	−60	−50	−5	−5 A	20 W	70	240	60	−0.4
2SA1261-K	PNP High Speed High Voltage Switching	NEC	−100	−100	−7	−10 A	60 W	100	200		−0.6
2SB674	PNP Hi-Power Switching	TOSHIBA	−80	−80	−5	−7 A	40 W	1000	15000		−1.3
2SB906-Y	PNP AF Power Amp	TOSHIBA	−60	−60	−7	3 A	20 W	100	200	9	−1.0
2SC1212A-B	NPN AF Power Amp	HITACHI	80	80	4	1 A	8 W	60	120	160	0.75
2SC1360A	NPN Video IF Amp	National	60	60	4	50 mA	1 W	20	100	300	0.4
2SC1627-Y	NPN Voltage Amp	TOSHIBA	80	80	5	300 mA	600 mW	120	240	100	0.5
2SC1815-BL	NPN AF Amp	TOSHIBA	60	50	5	150 mA	400 mW	350	700	80	0.1
2SC1815-Y	NPN AF Amp	TOSHIBA	60	50	5	150 mA	400 mW	120	240	80	0.1
2SC2983-Y	NPN Power Amp	TOSHIBA	160	160	5	1.5 A	15 W	120	240	100	1.5
2SC3098	NPN VHF-UHF LN Amp	TOSHIBA	30	20	3	50 mA	150 mW	30	300	3500	
2SC3258-Y	NPN Switching	TOSHIBA	100	80	7	5 A	30 W	120	240	120	0.2
2SC3303-Y	NPN Switching	TOSHIBA	100	80	7	5 A	20 W	120	240	120	0.4
2SD1680	NPN H-Deflection Out.	National	330	200	6	7 A	70 W	15	45		1
2SK302-GR	Nch FET VHF Amp	TOSHIBA		20	±5	30 mA	150 mW				
2SK525	Nch FET Switching	TOSHIBA		150	±20	±10 A	40 W				
2SK736	Nch FET Switching	NEC		100	±20	±15 A	35 W				

TABLE 5-6 OF DIODES USED

TYPE	KIND USE	SUPPLIER	VRM (V)	VR (V)	I_{FM}	I_o	P	V_F (V)	t_{rr}	REMARKS
11DF2	F.R.D.	IR	220	200	30 A	1 A		0.98	30 ns	
1AZ330	Zener V_z=330 V	TOSHIBA					1 W			
1S1585	High Speed Switching	TOSHIBA	90	80	480 mA	150 mA	300 mW	1.0	2 ns	
1S1588	High Speed Switching	TOSHIBA	35	30	360 mA	120 mA	300 mW	1.3	4 ns	
1S1832	F.R.D.	TOSHIBA	1800	1500		0.7 mA		2.0	6 μs	
1SS184	High Speed Switching	TOSHIBA	85	80	300 mA	100 mA	150 mW	0.72*	1.6 ns	*I_F=10 mA
1SS226	High Speed Switching	TOSHIBA		80		100 mA			1.6 ns	
1SV149B	Varactor	TOSHIBA		15						
5D2C11	General Purpose	TOSHIBA		200	250 A	5 A		1.2		
5KF20	F.R.D.	IR	220	200	80 A	5 A		0.98	35 ns	
ERA22-02	F.R.D.	FUJI ELECTRIC		200	10 A	0.5 A		1.5	0.4 μs	
ERA22-08	F.R.D.	FUJI ELECTRIC		800	10 A	0.5 A		1.5	0.4 μs	
ERB12-01	General Purpose	FUJI ELECTRIC		100	60 A	1.0 A				
ERB44-04	F.R.D.	FUJI ELECTRIC		400	30 A	1.0 A			0.4 μs	
ERB83-004	General Purpose	FUJI ELECTRIC		40	80 A	1.7 A		0.55		
F6P20F	F.R.D.	IR	220	200	60 A	6 A		0.98*	30 ns	* per leg
F6P40F	F.R.D.	IR	440	400	60 A	6 A		1.25*	30 ns	* per leg
HVR-1X-40A	High Voltage Diode	SANKEN	9 K		20 A	350 mA		9		
HZ11A3	Zener V_z=10.3 V	HITACHI					500 mW			
HZ36-1	Zener V_z=35.7 V	HITACHI					500 mW			
HZ3B2	Zener V_z=3.1 V	HITACHI					500 mW			
HZ5C1	Zener V_z=5.1 V	HITACHI					500 mW			
HZ6C1	Zener V_z=6.1 V	HITACHI					500 mW			
HZ7A1	Zener V_z=6.6 V	HITACHI					500 mW			
HZ9A2	Zener V_z=8.3 V	HITACHI					500 mW			
TLR123	Gap LED	TOSHIBA		4	20 mA		60 mW	2.8		
S6080B	Thyristor	TOSHIBA	750							
SM-1XN02	General Purpose	ORIJIN		200	45 A	1.5 A		1.0*		*I_F=I_O
U05C	General Purpose	HITACHI	300	200	100 A	2.5 A		1.1	3.0 μs	
U05J	General Purpose	HITACHI	1000	800	100 A	2.5 A		1.1	3.0 μs	
V11N	F.R.D.	HITACHI	1800	1500		0.4 A		2.5	0.4 μs	

TABLE 5-7 OF INTEGRATED CIRCUITS USED

TYPE	KIND, USE	SUPPLIER	REMARKS
AN5763	B/W TV V-Defection Sig. Processing and Output Cir.	National	$V_{CC(MAX.)}$=15.6 V, $P_{D(MAX.)}$=1.33 W, $V_{OSC\cdot S(V)}$=5 V, $I_{Y(P\text{-}P)}$=715 $mA_{P\text{-}P}$
AN5790N	H-Sig. Processing Circuit for CRT Displays	National	$V_{CC(MAX.)}$=13.2 V, $P_{D(MAX.)}$=1.44 W, $V_{CC(MAX.)}$=50 mA, $V_{OSC\cdot S(H)}$=7.5 V, f_{DC}=700 Hz/μs, τ_{HO}=2~40 μs, f_{HO}=14~60 kHz
MC1350P	IF AMP	MOTOROLA	$V^{+}_{(MAX.)}$=18 V, $V_{AGC(MAX.)}$=V^{+}, $V_{IN(MAX.)}$=5.0 V, $P_{D(MAX.)}$=625 mW
NE521N	High Speed Comparator	SIGNETICS	$V^{+}/V^{-}_{(MAX.)}$=±7 V, $V_{ID(R(MAX.))}$=±6 V, $V_{IN(MAX.)}$=±5 V, $P_{D(MAX.)}$=600 mW
NJM4558D	OP. Amp	NJRC	$V_{ID(MAX.)}$=±30 V, $P_{D(MAX.)}$=500 mW, SR=1 V/μs (RL≧2 kΩ)
NJM78M05FA	Regulator	NJRC	$V_{IN(MAX.)}$=35 V, $P_{D(MAX.)}$=7.5 W, V_O=5 V
HA17555PS	Timer	HITACHI	V_{CC}=18 V, I_O=200 mA
HM53461ZP-12	65536 word×4 bit Video RAM	HITACHI	$V_{T(MAX.)}$=−1.0~+7.0 V, $P_{T(MAX.)}$=1.0 W, V_{CC}=−0.5~+7.0 V, t_{RAC}=120 ns
HM6264ALP-15	8192 word×8 bit SRAM	HITACHI	V_{CC}=5.5 V, P_T=1 W
HM63021P-28	2048 word×8 bit Line Memory	HITACHI	$V_{T(MAX.)}$=−0.5~+7.0 V, $P_{T(MAX.)}$=1.0 W, V_{CC}=5 V, t_{syc}=28 ns
PST532A	System Reset, Battery Backup	Mitsumi	Detect Voltage 4.2 V, Battery Charge Output 50 mA min.
TA78DL12P	Regulator	TOSHIBA	$V_{IN(MAX.)}$=29 V, $P_{D(MAX.)}$=20 W, V_O=12 V
TC524256Z-10	262144 word×4 bit DRAM	TOSHIBA	$V_C{}^{C}{}_{(MAX.)}$=−1.0~7.0 V, $I_{O(MAX.)}$=50 mA, $P_{D(MAX.)}$=1 W, V_{CC}=5 V
TL082CP	OP. Amp	TI	$V^{+}/V^{-}_{(MAX.)}$=±18 V, PD=680 mW, SR=13 V/μs
TL431CLPB	Voltage Regulator	TI	$V_{KA(MAX.)}$=37 V, I_K=−100~150 mA
TL494CN	Switching-V Regulator	TI	$V_{CC(MAX.)}$=41 V, $V_{IN(MAX.)}$=V_{CC}+0.3 V, $I_{O(MAX.)}$=250 mA
TL499ACP	Switching-V Regulator	TI	$V_{IN1PIN(MAX.)}$=35 V, $V_{IN2PIN(MAX.)}$=10 V, $V_{O(MAX.)}$=35 V, $I_{SW(MAX.)}$=1.0 A
TLP521	Photo Coupler	TOSHIBA	[LED]: $I_{F(MAX.)}$=50 mA, $I_{FP(MAX.)}$=1 A [TR]: $V_{CEO(MAX.)}$=5.5 V, $V_{ECO(MAX.)}$=7.0, $I_{C(MAX.)}$=50 mA, $P_{C(MAX.)}$=100 mA [per 1 circuit], $P_{T(MAX.)}$=150 mW [per 1 circuit]
UPC596C	VIF Detector	NEC	V_{CC}=14 V, P_D=275 mW
UPD6326C	CMOS 6 bit D/A Converter	NEC	V_{DD}=V_{CC}~15 V, I_{DD}=15 mA
UPD72020GC-8-3B6	G.D.C.	NEC	$V_{DD(MAX.)}$=−0.5~+7.0 V, V_I=−0.5~V_{DD}+0.3 V, V_O=−0.5~V_{DD}+0.3 V
UPD78C10G-36	Micro Computer (CPU)	NEC	V_{DD}=7 V, I_{DD}=30 mA

SECTION 6

TECHNICAL DESCRIPTION

6.1 SCANNER UNIT

6.1.1. Radome Scanner

The scanner unit consists of the radiator, the motor-encoder, radiator rotating mechanism, bearing reset sw, transmitter and receiver units and power supply unit. These components are housed within the 24″ radome.

1) Radiator

The radiator is horizontally polarized printed array which is constructed on an aluminum frame. The radiator, approximately two feet in length, is coupled to the transmitter and receiver via a short wave-guide, rotary joint and circulator.

At half power points horizontal beamwidth is 4° and vertical beamwidth is 25°. Side lobes are reduced by better than −21 dB with respect to the main beam. The direction of maximum radiated power is perpendicular to the radiator. (Figure 6-1)

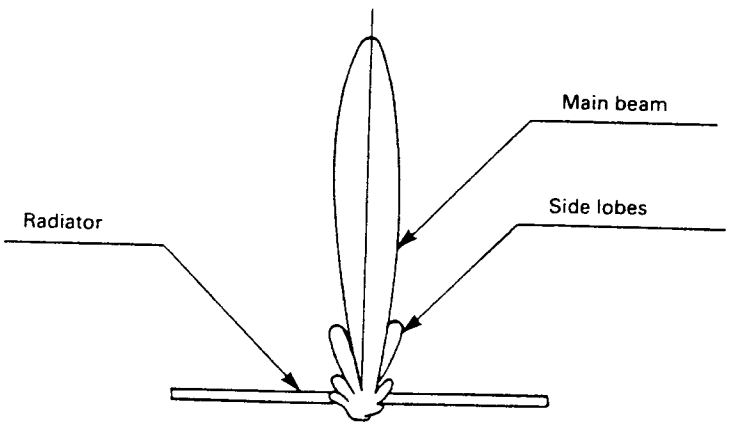


FIG. 6-1 RADIATOR PATTERN

2) Motor-Encoder

A dc motor is used to rotate the radiator. The encoder section of the assembly produces the bearing pulses for rotation synchronization. A bearing sync pulse is generated every 0.176 degrees of rotation (2048 pulses per 360°) at 13.5 V dc amplitude. These pulses are sent through TB101-BP to the Bearing Pulse circuit in the Display Unit.

3) Radiator Rotating Mechanism

Mechanical coupling between the radiator and the motor-encoder is effected by a reduction drive mechanism. The motor rotates at approx. 24 rpm.

4) Bearing Reset Sw

The bearing reset switch produces the signal for the bearing reset circuits when the permanent magnet fitted on the main gear passes across Reed Switch S102. The resulting bearing reset signal is sent to the bearing reset circuit in the Display Unit to synchronize the scanner position on the display.

6.1.2 Open Array Scanner

The Open Array Scanner Unit consists of the radiator, the motor-encoder, the radiator rotating mechanism, the bearing reset circuit, the transmitter, and the receiver.

A) Radiator

The radiator is a horizontally polarized, non-resonant, end-fed slotted waveguide array. The radiator, 3.9 ft. in length, is coupled to the transmitter and the receiver through a short waveguide, rotary joint and a circulator. The radiator is driven at 24 rpm by the motor-encoder via a gear reduction mechanism.

At the half power points, the horizontal beamwidth is 2.2 degrees with a vertical beamwidth of 30 degrees.

Within ±10 degrees of the main beam, the sidelobes are reduced by better than −23 dB down while outside ±10 degrees of the main beam, the sidelobes are −26 dB down.

The direction of maximum radiated power is perpendicular to the radiator.

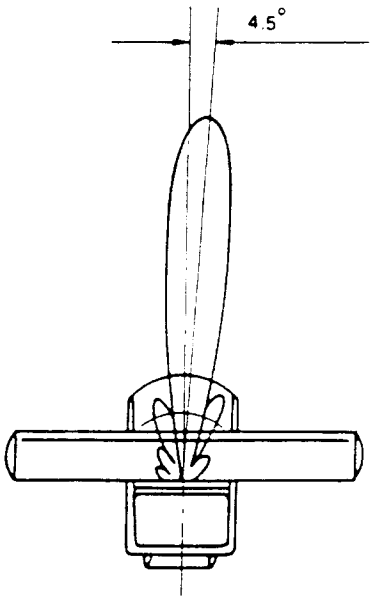


Fig. 6-2 RADIATOR PATTERN

B) Motor-Encoder

A 10 VDC motor is used to rotate the radiator. The encoder section of the assembly produces bearing pulses for the rotation synchronization. A bearing sync pulse is generated every 0.176 degrees of rotation (2048 pulses per 360 degrees) at 5 V amplitude. These pulses are sent to the Bearing Pulse Circuit in the Display Unit.

C) Bearing Reset Circuit

The bearing reset circuit produces a 5 V signal which generates a bearing counter reset pulse to synchronize the bearing on the display with the scanner rotation. The bearing reset circuit consists of a shutter mounted on the main shaft, and a photo-interrupter on the PCB.

6.1.3 Transmitter

The transmitter consists of the solid state modulator circuit and the 4 kW magnetron.

A) Modulator

A line-type pulser is used in the modulator and consists of a charging choke, SCR switch, pulse transformer and PFN.

By setting the X-MIT/OFF key on the indicator control panel to "ON", the transmitter trigger pulse is fed to the base of TR1 in the modulator from the transmit trigger generator circuit in the display unit.

The modulator high voltage of +330 VDC is fed to the PFN capacitors C10, C11, C12 and C13 via L1. Because of the resonant charging action of L1; the PFN charges to almost twice the input voltage. Since the charging efficiency is about 90% the PFN voltage is nearly +600 V.

Upon receiving the positive pulse at the gate of the SCR (CD2), CD2 conducts, and the charged voltage across the PFN capacitors is immediately discharged through CD2 and the pulse transformer T1. Consequently the pulse duration determined by the PFN appears on the primary windings of the pulse transformer T1 and is stepped up to the cathode of the magnetron via T1 secondary. The pulse peak voltage on the primary of T1 is −260 V, and the secondary voltage is −3.7 kV.

The pulse selection relays K1 and K2 are controlled by the range keys on the indicator front panel. This will provide three different pulse lengths: 0.08 μsec, 0.25 μsec and 0.5 μsec in accordance with the range scale selected. The pulse repetition frequency (PRF) changes automatically according to the operating pulse length. (See Table 6-1).

TABLE 6.1 RANGE, PULSE LENGTH, AND PRF RELATIONSHIPS

Range	Pulse length	PRF
0.125, 0.25, 0.5, 0.75, 1.5 nm	0.08 μs	2250 Hz
3, 6 nm	0.25 μs	1500 Hz
12, 24, 32, 48 nm	0.5 μs	750 Hz

B) Magnetron Transmitter

While the high voltage pulse is fed to the cathode of the magnetron, the magnetron generates high energy oscillations in the region of 9410 MHz for the duration of the input pulse.

The operating point of the magnetron is at a voltage of −3.7 kV and a current of 3 A.

C) Circulator and Diode Limiter

The circulator A101 directs the high amplitude RF energy of the magnetron to the antenna port and the received RF signals to the receiver.

A102 is the passive diode limiter between the circulator and the MIC Frontend. It serves as a barrier to protect the MIC Frontend from high amplitude RF energy, irrespective of whether or not the radar is energized.

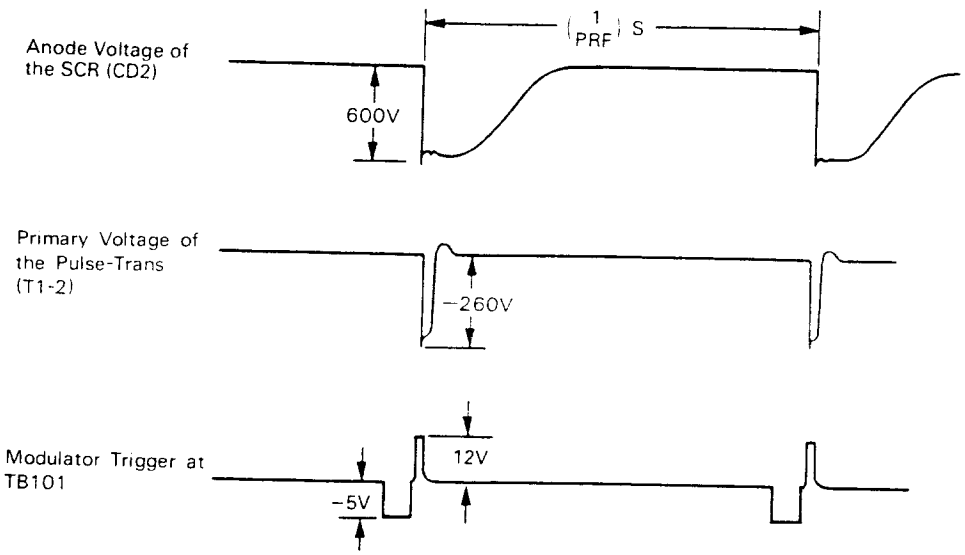


FIG. 6-3 TIME TABLE OF THE TRANSMITTER

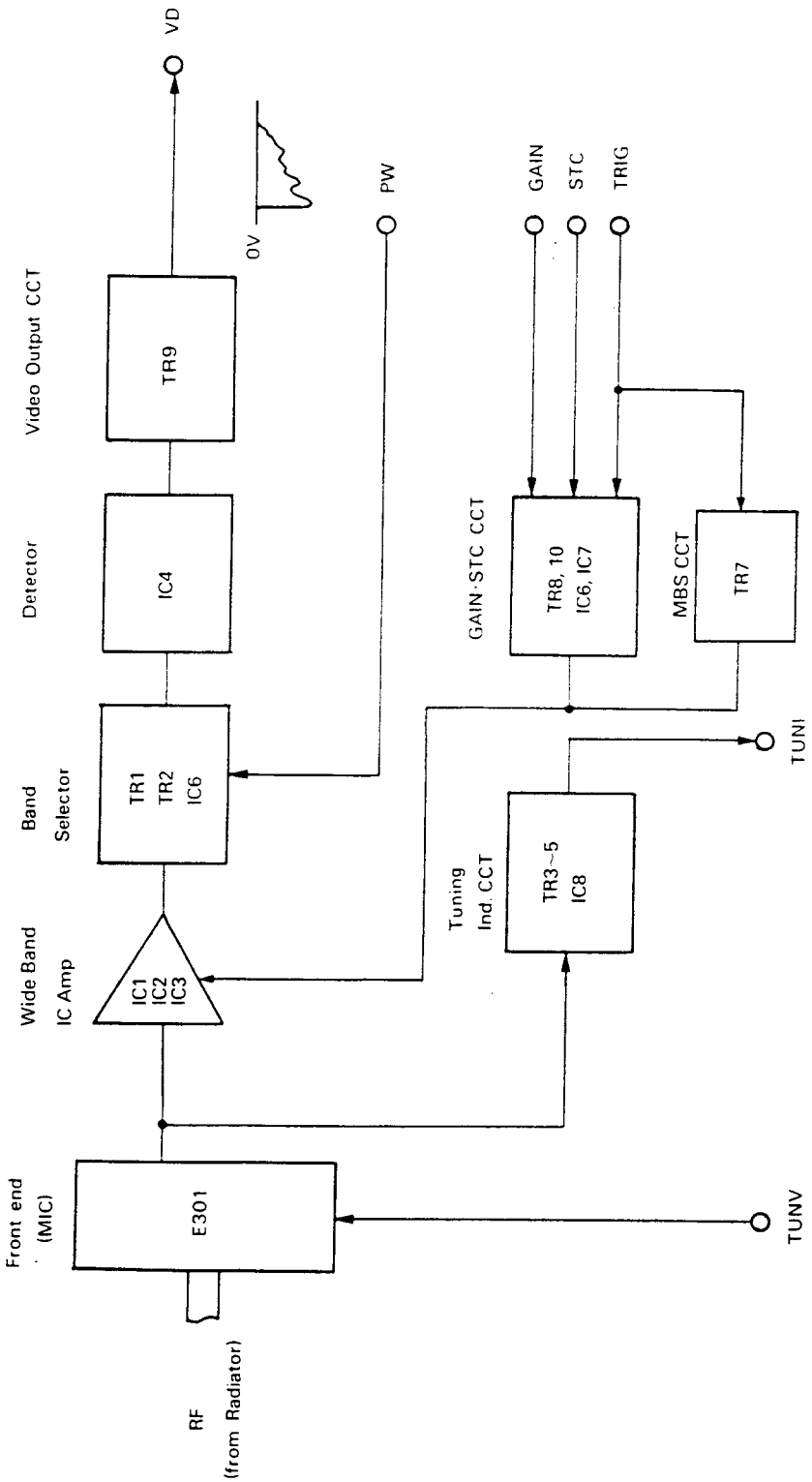


FIG. 6-4 RECEIVER UNIT BLOCK DIAGRAM

6.1.4 Receiver Unit

The receiver unit consists of the MIC Frontend and the receiver PCB.

A) MIC Frontend

The MIC Frontend consists of a low-noise RF amplifier, a double balanced mixer and the local oscillator. The received signal is amplified by a low-noise amplifier fed to the double balanced type mixer which presents a good signal-to-noise ratio to the receiver. The mixer output frequency is 60 MHz. The local oscillator tuning is achieved by the adjustment of the operator's tune control on the display control panel.

B) Receiver PCB

1) IF Amplifier Circuit

The IF amplifier consists of a low-noise, gain controlled IC amplifier IC1, IC2 and IC3, and a bandwidth selector circuit TR1 and TR2.

IC1, IC2 and IC3 are gain controlled by the Gain and STC control signals from the Gain and STC (Anti-Clutter Sea) controls on the display unit. The maximum gain is obtained when voltage of IC1-5, IC2-5 and IC3-5 is 4 volts.

The bandwidth selector IC6 receives the pulse length selector signal PW. When there is no pulse length signal, IC6 will be "Off", the gate voltage of TR2 will be 0 volt, the pulse length is 0.08 μs and the bandwidth is wide, 10 MHz. When the pulse length signal is available (when the pulse length is other than 0.08 μs) IC6 will be turned "On" and the gate of TR6 will be -4 V and the bandwidth will be narrow, 3 MHz.

2) Detector Circuit

The detector circuit IC4 operates as a sensitive detector amplifier. The negative video signal appears across R15, the IF component is removed and the video signal is fed to the video circuit.

3) Video Circuit

The video circuit consists of emitter follower TR9. The emitter follower operates as an impedance transformer to drive the coaxial cable which feeds the video signal to the display unit. The video signal can be checked at TB101-VD.

4) Tuning Indication Circuit

The tuning indicator circuit consists of amplifier TR3, detector TR4, emitter follower TR5 which charges C44 to the detector voltage. This detector voltage is sent to the display unit as a tuning indication voltage by buffer amplifier IC8. The range of the tuning indication voltage is +4 V (detuned) and +0.7 V (tuned in long pulse).

5) Gain-STC Circuit

The receiver has a built-in Gain-STC circuit. The gain control voltage from the display unit is 12 volts for maximum sensitivity, and 0 volts for minimum sensitivity.

The STC control circuit consists of TR8 and TR10. This circuit uses only the negative portion of the transmitter trigger as the STC pulse. The positive portion is removed by CD7.

TR8 will be turned "On" with the receipt of the transmit trigger (STC pulse). TR8 will be turned "On" and C56 will charge. When the transmit trigger (STC pulse) ends, TR8 will be turned "Off". C56 will discharge to the 0 V through R61, and RV3. The discharge rate will be determined by the time constant of R61, RV3 and C56. The slope of the STC signal can be varied by the adjustment of RV3. The STC signal is combined with the Gain control voltage and applied to the IC1, IC2 and IC3.

6) Main Bang Suppression (MBS) Circuit
The main bang suppression circuit consists of TR7. This circuit uses only the negative portion of the transmitter trigger as the MBS pulse. The positive portion is removed by CD8. TR7 will be turned "On" with the receipt of the MBS pulse. TR7 will be turned "On" and C57 will charge. When the MBS pulse ends, TR7 will be turned "Off". C57 will discharge to the 0 V through R63. The discharge rate will be determined by the time constant of C57 and R63. The MBS signal is combined with the Gain control voltage and STC signal, and applied to the IC1, IC2 and IC3.

6.1.5 Power Supply Unit (PC101)

The power supply unit consists of the AVR circuit (IC1, TR1, TR2) and the converter circuit (IC2, TR5, TR6) with rectifier circuits.

1) AVR Circuit
The AVR circuit is used to perform step down switching and to produce a regulated 7 V dc output from the ship's mains.

2) Converter Circuit
TR5 and TR6 are the transistor switches controlled by IC2 which is the power oscillator and driver. The 22.25 kHz square at 8 V wave appears in the primary winding of T1. The secondary output of T1 is fed to the various rectifier circuits. The rectifier circuits produce the +330 V, +13.5 V, −13.5 V and +7 V for the scanner circuits. IC3 is the HV (+330 V) protection circuit, controlling K1 if excess current is sensed.

6.2 DISPLAY UNIT

The display unit consists of the Main Control PCB's, the Ajustment PCB, the Receive Buffer PCB, the Power Supply PCB, and the CRT and its Display Control PCB.

6.2.1. Main Control PCB

6.2.1.1 Video Input Circuit

The incoming video signal from the receiver in the scanner is first routed to the FTC circuit components consisting of CD1 and C2.

The Varicap diode CD1 is controlled by the voltage supplied from the front panel RAIN CLUTTER Control in the range of +24 V to 0 V dc.

Maximum FTC occurs when the voltage is 0 V dc.

6.2.1.2 A/D Converter

The A to D converter changes the filtered video signal from an analog signal into a 3 bit digital signal. The A/D converter consists of IC's 2-6. Since the conversion must occur at high speed, four comparator ICs are used. The threshold level is set by RV1 (Upper), located on the Receive Buffer PCB (CQA-116). The digitized video output is then sent for storage in the buffer memory.

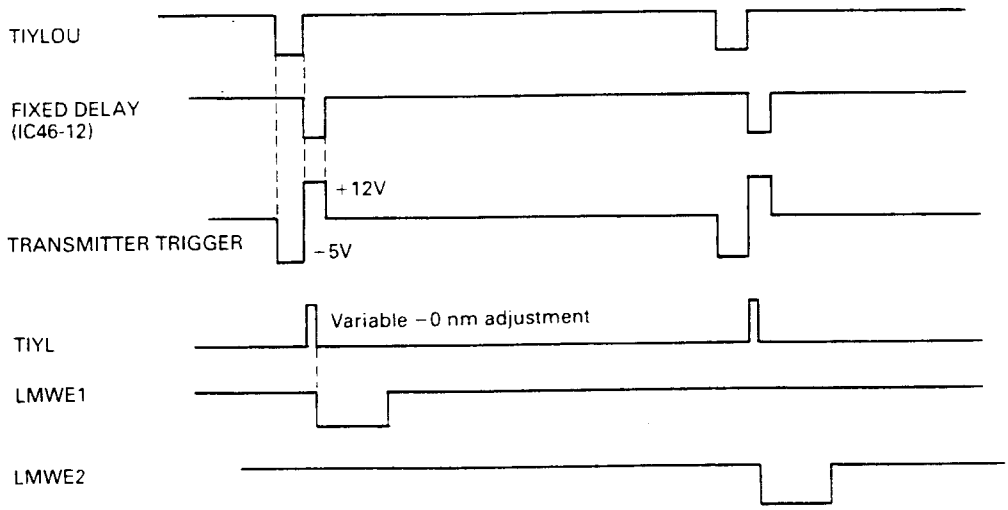
6.2.1.3 Sampling Clock Generator

The Sampling Clock generator consists of crystals CX2 and CX3, along with IC25 and IC29. The CX2 operates at 30 MHz and CX3 operates at 22.4 MHz. The 22.4 MHz is used to set the timing of the 0.125, 0.25, 0.5 and 32 nm range scales, and the 30 MHz is used the remaining range scales.

6.2.1.4 Buffer Memory

IC30 and IC31 are Buffer Memories, consisting of 2K bit×8 dual port input data and output data using random access. Each IC is written to alternately at each transmission and a read-out is made simultaneously.

The buffer memory timing and transmitter triggering are shown in the figure below.



6.2.1.5 Video Processor Circuit

The Video Processor consists of IC35–39, and performes two functions on the video signal.

a. Interference Rejection Processing

b. Expander Processing

The Interference Rejection processing is Performed by comparing the bit-by-bit content of the digital video stored from each successive radar transmission when the IR function is enabled by the operator. The IC35 and 37 performs the interference rejection of this radar.

Expander Processing is performed by extending one digital video cell to 8 digital video cells. IC35, IC37, IC38 and IC39 peform the expansion in this radar.

6.2.1.6 Video Memory

The start of the data readout of buffer memory is triggered on the trailing edge of the bearing pulse from the scanner unit. The bearing pulse is wave shaped by IC2 and IC29. This clock is used for data processing of IC28. The video data which has passed through IC28 is transfered to the video memory IC41. IC41 is a DRAM consisting of 256K bit×4. IC41 is used to produce a picture of 4 planes of which 3 will be used.

The address signals used to write into and readout of the video Memory are generated in IC28. The output data from the video memory is entered into IC22 the video signal mixer/Processor.

6.2.1.7 Graphic Control Memory

This radar use 8 bit CPU (IC7), and the Graphic Display Controller (IC8), IC7 (CPU)

and the IC8 (GDC) principally control the graphic system of the on screen display of the VRM, EBL, bearing scale, fixed range markers, and other peripheral parts. The CPU is provided with memory of 512K bit of ROM in IC6 and 64 K bit of RAM in IC5. The RAM memory has battery backup through IC1. The data of range, EBL, VRM, CRT brilliance, EXP, and IR will be maintained after shuttdown of power.

The CPU points the various character data, VRM, EBL, Range Marker, etc. through the GDC and performs processing of the data from the scan converter and from the keys on the control panel.

The content of the memory is read out by parallel-serial converter IC18 and sent to Video output circuit.

6.2.1.8 Video Output

The data which has been converted into raster scan data is read each raster. The 3 bit image signal is digital to analog converted by R8, R9 and IC22, and converted into video signals having 8 levels a outputted to the buffer amplifier TR2. The graphic data is input to TR2 via CD1 and IC22. When the image brilliance control signal is outputted from IC23 and applied to TR1, the CRT brilliance is varied in 8 steps. The video signal along with the HS and VS are sent to the monitor display.

6.2.1.9 Optional Inputs

This radar can be connected to the Loran C and Magnetic Flux Sensor.

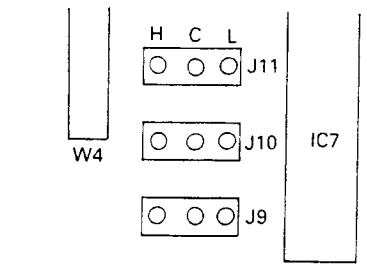
A) Loran C

The signal outputted from the Loran C of NMEA0180, 0182, 0183 or JRC standard, will display the LAT/LON or TD's at the bottom of the display screen. For Waypoint data to be displayed, the data must be NMEA0183 or JRC standard. The signal enters at J4, and passes through IC7–IC8–IC9 (in Receive Buffer PCB) to CPU.

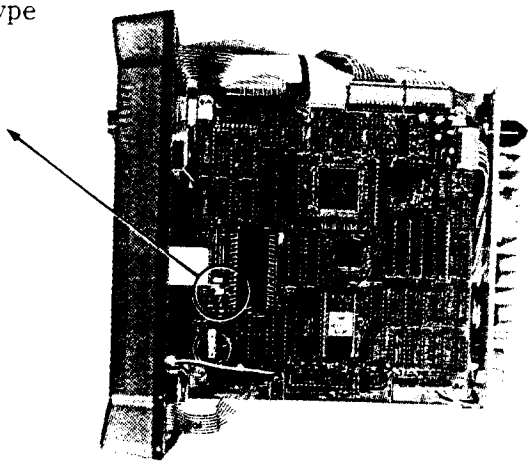
B) Magnetic Sensor

The output from the Magnetic Sensor is displayed at the top of the display screen. The data enters at J1, passes through IC7–IC8–IC9 (in Receive Buffer PCB) and is passed to CPU.

[Jumper settings for Main Control PCB]
J9, J10 and J11 determine radar type



	J9	J10	J11
R40X	L	L	H
R41X	L	H	H



6.2.2 Control PCB

The control PCB has 4 controls for the TUNE, GAIN, RAIN CLUTTER and SEA CLUTTER. There are 22 keys which perform various functions including turning the radar ON/OFF. The Control Panels are back-lighted in 8 control steps.

There are 6 variable resistors mounted on the adjustment PCB, which are necessary for proper alignment when the installation has been completed.

6.2.3 Power Supply PCB

The AVR converter circuit consists of a duty control AVR converter circuit (IC1–IC3 and TR3–TR4) and power ON/OFF control and X-MIT control circuit (IC2, IC5, IC6, TR5 and TR6).

IC1 controls the switching duty from the error signal of IC2 and drives the switching transistor TR3 and TR4. Consequently, the converter outputs regulated −5V, +5V and +12V dc. IC5 produces the power "ON" signal by depressing ST-BY/OFF switch on the Control Panel and the transmit signal by depressing X-MIT/OFF switch. When the ST-BY/OFF and X-MIT/OFF switches are depressed at the same time, IC5-2 is cleared and the power supply circuit turns off.

6.2.4 Display Monitor

The Display Monitor will operate with +12 V from the power supply, and the HS (Horizontal Sync.), VS (Vertical Sync.), and the video signals. The HS and VS signals are TTL (+) polarity, so the video image will be at maximum brilliance at +3.5 V and with a video signal of 20 MHz bandwidth.

The Display control board has the adjustments for H-Hold, Contrast, V-Hold, V-Gain, V-Size, Focus, Sub-Bright, and H-Size.

The CRT is used in a vertical position, so the horizontal adjustments will effect the vertical, and the vertical adjustments will effect the horizontal.

SECTION 7

PARTS LIST

7.1 ELECTRICAL PARTS LIST

7.2 MECHANICAL PARTS LOCATION LIST

7.1 ELECTRICAL PARTS LIST

R40X SCANNER UNIT TYPE M89950
MAIN CHASSIS TYPE CQC-507

REF.	TYPE	DESCRIPTION	JRC P/N	RAYTHEON P/N
A101	30211A25		5AJAF00010	
A102	NJS6930		5EZAA00024	
E301	NJT1946		5EZAA00021	
M101	H-7BDRD0023		7BDRD0023	
MT101	SR-1 FM4.9X4.9X6		5MPAB00001	
P1	60789-2		5JWAH00086	
P2	60789-2		5JWAH00086	
P3	60789-2		5JWAH00086	
P4	60789-2		5JWAH00086	
P5	60789-2		5JWAH00086	
P105	IL-G-4S-S3C2	4P	5JWAD00095	
PC101	H-7PCRD0938		7PCRD0938	
PT105	IL-G-C2-0001		5JWAD00214	
S101	S-116		5SAAB00809	
S102	NRS-109		5KRAA00036	
V201	MSF1421B		5VMAA00049	
W1	B4-6		1166140002	
ZC201	H-7ZCRD0324		7ZCRD0324	
ZC301	H-7ZCRD0325		7ZCRD0325	

POWER SUPPLY PCB (PC501) TYPE CBD-1028

REF.	TYPE	DESCRIPTION	JRC P/N	RAYTHEON P/N
C1	ECQ-V1H104JZ3		5CRAA00617	
C2	ECQ-V1H104JZ3		5CRAA00617	
C3	ECQ-V1H104JZ3		5CRAA00617	
C4	ECQ-V1H104JZ3		5CRAA00617	
C5	ECE-A1HU222		5CEAA01783	
C6	ECE-A1CU472		5CEAA01980	
C7	ECE-A1HU101B	50V 100U	5CEAA02306	
C8	ECE-A1CU100B	10UF 16V	5CEAA01826	
C9	ECQ-B1H103JZ3		5CRAA00587	
C10	ECQ-B1H222JZ3		5CRAA00805	
C11	ECQ-V1H104JZ3		5CRAA00617	
C15	ECE-A1CU222	2200UF 16V	5CEAA01757	
C16	ECE-A1CU222	2200UF 16V	5CEAA01757	
C17	ECE-A1CU222	2200UF 16V	5CEAA01757	
C18	ECE-A2WS2R2	450V 2.2UF	5CEAA02000	

REF.	TYPE	DESCRIPTION	JRC P/N	RAYTHEON P/N
C19	ECE-A2WS2R2	450V 2.2UF	5CEAA02000	
C20	ECE-A1EU100B		5CEAA01864	
C21	ECE-A1CN100SB	10UF 16V	5CEAA01920	
C22	ECE-A1EU330B		5CEAA01822	
C23	ECQ-V1H104JZ3		5CRAA00617	
C24	ECQ-B1H103JZ3		5CRAA00587	
C25	ECQ-V1H104JZ3		5CRAA00617	
C26	ECQ-V1H104JZ3		5CRAA00617	
CD1	U05JTYPE2	800V 2.5A	5TXAE00817	
CD2	5KF20		5TXAG00273	
CD3	HZ36-1RE		5TXAE00816	
CD4	HZ6C1RE		5TXAE00516	
CD5	HZ6C1RE		5TXAE00516	
CD6	11DF2FC		5TXAG00239	
CD7	11DF2FC		5TXAG00239	
CD8	11DF2FC		5TXAG00239	
CD9	11DF2FC		5TXAG00239	
CD10	11DF2FC		5TXAG00239	
CD11	11DF2FC		5TXAG00239	
CD12	V11N TYPE2		5TXAE00818	
CD13	V11N TYPE2		5TXAE00818	
CD14	V11N TYPE2		5TXAE00818	
CD15	1S1585-TPB2		5TXAP00008	
CD16	1S1585-TPB2		5TXAD00335	
CD17	SM-1XN02 LFK4		5TXAL00121	
CD18	SM-1XN02 LFK4		5TXAL00121	
CD19	SM-1XN02 LFK4		5TXAL00121	
CD20	1S1588-TPB2		5TXAD00335	
CD21	1S1588-TPB2		5TXAD00335	
CD22	1S1588-TPB2		5TXAD00335	
CD23	HZ3.6BP		5TXAE00503	
IC1	TL494CN		5DDAL00546	
IC2	TL494CN		5DDAL00546	
IC3	HA17555PS		5DAAG00028	
IC4	TC4528BP		5DDAE00070	
IC5	TLP521-1-Y		5TZAD00265	
J101	IL-G-9P-S3T2-E		5JWAD00383	
J102	IL-G-10P-S3T2-E		5JWAD00073	
J103	IL-G-12P-S3T2-E		5JWAD00082	
J104	B5P-SHF-1AA		5JWAP00135	

REF.	TYPE	DESCRIPTION	JRC P/N	RAYTHEON P/N
J105	IL-G-4P-S3T2-E	4P	5JWAD00091	
K1	LZ-12		5KLAC00055	
L1	SC-05-100		5LGAB00009	
L2	HP-054S		5LGAB00036	
PC501	H-7PCRD1113A		7PCRD1113A	
R1	ERG-12ANJ330U	33 OHM 1/2W	5REAG03136	
R2	ERG-2ANJP470S	2W 47 OHM	5REAG01258	
R3	ERD-25UJ222T	2.2K OHM 1/4W	5RDAA01548	
R4	ERD-25UJ102T	1K OHM 1/4	5RDAA01542	
R5	ERD-25UJ472T	4.7K OHM 1/4W	5RDAA01549	
R6	ERD-25UJ472T	4.7K OHM 1/4W	5RDAA01549	
R7	ERD-25UJ472T	4.7K OHM 1/4W	5RDAA01549	
R8	ERD-25UJ472T	4.7K OHM 1/4W	5RDAA01549	
R9	ERD-25UJ222T	2.2K OHM 1/4W	5RDAA01548	
R10	ERD-25UJ102T	1K OHM 1/4	5RDAA01542	
R11	ERD-25UJ103T	10K OHM 1/4W	5RDAA01547	
R12	ERD-25UJ104T	100K OHM 1/4W	5RDAA01623	
R13	ERD-25UJ103T	10K OHM 1/4W	5RDAA01547	
R15	ERG-12ANJ151U	150 OHM 1/2W	5REAG03138	
R16	ERG-12ANJ151U	150 OHM 1/2W	5REAG03138	
R17	ERG-2ANJP101S	2W 100 OHM	5REAG01297	
R18	ERG-2SJ333	33K OHM 2W	5REAG03560	
R19	ERG-2SJ333	33K OHM 2W	5REAG03560	
R20	ERD-25UJ104T	100K OHM 1/4W	5RDAA01623	
R21	ERD-25UJ152T		5RDAA01507	
R22	ERD-25UJ563T	56K OHM 1/4W	5RDAA01588	
R23	ERD-25UJ104T	100K OHM 1/4W	5RDAA01623	
R24	ERD-25UJ102T	1K OHM 1/4	5RDAA01542	
R25	ERD-25UJ471T	470 OHM 1/4W	5RDAA01541	
R26	ERD-25UJ103T	10K OHM 1/4W	5RDAA01547	
R27	ERD-25UJ102T	1K OHM 1/4	5RDAA01542	
R28	ERD-25UJ472T	4.7K OHM 1/4W	5RDAA01549	
R29	ERD-25UJ102T	1K OHM 1/4	5RDAA01542	
R30	ERD-25UJ103T	10K OHM 1/4W	5RDAA01547	
R31	ERG-1ANJ101U		5REAG02035	
R32	ERD-25UJ472T	4.7K OHM 1/4W	5RDAA01549	
R33	ERD-25UJ472T	4.7K OHM 1/4W	5RDAA01549	
R34	ERD-25UJ101T	1/4W 100 OHM	5RDAA01599	
RV1	GF06UT-2-1K OHM		5RMAB00117	
RV2	GF06UT-2-5K OHM		5RMAB00119	

REF.	TYPE	DESCRIPTION	JRC P/N	RAYTHEON P/N
T1	H-7LTRD0176		7LTRD0176	
TB101	TS-121P-5P		5JTAJ00198	
TP1	LC-2-G GRN		5JTCW00016	
TR1	2SA1261-K		5TAAB00097	
TR2	2SC3258-Y		5TCAF00722	
TR3	2SC1627Y TPE6		5TCAF00779	
TR4	2SC1815BLTPE2		5TCAF00780	
TR5	2SK736		5TKAA00224	
TR6	2SK736		5TKAA00224	
TR7	2SC1815BLTPE2		5TCAF00780	
TR11	2SC2983-Y		5TCAF00578	
TRS1	H-7ZSRD0013		7ZSRD0013	

R41X RADIATOR UNIT TYPE M89955

REF.	TYPE	DESCRIPTION	JRC P/N	RAYTHEON P/N
RC101	H-6ANRD00001A		6ANRD00001	

R41X MTR/PEDESTAL UNIT TYPE M89954
MAIN CHASSIS TYPE CQC-508

REF.	TYPE	DESCRIPTION	JRC P/N	RAYTHEON P/N
P102	IL-G-10S-S3C2		5JWAD00071	
P103	IL-G-12S-S3C2		5JWAD00343	
P107	VHR-4N		5JDAH00044	
P201	IL-G-10S-S3C2		5JWAD00071	
P301	IL-G-12S-S3C2		5JWAD00343	
PT102	IL-G-C2-0001		5JWAD00214	
PT103	IL-G-C2-0001		5JWAD00214	
PT107	BVH-21T-1.1		5JTCD00155	
PT201	IL-G-C2-0001		5JWAD00214	
PT301	IL-G-C2-0001		5JWAD00214	
S101	S-116		5SAAB00432	

MOTOR ASSEMBLY TYPE CBP-84

REF.	TYPE	DESCRIPTION	JRC P/N	RAYTHEON P/N
B101	H-7BDRD0026	7W	7BDRD0026	
CD1	EE-SX301		5HFAB00009	
P104	1-480698-0	2P	5JWAH00119	
P106	IL-3S-S3L-(N)		5JWAD00035	
PC1	H-6PCRD00633		6PCRD00633	

REF.	TYPE	DESCRIPTION	JRC P/N	RAYTHEON P/N
PT104	350550-1		5JWAH00111	
PT106	IL-C2-10000		2911101013	
R1	ERD-25PJ821	1/4W 820 OHM	5RDAA01156	

REF. BEARING GENERATOR TYPE CCJ-73

REF.	TYPE	DESCRIPTION	JRC P/N	RAYTHEON P/N
CD1	EE-SX301		5HFAB00009	
P103	IL-4S-S3L-(N)		5JWAD00032	
PC1	H-6PCRD00633		6PCRD00633	
PT103	IL-C2-10000		2911101013	
R1	ERD-25PJ821	1/4W 820 OHM	5RDAA01156	

MODULATOR CHASSIS TYPE CMN-263

REF.	TYPE	DESCRIPTION	JRC P/N	RAYTHEON P/N
A101	30211A25		5AJAF00010	
A102	NJS6930		5EZAA00024	
V101	MSF1421B		5VMAA00049	
W1	B4-6		1166140002	

RECEIVER CHASSIS TYPE CMA-434

REF.	TYPE	DESCRIPTION	JRC P/N	RAYTHEON P/N
E301	NJT1946		5EZAA00021	
P1	60789-2		5JWAH00086	
P2	60789-2		5JWAH00086	
P3	60789-2		5JWAH00086	
P4	60789-2		5JWAH00086	
P5	60789-2		5JWAH00086	

POWER SUPPLY PCB (PC501) TYPE CBD-1029

REF.	TYPE	DESCRIPTION	JRC P/N	RAYTHEON P/N
C1	ECQ-V1H104JZ3		5CRAA00617	
C2	ECQ-V1H104JZ3		5CRAA00617	
C3	ECQ-V1H104JZ3		5CRAA00617	
C4	ECQ-V1H104JZ3		5CRAA00617	
C5	ECE-A1HU222		5CEAA01783	
C6	ECE-A1CU472		5CEAA01980	
C7	ECE-A1HU101B	50V 100U	5CEAA02306	
C8	ECE-A1CU100B	10UF 16V	5CEAA01826	
C9	ECQ-B1H103JZ3		5CRAA00587	
C10	ECQ-B1H222JZ3		5CRAA00805	

REF.	TYPE	DESCRIPTION	JRC P/N	RAYTHEON P/N
C11	ECQ-V1H104JZ3		5CRAA00617	
C15	ECE-A1CU222	2200UF 16V	5CEAA01757	
C16	ECE-A1CU222	2200UF 16V	5CEAA01757	
C17	ECE-A1CU222	2200UF 16V	5CEAA01757	
C18	ECW-A2WS3R3	450V, 3.3UF	5CRAA02967	
C19	ECW-A2WS3R3	450V 3.3UF	5CRAA02967	
C20	ECE-A1EU100B		5CEAA01864	
C21	ECE-A1CN100SB	10UF 16V	5CEAA01920	
C22	ECE-A1EU330B		5CEAA01822	
C23	ECQ-V1H104JZ3		5CRAA00617	
C24	ECQ-B1H103JZ3		5CRAA00587	
C25	ECQ-V1H104JZ3		5CRAA00617	
C26	ECE-A1EU471B		5CEAA01865	
C27				
C28	ECQ-B1H103JZ3		5CRAA00587	
C29	ECEA1HU101B	50V 100U	5CEAA02306	
C30	ECQ-V1H104JZ3		5CRAA00617	
C32	ECQ-B1H103JZ3		5CRAA00587	
CD1	U05JTYPE2	800V 2.5A	5TXAE00817	
CD2	5KF20		5TXAG00273	
CD3	HZ36-1RE		5TXAE00816	
CD4	HZ6C1RE		5TXAE00516	
CD5	SM-1XN02 LFK4		5TXAL00121	
CD6	11DF2FC		5TXAG00239	
CD7	11DF2FC		5TXAG00239	
CD8	11DF2FC		5TXAG00239	
CD9	11DF2FC		5TXAG00239	
CD10	11DF2FC		5TXAG00239	
CD11	11DF2FC		5TXAG00239	
CD12	V11N TYPE2		5TXAE00683	
CD13	V11N TYPE2		5TXAE00683	
CD14	V11N TYPE2		5TXAE00683	
CD15	1S1585-TPB2		5TXAP00008	
CD16	1S1588-TPB2		5TXAD00008	
CD17	1S1588-TPB2		5TXAP00008	
CD18	HZ3B-2RE		5TXAE00566	
CD19				
CD20	1S1588-TPB2		5TXAD00335	
CD21	HZ7A1 RE	1/2W 6.5W	5TXAE00822	
CD22	5D2C11		5TXAD00305	

REF.	TYPE	DESCRIPTION	JRC P/N	RAYTHEON P/N
CD23	1S1588-TPB2		5TXAD00335	
CD24	1S1588-TPB2		5TXAD00335	
CD25	HZ6C1RE		5TXAE00516	
IC1	TL494CN		5DDAL00546	
IC2	TL494CN		5DDAL00546	
IC3	HA17555PS		5DAAG00028	
IC4	TC4528BP		5DDAE00070	
J101	IL-G-9P-S3T2-E		5JWAD00383	
J102	IL-G-10P-S3T2-E		5JWAD00073	
J103	IL-G-12P-S3T2-E		5JWAD00082	
J104	IL-4P-S3EN2		5JWAD00038	
J105	350428-1	2P	5JWAH00136	
J106	IL-3P-S3EN2		5JWAD00041	
J107	B4P-VH	4P	5JDAH00043	
K1	LZ-12		5KLAC00055	
L1	SC-05-100		5LGAB00009	
L2	HP-054S		5LGAB00036	
PC501	H-7PCRD1114C		7PCRD1114C	
R1	ERG-12ANJ330U	33 OHM 1/2W	5REAG03136	
R2	ERG-2ANJP470S	2W 47 OHM	5REAG01258	
R3	ERD-25UJ222T	2.2K OHM 1/4W	5RDAA01548	
R4	ERD-25UJ102T	1K OHM 1/4	5RDAA01542	
R5	ERD-25UJ472T	4.7K OHM 1/4W	5RDAA01549	
R6	ERD-25UJ472T	4.7K OHM 1/4W	5RDAA01549	
R7	ERD-25UJ472T	4.7K OHM 1/4W	5RDAA01549	
R8	ERD-25UJ472T	4.7K OHM 1/4W	5RDAA01549	
R9	ERD-25UJ222T	2.2K OHM 1/4W	5RDAA01548	
R10	ERD-25UJ102T	1K OHM 1/4	5RDAA01542	
R11	ERD-25UJ103T	10K OHM 1/4W	5RDAA01547	
R12	ERD-25UJ104T	100K OHM 1/4W	5RDAA01623	
R13	ERD-25UJ103T	10K OHM 1/4W	5RDAA01547	
R15	ERG-12ANJ151U	150 OHM 1/2W	5REAG03138	
R16	ERG-12ANJ151U	150 OHM 1/2W	5REAG03138	
R17	ERG-2ANJP101S	2W 100 OHM	5REAG01297	
R18	ERG-2ANJP333S	33K OHM 2W	5REAG02450	
R19	ERG-2ANJP333S	33K OHM 2W	5REAG02450	
R20	ERD-25UJ104T	100K OHM 1/4W	5RDAA01623	
R21	ERD-25UJ152T		5RDAA01507	
R22	ERD-25UJ563T	56K OHM 1/4W	5RDAA01588	
R23	ERD-25UJ104T	100K OHM 1/4W	5RDAA01623	

REF.	TYPE	DESCRIPTION	JRC P/N	RAYTHEON P/N
R24	ERD-25UJ102T	1K OHM 1/4W	5RDAA01542	
R25	ERD-25UJ471T	470 OHM 1/4W	5RDAA01541	
R26	ERD-25UJ152T		5RDAA01507	
R27	ERD-25UJ103T	10K OHM 1/4W	5RDAA01547	
R28	ERD-25UJ561T	1/4W 560 OHM	5RDAA01589	
R29	ERD-25UJ102T	1K OHM 1/4W	5RDAA01542	
R30	ERD-25UJ104T	100K OHM 1/4W	5RDAA01623	
R31	ERD-25UJ103T	10K OHM 1/4W	5RDAA01547	
R32	ERF-5ZXK4R7		5RHAC00164	
R33				
R34	ERD-25UJ471T	470 OHM 1/4W	5RDAA01541	
R35	ERG-2ANJP100S	2W 10 OHM	5REAG01299	
R36	ERD-25UJ102T	1K OHM 1/4	5RDAA01542	
R37	ERD-25UJ472T	4.7K OHM 1/4W	5RDAA01549	
R38	ERD-25UJ472T	4.7K OHM 1/4W	5RDAA01549	
R39	ERG-2ANJP222S	2.2K 2W	5REAG01257	
R40	ERD-25UJ471T	470 OHM 1/4	5RDAA01541	
R41	ERD-25UJ152T	1.5K OHM 1/4	5RDAA01507	
R42	ERD-25UJ471T	470 OHM 1/4	5RDAA01541	
R43	ERD-25UJ103T	10K OHM 1/4W	5RDAA01547	
R44				
R45				
R46	ERD-25UJ103T	10K OHM 1/4W	5RDAA01547	
R47	ERD-25UJ472T	4.7K OHM 1/4W	5RDAA01549	
R48	ERD-25UJ472T	4.7K OHM 1/4W	5RDAA01549	
R49	ERD-25UJ472T	4.7K OHM 1/4W	5RDAA01549	
R50	ERD-25UJ102T	1K OHM 1/4	5RDAA01542	
R51	ERD-25UJ102T	1K OHM 1/4	5RDAA01542	
R52	ERD-25UJ391T	390 OHM 1/4W	5RDAA01625	
R54	ERD-25UJ331T	330 OHM 1/4	5RDAA01480	
RV1	GF06UT-2-1K OHM		5RMAB00117	
RV2	GF06UT-2-5K OHM		5RMAB00119	
RV3	GF06UT-2-500 OHM	1/2W 500 OHM	5RMAB00132	
T1	H-7LTRD0176		7LTRD0176	
TB101	TS-121P-6P		5JTAJ00199	
TP1	LC-2-G GRN		5JTCW00016	
TR1	2SA1261-K		5TAAB00097	
TR2	2SC3258-Y		5TCAF00722	
TR3	2SC1627Y TPE6		5TCAF00779	
TR5	2SK736		5TKAD00116	

REF.	TYPE	DESCRIPTION	JRC P/N	RAYTHEON P/N
TR6	2SK736		5TKAD00116	
TR7	2SC1815BLTPE2		5TCAF00780	
TR8	2SA1145-Y		5TAAG00211	
TR9	2SA1145-Y		5TAAG00211	
TR10	2SC1815BLTPE2		5TCAF00780	
TR11	2SC1212A-B		5TCAA00137	
TR12	2SD1415		5TDAE00144	
TR13	2SK736		5TKAD00116	
TR14	2SB674		5TBAE00094	
TR15	2SA1015Y-TPE2		5TAAG00294	
TR16	2SC1815BLTPE2		5TCAF00780	
TRS1	H-7ZSRD0014		7ZSRD0014	

R40X/R41X SCANNER UNIT TYPE M89950/M89954
MODULATOR PCB (PC201) TYPE CNM-141

REF.	TYPE	DESCRIPTION	JRC P/N	RAYTHEON P/N
C1	DD12B472K500	500V 4700PF	5CBAB01718	
C2	CK45B3AD102KYAR	1KV 1000PF	5CBAD00949	
C3	ECE-A1CU470E		5CEAA02844	
C4	ECQ-V1H104JZ	50V 0.1UF	5CRAA00364	
C5	ECQ-V1H104JZ	50V 0.1UF	5CRAA00364	
C8	ECQ-V1H104JZ	50V 0.1UF	5CRAA00364	
C9	ECQ-V1H104JZ	50V 0.1UF	5CRAA00364	
C10	ECW-H10H153JR		5CRAA00847	
C11	ECW-H10H123JR		5CRAA00460	
C12	ECW-H10H123JR		5CRAA00460	
C13	ECW-H10H153JR		5CRAA00847	
C14	DD12B472K500	500V 4700PF	5CBAB01718	
CD1	1S1832LC5		5TXAD00644	
CD2	S6080B		5TZAD00201	
CD3	U05JTYPE2	800V 2.5A	5TXAE00817	
CD4	1AZ330-XLC5		5TXAD00645	
CD5	1S1832LC5		5TXAD00644	
CD7	HZ9A2S7		5TXAE00819	
CD8	SM-1XN02 LFK4		5TXAL00121	
CD9	SM-1XNO2 LFK4		5TXAL00121	
CD10	U05JTYPE2	800V 2.5A	5TXAE00817	
CD11	U05JTYPE2	800V 2.5A	5TXAE00817	
CD12	1S1588LB-10		5TXAD00248	
CD13	HVR-1X-40A		5TXAN00160	
CD14	SM-1XN02 LFK4		5TXAL00121	

REF.	TYPE	DESCRIPTION	JRC P/N	RAYTHEON P/N
CD15	SM-1XN02 LFK4		5TXAL00121	
CDS2	HS-UC-45-24-AN-0		5ZKAF00017	
J201	IL-G-10P-S3L2-E	10P	5JWAD00068	
K1	LZ-12		5KLAC00055	
K2	LZ-12		5KLAC00055	
L1	H-6LZRD00045		6LZRD00045	
L2	H-7LCRD0035		7LCRD0035	
L3	H-6LCRD00008		6LCRD00008	
L4	H-6LCRD00017		6LCRD00017	
PC201	H-7PCRD1112A		7PCRD1112A	
R1	ERG-1ANJP102S		5REAG02458	
R2	ERD-25UJ100	1/4W 10 OHM	5RDAA01297	
R3	ERD-25UJ222	1/4W 2.2K OHM	5RDAA01353	
R4	ERD-25UJ471	1/4W 470 OHM	5RDAA01337	
R5	ERD-25UJ100	1/4W 10 OHM	5RDAA01297	
R6	ERG-1ANJP470S	1W 47 OHM	5REAG01254	
R7	ERD-25UJ472	1/4W 4.7K OHM	5RDAA01361	
R8	ERD-25UJ472	1/4W 4.7K OHM	5RDAA01361	
R9	ERD-25UJ222	1/4W 2.2K OHM	5RDAA01353	
R10	ERD-25UJ222	1/4W 2.2K OHM	5RDAA01353	
R12	ERX-2ANJP4R7S		5REAG01357	
R13	ERG-3ANJP470S	3W 47 OHM	5REAG03144	
T1	H-6LPRD00041A		6LPRD00041	
TR1	2SC2983-Y		5TCAF00578	
TR2	2SC1815BL NO.2-5F106		5TCAF00783	
TR3	2SC1815BL NO.2-5F106		5TCAF00783	

RECEIVER PCB (PC301) TYPE CAE-269

REF.	TYPE	DESCRIPTION	JRC P/N	RAYTHEON P/N
C1	C3216CH1H100D-E-TP	10PF	5CAAD00785	
C2	C3216SL1H222J-E-TP	2200PF	5CAAD00792	
C3	C3216SL1H222J-E-TP	2200PF	5CAAD00792	
C4	C3216SL1H222J-E-TP	2200PF	5CAAD00792	
C5	C3216CH1H070D-E-TP	7PF	5CAAD00977	
C6	C3216CH1H220J-E-TP	22PF	5CAAD00869	
C7	C3216CH1H100D-E-TP	10PF	5CAAD00785	
C8	C3216SL1H222J-E-TP	2200PF	5CAAD00792	
C9	C3216SL1H222J-E-TP	2200PF	5CAAD00792	
C10	C3216CH1H070D-E-TP	7PF	5CAAD00977	

REF.	TYPE	DESCRIPTION	JRC P/N	RAYTHEON P/N
C11	C3216CH1H220J-E-TP	22PF	5CAAD00869	
C12	C3216CH1H100D-E-TP	10PF	5CAAD00785	
C13	C3216SL1H222J-E-TP	2200PF	5CAAD00792	
C14	C3216SL1H222J-E-TP	2200PF	5CAAD00792	
C15	C3216CH1H220J-E-TP	22PF	5CAAD00869	
C16	C3216CH1H270J-E-TP	27PF	5CAAD00793	
C17	C3216CH1H101J-E-TP	50V 100PF	5CAAD00780	
C18	C3216CH1H101J-E-TP	50V 100PF	5CAAD00780	
C19	C3216SL1H222J-E-TP	2200PF	5CAAD00792	
C20	C3216CH1H270J-E-TP	27PF	5CAAD00793	
C21	C3216SL1H222J-E-TP	2200PF	5CAAD00792	
C22	C3216CH1H101J-E-TP	50V 100PF	5CAAD00780	
C23	C3216CH1H050C-E-TP	50V 5PF	5CAAD00800	
C24	C3216CH1H070J-E-TP	7PF	5CAAD00977	
C25				
C26	ECE-A1CKS470B	47UF	5CEAA01707	
C27	C3216CH1H100D-E-TP	10PF	5CAAD00785	
C28	C3216CH1H100D-E-TP	10PF	5CAAD00785	
C29	C3216CH1H330J-E-TP	33PF	5CAAD00794	
C30	C3216CH1H050C-E-TP	50V 5PF	5CAAD00800	
C31	C3216SL1H222J-E-TP	2200PF	5CAAD00792	
C32	ECE-A1EKS100B	10UF 25V	5CEAA01750	
C33	C3216CH1H050C-E-TP	50V 5PF	5CAAD00800	
C34	C3216SL1H222J-E-TP	2200PF	5CAAD00792	
C35	C3216CH1H070D-E-TP	7PF	5CAAD00977	
C36	C3216CH1H100D-E-TP	10PF	5CAAD00785	
C37	C3216SL1H222J-E-TP	2200PF	5CAAD00792	
C38	ECE-A1EKS100B	10UF 25V	5CEAA01750	
C39	C3216SL1H222J-E-TP	2200PF	5CAAD00792	
C40	ECE-A1EKS100B	10UF 25V	5CEAA01750	
C41	C3216CH1H050C-E-TP	50V 5PF	5CAAD00800	
C42	ECE-A1EKN4R7B	4.7UF 25V	5CEAA01959	
C43	C3216SL1H222J-E-TP	2200PF	5CAAD00792	
C44	ECQ-B1H332JZ3	3300PF 50V	5CRAA00586	
C45	C3216SL1H222J-E-TP	2200PF	5CAAD00792	
C46	ECQ-V1H104JZ3		5CRAA00617	
C47	ECE-A1EKS100B	10UF 25V	5CEAA01750	
C48	ECQ-V1H104JZ3		5CRAA00617	
C49	C3216CH1H221J-E-TP	220PF	5CAAD00790	
C50	ECE-A1CKS470B	47UF	5CEAA01707	

REF.	TYPE	DESCRIPTION	JRC P/N	RAYTHEON P/N
C51	C3216JF1H104Z-E-TP	50V 0.1UF	5CAAD01268	
C52	ECE-A1CKS470B	47UF	5CEAA01707	
C53	ECE-A1CKS470B	47UF	5CEAA01707	
C54	ECE-A1EKN4R7B	4.7UF 25V	5CEAA01959	
C55	ECE-A1EKN4R7B	4.7UF 25V	5CEAA01959	
C56	C3216JB1H103K-E-TP	50V 0.01UF	5CAAD00789	
C57	C3216CH1H150J-E-TP	15PF	5CAAD00787	
C58	C3216SL1H222J-E-TP	2200PF	5CAAD00792	
C59	ECE-A1EKS100B	10UF 25V	5CEAA01750	
C60	C3216SL1H222J-E-TP	2200PF	5CAAD00792	
C61	ECE-A1EKS100B	10UF 25V	5CEAA01750	
C62	C3216SL1H222J-E-TP	2200PF	5CAAD00792	
C63	ECE-A1EKS100B	10UF 25V	5CEAA01750	
C64	C3216SL1H222J-E-TP	2200PF	5CAAD00792	
C65	ECE-A1EKS100B	10UF 25V	5CEAA01750	
C66	C3216SL1H222J-E-TP	2200PF	5CAAD00792	
C67	ECE-A1EKS100B	10UF 25V	5CEAA01750	
C68	C3216SL1H222J-E-TP	2200PF	5CAAD00792	
C69	ECE-A1EKS100B	10UF 25V	5CEAA01750	
C70	ECQ-V1H104JZ3		5CRAA00617	
C71	202L2502 225K5471	25V 2.2UF	5CSAC00826	
C72	ECE-A1EKS100B	10UF 25V	5CEAA01750	
C73	C3216SL1H222J-E-TP	2200PF	5CAAD00792	
C74	C3216CH1H220J-E-TP	22PF	5CAAD00869	
C75	C3216SL1H222J-E-TP	2200PF	5CAAD00792	
C76	ECE-A1EKS100B	10UF 25V	5CEAA01750	
C77	C3216SL1H222J-E-TP	2200PF	5CAAD00792	
C78	ECE-A1EKS100B	10UF 25V	5CEAA01750	
C79	C3216JB1H103K--TP	50V 0.01UF	5CAAD00789	
C80	C3216JB1H103K--TP	50V 0.01UF	5CAAD00789	
CD1	HZ3B2	3V	5TXAE00107	
CD2	1SS226 TE85L		5TXAD00320	
CD3	1SS226 TE85L		5TXAD00320	
CD4	1SS226 TE85L		5TXAD00320	
CD5	TLR123		5TZAD00101	
CD6	TLR123		5TZAD00101	
CD7	1SS226 TE85L		5TXAD00320	
CD8	1SS226 TE85L		5TXAD00320	
CD9	1SS184 TE85R		5TXAD00291	
CD10	1SS184 TE85R		5TXAD00291	

REF.	TYPE	DESCRIPTION	JRC P/N	RAYTHEON P/N
IC1	MC1350P		5DDAS00011	
IC2	MC1350P		5DDAS00011	
IC3	MC1350P		5DDAS00011	
IC4	AN5132		5DAAR00105	
IC5	TA78DL12P		5DAAD00636	
IC6	NJM4558D		5DAAF00027	
IC7	NJM4558D		5DAAF00027	
IC8	TL082CP		5DDAL00326	
IC9	NJM78M05FA		5DAAN00375	
J1	171255-1		BRTE00046	
J2	171255-1		BRTE00046	
J3	171255-1		BRTE00046	
J4	171255-1		BRTE00046	
J5	171255-1		BRTE00046	
J6	171255-1		BRTE00046	
J7	171255-1		BRTE00046	
J8	171255-1		BRTE00046	
J301	IL-G-12P-S3T2-E		5JWAD00082	
L1	H-7LARD0103A		7LARD0103A	
L2	H-7LARD0101A		7LARD0101A	
L3	H-7LARD0101A		7LARD0101A	
L4	H-7LARD0102A		7LARD0102A	
L5	H-7LARD0102A		7LARD0102A	
L6	H-7LARD0102A		7LARD0102A	
L7	H-7LARD0101A		7LARD0101A	
L8	H-7LARD0083		7LARD0083	
L9	H-7LARD0084		7LARD0084	
PC301	H-7PCRD1123E		7PCRD1123E	
R1	ERJ-8GEYJ223V	1/8W 22K OHM	5REAG01754	
R2	ERJ-8GEYJ151V	1/8W 150 OHM	5REAG01728	
R3	ERJ-8GEYJ223V	1/8W 22K OHM	5REAG01754	
R4	ERJ-8GEYJ151V	1/8W 150 OHM	5REAG01728	
R5	ERJ-8GEYJ223V	1/8W 22K OHM	5REAG01754	
R6	ERJ-8GEYJ151V	1/8W 150 OHM	5REAG01728	
R7	ERJ-8GEYJ332V	1/8W 3.3K OHM	5REAG01744	
R8	ERJ-8GEYJ681V	1/8W 680 OHM	5REAG01736	
R9	ERJ-8GEYJ222V	1/8W 2.2K OHM	5REAG01742	
R10	ERJ-8GEYJ681V	1/8W 680 OHM	5REAG01736	
R11	ERJ-8GEYJ473V	1/8W 47K OHM	5REAG01758	
R12	ERJ-8GEYJ681V	1/8W 680 OHM	5REAG01736	

REF.	TYPE	DESCRIPTION	JRC P/N	RAYTHEON P/N
R13	ERJ-8GEYJ222V	1/8W 2.2K OHM	5REAG01742	
R14	ERJ-8GEYJ331V	1/8W 330 OHM	5REAG01732	
R15				
R16	ERJ-8GEYJ102V	1/8W 1K OHM	5REAG01738	
R17	ERJ-8GEYJ471V	1/8W 470 OHM	5REAG01734	
R18	ERJ-8GEYJ103V	1/8W 10K OHM	5REAG01750	
R19	ERJ-8GEYJ103V	1/8W 10K OHM	5REAG01750	
R20	ERJ-8GEYJ472V	1/8W 4.7K OHM	5REAG01746	
R21	ERJ-8GEYJ220V	1/8W 22 OHM	5REAG01718	
R22	ERJ-8GEYJ220V	1/8W 22 OHM	5REAG01718	
R23	ERJ-8GEYJ220V	1/8W 22 OHM	5REAG01718	
R24	ERJ-8GEYJ220V	1/8W 22 OHM	5REAG01718	
R25	ERJ-8GEYJ100V	1/8W 10 OHM	5REAG01714	
R26	ERJ-8GEYJ221V	1/8W 220 OHM	5REAG01730	
R27	ERJ-8GEYJ683V	1/8W 68K OHM	5REAG01760	
R28	ERJ-8GEYJ331V	1/8W 330 OHM	5REAG01732	
R29	ERJ-8GEYJ331V	1/8W 330 OHM	5REAG01732	
R30	ERJ-8GEYJ332V	1/8W 3.3K OHM	5REAG01744	
R31	ERJ-8GEYJ473V	1/8W 47K OHM	5REAG01758	
R32	ERJ-8GEYJ472V	1/8W 4.7K OHM	5REAG01746	
R33	ERJ-8GEYJ103V	1/8W 10K OHM	5REAG01750	
R34	ERJ-8GEYJ470V	1/8W 47 OHM	5REAG01722	
R35	ERJ-8GEYJ222V	1/8W 2.2K OHM	5REAG01742	
R36	ERJ-8GEYJ470V	1/8W 47 OHM	5REAG01722	
R37	HMGL1/4A-10M OHM J		5REAA05607	
R38	ERJ-8GEYJ103V	1/8W 10K OHM	5REAG01750	
R39	ERJ-8GEYJ471V	1/8W 470 OHM	5REAG01734	
R40	ERJ-8GEYJ222V	1/8W 2.2K OHM	5REAG01742	
R41	ERG-18J470	47 OHM 1W	5REAG01286	
R42	ERJ-8GEYJ102V	1/8W 1K OHM	5REAG01738	
R43	ERJ-8GEYJ102V	1/8W 1K OHM	5REAG01738	
R44	ERJ-8GEYJ102V	1/8W 1K OHM	5REAG01738	
R45	ERJ-8GEYJ104V	1/8W 100K OHM	5REAG01762	
R46	ERJ-8GEYJ331V	1/8W 330 OHM	5REAG01732	
R47	ERJ-8GEYJ331V	1/8W 330 OHM	5REAG01732	
R48	ERJ-8GEYJ220V	1/8W 22 OHM	5REAG01718	
R49	ERJ-8GEYJ102V	1/8W 1K OHM	5REAG01738	
R50	ERJ-8GEYJ470V	1/8W 47 OHM	5REAG01722	
R51	ERJ-8GEYJ561V	1/8W 560 OHM	5REAG01735	
R52	ERJ-8GEYJ681V	1/8W 680 OHM	5REAG01736	

REF.	TYPE	DESCRIPTION	JRC P/N	RAYTHEON P/N
R53	ERJ-8GEYJ221V	1/8W 220 OHM	5REAG01730	
R54	ERJ-8GEYJ471V	1/8W 470 OHM	5REAG01734	
R55	ERJ-8GEYJ103V	1/8W 10K OHM	5REAG01750	
R56	ERJ-8GEYJ102V	1/8W 1K OHM	5REAG01738	
R58	ERJ-8GEYJ332V	1/8W 3.3K OHM	5REAG01744	
R59	ERJ-8GEYJ471V	1/8W 470 OHM	5REAG01734	
R60	ERJ-8GEYJ470V	1/8W 47 OHM	5REAG01722	
R61	ERJ-8GEYJ103V	1/8W 10K OHM	5REAG01750	
R62	ERJ-8GEYJ470V	1/8W 47 OHM	5REAG01722	
R63	ERJ-8GEYJ562V	1/8W 5.6K OHM	5REAG01747	
R64	ERJ-8GEYJ393V	1/8W 39K OHM	5REAG01757	
R65	ERJ-8GEYJ223V	1/8W 22K OHM	5REAG01754	
R66	ERJ-8GEYJ223V	1/8W 22K OHM	5REAG01754	
R67	ERJ-8GEYJ473V	1/8W 47K OHM	5REAG01758	
R68	ERJ-8GEYJ100V	1/8W 10 OHM	5REAG01714	
R69	ERJ-8GEYJ473V	1/8W 47K OHM	5REAG01758	
R70	ERJ-8GEYJ103V	1/8W 10K OHM	5REAG01750	
R71	ERJ-8GEYJ102V	1/8W 1K OHM	5REAG01738	
R72	ERJ-8GEYJ153V	1/8W 15K OHM	5REAG01752	
R73	ERJ-8GEYJ103V	1/8W 10K OHM	5REAG01750	
R74	ERJ-8GEYJ103V	1/8W 10K OHM	5REAG01750	
R75	ERJ-8GEYJ220V	1/8W 22 OHM	5REAG01718	
R76	ERJ-8GEYJ332V	1/8W 3.3K OHM	5REAG01744	
R77	ERJ-8GEYJ222V	1/8W 2.2K OHM	5REAG01742	
R78	ERJ-8GEYJ391V	1/8W 390 OHM	5REAG01733	
R79	ERJ-8GEYJ472V	1/8W 4.7K OHM	5REAG01746	
R80	ERJ-8GEYJ102V	1/8W 1K OHM	5REAG01738	
R81	ERJ-8GEYJ102V	1/8W 1K OHM	5REAG01738	
R82	ERJ-8GEYJ332V	1/8W 3.3K OHM	5REAG01744	
R83	ERJ-8GEYJ332V	1/8W 3.3K OHM	5REAG01744	
RV1	GF06UT-2-100 OHM		5RMAB00149	
RV2	GF06UT-2-10K OHM	1/2W 10K OHM	5RMAB00128	
RV3	GF06UT-2-10K OHM	1/2W 10K OHM	5RMAB00128	
RV4	GF06UT-2-10K OHM	1/2W 10K OHM	5RMAB00128	
RV5	GF06UT-2-10K OHM	1/2W 10K OHM	5RMAB00128	
RV6	GF06UT-2-10K OHM	1/2W 10K OHM	5RMAB00128	
RV7	GF06UT-2-5K OHM	1/2W 5K OHM	5RMAB00119	
TR1	2SK302-GRTE85L		5TKAA00225	
TR2	2SK302-GRTE85L		5TKAA00225	
TR3	2SC3098-TE85R		5TKAA00226	

REF.	TYPE	DESCRIPTION	JRC P/N	RAYTHEON P/N
TR4	2SK302-GRTE85L		5TKAA00225	
TR5	2SA495GTM-Y(TPE2)		5TAAG00325	
TR6	2SC1815Y TPE2		5TCAF00781	
TR7	2SA1015Y-TPE2		5TAAG00294	
TR8	2SA1015Y-TPE2		5TAAG00294	
TR9	2SA495GTM-Y(TPE2)		5TAAG00325	
TR10	2SC1815Y TPE2		5TCAF00781	
TR11	2SA495GTM-Y(TPE2)		5TAAG00325	

R40X/R41X DISPLAY UNIT TYPE M89957/M89959
MAIN CHASSIS TYPE CML-314

REF.	TYPE	DESCRIPTION	JRC P/N	RAYTHEON P/N
C401	ECE-A1HS101	50V100UF	5CEAA01368	
C402	ECE-A1HS101	50V100UF	5CEAA01368	
F401	MF51NN6.3A		5ZFAD00336	
F402	MF51NN-5A	250V	5ZFAD00045	
FS401	FH043		5ZFAN00003	
FS402	FH043		5ZFAN00003	
J401	SRCN2A13-3P		5JCAC00399	
J402	SRCN2A25-16P		5JCAC00307	
J403	BNC-RM-3510-E	BNC	5ZJUF00004	
J404	BNC-RM-3510-E	BNC	5ZJUF00004	
J405	SG-8022#01		5JJAL00064	
S401	MPSW00963A	R-SIDE	MPSW00963	
S402	MPSW00962A	L-SIDE	MPSW00962	
W401	H-7ZCRD0306A		7ZCRD0306A	
W402	H-7ZCRD0307A		7ZCRD0307A	

MAIN CONTROL PCB (PC1) TYPE CMC-663

REF.	TYPE	DESCRIPTION	JRC P/N	RAYTHEON P/N
BT1	CR2032-THB		5ZBBJ00001	
C1	ECQ-V1H104JZ	50V 0.1UF	5CRAA00364	
C2	FK26Y5V1H104Z	50V 0.1UF	5CAAD01175	
C4	DD105CH330J50	50V 33PF	5CAAA00852	
C5	DD105CH330J50	50V 33PF	5CAAA00852	
C6	ECQ-B1H472KZ3	0.0047UF	5CRAA01004	
C7	DD105SL101J50	50V 100PF	5CAAA01101	
C8	ECQ-V1H104JZ	50V 0.1UF	5CRAA00364	
C9	DD104CH050C50	50V 5PF	5CAAA00844	
C10	DD104CH050C50	50V 5PF	5CAAA00844	

REF.	TYPE	DESCRIPTION	JRC P/N	RAYTHEON P/N
C11	DD104CH150J50	50V 15PF	5CAAA00848	
C12	DD104CH150J50	50V 15PF	5CAAA00848	
C13	FK26Y5V1H104Z	50V 0.1UF	5CAAD01175	
C14	EXF-P8471ZW	470PX8	5CXAD00005	
C15	FK26Y5V1H104Z	50V 0.1UF	5CAAD01175	
C16	FK26Y5V1H104Z	50V 0.1UF	5CAAD01175	
C17	FK26Y5V1H104Z	50V 0.1UF	5CAAD01175	
C18	FK26Y5V1H104Z	50V 0.1UF	5CAAD01175	
C19	FK26Y5V1H104Z	50V 0.1UF	5CAAD01175	
C20	FK26Y5V1H104Z	50V 0.1UF	5CAAD01175	
C21	FK26Y5V1H104Z	50V 0.1UF	5CAAD01175	
C22	FK26Y5V1H104Z	50V 0.1UF	5CAAD01175	
C23	FK26Y5V1H104Z	50V 0.1UF	5CAAD01175	
C24	FK26Y5V1H104Z	50V 0.1UF	5CAAD01175	
C25	FK26Y5V1H104Z	50V 0.1UF	5CAAD01175	
C26	FK26Y5V1H104Z	50V 0.1UF	5CAAD01175	
C27	FK26Y5V1H104Z	50V 0.1UF	5CAAD01175	
C28	FK26Y5V1H104Z	50V 0.1UF	5CAAD01175	
C29	FK26Y5V1H104Z	50V 0.1UF	5CAAD01175	
C30	ECE-A1EU101	25V 100UF	5CEAA01839	
C31	ECE-A1EU101	25V 100UF	5CEAA01839	
C32	ECE-A1CU470	16V 47UF	5CEAA01698	
C33	ECE-A1CU470	16V 47UF	5CEAA01698	
C40	FK26Y5V1H104Z	50V 0.1UF	5CAAD01175	
C41	ECQ-B1H102KZ3	50V 1000PF	5CRAA00811	
C42	DD104B102K50	50V 1000PF	5CBAB00302	
C43	RPE131CH331K50		5CAAA02838	
C44	DD109SL471J50	50V 470PF	5CAAA01108	
C45	ECQ-V1H104JZ	50V 0.1UF	5CRAA00364	
C46	ECQ-B1H223KZ3	50V 0.022UF	5CRAA00816	
C47	ECE-A1EU330	25V 33UF	5CEAA01805	
C48	ECE-A1EU330	25V 33UF	5CEAA01805	
C49	ECE-A1EN100S	25V 10UF	5CEAA01249	
C50				
C51	FK26Y5V1H104Z	50V 0.1UF	5CAAD01175	
C52	DD104SL330J50	50V 33PF	5CAAA01095	
C53	DD110SL681J50	50V 680PF	5CAAA01110	
C54	DD107CH680J50	50V 68PF	5CAAA00856	
C55	DD104CH100D50	50V 10PF	5CAAA00846	
C56	DD107-979SL331J50	50V 330PF	5CAAA02917	

REF.	TYPE	DESCRIPTION	JRC P/N	RAYTHEON P/N
C57	FK26Y5V1H104Z-006	50V 0.1UF	5CAAD01318	
C58	DD106-989SL151J50	50V 150UF	5CBAB02809	
C61	FK26Y5V1H104Z	50V 0.1UF	5CAAD01175	
C70	FK26Y5V1H104Z	50V 0.1UF	5CAAD01175	
C72	FK26Y5V1H104Z	50V 0.1UF	5CAAD01175	
CD1	1S1588		5TXAD00040	
CD2	1S1588		5TXAD00040	
CD3	1S1588		5TXAD00040	
CD5	1S1588		5TXAD00040	
CD6	HZ9C1	1/2W 9V	5TXAE00303	
CD7	1S1588-TPB2		5TXAD00335	
CD8	1S1588-TPB2		5TXAD00335	
CD9	1S1588-TPB2		5TXAD00335	
CD10	1S1588-TPB2		5TXAD00335	
CD11	1S1588-TPB2		5TXAD00335	
CX1	CSA11.0MT020		5UNAB00042	
CX2	CSA30.00MX040		5UNAB00074	
CX3	CSA22.57MX040		5UNAB00085	
IC1	PST532A		5DZCY00011	
IC2	TC74HC11AP		5DDAE01335	
IC3	TC74HC573AP		5DDAE01345	
IC4	TC74HC139AP		5DDAE01242	
IC5	HM6264ALP-15		5DAAG00380	
IC6	H-7DERD0106E AM27C51 2-155DC		7DERD0106E	
IC6-1	MPNN23657E		MPNN23657E	
IC7	UPD78C10G-36		5DDAC00574	
IC8	UPD72020GC-8-3B6		5DDAC00829	
IC9	TC74HC573AP		5DDAE01345	
IC10	TC74HC573AP		5DDAE01345	
IC11	HM53461ZP-12		5DAAG00400	
IC12	HM53461ZP-12		5DAAG00400	
IC13	HM53461ZP-12		5DAAG00400	
IC14	HM53461ZP-12		5DAAG00400	
IC15	HM53461ZP-12		5DAAG00400	
IC16	TC74HC157AP		5DDAE01337	
IC17	TC74HC32AP		5DDAE01196	
IC18	TC74HC195AP		5DDAE01506	
IC19	TC74HC195AP		5DDAE01506	
IC20	TC74HC195AP		5DDAE01506	
IC21	TC74HC74AP		5DDAE00731	

REF.	TYPE	DESCRIPTION	JRC P/N	RAYTHEON P/N
IC22	TC74HC08AP		5DDAE01240	
IC23	UPD6326C	D/A	5DDAC00496	
IC24	TC74HC32AP		5DDAE01196	
IC25	TC74HCU04AP		5DDAE01270	
IC26	TC74HC221AP		5DDAE01399	
IC27	TC74HC32AP		5DDAE01196	
IC28	H-7DGRD0006		7DGRD0006	
IC29	TC74HCU04AP		5DDAE01270	
IC30	HM63021P-28		5DAAG00394	
IC31	HM63021P-28		5DAAG00394	
IC32	TC74HC85AP		5DDAE01330	
IC33	TC74HC157AP		5DDAE01337	
IC34	TC74HC157AP		5DDAE01337	
IC35	H-7DPRD0057 GAL16V8		7DPRD0057	
IC36	TC74HC283AP		5DDAE01326	
IC37	H-7DPRD0058A GAL16V8		7DPRD0058A	
IC38	TC74HC85AP		5DDAE01330	
IC39	TC74HC393AP		5DDAE01310	
IC40	NJM4558D		5DAAF00027	
IC41	TC524256Z-10		5DDAE01353	
IC42	TC74HC174AP		5DDAE01327	
IC43	TC74HC4040AP		5DDAE01499	
IC44	TC74HC86AP		5DDAE01361	
IC45	TC74HC257AP		5DDAE01224	
IC46	HD74221P		5DDAF00225	
IC47	H-7DPRD0059A GAL16V8		7DPRD0059A	
IC48	TC74HC08AP		5DDAE01240	
ICS1	IC26-2806GS4		5ZJAA00276	
J1	68100-012	12P FOR FLAT	5JWBE00182	
J2	68100-008	8P	5JWBE00216	
J3	IL-G-9P-S3L2-E	9P	5JWAD00090	
J4	IL-G-6P-S3L2-E	6P	5JWAD00092	
J5	B6B-EH-A		5JWAP00267	
J6	742J2-10	10P SOCKET	5JWDW00025	
J7	IL-G-10P-S3L2-E		5JWAD00068	
J8	IL-G-12P-S3L2-E		5JWAD00084	
J9	68931-203		5JWAD00188	
J10	68931-203		5JWBE00188	
J11	68931-203		5JWBE00188	
J12	742J2-10		5JWDW00025	

REF.	TYPE	DESCRIPTION	JRC P/N	RAYTHEON P/N
P1	66464-102		5JWAM00127	
P2	66464-102		5JWAM00127	
P3	66464-102		5JWAM00127	
PC1	H-7PCRD1104H		7PCRD1104H	
R1	ERD-25UJ563	1/4W 56K OHM	5RDAA01387	
R2	ERD-25UJ103	1/4W 10K OHM	5RDAA01369	
R3	IHR-2-103JA		5RZAB00793	
R4	MHR-7-103JA		5RZAB00987	
R5	ERD-25UJ153T	1/4W 15K OHM	5RDAA01594	
R6	ERD-25UJ391T	1/4W 390 OHM	5RDAA01625	
R7	ERD-25UJ102T	1K OHM 1/4	5RDAA01542	
R8	MHR-3-102JB	1KX3	5RZAB01345	
R9	IHR-2-471JB			
R10	ERD-25UJ152T		5RDAA01507	
R12	ERD-25UJ470	1/4W 47 OHM	5RDAA01313	
R13	ERD-25UJ471	1/4W 470 OHM	5RDAA01337	
R14	ERD-25UJ472	1/4W 4.7K OHM	5RDAA01361	
R15	ERD-25UJ122T	1.2K OHM 1/4	5RDAA01539	
R16	MHR-6-103JA		5RZAB01347	
R17	ERD-25UJ472	1/4W 4.7K OHM	5RDAA01361	
R18	ERD-25UJ100	1/4W 10 OHM	5RDAA01297	
R19	ERD-25UJ105	1/4W 1M OHM	5RDAA01417	
R20	ERD-25UJ105	1/4W 1M OHM	5RDAA01417	
R21	ERD-25UJ471	1/4W 470 OHM	5RDAA01337	
R22	ERD-25UJ912	1/4W 9.1K OHM	5RDAA01368	
R23	ERD-25UJ103T	1/4W 10K OHM	5RDAA01547	
R24	ERD-25UJ471	1/4W 470 OHM	5RDAA01337	
R25	ERD-25UJ682	1/4W 6.8K OHM	5RDAA01365	
R26	ERD-25UJ471	1/4W 470 OHM	5RDAA01337	
R27	ERD-25UJ103	1/4W 10K OHM	5RDAA01369	
R28	ERD-25UJ101	1/4W 100 OHM	5RDAA01321	
R29	ERD-25UJ102	1/4W 1K OHM	5RDAA01345	
R30	ERD-25UJ101	1/4W 100 OHM	5RDAA01321	
R31	ERD-25UJ101	1/4W 100 OHM	5RDAA01321	
R32	ERD-25UJ102	1/4W 1K OHM	5RDAA01345	
R33	ERD-25UJ101	1/4W 100 OHM	5RDAA01321	
R34	ERD-25UJ102	1/4W 1K OHM	5RDAA01345	
R35	ERD-25UJ221	1/4W 220 OHM	5RDAA01329	
R36	ERD-25UJ104	1/4W 100K OHM	5RDAA01393	
R37	ERD-25UJ473	1/4W 33K OHM	5RDAA01385	

REF.	TYPE	DESCRIPTION	JRC P/N	RAYTHEON P/N
R38	ERD-25UJ103	1/4W 10K OHM	5RDAA01369	
R39	IHR-3-103JA			
R40	ERD-25UJ132T	1.3K OHM 1/4W	5RDAA01742	
R41	ERD-25UJ222T	2.2K OHM 1/4W	5RDAA01548	
R44	ERG-2ANJ150P	15 OHM 2W	5REAG02088	
R45	ERG-2ANJ560P	56 OHM 2W	5REAG03217	
R48	ERD-25UJ103T	1/4W 10K OHM	5RDAA01547	
R49	ERD-25UJ361T	1/4W 360 OHM	5RDAA01610	
TR1	2SA1015-Y		5TAAG00070	
TR2	2SC1815-Y		5TCAF00219	
TR3	2SC1815-Y		5TCAF00219	
TR4	2SC2983		5TCAF00623	
TR5	2SA1244-Y		5TAAG00220	
TR6	2SC3303-Y		5TCAF00525	
TR7	2SA1015Y-TPE2		5TAAG00294	
W1	H-7ZCRD0311A		7ZCRD0311A	

RECEIVE BUFFER PCB (PC6) TYPE CQA-116

REF.	TYPE	DESCRIPTION	JRC P/N	RAYTHEON P/N
C1	ECQ-B1H472KZ	50V 4700PF	5CRAA00427	
C2	DD105SL101J50	50V 100PF	5CAAA01101	
C3	ECE-A1EN4R7S		5CEAA01286	
C4	ECE-A1EN4R7S		5CEAA01286	
C7	ECE-A1EU101	25V 100UF	5CEAA01839	
C8	FK26Y5V1H104Z	50V 0.1UF	5CAAD01175	
C9	FK26Y5V1H104Z	50V 0.1UF	5CAAD01175	
C10	ECE-A1CU470	16V 47UF	5CEAA01698	
C11	EXF-P8471ZW	470PX8	5CXAD00005	
C12	FK26Y5V1H104Z	50V 0.1UF	5CAAD01175	
C13	ECE-A1CU470	16V 47UF	5CEAA01698	
C14	FK26Y5V1H104Z	50V 0.1UF	5CAAD01175	
C16	ECE-A1CU470	16V 47UF	5CEAA01698	
C17	FK26Y5V1H104Z	50V 0.1UF	5CAAD01175	
C19	FK26Y5V1H104Z	50V 0.1UF	5CAAD01175	
C20	ECQ-V1H104JZ	50V 0.1UF	5CRAA00364	
CD1	1SV149B		5TXAD00332	
CD2	1S1588		5TXAD00040	
CD3	1K34A	5V 1/2W	5TXAE00130	
CD4	1S1588		5TXAD00040	

REF.	TYPE	DESCRIPTION	JRC P/N	RAYTHEON P/N
CD5	1S1588		5TXAD00040	
IC2	NE521N		5DAAL00024	
IC3	NE521N		5DAAL00024	
IC4	NE521N		5DAAL00024	
IC5	NE521N		5DAAL00024	
IC6	MC74F148N		5DAAJ00607	
IC7	TC74HC04AP		5DDAE01194	
IC8	TLP521-2-A		5TZAD00208	
IC9	TC74HC157AP		5DDAE01337	
J1	IL-G-6P-S3L2-E		5JWAD00092	
J2	68931-206	6P	5JWBE00181	
P2	66464-102		5JWAM00127	
P1	66464-102		5JWAM00127	
PC6	H-7PCRD1119D		7PCRD1119D	
R1	ERD-25UJ560	1/4W 56 OHM	5RDAA01315	
R2	ERD-25UJ821	1/4W 820 OHM	5RDAA01343	
R3	ERD-25UJ103	1/4W 10K OHM	5RDAA01369	
R4	ERD-50TJ102	1/2W 1K OHM	5RDAA00835	
R5	ERD-25UJ101	1/4W 100 OHM	5RDAA01321	
R6	ERD-25UJ681	1/4W 680 OHM	5RDAA01341	
R7	ERD-25UJ821	1/4W 820 OHM	5RDAA01343	
R8	ERD-25UJ220	1/4W 22 OHM	5RDAA01305	
R9	ERD-25UJ331	1/4W 330 OHM	5RDAA01333	
R11	ERD-25UJ103	1/4W 10K OHM	5RDAA01369	
R12	MHR-6-152JB		5RZAB1340	
R13	ERD-25UJ222	1/4W 2.2K OHM	5RDAA01353	
R14	ERD-25UJ471	1/4W 470 OHM	5RDAA01337	
R15	ERD-25UJ222	1/4W 2.2K OHM	5RDAA01353	
R16	ERD-25UJ471	1/4W 470 OHM	5RDAA01337	
R17	ERD-25UJ102	1/4W 1K OHM	5RDAA01345	
R18	ERD-25UJ103	1/4W 10K OHM	5RDAA01369	
R24	ERD-25UJ681	1/4W 680 OHM	5RDAA01341	
R25	ERD-25UJ222	1/4W 2.2K OHM	5RDAA01353	
R26	ERD-25UJ111	1/4W 110 OHM	5RDAA01322	
W3	H-7ZCRD0308A		7ZCRD0308A	
RV1	RUG0707V100-10-501M		5RVAF00026	
RV2	RVG0707V100-10-501M		5RVAF00026	
TR1	2SC1815-BL		5TCAF00255	
TR2	2SC1815-BL		5TCAF00255	
TR3	2SC1815-BL		5TCAF00255	

ADJUSTMENT PCB (PC2) TYPE CCB-392

REF.	TYPE	DESCRIPTION	JRC P/N	RAYTHEON P/N
BZ1	MEB-12-5		5UBBB00001	
PD1	H-7PDRD0023		7PDRD0023	
R1	ERD-25PJ103T	1/4W 10K OHM	5RDAA02188	
RV1	GF06UT-2-10K OHM	10K OHM	5RMAB00128	
RV2	GF06UT-2-10K OHM	10K OHM	5RMAB00128	
RV3	GE06VT-2-20K OHM	20K OHM	5RMAB00130	
RV4	GF06UT-2-500 OHM	500 OHM	5RMAB00132	
RV5	GF06UT-2-50K OHM	50K OHM	5RMAB00118	
RV6	GF06UT-2-5K OHM	5K OHM	5RMAB00119	
RV7	GF06UT-2-50K OHM	50K OHM	5RMAB00118	
W1	FS2N101.6A10		5ZCCA00035	

CONTROL PCB-A (PC3) TYPE CCK-591

REF.	TYPE	DESCRIPTION	JRC P/N	RAYTHEON P/N
PC3	H-7PCRD1106A		7PCRD1106A	
PL1	AS90140		5WAAB00258	
PL2	AS90140		5WAAB00258	
PL3	AS90140		5WAAB00258	
J1	IL-G-2P-S3L2-E		5JWAD00094	

CONTROL PCB-C (PC4) TYPE CCK-606

REF.	TYPE	DESCRIPTION	JRC P/N	RAYTHEON P/N
PD1	H-7PDRD0012A		7PDRD0012A	
PL1	AS90140		5WAAB00258	
PL2	AS90140		5WAAB00258	
PL3	AS90140		5WAAB00258	
PL4	AS90140		5WAAB00258	
PL5	AS90140		5WAAB00258	
PL6	AS90140		5WAAB00258	
R1	ERD-25PJ472	1/4W 4.7K OHM	5RDAA01162	
R2	ERD-25PJ103		5RDAA01146	
R3	ERD-25PJ683		5RDAA01265	
RV1	RK11K113 10KBL30 DC30	10K OHM	5RZBG00093	
RV2	RK11K113 10KBL30 DC30	10K OHM	5RZBG00093	
RV3	RK11K113 10KBL30 DC30	10K OHM	5RZBG00093	
RV4	RK11K113 10KBL30 DC30	10K OHM	5RZBG00093	
W1	FS2N228.6A10			

POWER SUPPLY PCB (PC5) TYPE CBD-1026

REF.	TYPE	DESCRIPTION	JRC P/N	RAYTHEON P/N
C1	ECE-A1HU102	50V 1000UF	5CEAA01780	
C2	ECE-A1CU101B	100UF 16V	5CEAA01827	
C3	ECE-A1CU101B	100UF 16V	5CEAA01827	
C4	ECE-A1CU101B	100UF 16V	5CEAA01827	
C5	ECQ-B1H222KZ3	2200P	5CRAA00954	
C6	ECQ-B1H103KZ3	0.01UF 50V	5CRAA00771	
C7	ECQ-B1H103KZ3	0.01UF 50V	5CRAA00771	
C8	ECE-A1CU222B	16V 2200UF	5CEAA02870	
C9	ECE-A1HU221	50V 220U	5CEAA01843	
C10	ECE-A1CU222	2200UF 16V	5CEAA01757	
C11	ECQ-V1H104JZ3		5CRAA00617	
C12	ECQ-V1H104JZ3		5CRAA00617	
C13	ECQ-V1H104JZ3		5CRAA00617	
C14	ECQ-V1H104JZ3		5CRAA00617	
C15	ECQ-V1H104JZ3		5CRAA00617	
C16	ECQ-V1H104JZ3		5CRAA00617	
C17	ECQ-V1H104JZ3		5CRAA00617	
C18	ECE-A1HU221	50V 220U	5CEAA01843	
C19	ECE-A1HU100B	50V 10UF	5CEAA02184	
C20	ECE-A1HU100B	50V 10UF	5CEAA02184	
C21	ECE-A1HU100B	50V 10UF	5CEAA02184	
C22	ECQ-B1H103KZ3	0.01UF 50V	5CRAA00771	
C23	DD05B471K500	500V 470PF	5CBAB00792	
C24	DD05B471K500	500V 470PF	5CBAB00792	
CD1	U05C		5TXAE00034	
CD2	HZ11A3	1/2W 10V	5TXAE00269	
CD3	1S1588		5TXAD00040	
CD4	F6P20F		5TXAG00288	
CD5	11DF2FC		5TXAG00239	
CD6	11DF2FC		5TXAG00239	
CD7	F6P40F		5TXAG00289	
CD8	HZ5C1	5V 1/2W	5TXAE00130	
CD9	1S1588		5TXAD00040	
CD10	V06C	200V 1.1A	5TXAE00016	
IC1	TL494CN		5DDAL00546	

REF.	TYPE	DESCRIPTION	JRC P/N	RAYTHEON P/N
IC2	TLP521-2-GB		5TZAD00234	
IC3	TL431CLPB		5DDAL01271	
IC4	TL499ACP		5DDAL01290	
IC5	TC4013BAP		5DDAE00817	
IC6	TC4011BP	MOS	5DDAE00053	
J1	B7P-VH		5JWAP00291	
J2	B2B-EH		5JWAP00213	
L1	SC-05-10J		5LGAB00058	
L2	HP-013J		5LGAB00059	
L3	FL-9H472J-H	4.7MH WITH TUBE	5LCAA00653	
L4	HP-013J		5LGAB00059	
L5	FL-5H101K	100UH	5LCAA00013	
PC1	H-7PDRD0009A		7PDRD0009A	
PC501	H-7PCRD1115A		7PCRD1115A	
R1	ERD-25UJ103T	10K OHM 1/4W	5RDAA01547	
R2	ERD-25UJ472T	4.7K OHM 1/4W	5RDAA01549	
R3	ERD-25UJ472T	4.7K OHM 1/4W	5RDAA01549	
R4	ERD-25UJ222T	2.2K OHM 1/4W	5RDAA01548	
R5	ERD-25UJ682T		5RDAA01713	
R6	ERD-25UJ472T	4.7K OHM 1/4W	5RDAA01549	
R7	ERD-25UJ103T	10K OHM 1/4W	5RDAA01547	
R8	ERD-25UJ472T	4.7K OHM 1/4W	5RDAA01549	
R9	ERD-25UJ472T	4.7K OHM 1/4W	5RDAA01549	
R10	ERD-25UJ472T	4.7K OHM 1/4W	5RDAA01549	
R11	ERD-50TJ331	1/2W 330 OHM	5RDAA00823	
R12	ERD-50TJ331	1/2W 330 OHM	5RDAA00823	
R13	ERG-2ANJ100	2W 10 OHM	5REAG00048	
R14	ERG-2ANJ100	2W 10 OHM	5REAG00048	
R15	ERD-25UJ102T	1K OHM 1/4	5RDAA01542	
R16	ERD-25UJ102T	1K OHM 1/4	5RDAA01542	
R17	ERD-25UJ102T	1K OHM 1/4	5RDAA01542	
R18	ERD-25UJ222T	2.2K OHM 1/4W	5RDAA01548	
R19	ERD-25UJ222T	2.2K OHM 1/4W	5RDAA01548	
R20	ERD-25UJ471T	470 OHM 1/4W	5RDAA01541	
R21	ERD-25UJ823T		5RDAA01921	
R22	ERD-25UJ472T	4.7K OHM 1/4W	5RDAA01549	
R23	ERD-25UJ102T	1K OHM 1/4	5RDAA01542	
R24	ERD-25UJ472T	4.7K OHM 1/4W	5RDAA01549	
R25	ERD-25UJ472T	4.7K OHM 1/4W	5RDAA01549	
R26	ERD-50TJ470	1/2W 47 OHM	5RDAA00803	

REF.	TYPE	DESCRIPTION	JRC P/N	RAYTHEON P/N
R27	ERD-25UJ471T	470 OHM 1/4W	5RDAA01541	
R28	ERD-25UJ103T	10K OHM 1/4W	5RDAA01547	
R29	ERD-25UJ333T	1/4W 33K OHM	5RDAA01591	
R30	ERD-25UJ103T	10K OHM 1/4W	5RDAA01547	
R31	ERD-25UJ103T	10K OHM 1/4W	5RDAA01547	
R32	ERD-25UJ103T	10K OHM 1/4W	5RDAA01547	
R33	ERD-25UJ103T	10K OHM 1/4W	5RDAA01547	
R34	ERD-25UJ471T	470 OHM 1/4W	5RDAA01541	
R35	ERD-25UJ471T	470 OHM 1/4W	5RDAA01541	
R36	ERD-25UJ471T	470 OHM 1/4W	5RDAA01541	
R37	ERD-25UJ222T	2.2K OHM 1/4W	5RDAA01548	
R38	ERG-2ANJ101	2W 100 OHM	5REAG00014	
R39	ERG-2ANJ101	2W 100 OHM	5REAG00014	
RV1	GF06X-1K OHM	1K OHM	5RMAB00105	
T1	H-7LTRD0173		7LTRD0173	
TP1	LC-2-G YEL		5JTCW00015	
TR1	2SC1627-Y		5TCAF00299	
TR2	2SA1010 K		5TAAB00034	
TR3	2SK525		5TKAA00160	
TR4	2SK525		5TKAA00160	
TR5	2SB906Y		5TBAE00088	
TR6	2SB906Y		5TBAE00088	
W2	H-7ZCRD0313A		7ZCRD0313A	
ZS1	H-7ZSRD0012		7ZSRD0012	

CRT MONITOR PCB (PC501, PC502)
TYPE CCN-182

REF.	TYPE	DESCRIPTION	JRC P/N	RAYTHEON P/N
AG151	AG20P122FH3D		5RZCK00003	
C101	ECE-A1CU471B	470UF	5CEAA01829	
C151	ECE-A2CU4R7B	4.7U 160V	5CEAA02835	
C152	DD104B221K50	50V 220PF	5CBAB00401	
C153	ECEA2CU2R2B	2.2U 160V	5CEAA02836	
C154	DE1510E103Z1	1KV 0.01UF	5CBAB01934	
C155	DD106F103Z50	50V 10000PF	5CBAB00400	
C156	DD09B222K500		5CBAB00943	
C201	DD104-989SL470J50	50V 47P	5CBAB02653	
C202	ECH-S1H472GZ3	50V 4700P	5CBAA00167	

REF.	TYPE	DESCRIPTION	JRC P/N	RAYTHEON P/N
C203	ECQ-B1H223KZ	0.022UF	5CRAA00428	
C204	ECEA1HUR22	50V 0.22UF	5CEAA02096	
C206	ECS-F1VZ105BB	1U 35V	5CSAA00274	
C207	ECE-A1CU102B	1000UF 16V	5CEAA01830	
C208	ECE-A1EU101B		5CEAA01813	
C209	ECE-A1CU102B	1000UF 16V	5CEAA01830	
C210	ECE-A1CU102B	1000UF 16V	5CEAA01830	
C211	ECSF1CZ106BB	16V 10U	5CSAA00284	
C212	ECQ-V1H224JZ3	0.22UF 50V	5CRAA00482	
C301	DD106F103Z50	50V 10000PF	5CBAB00400	
C302	ECQ-B1H102KZ3	50V 1000P	5CRAA00811	
C303	DD308-959F104Z50	50V 0.1U	5CAAA03363	
C304	ECQ-P1H333GZ3	50V 0.033U	5CRAA01019	
C305	ECEA1AU101B	10V 100U	5CEAA02837	
C306	ECQ-B1H562KZ3	50V 5600P	5CRAA01002	
C307	ECQ-B1H472KZ3	50V 4700P	5CRAA01004	
C308	ECQ-B1H103KZ3	0.01UF 50V	5CRAA00771	
C309	DD106F103Z50	50V 10000PF	5CBAB00400	
C310	DD12-63B472K500	4700P	5CAAA03364	
C311	ECQ-F2473KZ3	0.047U	5CRAA01006	
C312	ECE-A1CG471S	16V 470UF	5CEAA02264	
C313	ECE-A1CG471S	16V 470UF	5CEAA02264	
C314	DD1510E103Z1	0.01U	5CBAB02654	
C315	DD18-64B103K500	500V 0.01U	5CAAA03365	
C316	ECE-A2CU010B	160V 1U	5CEAA02838	
C317	ECQ-B1H223KZ3	50V 0.022U	5CRAA00816	
C318	UHA1E6R8KRA		5CEBD00001	
CD151	EM1Z	200V 1A	5TXAN00061	
CD152	HZ24BPRE		5TXAE00811	
CD153	HZ24BPRE		5TXAE00811	
CD201	EM1Z	200V 1A	5TXAN00061	
CD301	RU-3A		5TXAN00134	
CD302	RU-3A		5TXAN00134	
CD303	RH-1C		5TXAN00135	
CD304	ES-1		5TXAN00136	
CD305	RH-1C		5TXAN00135	
IC201	UPC1379C		5DDAC00547	
J501	RTB-1.5-4F	4PIN	5JDAH00066	
J551	RT-01N-2.3A		5JTCD00081	
L151	LAL02KR3R9K	3.9UH	5LCAA00227	

REF.	TYPE	DESCRIPTION	JRC P/N	RAYTHEON P/N
L301	H-7LGRD0038		7LGRD0038	
L302	FLH-5L98	H-7LGRD0032	5LCAU00033	
PC501	H-7PCRD1109D		7PCRD1109D	
PC502	H-7PCRD1110B		7PCRD1110B	
PD1	H-7PDRD0006C		7PDRD0006C	
R101	ERD-25UJ331T	1/4W 330 OHM	5RDAA01480	
R102	ERD-25UJ101T	1/4W 100 OHM	5RDAA01599	
R103	ERD-25UJ2R2T	1/4W 2.2 OHM	5RDAA01633	
R151	ERD-25UJ101T	1/4W 100 OHM	5RDAA01599	
R152	ERD-25UJ220T	22 OHM	5RDAA01622	
R153	ERD-25UJ330T		5RDAA01621	
R154	ERD-25UJ183T	18K OHM 1/4W	5RDAA01605	
R155	ERD-25UJ101T	1/4W 100 OHM	5RDAA01599	
R156	ERD-25UJ683T	68K OHM 1/4W	5RDAA01705	
R157	ERD-25UJ221T	220 OHM 1/4	5RDAA01543	
R158	ERD-50VJ152	1/2W 1.5K OHM	5RDAA01069	
R159	ERD-25UJ102T	1K OHM 1/4	5RDAA01542	
R160	HMGL1/2A-22M OHM J		5REAA05621	
R161	ERD-25UJ103T	10K OHM 1/4W	5RDAA01547	
R162	ERD-25UJ473T	1/4W 47K OHM	5RDAA01618	
R163	ERD-25UJ222T	2.2K OHM 1/4W	5RDAA01548	
R164	ERD-25UJ221T	220 OHM 1/4	5RDAA01543	
R202	ERD-25UJ332T	3.3K OHM 1/4W	5RDAA01544	
R203	ERD-25UJ152T		5RDAA01507	
R204	ERD-25UJ102T	1K OHM 1/4	5RDAA01542	
R205	ERD-25UJ472T	4.7K OHM 1/4W	5RDAA01549	
R207	ERD-25UJ202T	2K OHM 1/4W	5RDAA02044	
R208	ERD-25UJ103T	10K OHM 1/4W	5RDAA01547	
R209	ERD-25UJ103T	10K OHM 1/4W	5RDAA01547	
R210	ERD-25UJ121T		5RDAA01579	
R211	ERD-25UJ4R7T		5RDAA01550	
R212	ERD-25UJ333T	1/4W 33K OHM	5RDAA01591	
R213	ERD-25UJ153T	1/4W 15K OHM	5RDAA01594	
R214	ERD-25UJ183T	18K OHM 1/4W	5RDAA01605	
R215	ERD-50VJ2R7	1/2W 2.7	5RDAA02126	
R216	ERD-25UJ183T	18K OHM 1/4W	5RDAA01605	
R217	ERD-25UJ181T	180 OHM	5RDAA01628	
R218	ERD-25UJ222T	2.2K OHM 1/4W	5RDAA01548	
R301	ERD-25UJ331T	1/4W 330 OHM	5RDAA01480	
R302	ERD-25PJ103	10K OHM 1/4W	5RDAA01146	

REF.	TYPE	DESCRIPTION	JRC P/N	RAYTHEON P/N
R303	ERD-25UJ331T	1/4W 330 OHM	5RDAA01480	
R304	ERD-25UJ123T	1/4W 12K OHM	5RDAA01592	
R305	ERD-25UJ683T	68K OHM 1/4W	5RDAA01705	
R306	ERD-25UJ562T	1/4W 5.6K OHM	5RDAA01597	
R307	ERX-1ANJP1R5S	1.5 OHM 1W	5REAG02567	
R308	ERD-25UJ270T		5RDAA01708	
R309	ERD-25PJ5R6	1/4W 5.6	5RDAA01205	
R310	ERD-25UJ104T	100K OHM 1/4W	5RDAA01623	
R311	ERD-50VJ102	1/2W 1K OHM	5RDAA01070	
R312	ERD-25UJ101T	1/4W 100 OHM	5RDAA01599	
R313	ERD-25PJ101	1/4W 100 OHM	5RDAA01175	
RV101	RVG0707V101-10-201M	200	5RVAF00135	
RV151	VG152H7SB2M OHM	2M OHM	5RMAC00151	
RV201	RVG0707V101-10-103M	10K	5RVAF00136	
RV202	RVG0707V101-10-501M	500	5RVAF00137	
RV203	RVG0707V101-10-103M	10K	5RVAF00136	
RV301	RVG0707V101-10-502M	5K	5RVAF00138	
RV302	RVG0707V101-10-504M	500K	5RVAF00139	
T301	H-6LRBS00054		6LRBS00054	
T302	H-7LPRD0092A	FOR 10"	7LPRD0092A	
TR151	2SC1675-T		5TCAB01350	
TR152	2SC22290TPE2		5TCAF00773	
TR201	2SC1815GRTPE2		5TCAF00774	
TR301	2SC1214CTZ		5TCAA00338	
TR302	2SC2233		5TCAF00617	
TR302-1	AC84		5ZJAR00023	
W501	H-7ZCRD0319A		7ZCRD0319A	
W502	H-7ZCRD0310B		7ZCRD0310B	
W503	H-7ZCRD0314A		7ZCRD0314A	
Z501	H-7ZKRD0038		7ZKRD00038	
Z551	S7-524T-200		5ZJAT00085	

CRT UNIT TYPE CKJ-97

REF.	TYPE	DESCRIPTION	JRC P/N	RAYTHEON P/N
T502	H-7LGRD0036A		7LGRD0036A	
V501	E2728B39-SDHT		5VBAB00062	
W511	H-7ZCRD0248		7ZCRD0248	
W512		*		

7.2 MECHANICAL PARTS LOCATION LIST

Reference to Fig. 120
Assembly Drawing of R20X/R40X Scanner Unit

Location	Description	Symbol	JRC P/N	Raytheon P/N
1	Upper Radome Assy		MPBX16084	
1-1	Radome		MPBC09205	
1-2	Nut, Special		MTL035987A	
1-3	Toothed Washer		BRTG03668	
2	Lower Radome Assy		MPBX16086A	
2-1	Radome		MTV002211A	
2-2	Packing		MTT016990A	
2-3	Bolt, Special		MPTG02144A	
2-4	Washer, Plain		BSFW06000B	
2-5	Washer, Rubber		MTT026587	
2-6	O-Ring		BRPK00109	
3	Mounting Base Assy		MPBP02927	
3-1	Mounting Base		MTC003612	
3-2	Nut 3/8-16 UNC		BRTG04437	
3-3	Plate		MTB186258	
4	Chassis		MTC003611	
5	Antenna Assy		MPAE00529	
6	Main Shaft Assy		MPGK03589	
6-1	Rotary Joint		MPAB02055	
6-2	Housing		MTC003613	
6-3	Bearing		BRGK00165	
6-4	C-Ring		BRTG00735	
6-5	Plate, Retaining		MTB186261A	
6-6	SHM Switch	S102		
6-7	Connecting Wave Guide		MPAB01766	
6-8	Cover		MTB154257	
7	Gear Assy		MPGK02946	
7-1	Gear		MTV002340	
7-2	Magnet	MT101	5MPAB00001	
8	Motor Assy	M101	7BRRD0023	7BRRD0023
9	Circulator	A101		
10	Diode Limiter	A102		
11	Corner Wave Guide		MTM003700	
12	Plate		MTD002559D	
13	Magnetron	V201		
14	PCB	PC201	CNM-141	
15	Cover		MTB186255A	
16	MIC	E301		
17	PCB	PC301	CAE-269	
18	Cover		MTB186256B	

Location	Description	Symbol	JRC P/N	Raytheon P/N
19	PCB	PC501	CBD-1028	
20	Cover		MTB186257A	
21	Plate		MTB186260	
22	Rubber Sheet		MTT026591	
23	Sheet, Radiating		7ZSRD0013	
24	Plate		MTB186259A	
25	Gasket		MTT026586	
26	Toggle Switch	S101		
27	Switch Cover		MPPK06925	

Reference of Fig. 121, 122
Assembly Drawing to R21X/R41X Scanner Unit

Location	Description	Symbol	JRC P/N	Raytheon P/N
1	Radiator		MPAE00650	
2	Nut		BRTG00142	
3	Washer, Spring		BRTG00404	
4	Washer, Plain		BRTG00402	
Antenna Support Assy			MPGK03292	
5	Antenna Support		MTC003301A	
6	Plate		MTD002498	
7	O-Ring		BRPK00054	
8	Grease Nipple		BRXL00153	
9	Cap		BRPK00265	
Bolt Assy			MPTG02229	
10	Bolt		BRTG000389	
11	Washer, Spring	(M8 SUS304)	BRTG00747	
12	Seal-Washer		BRPK00322	
13	V-Ring		BRPK00189	
14	Housing		MTC003302	
15	Bolt		MTL006545A	
16	Washer, Plain		BRTG00224	
17	O-Ring		BRPK00083	
Main Shaft Assy			MPGK03291	
21	Main Shaft		MTC002796A	
22	Ball Bearing		BRGK00119	
23	Spacer		MTL037731	
24	Key		MTK005301	
25	Gear		MTG003623A	
26	Spacer		MTL037732	
27	Bracket		MTC002798A	
28	Ball Bearing		BRGK00166	
29	Ring, Retaining		BRTG03865	
30	Lock Nut		BSAN08000S	
31	Wave Guide		MTM003254A	
32	Coaxial Rod		MTL017354	
33	Insulator		MTV001459	

Location	Description	Symbol	JRC P/N	Raytheon P/N
34	Connecting Wave Guide		MPAB01848	
35	Plate, Retaining		MTB154257	
36	Shutter		MTB163559	
37	Plate, Mounting		MTB163560	
38	PCB	(CCJ-73)		
Motor Assy			MPGK03293	
41	Motor		H-MPGK03332	
42	Gear		MTG003634	
43	Ring, Retaining		BRTG03864	
Bearing Pulse Generator			MPLW04069	
44	Plate, Mounting		MTB167205	
45	Spacer		MTL029971	
46	Slitted Plate		MTB124251	
47	PCB	(CBP-38)		
48	Cover		MTB167206	
Housing Assy			MPBX19425	
51	Housing		MTC003303A	
52	Mounting Leg		MTC003621	
53	Mounting Leg		MTC003622	
54	Bolt	(M8×30 SUS304)	BRTG00677A	
55	Nut		BSHN08000S	
58	Rubber Seal		MTT024066	
59	Plate		MTB163583	
60	Breathing Tube		MTV003698	
61	Toggle Switch	(S-101)		
62	Switch Cover		MPPK00925	
63	Cramp, Gland		BRTG00881	
64	Body, Gland		BRTG01271	
65	Nut, Gland		BRTG01272	
66	Washer, Gland		BRTG00882	
67	Gasket, Gland		MTT026595	
68	PCB	(CBD-1029)		
69	Shaft		MTL042405A	
70	Stay		MPDM00675A	
71	Ground Cable		MPKC05206A	
72	Cable Clamp		BRBP00012	

Location	Description	Symbol	JRC P/N	Raytheon P/N
73	Plate		MTB186290	
74	Rubber Seat		MTT026597	
75	Plate		MTB186291	
MTR Assy			MDNTG0169	
76	Modulator		MDNMA0350	
77	Receiver		MDNRG0073	

Modulator

Chassis Assy			MPBX19316	
1	Chassis		MTB186245C	
2	Plate		MTB186321	
3	Plate		MTB163557A	
4	Cover		MTB186244B	
5	Plate		MTB163575B	
6	Corner Wave Guide		MTM003256A	
7	Circulator			
8	Diode Limiter			
9	Magnetron			
10	Screw	(M4×55)	BRTG02029	
11	Connecting Wave Guide		MTM003496	
PCB Assy			MDMW01895	
12	PCB	(CNM-141)		

Receiver

21	Chassis		MTB186250	
22	Plate		MTB186246	
23	PCB	(CAE-269)	MDHW01007	
24	Cover		MTB186248A	
25	Plate		MTB186249	
Front End Assy			MDHW00922	
29	Front End			
32	Cover		MTC003358	
33	Screw	(M3×50 SS41)	BRTG03161	

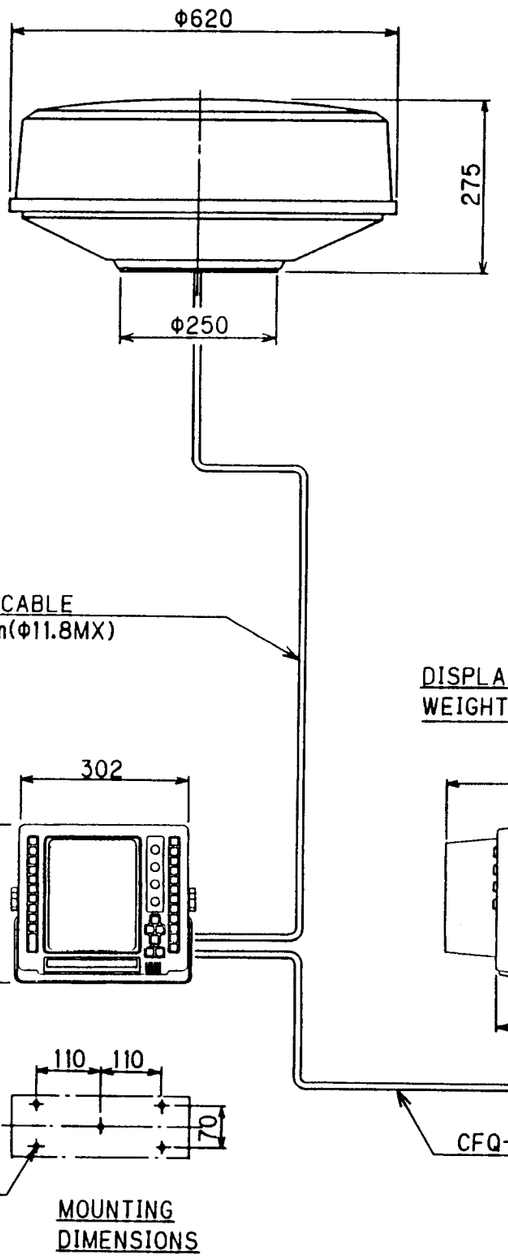
PARTS LOCATION LIST

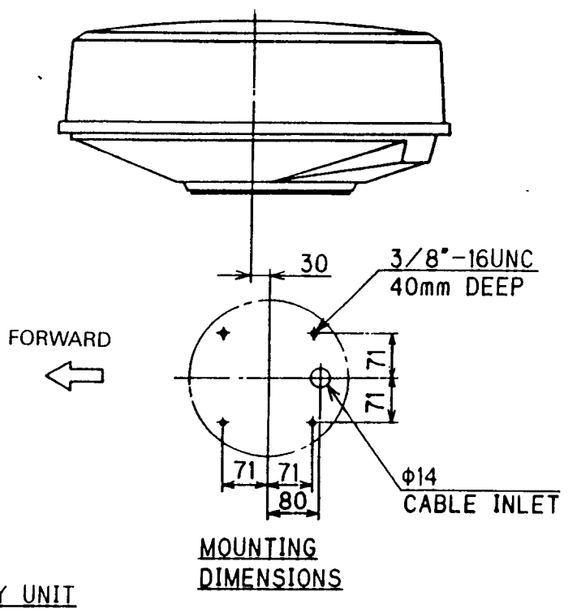
Reference to Fig. 123
Assembly Drawing of R40X/R41X Display Unit

Location	Description	JRC P/N	Symbol
1	Bezel Assy	MPBC09057	
1-1	Front Bezel	MPWM00846	
1-2	Cap	MPBC09060	
1-3	Blank		
1-4	Film	MTZ003059	
1-5	Front Panel	MPNM14601	
1-6	Packing, Rubber	MPPK01554	
1-7	Packing, Rubber	MPPK01555	
1-8	Cap, Rubber	MTV003546	
1-9	Grommet	MPNG00277	
2	Cabinet Assy	MPBX19432	
2-1	Cabinet	MTV003553	
2-2	Packing Rubber	MTT026588	
2-3	Packing Rubber	MPPK01525	
2-4	Plate, Retaining	MPBP02929	
3	Heat Sink	MTC003609	
4	Chassis	MPBC09058	
5	Bracket Assy	MPBX19433	
5-1	Bracket	MTB186234	
5-2	Washer, Serration	MTV003561	
6	Knob	MPTG02475	
7	Contact Rubber	MTV003564	
8	Contact Rubber	MTV003549	
9	Panel Switch R-Side	MPSW00963A	S401
10	Panel Switch L-Side	MPSW00962A	S402
11	CRT		V501
12	Deflection Yoke		T502
13	CRT Control PCB Assy	CCN-182	PC501
14	Video PCB Assy		PC502
15	Main Control PCB Assy	CMC-576	PC1
16	Adjustment PCB Assy	CCB-351	PC2
17	Control PCB Assy A	CCK-591	PC3
18	Control PCB Assy C	CCK-606	PC4
19	Power Supply PCB Assy	CBD-1026	PC5
20	Receive Buffer PCB Assy	CQA-116	PC6
21	Shield Case	MTB186226	
22	Tube	MTT026594	
23	Bushing, Insulating	MTV003558	
24	Cap, Rubber	MPPK01548	
25	Cap, Rubber	MPNG00279	

Location	Description	JRC P/N	Symbol
26	Packing, Rubber	MTT020295	
27	Packing, Rubber	MTT022410	
28	Washer	BRTG00553	
29	Cap	BRXP00866	
30	Plate, Retaining	MTB186295	
31	Sheet, Radiating		
32	Hood	MTV003554	
33	Knob Assy	MPHD01459	
33-1	Knob	MPHD01437A	
33-2	Spring, Clamp	BRSR00077	
34	Logo Plate (R40X)	MPNM14602	
	(R41X)	MPNM14603	
35	Screw, Tapping	BRTG03437	
36	Screw, Tapping	BRTG02970	
37	Screw, Tapping	BRTG03100	
38	Screw, Tapping	BRTG03095	
39	Screw, Tapping	BRTG03848	
40	Screw, Tapping	BRTG03616	
41	Screw, Tapping	BRTG03217	
42	Sems Screw	BSNC03010B	
43	Sems Screw	BSNC03012B	

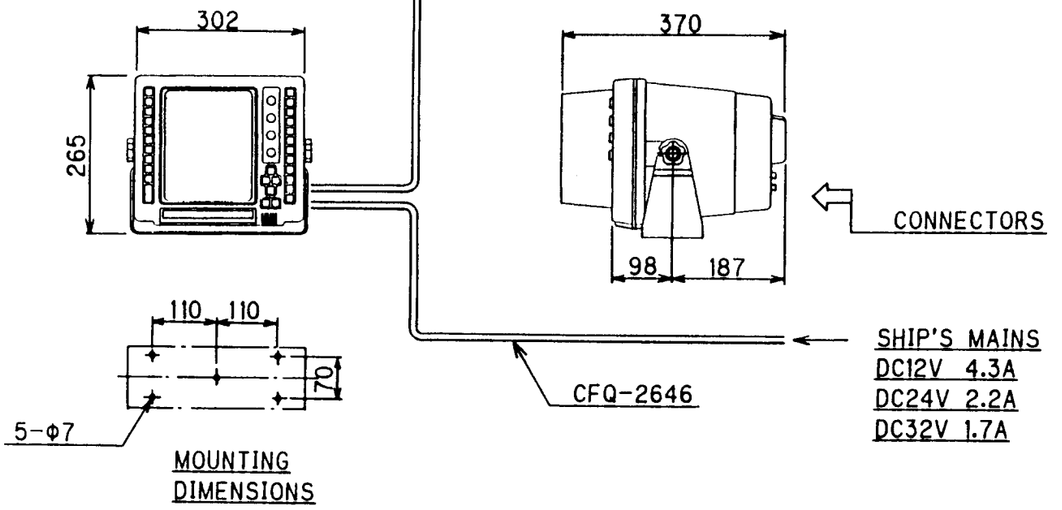
SCANNER UNIT
WEIGHT APPROX. 9.5kg





MOUNTING
DIMENSIONS

DISPLAY UNIT
WEIGHT APPROX. 6kg



MOUNTING
DIMENSIONS

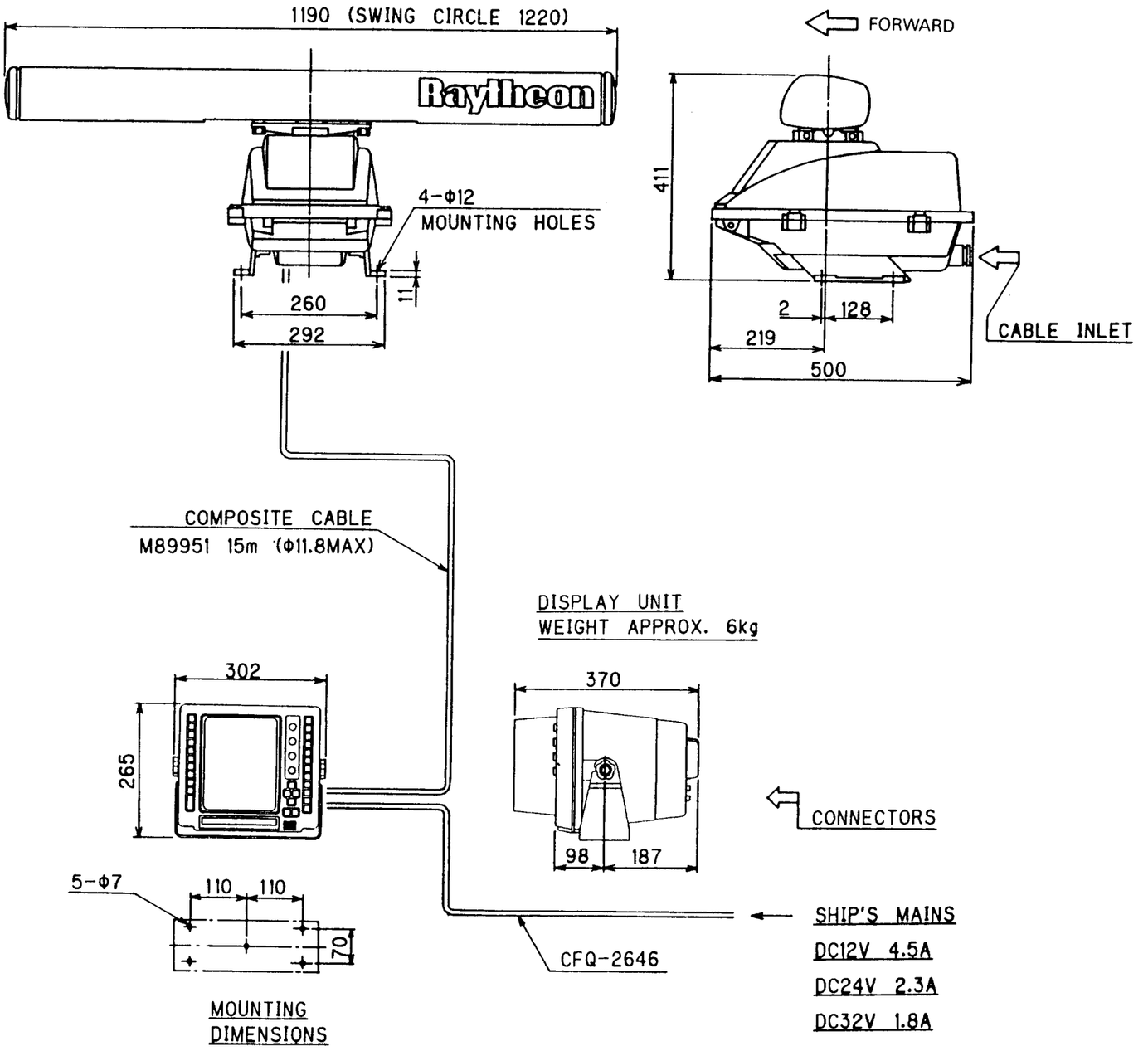
NOTES: 1. THE DISTANCE BETWEEN THE UNITS AS FOLLOWS.

	STANDARD	MAXIMUM
SCANNER UNIT TO DISPLAY UNIT	15 m	20 m

2. ELIMINATING THE INTERFERENCE ON FREQUENCIES USED FOR MARINE COMMUNICATIONS AND NAVIGATION DUE TO OPERATION OF THE RADAR. ALL CABLES OF RADAR ARE TO BE RUN AWAY FROM THE CABLES OF RADIO EQUIPMENT (EX. RADIOTELEPHONE, COMMUNICATIONS RECEIVER AND DIRECTION FINDER ETC.). ESPECIALLY INTER-WIRING CABLES BETWEEN SCANNER UNIT AND DISPLAY UNIT OF THE RADAR SHOULD NOT BE RUN PARALLEL WITH THE CABLES OF RADIO EQUIPMENT.

FIG. 101 GENERAL SYSTEM DIAGRAM R40X

SCANNER UNIT
WEIGHT APPROX. 24 kg



NOTES: 1. THE DISTANCE BETWEEN THE UNITS AS FOLLOWS.

	STANDARD	MAXIMUM
SCANNER UNIT TO DISPLAY UNIT	15 m	20 m

2. ELIMINATING THE INTERFERENCE ON FREQUENCIES USED FOR MARINE COMMUNICATIONS AND NAVIGATION DUE TO OPERATION OF THE RADAR. ALL CABLES OF RADAR ARE TO BE RUN AWAY FROM THE CABLES OF RADIO EQUIPMENT (EX. RADIOTELEPHONE, COMMUNICATIONS RECEIVER AND DIRECTION FINDER ETC.). ESPECIALLY INTER-WIRING CABLES BETWEEN SCANNER UNIT AND DISPLAY UNIT OF THE RADAR SHOULD NOT BE RUN PARALLEL WITH THE CABLES OF RADIO EQUIPMENT.

FIG. 103 GENERAL SYSTEM DIAGRAM R41X

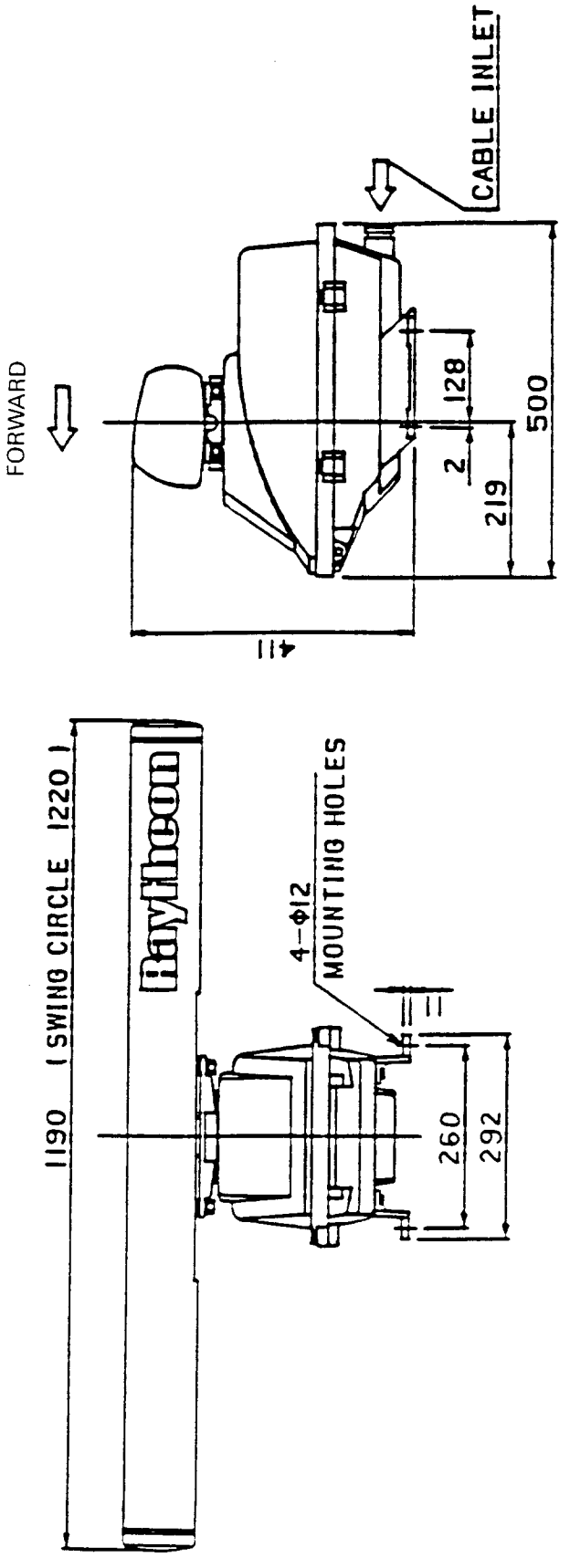
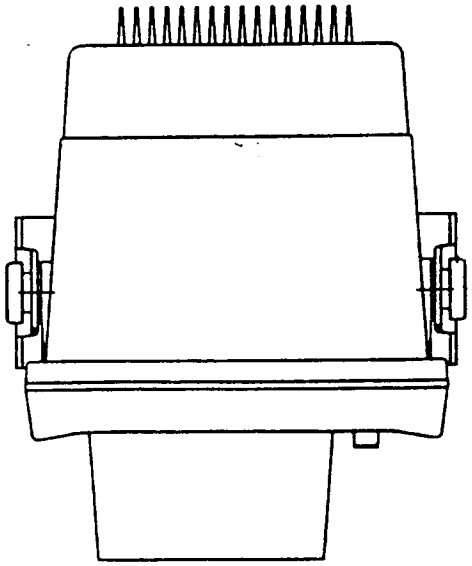
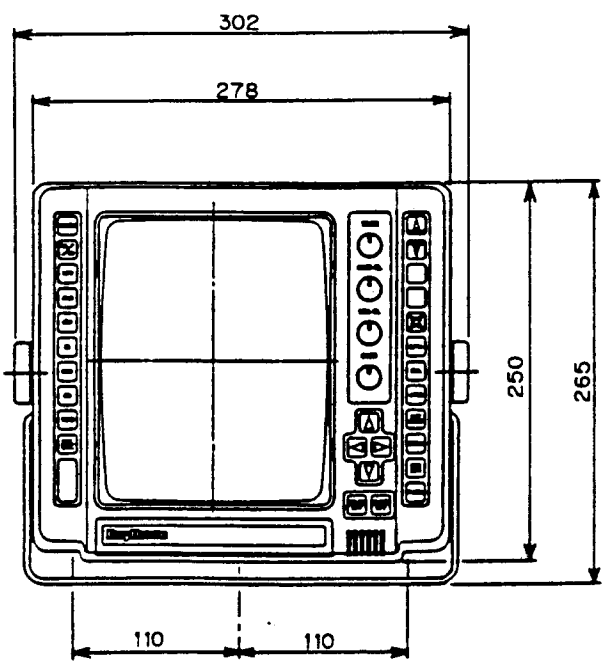
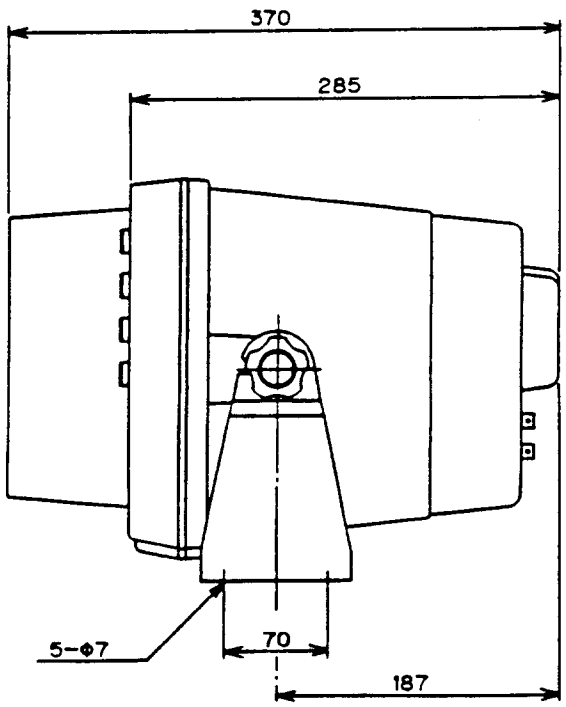


FIG. 104 OUTLINE DRAWING OF R41X SCANNER UNIT







WEIGHT APPROX. 6kg

FIG. 105 OUTLINE DRAWING OF R40X/R41X DISPLAY UNIT

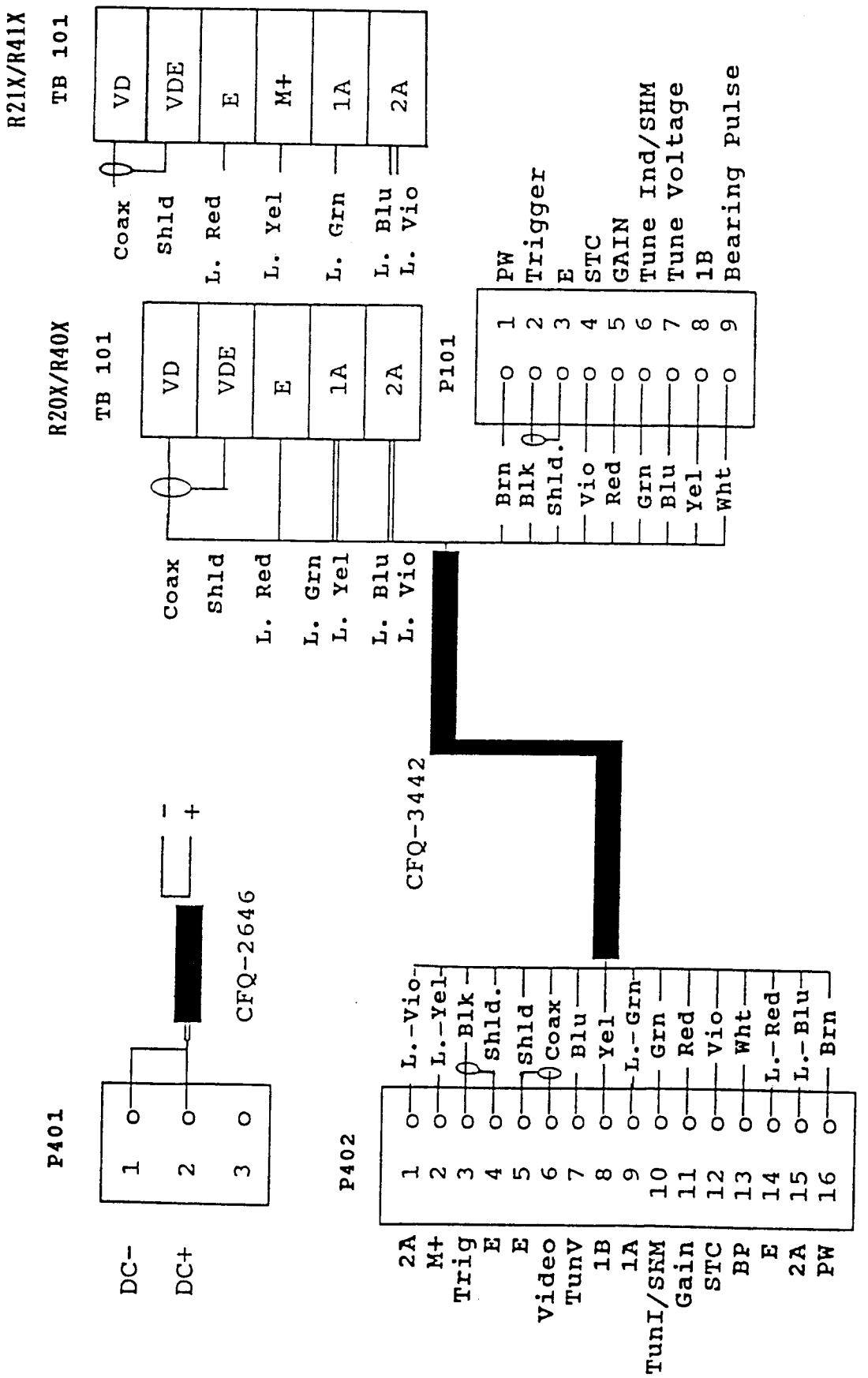


FIG. 106 INTERUNIT WIRING X SERIES RADAR

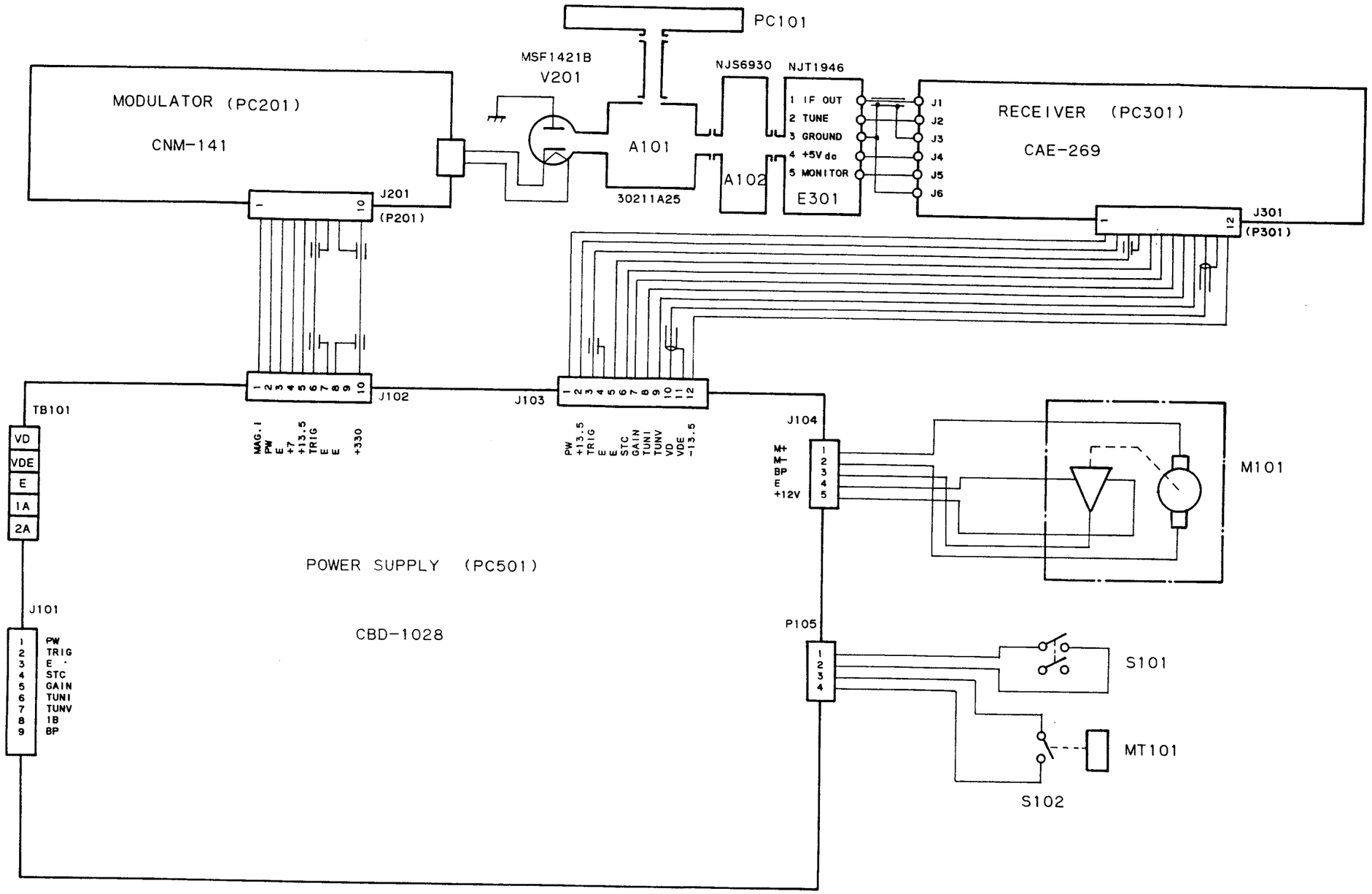


FIG. 107 INTERNAL CONNECTION DIAGRAM FOR R20X/R40X ANTENNA UNIT

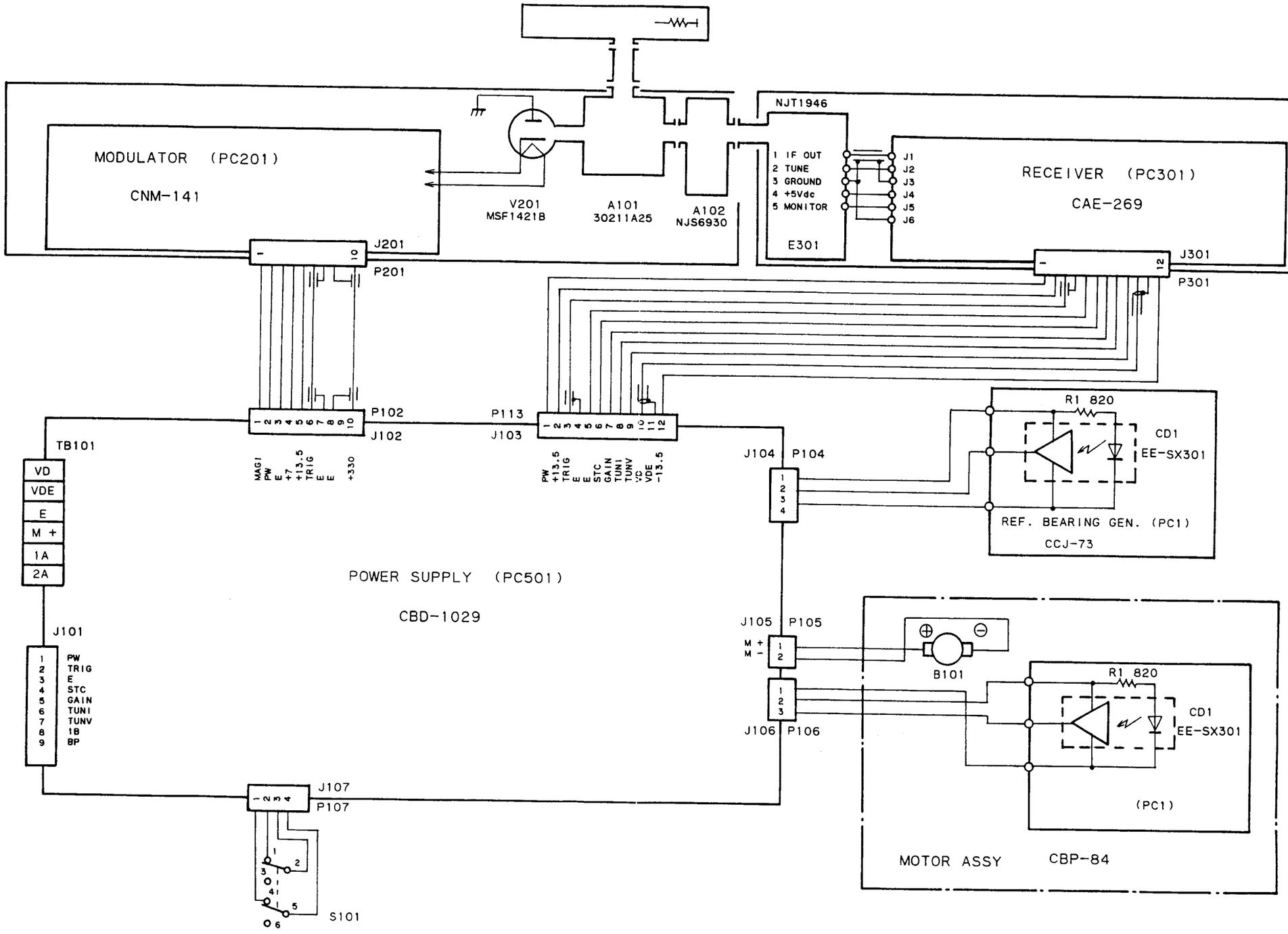
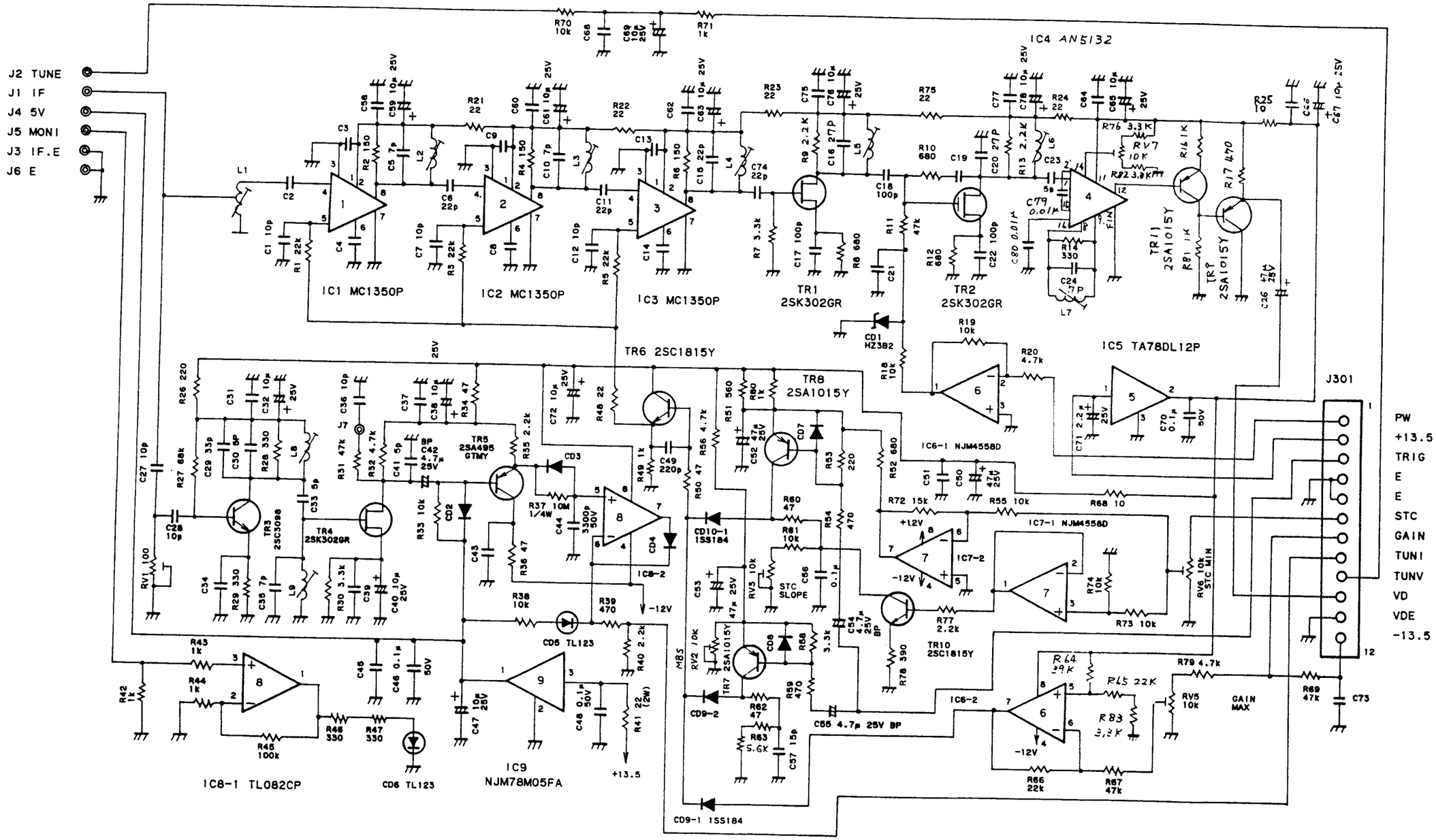


FIG. 108 INTERNAL CONNECTION DIAGRAM FOR R21X/R41X ANTENNA UNIT

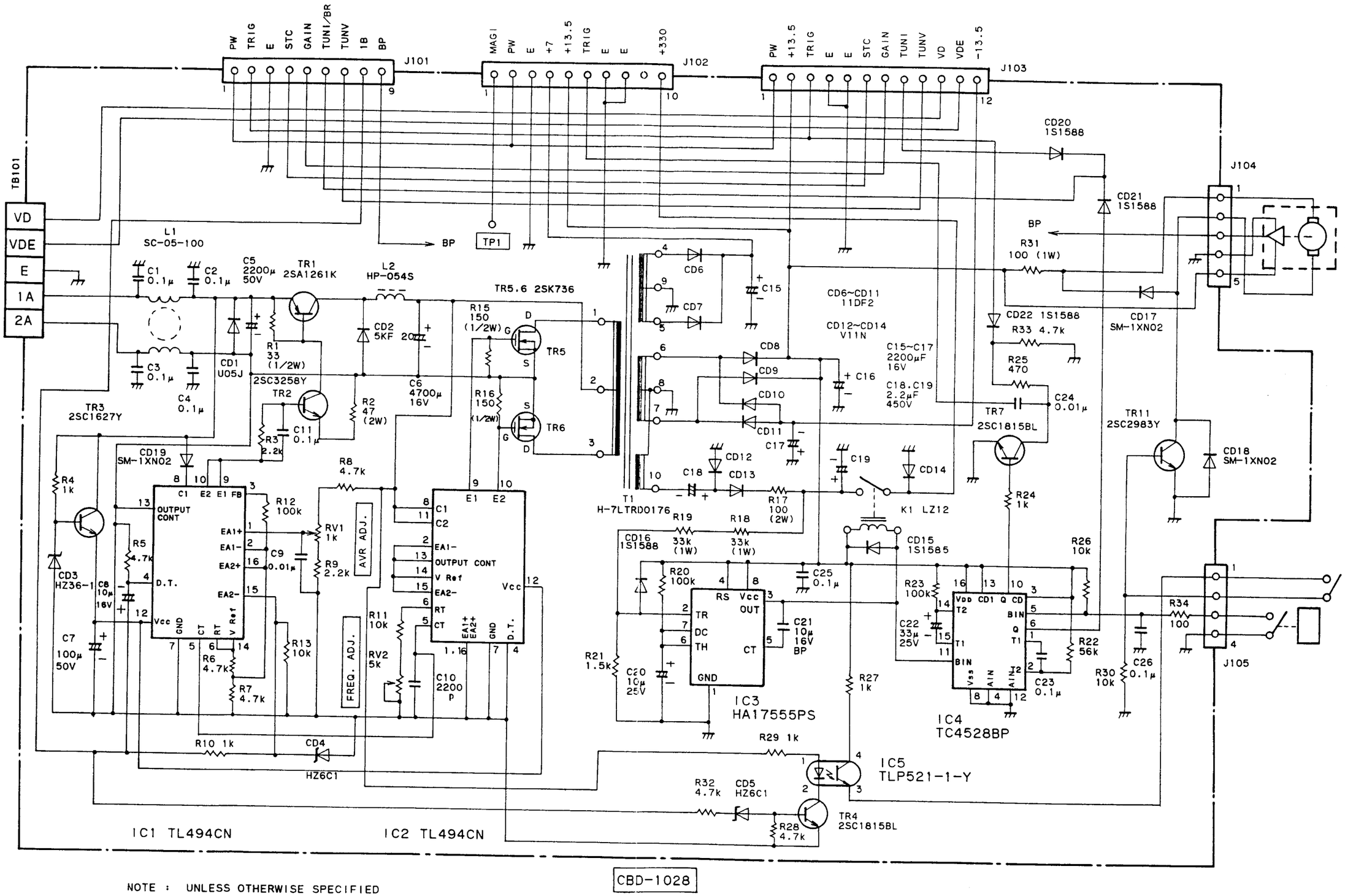


NOTE1 : UNLESS OTHERWISE SPECIFIED
ALL RESISTORS ARE IN OHMS. 1/8W RATING
ALL CAPACITORS ARE IN FARADS. 50V RATING

NOTE2 : ALL CAPACITORS ARE 2200pF. UNLESS SPECIFIED
ALL DIODES ARE 1SS226. UNLESS SPECIFIED

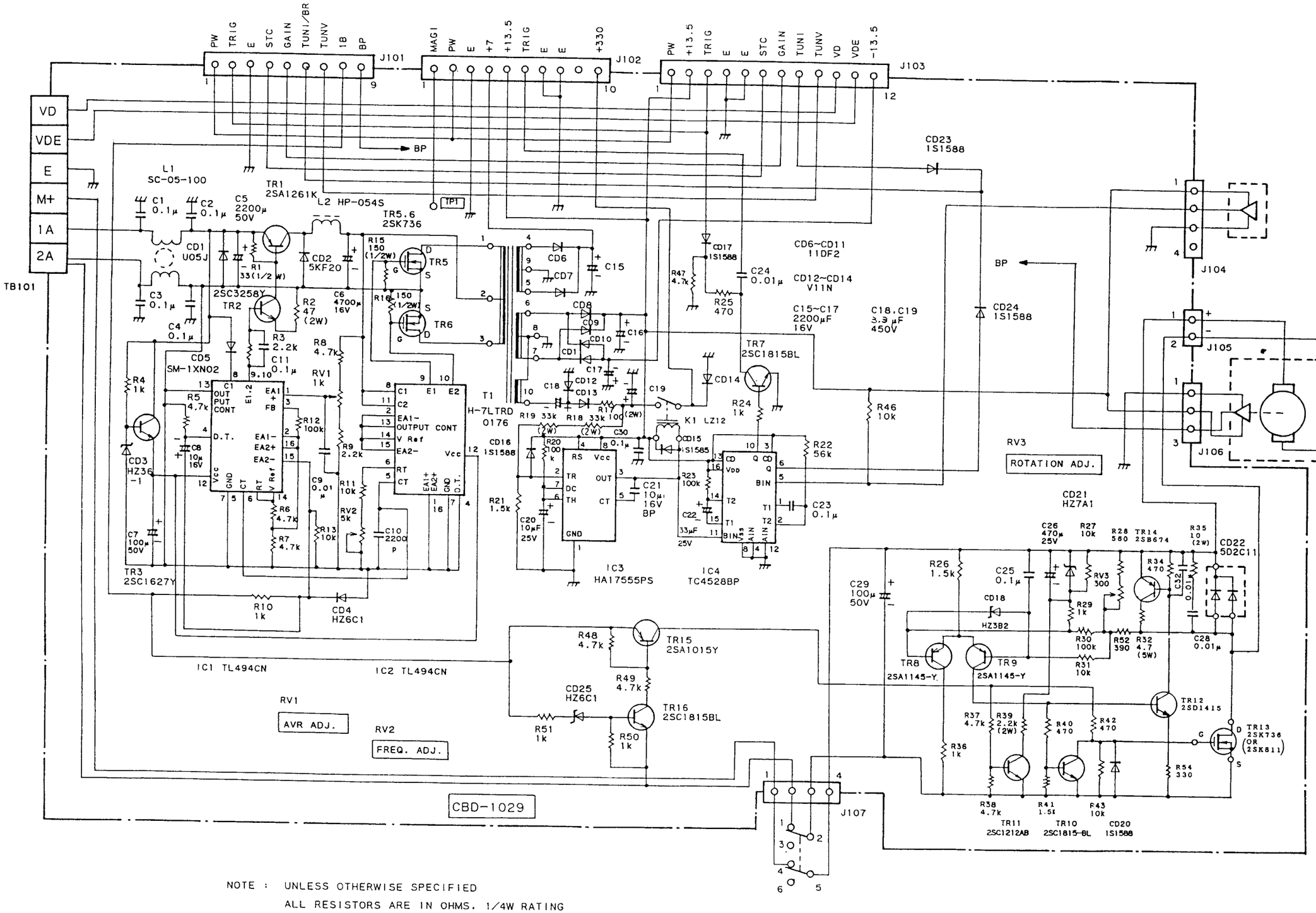
CAE-269

FIG. 110 CIRCUIT DRAWING OF RECEIVER PCB (CAE-269)



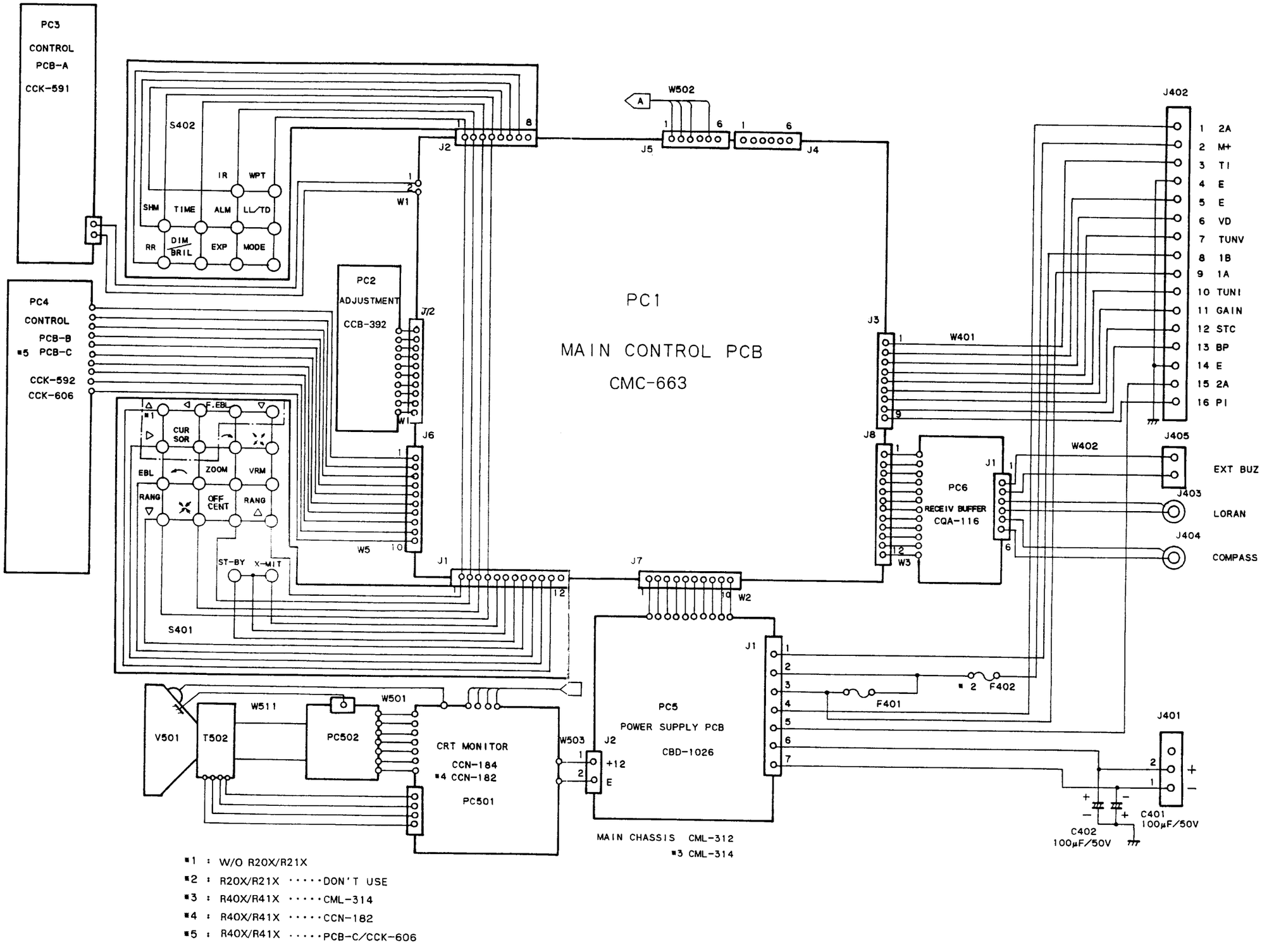
NOTE : UNLESS OTHERWISE SPECIFIED
ALL RESISTORS ARE IN OHMS, 1/4W RATING
ALL CAPACITORS ARE IN FARADS, 50V RATING

FIG. 111 CIRCUIT DRAWING OF POWER SUPPLY PCB (CBD-1028)



NOTE : UNLESS OTHERWISE SPECIFIED
ALL RESISTORS ARE IN OHMS. 1/4W RATING
ALL CAPACITORS ARE IN FARADS. 50V RATING

FIG. 112 CIRCUIT DRAWING OF POWER SUPPLY PCB (CBD-1029)



*1 : W/O R20X/R21X
*2 : R20X/R21X ·····DON'T USE
*3 : R40X/R41X ·····CML-314
*4 : R40X/R41X ·····CCN-182
*5 : R40X/R41X ·····PCB-C/CCK-606

FIG. 113 INTERNAL CONNECTIONS OF DISPLAY UNIT

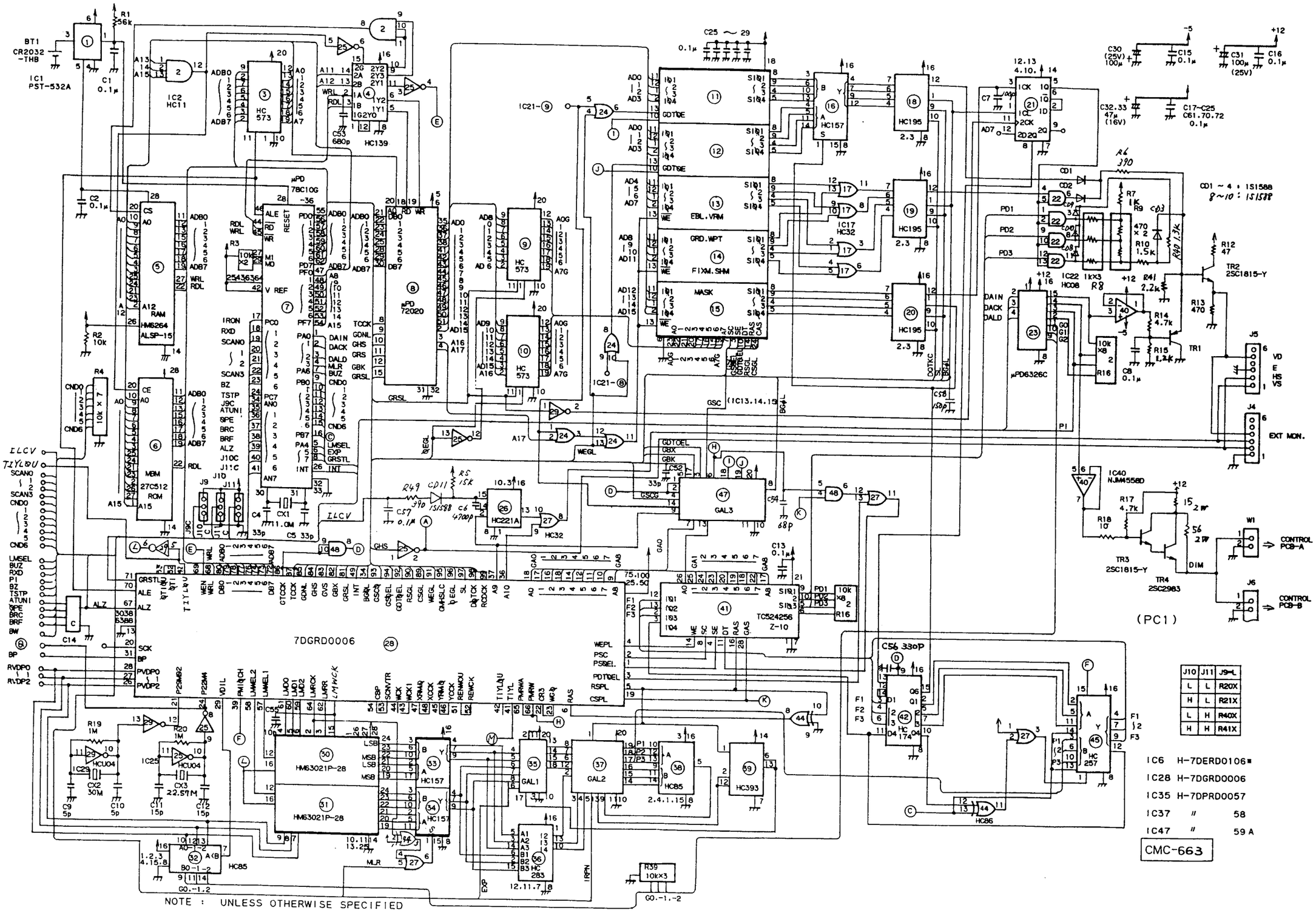
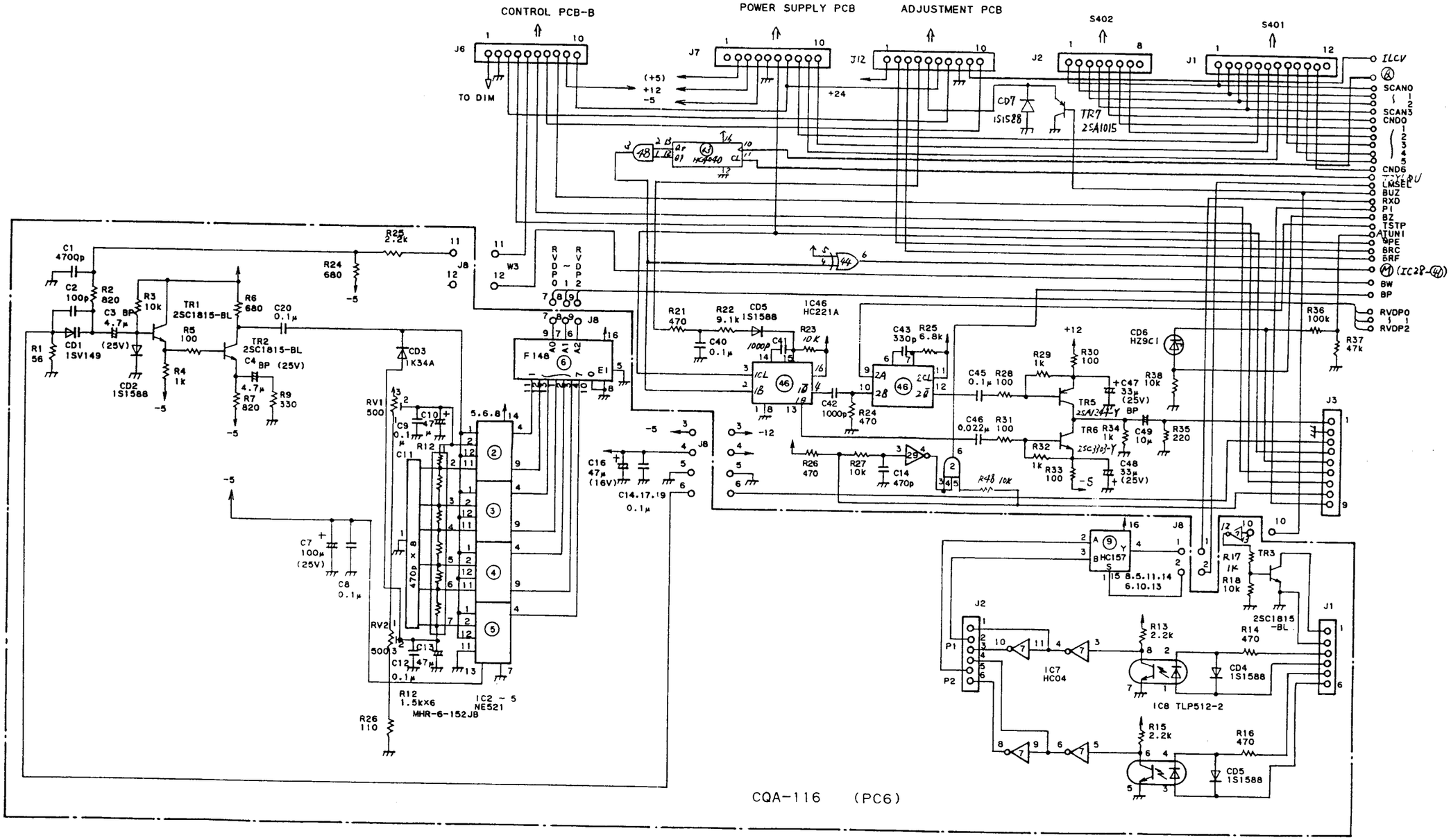


FIG. 114 CIRCUIT DRAWING OF MAIN CONTROL PCB (CMC-663) 1 OF 2

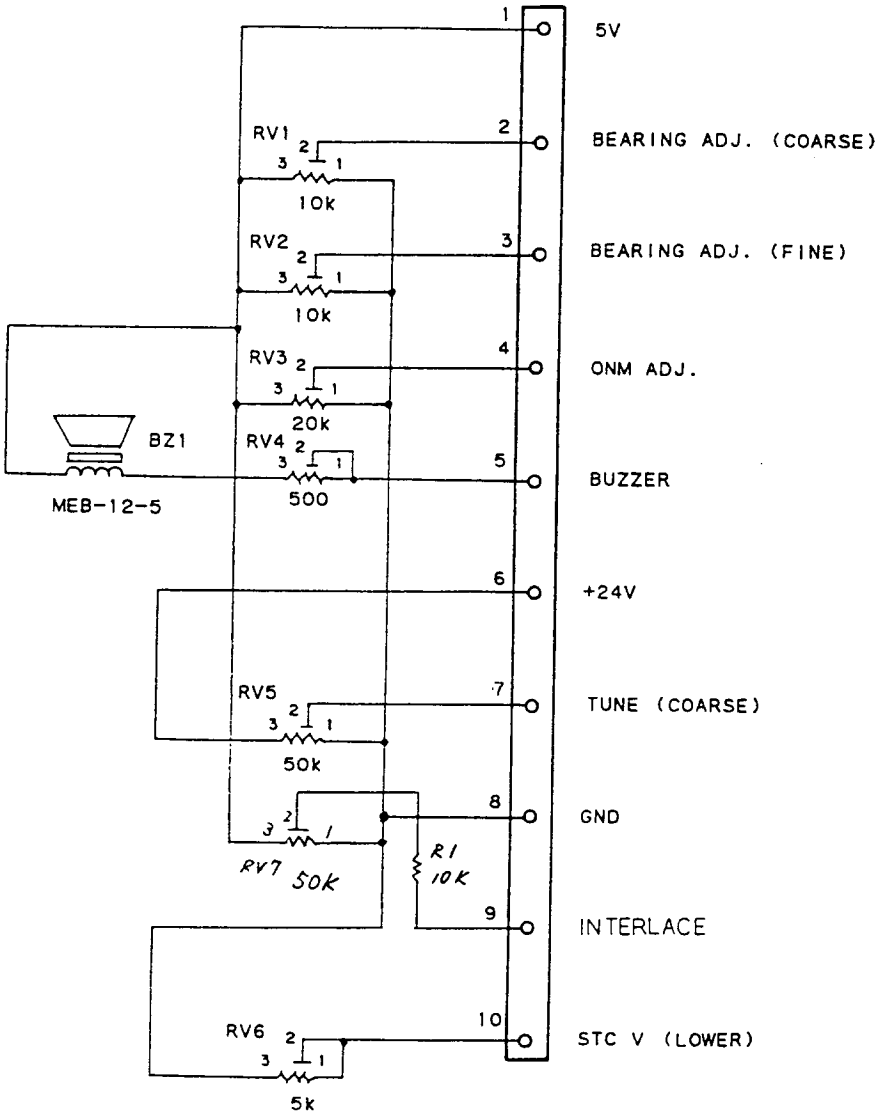


CQA-116 (PC6)

NOTE : UNLESS OTHERWISE SPECIFIED
ALL RESISTORS ARE IN OHMS, 1/4W RATING
ALL CAPACITORS ARE IN FARADS, 50V RATING

CMC-663

FIG. 115 CIRCUIT DRAWING OF MAIN CONTROL PCB (CMC-663 CQA-116) 2 OF 2



RV1~6 B.1/3W, 100VDC. Ω

CCB- 392

FIG. 116 CIRCUIT DRAWING OF ADJUSTMENT PCB (CCB-392)

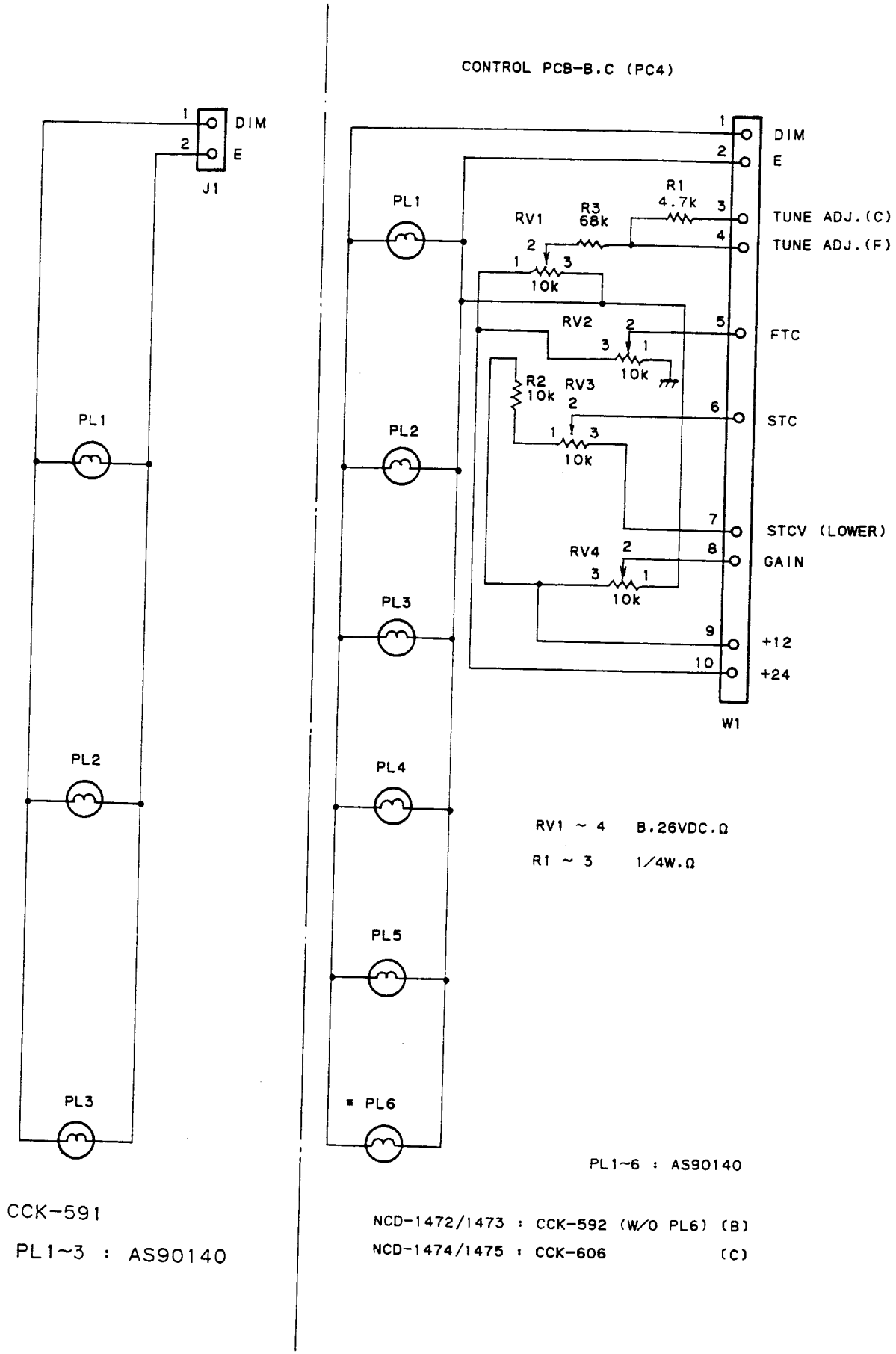


FIG. 117 CIRCUIT DRAWING OF CONTROL PCB (CCK-591/592/606)

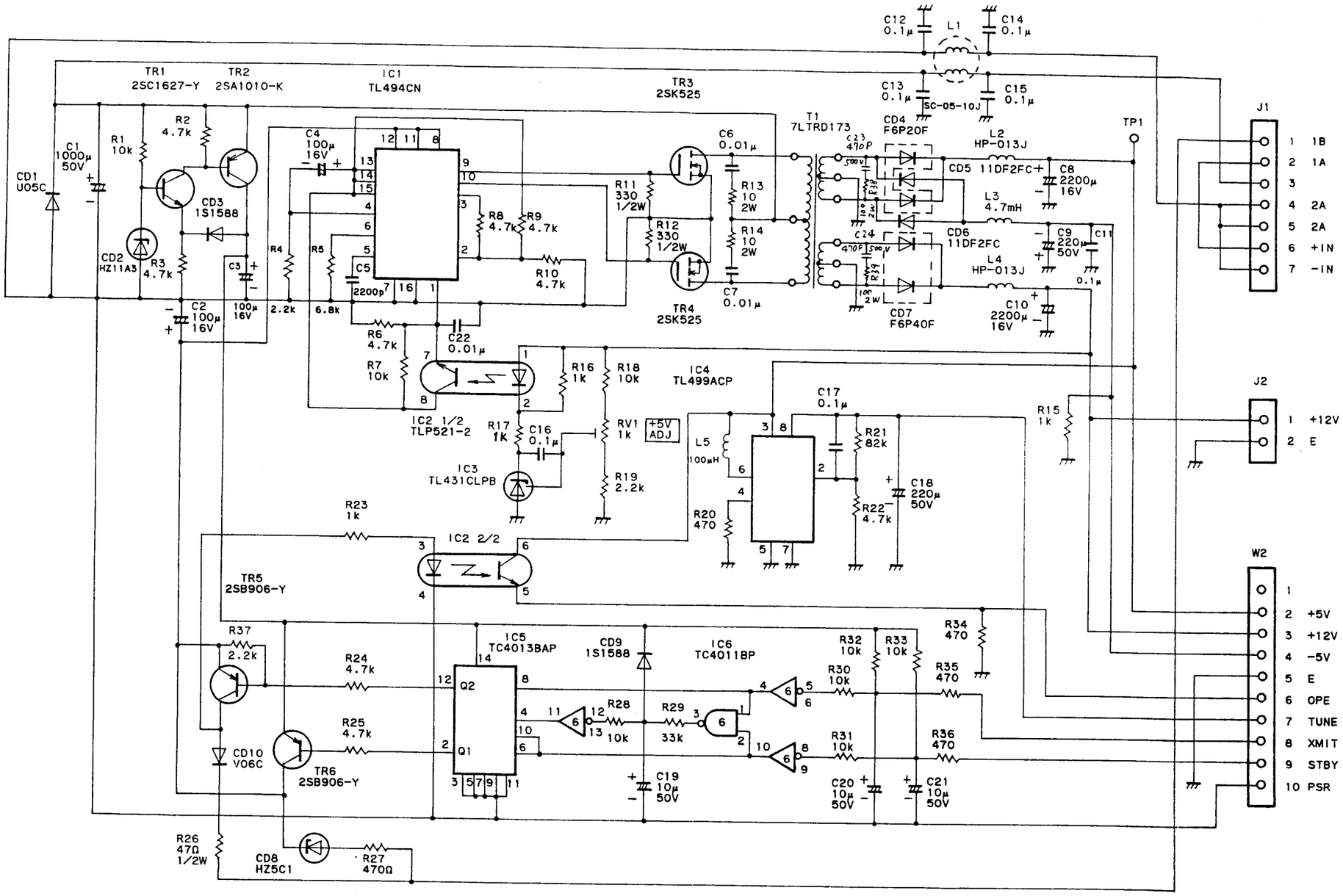
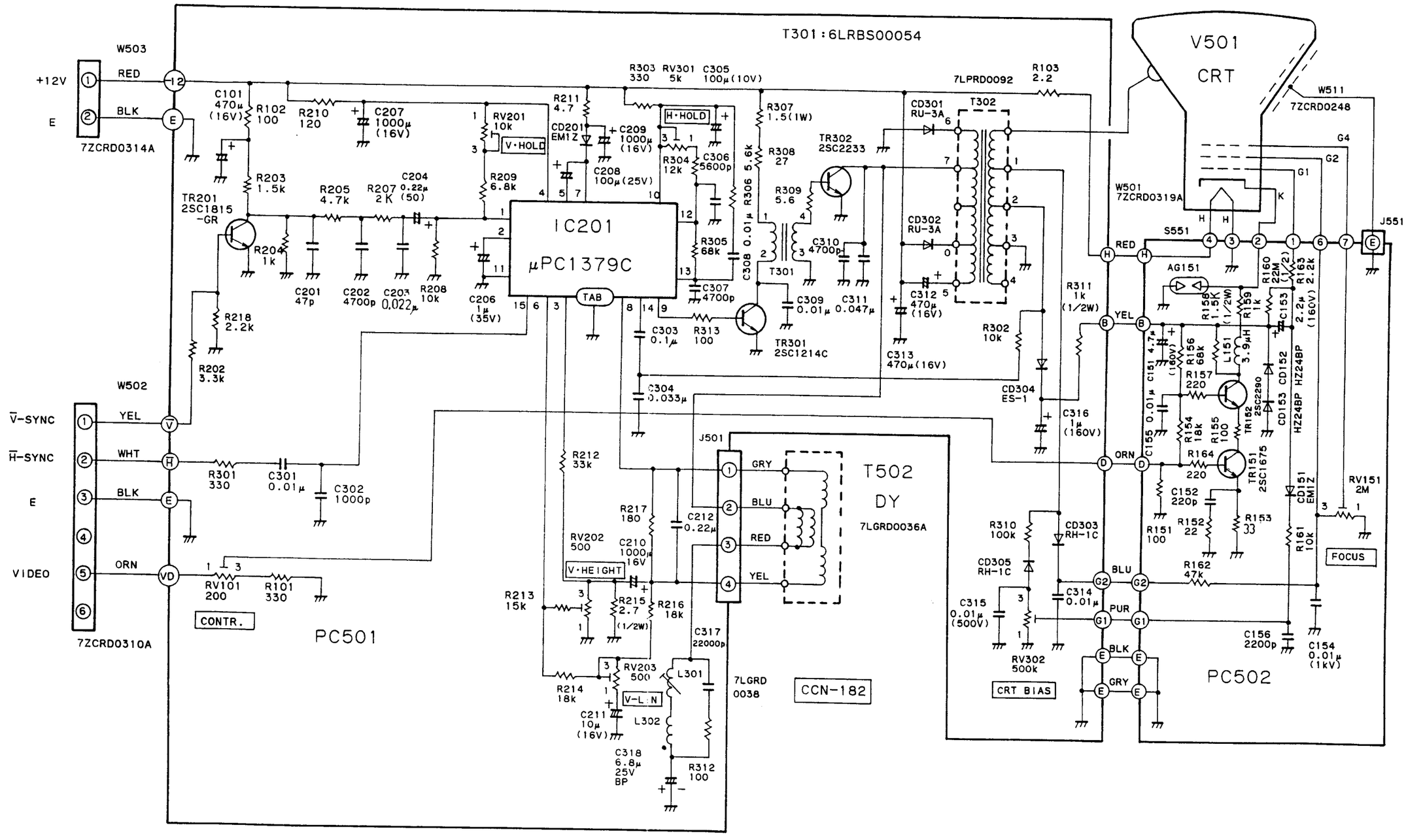


FIG. 118 CIRCUIT DRAWING OF SUPPLY PCB (CBD-1026)



NOTE : UNLESS OTHERWISE SPECIFIED
ALL RESISTORS ARE IN OHMS. 1/4W RATING
ALL CAPACITORS ARE IN FARADS. 50V RATING

FIG. 119 DISPLAY ASSEMBLY 10" DISPLAY UNIT (CCN-182)

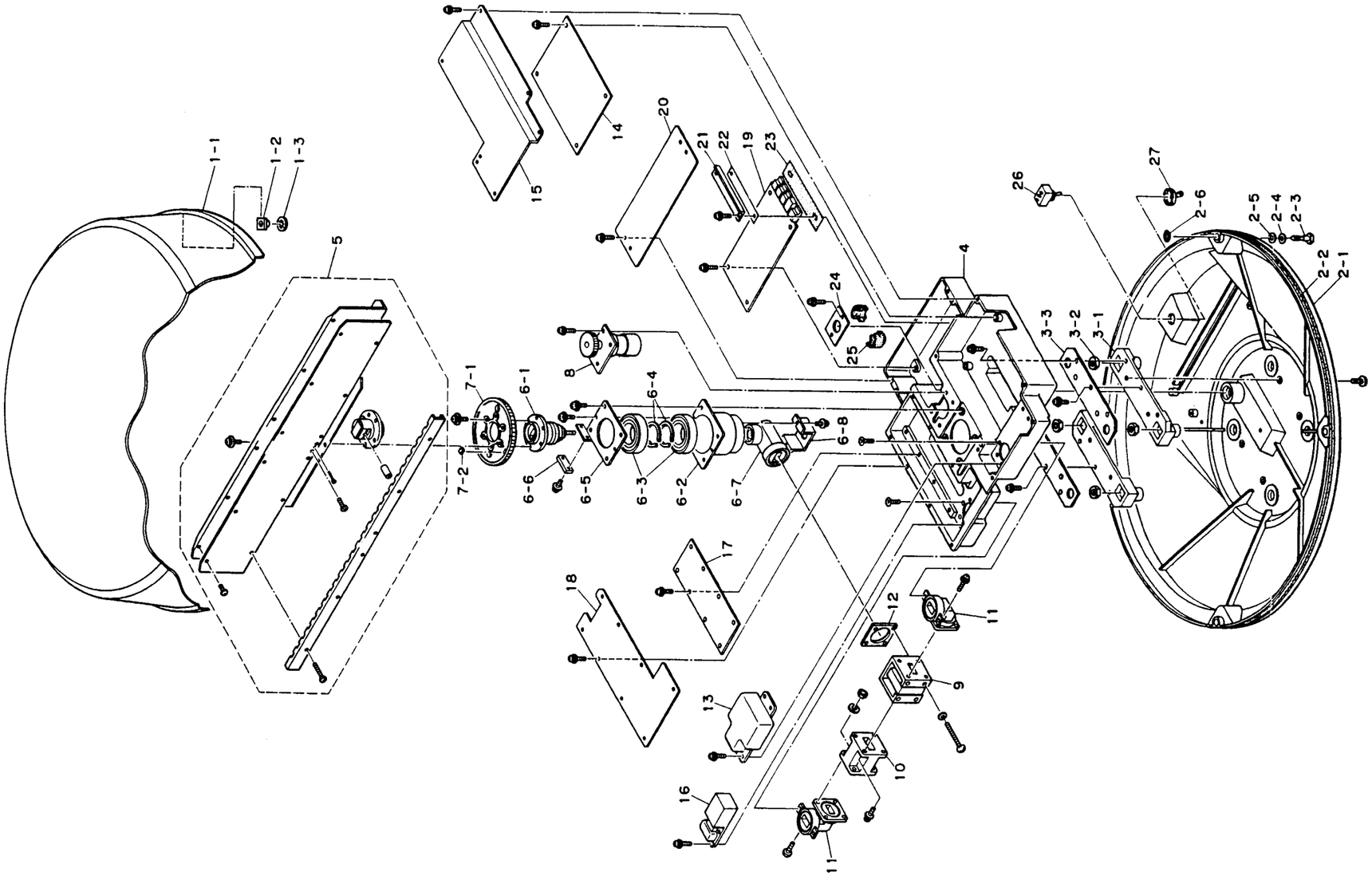


FIG. 120 ASSEMBLY DRAWING OF RADOME SCANNER UNIT

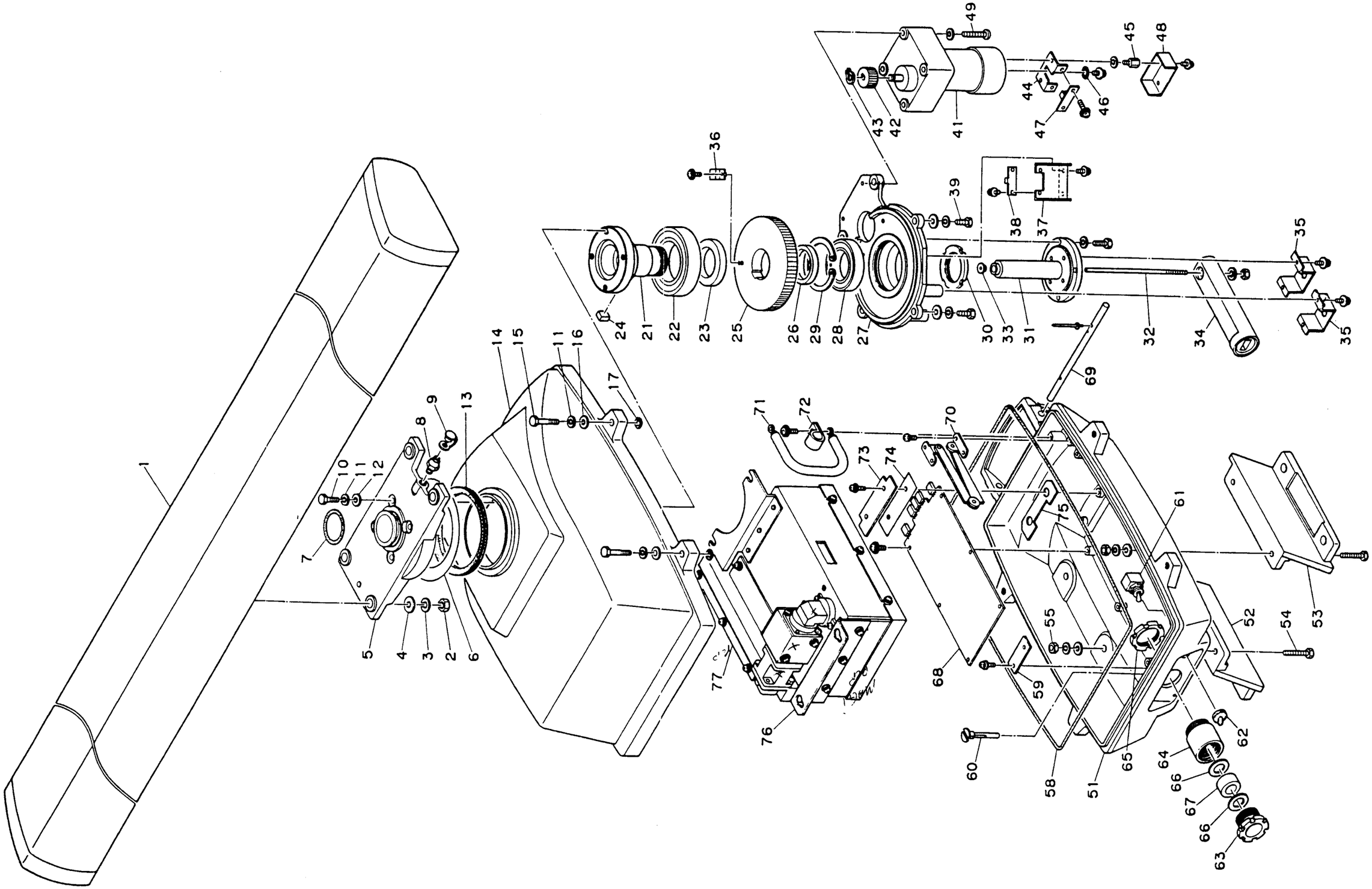


FIG. 121 ASSEMBLY DRAWING OF OPEN ARRAY SCANNER UNIT (1/2)

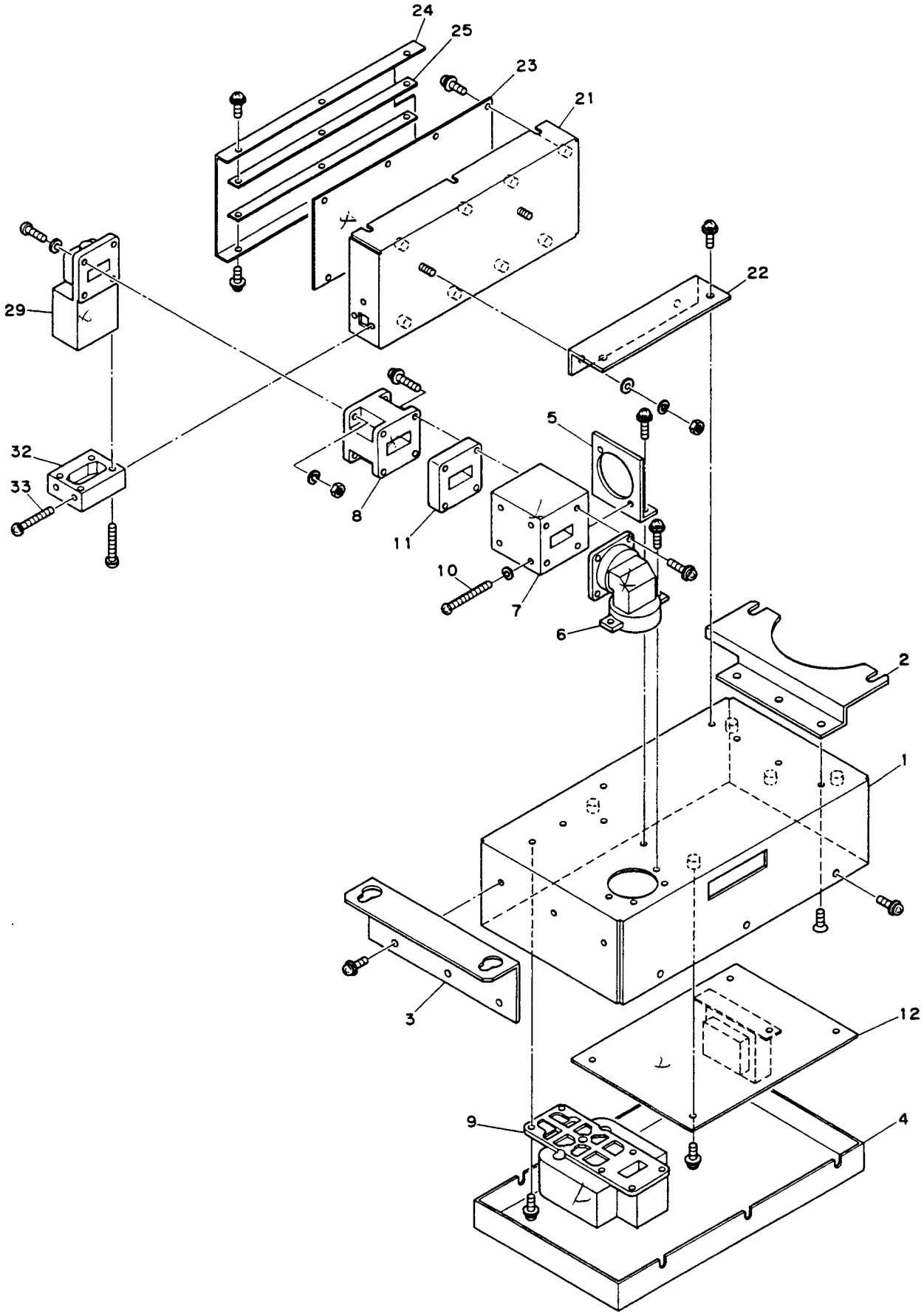


FIG. 122 ASSEMBLY DRAWING OF OPEN ARRAY SCANNER UNIT (2/2)

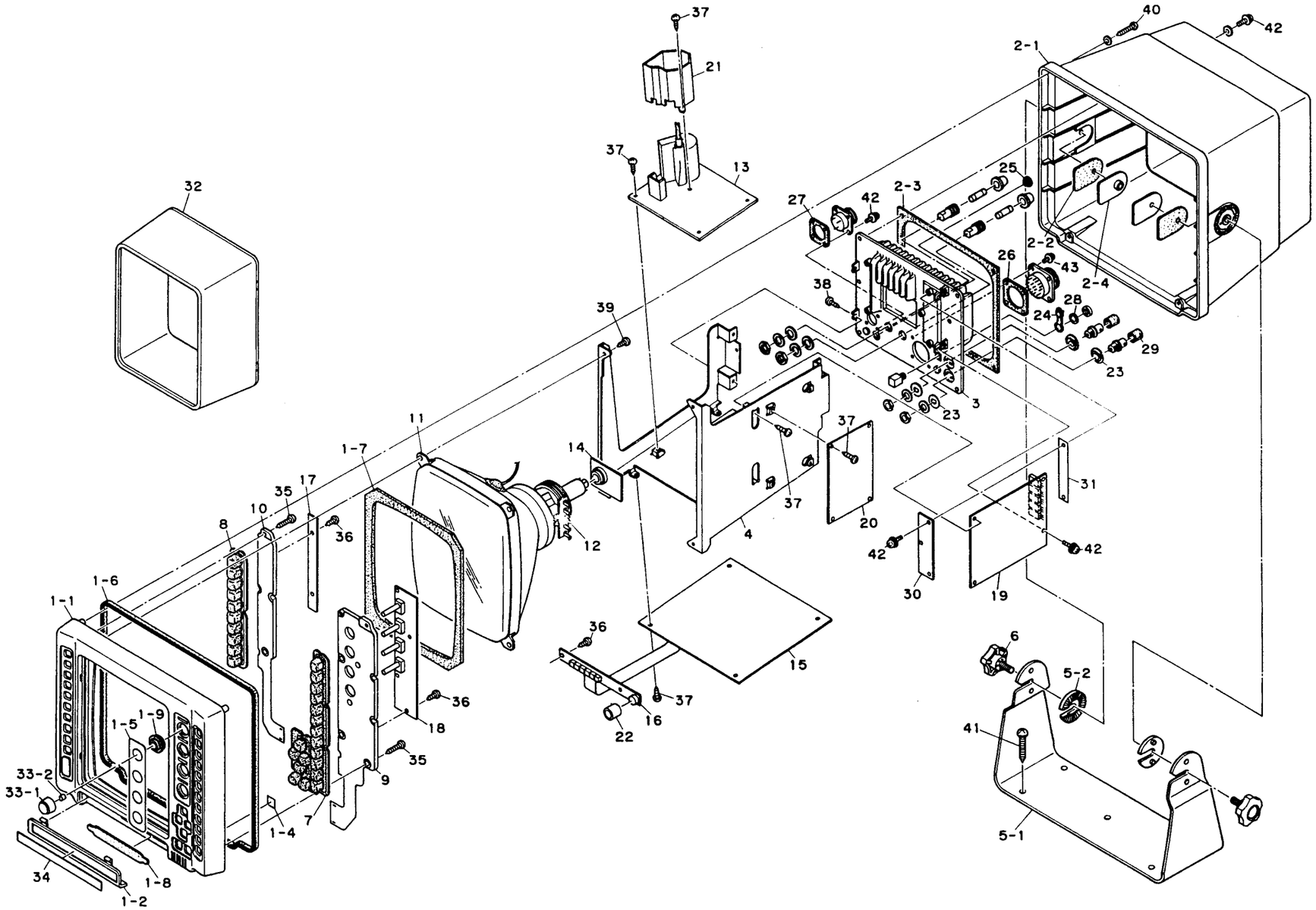


FIG. 123 ASSEMBLY DRAWING OF DISPLAY UNIT