MARINE RADAR EQUIPMENT

RADAR 3000

FIELD SERVICE MANUAL

JRC Japan Radio Co., Ltd.

CONTENTS

SECTION 1

SPECIFICATIONS

1.1 GENERAL

1. Maximum ranee: 24 Nautical Miles
2. Minimum ranee: Less than 25 m on the. 125 NM range
3. Ranee scales

Range (NM)	Number of Rings	Ranee ring Interval(NM)
0. 125	2	0.0625
0.25	2	0.125
0.5	2	0.25
0.75	3	0.25
1.5	6	0.25
3.0	6	0.5
6.0	6	1.0
12.0	6	2.0
24.0	6	4.0

4. Range discriminations: Less than 25 m
5. Range rind accuracy: Better than ;±0.9% of maximum maximum range of the scale in use, or 8 m, whichever is the greater.
6. Bearing accuracy: ± 1 degree
7. Display device: CRT: 7" (640 x480 dots)
8. Environmental conditions:

Scanner unit	Temperature	- 15° C to +55° C
	Humidity	UP to 95% at 35° C
Display unit	Temperature	- 10° C to + 50° C
	Humidity	UP to 95% at 35° C

9. Input power: 10.2 V to 42V
10. Power consumption: 65 W
11. AVR: Floating AVR system

1.2 SCANNER UNIT

1. Dimensions: Diameter 620mm; Height 275mm
2. Weight: Approx. 9.5 Kg
3. Polarization: Horizontal
4. Beamwidth: Horizontal 4° nominal; Vertical 25°
5. Sidelobes: -21 dB or greater
6. Rotation: Approx. 27 rpm
7. Transmitter frequency: 9410±30 MHz
8. Peak power output: 4KW
9. Pulse length/PRF: 0.08us/2250Hz (0. 125, 0.25, 0.5, 0.75 NM)
   0.35us/1500Hz (1.5, 3. 6 NM)

w

	0.7us/750Hz (3, 6, 12, 24 NM)
10. Duplexer:	T-junction with diode Limiter
11. Mixer:	MIC frontend
12. IF amplifier:	Center frequency 60 MHz Bandwidth 3/10 MHz
13. Noise figure	Less than 6 dB
14. Characteristic	Semi-Log

1.3 DISPLAYUNIT

1. Dimensions:	Width	276 mm
	Depth	250 mm
	Height	204 mm
2. Weight:	Approx.	6 Kg
3. Mounting:	Table, Overhead, or Flush mount	
4. Video:	8 levels quantitized	
5. Tuning:	Auto/ Manual	
6. Bearing scale:	360° scale graduated at intervals of 1°	
7. VRM:	3 digit readout	
8. EBL:	3 digit readout	
9. Alarm:	Audible alarm with zone mark	
10. Off Center:	2/3 radius	
11. Planned TX:	Rotation period 10, 20 or 30 scans Repetition period 3, 5, 10, 15 min.	
12. LANGUAGE:	English, Spanish, Norwegian	
13. Features:	VRM(2), EBL(2), Cursor with LL, Interference rejection, Target expansion, Target alarm, LL or TD readout, Waypoint with LL, Offset, Timed TX, Target Trail, Auto tune, Man Overboard	
14. External input:		
NAV-AID	NMEA0183 (RMA, RMB, RMC, GLL, GTD, VTG, BWC sentence) NMEA0182	
Compass	NMEA0183 (HDM, HDT, VWH, or HSC sentence)	

SECTION 2

TECHNICAL DESCRIPTION

2.1 GENERAL

The theory of operation for the Radar Set RADAR 3000 is presented here with descriptions following the functionalblock diagram circuits Figure 2-2.

2.2 RADOME ANTENNA UNIT

The Radome antenna unit consists of the RF PCB radiator, the motor /encoder assembly, radiator rotating mechanism, bearing reset assembly, and the transmitter/receiver units. These components are all housed within the 24.5" radome. The functional Block Diagram of Radome Antenna Unit appears in Figure 2-2.

2.2.1 RADIATOR

The RF PCB radiator forms the main RF transmitting beam for the radar tramsmitter and becomes the receiving antenna during the receive cycle. The beam formed by the phased array styled PCB at half power points is 4°horizontally and 25°vertically. The direction of the beam (maximum radiated power) is essentially perpendicular to the radiator surface.

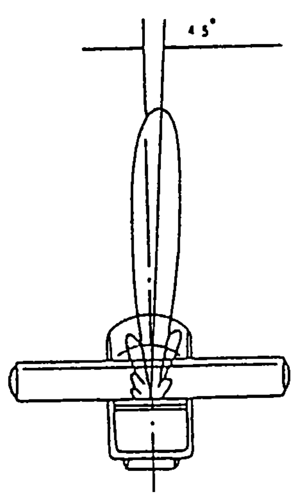


Fig. 2-1 RADIATOR PATTERN

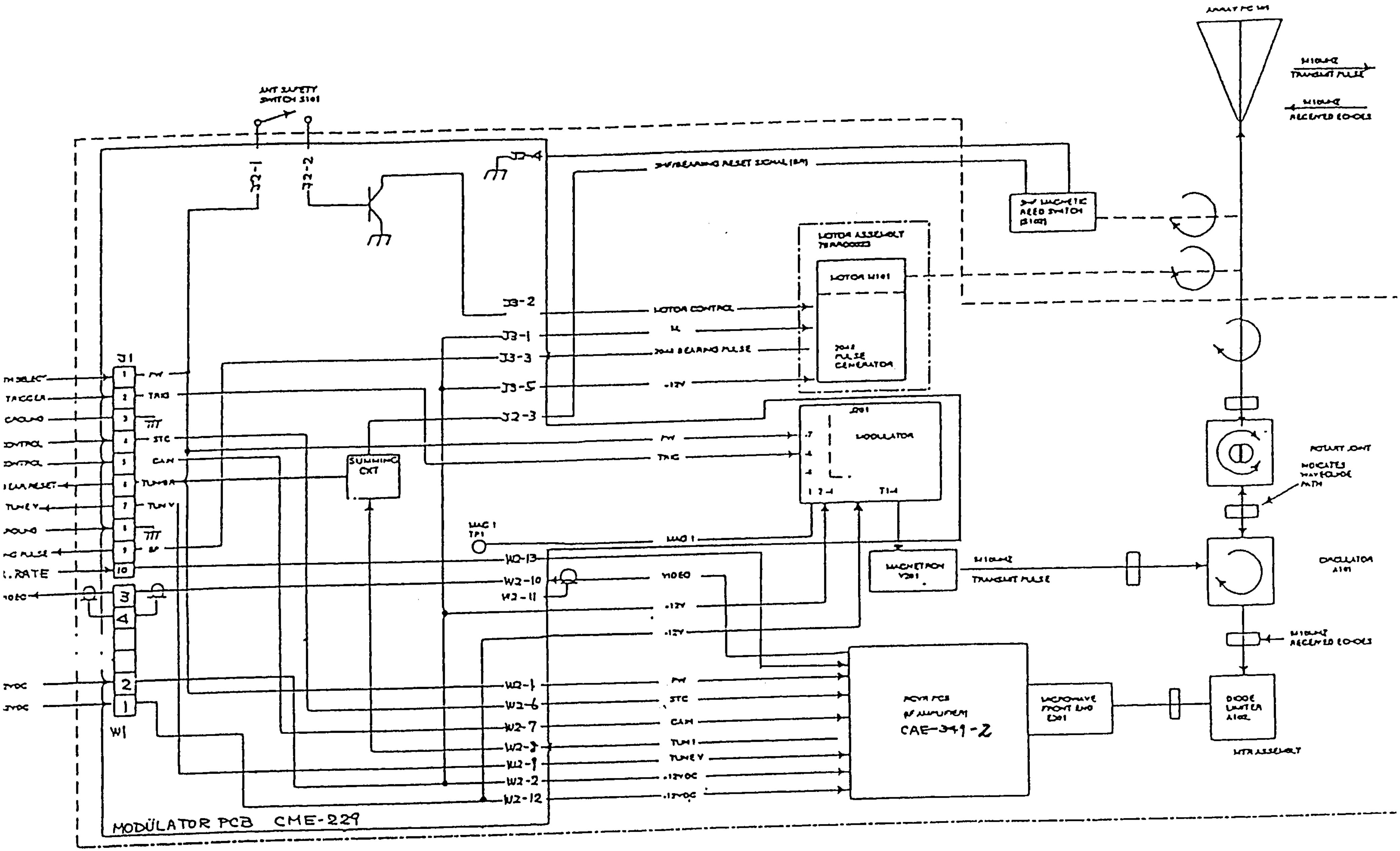


FIG. 2-2. BLOCK DIAGRAM OF RADOME SCANNER UNIT

2.2.2 RADIATOR ROTATING MECHANISM

The mechanical coupling between the PCB radiator assembly and the motor-encoder is effected by a reduction drive gearbox. The antenna motor normally rotates the radiator at approximately 27 rpm.

2.2.3 MOTOR-ENCODER

A 12 VDC motor operating at a regulated 12VDC is used to rotate the radiator. At the bottom end of the motor an encoder section produces bearing pulses used for sweep line generation, rotation synchronization of the sweep line within the display unit. A bearing sync pulse(BP)is generated for every 0.176 degrees of rotation (2048 pulses pereach revolution) at 5 VDC amplitude. These pulses are sent through J1-9 down to the Bearing Pulse circuitry in the display unit.

2.2.4 BEARING RESET SWITCH

The bearing reset switch, or otherwise referred to as the "heading reference switch", produces the signal to reset the scan converter circuitry to "0" when the permanent magnet fitted on the main gear passes across the reed switch S102. The resulting signal (BZ) is sent down to the bearing reset circuitry in the display unit and synchronizes the scanner position to the display sweep. The BZ signal is sent down to the display together with the Tune indication signal at J1-6.

2.3 TRANSMITTER UNIT

The transmitter consists of the solid state modulator circuits, the power supply, and the 4kW magnetron.

A. Modulator

A solid state type pulsar design is used by the modulator and primarily consists of a pulse generator circuit, power MOSFET switch, and pulse transformer.

When setting the X-MIT/STBY key on the indicator control panel at the display unit to "ON", the transmitter trigger pulse is sent via the interunit cable from the transmit trigger generator circuit in the display unit to the base of TR2 in the modulator.

Simultaneously+12 VDC and-12 VDC is supplied to the modulator to operate the HV power supply for the transmitter. The switching regulator power supply provides +350 VDC to charge the capacitor (C21 and C22). In addition to the high voltage for the modulator, the power supply also provides the magnetron filament voltage and the operating Vcc for the PFN control circuits TR7-TR10.

Generally the pulse width of the pulse generator circuit is controlled by the range key selectons on the indicator front panel.

Three different pulse lengths: 0.08μsec, 0.35μsec and 0.7μsec(in accordance with the range scale or menu selections) can be provided. The pulse repetition frequency(PRF) always changes automatically to match the selected operating pulse length(See TABLE 2-1).

Upon receiving the positive trigger pulse, TR2 generate a differential waveform at C15, RV2, RV3, and RV4 setup the discharge period of this waveform to generate a short (80ns), medium(350ns), or long(700ns) gate to IC2-2. The pulse is amplified and applied to the gate of TR11 which will conduct for the selected pulse length drawing current through the primary of the Pulse Transformer (T2) generating a 3.7kV pulse to the magnetron cathode.(See Fig 2-3)

TABLE 2-1 RANGE, PULSE LENGTH, AND PRF RELATIONSHIPS

Range	Pulse Length	PRF
0.125, 0.25, 0.5, 0.75, 1.5 nm	0.08μS	2250 Hz
3.6 nm	0.35μS	1500 Hz
12, 24, 32 nm	0.7μS	750 Hz

2.4 RECEIVER UNIT

The receiver unit consists of the passive diode limiter, the MIC Front End and the Receiver IF PCB(CAE-349-2).

The MIC Front End(E301, S-RX24) device consists of low-noise RF amplifier, a double balanced mixer, and the local oscillator. The received radar echo signals at 9410 MHz are first amplified by the low-noise RF amplifier. The signals are then sent into the double balanced mixer of the MIC. The MIC Local Oscillator, tuned by the adjustment of the operator's Tune control on the display unit front panel to be 60 MHz higher than the magnetron's operating frequency for maximum target detection, is also fed into the double balanced mixer. The balanced mixer output of 60 MHz echo signals is then coupled into the 60 MHz IF amplifier.

RECEIVER PCB (CAE-349-2)

The Receiver PCB includes the 60 MHz IF amplifier, bandwidth control circuits, video detector, tune circuitry, the GAIN/STC/MBS amplifiers and the video output circuitry.

IF Amplifier Circuit: The IF amplifier consists of low-noise gain controlled IC amplifiers IC1, IC2 and IC3, and bandwidth selector circuits TR1 and TR2.

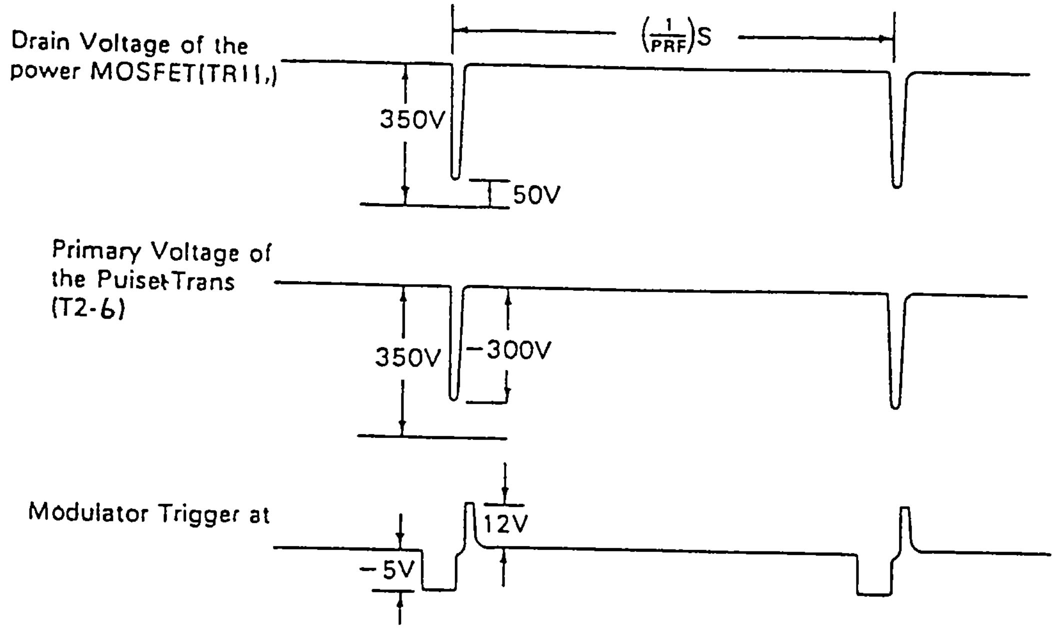


FIG. 2-3. TIME TABLE OF THE TRANSMITTER

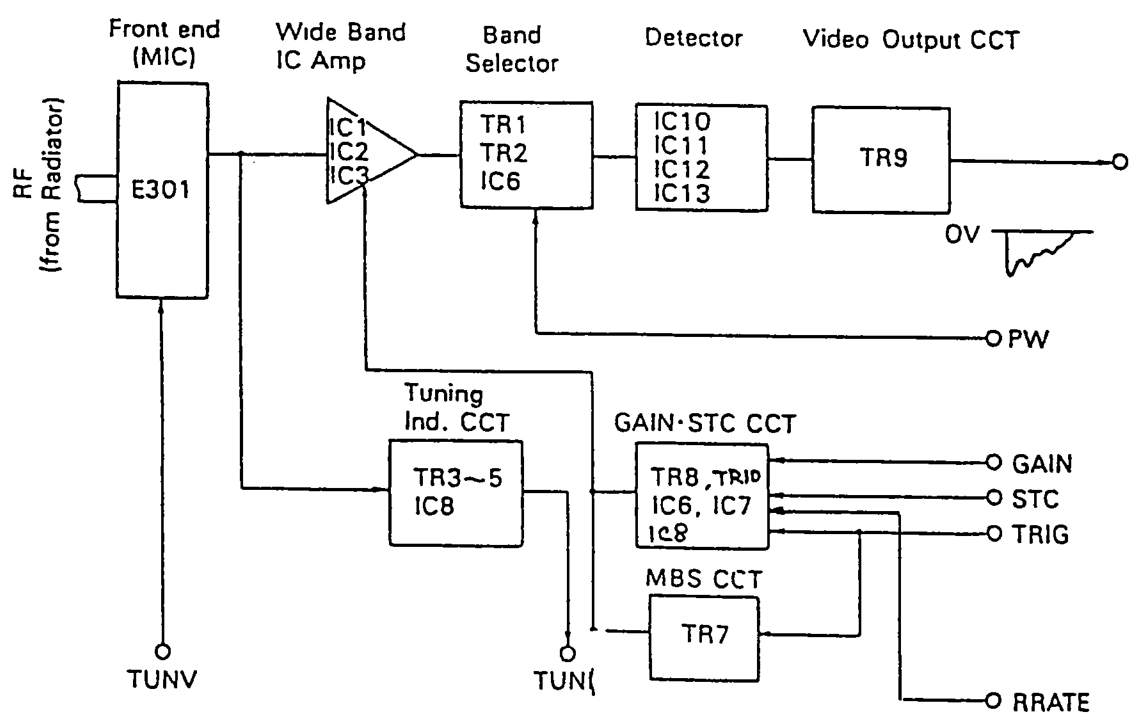


FIG. 2-4. RECEIVER UNIT BLOCK DIAGRAM

RADAR 3000

IC1 and IC2 are controlled by the gain and STC control signals generated by the TR8, IC6, IC7. Maximum gain is obtained when the voltage level at IC1-5 and IC2-5 reaches 4 volts.

The bandwidth selector IC6 enables components to be activated in the amplifier circuit so the receiver has either a 10 MHz or a 3 MHz bandwidth characteristic. The selection depends on the pulse length selector signal (PW).

When no pulse length signal is present, IC6 will be "OFF" and the gate voltage of TR2 will be 0 volts. In this condition, the pulse length in operation is 0.08 μS and the bandwidth of the receiver is widened to 10 MHz. When the pulse length signal is other than 0.08 μS, IC6, will be turned "On", the gate of TR6 will be -4V, and the bandwidth will become narrow at 3 MHz.

Video Detector Circuit.

The video detector circuits IC10, IC11, IC12 and IC13 operate as logarithmic amplifiers to remove the 60 MHz IF component from the incoming signals. The negative going signals appear across R76 where the IF component is removed by filter R14, L7. The detected signals, now at video frequency rates, are sent to the video output circuit.

Video Output circuit

The video output circuit consists of emitter follower TR9. The emitter follower operates strictly as an impedance transformer to drive the 50 ohms coaxial cable which carries the video signal to the display unit. The video signal is shown in FIGURE 2-4.

TUNING Indication Circuit

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

Gain-STC Circuit

The receiver includes GAIN and STC circuitry compresed of TR8, IC6 and IC7. The GAIN control voltage from the display unit is 12 volts for maximum sensitivity and 0 volts for minimum sensitivity. IC 6-6 controls the GAIN DC threshold at the summing amplifier TR6. RV4 sets the maximum gain level for the receiver when +12 VDC is supplied at the GAIN input.

The STC control circuitry consists of TR8 and IC7. The transmit trigger is coupled to the STC gate generator by C54. This circuit uses only the negative portion of the transmitter trigger to generate the STC pulse. The positive portion is removed by CD7. TR8 will be turned "ON" and C56 will charge. When the trigger pulse ends, TR8 will be turned "Off". C56 can then discharge back to 0V through R61 and RV3. The rate of C56's discharge will be determined by the time constants of R61, RV3, C56, C24 and R57. The STC signal resulting from C56 discharging is combined with the Gain control voltage at TR6 and applied to the IC1 and IC2.

Main Bang Suppression (MBS) Circuit

The main bang suppression circuit is intended to blank the nearby transmitter energy at the start of the display sweep. TR7 is used to generate the main bang suppression pulse. This circuit also uses only the negative portion of the transmitter trigger to make the MBS pulse. The positive portion is removed by CD8. TR7 will be turned "ON" with the receipt of the MBS pulse and C57 will charge. When the trigger pulse ends, TR7 will be turned "OFF". C56 will discharge to 0 V through R63. The discharge rate will be determined by the time constant of C57, RV2, and R63. The MBS signal is combined with the Gain control voltage and STC signal and applied to the IC1 and IC2.

2.5 DISPLAY UNIT

The display unit normally contains the Main Control PCB, the Power Supply PCB, the CRT and the CRT Display Control PCB, and the Control Panel PCBs.

2.5.1 SIMPLIFIED BLOCK DIAGRAM

FIG.2-5 shows the fundamental circuits of the display unit in a simplified functional block diagram. Most system operations within the display unit occur primarily on the Main Control PCB (CMC-1008). It is on this PCB that most of the signal processing takes placed. The following is a brief description of the main circuit functions of the display unit.

2.5.2 MAIN CONTROL PCB

2.5.2.1 VIDEO INPUT CIRCUITRY

The incoming video signals from the receiver in the scanner are first routed through the FTC circuit components consisting of CD11 and C52.

The Varicap diode CD11 controlled by the voltage supplied from IC30-(8) which is determined by the front panel RAIN CLUTTER Control.

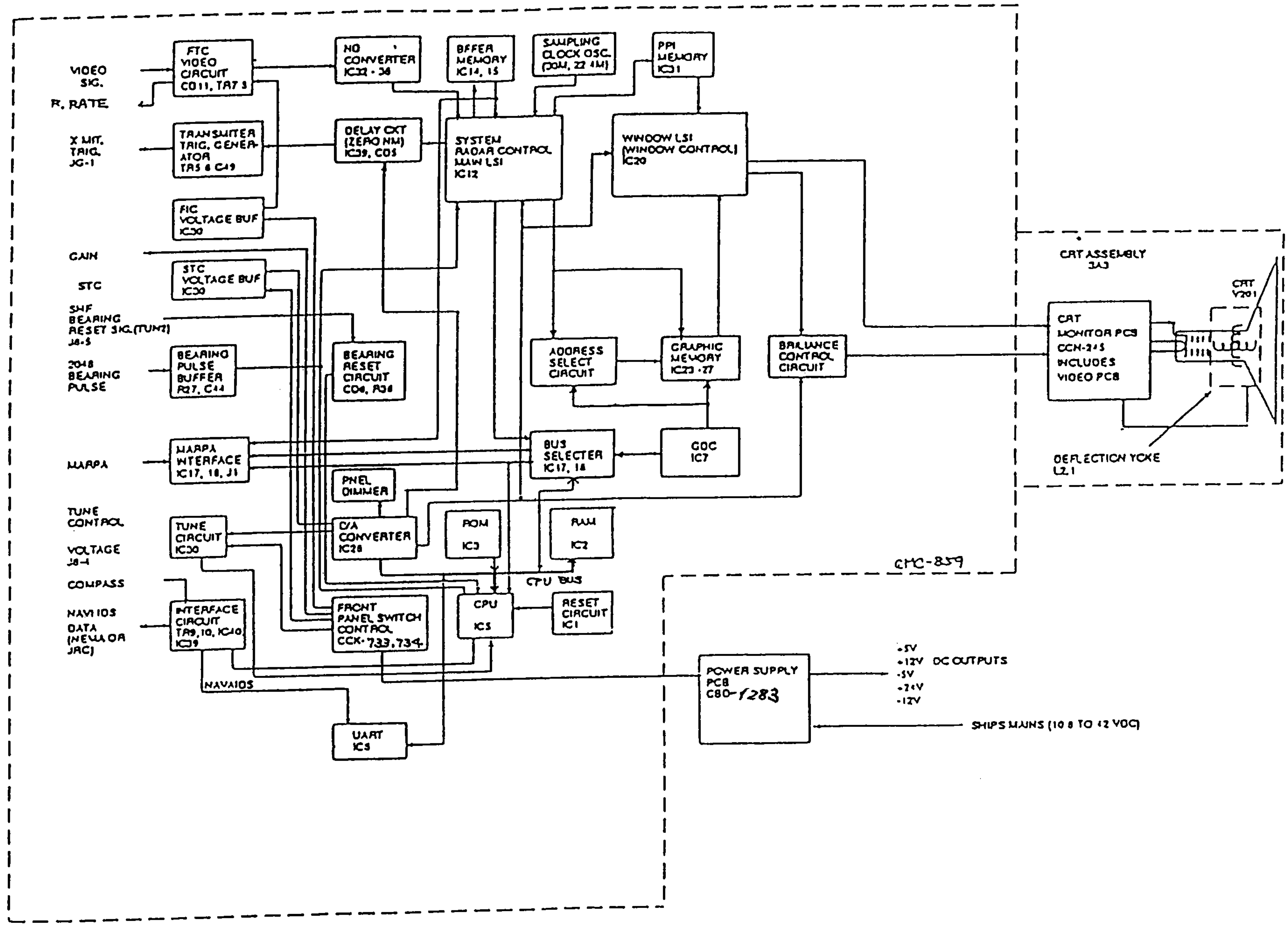


FIG. 2-5. BLOCK DIAGRAM OF DISPLAY UNIT

Maximum FTC occurs when the voltage level at CD11 cathode is 3VDC.

2.5.2.2 A/D CONVERTER

The A/D converter changes the incoming video signal form analog video signals into 3 bit digital signals. The A/D converter consists of IC32-IC36. Since the conversion must occur at high speed, four comparator ICs are used. The MSB threshold level (brightest video) is set by RV2(Upper) located in the Main Circuit PCB. The digitized video output (RVDPO-3) is then sent to IC12, the Main LSI and Video Processor for storage into the video buffer memory.

2.5.2.3 MAIN LSI/VIDEO PROCESSOR

The Main LSI, IC12 receives the bearing pulse signals(BP) generated by the antenna motor/encoder assembly to synchronize the timing of the scan converter and to control the various clock inputs and outputs for the video memory and display. When the bearing pulses are received, IC12 also generates the radars transmit trigger at TIYLOU. The trigger signal is sent over to IC27 where the ONM delay timing adjustment is applied. The output at IC37-12 and IC37-13 provide complementary drive signals to TR5 and TRD6. These amplifiers boost the output transmit trigger(TI) level to +12 VDC in amplitude.

2.5.2.4 SAMPLE CLOCK GENERATOR

The sampling clock oscillators generate the frequencies necessary to create the various timing signals including those used for controlling the processing of the digital video signals into the memories.

The Sampling Clock Generators consist of crystals CX2 and CX3, along with IC13 and IC10. The CX2 operates at 30MHz and CX3 operates at 22. 3MHz. The 22.3 MHz frequency is used to determine the timing clocks used on the 0.125, 0.25, and 0.5 and 32 nm range scales, while the 30 MHz clock frequency is used to determine the clock timing on the remaining range scales.

The Video Processor is contained in IC12 (Main LSI) and can perform two additional processing functions on the video signal when activated in menu. They are: Interference Rejection Processing and Target 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 whenever the IR function is enabled by the operator. The Expander Processing is performed by extending the target digital video pulse length up to 8 additional digital video cells whenever target expansion is enabled in the menu.

2.5.2.5 BUFFER MEMORY

IC14 and IC15 are Buffer Memories capable of 2K word × 8 bit dual port input data and output data handling. The buffer memories are used to temporarily store the digitized video input signals according to the clock timing for the range scales in use for the video processor. Memory IC15 is used to store the IR processed video data memory.

2.5.2.6 VIDEO MEMORY

The start of the data readout of the video buffer memory is triggered on the trailing edge of the bearing pulse from the scanner unit. This clock is used for data processing in IC12. The processed video data which has passed through IC12 is now transferred to the video memory IC31. IC31 is a DRAM consisting of 256K × 4 Memory planes which are used to produce the picture data, EBLs, VRM, video (including wakes) range rings, etc.

The address signals used to write into the read out of the video memory are generated in IC12. The output data from the video memory is entered into IC20, the video signal mixer/ processor.

2.5.2.7 CONTROL PCBS

The RADAR 3000 use a keypad control PCB assembly(CCK-781) to activate the radar system
and control its functions. These keypad control PCBs interface directly into the Main Control PCB via connectors J6 and J7 to IC5(CPU) on the Main PCB.

CCK-781 contains 13 key switches and the jog dial controls for the TUNE, GAIN, FTC, STC and RANGE. Each panel includes LEDs for backlighting the keyboard panels and the LED intensity can be controlled in 8 levels of brightness by the menu selection via the DIM line. The operating voltage for the LEDs originates at IC29 and TR3 on the Main PCB.

2.5.2.8 GDC(GRAPHIC CONTROL MEMORY)

This radar uses an 8 bit CPU(IC5), and a Graphic Display Controller(IC7) to principally control the graphic system of the on-screen display of VRM, EBL, Bearing Scale, Range markers, and other graphic characters. The CPU receives operating instructions from the 1 Mbit EPROM in IC3 and system setting stores data in the 64 Kbits of RAM available in IC2. The RAM memory has a battery backup through IC1 so that the settings of Range, EBL, VRM, CRT brilliance, EXP, and IR will be maintained in memory after each shutdown of power.

The DGC(Display Graphic Controller) paints the various character data, VRM, EBL, Range Marker, etc. under direction of the CPU to the graphic DRAM memories IC23-IC27 while performing processing of the data from bearing pulsesd, reset pulses and from the keys on the control panel.

The contents of the DRAM memories is read out by input parallel-serial converters located in IC12 and ultimately is sent to IC20.

2.5.2.9 VIDEO OUTPUT

In IC20, data which has been written into the Video Mixer/ Processor by the range and sample clock timing signals will now be read out to the CRT monitor in raster scan timing; that is, the Horizontal frequency of 15.750 KHz and 60 Hz Vertical frequency.

The 3 bit digital video signals are re-converted by IC20, into analog video signals having 8 levels and outputted to the buffer amplifier TR2. The graphic data is input to TR2 via CD1 and IC20. When the brilliance control is changed in the function menu, the brilliance control signal is outputted from IC28 and applied to TR1. The CRT brilliance will be varied in 8 steps. The combined video signals(radar targets and display graphics) along with the horizontal(HS) and vertical(VS) synchronization signals are sent to the monitor display.

2.5.2.10 DISPLAY MONITOR

The display monitor receives its operating supply voltage from the +12VDC supplied by the power supply PCB. The video signal is sent to TR4 and TR5 amplifiers before coupling to the CRT cathode. RV1 sets the contrast level of the video for the CRT.

The horizontal sync signal operates the horizontal oscillator IC1. The oscillator provides the drive via TR6 to run the HV flyback transformer and generate the operating voltages for the CRT as well as the horizontal deflection coil.

The vertical sync signal operates the Vertical oscillator IC3 via IC2. The oscillator output at VOUT drives the vertical deflection coil.
Traditional adjustments are provided to set the focus, CRT brightness, vertical hold, size, and linearity, horizontal hold, and the video contrast.

The CRT is mounted and arranged in the "portrait" mode in the radar. Therefore, the horizontal adjustments will effect the vertical picture and vice-versa, the vertical adjustments will effect the horizontal aspects of the picture.

2.5.3 OPTIONAL INPUTS

The RADAR 3000 can receive various input signals from Navaids and Flux Sensors.

If more than one data type is present at the radar inputs(for examples; flux sensor and NMEA) a system priority has been established in the radar's software to respond to the inputs in driving the features. The assigned priorities are set in this manner:

HEADING:
1. Flux Sensor(NMEA 0183"HDM, HDT, HSC" sentences)
2. Sea Talk Data (Heading via Autopilot compass)
3. Navaid Data (NMEA 0183 "RMC, RMA, VTG" sentences)

POSITION:
1. Navaid Data(NMEA 0183 "RMC, RMA, GLL, GTD" sentences)
2. Sea Talk Data

SPEED:
1. Navaid Data(NMEA 0183 "RMC, RMA, VTG, VHW" sentences)
2. Sea Talk Data

WAYPOINT:
1. Navaid Data(NMEA 0183 "RMB, BWC" sentences)
2. Sea Talk Data

The NAVAID input is connected at J403, Pins 1 and 2. The signal is coupled via J9-1,2 to section 1 of IC40 (Optical Isolator), to Inverters 1 and 2 of IC39, to the data selector IC38, to UART IC6, and finally to the CPU IC5.

The HEADING data input essentially follows a similar route. The signal is connected at J403 Pins 3 and 4, coupled via J9-3,4 to section 2 of IC40(Optical Isolator), Inverters 3 and 4 of IC39, to the data selector IC38, to UART IC6, and finally to the CPU IC5.

2.5.4 POWER SUPPLY (CBD-1283)

The Power Supply converts the ship's DC input voltage to the necessary DC voltages to operate the radar system. These output voltages include regulated +12 VDC, -12 VDC, +5VDC, -5VDC, and +24VDC.

The power supply can begin operation when the STBY/OFF switch is pressed on the Control (Right) PCB. The STBY signal toggles IC5-2 output and TR8 conducts. This enables the Vcc supply to the AVR converter circuit. IC4 is the 90 second timer and its output at pin 3 via IC2/2 becomes the OPE signal to put the radar into the Transmit mode. When the XMIT/OFF key is pressed, IC5-12 operates TR7 and IC2/2 to enable the OPE output.

The AVR converter consists of IC1, IC2, and IC3, as well as TR3, TR4, TR5, and TR6. IC1 controls the switching of the power FETs TR5 and TR6. Sensing of the AVR output occurs from the +12VDC line, sampled via RV1, compared at IC3 and controlled via IC2/1 to the AVR. RV1 is normally set by monitoring the +5 VDC output at TP1 and adjusting for +5VDC, +/-.1 VDC with a volt-ohm meter.

When both the POWER and XMIT/STBY keys are pressed together, IC6 resets IC5 outputs and disconnects the Vcc from the AVR IC1. This will turn the power supply and the radar system to OFF.

SECTION 3

TROUBLESHOOTING

3.1 TROUBLE-SHOOTING GUIDE

While the radar 3000 is highly reliable systems, early signals and detection of component fatigue can sometimes be spotted during regular operational checks.

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

3.2 MASTER RESET

The first step in attempting to clear a problem associated with the general operation of this Radar is to perform a MASTER RESET. This can be done by pressing the RANGE △ and RANGE ▽ keys simultaneously, and while holding, turning the power on. This should be performed anytime a component or PCB within the Radar is replaced. This function will clear the Radar's memory and will return it to its factory settings. It may then be necessary to make the INITIAL SETTING and to re-enter the parameters previously established by the operator.

It should be noted that micro-components within the Radar are generally not field replaceable, therefore, repairs to the Radar typically go down to the board level only.

CAUTION

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

3.3 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 3-1 shows a table of fuses employed in the equipment.

TABLE 3-1 FUSES USED

Location	Part No.	Rating Current	Protective circuit	Type	Remarks
DISPLAY	F401	8A	All circuit	Glass tube	8A dc 12V
DISPLAY	F401	4A	All circuit	Glass tube	4A dc 24 V, 32V
DISPLAY	F402	5A	Scanner motor	Glass tube	5A dc 12V
DISPLAY	F402	3.15A	Scanner motor	Glass tube	3.15A dc 24V, 32V

3.4 FAULT FINDING PROCEDURE

Often the display on the CRT can help indicate which major circuit is at fault. It may be quicker to check-out the equipment according to the trouble shooting guide that follows (TABLE 3-2).

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 procedures and may prove necessary in some cases.

TABLE 3-3 is the trouble shooting guide and check-out procedure, TABLE 3-4 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 3-2 OPERATION CHECKLIST

Unit to be checked	Check item	Correct condition	Remarks	Measuring point
Scanner Unit	a. Input voltage	+12V -12V		CME-229-W1-1, 2
	b. AVR output voltage	350V	X-MIT	CME-229-CD6-K
	c. Mag. current	12V~20V		CME-229-TP1 or
Display Unit	a. Input voltage	Refer to Note		J401-1-2
	b. AVR output voltage	5V		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, DC10.2V-42V

TABLE 3-3 TROUBLE SHOOTING GUIDE

	Trouble	Remedy
1.	Does not start at OPERATE switch to STBY.	Check:[DISPLAY] Blown fuse F401. Check input power circuits. Check modulator circuits in scanner. Faults of contact on CCK-733. Faults of power supply circuit on CBD-1283. Faults of contact on connector of CBD-1283. Faults of rectifier diodes on CBD-1283.
2.	Scanner fails to rotate.	Check:[SCANNER] Fault of S101.(Safety Switch OFF) Fault on contact on terminal boards. Fault of M101/B101. Fault of drive mechanism. Faults of modulator circuition CME-229
3.	Scanner rotates but rotation of sweep is abnormal.	Fault of connection between M101/B101. Check:[DISPLAY, SCANNER] Fault of encoder(BP). Fault of main circuit for the Display Unit.
4.	No picture on the screen.	Fault of CRT display unit or its supply voltages. Check:[DISPLAY] Open heater of CRT. Fault of contact on CRT socket. Fault of contact on CRT cap. Fault of video circuit.
5.	Only horizontal line screen.	There may be fault in vertical sweep generator, amplifier circuits and deflection coil. Check:[DISPLAY] Fault in vertical sweep generator, amplifier circuit.
6.	Incorrect sweep - Start of sweep is not centered on the screen. - Markers are oval.	Adjust CENTERING MAGNET. Adjust horizontal or vertical hold. Adjust vertical length and linearity. Adjust height as necessary. Adjust horizontal length.

	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: [DISPLAY] Fault of GAIN, STC control settings. Fault of receiver unit. Fault of contact on terminal boards and connector.
8.	Noise and range the screen but no echoes.	If no transmission is present, check the modulator and magnetron. Check:[SCANNER] If transmission appears to be present as indicated by the correct MAG. I reading on Tester. CME-229 TP1=12VDC～20VDC 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:[SCANNER, DISPLAY] Reduction of transmitting output power. Fault of magnetron. → Check of MAG. I reading on PC101-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 CMC-1008 (Main Circuit) Fault of receiver unit.
10.	NO VRM or VRM cannot be controlled.	Check:[DISPLAY] Fault of CCK-781. Fault of main circuit(CMC-1008).
13.	NO EBL or EBL cannot be controlled	Check:[DISPLAY] Fault of CCK-781. Fault of main circuit(CMC-1008).
14.	No alarm zone marker, cannot be controlled or no alarm sound.	Check:[DISPLAY] Fault of CCK-781. Fault of main circuit(CMC-1008). Fault of Buzzer BZ1.

TABLE 3-4 shows typical voltage and resistances at significant points throughout the equipment.

(A) Inter-unit terminal board

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. = 12V(D.C.)

TABLE 3-4 TYPICAL VOLTAGES AND RESISTANCES

RADAR 3000 (with interunit cable connected)

Measuring Point	Resistance (Ω)	Voltage(V) 0.125～1.5 (nm)	3.6 (nm)	12 (nm)	Remarks
W1-3	5.5×10	-0.06	-0.06	-0.06	DC0.3V
W1-1	2 ×10	11.6	11.5	11.5	12 V
W1-2	0.1×10	-11.9	-11.8	-11.8	12 V
J1 1	26×10	4.0	5.1	10.8	12 V
2	22×10	0.05	0.05	0.05	0.3V
4	60×10	2.7	2.7	2.	3 V
5	3.5×10	11.8	11.8	11.8	12 V
6	20×10	4.17	4.17	4.17	12 V
7	50×10	8.9	8.9	8.9	12 V
9	8×10	2.4	2.4	2.4	3 V
10	0.5×10	0.05	0.05	0.05	0.3V

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

NOTE
Refer to Note given in item(A).

SCANNER UNIT(Without Interunit Cable connected)

Measuring Point		Radome Resistance			FUNCTION
Radome	Open Array	(Ω)			
TB1-1	J1 - 3	5.5	×10		+12Vdc
2	4	0.5	×10		-12Vdc
3	5	∞	×10		VIDEO
4	6	0	×10		VIDEO RET
J1 -1	J2 - 1	2K	×10		Pulse Width
2	2	∞	×10		Trigger
3	3	0	×10		GND
4	4	250	×10		STC Control
5	5	1.3K	×10		GAIN Control
6	6	7.5	×10		TUNI/SHF
7	7	∞	×10		TUN V
8	8	0	×10		GND
9	9	7	×10		2048 BP
10	10	300			RRATE

DISPLAY UNIT(Without Interunit Cable connected)

Measuring Point	Resistance (∞)	
J402 1	∞	× 10
2	∞	× 10
3	23	× 10
4	0	× 10
5	0	× 10
6	6	× 10
7	54	× 10
8	0	× 10
9	∞	× 10
10	21	× 10
11	4	× 10
12	1K	× 10
13	50	× 10
14	3.5	× 10
15	42	× 10
16	24	× 10

SECTION 4

MAINTENANCE

4.1 GENERAL

It is necessary to perform the maintenance services listed below to keep the RADAR 3000 in good workihg conditions. Proper maintenance of the RADAR 3000 minimizes the possibility of machine failures. The maintenance operations that are common to all components of the RADAR 3000 is listed below.

(1) Cleaning

Remove dirt, dust, or water-spray from the RADAR 3000 enclosure and keep it as clean as possible. Use a dry lint-free cloth.

(2) Screw inspection

Check the screws used to assemble and secure the components of the RADAR 3000 for loose connection.

(3) Cabling check

Check the cables connecting between the components (between the scanner unit and display unit, display unit and power supply, and display unit and optional devices) for poor connection.

Caution: When servicing the RADAR 3000, be sure to turn it off to prevent electric shock. If a rectifier unit is used, in particular, tum off power to the display unit. Note that voltages from the rectifier unit are always present even if the radar is stopped.

4.2 SCANNER UNIT

When inspecting the scanner unit of the RADAR 3000, be sure to turn off power to the display unit and set the safety switch on the scanner unit to OFF. Keep watches or magnetic cards away from the modulator block as it contains a magnetron having a strong magnetic force.

4.2.1 Radome Scanner Unit

(1) Radome

A radome surface contaminated by smoke, dust, or paint would cause attenuation or reflections of radio waves, resulting in reduced radar performance. Periodically check the radome scanner unit. If it proves dirty, wipe the radome surface with a soft lint-free cloth moistened with alcohol or damped cloth.

* Never use solvents such as thinner, gasoline, benzene, trichlene, and ketone.

(2) Lubricating gears

(A) Apply grease to gears evenly using a knife or brush. This lubrication needs to be performed at least semiannually. The shorter the lubrication period, the longer the gears will endure.

Use Mobilux No. 2 from Mobile Oil Co., Ltd. or equivalent.

(B) Check the mounting bolts for loose connection occasionally.

4.3 Display Unit

4.3.1 Cleaning the Display Unit Screen

Dust on the CRT tube would reduce the glass transparency and make the video image dim. Wipe the screen surface with a soft lint-free cloth (made of flannel or cotton). A

cloth moistened with an antiseptic agent would cause little problem. When using it, wipe softly; never rub the screen surface with force.

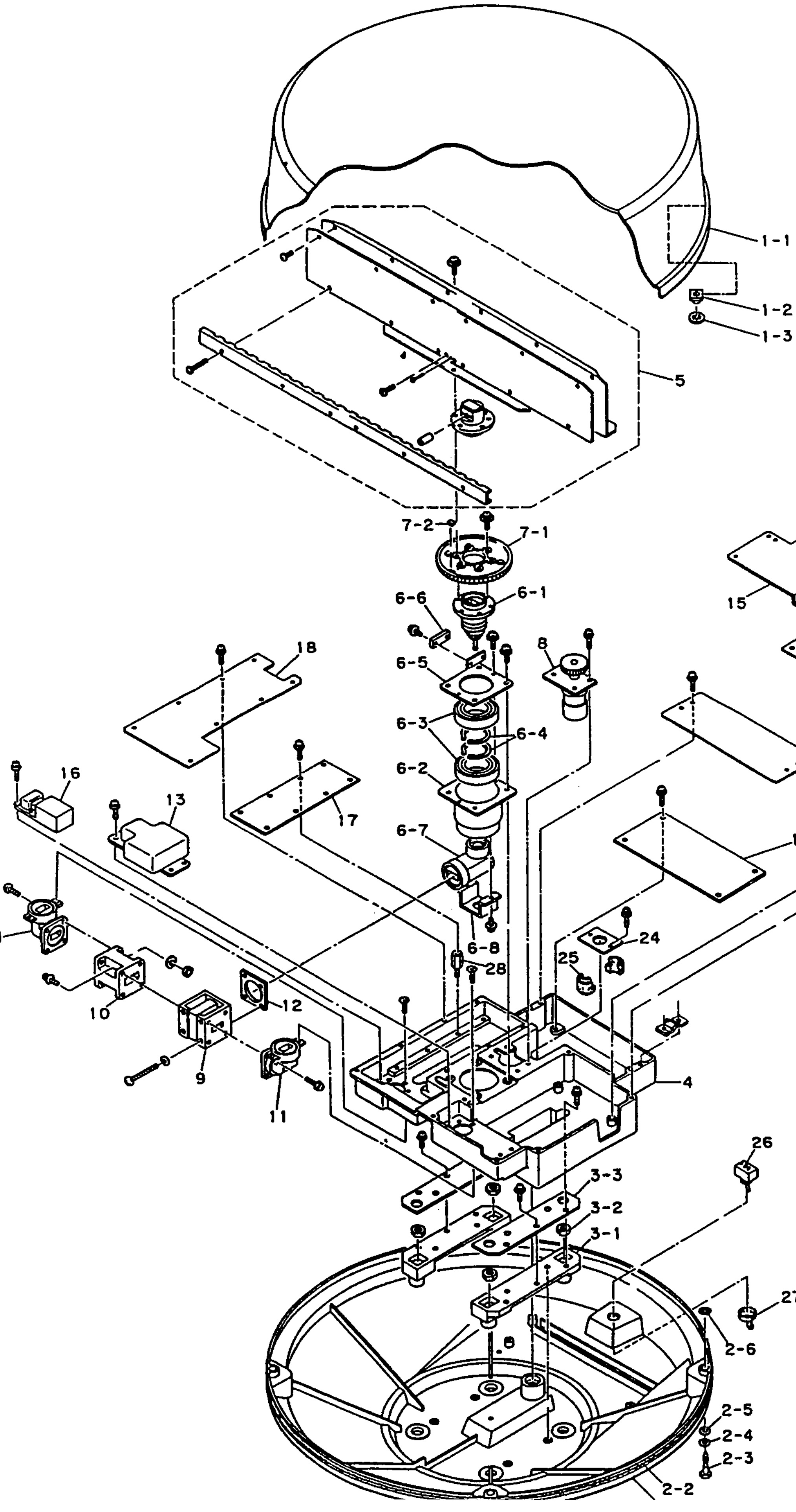
APPENDIX

RADAR 3000 PARTS LIST

Description	Part No.	Drawing (FIG)
Radome Scanner Unit	NKE-1046A	106
Receiver PCB	CAE-349	108
Diode Limiter (A102)	5EZAA00028	106
Modulator PCB	CME-229	107
Motor Assy (M101)	7BDRD0023	106
Magnetron (V201)	5VMAA00065	106
SHM Switch	5KRAA00058	106
Display Unit	NCD-3744	109
Power Supply PCB	CBD-1283-J	113
Main Control PCB	CMC-1008	110, 111
Control PCB	CCK-781	112
CRT Assembly		114
Consisting of:		
CRT Monitor PCB	CCN-245	114

MECHANICAL PARTS LOCATION LIST
REFERENCE TO FIG.
ASSEMBLY DRAWING OF NKE-1046

LOCATION	DESCRIPTION	P/N	SYMBOL
1	Upper Radome Assy		MPBX31105
1-1	Radome		MPBC09205
1-2	Nut		MTL035987A
1-3	Toothed Washer		BRTG03668
2	Lower Radome Assy		MPBX16086A
2-1	Radome		MTV002211A
2-2	Packing		MTT016990A
2-3	Bolt		MPTG02144A
2-4	Washer		BSFW06000B
2-5	Washer		MTT026587
2-6	O-Ring		BRPK00109
3	Mounting Base Assy		MPBP02927
3-1	Mounting Base		MTC003612
3-2	Nut		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,		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	Moter Assy	M101	7BDRD0023
9	Circulator	A101	
10	Diode Limiter	A102	
11	Coner Wave Guide		MTM003700
12	Plate		MTD002559D
13	Magnetron	V201	
14	PCB	PC201	
15	Cover		MTB308167
16	MIC	E301	
17	PCB	PC301	
18	Cover		MTB307956
19	PCB	PC501	
20	Cover		MTB186257A
21	Plare		MTB186260
22	Rubber Sheet		MTT026591
23	Sheet, Radiating		7ZSRD0013
24	Plate		MTB186259A
25	Gasket		MTT026586
26	Toggle Switch	S101	
27	Switch Cover		MPPK06925
28	Spacer		MTK000359



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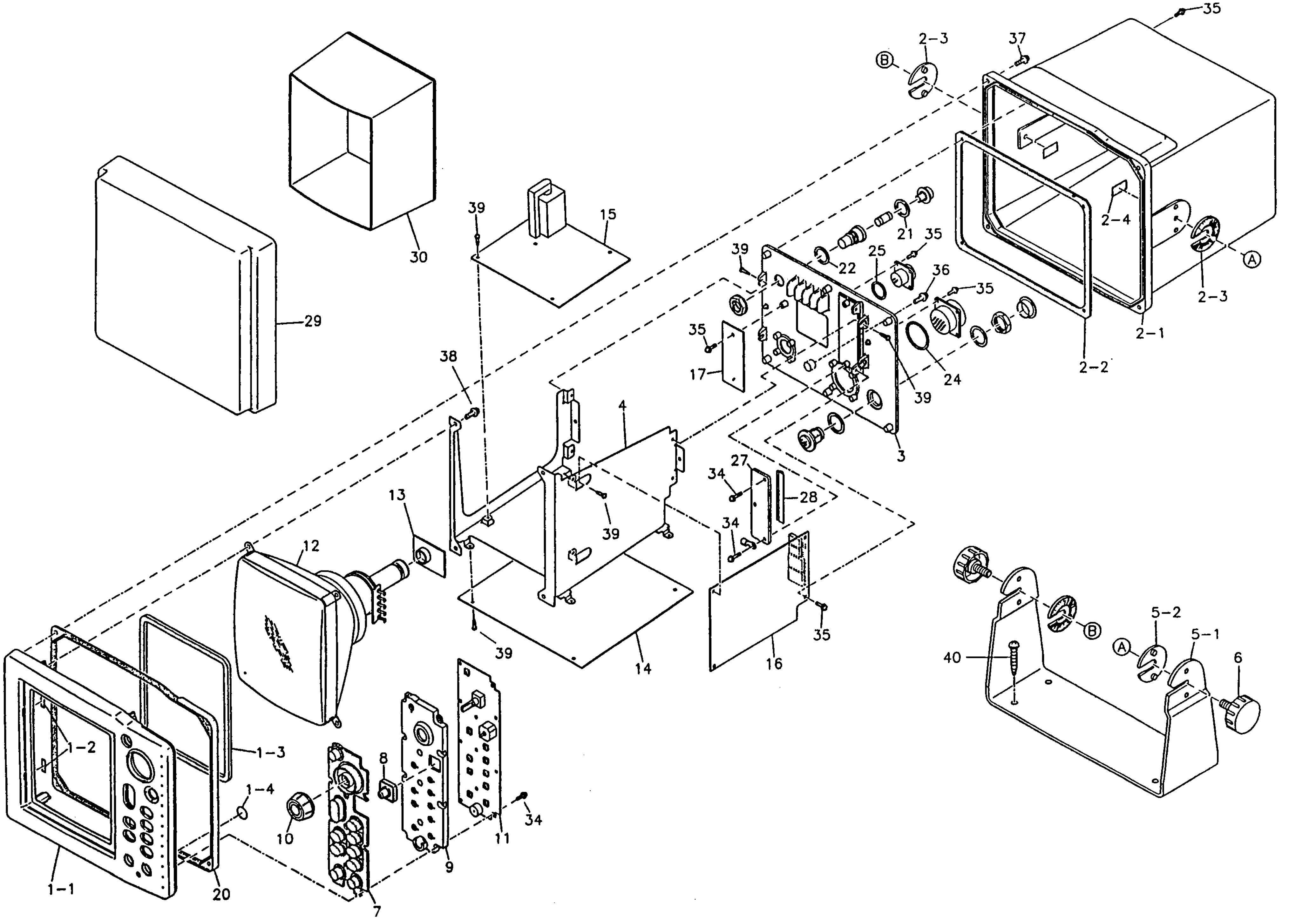
ASSEMBLY DRAWING of NCD-3744

Location	Description	JRC Code	Symbol
1	BEZEL ASSY	MPBC32831	
1-1	FRONT BEZEL	MTC300598	
1-2	RUBBER SEAL	MTT300800	
1-3	CRT'GASKET	MTT300871	
1-4	POROUS FILM	BRPK05033	
2	CABINET ASSY	MPBX34751	
2-1	CABINET	MTC300599	
2-2	PACKING	MTT304229	
2-3	WASHER, SERRATION	MTV002834	
2-4	RUBBER PLATE	MTT304265	
3	HEAT SINK	MTC300600A	
4	CHASSIS	MPBC32833	
5	BRACKET ASSY	MPBX34752	
5-1	BRACKET	MTB331859	
5-2	WASHER, SERRATION	MTV002834	
6	KNOB	MPTG30053	
7	RUBBER KEY	MTV301852	
8	CAP	MPPK30390	
9	LIGHT GUIDE	MTV301853	
10	DIAL	MPHD30171	
11	CONTROL PCB ASSY	CCK-781	PC3
12	CRT		V202
13	VIDEO PCB ASSY		
14	MAIN CONTROL PCB ASSY	CMC-1008	PC1
15	CRT MONITOR PCB ASSY	CCN-245	
16	POWER SUPPLY PCB ASSY	CBD-1283-J	PC5
17	NOISE FILTER PCB ASSY	CFR-160	
18	BLANK		
19	BLANK		
20	PANEL GASKET	MPPK30387A	
21	PACKING, RUBBER	MTT301170	
22	PACKING, RUBBER	MTT301033	
23	BLANK		
24	O-RING	BRPK05021	
25	O-RING	BRPK05020	

ASSEMBLY DRAWING of NCD-3744

Location	Description	JRC Code	Symbol
27	PLATE, RETAINING	MTB186295	
28	SPRING	MPSR30054	
29	SUN COVER	MTV301855	
30	SUN SHIELD	MTV301854	
31	BLANK		
32	BLANK		
33	BLANK		
34	SCREW with captive washer	BSNC03010B	
35	SCREW with captive washer	BSNC03008B	
36	SCREW with captive washer	BSNC04008B	
37	SCREW with captive washer	BSNC04014B	
38	SCREW with captive washer	BSNC04012B	
39	TAPPING SCREW	BRTG03095	
40	TAPPING SCREW	BRTG03217	



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LIST OF SCEMATIC DRAWINGS

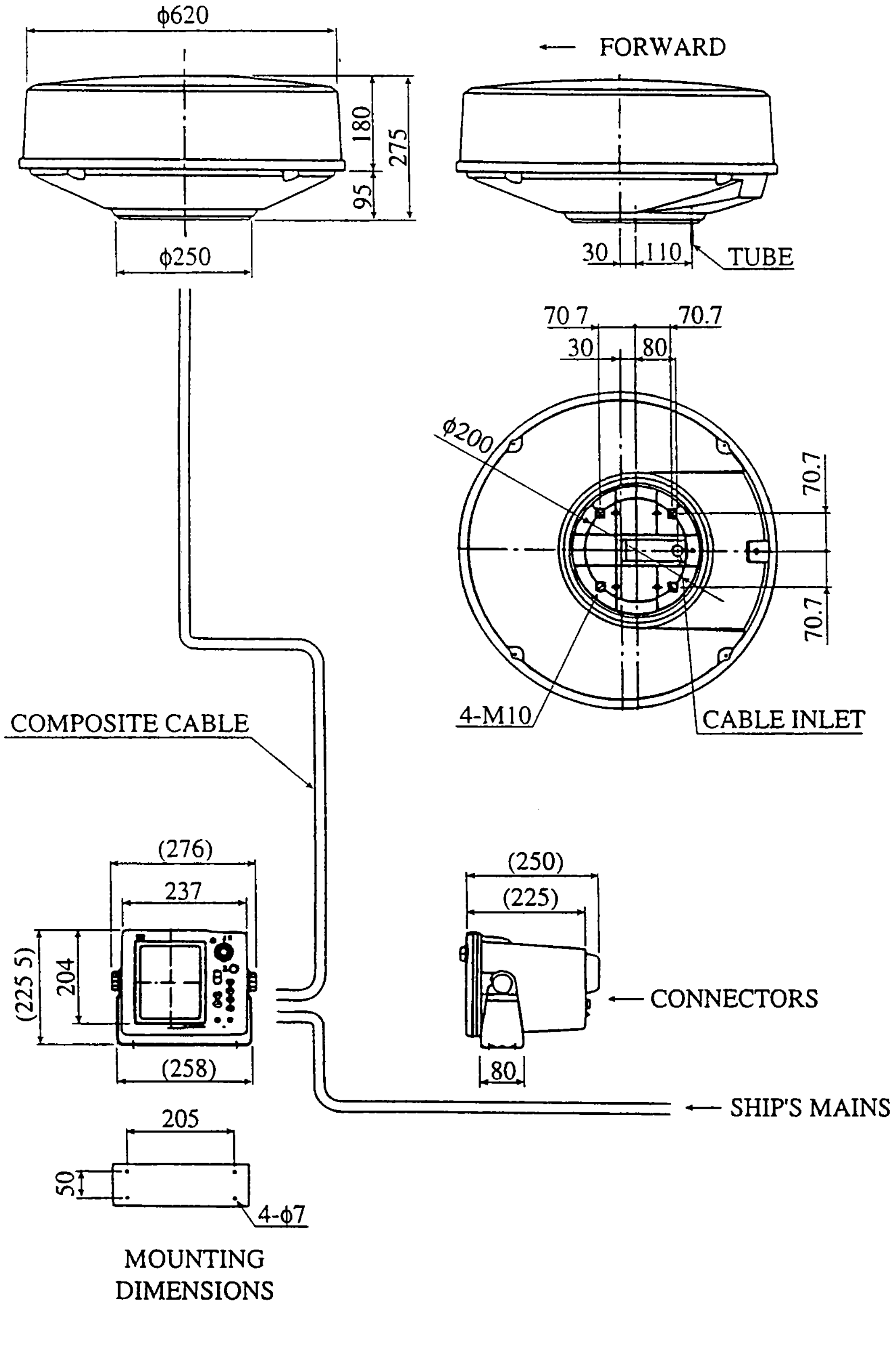

FIG. 101. GENERAL SYSTEM DIAGRAM

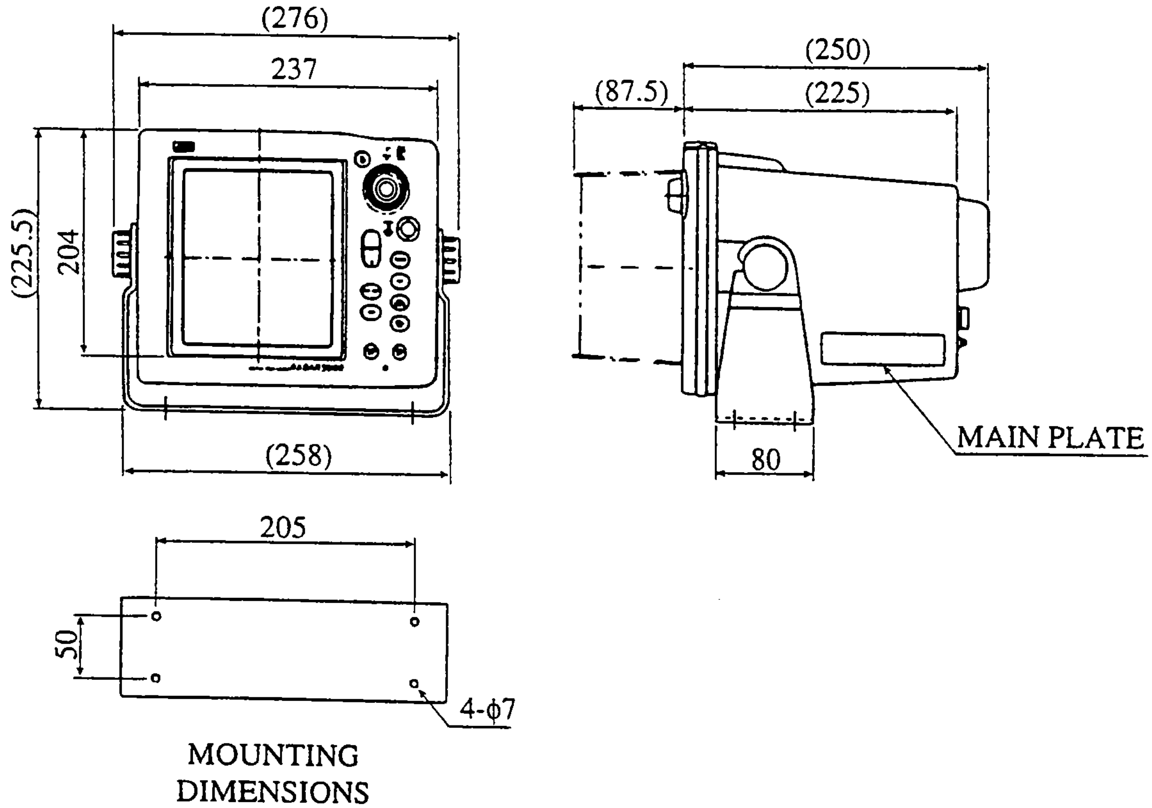

FIG. 102. DISPLAY MOUNTING DIMENSIONS

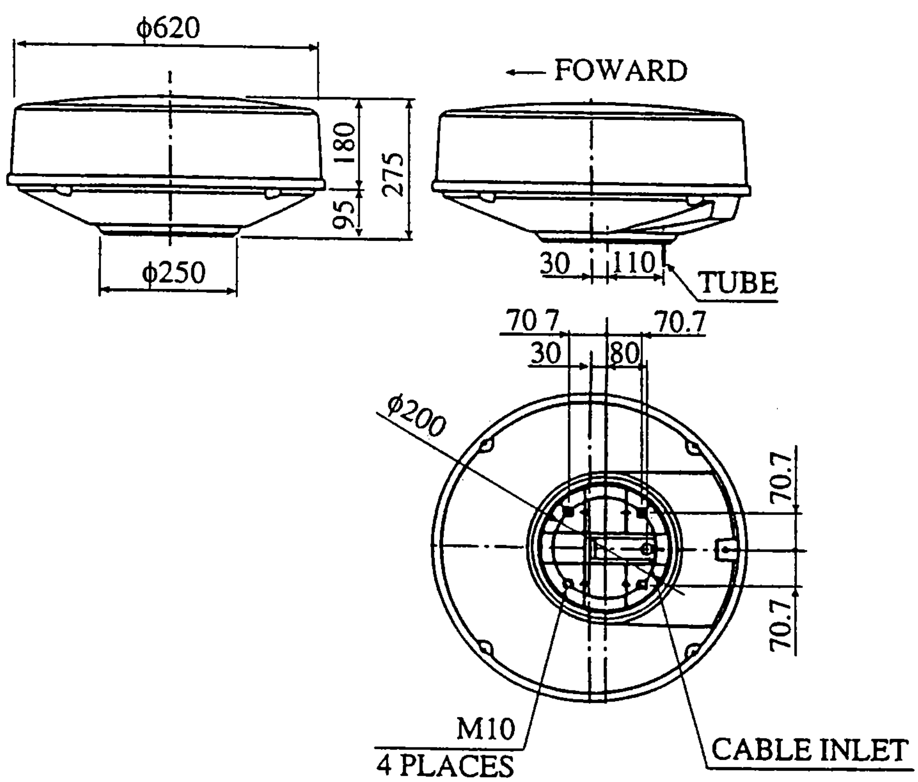

FIG. 103. SCANNER MOUNTING DIMENSION

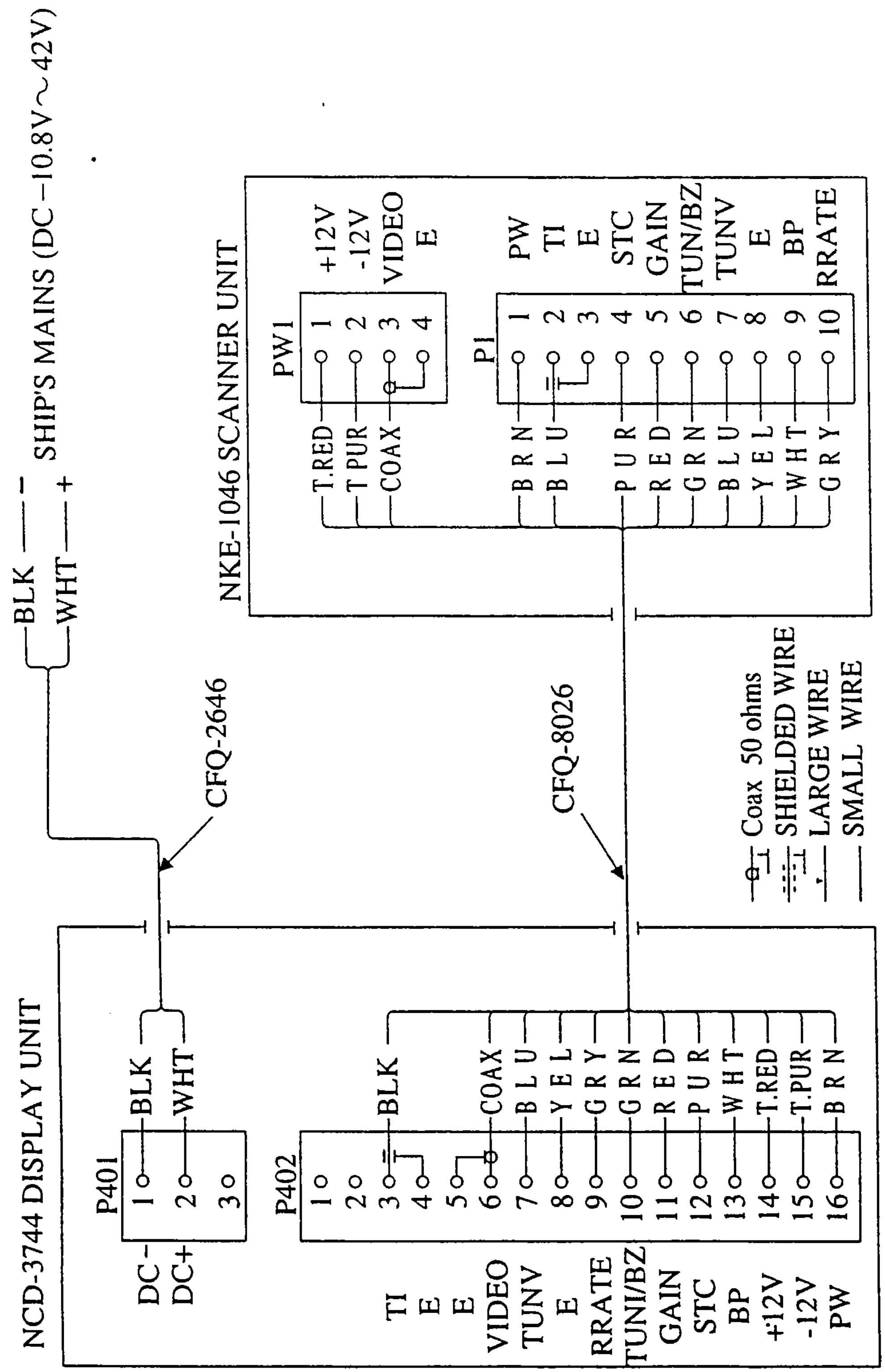

FIG. 104. INTERCONNECTION DIAGRAM

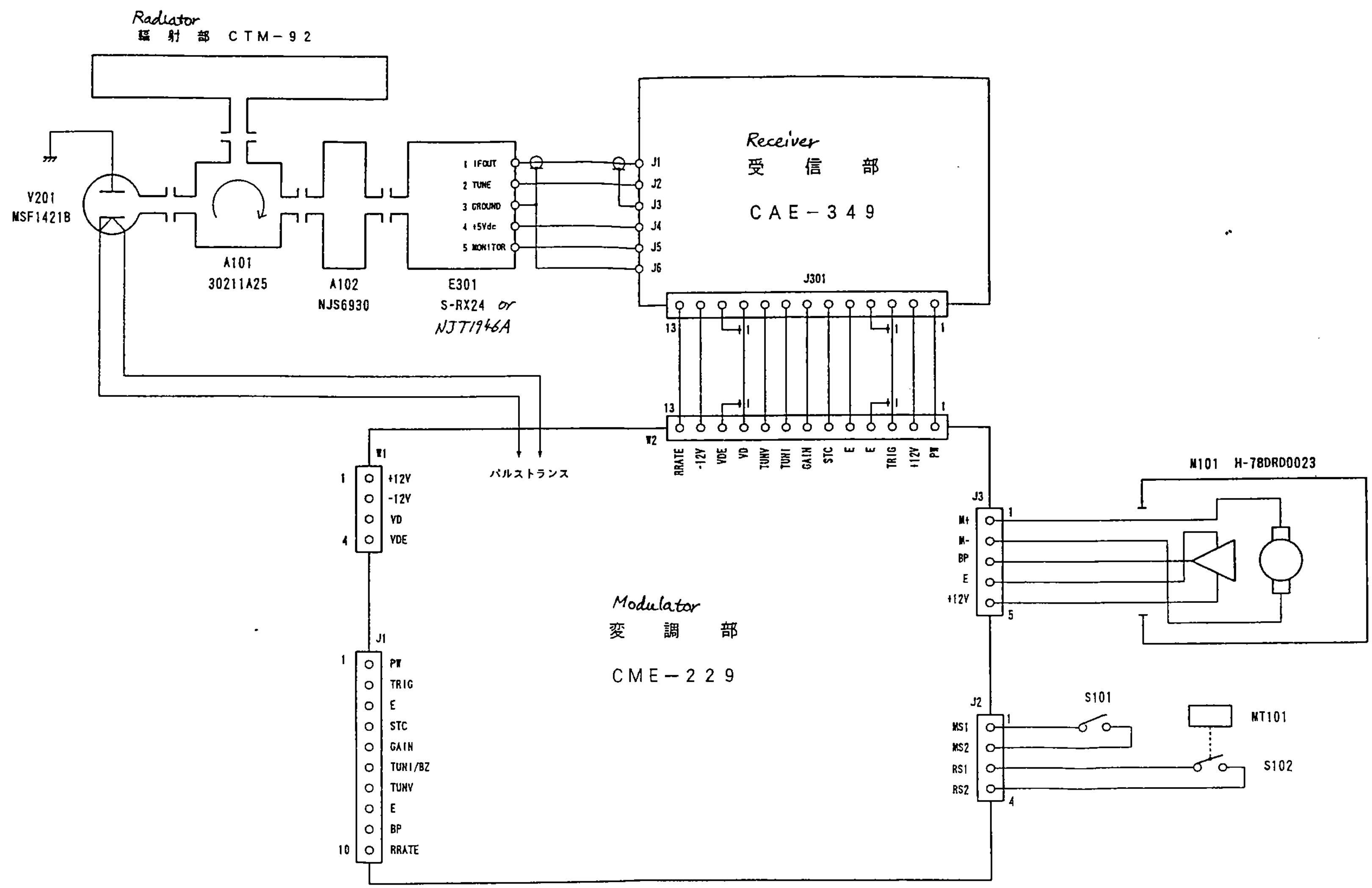

Fig.106 NKE-1046 INTERNAL CONNECTION

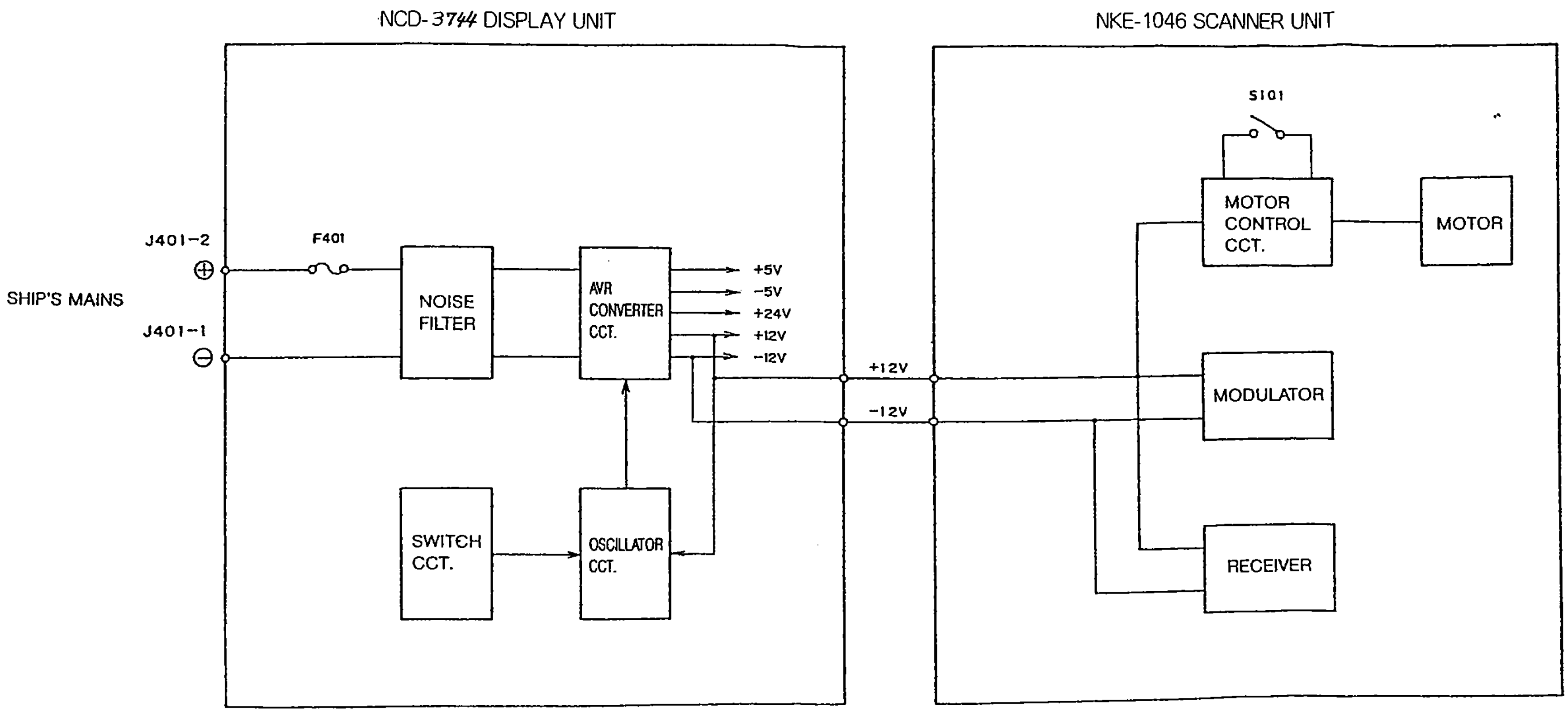

Fig. 105 POWER SUPPLY DIAGRAM OF RADAR 3000

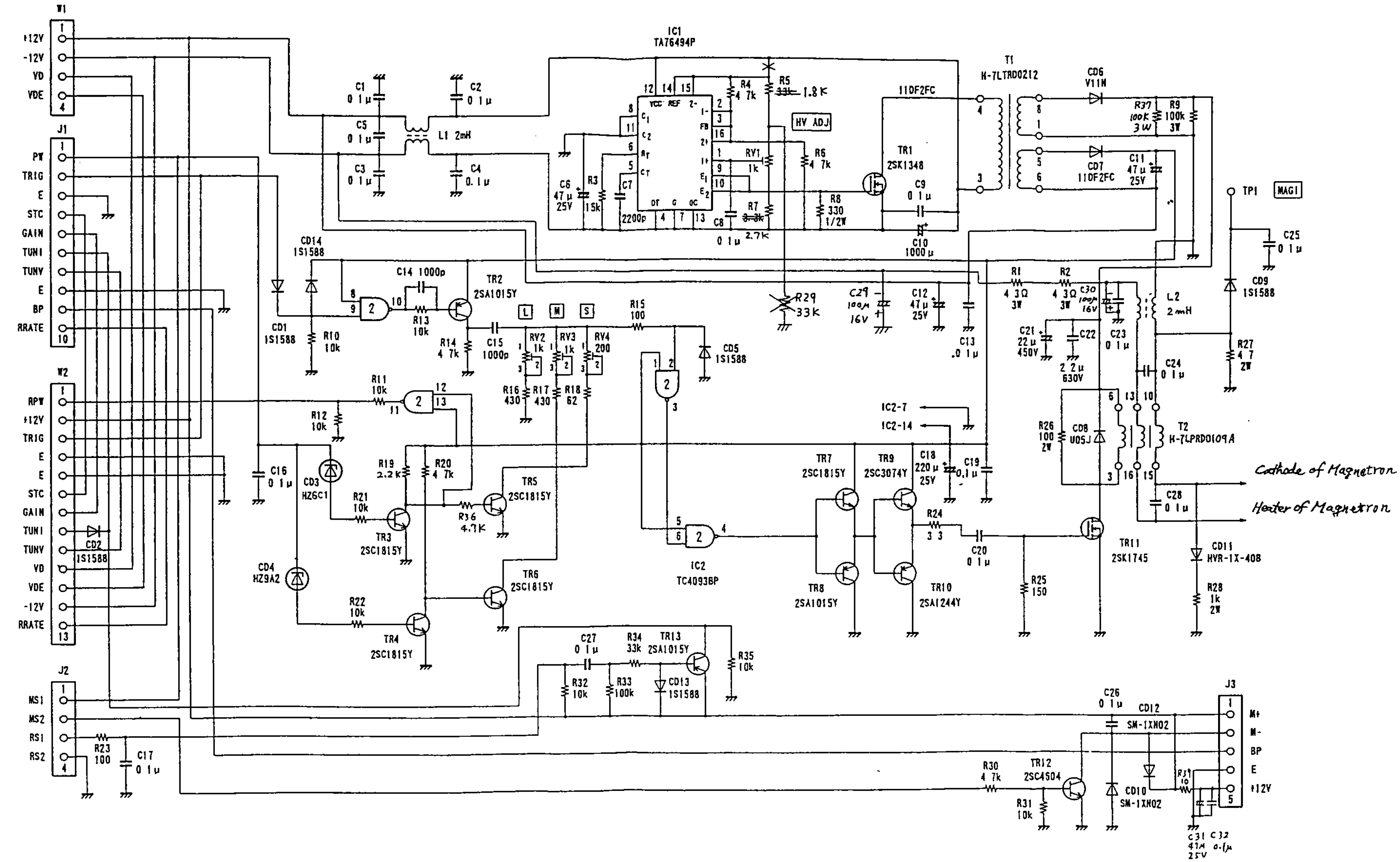

Fig 107 CME-229, MODULATOR