MARINE RADAR EQUIPMENT

JMA－2253／2254

FIELD SERVICE MANUAL

JRC Japan Radio Co., Ltd.

CAUTIONS FOR HIGH VOLTAGE

High voltages of hundreds upto thousands volt are used in radio and radar devices. Although prudent measures for safety have been adopted, sufficient cares should be taken on operation, maintenance and adjustment of the device.

Electric shock by thousands volt leads to an instantaneous death for certain, and even electric shock by hundreds volt leads to an instantaneous death occasionally. To prevent such an accident, turn off the power source, discharge capacitors by a were surely earthed at one end, and check that any charge is no longer inside the device, before you put your hand into the inside. It is still better to wear dry wool gloves. It is also necessary caution not to use both hands simultaneously, by putting the one hand into your pocket.

The selection of a stable foothold is essential to prevent more extensive or additional injuries. When injured by electric shock, disinfect the burn perfectly and give first aid as soon as possible.

HEALTH HAZARD

Some person allergic to dust may temporarily be affected in health, if he inspires dust scattered at the time of cleaning the radar inside.

RADIATION HAZARD

If the human body is exposed to a microwave of 10mW/cm2 in mean power density, it will be affected, in particular, at the eyes.
Don not approach to any antenna during standstill as near as 60cm or less.
If it is unavoidable by any means to disconnect a microwave transmission line upon the maintenance or checks, always connect a microwave dummy load to associated radar transmitter. If it is unavoidable to radiate the microwave without using any microwave dummy load, never peep the active waveguide into its end during transmission, since the end is open.

WHAT TO DO IN CASE OF ELECTRIC SHOCK

When a victim of electric shock is found, turn off the power source and earth the circuit immediately. If this is impossible, move the victim away from it without touching him with bare hands as quick as possible. He can safely be moved if an insulating material such as dry wood plate or cloth is used.

Breathing may stop if current flows through the respiration center of brain due to electric shock. If the electric shock is not large, breathing can be restored by artificial respiration. A victim of electric shock looks pale and his pulse becomes very weak or stops, resulting in unconsciousness and rigidity.

FIRST-AID TREATMENTS

As far as the victim of electric shock is not in dangerous condition, artificial respiration should be started at once at the site. Once started it should be continued rhythmically.

1) Do not touch the victim confusedly or rescuer may also receive an electric shock.

2) Turn off the power source and move the victim from the electric line calmly.

3) Call a physician or ambulance immediately, or instruct someone else to call.

4) Place the victim on his back and loose his necktie, clothes, belt, etc.

5) a. Examine the victim's pulse.
   b. Examine the heartbeat by laying your ear on his heart.
   c. Examine breathing by bringing your face or back of hand close to his face.
   d. Examine the victim's pupils.

6) Open the victim's mouth and remove the artificial teeth, cigarette or chewing gum, if any. Keeping the mouth open, stretch the tongue and insert a towel or the like to prevent the tongue from suffocating. (If it is hard to open the mouth with set teeth, open it by a screwdriver and insert a towel.)

7) Wipe the mouth to prevent foamable mucus and saliva from accumulating.

IN CASE PULSE CAN BE DETECTED BUT BREATHING STOPS

(Mouth to mouth artificial respiration)

a) Tilt the victim's head back as far as his face looks back.
(A pillow may be inserted under the neck.)

b) Pull the jaw into jutting position to open the throat.

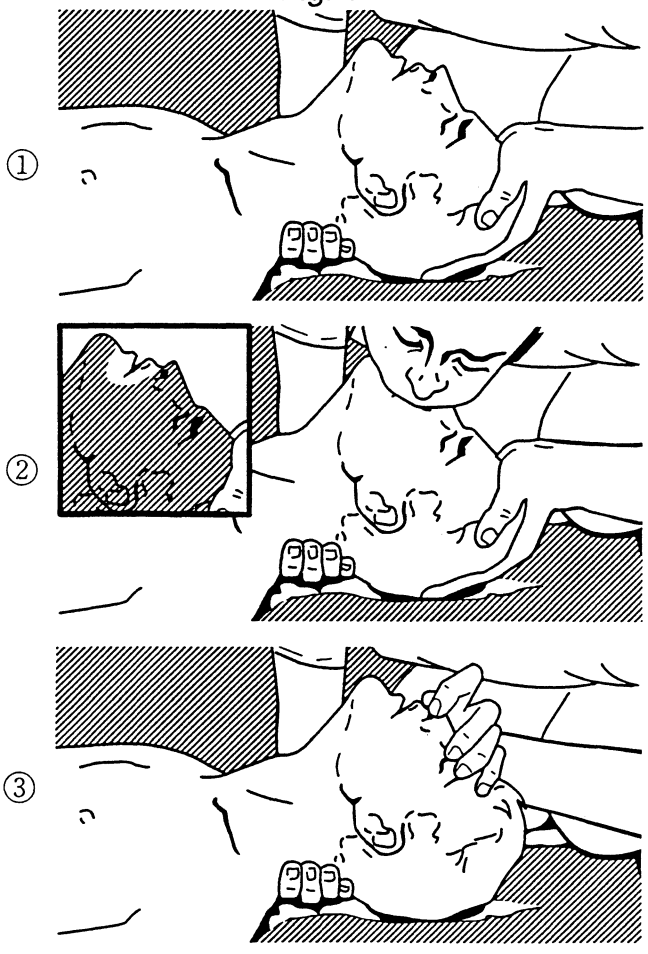
c) Pinch the victim's nostrils shut and place your mouth tightly over his after drawing your breath long. Then blow into mouth strongly. Continue blowing at a rate of 10-15 breathes a minute.

d) Watch carefully and continue artificial respiration till natural respiration is restored.

e) If the opening of mouth is difficult, insert a vinyl pipe or the like into a nostril and blow into it by shutting the other nostril and mouth perfectly.

f) Victim may stand up suddenly when he becomes aware. He should lie quietly and kept warm and calm.
Serve him with hot coffee or tea (but never alcoholic drinks).

Fig. 1



Method of Mouth to Mouth artificial respiration

Tilting Back of Victim's Head

Put one of your hands on the victim's forehead and the other under the neck 1. In general his mouth opens when the head is tilted back, making easy mouth to mouth artificial respiration.

Place your mouth tightly over his and press your cheek against his nose 2 or pinch his nostrils by your fingers 3 to prevent air leakage.

Blowing into Lungs

Blow into the mouth till the chest rises. The first 10 breathes should be performed as fast as possible.

IN CASE OF CARDIAC ARREST AND CESSATION OF BREATHING

(Cardiac massage and mouth to mouth artificial respiration)

a) When no pulse can be detected, the pupils are open and no heartbeat is heard, cardiac arrest is considerable.
Therefore, artificial respiration should be started at once.

b) Put the heel of one hand over the lower 1/3 of his breastbone and the other hand on the back of the first. Apply your weight so that the breastbone is compressed by about 2cm. (Repeat it at a rate of about 50 times a minute.)
(Cardiac massage)

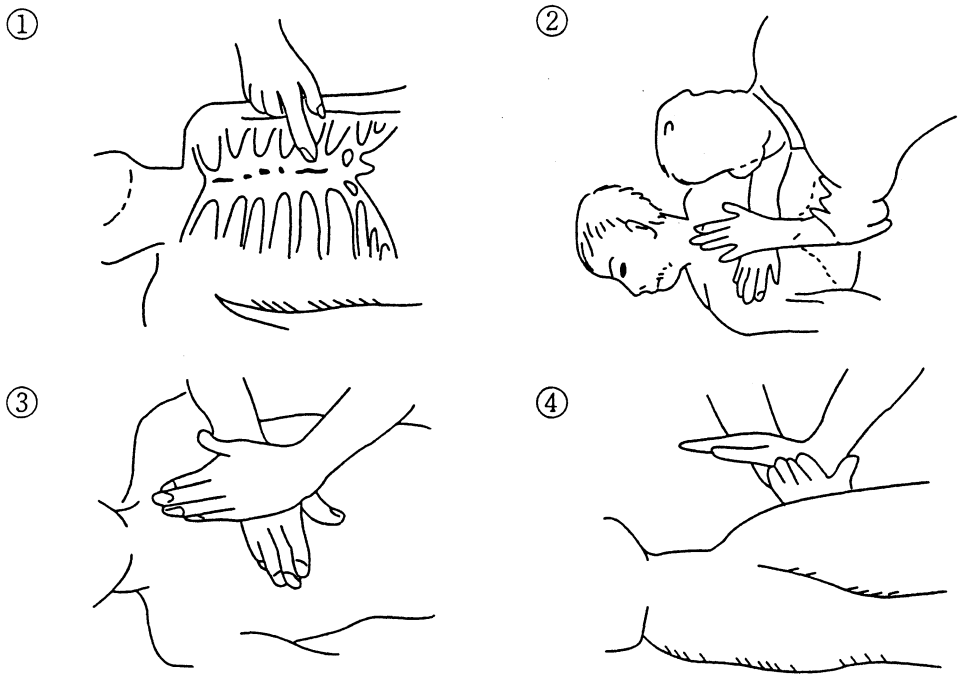
c) In case of one rescuer
After about 15 times cardiac massages, give mouth to mouth artificial respiration 2 times, and repeat them in this manner.

d) In case of two rescuers
While the victim is massaged, another person should give mouth to mouth artificial respiration. A breath is interposed after 5 cardiac massages.
(Cardiac massage and mouth to mouth artificial respiration)

e) Examine the pupils and pulse often. When they become normal, stop the first aid treatments, serve the victim with coffee or tea and keep him warm and calm, while watching him carefully.

f) Commit the victim to a medical specialist, according to the situation. For earlier recovery of the victim fro the mental shock, the understanding of bystanders is essential.

Fig. 2



WARNING

This radar equipment must be installed and operated in accordance with the instructions contained in this manual. Failure to do so can result in personal injury/or navigational inaccuracies. In particular:

HIGH VOLTAGE

The radar display unit contains high voltage. Adjustments require specialized service procedures and tools only available to qualified service technicians, and there are no user serviceable parts or adjustments. The operator never should remove the display unit covers or attempt to service the equipment.

ANTENNA

A mechanical hazard exists from the external rotating antenna. Remain clear of rotating antennas at all times. It is recommended that the radar antenna (whether external or internal) be mounted above objects which interfere with the radar signal such as the flying bridge, large engine stacks, and personnel. This may be difficult on some vessels and in such a case it is recommended that a radar mounting pedestal be used. Always turn off the system before servicing the antenna or nearby equipment.

ELECTROMAGNETIC ENERGY

The radar antenna transmits electronic energy. It is important that the radar be turned off whenever personnel are required to come in range of the antenna to perform work on the antenna assembly or associated equipment. When properly installed and operated, the use of this radar will conform to the requirements of ANSI/IEEE C95.1-1992 Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3kHz to 300Ghz.

NAVIGATION AID

This radar unit is only an aid to navigation. Its accuracy can be affected by many factors including equipment failure or defects, environmental conditions, and improper handling or use. It is the user's responsibility to exercise common prudence and navigational judgment. This radar unit should not be relied upon as a substitute for such prudence and judgment.

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LIST OF ILLUSTRATIONS

SECTION 1 INTRODUCTION

1.1 GENERAL

The JRC JMA-2253/JMA-2254 Series Radars are compact raster scan radars with a 4 kW transmitter and a 10-inch cathode ray tube. Except special tubes, they are all made up of solidstate devices for improved reliability.

1.1.1 Configuration

Input power requirements	DC (12V, 24V, 32V) or AC* (100V/110V/115V/ 200V/220V/230V), 50/60 Hz, single phase	
Model name	JMA-2253	JMA-2254
Scanner model name	NKE-1046	NKE-1047
Display model name	NCD-1982	NCD-1983
Rectifier model name (optional)	NBA-797A	

*: An optional rectifier is required for the AC power supply.

The following components are indentified by the respective labels:

Scanner: SCANNER UNIT
Display: DISPLAY UNIT
Rectifier: RECTIFIER UNIT

1.1.2 Accessories

The JMA-2253/JMA-2254 comes with the accessories listed below.

Product Name	Q'ty	Remarks
Instruction manual	1	This manual
Interunit Cable	1	10m(Option 15m or 20m)
Power cable Assembly	1	2 m
Sun shade	1	
Spare fuse	2	8 A
	2	5 A
	3	4 A
	3	3.15A
6-pin connector	1	For data communication with NMEA

1.2 SPECIFICATIONS

1.2.1 General

1) Scanning mode — Raster scanning, PPI
2) Display unit — 10-inch square monochrome cathode ray tube (long storage CRT)
3) Display color — Green
4) Ranges — 0.125, 0.25, 0.5, 0.75, 1.5, 3, 6, 12, 24, 32(JMA-2253), 48(JMA-2254)Nmi
5) Range resolution — 30 m maximum
6) Minimum range — 30 m maximum
7) Bearing accuracy — ±1° maximum
8) Bearing discrimination — 4.2° (JMA-2253)
   2.2° (JMA-2254)
9) Bearing measurement mode
   True/relative bearing
10) Environmental conditions
   - Temperature — Scanner unit: −15℃ to +50℃
     Display unit: −10℃ to +50℃
   - Relative humidity — Scanner unit / Display unit: 95% maximum at 40℃
   - Relative wind velocity — Scanner unit: 51.5 m/sec (100 knots) (JMA-2253)
     41.0 m/sec (80 knots) (JMA-2254)
11) Power consumption — DC (12V, 24V, 32V) input : 57 W (JMA-2253)
     62 W (JMA-2254))
   AC (100V/110V/115V, 200V/220V/230V, 50/60 Hz, single phase) input : 100 VA

   Note: The following rectifiers need be used when AC input is to be used:
   NBA-797A

12) Input power range
   - DC — 10.2V to 42V
   - AC — ±15% (when the rectifier unit (NBA-797A) is used)
13) Preheating time — Approx.90 seconds
14) Warm-up time — Approx. 3 seconds maximum

1.2.2 Scanner Unit

1) Dimensions
   - Diameter of radome 620 mm
   - Height 275 mm
   - Bese 250 mm

   (JMA-2253)

   Dimensions
   - Height 432 mm
   - Swing circle 1220 mm

   (JMA-2254)

2) Weight Approx.9.5 kg (JMA-2253)
   Approx.24 kg (JMA-2254)
3) Polarization Horizontal
4) Directivity characteristics
   - Horizontal beam width 4.0° (JMA-2253), 2.0° (JMA-2254)
   - Vertical beam width 25° (JMA-2253), 30° (JMA-2254)
   - Side lobe level −21 dB (less than ±10°) maximum (JMA-2253)
     −23 dB (less than ±10°) maximum
     −26 dB (other than ±10°) maximum

     (JMA-2254)
5) Rotation Approx. 27 rpm
6) Transmitter frequency
   9410±30 MHz
7) Peak power 4kW
8) Transmitter tube Magnetron MSF1421B (JMA-2253)
   MSF1421B or MG5388 (JMA-2254)
9) Pulse length/PRF
   0.08 μ sec/2250 Hz (0.125, 0.25, 0.5, 0.75, 1.5 Nmi)
   0.35 μ sec/1500 Hz (1.5, 3, 6 Nmi)
   0.7 μ sec/750 Hz (3, 6, 12, 24, 32 (JMA-2253) ,
   48(JMA-2254))
10) Modulator Solidstate modulator driver
11) Duplexer Circulator and diode limiter
12) Mixer MIC front-end
13) IF amplifier
   - Intermediate frequency 60 MHz
   - Bandwidth 10 MHz/3 MHz
   - Characteristic Semi-log characteristic
14) Noise figure 6 dB maximum

1.2.3 Display Unit

1) Dimensions
   - Width — 278mm — without mounting yoke
   - Height — 242 mm
   - Depth — 275 mm — without sunshield
2) Mounting — Table, overhead, bulkhead or flush mounting
3) Weight — Approx. 8.7 kg
4) Cathode-ray tube — 10-inch square monochrome CRT
5) Range scales

	Range	Range ring interval	Number of rings
	0.125 Nmi	0.0625 Nmi	2
	0.25 Nmi	0.125 Nmi	2
	0.5 Nmi	0.25 Nmi	2
	0.75 Nmi	0.25 Nmi	3
	1.5 Nmi	0.25 Nmi	6
	3 Nmi	0.5 Nmi	6
	6 Nmi	1 Nmi	6
	12 Nmi	2 Nmi	6
	24 Nmi	4 Nmi	6
(JMA-2253)	32 Nmi	8 Nmi	4
(JMA-2254)	48 Nmi	8 Nmi	6

6) Range ring accuracy — ±1% of selected range or 22 m, whichever is greater
7) VRM
   - 000 to 64 Nmi digital display(JMA-2253)
   - 000 to 96 Nmi digital display(JMA-2254)
8) EBL — 000° to 359° digital display
9) Tuning mode — Manual or automatic
10) Bearing scale — 360° scale graduated at intervals of 1°
11) Ship's heading marker — Electronic
12) Controls, front panel

RANGE ▲	key
RANGE ▼	key
VRM	key
EBL	key
F.EBL	key
CURSOR	key
SHM	key
OFF CENT	key
GUARD	key
BRIL	key
[TUNE]	knob
[RAIN CL]	knob
[SEA CL]	knob
[GAIN]	knob
IR	key
EXP	key

	(MENU)	key
	(ENTER)	key
	(TRACKPAD)	Pressure sensitive operator pad
	(STBY/OFF)	key
	(X-MIT/OFF)	key

• Menu

Function	Select #2VRM (#2VRM)
	Select #2EBL (#2EBL)
	Magnify a selected area of the PPI Image (ZOOM)
	Select true or relative motion display (TM/RM)
	Select the heading mode (HDG MODE)
	Tuning mode (TUNE)
	Display radar wake (WAKES)
DISPLAY	Display the positions of the own ship and target (POSITION)
	Display destination (WAYPOINT)
	Range unit (RANGE)
	Bearing reference (BEARING)
	Select EBL relative or true bearing (EBL READOUT)
	Transmit intermittent (TIMED-TX)
	Transmutation time (TX PERIOD)
	Preparation time (STBY PERIOD)
RADAR SET-UP	Alarm sensitivity (ALM LEVEL)
	Transmitter pulse width (TX PULSE) (1.5 NM)
	Transmitter pulse width (TX PULSE) (3 NM)
	Transmitter pulse width (TX PULSE) (6 NM)
	Panel illumination (KEYBOARD DIMMER)
	Select the language (LANGUAGE)
INITIAL SETTING	Adjust bearing (BEARING)
	0-mile adjust (DIAPLAY TIMING)
	Preset tuning (TUNE PRESET)
	Preset sea return (STC PRESET)
	Buzzer volume (BUZZER)

1.2.4 Rectifier Unit

1) NBA-797A

Dimensions	• Width	270 mm
	• Depth	175 mm
	• Height	430 mm
Mounting		Wall type, drip proof structure
Weight		Approx. 17.5 kg
Input power		AC 100V/110V/115V, ±15%, 50/60 Hz, single phase, 200 VA AC 200V/220V/230V, ±15%, 50/60 Hz, single phase, 200 VA
Output		26 VDC, 7A

1.2.5 Unit-to-unit Spacing

	Maximum Cable Length	Standard Cable Length
Scanner to display	20 m	10m
Display to rectifier	See Subsection 4.5.3 "Selecting a Long Cable"	

Notes: • Install the component units so that the interunit cables between them do not exceed 20 m.

• The standard cables are provided with connectors and plugs.

SECTION 2

TECHNICAL DESCRIPTION

2.1 GENERAL

The theory of operation for the Radar Set JMA-2253 and JMA-2254 is presented here with descriptions following the functional block diagram circuits.

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 areall 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.

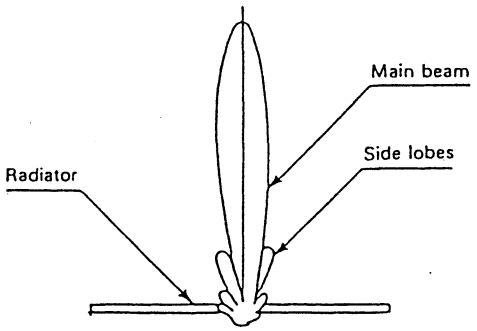


Fig. 2-1 RADIATOR PATTERN

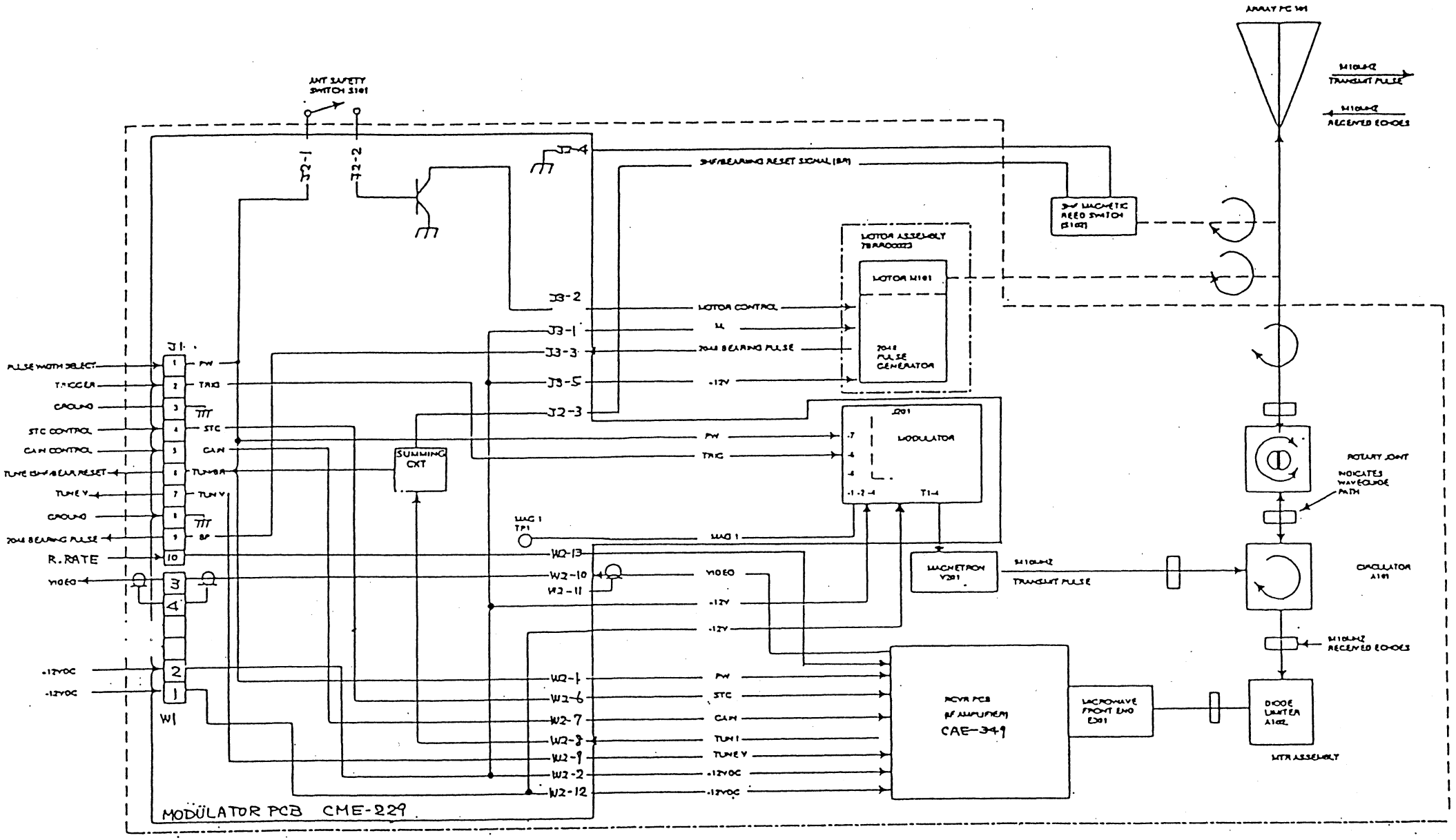


FIG. 2 -2 BLOCK DIAGRAM OF RADOME SCANNER UNIT

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 scanconverter 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 OPEN ARRAY ANTENNA UNIT

The Open Array antenna unit consists of the RF radiator housed in a separate array assembly and coupled to a "T-Bar" assembly on the pedestal housing. The radiator rotating mechanism, antenna motor/encoderd assembly, bearing reset circuitry, transmitter and receiver modules are all mounted within the pedestal housing. The Functional Block diagram for the Open Array Antenna unit is shown in figure 2-4.

2.3.1 RADIATOR

The purpose of the RF radiator is to shape the main transmitted beam of the radar during the transmission phase of the radar's operating cycle and to receive any incoming echo pulses during the receive portion of the cycle.

The radiator is a horizontally polarized, non-resonant, end-fed slotted waveguide array. The radiator, 3.9 feet in length, is coupled to the transmitter and the receiver through a short waveguide section, a rotary joint, and a circulator assembly. The radiator is driven at 27 rpm by the motor-encoder via a gear reduction mechanism.

Electrically, the array produces a horizontal beamwidth of 2° at the half power points with a vertical beamwidth of 30°. The direction of the beam (maximum radiated power) is essentially perpendicular to the face of the radiator. Within +/-10° of this main beam, the side lobes are reduced by greater than -23dB. Outside of this area, the sidelobes are reduced by more than -26dB.

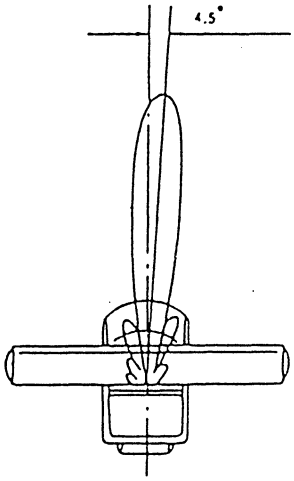


Fig. 2-3 RADIATOR PATTERN

2.3.2 RADIATOR ROTATING MECHANISM

The antenna drive mechanism consists of a 10 Vdc motor/encoder and a gear reducer assembly. The DC operating power for the motor is supplied from the ship's DC power via the interunit cable through the antenna motor power supply regulator circuit. When the radar is turned to the X-MIT condition, the motor drives the gear reducer assembly through a 5.6:1 ratio thus providing the antenna rotation of approximately 27 RPM. This electrical/mechanical assembly is designed to maintain the antenna rotation in a wind speed of up to 80 knots.

2.3.3 MOTOR-ENCODER

The antenna motor also includes a pulse encoder as part of its assembly. The encoder section produces the bearing pulses for display sweep generation, and rotation synchronization. A bearing syncpulse is generated every 0.176degrees of rotation or 2048 pulses per each rotation at 5V amplitude. These pulses (BP) are ent down to the Bearing Pulsecircuitry in the display unit via J2-9.

2.3.4 BEARING RESET CIRCUIT

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(SHM) is sent down to the bearing reset circuitry in the display unit and synchronizes the scanner position to the displaysweep. The SHM signal is sent down to the display together with the Tune indication signal at J2-6.

2.4 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 viathe 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(inaccordance with the range scale or menu selections) can be provided.The pulse repetition frequency(PRF) always changes automatically tomatch the selected operating pulse length(See TABLE 3-1).

Upon receiving the positive trigger pulse, TR2 generate a differential waveform at C15, RV2, RV3, and RV4 setup the dischargeperiod 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.

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(JMA-2253)	0.7μS	750 Hz
12, 24, 48 nm(JMA-2254)	0.7μS	750 Hz

2.5 RECEIVER UNIT

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

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 frontpanel 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)

The Receiver PCB includes the 60 Mhz IF amplifier, bandwidth control circuits, video

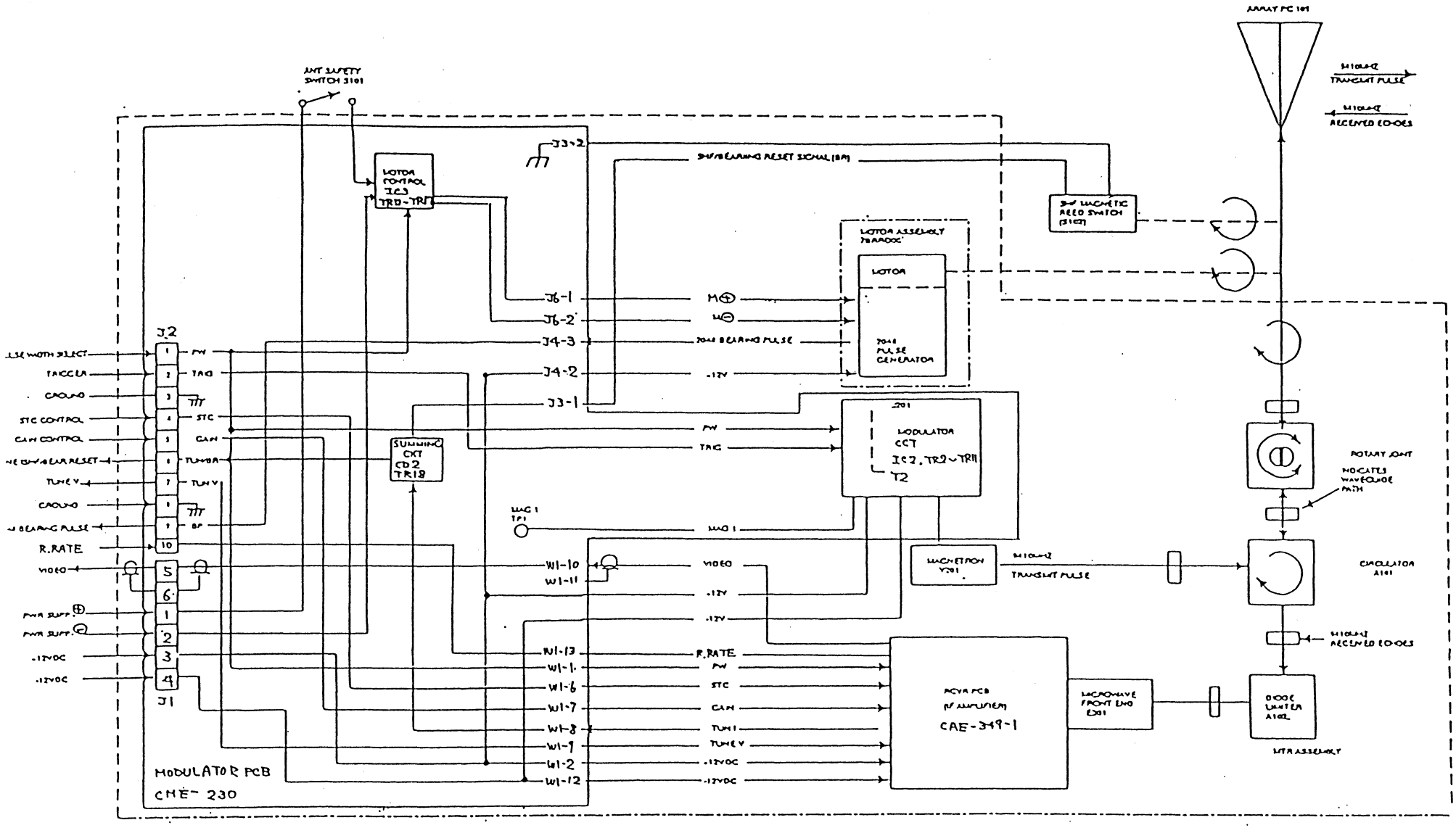


FIG.2 -4 BLOCK DIAGRAM OF OPEN ARRAY SCANNER UNIT

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.

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 TR 2 will be 0 volts. In this condition, the pulselength in operation is 0.08μS and the bandwidth of the receiver iswidened to 10 Mhz. When the pulse length signal is other than 0.08μS, IC6, will be turned "On", the gate of TR6 will be -4V, andthe 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 2-5-2.

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(detruned)and -0.7V (tuned in long pulse).

Gain-STC Circuit

The receiver includes GAIN and STC circuitry compresed of TR8, IC6and 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.RV5 sets the maximum gain level for the receiver when +12 VDC is supplied at the GAIN input.

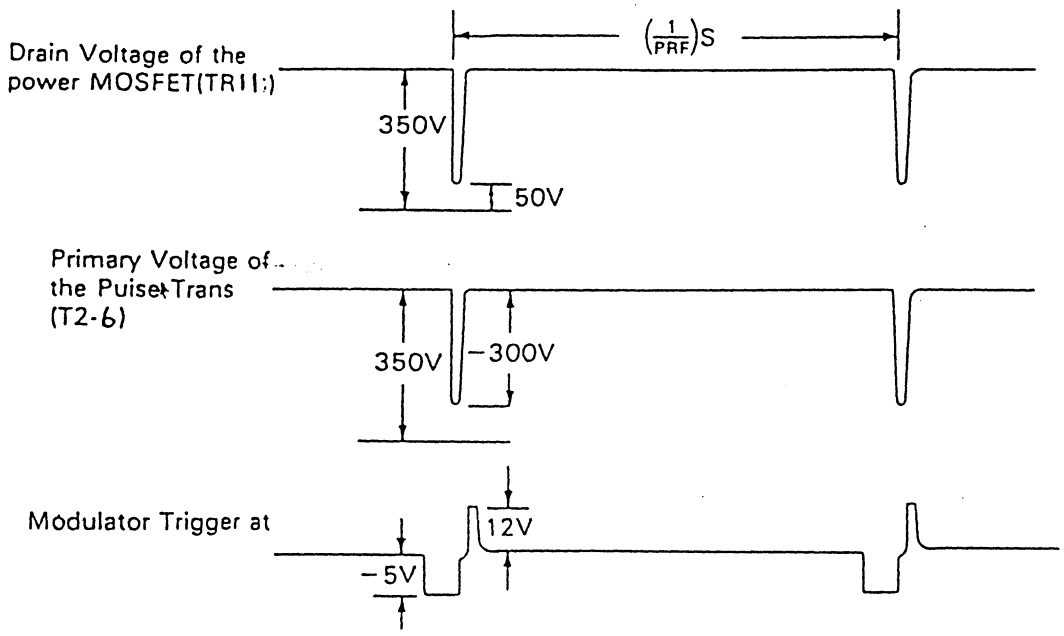


FIG. TIME TABLE OF THE TRANSMITTER

2-5-1

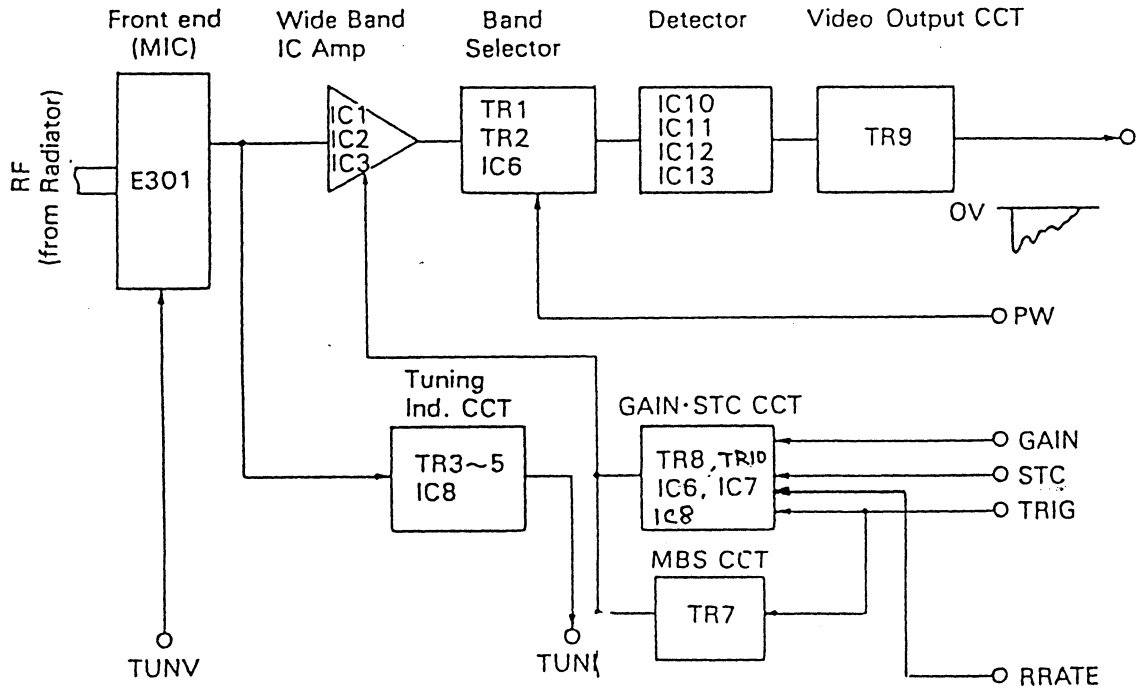


FIG. RECEIVER UNIT BLOCK DIAGRAM

2-5-2

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 tuned "ON" and C56 will charge. When the trigger pulseends, TR8 will be turned "Off". C56 can then discharge back to 0V through R61 and RV3. The rate of Cd56'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". C56will discharge to 0 V through R63. The discharge rate will be determined by the time constant of C56, RV2, and R63. The MBS signal is combined with the Gain control voltage and STC signal and applied to the IC 1 and IC2.

2.6 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. If separately ordered, the display may also include the optional MARPA PCB.

2.6.1 SIMPLIFIED BLOCK DIAGRAM

FIG.2-6 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(CMC859). 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.

2.6.2 MAIN CONTROL PCB

2.6.2.1 VIDEO INPUT CIRCUITRY

The incoming video signals from the receiver in the scanner are first routed through the FTC circuit components consisting of CD11F and C52.

The Varicap diode CD11D controlled by the voltage supplied from IC30-(8) which is determined by the front panel RAIN CLUTTER Control.

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

2.6.2.2 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

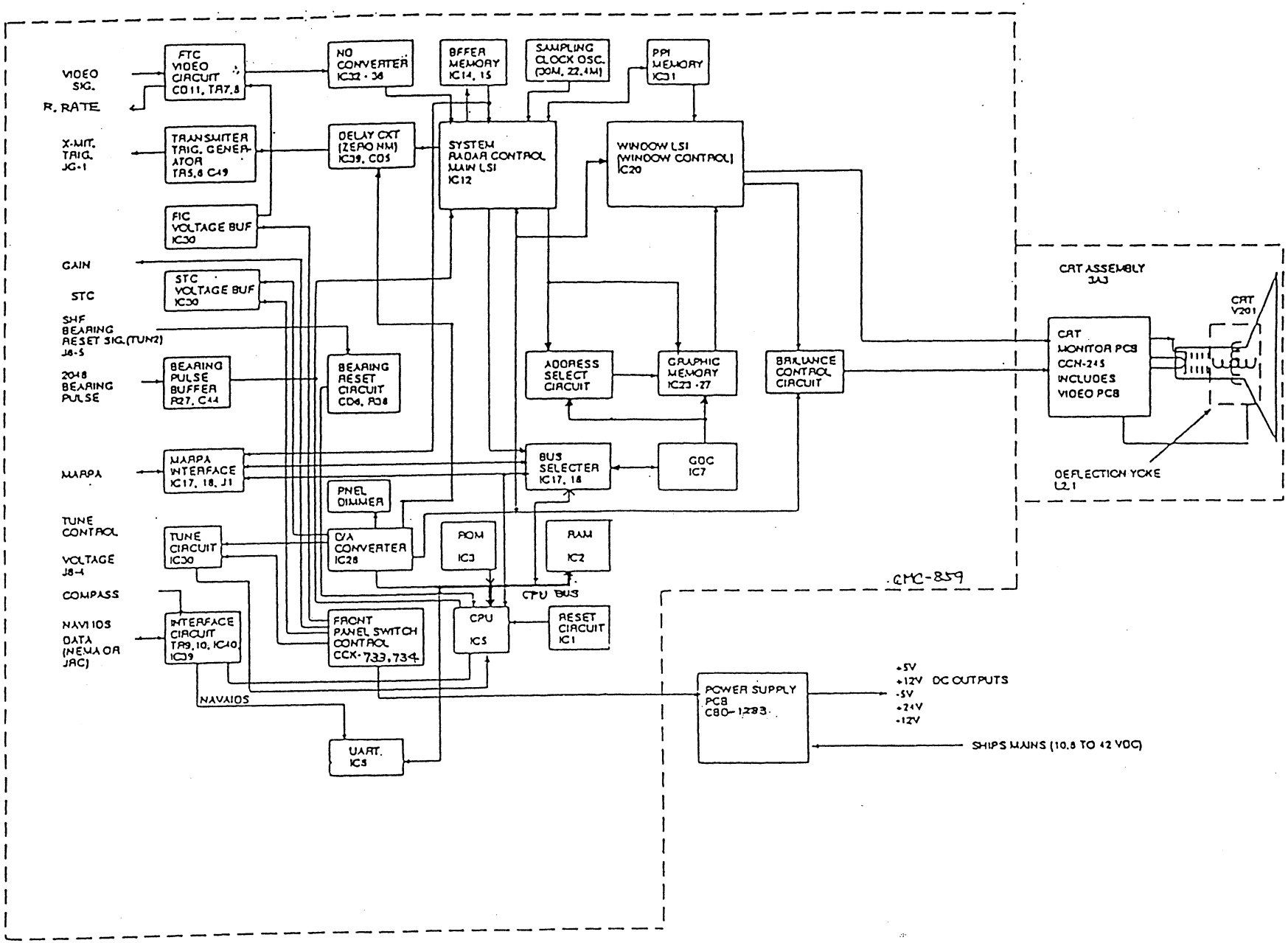


FIG. BLOCK DIAGRAM OF DISPLAY UNIT

threshold level (brightest video) is set by RV2(Upper) located in the Main Circuit PCB. The LSB threshold level (dimmest video) is set by RV3. The digitized video output (RVDP0-3) is then sent to IC12, the Main LSI and Video Processor for storage into the video buffer memory.

2.6.2.3 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 convertor 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 complimentary drive signals to TR5 and TRD6. These amplifiers boost the output transmit trigger(TI) level to +12 VDC in amplitude.

2.6.2.4 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 develop 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 signalwhen 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 Processingis performed by extending the target digital video pulse length up to 8 additional digital video cells whenever target expansion is enabled in the menu.

2.6.2.5 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.

2.6.2.6 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.

2.6.2.7 CONTROL PCBS

The JMA-2253/2254 series radars use two separate keypad control PCB assemblies (CCK-733and CCK-734) to activate the radar system and control its functions. The se key- pad control PCBs interface directly into the Main Control PCB via connectors J6 and J7 to IC5, the CPU.

CCK-733, which is mounted to the left side of the display unit front panel, contains 8 of the 16 key switches used by the radar. CCK-734, on the right side of the front panel, contains the remaining 8 key switches and the four variable controls forthe TUNE, GAIN, FTC, and STC. Each panel includes LEDs for back-lighting 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.

2.6.2.8 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 EROM 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, resetpulses 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.

2.6.2.9 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.

2.6.2.10 DISPLAY MONITOR

The display monitor receives its operating supply voltage fromthe +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.

2.6.3 OPTIONAL INPUTS

The JMA-2250 Series radars 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. Navaid Data (NMEA 0183 "RMC, RMA, VTG" sentences)

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

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

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

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.

2.6.4 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 ispressed on the Control R 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 operatesTR7 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 outputat TP1 and adjusting for +5VDC, +/-.1 VDC with a volt-ohm meter.

When both the POWER and XMIT/STBY keys are pressed together, IC6resets IC5 outputs and disconnects the Vcc from the AVR IC1. This will turn the power supply and the radar system to OFF.

2.7 TROUBLE-SHOOTING GUIDE

While the JMA-2250 Series Radars are highly reliable systems, earlysignas and detection of component fatigue can sometimes be spotted during regular operational checks.

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

2.7.1 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.

2.7.2 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 2-2 shows a table of fuses employed in the equipment.

TABLE 2-2 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

2.7.3 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 2-3).

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 procedures and may prove necessary in some cases.

TABLE 2-3 is the trouble shooting guide and check-out procedure,TABLE 2-4 shows typical voltages and resistances at significant points throughout the equipment. The internal resistance of the tester used in measurements was 20kΩ/Vdc, 8 kΩ/Vac.

TABLE 2-2 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 CME-230-J1-3,4
	b. AVR output voltage	350V	X-MIT	CME-229-CD6-K CME-230-CD6-K
	c. Mag. current	12V～20V		CME-229-TP1 or CME-230-TP1 -ground
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 2-3 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 or CME-230
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 or CME-230 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-859 (Main Circuit) Fault of receiver unit.
10.	NO VRM or VRM cannot be controlled.	Check:[DISPLAY] Fault of CCK-734. Fault of main circuit(CMC-859).
13.	NO EBL or EBL cannot be controlled	Check:[DISPLAY] Fault of CCK-734. Fault of main circuit(CMC-859).
14.	No alarm zone marker, cannot be controlled or no alarm sound.	Check:[DISPLAY] Fault of CCK-734. Fault of main circuit(CMC-859). Fault of Buzzer BZ1.

TABLE 2-4 shows typical voltage and resistances at significant pointsthroughout 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	TUNE.....CENTER
FTC.....MIN	GAIN.....MAX
	P.S. = 12V(D.C.)

TABLE 2-4 TYPICAL VOLTAGES AND RESISTANCES

RADOME RADAR[JMA-2253](with interunit cable connected)

Measuring Point	Resistance (Ω)	Voltage(V)			Remarks
		0.125～1.5 (nm)	3.6 (nm)	12 (nm)	
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

OPEN ARRAY RADAR[JMA-2254](with interunit cable connected)

Measuring Point	Resistance (Ω)	Voltage(V)			Remarks
		0.125～1.5 (nm)	3.6 (nm)	12 (nm)	
J1-5	5.5×10	-0.06	-0.06	-0.06	DC0.3V
J1-1～2	0.4×10	12	12	12	12 V
J1-3	2 ×10	11.7	11.7	11.7	12 V
J1-4	0.1×10	-12.0	-11.9	-11.9	12 V
J2 1	26×10	4.0	5.1	10.8	12 V
2	22×10	0.05	0.05	0.05	0.3V
4	180×10	2.7	2.7	2.7	3 V
5	3.5×10	11.9	11.9	11.9	12 V
6	20×10	4.2	4.2	4.2	12 V
7	500×10K	8.9	8.9	8.9	12 V
9	8 ×10	1.9	1.9	1.9	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	Open Array Resistence	FUNCTION
Radome	Open Array	(Ω)	(Ω)	
TB1-1	J1 - 3	5.5 ×10	5.5 ×10	+12Vdc
2	4	0.5 ×10	0.5 ×10	-12Vdc
3	5	∞ ×10	∞ ×10	VIDEO
4	6	0 ×10	0 ×10	VIDEO RET
J1 -1	J2 - 1	2K ×10	2K ×10	Pulse Width
2	2	∞ ×10	∞ ×10	Trigger
3	3	0 ×10	0 ×10	GND
4	4	250 ×10	250 ×10	STC Control
5	5	1.3K ×10	1.3K ×10	GAIN Control
6	6	7.5 ×10	7.5 ×10	TUNI/SHF
7	7	∞ ×10	∞ ×10	TUN V
8	8	0 ×10	0 ×10	GND
9	9	7 ×10	7 ×10	2048 BP
10	10	300	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 3 MAINTENANCE

3.1 GENERAL

It is necessary to perform the maintenance services listed below to keep the JMA-2253/JMA-2254 in good working conditions. Proper maintenance of the JMA-2253/JMA-2254 minimizes the possibility of machine failures. The maintenance operations that are common to all components of the JMA-2253/JMA-2254 are listed below.

(1) Cleaning

Remove dirt, dust, or water-spray from the JMA-2253/JMA-2254 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 JMA-2253/JMA-2254 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 JMA-2253/JMA-2254, be sure to turn it off to prevent electric shock. If a rectifier unit is used, in particular, turn off power to the display unit. Note that voltages from the rectifier unit are always present even if the radar is stopped.

3.2 SCANNER UNIT

When inspecting the scanner unit of the JMA-2253/JMA-2254, 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.

3.2.1 Radome Scanner Unit (JMA-2253)

(1) Radome

(A) 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.

3.2.2 Rotary Scanner Unit (JMA-2254)

(1) Radiator

(A) A radiator front panel (radiator surface) contaminated by smoke, dust, or paint would cause attenuation or reflections of radio waves, resulting in reduced radar performance. Periodically check the rotary scanner unit. If it proves dirty, wipe the radiator front 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) Rotary drive block

(A) Lubricating the oil seal (see the figure below)
Remove the cap from the antenna support and apply grease using a grease gun. This lubrication needs to be performed at least semiannually. Apply grease of approximately 20 cc or amount such that the oil seal will come out. Use Mobilux No. 2 from Mobile Oil Co., Ltd. or equivalent.

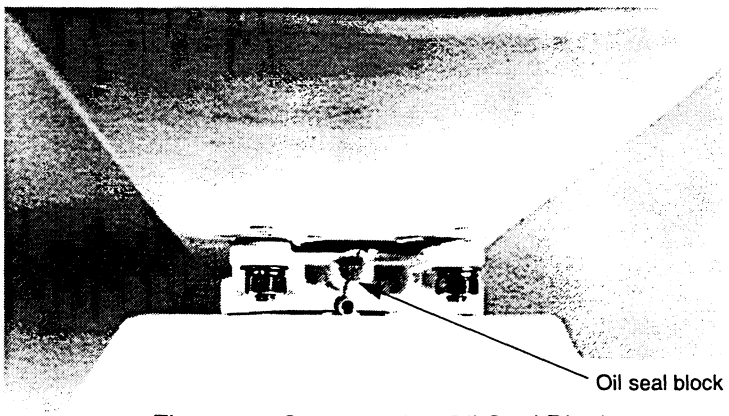


Figure 4-1 Scanner Unit Oil Seal Block

(B) Lubricating gears

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.

(C) Drive motor

(a) Reduction gears

The reduction gears need no lubrication unless it is subject to oil leakage. If they are disassembled for overhaul, replenish lubricant "Beacon 325" from Esso Standard.

(b) Motor

The life time of the brush unit is 3,000 hours. The brush needs to be replaced if 1/2 of the overall length is worn (an undercut is provided 1/2 along the length of the brush).

The commuter needs to be kept clean. If any carbon power fixed on the commuter cannot be removed with a dry cloth, burnish it with a sand paper # 150 to #140.

The carbon brush can be removed by removing the caps located on both sides of the bottom portion of the motor.

(c) Pedestal

Check the scanner unit mounting molts occasionally and apply paint semiannually to protect them from corrosion.

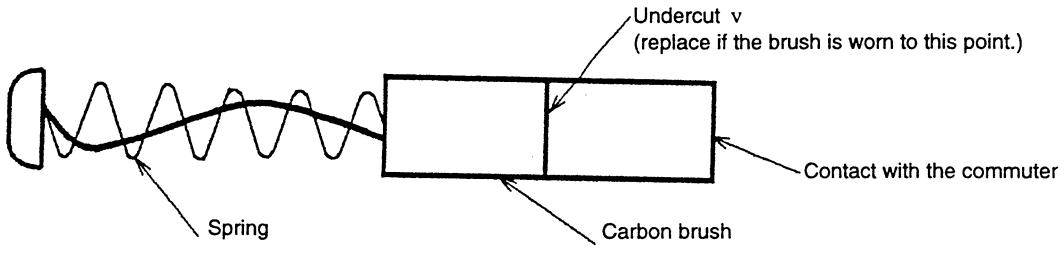


Figure 4-2 Carbon Brush

3.3 Display Unit

3.3.1 Cleaning the Display Unit Screen

Dust on the CRT tube would reduce the glass transparency and make the vide image dim. Wipe the screen surface with a soft lint-free cloth (made of flannel or cotton). A cloth moistened with an antistatic agent would cause little problem. When using it, wipe softly; never rub the screen surface with force.

SECTION 4 INSTALLATION

4.1 GENERAL

Proper installation of a radar unit is essential for extracting full capability of the unit reliably and for facilitating troubleshooting and maintenance. Follow the guidelines given below when installing the JMA-2253/JMA-2254.

(a) Install the scanner unit as high as possible while taking its weight into consideration.

(b) Install the display unit in the wheel house for comfortable observation.

(c) The scanner unit and display unit are connected by 10 to 20 m compound cable with 20 conductors with vinyl sheath and an internal shield. The maximum permissible cable length is 20 m. Cables larger than 20 m would deteriorate the radar performance of the JMA-2253/JMA-2254.

(d) Figures 101 and 102 shows the General System for the JMA-2253 and JMA-2254, respectively.

4.2 INSTALLING THE SCANNER UNIT

4.2.1 Selecting the Installation Location

Consider the following points when determining the location of the scanner unit:

(a) Install the scanner unit in a location such that there is no large obstacle ahead of the scanner unit along the ship's heading line.

(b) Installing the scanner unit near the outlet of a chimney stack will cause reduced radar performance or machine failures due to excessive heat. Keep the scanner unit as far away from such heat sources as possible.

(c) Installing a direction finding antenna or VHF antenna near the radar scanner unit will cause radio interferences. Keep such devices as far away from the scanner unit as possible. For the same reason, keep the radar and anntena lead-in cables as far away from the scanner unit as possible (never bundle these cables togehter).

(d) Any ropes near a rotary type scanner unit would be caught in the radiator block of the scanner unit due to high wind, causing machine failures.

4.2.2 Installation Procedure

(1) Precautions to be observed when installing the scanner unit on a power boat

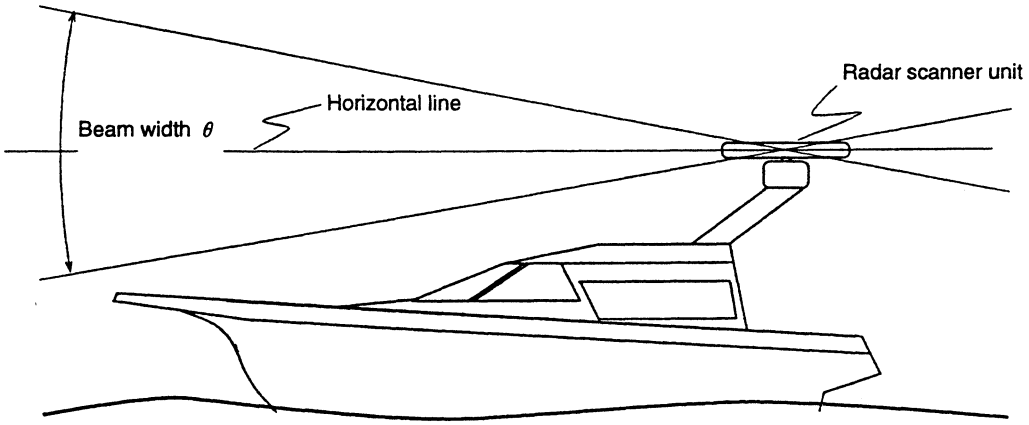
The bow of a power boat is kept in a raised position when it is running at a high speed. Consequently, if the radar's scanner unit is installed horizontally when the boat is stopped, the following conditions will occur if the trim (elevation angle of the ship's bow at run time) exceeds 1/2 of the vertical beam width (θ):

- On the front side, the water surface lies outside the beam, weakening the radio wave that is incident to the target on the water surface. Consequently, the echo generated by this target is will hardly be visible on the radar screen.

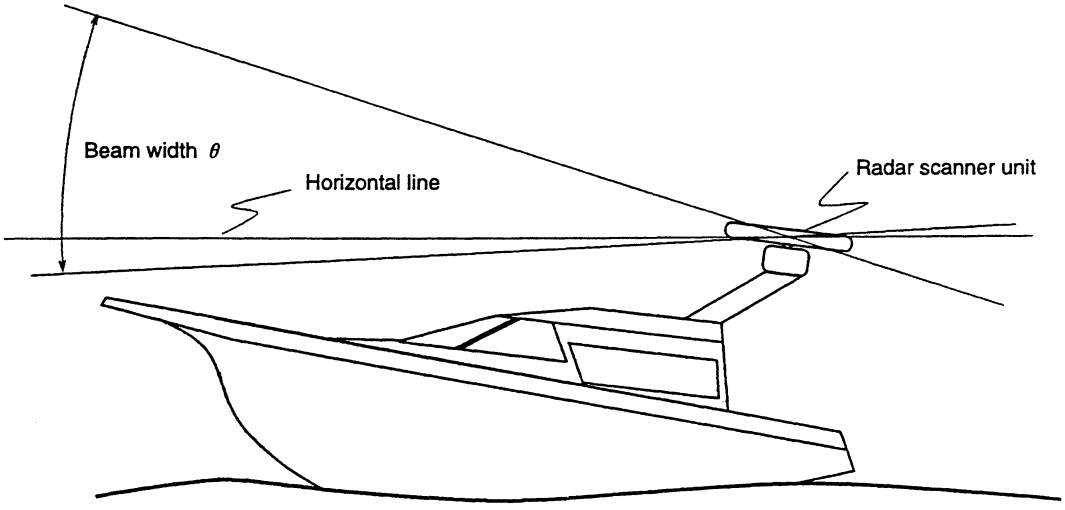
Conversely, on the rear side:

- Since the radio wave that is incident to the water surface is stronger, strong sea clutter will develop.
- The echoes on the starboard and port sides of the ship undergo almost no influence.

For vessels on which the trim is 1/2 or greater than the vertical beam width (θ), it is recommended that the scanner unit be installed in such an orientation that it is tilted forwards.



[When the ship is stopped or running at a slow speed]



[High speed run: the lower part of the beam is almost horizontal.]

(2) Precautions to be observed when installing the scanner unit on a yacht

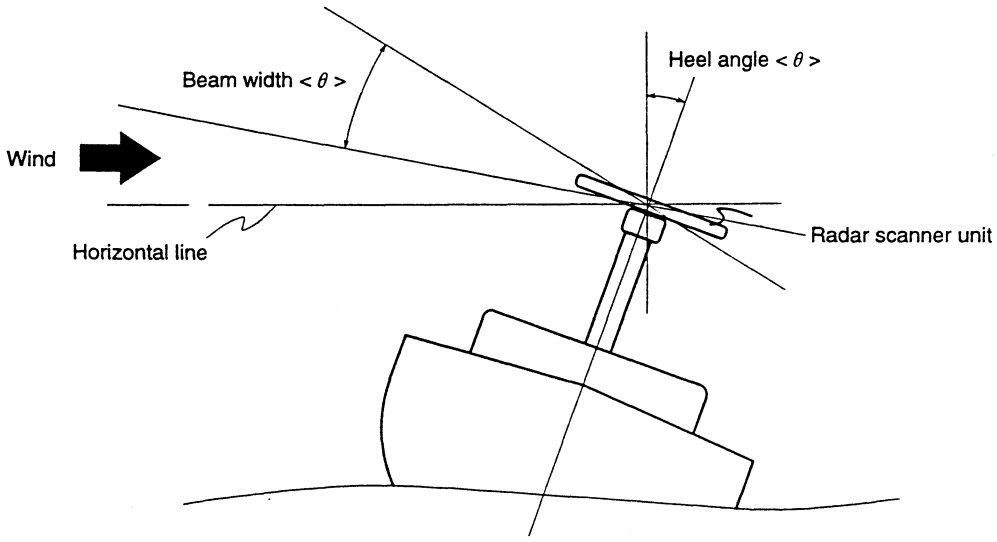
A yacht heels on the lee side when a wind with a certain level of force blows. The following condition occurs if the heel angle exceeds 1/2 of the beam width:

- On the windward side, the water surface lies outside the beam, weakening the radio wave that is incident to the target on the water surface. Consequently, the echo generated by this target is will hardly be visible on the radar screen.

Conversely, on the lee side:

- Since the radio wave that is incident to the water surface is stronger, strong sea clutter will develop.
- The echoes on the front and rear sides of the ship undergo almost no influence.

For yachts on which the heel is 1/2 or greater than the vertical beam width (θ), it is recommended that the scanner unit be installed on a mounting base so that the scanner unit can be tilted on the left and right sides according to the heel angle.



(a) Figures 122/123 show the mounting hole templates for the JMA-2253/2254 scanner units, respectively. Use this template to drill mounting holes when installing the scanner unit (make sure that the safety switch faces the stern). When installing the scanner unit, make draft holes. Installing a scanner unit without making a draft hole forces the draft tube to be bent, resulting in entry of water.

(b) If it is found that there is no height above the roof of the wheel house enough to directly accommodate a scanner unit, install a pedestal or radar mast.

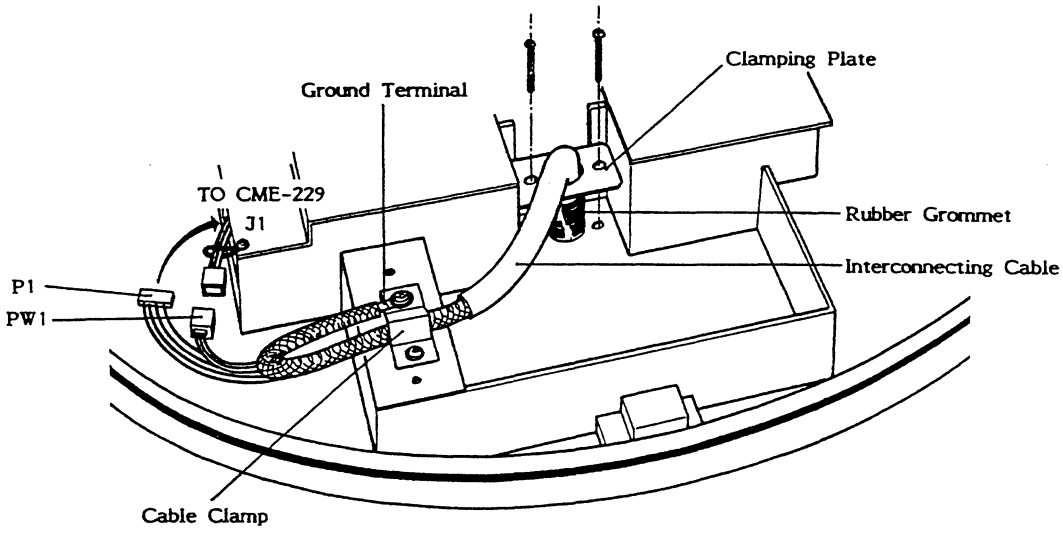
(c) In addition to a pedestal or radar mast, it is necessary to provide an appropriate staging for convenience in installation, maintenance, adjustment, and repair of the scanner unit.

4.2.3 Cabling the Scanner Unit

(1) Redome scanner unit (NKE-1046)

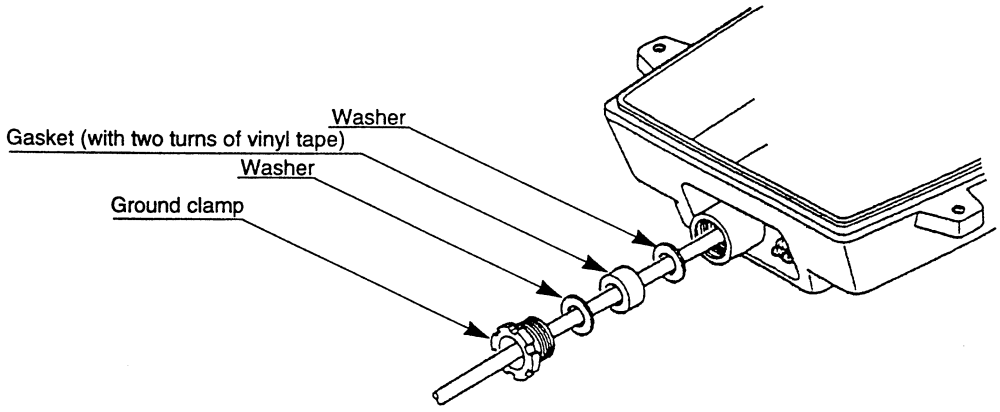
a) Route the scanner unit cables from bottom of the mounting base and connect them to connectors J1 and J2 of the CME-229 modulator printed circuit board.

b) Connect and tighten the ground terminal when securing the cables with the cable clamp.



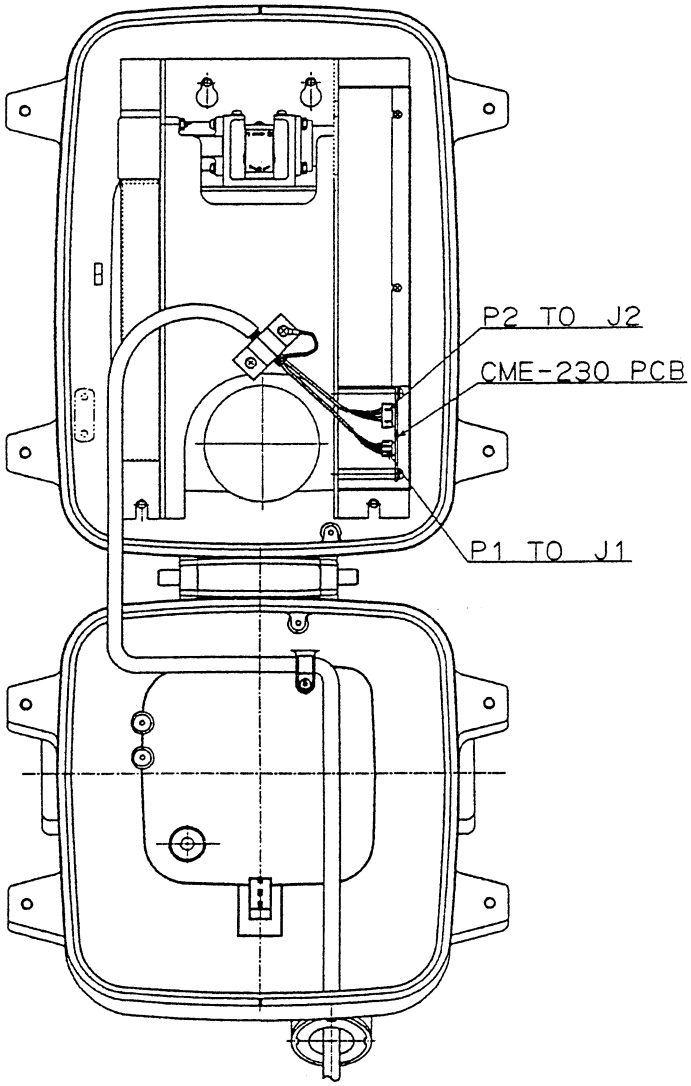
(2) Rotary scanner unit(NKE-1047)

(a) Fit washers, gasket, and ground clamp on the scanner unit cable and insert the cable into the cable access hole located on the rear of the scanner unit pedestal. Wind two turns of vinyl tape around the gasket.

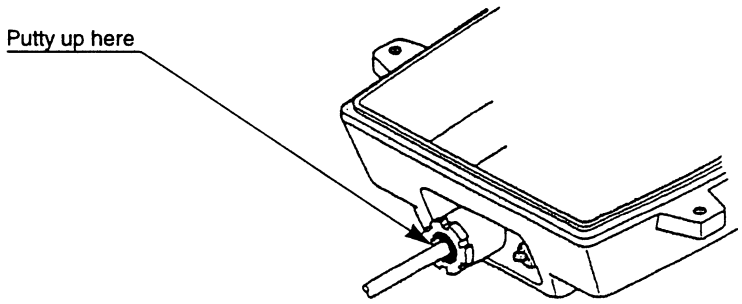


(b) Connect cable plugs P1 and P2 to connectors J1 and J2, respectively, on the printed circuit board CME-230 located inside the scanner unit pedestal.

(c) Clamp the exposed braided shield wire from the scanner unit cable with the cable clamp and secure the ground terminal with a screw.



(d) Tighten the ground fitting at the cable access hole located on the rear of the scanner unit pedestal, then putty up the clearance between the cable and ground fitting for waterproofing.



4.3 INSTALLING THE DISPLAY UNIT

4.3.1 Selecting the Installation Location

Consider the following points when determining the location of the display unit:

(a) Install the display unit in a location that provides the operator with a convenient viewing position.

(b) Keep the display unit at least 1 m away from the compass to minimize the influence of the display unit on the magnet compass.

(c) Take after-installation maintenance into consideration.

4.3.2 Installation Procedure

(a) The physical dimensions of the display unit are shown in Figure 105. According to this figure, make mounting holes and install the display unit (the display unit should be oriented so that the observer can face the ship's heading (the CRT tube faces the stern of the ship) for easy observation).

(b) Wherever possible, select a location that is free of vibration.

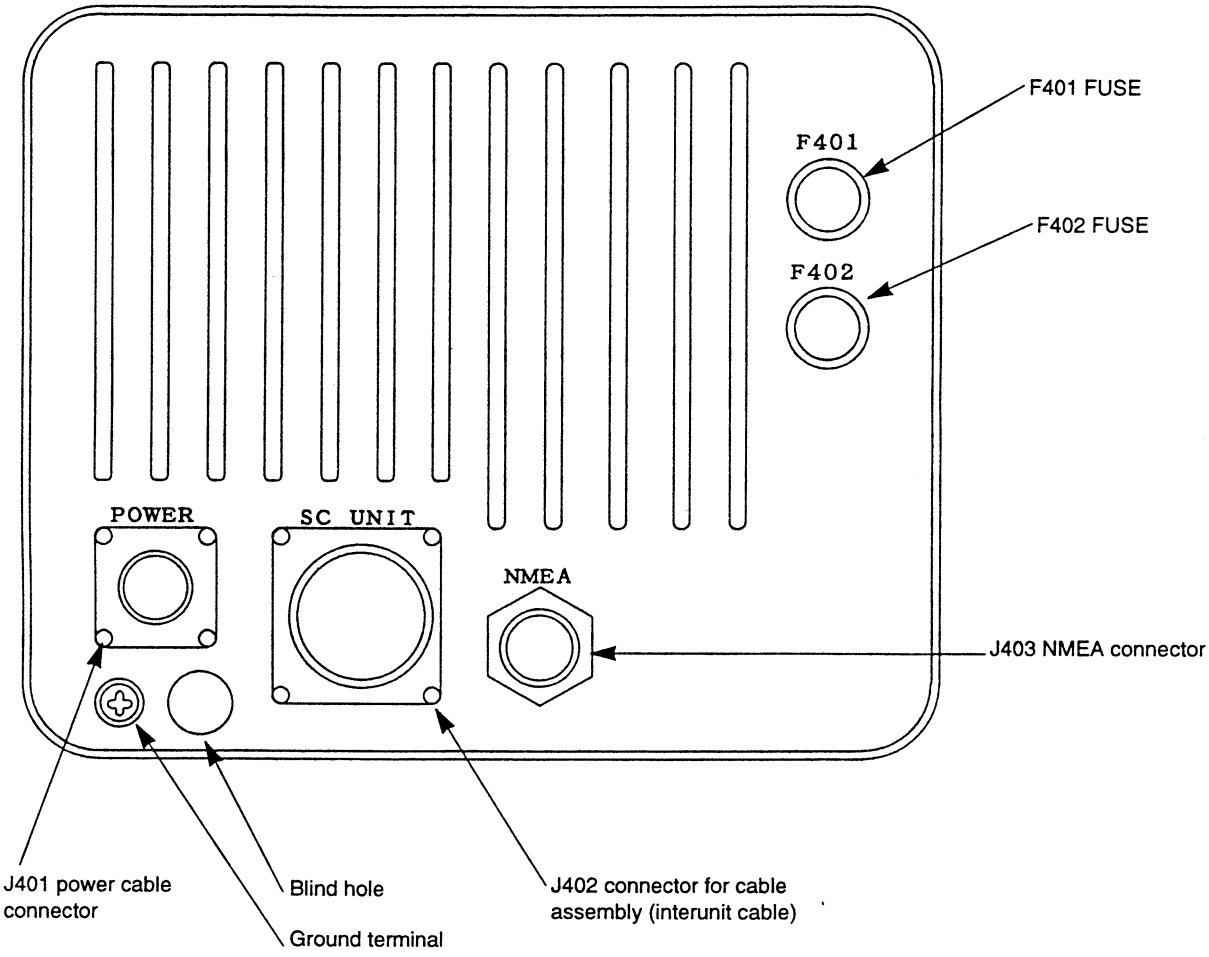
4.3.3 Installing the Power Cable

(a) Connect the power cable plug to the J401 connector on the rear panel of the display unit.

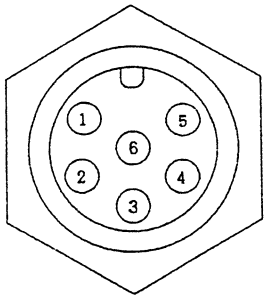
(b) Connect the plug of the cable from the scanner unit to the J402 connector on the rear panel of the display unit.

Caution: Use an adequately heavy earth cable when connecting the earth terminal of the display unit to the ship body.

4.3.4 Display Unit Rear Panel



[Display Unit Rear Panel]



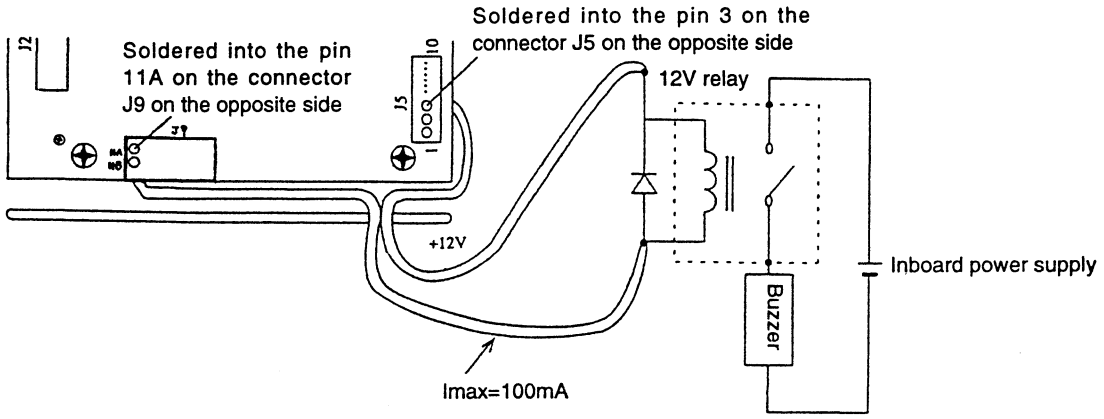
① NAV(+) (from LORAN or GPS)
② NAV(-) (from LORAN or GPS)
③ COMPASS(+) ┐ To electromagnetic compass
④ COMPASS(-) ┘ (magnetic sensor)

[J403 NMEA Connector]

* The pin layout will appear the same when viewed from the soldering side of the 6P connector.

4.3.5 Cabling External Buzzer and Other Devices

Route the signal cables from the display unit main control PCB (PC1) to the external devices through the access hole in the (rubber) blind cap that is located on the rear panel of the display unit.



Parts list

	Vendor	Model Name
Relay	Takamizawa	LZ12H
Diode	Hitachi	V06C

* The above relays are rated at 5A (DC30V/AC120V) and 4A (AC240V). They cannot be used for any buzzers that have a higher rating.

4.3.6 Connecting an Electromagnetic Compass

The figure below shows a cabling diagram for the JRC NJZ-1086 electromagnetic compass (refer to the instruction manual for the NJZ-1086 for details).

(1) Solder the data cable from the compass electronic unit to the 6-pin connector in the radar's display unit. Take care with the polarity of the cable.

6-pin connector (pin 3) ◄——► Data cable (white conductor)
6-pin connector (pin 4) ◄——► Data cable (black conductor)

(2) Plug the compass electronic meter cable from the compass electronic unit to the compass electronic meter.

(3) Plug the connector of the data cable from the compass electronic unit into J403 (NMEA) on the rear panel of the display unit.

(4) Connect the power cable to the ship power source. Check the polarity of the power cables.

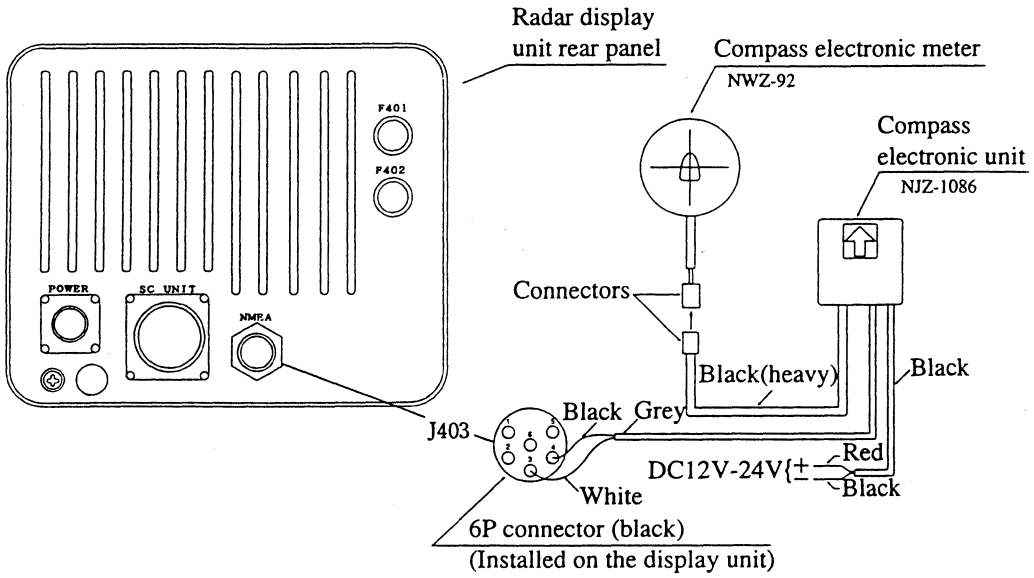
Power cable (red conductor) ◄——► Ship power source (+)
Power cable (black conductor) ◄——► Ship power source (-)

The power input range is from 12 VDC to 24 VDC.

This completes the cabling of the electromagnetic compass.

If the user's electromagnetic compass is not the NJZ-1086, it may be connected to the display unit of the JMA-2253/JMA-2254 provided that it has NMEA output terminals. The display unit cannot receive data normally unless the data format of the user's compass is not NMEA0183. Refer to the instruction manual attached to the compass. In this case, connect the cable as follows:

6-pin connector (pin 3) ◄——► Data (+)
6-pin connector (pin 4) ◄——► Data (-)



4.4 MODIFICATIONS TO BE MADE TO THE INBOARD POWER SUPPLY

Make the modifications explained below to the JMA-2253/JMA-2254 components according to the power requirements of the inboard power supply (12V fuses are installed at the factory).

(1) Display unit

Fuse ratings

Ship power source	Rating of F401	Rating of F402
DC12V	8A	5A
DC24/32V	4A	3.15A

(2) Scanner unit

The scanner unit needs no modification.

4.5 CABLE ASSEMBLIES

4.5.1 Interunit Cable (CFQ-8026-10/-15/-20, CFQ-8029-10/-15/-20)

(a) Use this cable to connect between the display unit and the scanner unit of the JMA-2253/JMA-2254.

(b) Use a CFQ-8026-10 10m cable, CFQ-8026-15 15m cable or CFQ-8026-20 20 m cable for the JMA-2253.

(c) Use a CFQ-8029-10 10m cable, CFQ-8029-15 15m cable or CFQ-8029-20 20 m cable for the JMA-2254.

Color	Number of Conductors/Diameter (mm)	Signal Name	
Shielded wire (conductor): Black		TI	
Shielded wire (shield)		E	
Gray	0.2	RRATE	
Co-axial cable (conductor)		VD	
Co-axial cable (shield)		VDE	
White	0.2	BP	
Red	50/0.18	+12	
Green	0.2	TUNI/BZ	
Purple	0.2	STC	
Yellow	50/0.18	1A	JMA-2254
Green	50/0.18	1A	
Gray	50/0.18	2A	
Blue	50/0.18	2A	
Red	0.2	GAIN	
Brown	0.2	PW	
Blue	50/0.18	-12	
Blue	0.2	TUNV	
Yellow	0.2	E	

*: Cable: 11.7 ±0.6[mm]

4.5.2 Power Cable (CFQ-2646)

(a) The JMA-2253/JMA-2254 is provided with a 2 m power cable with connectors

Color	Number of Conductors/Diameter	Cross Section	Polarity
White	50/0.18	1.25	+
Black	50/0.18	1.25	-

4.5.3 Selecting a Long Cable

The effective voltage of the input to the radar is the voltage at the inboard power supply minus the voltage drop caused by the power cable. Too thin or long a power cable incurs a large voltage drop and may not be able to supply adequate power to the radar. In is recommended that the following guidelines be observed when selecting the power cable for your radar:

(a) Consider the possible voltage regulation of the inboard power supply (Vs).

(b) Use the following equation to calculate the voltage drop:

$$V=2LRKI$$

where:

L : represents the cable length.

R : represents the direct-current resistance (<ohm>/m) at 20<degree>

K : represents the conductor resistance temperature coefficient (= 1.22)

I : Maximum peak current (A)

(c) The table below lists the direct-current resistance (R) and permissible current (Imax) of several cables.

Cable Type	R (20℃)	Imax (45<degree>, continuous)
CVVS2 x 1.25	16.7Ω/km	13A
CVVS2 x 2.0	9.42Ω/km	19A
CVVS2 x 3.5	5.30Ω/km	26A

* The cable to be used must possess a sufficient permissible current (Imax) characteristic.

4.6 AFTER-INSTALLATION ADJUSTMENTS

4.6.1 Installation-time Check

(a) After completing the installation procedure, it is necessary to check the JMA-2253/JMA-2254 to verify that all installation steps have been conducted as instructed. In particular, check for correct cabling, for normal component operating state, for water leakage in the scanner unit, and for proper grounding of braided shielding cable.

4.6.2 Functional Checks

(a) After completing the installation-time check and before checking the operation of the radar, make sure that the output voltages of the inboard power supply fall within their permissible range.

(b) Read Section 2 carefully and thoroughly and make sure that the radar functions normally. Then, manipulate all controls and menu functions to ensure that they function normally.

(c) If it becomes necessary to make an adjustment though the JMA-2253/JMA-2254 is normal, read Section 5 carefully and follow the instructions given in that section.

4.6.3 Adjustment Items

(a) Radar's bearing adjustment is mandatory.

(b) If the control is not positioned near the center of the scale during tuning or if tuning fails, make a coarse tuning from the "TUNE PRESET" menu.

(c) If there is a difference between the range displayed on the radar's PPI screen and the actual range, adjust the range from the "DISPLAY TIMING" menu.

(d) The "BUZZER" menu can be used to adjust the volume of the alarming buzzer.

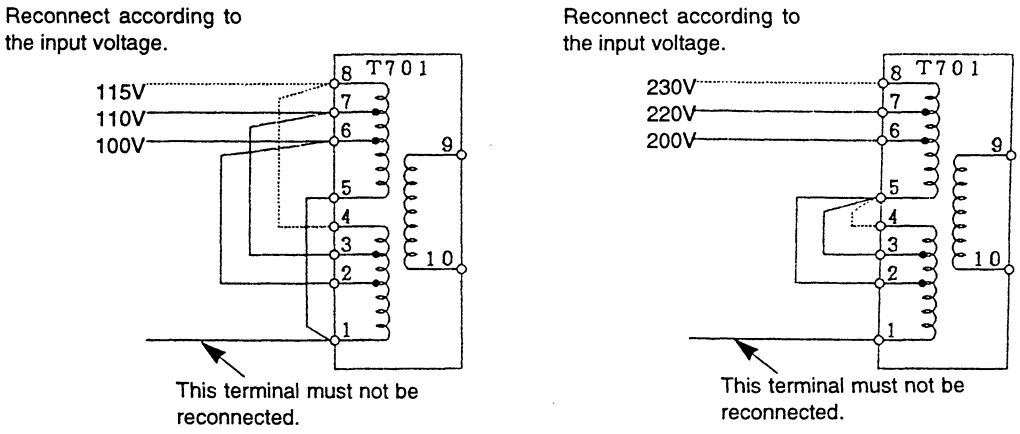
(e) The "STC PRESET" menu can be used to adjust the STC.

[For details on the above instructions, see Section 2.6 "USING THE JMA-2253/JMA-2254 FOR THE FIRST TIME."]

4.6.4 Rectifier Unit

The rectifier unit can run on inboard voltages of 100/110/115 VAC and 200/220/230 VAC provided that connections at the input terminals on the NBA-797A T701 are changed.

The figures below show how to change the connections at the input terminals.



[Reconnecting the NBA-797A input terminals]

SECTION 5 ADJUSTMENT

5.1 ADJUSTMENT PROCEDURES

5.1.1 General Adjustments

(1) Adjustments to be made when a part is replaced

Adjustments need to be performed when major parts of the JMA-2253/JMA-2254 are replaced.

(a) When the V201 magnetron is replaced → Tuning
(b) When the E301 front end is replaced → Tuning
(c) When the V201 CRT tube is replaced → Off center adjustment
When the CRT monitor PCB is replaced → Off center adjustment
→ Brilliance level adjustment
→ Focus adjustment

(2) Tune presetting

(a) See Subsection 2.6.2, "Tuning the Receiver," for the adjustment procedure.

(3) CRT monitor off center adjustment

(a) This adjustment must be performed on the centering magnet (permanent magnet) located immediately behind the deflection coil. This permanent magnet is made up of two doughnut-like disks.
(b) Turn the centering knob so that the center of the CRT tube is in alignment with the center of the PPI screen.

(4) Adjusting the brilliance level of the CRT monitor screen.

(a) Set the brilliance level of the CRT monitor screen to its maximum from the menu (see Subsection 2.7.1, "Changing the Screen Intensity.")
(b) Turn potentiometer RV6 on the CRT monitor PCB so that no raster appears in the non-displayable area. (Turn the potentiometer slowly since the circuit's sensitivity is very high.)

(5) Adjusting the focus of the CRT monitor screen

(a) Turn potentiometer RV7 on the neck PCB in the display unit so that the range rings and video images appear most clearly.

5.1.2 Adjusting the Scanner Unit

The scanner unit has several locations that need adjustment. They are factory set and normally need not be adjusted by the user. If it is necessary to make functional checks during inspection or repair, make the adjustments that are explained below.

High voltage warning:

High-tension voltages of 4,000 volts or higher are present at the modulator units (CME-230 or CME-229). The modulator unit must be accessed only by qualified service engineers.

(1) Adjusting the AVR output voltage from the modulator

(a) Place the JMA-2253/JMA-2254 into the transmisson state (the range scale set to 12Nmi), connect a VOM across the cathode terminal of the diode CD6 on the CME-230 or CME-229 and the GND terminal, and adjust RV1 so that the output voltage reads 350 volts.

(2) Adjusting the transmitter pulse width of the modulator unit

(a) Set the transmitter pulse width for 6 Nmi to 0.35 us from the menu before making this adjustment (see Subsection 2.8.18, paragraph 2., "Changing the transmitter pulse width").

(b) Connect a sync. scope across the GATE terminal of the transistor TR11 on the CME-230 or CME-229 and the GND terminal, and follow the adjustment steps described below:

1. With the range scale set to 24 Nmi in the transmission sate, adjust RV2 so that the pulse width is set to 0.7 us.
2. With the range scale set to 6 Nmi in the transmission sate, adjust RV3 so that the pulse width is set to 0.35 us.
3. With the range scale set to 0.125 Nmi in the transmission sate, adjust RV4 so that the pulse width is set to 0.08 us.

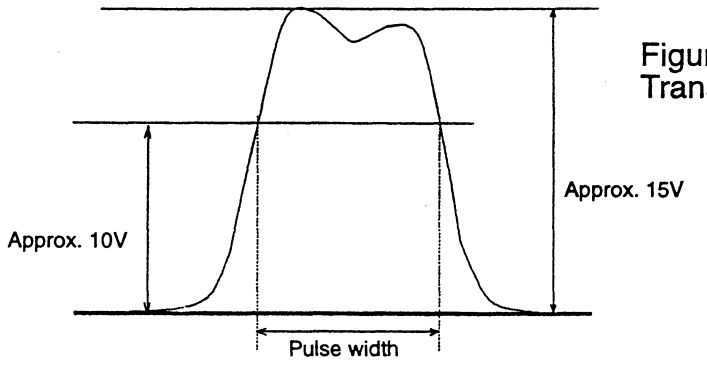


Figure 5-1 Adjusting the Transmitter Pulse Width

(3) Adjusting the maximum gain of the receiver

(a) Set the range scale to 32 Nmi (JMA-2253) or 48 Nmi (JMA-2254), [RAIN CL] to the minimum position (fully counterclockwise), the [SEA CL] to the minimum position (fully counterclockwise), and the [GAIN] to the maximum position (fully clockwise).

(b) Adjust RV5 (GAIN MAX) on the CAE-349 receiver so that an adequate amount of white noise appears on the radar's PPI screen.

Caution: Too high a RV5 setting (too much white noise) will enable the sea return suppression function even when the SEA RETURN control is set to the minimum position.

(4) Adjusting the sea return level of the receiver

(a) Set the range scale to 12 Nmi, [RAIN CL] to the minimum position, the [SEA CL] to the minimum position, and the [GAIN] to the maximum position (fully clockwise).

(b) Adjust RV3 (STC) on the CAE-349 receiver so that sea return suppression extends up to 5 to 6 Nmi.

(5) Adjusting the main bang suppression level of the receiver

(a) Set the range scale to 0.125 Nmi, [RAIN CL] to the minimum position, the [SEA CL] to the minimum position, and the [GAIN] to the maximum position (fully clockwise).

(b) Adjust RV2 (MBS) on the CAE-349 receiver so that the main bang at the center disappears.

Caution: Turning the RV2 excessively in the direction in which the main bang disappears will also cause the echoes of the targets to disappear.

(6) Adjusting the tuning indicator level of the receiver

(a) If the tuning mode is set to "AUTO", reset it to "MANUAL".

(b) Tune the receiver with the range scale set to 12 Nmi.

(c) Adjust RV1 (TUN. LEV.) on the CAE-349 receiver so that the right-most cell in the tuning indicator at the lower left corner of the display unit screen is blank (the right-most cell may flicker).

(7) Adjusting the rotational speed of the scanner unit(JMA-2254)

(a) Connect a frequency counter across pin 3 of the connector J4 on the modulator unit (CME-230) and the GND pin.

(b) Set the radar into the transmission state (the scanner unit will rotate) and adjust the RV5 on the CME-230 so that a frequency of 920 Hz±30Hz (27 rpm) is obtained for the JMA-2254.

5.1.3 Adjusting the Display Unit

The display unit has several locations that need adjustment. They are factory set and normally need not be adjusted by the user. If it is necessary to make functional checks during inspection or repair, make the adjustments that are explained below.

(1) Adjusting the brilliance level

(a) Set the brilliance level of the screen to its maximum from the (BRIL) key (see Subsection 2.7.1, "Changing the Screen Intensity").

(b) Turn potentiometer RV6 on the CRT monitor PCB so that no raster appears in the non-displayable area. (Turn the potentiometer slowly since the circuit's sensitivity is very high.)

(2) Adjusting the focus of the CRT monitor screen

(a) Turn potentiometer RV7 on the neck PCB in the display unit so that the range rings and video images appear most clearly.

(3) Adjusting the tilt angle of the display unit

(a) The angle of the screen can be adjusted by loosening the lock screw on the deflection coil assembly at the neck of the CRT tube and turning the entire screen. The user can also adjust the screen position using the centering magnet.

(4) Adjusting the CRT display

In addition to adjustment steps (1) to (3) explained above, CRT monitor adjustments include the following:

(a) Horizontal sync. adjustment:	CCN-246, RV2 (H.HOLD)
(b) Horizontal level adjustment:	CCN-246, LV1
(c) Vertical sync. adjustment:	CCN-246, RV4 (V.HOLD)
(d) Vertical size adjustment:	CCN-246, RV5 (V.SIZE)
(e) Vertical linearity adjustment:	CCN-246, RV3 (V.LINE)
(f) Contrast adjustment:	CCN-246, RV1 (CONT)
(g) Interlace adjustment:	CMC-859, RV1

(5) Adjusting the AVR output voltage

Connect a high-precision voltmeter across pint TP1 on the CBD-1283 power supply and the chassis, adjust potentiometer RV1 so that the output voltage reads +5.03V.

Caution: Be sure to connect the scanner unit when making this adjustment.

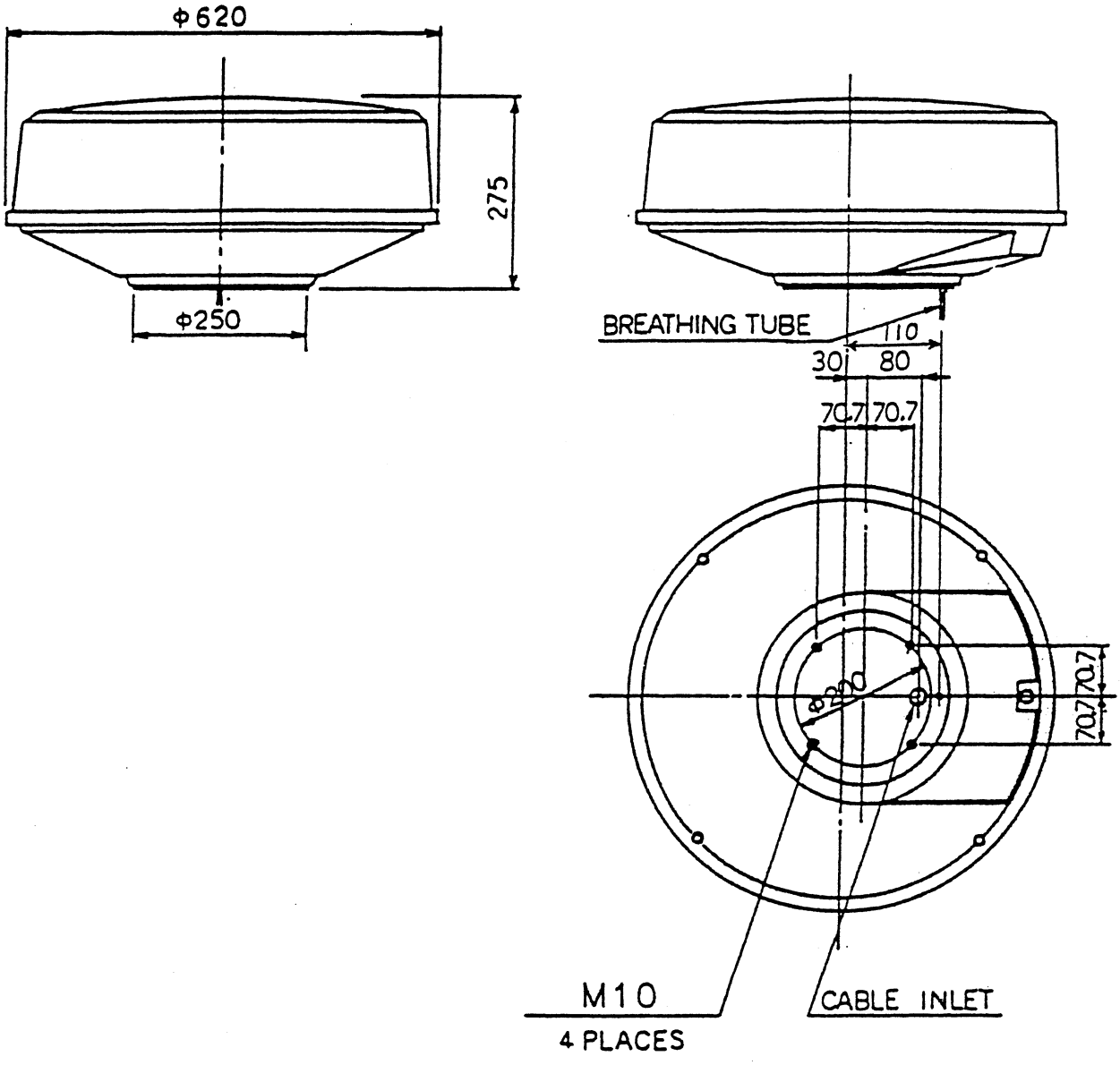


Fig. 103 OUTLINE DRAWING OF SCANNER UNIT NKE-1046

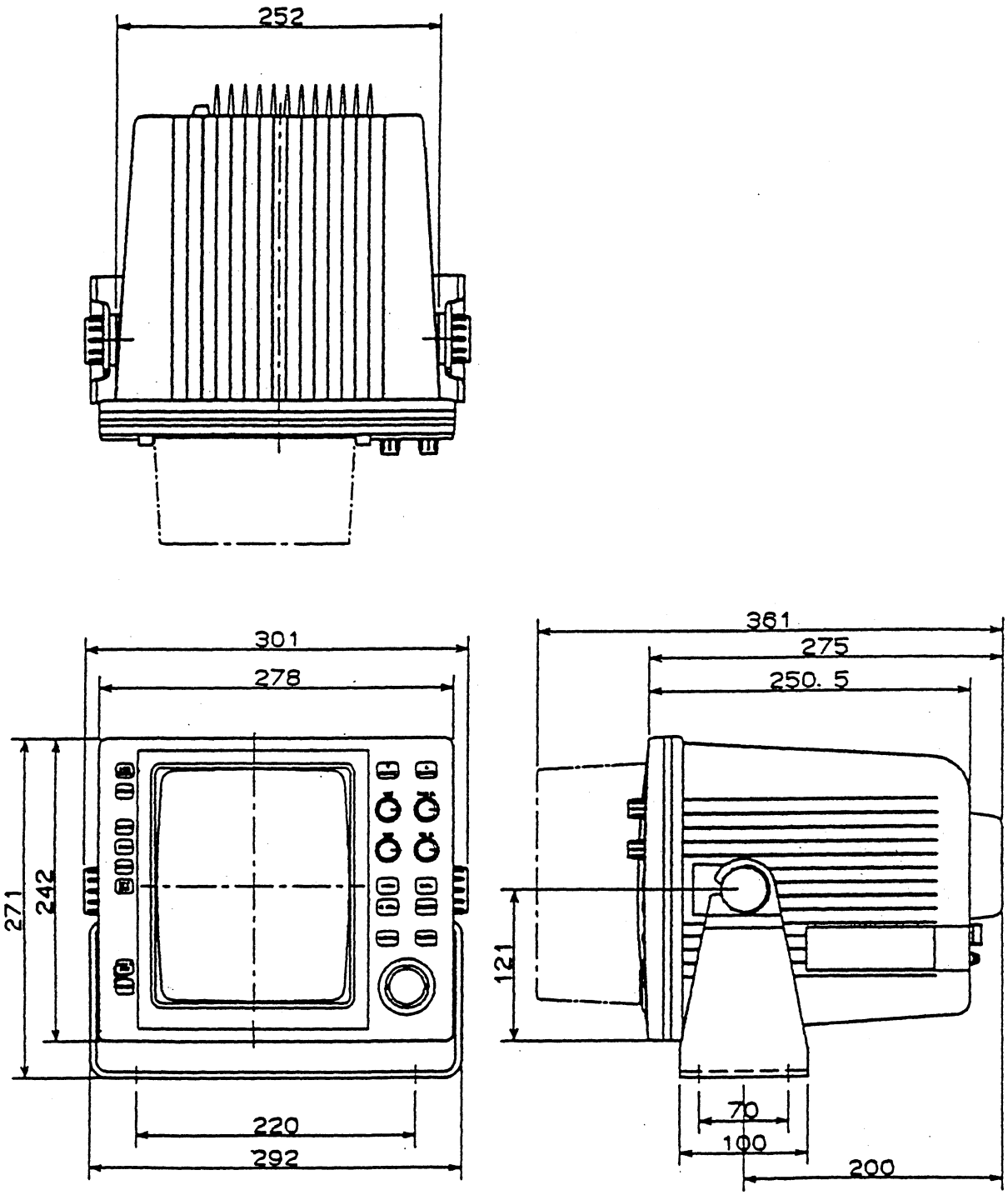


Fig. 105 OUTLINE DRAWING OF DISPLAY UNIT JMA-2253/2254

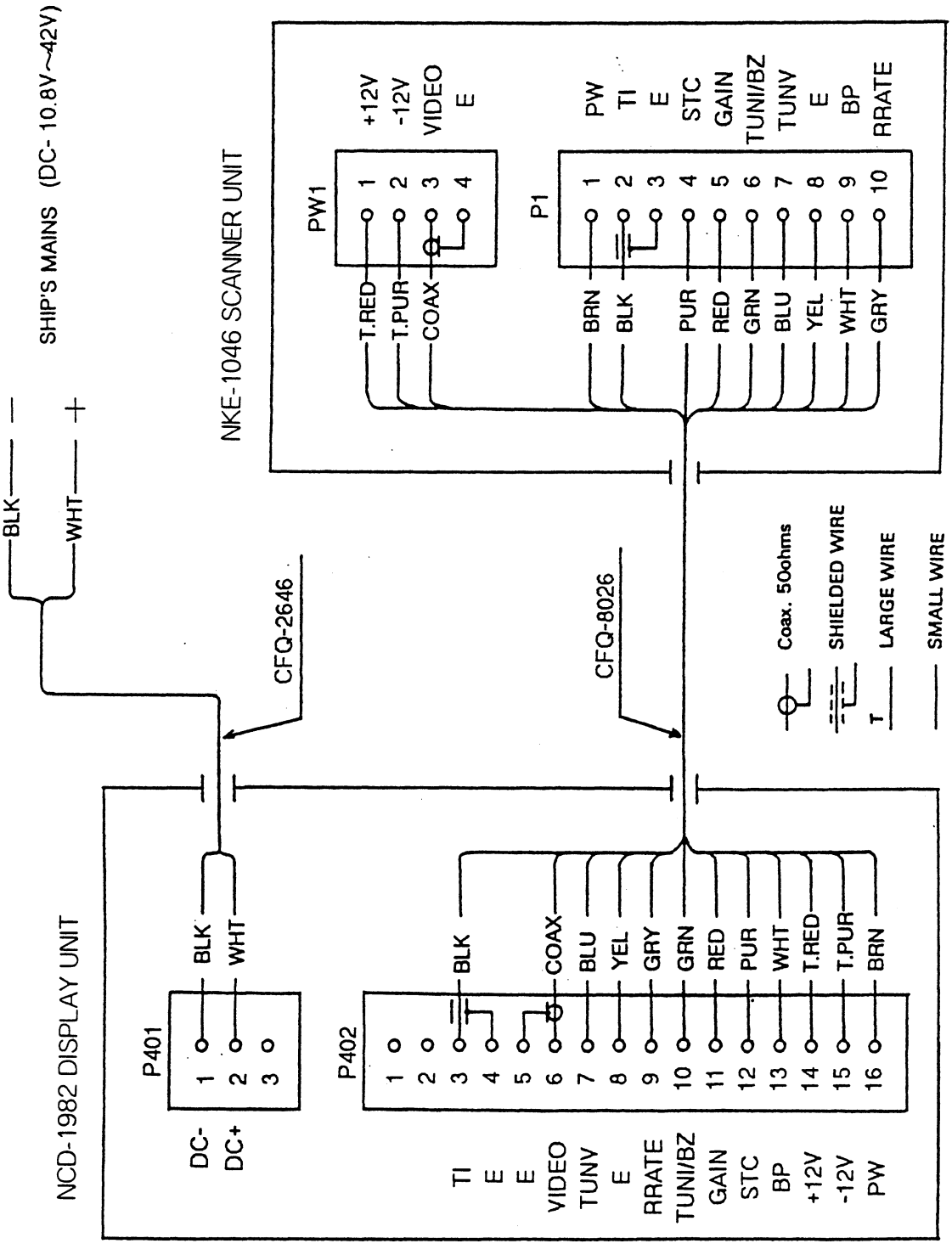


Fig. 106 INTERCONNECTION DIAGRAM OF JMA-2253

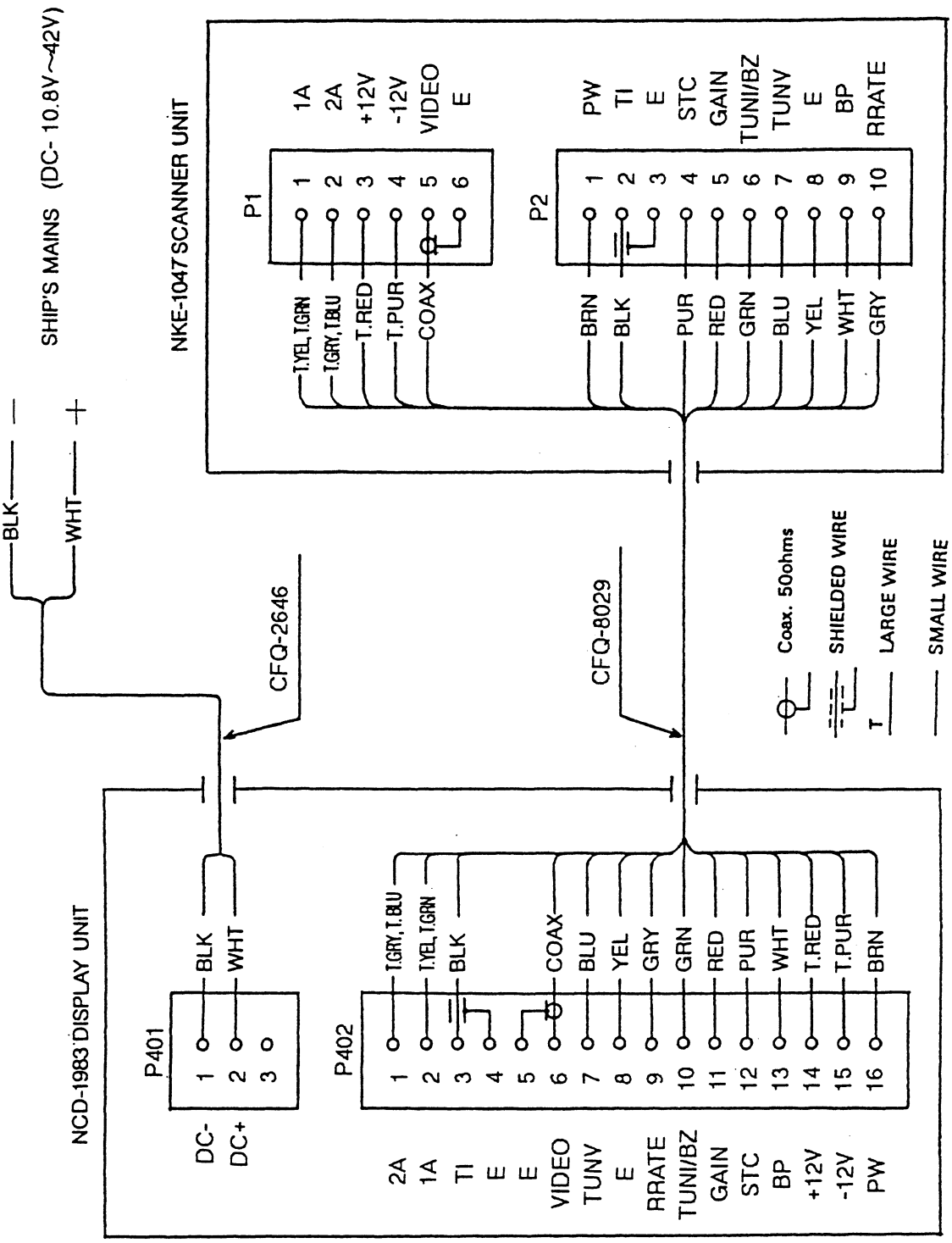


Fig. 107 INTERCONNECTION DIAGRAM OF JMA-2254

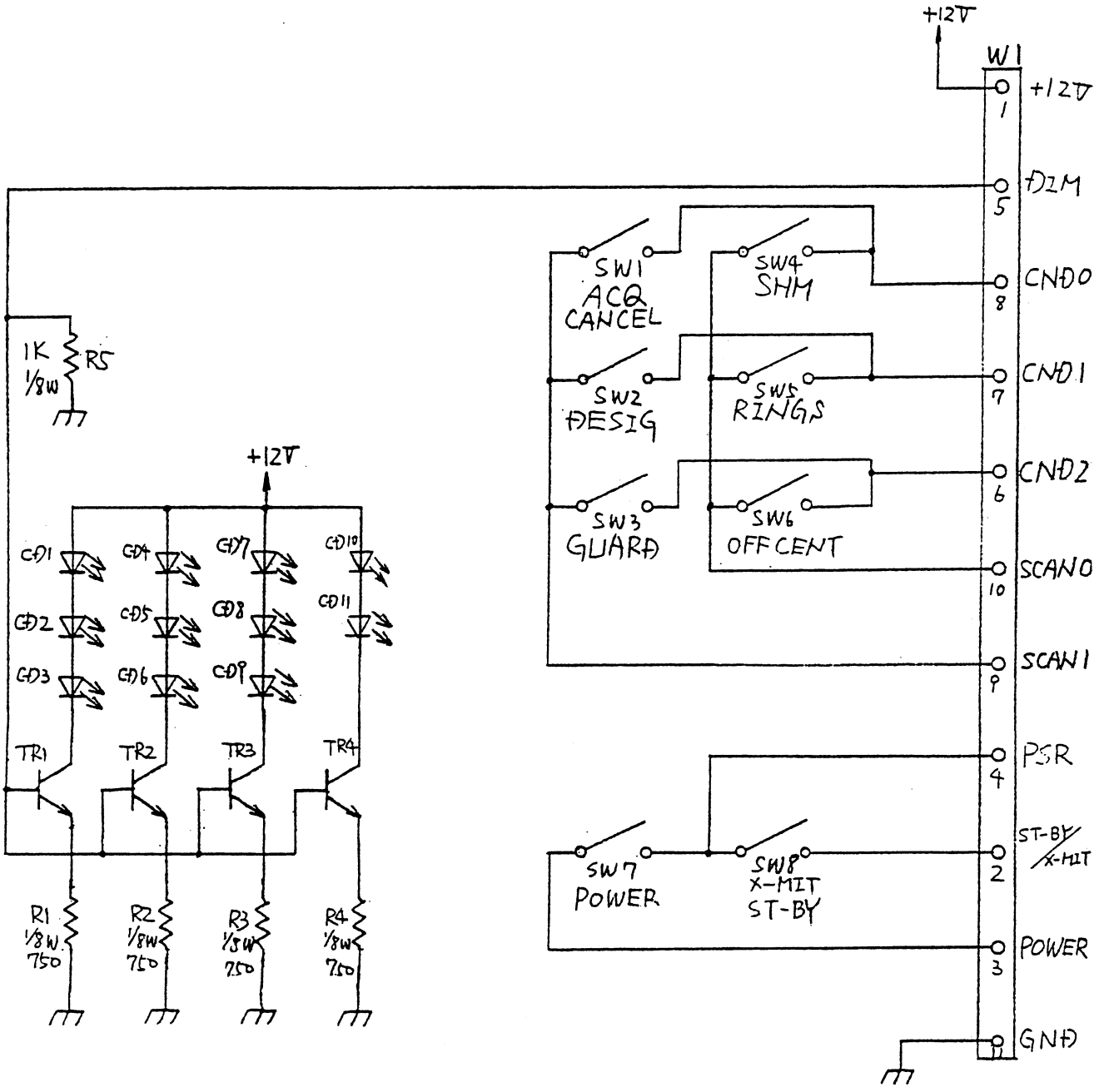


Fig. 118 CIRCUIT DRAWING OF CONTROL UNIT CCK-733

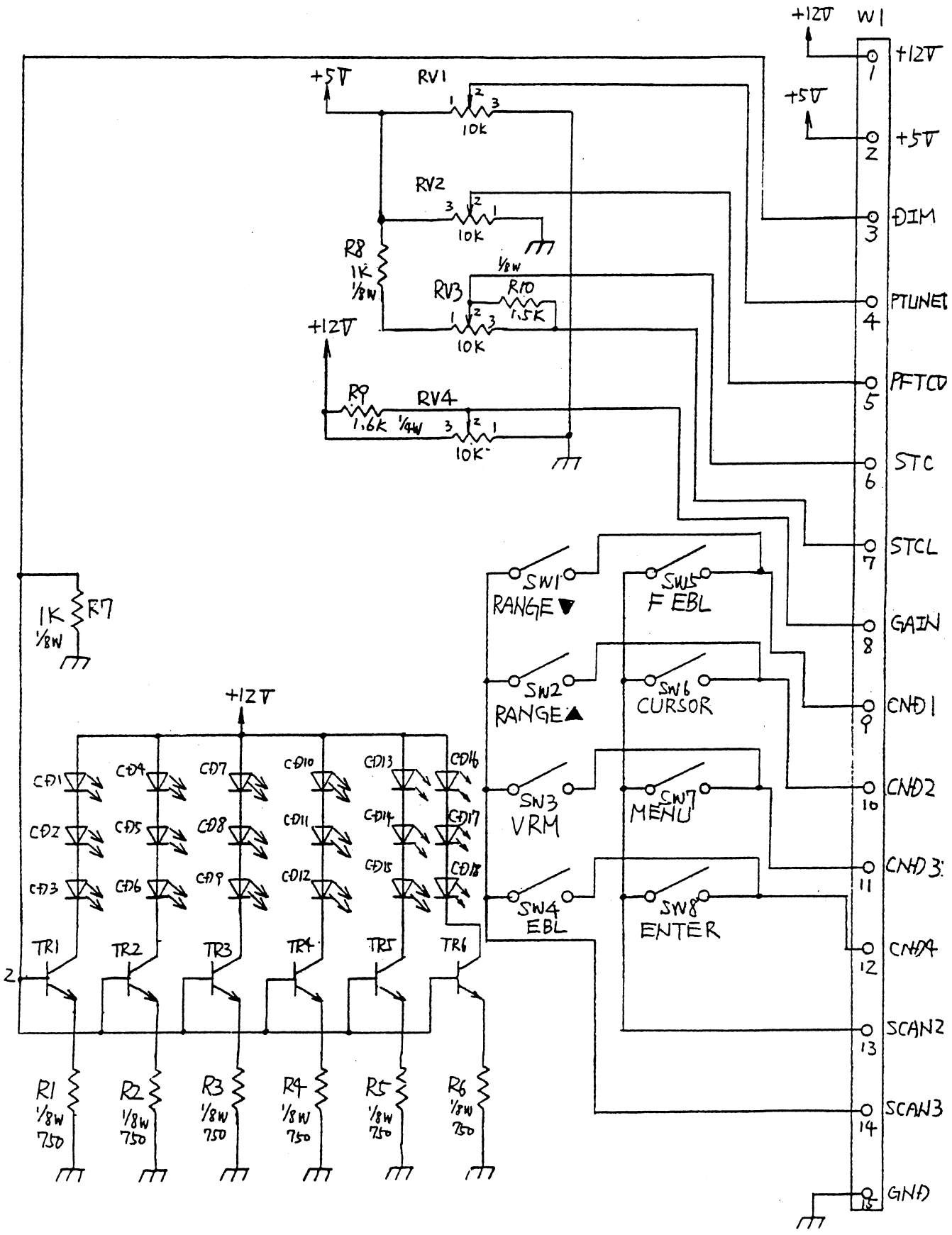


Fig. 119 CIRCUIT DRAWING OF CONTROL UNIT CCK-734

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