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RL9 Radar

LCD RADAR

OPERATION MANUAL

SECOND EDITION

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WARRANTY DATA

To verify your ownership and warranty registration, you should take a few minutes to fill out your warranty registration card found just inside the front cover of this manual. It is very important that you take the time to fill this card out. The warranty registration card should be returned to the factory immediately after your purchase in order to receive full warranty benefits.

RL9 LCD

RADAR SYSTEM
OPERATION MANUAL

This manual contains very important information on the installation, operation and maintenance of your new equipment. In order to get the best results in operation and performance, please take the time to read this manual thoroughly.

IMPORTANT NOTICE

This RADAR UNIT 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 device should not be relied upon as a substitute for such prudence and judgment.

SECOND EDITION.
JAN 1996

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 and/or navigational inaccuracies. In particular:

1. 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.

2. 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 could 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 radar system before servicing the antenna or nearby equipment.

3. ELECTROMAGNETIC ENERGY. The radar antenna transmits electromagnetic 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, 3 kHz to 300 GHz.

4. 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.

CONTENTS

RADAR GLOSSARY

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

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

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SECTION 1

INTRODUCTION

1.1 GENERAL

Congratulations on selecting the Raytheon RL9 LCD Radar for your radar navigation needs.

Whether you purchased this radar because of its compactness, power economy, ease of installation, or long term reliability, one thing is certain; the moment you turn on your RL9 Display you will know you are seeing a revolutionary new concept in radar technology at work. You are the proud owner of a radar system unmatched within the recreational marine industry.

Radar signals are "stored" on an LCD display with chart like clarity and detail. A single glance at your Display will give you a complete and accurate 360° radar picture of other vessels, buoys and landfall surrounding your vessel.

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

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

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

When interfaced with the Raytheon Raychart 600 XX (option), the revolutionary new ability to dsiplay chart information alternately, with the radar picture, adds simplicity and convenience. The industry standard, C-MAP chart cartography, is used to provide you with highly detailed chart information, making navigation both informative and exciting. The unique Split Screen Mode allows simultaneous viewing of radar and Seatalk™ Data.

With all of these electronic features and the thoughtful compact and efficient design of this radar, it soon becomes apparent that human engineering and operational simplicity have been foremost considerations in the RL9 product design.

You, the customer, set the high standard for the development of our products.

We trust that you will enjoy many years of excellent performance, reliability, and smooth sailing with your new "cutting edge" RL9 radar system.

To verify your ownership and warranty registration, you should take a few minutes and fill out your warranty registration card found just inside the front cover of this manual. It is very important that you take time to fill this card out. The warranty registration card should be returned to the factory immediately after your purchase in order to receive full warranty benefits.

1.2 EQUIPMENT FEATURES

The RL9 LCD Radar system is designed and manufactured to provide ease of installation and operation combined with excellent reliability. Some of the many important built-in features of the equipment are listed below:

1. Alternate ability to switch between a Radar and a Raychart 600XX screen (option).
2. Arrow Key for quick information access, anyplace on the display.
3. Waterproof to U.S.C.G standards, allowing for flexibility of installation.
4. Rugged aluminum housing.
5. The ability to display destination waypoint.
6. Multi-language operation (English, French, Spanish, German, Norwegian and Italian.) All six languages are standard within each system which are selectable via a menu prompt.
7. Automatic Tuning Feature.
8. Interfaces with Autohelm Seatalk instruments (Optional), and NAVAIDS, including Raytheon's Smart Heading Sensor magnetic compass.
9. Basic radar alignments can be performed via menu prompts.
10. Automatic tune, rain and gain controls.
11. Auto-temperature compensated screen to prevent "darkening" in sunlight.

1.2.1 RL9 DISPLAY UNIT

The RL9 display unit uses a monochrome LCD monitor enclosed in a compact, aluminum, rugged, waterproof cabinet.

The front panel contains all of the operating controls for the radar system organized in a combination of controls for precise setting of the Gain, Tuning, Sea-clutter, and Rain-clutter for clear and detailed radar presentations and Silicone rubber covered keys to assure fast and accurate selection of key operating functions. The keys are logically arranged for the operator's convenience and are well backlit for nighttime use.

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

All system set-up adjustments are made from the display front panel, negating any requirement to open the display unit cabinet, during the installation. Screw drivers and adjustment tools are no longer required for display setups.

WARNING

This radar display unit contains **HIGH VOLTAGE.** Adjustments require specialized service procedures and tools only available to qualified service technicians, and there are no user servicable parts or adjustments. The operator never should remove the radar unit covers nor attempt to service this equipment.

The compact design of the display unit is made possible by the use of custom LSI (Large Scale Integrated circuit) components. An LSI type of "chip" contains, in one package, the equivalent of up to 30 integrated circuits. Thus compact size, power efficiency, and full radar navigation features at an economical price are all "standard" in the RL9 radar system.

1.2.2 RADOME ANTENNA UNIT MAIN FEATURES

The antenna and transceiver are contained within the 18 inch radome assembly, the radome is made of AES plastic and has a single-flange mounting. The radome protects the electronic assemblies from the environment, yet is transparent to the radar's RF energy, thereby allowing full performance. A small, flexible interunit cable connects the Radome Unit to the Display Unit.

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

Inside, the radome features a printed-circuit card array. This technically innovative antenna provides a narrow 6° beamwidth for excellent short range resolution and high gain in a very compact antenna package.

The internal X-band transmitter operates at a 2 kW peak power, with a sensitive micro-integrated circuit (mic) front end receiver.

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

1.3 ABOUT THIS MANUAL

This manual contains important information to help you get the best operation and performance from your new RL9 and its associated optional equipment. Although the unit is actually pretty simple to master, please take the necessary time to read through each section.

Section 2 contains very important information on the proper installation of your new RL9 Radar. Although the typical installation might seem straight forward and simple, we highly recommend that this section be read thoroughly and the guidelines for installation be closely followed to obtain trouble-free and efficient operation of your new units.

Section 3 contains a brief discussion of the general principles of radar, along with the operating instructions for the RL9 Radar which will guide you through the unit's operating controls and display layouts. To more easily recognize how to enable the various operations, the names of the keys that must be pressed to complete the described operation are enclosed in boxes, such as [MENU], or [RANGE]. In most cases, pictures, showing the correct displays to obtain the desired entry, are included next to each function.

The best way to learn about your RL9 is to dive right in. You can't damage the unit by randomly pressing keys. So don't be afraid to experiment.

Sections 4 and 5 contains technical information about the theory of operation and maintenance for your new radar. In the event that your RL9 should ever experience an operational failure, it is recommended that all repair services be provided by an authorized Raytheon service dealer or by the Raytheon Factory Service Center.

1.4 SPECIFICATIONS

1.4.1 GENERAL

1) Maximum range: 16 nautical miles
2) Minimum range: Less than 35 m (25 yds) on the .125 nm range.
3) Range Scales:

Range	Number of rings	Range ring interval
0.125 nm	2	0.0625 nm
0.25 nm	2	0.125 nm
0.5 nm	2	0.25 nm
0.75 nm	3	0.25 nm
1.0 nm	4	0.25 nm
1.5 nm	6	0.25 nm
3 nm	6	0.5 nm
6 nm	6	1 nm
12 nm	6	2 nm
16 nm	4	4 nm

4) Range discrimination: Less than 35 yds.
5) Range ring accuracy: Better than ±1.5% of maximum range of the scale in use, or 22 m, whichever is the greater.
6) Bearing accuracy: ±1 degree.
7) Display device: LCD: Diagonal 168 mm (6.6")
Effective display area 134.4 × 100.8 mm (5.3 × 3.9")
8) Environmental conditions:
Radome: Temperature −15°C to +55°C
Humidity Up to 95% at 35°C
Display Units: Temperature −10°C to +55°C (EXCEPT LCD)
Temperature 0°C to +40°C (LCD)
Humidity Up to 95% at 35°C
9) Input power requirements: 10.2 ~ 16V dc
10) Power Consumption: 30 W

Note: LCD performance will be slightly deteriorated in response speed and brightness during extreme low temperatures.

1.4.2 DISPLAY UNIT

1)	Dimensions:	Width 208 mm (8.2") Depth 68 mm (2.7") Height 198 mm (7.8") without bracket
2)	Mounting:	Table, bulkhead, overhead or flush mounting
3)	Weight:	Approx. 1.8 kg (Approx. 4 lbs)
4)	LCD: Contrast:	7" equivalent display area (6.61" diagonal) Auto temperature, sensing compensation
5)	Video	4 levels quantitized.
6)	Display Resolution:	320 × 240 pixels
7)	Bearing synchronizing system:	Motor Encoder
8)	Tuning:	Auto/Manual
9)	Bearing scale:	360° scale graduated at intervals of 10°
10)	Ship's heading marker:	Electrical
11)	VRM:	Digital readout on LCD in the range of 0.00 to 16.0 nm, 3 digit Digital-On-Screen-Display
12)	EBL:	Digital readout on LCD in the bearing of 0° to 360°, 3 digit Digital-On-Screen-Display
13)	EBL Resolution:	1°
14)	Alarm:	Audible alarm and zone mark on PPI
15)	Off Center	Up to 66% radius (all ranges, except 16 nm range scale)
16)	Zoom	X2 enlargement any range except 1/8 nm scale.
17)	Timed TX	Rotation Period Select 10, 20 or 30 Scans Repetition Period Select 3, 5, 10 or 15 Minutes
18)	Features	Cursor, VRM, EBL, Interference Rejection, Target Expansion, Target Alarms, LAT/LONG or TD Readouts, Waypoint L/L, Off Center/ Zoom, Timed Transmit, Target trails, Built in Simulator, Hold Mode, Auto Gain, Auto FTC, Auto Tune
	Other Optional Features:	Raychart, Seatalk

19) Control Keys
(All push bottons)

RANGE KEYS	UP/DOWN
TUNE KEYS	UP/DOWN
RAIN KEYS	UP/DOWN
SEA KEYS	UP/DOWN
GAIN KEYS	UP/DOWN
HOLD KEY	OFF/ON
MENU KEY	OFF/ON
GUARD KEY	OFF/ON
EBL KEY	OFF/ON
VRM KEY	OFF/ON
CURSOR KEY	OFF/ON
CTR/ZOOM KEY	OFF/ON
CONT/DIM KEY	OFF/ON
STBY/XMIT KEY	OFF/ON
▲, ▼, ◀, ▶, DIRECTION KEYS	

Inputs:

Loran-C/GPS

NMEA 0183, must include GLL, GTD, VTG, BWC, or RMA and RMB, or RMB and RMC sentences for full function displays and capabilities.

Seatalk

Magnetic Sensor NMEA 0183 HDM, HDT, VHW or HSC, data sentences.
Wind Direction, Wind Velocity, Depth, SOG/COG, MTW, Position, Waypoint, Tide, etc.

20) Rear Panel Connectors:

Inter-unit (Ant.)	10-pin
Power DC input/ NMEA	4-pin
Compass/Seatalk	7-pin
Raychart	8-pin (option)

1.4.3 RADOME ANTENNA

1)	Dimensions:	Diameter of radome	450 mm (17.7")
		Height	227 mm (8.9")
		Base Dimensions	Front to end 270 mm (10.6")
			Width 200 mm (7.9")
2)	Weight:	Approx.	5.5 kg (12.1 lbs)
3)	Polarization:	Horizontal	
4)	Beam width:	Horizontal	6° nominal
		Vertical	25° nominal
5)	Sidelobes:	−21 dB or greater (within ±10°)	
6)	Rotation:	Approx. 24 RPM	
7)	Drive motor input voltage:	+12 VDC	
8)	Transmitter frequency:	9445±30 MHz	
9)	Peak power output:	2.0 kW	
10)	Transmitter device:	Magnetron (RMC-2)	
11)	Pulse length/Pulse repetition frequency:	0.08 μs/2250 Hz (0.125, 0.25, 0.5, 0.75 nm)	
		0.3 μs/1200 Hz (1, 1.5 nm)	
		0.8 μs/600 Hz (3, 6, 12, 16 nm)	
12)	Modulator:	Solidstate modulator driving magnetron	
13)	Duplexer:	T-junction with diode limiter	
14)	Mixer:	MIC front end	
15)	IF amplifier:	Center frequency	60 MHz
		Bandwidth	7 MHz
16)	Noise figure:	Less than 10 dB	
17)	Characteristic:	Linear	

SECTION 2

INSTALLATION

2.1 GENERAL

Congratulations on selecting the Raytheon RL9 LCD radar to meet all of your radar navigation requirements.

Although your RL9 radar is designed to the highest levels of quality and performance, it can only attain those standards when a proper installation of the equipment has been achieved.

This section provides practical guidelines to assist in the planning and installation of the RL9 aboard your vessel.

2.2 UNPACKING AND INSPECTION

Use care when unpacking the RL9 radar from the shipping carton to prevent damage to the contents. It is also good practice to save the carton and the interior packing material until the radar has been satisfactorily installed on the vessel. The original packing material should be used in the unlikely event that it is necessary to return the unit for service.

2.3 EQUIPMENT SUPPLIED

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

2.3.1 OPTIONAL ACCESSORIES

XX Fluxgate Heading Sensor	M92580
Universal Mast mount	M88390
Extension Cable, 15 Ft.	M92605
Extension Cable, 33 Ft.	M92632
Raychart 600XX Interface Kit	G623140-1
Interunit Cable Assembly, 66 Ft.	M92604

2.4 PLANNING THE INSTALLATION

The layout for installing the RL9 radar should be planned to give the best operation and service aboard your particular vessel. In general, the Radome Unit should be mounted as high as possible above the waterline. The Display Unit should be installed in a convenient viewing position near the helm. Keep in mind the optimum viewing angle when installing the display. You may want to apply power in advance of installing the unit so that you can determine a satisfactory viewing angle prior to installation.

NOTE

In order to maximize the operation of your radar system, it is recommended that the radar antenna be mounted above objects which would interfere with the radar signal. Installation of the radar antenna above such obstacles as the flying bridge, large engine stacks and out of the range of personnel will insure maximum benefit from your radar system.

A 10 meter (33') length of Vinyl-covered, shielded, 8 conductor cable is furnished with connect plug and terminal connections for interconnecting the two main units (Scanner and Display).

This length of cable should be sufficient to complete the cable run required on most small vessels. It is recommended that the maximum length of cable between the Scanner Unit and the Display Unit not exceed 20 meters (60').

A General System diagram for the RL9 is shown below.

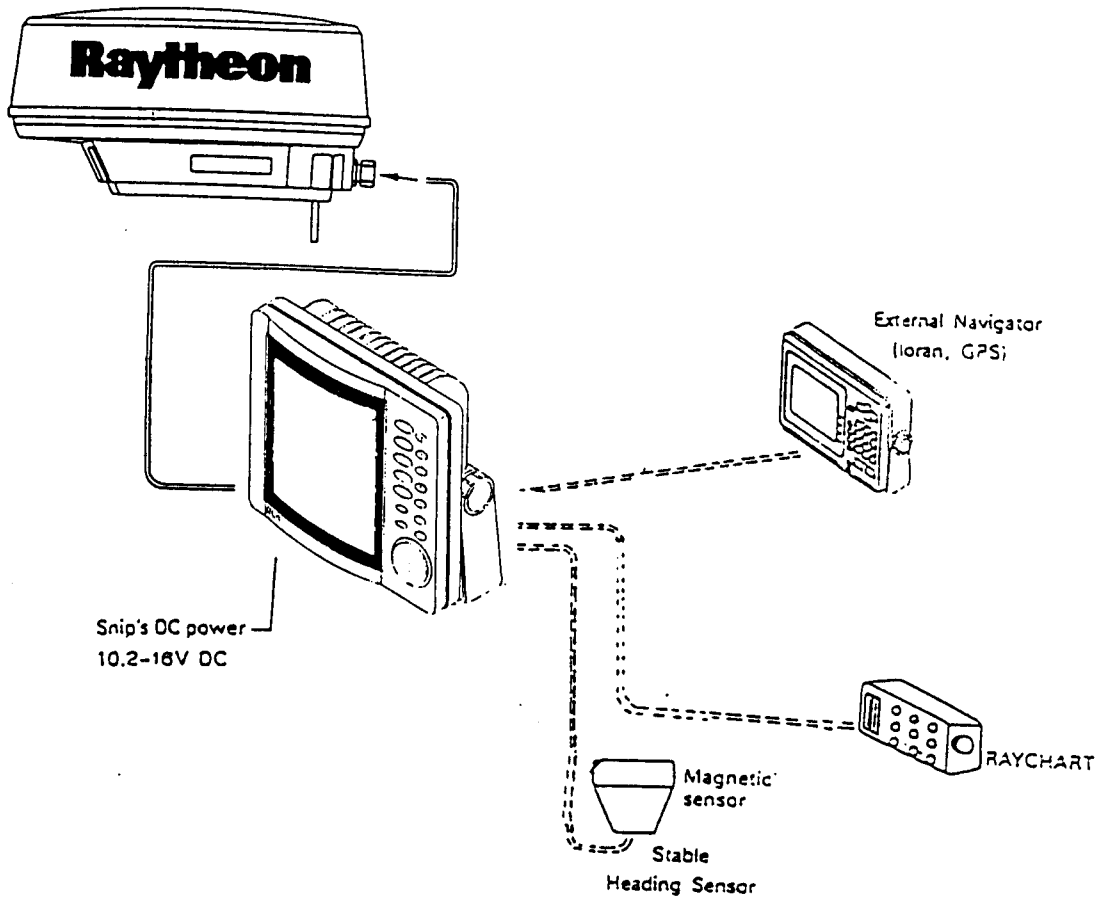


FIG. 2-1 GENERAL SYSTEM DIAGRAM

2.4.1 MOUNTING THE DISPLAY UNIT

When planning the installation for your RL9 LCD Display Unit, the following conditions should be considered to insure dependable and trouble free operation.

1) The mounting location should be easily accessible to allow operation of the front panel controls.
2) There should be adequate ventilation.
3) There should be sufficient space behind the display to allow cable connections to the rear panel connectors.
4) The Display Unit should be located near a DC power source.

5) The selected location should be far enough away from devices that may cause interference, such as motors and generators.

6) Generally speaking, the display should be located in a protected area away from prolonged direct exposure to rain and salt spray. It is good practice to protect your valuable electronic equipment as much as possible.

The Display Unit can be conveniently mounted on a chart table, bulkhead, overhead or console mounted in a desired locatin. (Refer to Figure 2-2 for typical mounting methods).

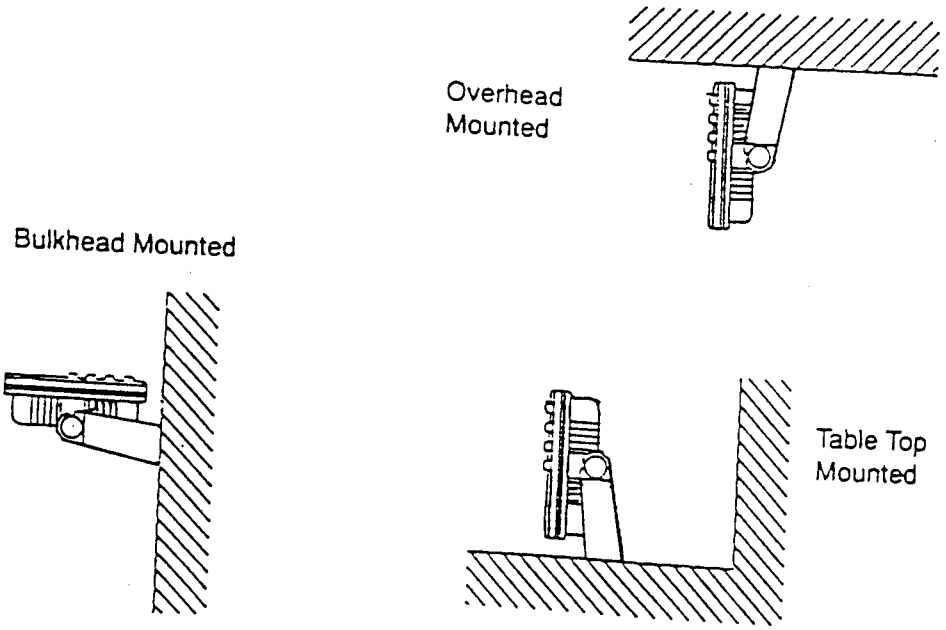


FIG. 2-2 TYPICAL MOUNTING METHODS

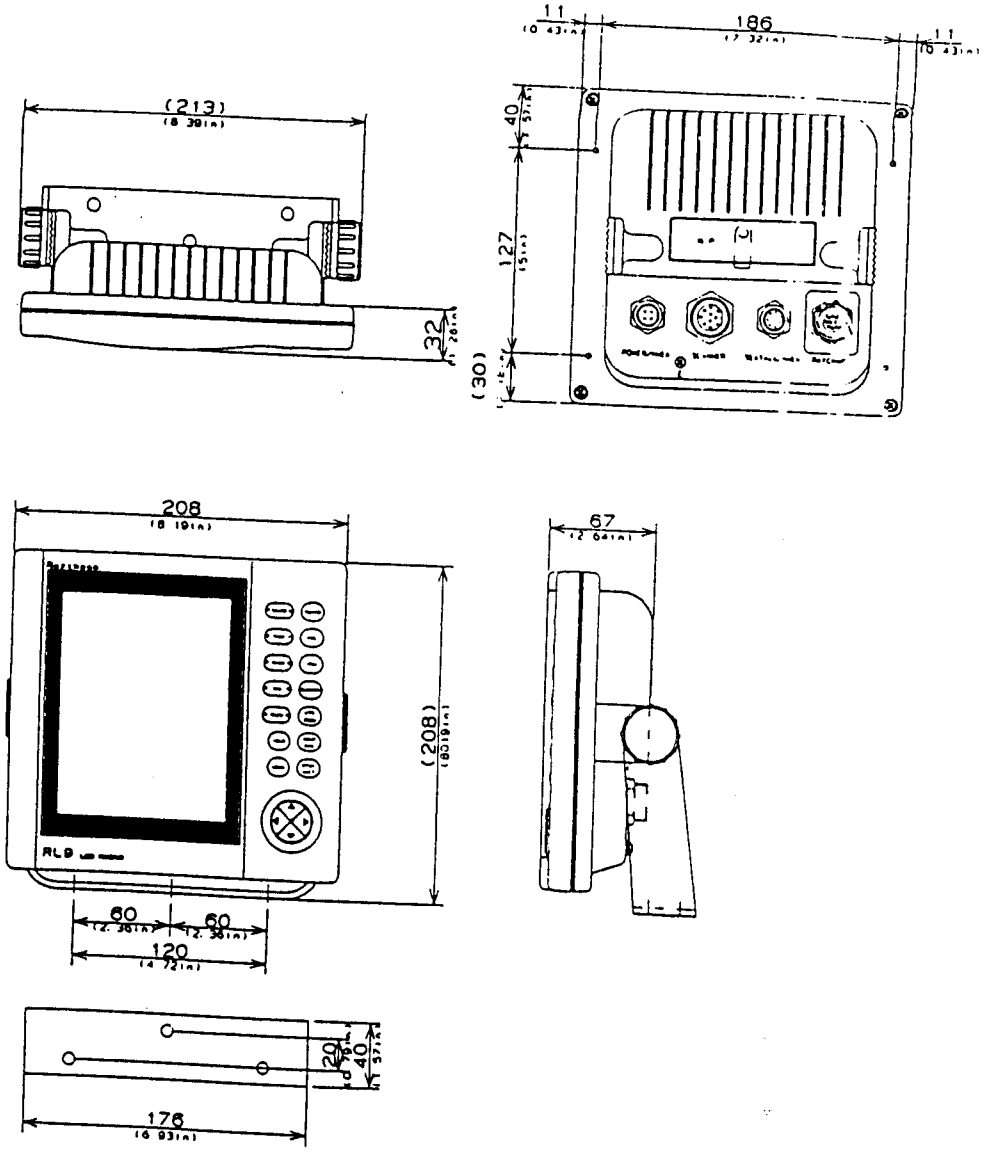


FIG. 2-3 DISPLAY MOUNTING DIMENSIONS

2.4.1.1 Console Mounting Instructions

The procedure below can be used to console mount the RL9 Display. Refer to the console mounting figure to see how the various hardware items are arranged during assembly.

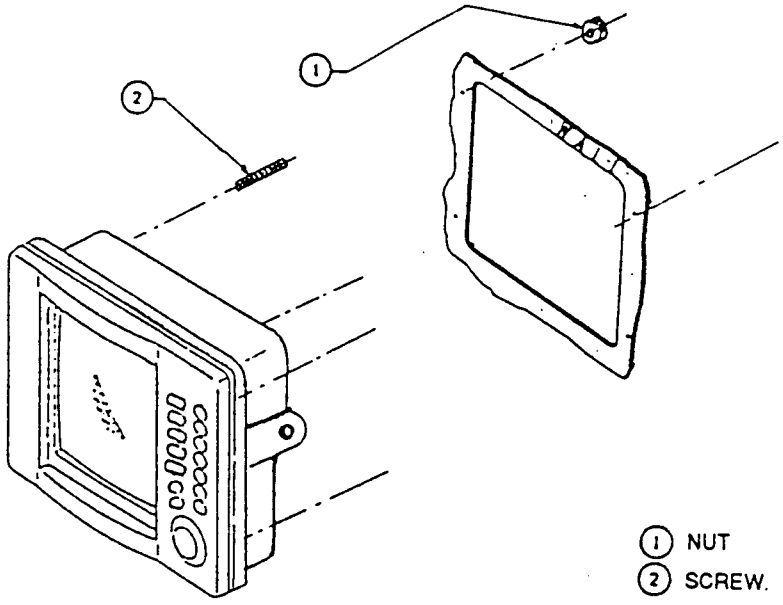


FIG. 2-4 CONSOLE MOUNTING THE DISPLAY

1. Select the location for the unit. A clear, flat area of at least 8" wide by 9" high having at least 6" of clearance depth behind the panel is required.

> **CAUTION**
>
> Make sure there are no hidden electrical wires or other items behind the desired location before proceeding. Check that free access for mounting and cabling is available.

2. Unpack the template mounting kit and also confirm that all hardware is present.

3. Using the instruction template supplied with the kit, trace out the appropriate screw hole locations for flush mounting including the display unit opening.

4. Drill a 1/2" pilot hole in each opposing corners of the cut-out area.

5. Using an appropriate saw, cut the outside edge of the cut-out line.

6. Remove the yoke knobs, from the display cabinet. Check that the unit will fit into the cut-out area.

7. Complete the installation of the DC power cabling, antenna cable, data input, ground, and any other accessory cables, into the console.

8. Slide the unit into the cutout of the panel. A suitable sealant may be used between the trim ring and console to prevent moisture entry.

9. Use the hardware supplied in the kit to secure the unit to the console. Tighten the hardware as necessary. Connect all cables to the unit rear panel.

2.4.2 RADOME ANTENNA MOUNTING

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

The scanning beam should not be obstructed by surrounding large objects. Try to locate the radome unit where other large structures or equipment such as searchlights, horns, or masts are not in the same horizontal plane, otherwise, blind areas and false targets can appear on the radar screen.

Installation near the top of exhaust stacks must be avoided as damage to the radome could result excessive heat and the corrosive effects of stack gases.

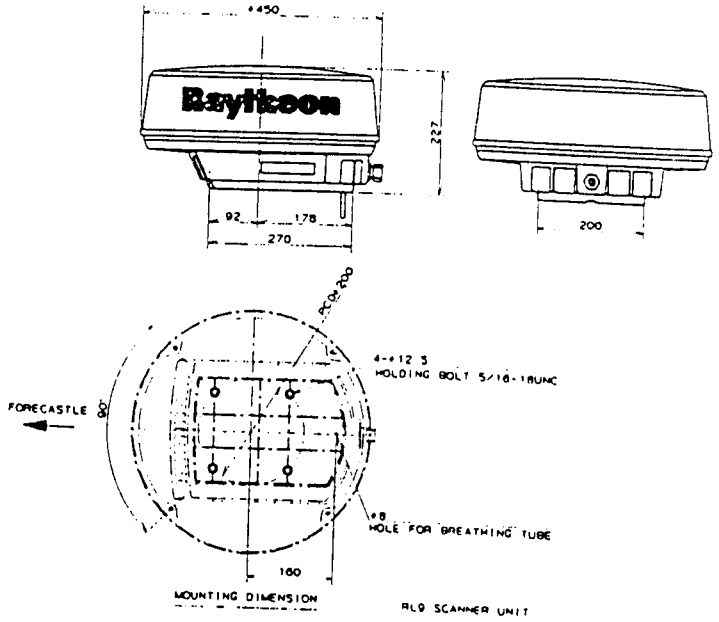
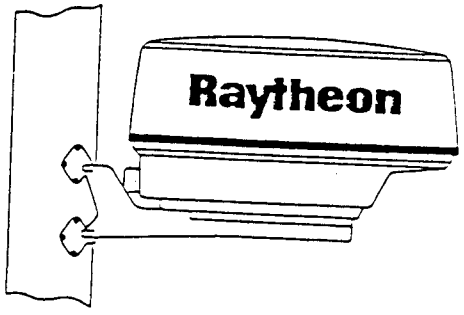


FIG. 2-5 OUTLINE DRAWING OF RADOME ANTENNA UNIT



OPTIONAL MAST MOUNT:

POLYESTER GLOSS WHITE FINISH
DIE CAST ALUMINUM CONSTRUCTION
STAINLESS HARDWARE
WEIGHT: 4.5 lbs.
FITS MASTS FROM 2¼" DIA AND UP

FIG. 2-6 UNIVERSAL MAST MOUNT (M88390)

WARNING

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 could 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 radar system before servicing the antenna or nearby equipment.

For sailboat installations, Raytheon offers a universal mast mount kit (Product Code M88390). This optional mount fits masts with diameters from 2 1/4" and larger. When using the mast mount kit, appropriate hardware should be used for the style and structure of the mast aboard the vessel.

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

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

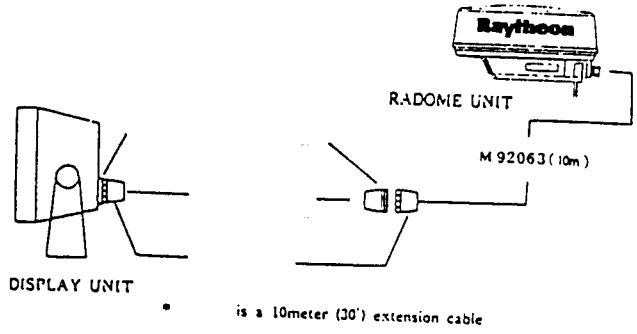


FIG. 2-7 TYPICAL INSTALLATION FOR SAILBOAT SHOWING IN-LINE CONNECTION AT MAST BASE

Using the outline drawing of the Scanner base or template in the back of the manual as a guide, prepare the mounting surface with the four mounting holes as required. Install the Scanner and secure it to the mounting surface. The correct mounting hardware is stainless steel hexhead bolts 5/16", 1 1/4" long with 18 UNC thread. A flat and lock washers should be used. The Scanner should be parallel to the ship's waterline and oriented so the cable inlet is pointed AFT.

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 could 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 radar system before servicing the antenna or nearby equipment.

CAUTION:
When mounting the scanner unit, please observe a minimum mounting surface thickness of .25 inches. If the thickness of the mounting base is too thin, the modulator PCB could potentially be damaged (Fig. 2-8). The mounting base should be at least 0.25 inches thick. Use additional washers if necessary to meet this requirement.

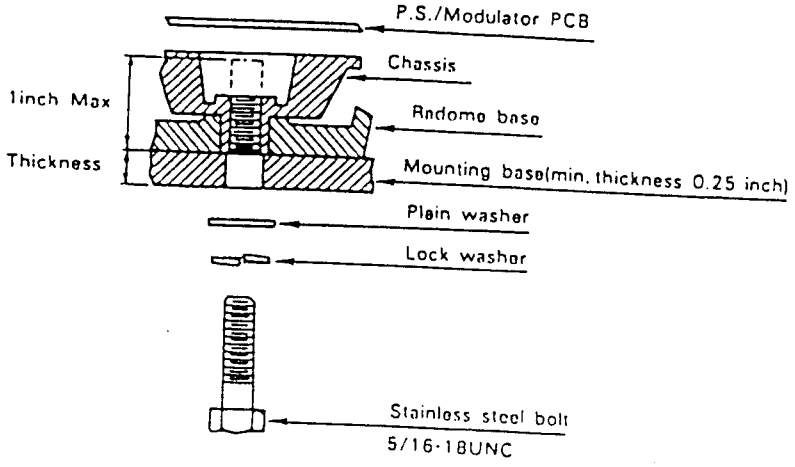


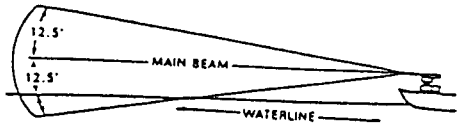
FIG. 2-8

Some vessel's however, may adopt a HIGHER BOW angle when the vessel is at it's cruising speed that substantially alters and raises the radar's main radiation plane. In this case nearby target detection might be poor. It may be helpful to lower the radar beam towards the parallel by shimming the radar pedestal to tilt the beam angle slightly downward with respect to the waterline.

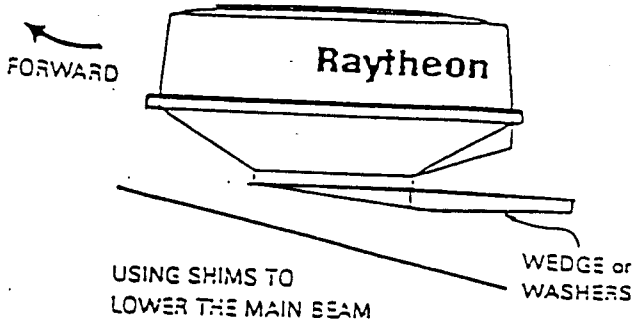
The figure shows one approach, that of using an angled wood block between the pedestal mounting feet and the mast or platform surface to obtain the desired tilt angle. The shims may also be made from aluminum plate wedges or simple flat washers.

SETTING THE RADIATION PLANE

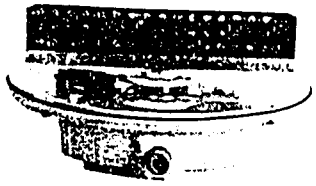
In the standard antenna installation the scanner/pedestal unit is mounted so the array will rotate parallel to the waterline. The beam of the radar is approximately 25° wide in the vertical direction so target detection during the vessel's pitching and rolling will be generally good.



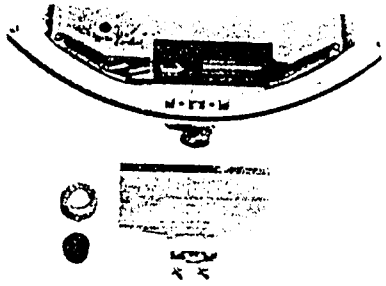
IDEAL RADIATION PLANE



USING SHIMS TO
LOWER THE MAIN BEAM

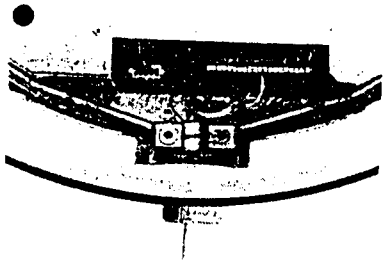


Step 1. Loosen the 4 clamping bolts securing the radome and remove the radome cover. – The clamping bolts are captive and should remain in the lower flange assembly.

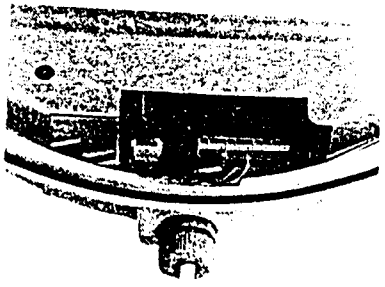


Step 2. Remove watertight gland and grommet where the interconnect cable enters the radome base.

Remove shield jacket retaining plate.



Step 3. Slide gland nut and the rubber grommet onto the cable and insert the connecting cable into the radome base. Secure the watertight gland.



Step 4. Connect the cable leads to terminal board J1, using clamping tool supplied. Ground the shield with the lug to cable clamp bolt provided. Dress the wire harness with cable clamps or tie-raps as necessary for neatness.

FIG. 2-9 CONNECTING PROCEDURE FOR RADOME ANTENNA UNIT

The cable entrance is provided at the rear of the radome unit. If the unit is mounted on a hollow mast, the cable may be run inside the mast and then fed through the radar's cable entrance.

Before wiring the scanner unit, confirm that the interunit cable is not connected and power is not applied to the display unit. Connect the cable leads onto terminal strip JI, using clamping tool as shown below.

Tie shield jacket by retaining plate.

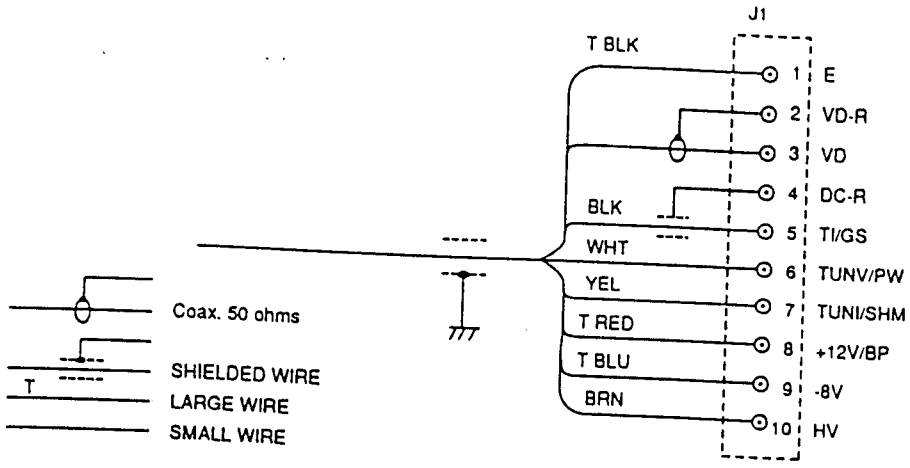


FIG. 2-10 WIRING DIAGRAM FOR RL9 RADOME ANTENNA UNIT

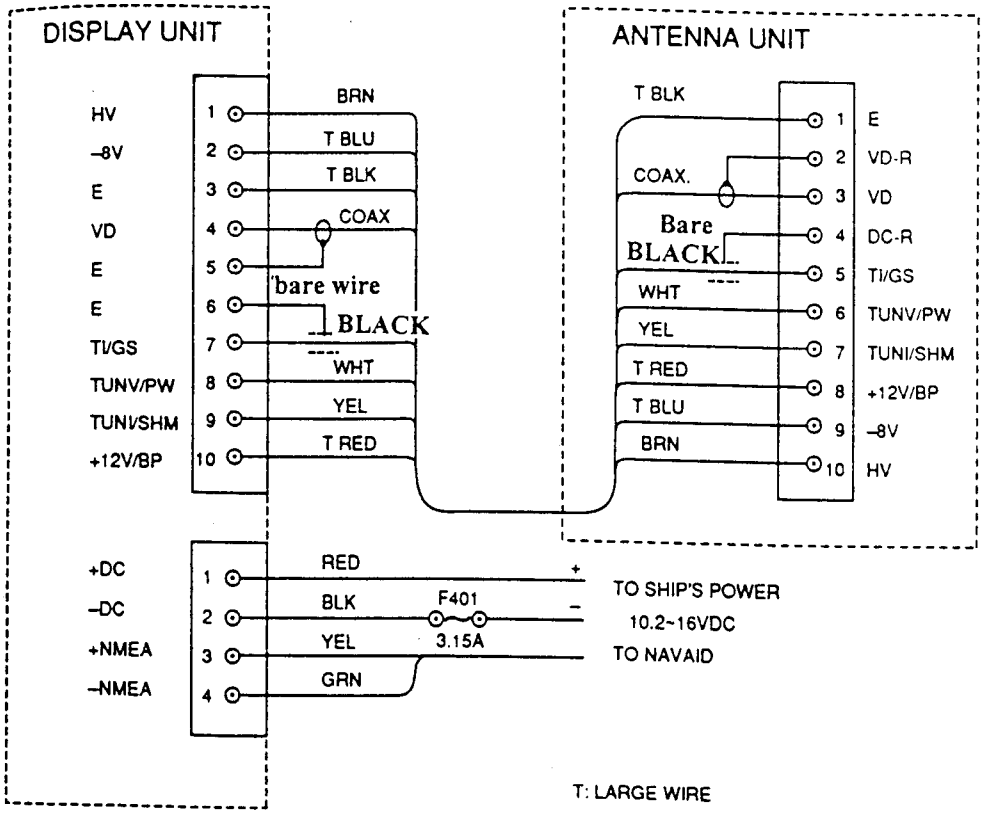


FIG. 2-11 RADAR INTERCONNECTION DIAGRAM

2.5 ELECTRICAL CONNECTIONS

2.5.1 DC POWER CONNECTION

The RL9 is intended for use on DC ships power systems and can operate as long as that DC supply system is maintained from 10.2 to 16 Vdc. The DC system can be "negative" grounded or have both positive and negative supply lines "floating" above ground. This radar is not intended for use on "positive" ground vessels.

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

In order to properly determine the supply cable wiring size to use if the power cable must be extended, a graph is supplied in TABLE 2-3 for recommending an appropriate cable diameter. Begin by estimating the length of cable you will require between the ship's main power source and the radar. Select the wire size indicated by the distance and input voltage.

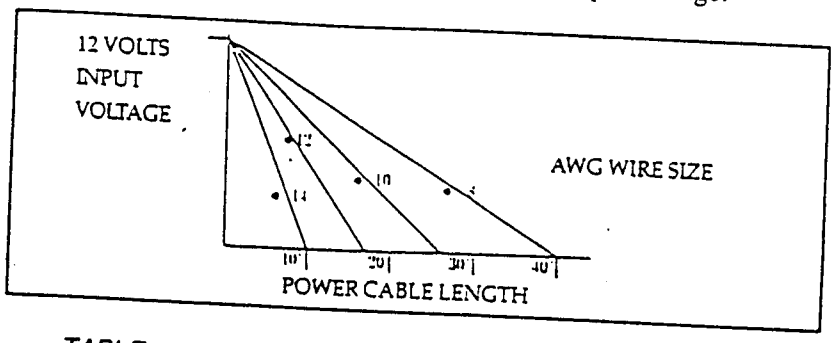


TABLE 2-3 POWER CABLE SIZE VERSUS LENGTH

Table 2-3 is a recommended guide for selecting power cable wire sizes based on the length of the cable to the ships' power connection point.

The connections should be made at a power distribution panel, isolation switch, or may be made (but not preferred) to the battery. Check that all connections are clean. The RED wire must be connected to (+) positive battery terminal and the BLACK wire to (–) negative battery terminal. The shielded wire should be connected to the ships RF ground.

Should the power connections be accidently reversed, protective in-line fuse F401 (3.15A) will blow. Make sure that the input power leads are connected for correct polarity with a VOM. Replace the fuse.

GROUNDING THE RADAR SYSTEM

It is important for proper operation that an effective RF ground be connected to the radar system. You may elect to ground the radar by

connection of a 10 or 12 gauge wire to the ground on the rear of the display to be connected to the nearest ground point of the ship's RF ground system.

2.5.2 EXTERNAL SYSTEM INTERFACE

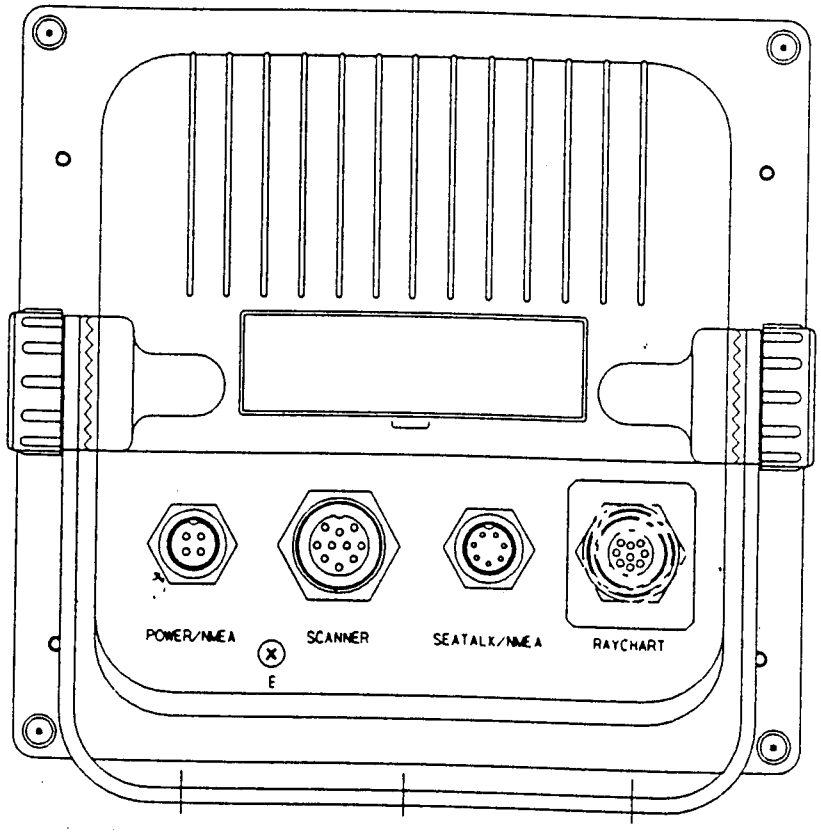


FIG. 2-12 DISPLAY REAR CHASSIS

The RL9 radar can receive various input signals from Navaids, Flux Sensors, Raychart Units, and Seatalk Data networks. The inputs from Seatalk, the flux sensor, and Navaids will be digital data conforming to the NMEA 0183, or Seatalk formats to drive various radar features such as Waypoint Mode.

If more than one data type is present at the radar inputs (for example; Flux Sensor and NMEA and Seatalk) 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")
2. Seatalk Data (Heading via Autopilot compass)
3. Navaid Data (NMEA 0183 "RMC, RMA VTG")

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

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

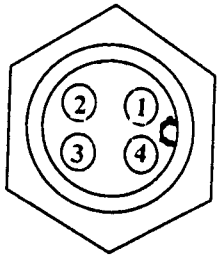
WAYPOINT:
1. Seatalk Data
2. Navaid Data (NMEA 0183 "RMB, BWC")

SEATALK: Seatalk Data only

2.5.2.1 CONNECTION WITH EXTERNAL NAVAIDS

Navaid data is the primary source for position, speed, and waypoint bearing and range input information to the radar. Check the list above and verify that the Navaid that will be used to supply data input to the radar contains the required sentences in it's NMEA 0183 output. The Navaid input should be connected at the NMEA connector J401, Pin 3 (DATA +) and pin 4 (DATA –).

If for some reason, NMEA 0183 data is not available from any Navaids on the vessel, the radar can accept and operate in full function with the Seatalk format (option).



POWER/NMEA CHASSIS CONNECTOR (J401)
View from the rear the display.

① POWER DC 12V + (RED)
② POWER DC 12V – (BLK)
③ NAV DATA IN + (YEL)
④ NAV DATA IN – (GRN)

2.5.2.2 INSTALLING THE XX HEADING SENSOR

The sensor should be placed in a location on the vessel where magnetic interference is minimal and where it will remain undisturbed. The optimum subject to minimum (pitch and roll) such as on a deck close to the waterline. Flying bridge installations are not recommended. On steel vessels however, the sensor may need to be mounted above the deck enclosure on a mast and between one meter and three meters from the main structure in order to minimize magnetic disturbances.

1. Locate a suitable installation area, resonably free from magnetic interference. Keep away from magnetic devices using coils, transformers or other types of permanent and electrical magnets. Examples: generators, motors, radio or radar receivers and transmitters, loudspeakers and magnetic compasses etc. Minimum mounting distances are shown below.

Minimum Mounting Distances	
Radios, RDF, Depth Recorders etc.	3ft (1 meter)
Power Cables carrying mofe than 0.5 Amp.	3ft (1 meter)
Radar Magnetrons	9 ft (3 meters)
Ships Engines	3 ft (1 meter)

2. Each compass is accurately compensated at the factory, so the more carefully you locate the sensor, the less compensation will be required for heading errors introduced by the installation. Even though the sensor is internally gimbaled, it should be mounted as close to horizontal as possible. The sensor must never be mounted on its side or upside down; i.e., the cable plate of the sensor should be facing upwards. After selecting the best possible location for the sensor, ensure that there is enough cable provided for the installation.

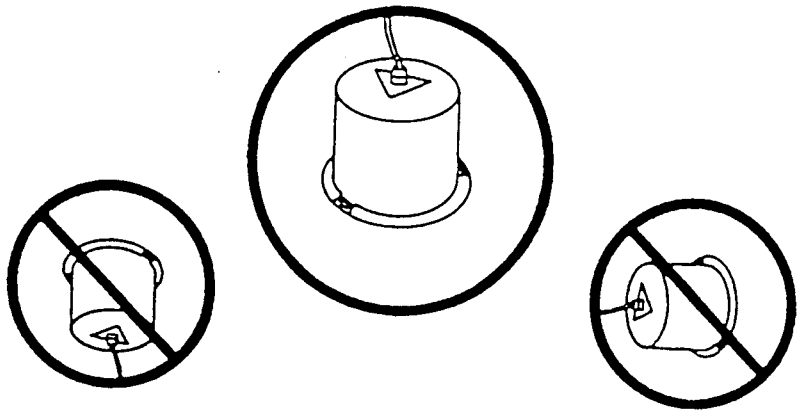


FIG. 2-13

3. Before mounting the sensor, carefully align the arrow on the sensor's top parallel with the keel line of the boat. The arrow point must be facing forward.

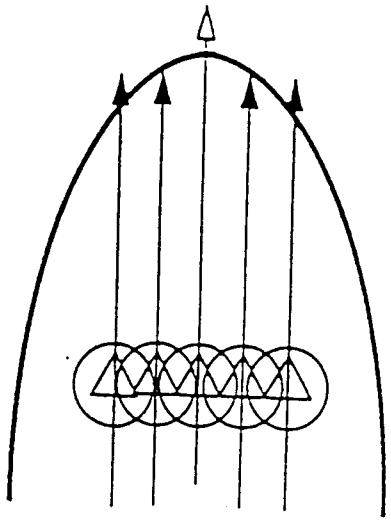


FIG. 2-14

4. Drill a 9/64" hole in the center of each of the three slots in the base of the sensor. These slots will allow you to turn the sensor slightly to align it with the center line of the vessel during compensation.

5. Using the three #10 stainless steel screws provided, or three #10 brass screws, secure the sensor in place.

6. Install a terminal strip or junction box (not supplied) in any convenient place to allow system interconnection.

7. It is advisable to connect the sensor through a fused supply or circuit breaker at either an existing switch panel or separate fuse block. Since the current drain is very low, the sensor could be left on with very little battery drain. However, it is best secure power to the sensor when the vessel is not in use. These sensors are not intended for use on "Positive" ground vessels.

2.5.2.3 INTERCONNECTION (XX HEADING SENSOR)

The XX heading sensor is intended for use on vessels with 12 VDC power systems and can operate between 9.5 (min) and 16 VDC (max). The power system can be "Negative" grounded or have both positive and negative lines "floating" above ground. The sensor is NOT intended for use on "positive" ground vessels.

A 10 foot shielded cable is supplied with the sensor unit. The cable contains 7 conductors. Two conductors (GRN, ORG) are used to supply heading data to the radar display and two conductors (RED, BLK) are used to supply 12 VDC ships power to the unit. The unused conductors (WHT, BRN and BLU) should be insulated and tied back. It is suggested that the wiring terminate on a suitable terminal strip. Refer to Fig. 2-15, below.

When connecting power to the sensor, OBSERVE PROPER POLARITY! The RED wire should be connected to the Positive (+) source terminal; the BLACK wire should be connected to the NEGATIVE (–) source terminal. If the power leads are reversed the sensor will not operate.

If it appears that the sensor is inoperative, check the input voltage polarity with a DVM or VOM and if necessary, reverse the wires to correct the error.

NOTES

The sensor is designed to output the NMEA 0183 "HDM" sentence for the radar. The sensor can supply data for up to two (2) external inputs which conform to the NMEA interface requirements.

Ensure that the wiring is as shown in Fig. 2-15, below.

To avoid ground loops DO NOT CONNECT the sensor cable shield to ground.

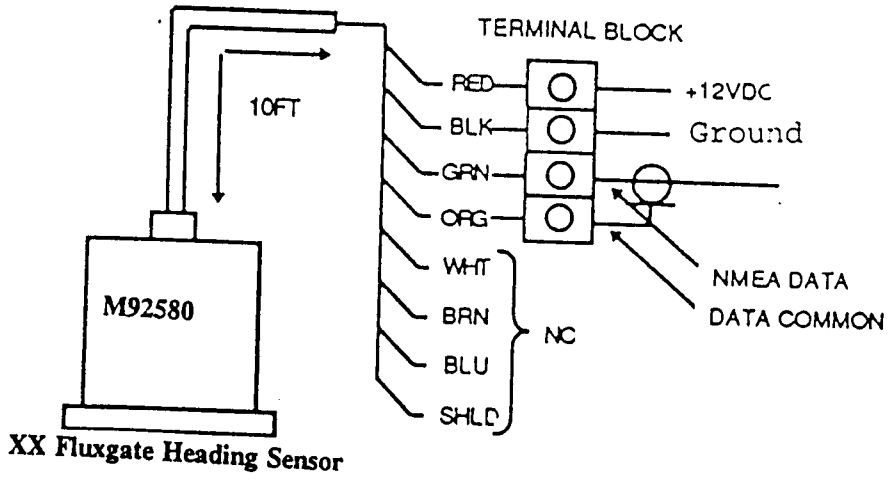


FIG. 2-15 XX HEADING SENSOR WIRING

2.5.2.4 INTERCONNECTION (INI-100)

The INI-100 intended for use on vessels with 12 VDC power systems and can operate between 8.5 (min) and 28 VDC (max). The power system can be "Negative" grounded or have both positive and negative lines "floating" above ground. The INI-100 is NOT intended for use on "positive" ground vessels.

A 10 foot shielded cable is supplied with the INI-100 unit. The cable contains 4 conductors. Two conductros (WHT, GRN) are used to supply heading data to the radar display and two conductors (RED, BLK) are used to supply 12 VDC ships power to the unit. It is suggested that the wiring terminate on a suitable terminal strip. Refer to Fig. 2-16, below.

When connecting power to the sensor OBSERVE PROPER POLARITY! The RED wire should be connected to the POSITIVE (+) source terminal; the BLACK wire should be connected to the NEGATIVE (–) source terminal. If the power leads are reversed the sensor will not operate.

It it appears that the sensor is inoperative, check the input voltage polarity with a DVM or VOM and if necessary, reverse the wires to correct the error.

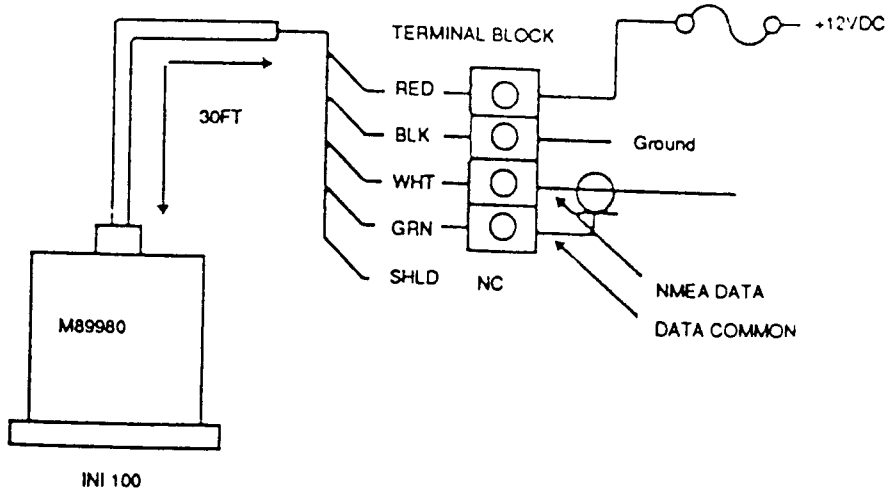


FIG. 2-16 INI-100 WIRING

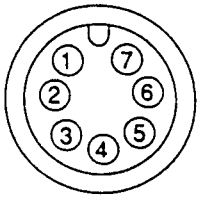
NOTES

The sensor is designed to output the NMEA 0183 "HDM" senstence for the radar. The sensor can supply data for up to two (2) external inputs which conform to the NMEA interface requirements.

Ensure that the wiring is as shown in Fig. 2-16, above.

To avoid ground loops DO NOT CONNECT the sensor cable shield to ground.

2.5.2.5 SEATALK/COMPASS INTERFACE CONNECTION [J403]



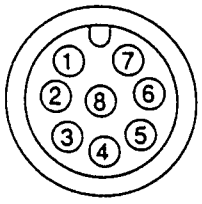
1 COMPASS E
2 COMPASS +12
3 COMPASS + [nmea data]
4 COMPASS - [data common]
5 SEATALK Vcc [10-16Vdc]
6 TX-RX SEATALK DATA
7 SEATALK - [E]

*solder side shown

In order to view Seatalk data on the bottom of the RL9 display, a simple connection to your existing Autohelm capable equipment is all that is required. Seatalk is a factory installed option so you must have purchased the display unit with Seatalk already installed in order to view this capability (it is imbedded in the PCB design of the Main Control PCB). Once connected, you simply need to select "DISPLAY RADAR SEATALK" from the MAIN menu in order to see the split screen capabilities of the RL9.

An external compass sensor such as a Smart Heading Sensor (M92580) can also be connected to the RL9 display unit as shown above.

2.5.2.6 RAYCHART 600XX INTERFACE CONNECTOR [J40-4]

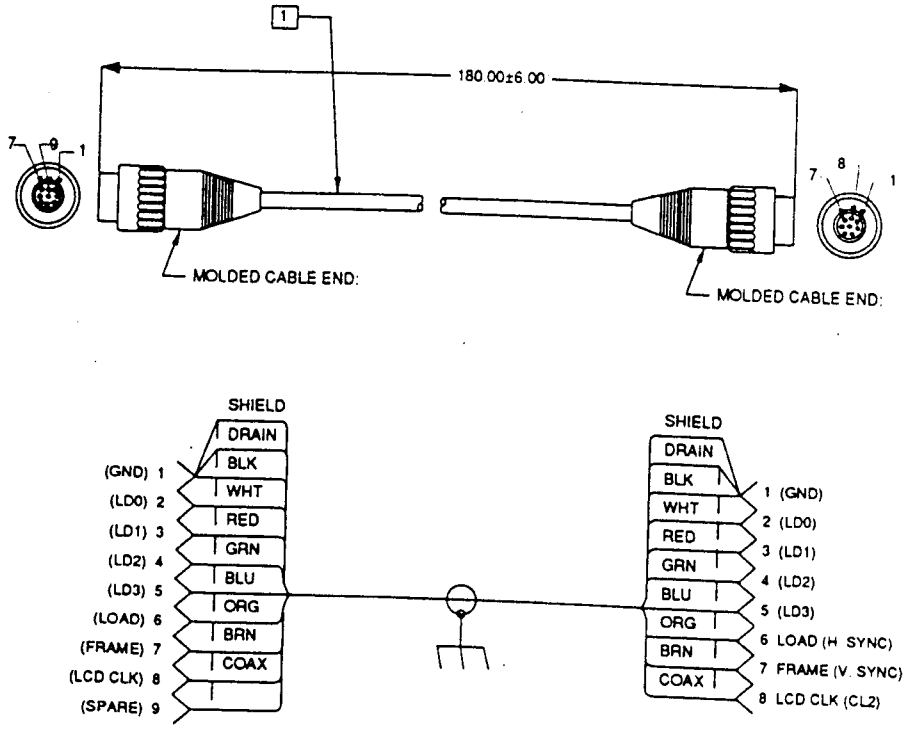


1 E
2 LD0
3 LD1
4 LD2
5 LD3
6 LOAD
7 FRAME
8 LCD CLK

*solder side shown

In order to access the full charting and alternate screen operations of the RL9 radar, a simple connection between your Raychart 600XX and the display must be made. If your unit does not have the Raychart option already installed, then you will need the Raychart option kit **G623140-1.**

When the Raychart unit is first turned on, the radar will detect the incoming signals and will switch instantly to the Raychart screen. Pressing the CHT ON key can select the full screen display of the charting presentation at any time.



INTERFACE CABLE G623011-1

FIG. 2-17 RADAR/RAYCHART INTERCONNECTION

SECTION 3

OPERATION

3.1 INTRODUCTION

1 Congratulations on selecting the Raytheon RL9 LCD Radar to fulfill all of your radar navigation requirements.

2 The RL9 Radar besides being an outstanding Radar System by itself, combines the operation of Chart Plotting with those of Radar Navigation. This Section of the manual provides the descriptions and instructions for all of the operations and features within this radar system.

3 For first time users of Radar we have included some basic information on the general principles of how radar works to start, this should provide you with a basic understanding of how the controls affect the radars operation ;and display. Part 3.3 of this section (pg. 3-9) begins the actual description of the front panel controls along with an explanation of how they work.

4 This section begins by describing the keypad layout and the various display screens of the RL9 Radar. A fold-out page with a drawing of the display and locations of all the controls and display data is provided on page 3-10 (FIG. 3-2) for your reference while reading about these controls.

5 As you are reading through this section of the manual you will notice that whenever operations call for keys to be pressed, the keys are high-lighted by being enclosed inside boxes. (i.e. CTR/ZOOM in the instructions.)

6 To keep the operation of the RL9 Radar simple and as automatic as possible, the Radar uses many on-screen menus, messages, and prompts to help guide you through various operations. You should master the unit very quickly and the approach you should take, while becoming familiar with the operations, is one of relaxed confidence.

3.2 RADAR MAP

The radar display is a map-like representation of the area in which the radar is operating. Typically, the ship's position is at the center of the display or sometime may be repositioned or offset up to 66% of the radius anywhere on the screen in the OFFSET MODE. The ship's dead ahead bearing is indicated by the heading line at the 0° bearing with every revolution of the sweep trace.

Coastline contours are generally depicted in solid filled blue echo areas. Other surface vessels, and channel buoys, are displayed as smaller single echoes. The radar picture or map can be viewed in many sizes or scales from own ship. These sizes are selected by the range scale controls. Greater detail of radar echoes nearby own ship is shown when using the short range scales. The best technique is to start with using a longer range scale and then switching to shorter ranges when nearby targets appear, or as the ship approaches the coastline, harbor, or other vessels in the area.

Until the operator becomes familiar with interpreting the radar display, every opportunity should be taken to compare the radars display patterns with visual targets, such as other vessels, buoys, coastal structures etc. Harbor and coastal navigation should be practiced during daylight with clear weather conditions.

3.2.1 MAP ORIENTATION

In the RELATIVE mode, the heading line always appears on the Display Unit at 0° relative, and is coincident with the antenna beam passing the ship's bow. Thus the top of the displayed picture represents the direction in which the ship is heading. All targets appearing on the display are "Relative" to own ship's position and heading.

The EBL's give relative bearing data. When in the TRUE mode, EBL readouts give true bearing to targets. The MAGNETIC mode provides magnetic bearings to targets.

A compass input is required in order to have magnetic bearings. A GPS or Loran input is required in order to have true heading. Some GPS and Loran units allow for the input of magnetic variation into them, which in turn, will provide magnetic course information to the radar.

3.2.2 EFFECT OF SHIP'S MOVEMENT

Radar Displays can be drawn in two ways to show the ship's motion. The displays are called "Relative Motion" and "True Motion" Display. In Relative Motion, the most common radar display mode the appearance of the radar display changes according to the ship's speed and course, that is own ship is permanently fixed in position but radar echoes (targets) move in relation to your vessel. With no movement of the ship, a steady display of fixed radar echoes is shown. If the ship is moving ahead on a constant course, echoes appearing at the top of the display will move downward across the display. Your position will always remain at the center of the display.

If your vessel alters course to the right, the displayed echoes will be displaced by an equal amount in bearing in a counterclockwise direction, and vice versa. These changes in the display pattern with ship movement is an extremely important factor when plotting the ship's course and the courses of nearby vessels.

The True Motion Display Mode is very much like seeing your vessel moving on a map or chart. In True Motion, the surrounding landmass echoes will remain stationary on the screen. If your ship is moving at a constant course and speed, you will see your position move across the screen towards the edge of the display. Any other targets which are underway will also be moving on the display screen at their True course and True speed. All motion seen on the True Motion display is "TRUE". (meaning motion over the ground).

The RL9 Radar only operates in the Relative Motion mode.

3.2.3 NAVIGATIONAL ECHOES

Echoes displayed on the radar screen may be large or small, bright or faint, depending on the size of the object. The radar indication may not be similar to an observer's visual indication; a nearby small object may appear to be the same size as a distant large object on the radar. With experience, however, the approximate size of different objects can be determined by the relative size and brightness of their radar echoes.

Buoys and small boats are an example of targets that are sometimes difficult to differentiate between. Since they bob and toss about in the waves, they do not present a consistent reflecting surface. Consequently, their echoes have a tendency to fade and brighten and at times to disappear momentarily. Very often buoys and small boats resemble each other, but usually the motion of one target to the other identifies the boat from the buoy.

High coastlines and mountainous coastal regions can be observed at the longest range of the radar. However, the first sight of landfall on the radar display may be a mountain several miles inland from the coastline. The actual coastline may not appear on the radar until the vessel has closed the range to the land near the line of sight distance.

3.2.4 SEA RETURN

Not all radar echoes are produced by hard navigation items such as boats, buoys and land. Some Radar echoes may be received from irregularities on the surface of the water, particularly at close range by breaking wavecrests in heavy seas. These echoes appear on the PPI screen usually on the very short range scales as multiple small echoes not in a repetative or consistant position. Under high winds and extreme conditions the echoes from sea clutter may appear as dense background of clutter forming the shape of an almost solid disc, as far as one to three miles in all directions from the display center.

3.2.5 STORM & RAIN SQUALL RETURNS

The Radar can also see echoes from rain or snow. Returns from storm areas and rain squalls consist of countless small echoes, continuously changing in size, intensity, and position. These returns sometimes appear as large hazy areas on the display depending on the intensity of the rainfall or snow in the storm cell. The cells usually are visible for long distances due to their extreme altitude and are very helpful for observing bad weather warnings. If the returns from storm areas and rain squalls are not desired, the RAIN control can be adjusted to minimize them.

3.2.6 BLIND SECTORS OR SHADOW EFFECT

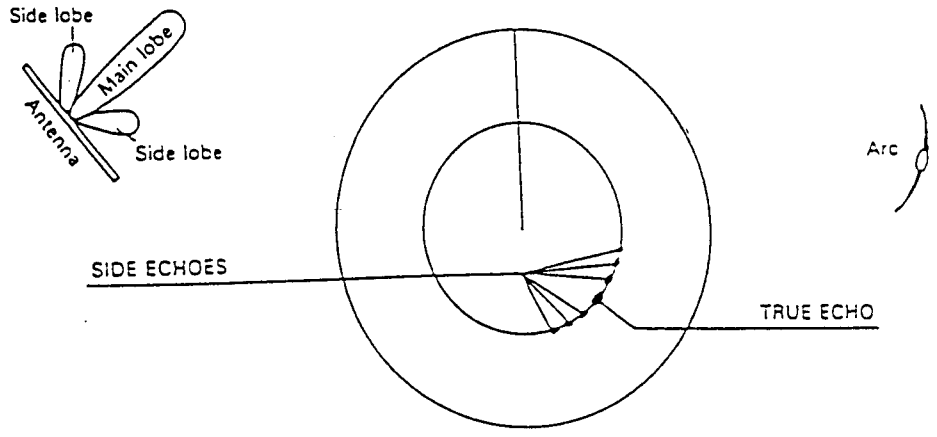
Not all echoes on the radar are direct returns to the radar antenna. There are many types of echoes that can appear on the display if certain conditions occur. The sections that follow briefly describe the echo patterns that may be produced by these false echoes and their likely cause. It should be noted that the Radar operator, through observation, practice, and experience can detect these conditions generally very quickly.

Funnels and masts, (when located near the antenna array) may cause shadows. In the shadow area beyond the obstruction there will be a reduction of the beam intensity, although not necessarily a complete cutoff. However, if the subtended angle is more than a few degrees there will be a blind sector.

In some shadow sectors the beam intensity may not be sufficient to obtain an echo from a very small object even at close range, despite the fact that a large vessel can be detected at a much greater range. For this reason the angular width and relative bearing of any shadow sector must be determined at installation. Sometimes shadowing can be seen by increasing the Radar Gain until noise is present. Dark sectors indicate possible shadowed areas. This information should be posted near the Display Unit, and operators must be alert for objects in these blind sectors.

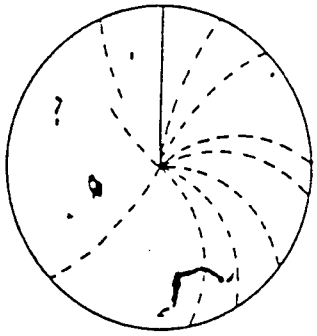
3.2.7 SIDE LOBES

A very small part of the RF energy from each transmitted pulse is radiated outside the single narrow beam, producing side lobe patterns. Side lobes have no effect on distant or small surface objects, but the echo from a large object at short range may produce an arc on the radar screen similar to a range ring, or appear as a series of echoes forming a broken arc. Side-lobe echoes normally occurs at a range below 3 miles and can be reduced by adjustment of the SEA control.



3.2.8 RADAR INTERFERENCE

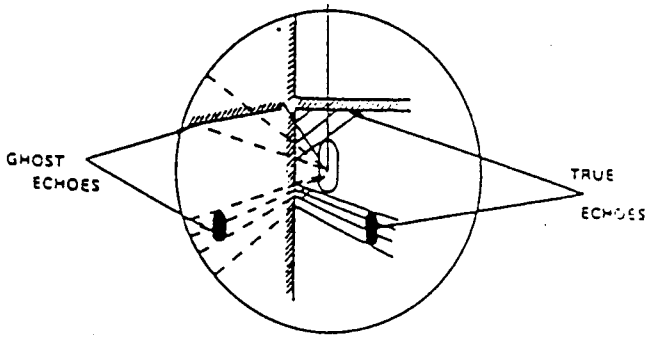
Whenever two or more radar equipped vessels are operating within reception range of each other, mutual interference is likely. This will usually appear on the screen as a series of small dots, which move to and from the PPI center, sometimes in a straight line, but more often in a long, sweeping curve. This type of interference is most noticeable in longer ranges. This should not, as a rule, impair the effectiveness of the radar as a navigational aid. Radar interference can be completely eliminated by turning IR "ON" on the Display Unit function menu. The IR feature is normally left "on".



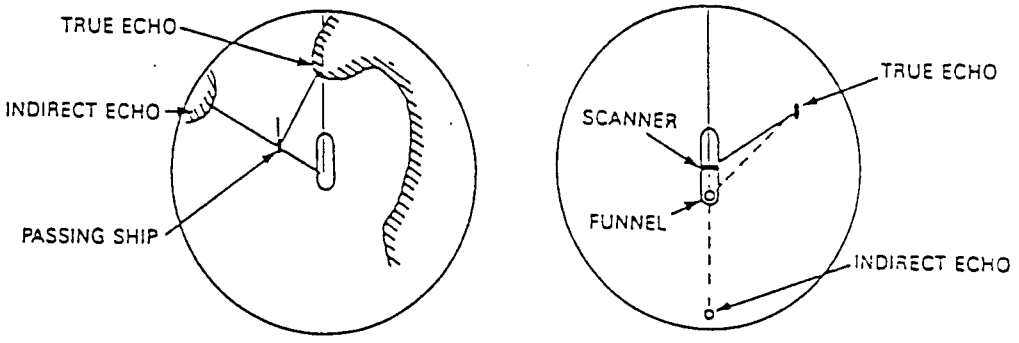
3.2.9 FALSE ECHOES

Occasionally, signals will appear on the screen at positions where there is no actual target. These targets are called "False Echoes" and may be caused by Ghost Images, Indirect Echoes or Multiple Echoes.

There are several types of ghost images. They sometimes have the appearance of true echoes, but in general they are intermittent and poorly defined. A ghost image retains a fixed relationship with respect to the true image and has a more arc-like appearance with a tendency to smear. They are sometimes caused by targets which have a wide, smooth surface near your own ship.

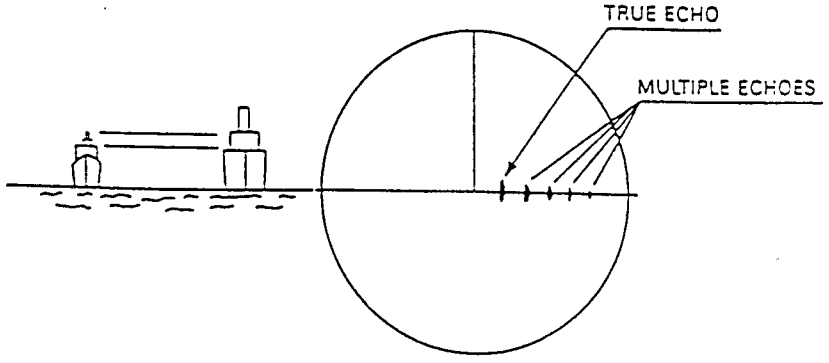


Indirect echoes may appear when there is a large target, such as a passing ship at a short range, or a reflecting surface, such as a funnel on your own ship in line with the antenna. The signal, on first striking the smooth side of the large target, will be reflected, and these subsequent echo returns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



Multiple echoes could appear if there is a large target having a wide vertical surface to your own ship at a comparatively short range. The transmitted signal will be reflected back and forth between the wide vertical surface of the target and your own ship.

Thus, multiple echoes will appear beyond the true target's echo on the same bearing as shown below. This is not a very common phenomena.



3.2.10 DETERMINING RADAR LINE-OF-SIGHT RANGE

When searching for distant echoes, the radar line-of-sight range to the echo can be a limiting factor. Radar waves behave like light waves but are refracted slightly more, increasing the distance to the radar horizon to slightly beyond the optical horizon (displayed range is correct, however). As Fig. 3-1, below, shows, the radar line-of-sight range is a combination of the radar horizon of the ship's radar antenna and the radar horizon of the target. The nomograph shown in Fig. 3-1, below, provides a convenient method of determining any of the three factors involved when the other two factors are known.

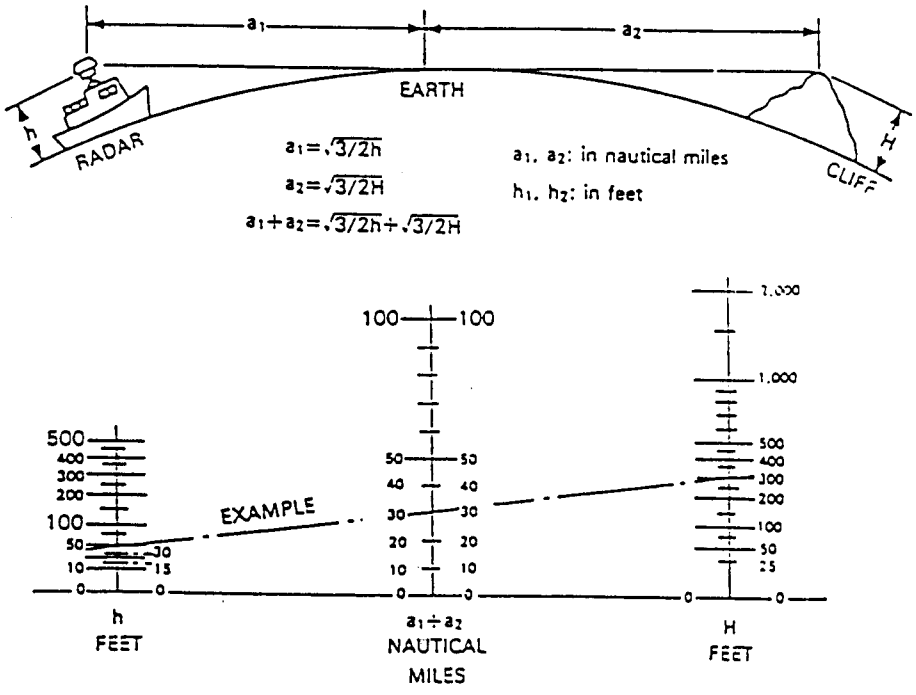


FIG. 3-1 RADAR LINE-OF-SIGHT RANGE NOMOGRAPH

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

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

For example, an antenna at a height of 5 meters has a radar horizon of 5.0 nm.

A 5 meter cliff has a radar horizon of 5 nm. Therefore, under standard conditions, the cliff should begin to appear on the screen when the ship comes within 5.0 + 5.0 = 10 nm.

3.3 OPERATING CONTROLS

Generally the operation of the RL9 is easy and straight forward. However, the navigator who takes the time to become fully familiar with the panel layout and understands the functions of the various controls will be able to obtain the best performance from his equipment.

3.3.1 LAYOUT OF THE CONTROLS

The layout of controls is shown in Figure 3-2.

3.3.2 FUNCTIONS OF THE CONTROLS

① "POWER" STBY/XMIT KEY

In the "OFF" state no power is applied to the radar system. Upon Pressing the STBY/XMIT key, ship's DC power is applied to the scanner and display units. The radar normally requires approximately 90 seconds to warm up. A countdown timer on the radar display shows the time remaining in the warm up period. During the warm-up period the radar transmitter does not operate and antenna does not rotate.

After the warm up period, one beep will sound and "PUSH XMIT TO OPERATE" will be displayed on the screen.

The display will also show the operating time (hours) of the radar during the warm up period, as well as the software level (i.e. v1.0).

The radar is now available for operation.

Pressing the STBY/XMIT key puts the radar into the "transmit" mode. The antenna will begin rotation, and targets will be displayed on the screen.

If the STBY/XMIT key is pressed again, the radar will return to the "stand-by" condition with the transmitter OFF and the "PUSH XMIT TO OPERATE" indication again appears on the screen.

By pressing and holding down the STBY/XMIT key indication approximately 2 seconds, the radar will be turned OFF and all alpha-numeric information on-screen will extinguish.

② RANGE KEY

By pressing the UP (Right side) or DOWN (Left side) of the key, the desired range scale can be selected.

Each time the radar is turned on, the initial range displayed will be the same range scale that was previously in use when the radar was turned off. During range changes, the UP and DOWN keys change not only the range scaling, but simultaneously change the number and interval of the fixed range rings as well as the pulse repetition frequency and the pulse length for the radar transmitter. Table 3-1 shows this relationship.

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

Range (nm)	Range Ring Interval (nm)	Number of Rings	Pulse Repetition Frequency (Hz)	Transmitting Pulse Length (μs)
0.125	0.0625	2	2250	0.08
0.25	0.125	2	2250	0.08
0.5	0.25	2	2250	0.08
0.75	0.25	3	2250	0.08
1.0	0.25	4	1200	0.3
1.5	0.25	6	1200	0.3
3	0.5	6	600	0.8
6	1	6	600	0.8
12	2	6	600	0.8
16	4	4	600	0.8

The small dot on this key indicates a decrease in selection, while the larger dot represents an increase.

NOTE

Pressing the GUARD key at the same time while turning the radar to standby will perform a Soft Master Reset to the unit in the event that a "lock up" condition should occur. A Soft Master Reset will NOT reset the radar's initial settings (i.e. bearing, STC, tune, timing ...). In order to perform the Soft Master Reset, shut the Radar System OFF. Hold down the GUARD key; then press the ST-BY key to place the unit in ST-BY. Release the GUARD key. The Master Reset condition is verified by observing that the total hour meter is reset to 0000Hrs.

A Hard Master Reset can also be performed. This type of reset will clear all memory including the radar's initial settings. To perform a hard master reset press • RANGE●. Then press the ST-BY key. Release the ST-BY key and then the • RANGE● key in order to Hard Reset the radar.

③ TUNE CONTROL

The tune control is used to tune the receiver in the antenna unit for maximum targets on the display. If there are no targets available, this control can be used to tune for maximum sea clutter. The on-screen tune level indicator will show the tuning peak condition by displaying a maximum deflection to the right. The tuning adjustment of the radar should be normally performed on the longer range scales from 3 to 16 nm but should always be re-checked for peak indication on the range scale you are using. Tuning is controlled by pressing the tune left or right keys for maximum bars.

The minimum deflection of the tuning indicator will occur when there are few or no targets. Minor retuning of the radar may be necessary after the radar has warmed up 10 minutes. The 10 minutes accounts for time to allow the magnetron frequency to stabilize.

AUTO TUNE MODE

The Radar includes an Automatic TUNE Feature. In the Automatic mode, the radar tunes itself automatically on all range scales. Auto Tune is available by pressing the [MENU] key (14). Use the Arrow key to Select Tune ... Auto with the highlighted Cursor. Press [MENU] to activate Tuning Mode. The Manual mode is indicated by the "Tuning Bar" and the Automatic mode is indicated by an "A" after it.

④ RAIN CLUTTER CONTROL

The Auto or Manual rain clutter control, also known as Fast Time Constant (FTC), is used to reduce large undesirable echoes from clutter such as rain or snow which may obscure smaller echoes in their vicinity. The rain clutter control is normally adjusted to reduce such echoes so that only the leading edges of the larger echoes are displayed, while the smaller echoes are only slightly effected. To reduce rain or snow target pickup, press the [RAIN•] key until rain details are reduced. To turn off rain press the rain [•RAIN] until the bars are gone. To turn ON auto rain press [MENU] and select RAIN AUTO . Press the [MENU] key again to return to the radar display, the automatic mode is indicated by an "A" next to the RAIN bar graph. In manual control mode if the rain clutter is advanced too far, some small, weak targets may be suppressed by the controls effect.

⑤ SEA CLUTTER CONTROL

The sea clutter control, also known as the Sensitivity Time Control (STC), is used on the short ranges to suppress the effects of sea clutter close to own ship by reducing the nearby gain. To set sea clutter, press

the [SEA●] key to reduce clutter. Press the [•SEA] to increase sea clutter. The sea clutter should be set to the point where nearby clutter is reduced to small noise dots and small target echoes can still be distinguished.

> **NOTE**
>
> On short range scales, the setting of the SEA CLUTTER Control should never be advanced so high as to completely obliterate all clutter, since this setting could prevent the detection of close-in target echoes.

The SEA CLUTTER Control setting should always be checked and readjusted as necessary after changing ranges or when ever sea conditions change. It should also be noted that the GAIN Control setting interacts with the SEA CLUTTER Control. That is; if you reduce the Gain Control, less Sea Clutter control is needed. If you increase the Gain, the Sea Clutter level may need to be reset. Judicial use of these controls is important to assure that excessive sea clutter or insufficient gain will not cause targets to be overlooked or not displayed.

When the STC Control is adjusted for the optimum setting, a crescent of clutter will probably remain toward the windward direction. Excessive application of STC will create a target less zone around and beyond the maximum range to which the clutter extends. This could eliminate some desired echoes, particularly if the GAIN Control is set so that a light speckled background is not clearly visible at longer ranges. In any event, small adjustments of the GAIN Control the STC Control may be necessary to obtain the optimum picture and target detection, in varying conditions.

⑥ GAIN CONTROL

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

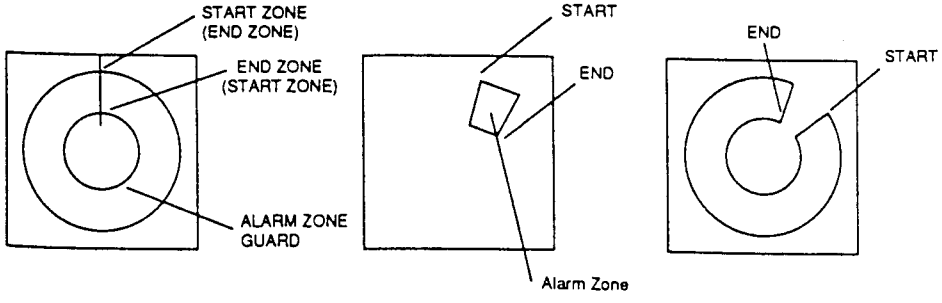
if the gain is set too high, the LCD may be saturated with noise, making target observation difficult.
To increase the gain, press the [GAIN●] key. To decrease it press the [•GAIN] key. To turn on AUTO GAIN, press [MENU] and select GAIN AUTO. Press the [MENU] key AGAIN to Return to the RADAR display. The automatic mode is indicated by an "A" next to the GAIN bar graph.

⑦ HOLD KEY

This HOLD key is used to freeze the picture on the screen. In HOLD mode, the SHM disappears and the word "HOLD" flashes at the top of PPI. The HOLD mode will turn OFF automatically after 30 seconds or anytime by pressing the HOLD key again.

⑧ GUARD KEY

The [GUARD] key turns ON or OFF the radar's Guard Zone feature. The Guard Zone may be a zone completely surrounding the vessel or a partial trapezoidal zone to monitor targets entering the specified area.
The [GUARD] key turns the Alarm mode "ON". When the Alarm mode is ON, "ALM" is displayed in the upper left window of the screen.
The GUARD zone can be set by using the touchpad arrow keys at the desired distances and bearings.
When the [GUARD] key is pressed, the CURSOR mark is displayed on the screen. The Guard Zone is made by setting the Start point and End point.
You can move the CURSOR to the start point by using arrow keys and then start it by pressing [GUARD] key. Next you can set the END point by using arrow keys and pressing [GUARD] key. As you do this, the Guard zone area will be drawn. After setting the Start point and the END point, the Alarm function will operate. If the [GUARD] key is pressed again while the Alarm function is operating, the Alarm function will be turned off.



Ex. 360° GUARD ZONE Ex. SECTOR ZONE

⑨ ELECTRONIC BEARING LINE (EBL) CONTROL

The EBL bearings may be displayed in either Relative "R", True "T" or Magnetic "M" depending on the mode selected within the RADAR SET UP MENU. The digits of the bearing display will be followed by a "T" when the bearing is "True", an "M" when the bearing is "Magnetic", or blank when the bearing is "Relative". It should be noted that a Loran, GPS navigator, Flux Gate compass or Sea Talk is required in order to display True or Magnetic bearings depending on your selection of RADAR SETUP BEARING REL. MAG. TRUE where you can select either Magnetic or True bearings.

If the [EBL] key is pressed the EBL will be displayed as a "Dashed" line and "EBL" will be highlited at the bottom of the display. By pressing the clockwise [▶] or counterclockwise [◀] key, the EBL can be rotated in the corresponding direction, and the bearing of the EBL will be displayed under the EBL characters in the center panel on the bottom of the screen. If you wish to move the EBL more quickly keep the direction key held depressed and after one sec, the EBL will rotate quickly around the screen.

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

If the [EBL] key is again depressed, the EBL will be turned "off"and the EBL box will go blank.

⑩ VARIABLE RANGE MARKER (VRM) CONTROL

The VRM is used to obtain accurate range measurements to targets or land masses. When the [VRM] key is pressed, VRM will be displayed as a dashed ring on-screen and an inverse block "VRM" character will be displayed in the lower right corner of the display. By pressing the "Increase" [▲] or "Decrease" [▼] key on the track pad, the VRM range is changed and the VRM distance value will be displayed on the LCD, following the VRM characters, in nautical miles. If you wish to move the VRM ring more quickly, keep the "increase" [▲] or "decrease" [▼] key held pressed. After one sec, the VRM will speed up its movement. If the VRM key is depressed again, the VRM ring will be turned off. After VRM control has been used, if any another function key (such as EBL) using the arrow keys is pressed, the inverse "VRM" character will change to just "VRM" letters indicating the VRM will not be controlled by the [▼] [▲] keys until the [VRM] key is pressed again. If the VRM is active, pressing the [VRM] key a second time will shut it off.

⑪ CURSOR CONTROLS

The Cursor feature combines the EBL and VRM functions and can be used to quickly determine the range and bearings from your own ship to any point on the radar screen. The cursor appears on the display as a large (+) character.

To turn ON the Cursor mode, just press the [CURSOR] key. A blocked word "CURSOR" appears at the bottom left side to let you know that you are in the "Cursor" mode. The cursor (+) may now be positioned by using the arrow keys. The cursor can be moved diagonally by pressing the [◀] [▼] keys simultaneously, or the [▲] [▶] keys simultaneously. When the cursor is set to a position on the screen, the range and bearing, will be displayed in the cursor window.

The bearing type of the cursor position will be the same as that of the EBL as noted by the blank for Relative, "T" True or "M" Magnetic next to the cursor bearing.

To turn off the cursor, press the [CURSOR] key again. The cursor information will be replaced by position information.

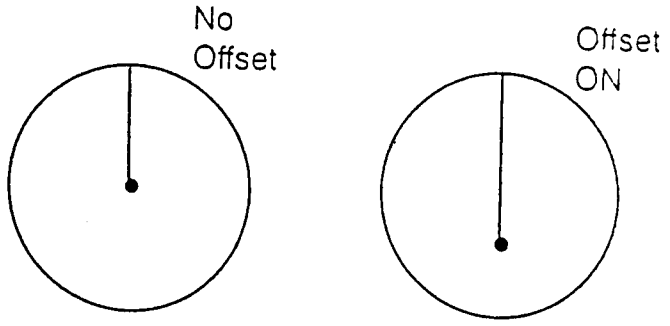
⑫ CTR/ZOOM KEY

The Off Center Mode lets you re-position the radar picture center at any other point on the display so you can have a greater view in the direction of interest.
When the [CTR/ZOOM] key is pressed, the position of own ship can be set anywhere on the screen up to 66% of the radius.

Press the [CTR/ZOOM] key. Both the cursor and the message "Use ▲/▼/◀/▶ to set sweep origin or press CTR/ZOOM for zoom" appears in the lower center portion of the display. Use direction keys to set cursor for sweep origin (start point) then press [CTR/ZOOM] key again to offset the picture. The Off Center Origin is set using the arrow keys. To use the Off- Center feature set the cursor with arrow keys to the desired location for the Off Center sweep origin. Press the [CTR/ZOOM] key to activate the offset mode and place own ship to the designed cursor location. The origin of the radar sweep will now shift to the cursor point. To turn off Off Center and recenter the sweep, press the [CTR/ZOOM] key again.

The Off Center Mode does not operate on the 16 nm range and cannot be used together with the ZOOM mode.

Since off centering cannot be used on the maximum range scale, if the range scale is increased to 16 NM, the origin of own ship will automatically "cancel" the OFF Center mode and recenter own ship. If the radar system is turned OFF while off center mode is on, at next power up the offset mode will still be on.



The Zoom mode can be used to magnify any designated area of the display by "two times". When the CTR/ZOOM key is pressed twice quickly, "X2" will be displayed on the top left of the screen. The area between own ship and the designated location can be magnified by a factor of 2 times by using the cursor as the centering point. The zoom location can be set any where on the screen up to 66% of the radius by using the arrow keys. Once you have set the cursor, press the CTR/ZOOM key to turn "ON" Zoom mode. To assist you in maintaining proper range determination, the fixed range rings are also turned "on" automatically.

Zoom mode can provide a quick means of getting a closer look at a channel entrance, for example, but for navigation purposes it is recommended that you choose the next lower range scale and use the Off Center feature for the same effect. By pressing the CTR/ZOOM key again, the function can be turned "off". Zoom does not operate on the 1/8 nm range and cannot be used together with "OFF CENTER".

⑬ CONT/DIM KEY

This CONT/DIM key is used to adjust the contrast of LCD or the backlight brilliance of LCD and key pad.

The [CONT/DIM] key turns the contrast and dimmer control mode "ON". The message prompt appears "Use ▲/▼ for contrast" "Use ◀/▶ for Back light". Set the contrast by using [▲] [▼] keys and the dimmer level by using [◀] [▶] keys. The condition is set by pressing the [CONT/DIM] key again.

You can control the contrast in 64 steps and the dimmer in 10 steps.

⑭ MENU KEY

The [MENU] key may be pressed at any time in order to call up the Operation and SETUP page menu. The SETUP page settings can be "skipped over" once set by selecting "SETUP PAGE OFF" in the operation menu. Pressing the [MENU] key again will return the display to the normal video presentation.

When the [MENU] key is pressed, the OPERATION MENU is displayed on the screen as follows.

OPERATION MENU			
RANGE R.	OFF		ON
TUNE	AUTO		MANUAL
RAIN	AUTO		MANUAL
GAIN	AUTO		MANUAL
TRAIL	OFF	SHORT	LONG
IR	OFF		ON
EXPANSION	OFF		ON
WAYPOINT	OFF		ON
DISPLAY	RADAR		SEATALK
SETUP PAGE	OFF		ON

SELECT W/▲/▼ CHANGE W/◀/▶
PRESS MENU TO RETURN

You can select each item with [▲][▼] keys and change with [◀][▶] keys. After setting you can return by pressing [MENU] key again. The selected position changes reverse character and the set characters are underlined. Default settings are underlined.

(1) RANGE R.

The RANGE RINGS can be set to "OFF" or "ON" via this MENU item. The fixed rings are used to estimate the distances to targets. The interval between range rings is displayed at the upper left of the screen just below the range scale indicator. The ships heading marker is displayed to show Own Ship's Heading (SHM) on the screen.

(2) TUNE

The TUNE control can be selected between "AUTO" or "MANUAL" mode.

This item selects the receiver tuning method for the Radar. If Manual is selected the Tune Control on the front panel is used and the Tune Bar indicator is present. The AUTO tuning mode will automatically tune the radar for optimum whenever the radar is turned on or ranges changed. Generally, the AUTO tuning mode provides unattended operation and should be selected. "A" appears to the Right of the Tune Bar indicator.

(3) RAIN AUTO MANUAL

The RAIN Clutter control can be selected from "AUTO" or "MANUAL" mode.

(5) GAIN

The GAIN control can be selected between "AUTO" or "MANUAL" mode.

This item selects the receiver gain sensitivity method for the Radar. If Manual is selected the GAIN Control on the front panel is used and the GAIN Bar indicator reacts to front panel changes. The AUTO gain mode will automatically adjust the radar for optimum sensitivity whenever the radar is turned on or ranges changed. Generally, the AUTO gain mode provides unattended operation and should be selected. "A" appears to the right of the GAIN Bar indicator.

(6) TRAIL

The TRAIL is displayed on the moving target in the TRAIL mode, and SHORT TRAIL, LONG TRAIL or TRAIL OFF can be selected.
This feature allows the operator to see the past history of target movement as an after-glow or "TRAIL" behind the moving targets. The OFF selection inhibits this function. The "SHORT" enables "TRAILS", placing a short after-glow behind the moving targets. The "LONG" enables "TRAILS" with a longer after-glow.

If range scales are changed, the trails are cleared and new trail histories must be redrawn to the screen.

The trails are drawn for anything that moves on the screen, including sea gulls, sea clutter, buoys, lobster pots, and shoreline. In general it is better to use the trail feature away from harbors and the shoreline to avoid a cluttered display and concentrate on trails of target vessels.

(7) IR

IR (Interference Rejection) mode can be set to "OFF" or "ON". The IR reduces noise on the display caused by other radars operating nearby in the same frequency band. This function is also effective in reducing some background noise. When active, the "IR" characters are displayed in upper window on the screen.
If you are navigating in a port area serviced by a "RACON" beacon, you should turn off the IR mode to see the RACON signals.

(8) EXPANSION

Target Expand mode can be set to "OFF" or "ON".
The target expand mode allows the operator the ability to make small targets appear larger on the display for better viewing. When active, "EXP" characters are displayed in the upper left window on the screen. This function enlarges all targets so use of expansion mode might want to be limited to only certain occasions on the display.

(9) WAYPOINT

The WAYPOINT mode can be set to "OFF" or "ON".

When active and the radar is connected to a NAVAID with the necessary data output, a waypoint symbol at the bearing and range to the selected waypoint can be presented on the radar display. Numeric data, showing bearing, range and time to target, appears with "WPT" characters in the upper right side of the screen. If the way point is not within the selected range scale of the radar, only the dashed line indicating the bearing to the waypoint can be displayed. When waypoint appears on the range scale in use, the waypoint is displayed as a ○ with the center (own ship) and the waypoint interconnected by a dotted line.

Should data be lost from a heading sensor or NAVAID, the waypoint mode will disable and the message "NO DATA" will appear on the display.

The waypoint mode cannot be used if there is no course data from a NAVAID or magnetic sensor.

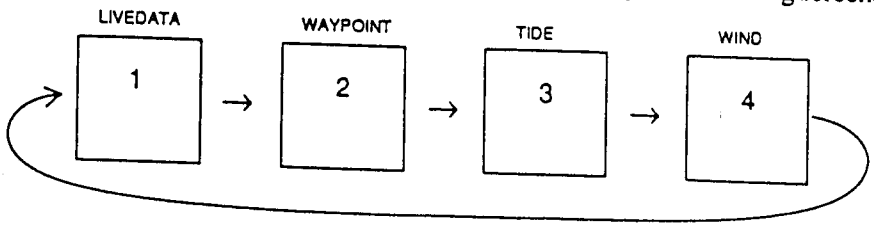
When using the waypoint mode on higher speed vessels the waypoint symbol will tend to lag behind the actual waypoint. Often this condition is due to lag in getting data from NAVAID and is more noticeable on the shorter range scales.

(10) DISPLAY (RADAR/SEATALK)

DISPLAY mode can be selected from RADAR mode or SEATALK mode (Option).

The SEATALK mode is available when SEATALK interface unit is installed and connected to SEATALK bus system. The bottom portion of the display will then shift from radar information the Seatalk information.

There are 4 Seatalk pages then available to you. Each quick press of the [MENU] key will cycle through then (Livedata→Waypoint→Tide→Wind→Livedata ···). You must be connected to instruments which provide the necessary Seatalk sentences to display the following screens.



Held pressing [MENU] key over one second will exit the Seatalk displays and will return the unit to its previous operation.

This menu item does not appear if the Seatalk option is not installed.

(11) SET UP PAGE

By setting the SET UP PAGE to "ON" and pressing the [MENU] key, the RADAR SET UP MENU will be displayed on the screen as follows.

```
RADAR SET UP
TIMED TX        OFF ON
TX              10 20 30 SCANS
STBY            3 5 10 15 MIN
POSITION        OFF L/L TD WPT
BEARING         REL. MAG. TRUE
OPER. PROMPTS   OFF ON
SIMULATOR       OFF ON
LANGUAGE        ENG. SP. FR.
                GER. NOR. IT.

SELECT W/ ▲/▼ CHANGE W/ ◀ /▶
PRESS MENU TO RETURN
```

(a) TIMED TX

TX	10, 20, 30	SCANS
STBY	3, 5, 10, 15	MIN

The TIMED TX "ON" allows the operator to program the radar to automatically transmit for a programmed period and return to standby for a prescribed period. This permits the user to maintain a radar watch while minimizing the power consumption experienced during full transmit operation.

The TX (transmit) period can be set to 10, 20 or 30 scans. And the STBY (standby) period can be set to 3, 5, 10 or 15 minutes. If you wish to turn the TIMED TX mode off, open the OPERATION MENU by pressing [MENU] key (and with SET UP PAGE still set to ON) press [MENU] again. Set TIMED TX to OFF and press [MENU].

The radar returns to its normal operation. Normal operation may also be restored without entering the menus by pressing the [STBY] key. This places the unit in STBY. Pressing this key again will put the unit in XMIT.

(b) POSITION

The POSITION display can be selected from present position L/L (Latitude/Longitude), TD (Time Difference) WPT (way point Lat/Long) or OFF. L/L or TD data can only be displayed if you are connected properly to a Loran C or GPS Receiver with proper data output, or to Seatalk. This information appears at the lower left corner of the display.

(c) BEARING

When connected to a navigator such as a Loran-C or GPS, this radar has three bearing modes available. They are "Relative", "Magnetic" and "True".

The "Relative" mode allows the operator to determine bearing to objects displayed on the radar screen relative to own ship's heading. These bearings are taken by utilizing the EBL or the cursor. All of the bearing data acquired in the relative mode is referenced to the "SHM" (Ships Heading Marker).

When planning to plot information from the radar display to a chart, it will be helpful to have the bearing information readouts be in degrees True or Magnetic. This bearing data may be obtained directly from the radar by selecting "MAGNETIC" or "TRUE". The "MAGNETIC" and "TRUE" modes all depend on having a NAVAID or a magnetic flux sensor with proper data format connected to the radar system. In "MAGNETIC" mode, EBL, CURSOR and course bearings are indicated in magnetic bearing as determined by the NAVAID input or optional magnetic flux sensor input. The character "M" will be displayed to the right of the EBL and Cursor characters to indicate the type of bearing input. In "TRUE" mode, EBL, CURSOR and course bearings are indicated in True bearing as determined by the NAVAID input (i.e. no magnetic variation).

The character "T" will be displayed to the right of the EBL and Cursor characters to indicate the type of bearing input.

Magnetic bearing data is the best when inputted from the optional magnetic flux sensor.

(d) OPER. PROMPTS

The OPERATION PROMPTS can be displayed by setting this MENU item to "ON", and can be turned off by setting to "OFF". The OPERATION PROMPTS are helpful for radar operation, and are generally recommended to REMAIN ON.

(e) SIMULATOR

The SIMULATOR mode enables a sample radar picture on the display when set to "ON". This mode is used to practice becoming familiar with the various features and modes of the display unit.
When active, the word "SIMULATION" is displayed at the top of the LCD screen.
The SIMULATOR mode is shut off by setting the MENU item to "OFF".

(f) LANGUAGE

The radar menus can be displayed in one of 6 LANGUAGES. They are English, Spanish, French, German, Norwegian and Italian.
After selecting any language, MENU and OPERATION PROMTS will change to the selected language. A master reset will default the unit back to English.

NOTE:

Pressing the [MENU] and [GUARD] keys simultaneously (with the unit already on) will cause the INSTALLATION ADJUSTMENT menu to appear. These items are used to align your system and are explained in detail in Section 5.

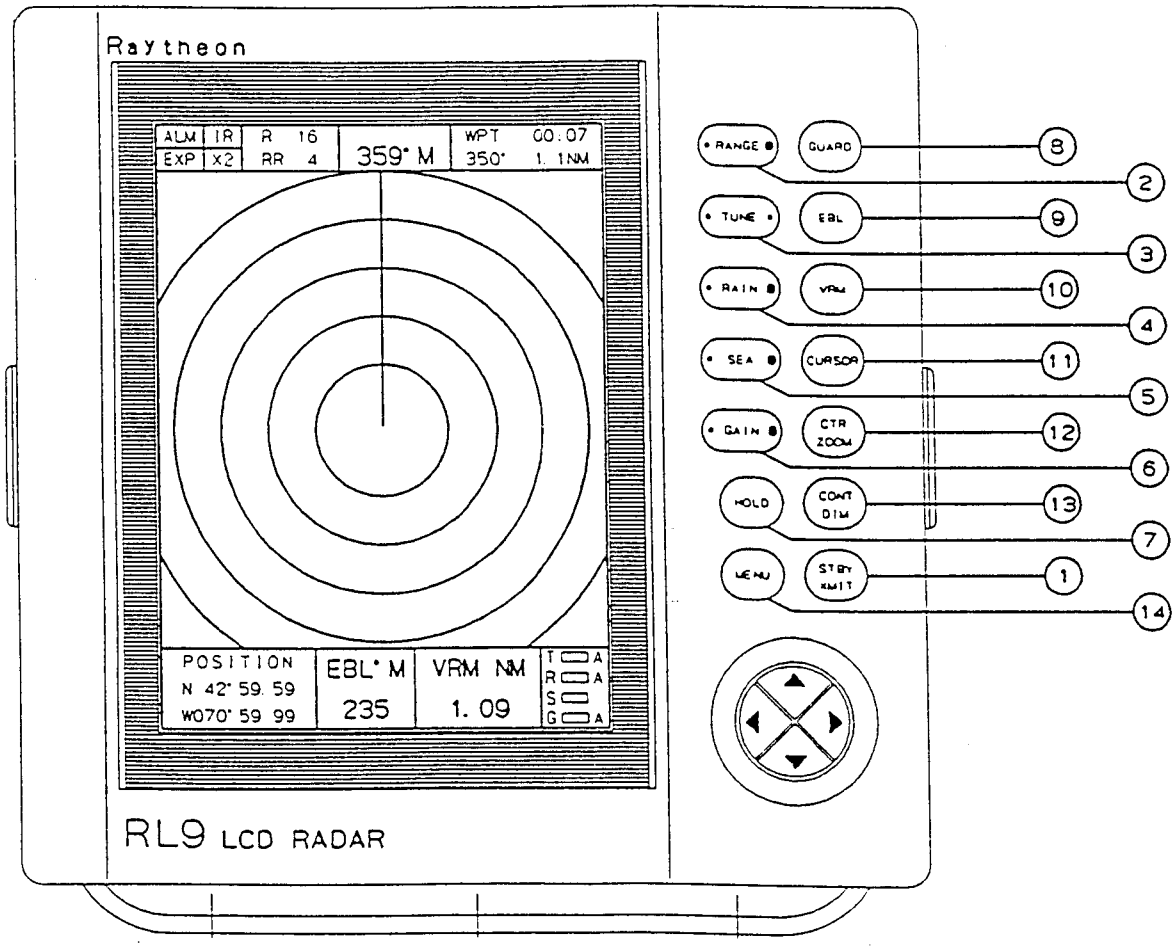


FIG. 3-2 RL9 CONTROL LOCATIONS

SECTION 4

TECHNICAL DESCRIPTION

4.1 GENERAL

The theory of operation for the Radar Set RL9 is presented here with descriptions following the functional block diagram Fig. 4-2.

4.2 ANTENNA UNIT

The 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 17.7" radome.

4.2.1 RADIATOR

The RF PCB radiator forms the main RF transmitting beam for the radar transmitter and becomes the receiving antenna during the receive cycle. The beam formed by the phased array styled PCB at half power point is 6° horizontally and 25° vertically. The side lobes are reduced by better than -21dB with respect to the main beam. The direction of the beam (maximum radiated power) is essentially perpendicular to the radiator surface.

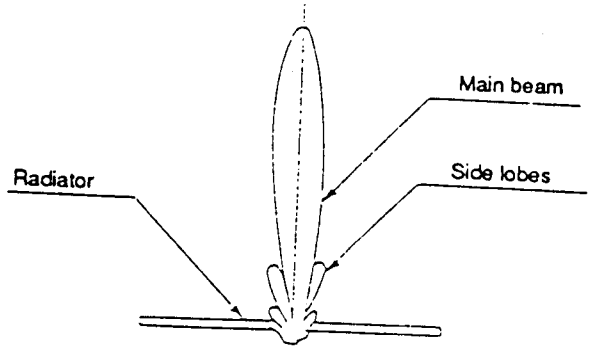


FIG. 4-1 RADIATOR PATTERN

4.2.2 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 24 rpm.

4.2.3 MOTOR-ENCODER

A 12V DC motor operating at a regulated 12V DC is used to rotate the radiator. At the bottom end of the motor, an encoder section produces bearing pulses used for sweep line generation, and rotation synchronization of the sweep line within the display unit. A bearing pulse is generated for every 0.176 degrees of rotation (2048 pulses for each revolution) at 12V amplitude. These pulses are sent through +12V DC supply cable (J1-8) down to the display unit.

4.2.4 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 "O" when the permanent magnet fitted on the main gear passes across the reed switch S101. The resulting signal (SHM) is sent down to the display unit with the tune indication signal at J1-7 TUNI/SHM and synchronizes the display sweep to the scanner position.

4.3 TRANSMITTER

The transmitter consists of the solid state modulator circuit and 2 KW magnetron.

A solid state type pulsar design is used by the modulator and consists of a pulse generator circuit (IC1, 2, TR1-6), power FET switch (TR7), and pulse transformer (T1).

The pulse generator generates the pulses by the transmitting pulse from the display unit when X-MIT switch is "ON", and its output pulse length and repetition frequency are controlled by Range switches of the display unit.

Power FET switch TR7 is switched ON by the positive pulse from pulse generator at its gate (230V supply from the display unit is switched) and generates 1.85 KV pulse for magnetron on the pulse transformer secondary.

TABLE 4-1 RANGE, PULSE LENGTH, AND PRF RELATIONSHIPS

Range	Pulse Length	PRF
0.125, 0.25, 0.5, 0.75	0.08 μs	2250 Hz
1, 1.5	0.3 μs	1200 Hz
3, 6, 12, 16	0.8 μs	600 Hz

4.4 RECEIVER

The receiver consists of the Passive Diode Limiter, the MIC Front End and the receiver circuit on the Reciever/Modulator PCB.

The MIC Front End (E301, NJT1949) device consists of a balanced mixer and local oscillator. The received radar echo signals at 9445 MHz are mixed with the local oscillator output, tuned by the adjustment for maximum target detection. The mixer output of 60 MHz echo signals is then coupled to IF amplifier.

4.4.1 RECEIVER CIRCUIT

The receiver circuit include the 60 MHz IF amplifier, video detector, tune circuitry and the video output circuitry.

4.4.2 IF AMPLIFIER CIRCUIT

The IF amplifier consists of low-noise gain controlled amplifiers TR9, IC4 and IC5. TR9, IC4 and IC5 are controlled by the gain and STC control signals from the display unit.

The receiver has a 7 MHz bandwidth characteristic.

4.4.3 VIDEO DETECTOR CIRCUIT AND VIDEO OUTPUT CIRCUITRY

The video detector circuit IC6 operate as a video detector to remove the 60 MHz IF component from the incoming signals. The output signals on IC6-12 are inverted to negative going pulses and fed to the video output circuit. The video output circuit consists of emitter follower TR9 to operate strictly as an impedance transformer driving the 50 ohms coaxial cable which carries the video signal to the display unit.

4.4.4 TUNING INDICATION CIRCUIT

The tuning indicator circuit consists of amplifier TR12, detector TR13 and output circuit TR14, 15. TR14 charges C83 to the detected signal voltage. This voltage is sent to the display unit as a tuning indication voltage via buffer TR15 with SHM signal. The tuning indication voltage range varies between +5V (detuned) and +1V (peaked tuning in long pulse).

4.5 DISPLAY UNIT

The display unit normally contains the Main Control PCB, the Power Supply PCB and LCD unit. IF separately ordered, the display may also include the Main Control PCB installed optional Seatalk Interface Circuit and or optional Raychart Interface PCB.

4.5.1 MAIN CONTROL PCB

4.5.1.1 VIDEO CIRCUIT & A/D CONVERTER

The incoming video signals from the receiver in the antenna unit are first routed through the FTC circuit components consisting of CD1 and C1. CD1 controlled by the voltage supplied from IC18-11 which is determined by the front panel RAIN CLUTTER Control. The video signals from CD1 and C1 are fed to an amplifier TR1 and TR1 output video signal are converted to digital pulses by 3 comparator ICs IC1, 2 and 3. The digitized video output is then sent to the system control LS1 IC10.

4.5.1.2 SYSTEM CONTROL LSI

The system control LSI IC10 containes video processor, video buffer memory, scanconverter, PPI video memory control circuit, various clock input and output circuit, LCD drive signal generator, and system control signal generator circuit.

4.5.1.3 PPI MEMORY AND GRAPHIC MEMORY

The processed video signals are stored in the buffer memory of the system control LSI, and then read out on the bearing pulse timing. The buffer memory output is fed to PPI memory IC21 followed by the scan converter data onto its adress pins. And also Graphic data from Main CPU and GDC are stored in the Graphic Memory IC19 and 20.

IC 19, 20 and 21 are 64K x 4 bit DRAM. The output data from memories are fed to the LCD drive circuit of IC10. LCD drive signal timing are controlled by GDC and the LCD drive signal are fed to the LCD unit via output buffer IC23.

4.5.1.4 MAIN CPU CIRCUIT

The main CPU circuit consists of CPU IC14, RAM IC12, and ROM IC13. The main CPU controlles all of the radar system with GDC and system control LSI according to the front panel key output and the data from the other navaid units. The tuning voltage and gain, STC signal are generated by the D/A converter outputs which are controlled from CPU.

4.5.2 POWER SUPPLY PCB

The Power Supply converts the ship's DC input voltage to necessary DC voltages to operate the radare system. These output voltages include regulated -22V, -8V, +5V, +8V, +12V, +22V, +230V DC, and 300 V AC for LCD backlight.

The power supply can begin operation when the STBY/X-MIT switch is pressed on the front panel, and will switch off after the STBY/X-MIT switch holding in 2 seconds.

The AVR consists of IC1, TR1 and TR4, the main converter consists of IC2, TR2 and TR3, and the backlight converter consists of TR6, 7, 8 and 9. RV1 is normally set by monitoring the +12V DC output at J2-7 and adjusting for +12V DC ± 0.5V DC.

4.5.3 OPTIONAL INPUTS

The RL-9 radar can receive various input signals from Navaids, Flux Sensor, Raychart unit, and Seatalk Data network.

The inputs from the Raychart unit are digital video and sync signals to drive the LCD unit. The inputs from Seatalk, the flux sensor, and Navaids will be digital data conforming to the NMEA0183, or Seatalk formats.

If more than one data type is present at the inputs, a system priority has been established in the radar's software to respond to inputs in driving the features. The assigned priorities are set in this manner:

HEADING:	1. Flux Sensor (NMEA 0183 "HDM, HDT, HSC" sentences) 2. Seatalk Data (Heading via Autopilot compass) 3. Navaid Data (NMEA 0183 "RMC, RMA, VTG" sentences)
POSITION:	1. Seatalk Data 2. Navaid Data (NMEA0183 "RMC, RMA, GLL, GTD" sentences)
SPEED:	1. Navaid Data (NMEA 0183 "RMC, RMA, VTG, VHW" sentences)
WAYPOINT:	1. Seatalk Data 2. Navaid Data (NMEA0183 "RMB, BWC" sentences)
SEATALK:	1. Seatalk data only

The Navaid input is connected at J401 pin 3 and 4, and the Heading data input from flux sensor is connected at J403 pin 3 and 4 with +12V DC for flux sensor at pin 1 (GND) and 2 (+12V DC). The Seatalk bus provides two-way communication of navigation data between units connected to the bus.

The RL9 radar can receive various data for the Seatalk pages display. Seatalk data input is connected at J403 pin 5, 6 and 7 and received by Seatalk CPU. The Seatalk CPU converts the Seatalk format data to NMEA sentences and then send to the Main CPU system.

The Raychart video and sync. signals are connected at J404 and fed to the LCD unit via Interface PCB.

When the Raychart sync. signal appears on the interface circuit, the interface circuit generates the switch control signal and switch the data for LCD unit from the radar to the Raychart.

SECTION 5

MAINTENANCE

5.1 GENERAL

The purpose of this section is to provide servicing instructions to the service technician. The RL9 Radar is designed to provide long periods of trouble-free operation, however it is recognized that environmental and other factors may result in a need for occasional service.

> **Warning**
>
> This radar equipment contains high voltage. Adjustments require specialized service procedures and tools only available to qualified service technicians, and there are no user servicable parts or adjustments. The operator never should remove the radar unit cover nor attempt to service this equipment. When servicing this equipment, it is important that you comply with all safety precautions set forth in this manual.

5.1.1 PRODUCT AND CUSTOMER SERVICE

In the event that your RL9 LCD Radar is in need of service, the dealer from whom the Radar was purchased, or an authorized Raytheon dealer should be contacted for assistance. The authorized Raytheon dealer is best equipped to handle your inquiries. If, after contacting your dealer, you have further questions and require further assistance, you may contact Raytheon Marine Company directly at the following numbers:

Customer Service: (603) 647-7530 Ext. 2333

Phone calls to this department should deal primarily with questions regarding: Authorized Raytheon dealer locations, basic product information and brochure/literature requests.

Product Support: (603) 647-7530 Ext. 2444

Phone calls made to this department should deal primarily with the operation and technical aspects of Raytheon Marine equipment. Please contact your dealer in advance.

When calling the above numbers, your phone call will be placed in a queue and will be answered in the order in which it was received.

The normal operating hours for this system are from 8:00 am - 5:00 pm Eastern Standard Time.

> **WARNING**
>
> A mechanical hazard exists from internal rotating gears of these antenna systems. Use extreme caution when working on or around these antenna systems. Always turn off the radar power at the main breaker panel before attempting any work on the antenna system.

5.2 PREVENTIVE MAINTENANCE

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

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

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

5.2.1 HIGH VOLTAGE ARC PREVENTION

High voltage components within the MTR Assembly and the Display must be kept clear and dust free to prevent the possibility of HV arcing. Diesel soot and dirt should be removed with a sash brush and dry cloth.

5.2.2 CLEANING (MONTHLY INTERVALS)

Wash the exterior of the radome with fresh water. Clean the face of the Display Unit with a clean, soft, lint-free cloth slightly dampened with fresh water.

5.2.3 LUBRICATION

Radome should be lubricated as follows approximately every 6 months.
Radome Lubrication (Semi-Annual Intervals)

1. De-energize equipment at the main breaker panel.
2. Remove radome cover and clean up the old lubrication and any dirt or residue located on the main drive gear.
3. Apply a general bearing grease compound (Moly Kote 33 RMC P/N 98155-1) using an appropriate applicator, to the main drive gear. The main drive gear consists of the main shaft and drive motor gears.
4. Operate the radar system in order to verify proper operation.

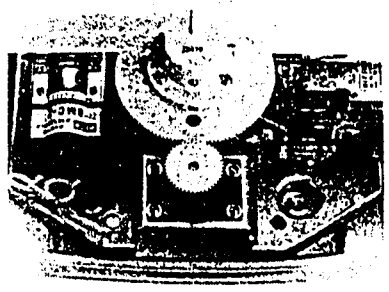


FIG. 5-1 RADOME LUBRICATION

5.2.4 CONNECTOR MAINTENANCE (SEMI-ANNUAL INTERVALS OR AS REQUIRED)

During installation and maintenance, it is recommended that Dow Corning Compound #4 silicone grease (RMC P/N 230-1014P5) be inserted inside the power and control cable connectors on the rear of the display unit. This silicone grease is an insulator and may be used to protect RF, power, and control connector pins from the corrosive effects of the marine environment.

Carefully squeeze a small amount of DC-4 compound inside the connector on the pins. Do not fill the entire connector cavity. When the connector is installed, the DC-4 compound seals out the air preventing any possibility of pin corrosion.

CAUTION

Never use RTV or Silicone Sealant within electrical connectors. DC-4 compound is specifically designed for this purpose.

5.2.5 GASKET MAINTENANCE (SEMI-ANNUAL INTERVALS)

Every 6 months the Display and Pedestal gaskets should be carefully lubricated, using silicone grease (Dow Corning #4 RMC P/N 230-1014P5). The 2 primary locations to lubricate with this grease are shown below.

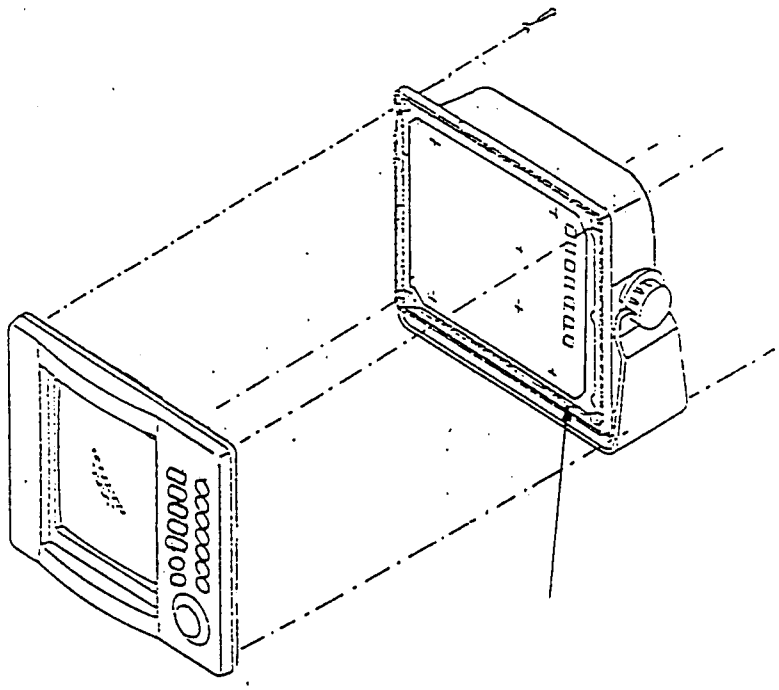


FIG. 5-2 GASKET LOCATION, DISPLAY UNIT

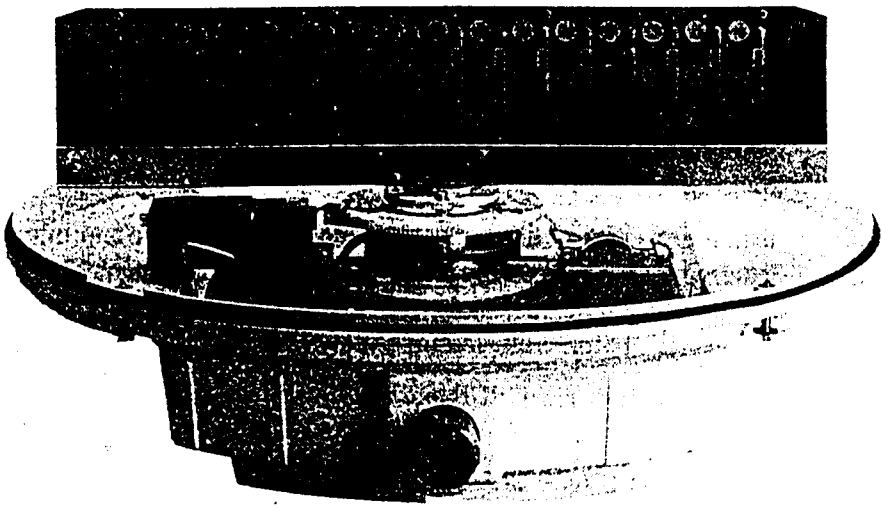


FIG. 5-3 LUBRICATION LOCATING RADOME

5.2.6 BATTERY CHECK (CMC-806, 807) (EVERY 2 YEARS)

The Lithium Battery (BT1) on the Main Control PCB (CMC-806, 807) should be checked every 2 years or as required and replaced when the voltage reaches 2.00 Vdc. The purpose of this onboard battery is to maintain certain memory functions such as the hour meter, last position of Range Rings, EBLs, VRMs, initial settings etc., when the radar is switched off. If the Display Unit does not return to the functions in use (i.e., Range, Range Rings, EBLs, VRMs, etc.) when the unit was turned off, then the Lithium Battery (BT1) should be replaced per the following procedures.

1. De-energize the radar equipment by securing the input power to the Display Unit.
2. Remove the Display Unit interconnect cable and power cable.
3. Remove the Display Unit rear cover (4 screws) and the Main Control PCB (CMC-806) from the chassis (6 screws).
4. With soldering iron and de-soldering tool remove battery BT1 from the Main control PCB. Use caution not to short out battery leads.
5. Install replacement lithium battery (P/N 5ZBAD00096) noting proper battery polarity. Check that battery voltage is greater than 3.00 Vdc. If less than 2.50 Vdc, the battery may be used but should be replaced with new battery before voltage drops below 2.00 Vdc.
6. Replace Main Control PCB and rear cover.

5.2.7 LCD FILTER SURFACE CLEANING

The surface of the LCD FILTER may, in time, accumulate a film of contaminants which tends to dim the picture.

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

5.2.8 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. Replace the 3.15A power cable fuse if necessary.

5.3 OPERATIONAL CHECKOUT

Activate the power circuits to the radar and switch the radar into standby (STBY). During warm up the time will count down to zero. After approximately 90 seconds "PUSH XMIT TO OPERATE" should appear on the LCD.

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

Press the STBY/XMIT switch to "XMIT" and observe the presence of radar targets on the screen. Check the Range selection keys for correct range scale selection.

Operate the CONT/DIM key. Check the picture contrast level operation.

After approximately 10 minutes of operation, check the TUNE control for maximum target returns occurring at the center of the TUNE control range (UNLESS IN AUTO TUNE).

If readjustment is required, follow the instructions for tuning alignment in section 5.3.1 Post Installation set up Adjustments.

5.3.1 POST INSTALLATION SET UP ADJUSTMENTS

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

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

Other adjustments are:

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

5.3.2 TROUBLE-SHOOTING GUIDE

While the RL9 Radars are highly reliable systems, early signs and detection of component fatigue can sometimes be spotted during regular operational checks.

When a problem is observed, corrective service should be arranged to avoid failure at critical times at sea. In some cases, problems may be cleared by a system master reset.

5.3.3 MASTER RESET

The first step in attempting to clear any problem associated with the general operation of this Radar is to perform a MASTER RESET. This can be done by starting with the radar turned OFF. Press and hold the [GUARD] key, and while holding the key, press the [STBY/XMIT] key to put the radar to standby. This should be performed anytime a component or PCB within the Radar is replaced. This function will clear the Radar's Ram memory and will return the radar to its factory settings.

It should be noted that micro-components within the Radar are generally not field replaceable, therefore, most repairs to the radar typically go to the PC board level only. A replacements parts list for the RL9 system can be found in Section 6.

> **CAUTION:**
> In making any measurements or other checks, be alert to the high voltage points existing throughout the equipment.

5.4 ALIGNMENTS AND SERVICE

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

The alignments detailed in paragraphs 5.4.2.2 (A) through 5.4.2.2 (E) should normally be accomplished when the radar is installed and/or when necessary.

Replacement Item	Adjustment Required	See Sect. #
Magnetron V201	Tuning	5.4.2.2 C)
MIC Frontend E301	Tuning	5.4.2.2 C)
SHM Unit	Bearing Alignment	5.4.2.2 A)

5.4.1 ANTENNA RECEIVER ALIGNMENTS

The antenna receiver alignments should be serviced by a qualified technician. The following technical information is include in this manual for the assistance of the technician making the antenna receiver alignment adjustments.

5.4.1.1 RECEIVER GAIN ADJUSTMENTS

This adjustment sets the sensitivity level of the Receiver on Receiver/ Modulator PCB CNM-179.

1. Set the Radar Display unit controls as follows:
   GAIN - MAX
   RAIN CL - MIN
   SEA CL - MIN
   MODE - STBY

2. Connect an oscilloscope probe on TP5 and adjust RV1 for a reading of 2 VPP white noise level.

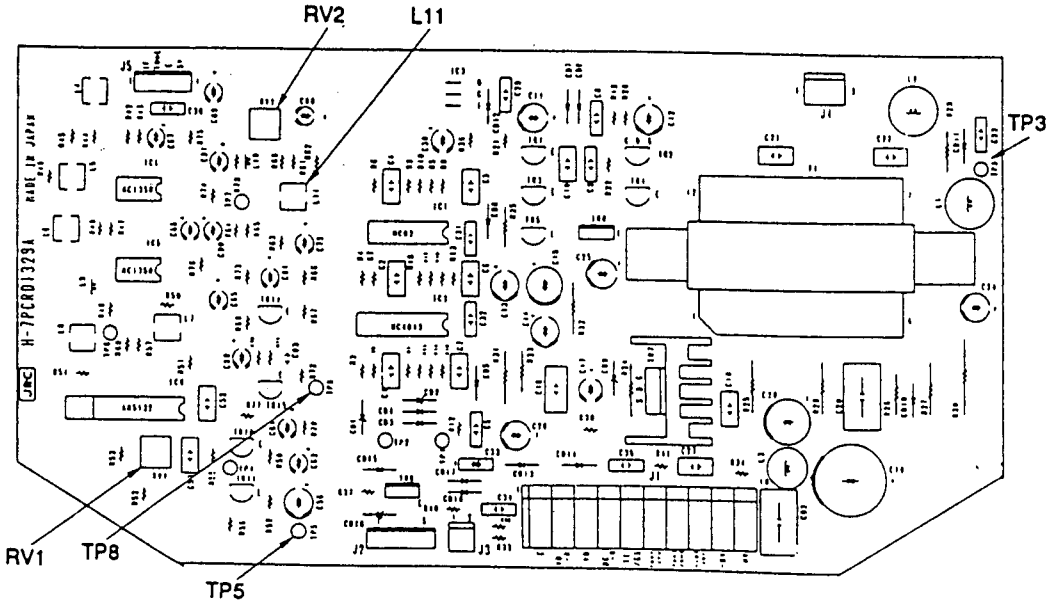


FIG. 5-4 RECEIVER COMPONENT LOCATIONS

NOTE

Do NOT adjust or attempt to adjust L4 thru L8. These are factory adjustments only.

5.4.1.2 TUNE INDICATOR ADJUSTMENT

This adjustment matches the maximum tuning peak of Radar Video with the maximum tune bar deflection on the display. If both agree, this adjustment is not required.

1. Connect a voltmeter to TP8 on the Receiver PCB (CNM-179).

2. While in 3 nm or above, place the Radar in X-MIT and adjust the front panel TUNE control as maximum echoes are obtained. It may be necessary to adjust the Initial Setting Menu "Tune Preset".

3. Adjust (L11) on the Receiver PCB (CNM-179) for a minimum voltage reading.

4. Adjust RV2 for a voltage reading of +2.0 VDC.

5.4.1.3 FACTORY ADJUSTMENTS

It is important to note that the tuning coils located on the Receiver PCB are primarily used to adjust for proper operation. These components set the IF Amplifier 60 MHz bandwidth and general receiver sensitivity.

These adjustments require specialized test equipment and may be performed only at the factory. These adjustments should not be performed in the field.

5.4.2 DISPLAY ALIGNMENTS

HIGH VOLTAGE WARNING

Only qualified licensed service technicians should remove the equipment covers and service this equipment. This equipment contains High Voltage and requires specialized service procedures and tools only available to qualified licensed service technicians.

When aligning this equipment, all standard safety precautions must be followed.

The following display alignment procedures are to be performed after corrective maintenance to assure proper operation or at any time system performance is not as specified.

Remove the 4 phillips head screws at the rear of the Display Unit to remove the rear cover.

Figure 5-5 details the Power Supply PCB adjustment. Then remove 6 screws of the main control PCB to remove it.

5.4.2.1 DISPLAY AVR VOLTAGE ADJUSTMENT

The following adjustment correctly sets the values of the output voltages on the Display Power Supply PCB (CBD-1245). Refer to Figure 5-5 below while performing these adjustments.

1. Place a DVM positive lead to CD9 cathode and negative lead to ground.
2. Adjust RV1 so that reading on DVM is +12V ±0.5V DC.

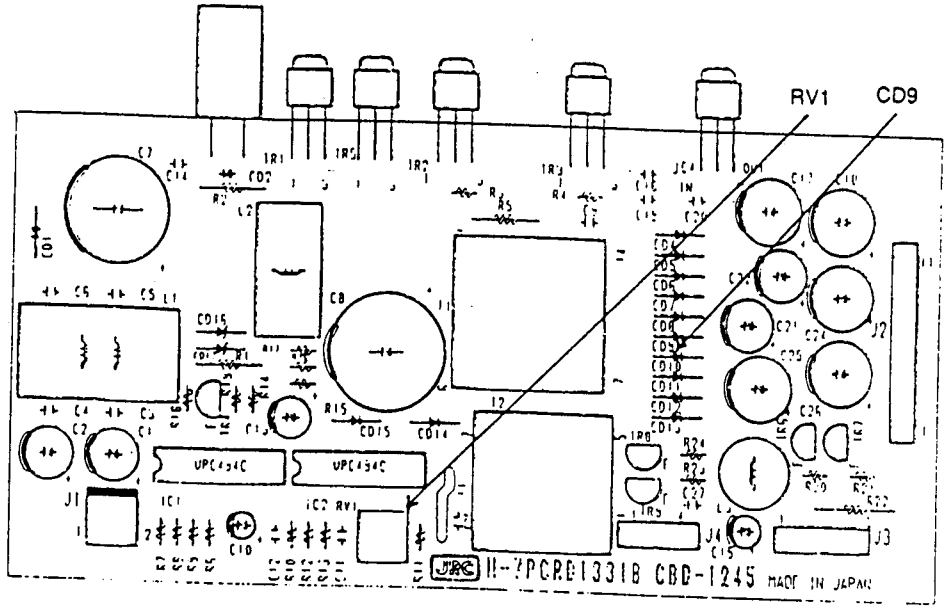
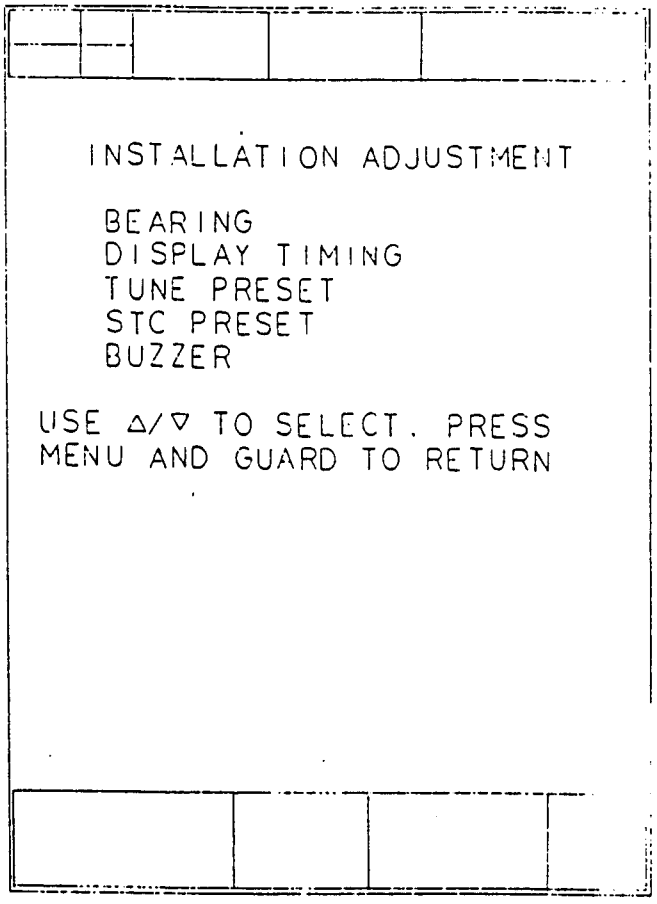


FIG. 5-5 POWER SUPPLY (CBD-1245) TEST POINT AND ADJUSTMENT LOCATIONS

5.4.2.2 DISPLAY MENU ALIGNMENTS

Access to these adjustments is made by pressing MENU and GUARD keys at the same time. This activates the installation adjustment menu when you are in the xmit mode.



POST INSTALLATION SET UP ADJUSTMENTS

A) BEARING

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

Proceed as follows:

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

② Use an accurate visual means to establish the relative bearing to the target (lining up bow of the vessel to the target is the easiest method.)

③ Put the EBL marker on the target and measure the bearing.
④ Open the Installation Adjustment Menu by pressing [MENU] and [GUARD] key at same time.
⑤ Select "BEARING" by using [◀] [▶] keys and enter the mode by pressing [MENU] and [GUARD] key at same time. At this time, display prompt reads: BEARING ADJUSTMENT MODE PUT EBL ON THE TARGET w/◀/▶ PRESS MENU
⑥ Put the EBL on the target measured at ③, and press [MENU] key. The display prompt changes: SET EBL W/◀/▶ FOR CORRECT BEARING PRESS MENU TO END
⑦ Set the EBL for the correct bearing of the selected target to within ±1 degree.
⑧ Press the [MENU] key to end the BEARING ADJUSTMENT MODE.

B) DISPLAY TIMING

It is necessary to ensure targets are at their proper range on the display unit. Incorrect timing is mostly noticed on the .125 nm or .250 nm range scales. Targets, such as bridges or piers will be bent or bowed. To adjust for correct timing perform the following steps:

① Set the range at 0.125 nm.
② Locate a straight dock, seawall or bridge on the display. Observe whether the radar target is straight on the display. If not, adjustment is required.
③ Access the Installation Adjustment Menu by pressing [MENU] and [GUARD] keys at same time. Select "DISPLAY TIMING" by using [▼] [▲] keys and enter the mode by pressing [MENU] and [GUARD] keys at same time. The display message prompt reads: DISPLAY TIMING ADJUST MODE ADJUST W/▲ / ▼ PRESS MENU TO END
Adjust the display timing with [▲] [▼] keys so that the object appears to be straight on the display. When the timing is correct, press the [MENU] key to end the DISPLAY TIMING ADJUSTMENT MODE.

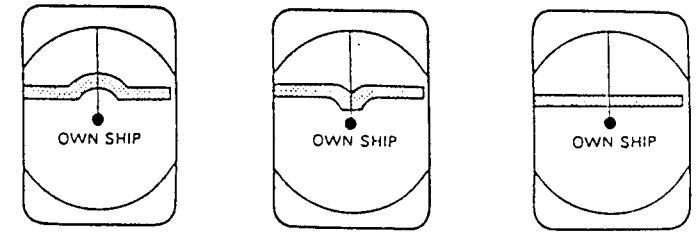


FIG. 5-6 DISPLAY TIMING ADJUSTMENT

The remaining adjustments affect operating conditions that are normally set at the factory and typically will not require any further adjustments. However, these settings should be checked at installation so that optimum operation will be realized. They are printed here for convenience should some adjustment be necessary:

C) TUNE PRESET

Normal tuning of the radar should be indicated on the Radar Display by seeing maximum target returns when the "TUNE" control is at its "mid" control range.

If, after about 10 minutes of operation, the tune bar is oriented towards one end or its range for video peak, perform the following steps:

① Set radar to 3 nm range scale or above.
② Set GAIN control for normal gain level.
③ Set SEA, RAIN, IR to "OFF".
④ Access the Installation Adjustment Menu and select "TUNE PRESET". The display message prompt reads: TUNE PRESET ADJUST MODE ADJUST W/▲/▼ PRESS MENU TO END. Adjust the radar tuning with [▲] [▼] keys carefully to see maximum targets on the display. When maximum targets are visible, press the MENU key to end the TUNE PRESET ADJUSTMENT MODE.

D) STC PRESET

The STC Preset controls how far in range the STC gain reduction should be effective. Typically the suppression is visible to approximately 4 NM. To change this setting perform the following.

① To check the operation Set Range to 12 nm.
② Set the Gain to maximum setting by pressing the right side of the [GAIN] key.
③ If STC adjustment is desired, Open the Installation Adjustment Menu and select "STC PRESET". At this time, display prompt reads: STC PRESET ADJUST MODE ADJUST W/▲/▼ PRESS MENU TO END. Adjust STC with [▲] [▼] keys so that no background noise appears in the range of 0 to 4 nm. In some conditions the STC action range may be extended even further to compensate for severe sea states. Press the MENU key to end the STC PRESET ADJUSTMENT MODE.

E) BUZZER

At the time of shipment, the Buzzer Volume has been adjusted to the maximum volume position. If it is necessary to lower the volume level, open the Installation Adjustment Menu and select "BUZZER". The display prompt reads: BUZZER ADJUST MODE ADJUST W/▲/▼ PRESS MENU TO END. Adjust with [▲] [▼] keys listening to the beep level. When the desired volume is achieved, press the MENU key to end.

5.4.3 FAULT FINDING PROCEDURES

Often the display on the LCD 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 5-1).

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 5-1 is the trouble shooting guide and check-out procedure, TABLE 5-2 shows typical voltages and resistances at significant points throughout the equipment. The internal resistance of the voltmeter used in these measurements was 20 kΩ/V dc, 8kΩ/V ac.

TABLE 5-1 TROUBLE SHOOTING GUIDE

	Trouble	Remedy
1.	Does not start at OPERATE switch to STBY.	Check: Blown fuse at in-line power cable Check input power circuits. Faults of contact at J401. Faults of power supply circuit on PC2. Faults of contact on connector of PC2. Faults of rectifier diodes on PC2.
2.	Scanner fails to rotate.	Check: Fault on contact on terminal boards. Fault of M101. Fault of drive mechanism.
3.	Scanner rotates but rotation of sweep is abnormal.	Fault of connection between M101 Check: Fault of encoder (BP) Fault of main circuit for the Display Unit.
4.	No picture on the screen.	Fault of LCD display unit and drivers or its supply voltages. Check: Fault of contact on LCD connector. Fault of contact on J3 connector. Fault of video circuit.
5.	Range rings on the screen but no noise and no echoes.	Fault circuit between IF amplifier of receiver unit and input circuit of display unit video amplifier. Check: Fault of GAIN, STC control settings. Fault of receiver unit. Fault of contact on terminal boards and connector.

	Trouble	Remedy
6.	Noise and range on the screen but no echoes.	If no transmission is present, check the modulator PCB and magnetron. Check: If transmission appears to be present as indicated by the correct MAG. I reading on Tester. CNM-179 TP3 - 11 VDC. Failure of Local Oscillator tuning Fault of the MIC Mixer. If no transmission is present, whether the lead wire to magnetron is grounded to chassis. Fault of magnetron.
7.	Poor sensitivity Dim Echoes.	Check: Reduction of transmitting output power. Fault of magnetron. Check of MAG. I reading on CNM-179 TP3. Fault of MIC Frontend. Fault of LCD drivers. Fault of video amplifier circuit on CMC-806, 807 (Main Circuit) Fault of receiver unit. Failure of Contrast adjustment.
8.	No VRM or VRM cannot be controlled	Check: Fault of main circuit (CMC-806, 807)
9.	NO EBL or EBL cannot be controlled	Check: Fault of main circuit (CMC-806, 807).
10.	No alarm zone marker, cannot be controlled or no alarm sound.	Check: Fault of main circuit (CMC-806, 807) Fault of Buzzer BZ1.

TABLE 5-2

RL9 RADAR (With Interunit Cable connected)

Measuring point	Resistance (Ω)	Voltage (V)			Remarks
		0.125, 0.25, 0.5, 0.75(nm)	1.0, 1.5 (nm)	3, 6, 12, 16 (nm)	
J1- 1 GND	0	0	0	0	
2 VD-R	0	0	0	0	
3 VD	5.5 × 10	-0.07	-0.07	-0.07	0.25V
4 DC-R	0	0	0	0	
5 TI/GS	18 × 10	-0.19	-0.077	-0.05	0.25V
6 TUNV/PW	70 × 10	15	15	15	50V
7 TUN1/SHM	175 × 10	3.6	1.2	0.7	10 V
8 +12/BP	9 × 10	11	11	11	50V
9 -8V	8 × 1	-7.8	-7.7	-7.6	10V
10 HV	16 × 10	238	235	232	250V

ANTENNA UNIT

Measuring point	Resistance (Ω)
J1- 1	0
2	0
3	∞
4	0
5	22 × 100
6	∞
7	43. × 100
8	12.5 × 10
9	9.5 × 1
10	16 × 10

DISPLAY UNIT

Measuring point	Resistance (Ω)
J402- 1	15 × 1K
2	0
3	70 × 10
4	5.5 × 10
5	0
6	0
7	18.5 × 10
8	73 × 10
9	77 × 100
10	9.4 × 10

SECTION 6

PARTS LIST AND DRAWINGS

INTRODUCTION

This chapter contains, assembly drawings and parts lists for Radar Set RL9. Assembly drawings will assist in identifying and locating components. Find numbers on the drawings are the same as location numbers in the parts list tables.

WARNING

This radar equipment contains high voltage.
Adjustments require specialized service procedures and tools only available to qualified service technicians, and there are no user servicable parts or adjustments. The operator never should remove the radar unit covers nor attempt to service this equipment.

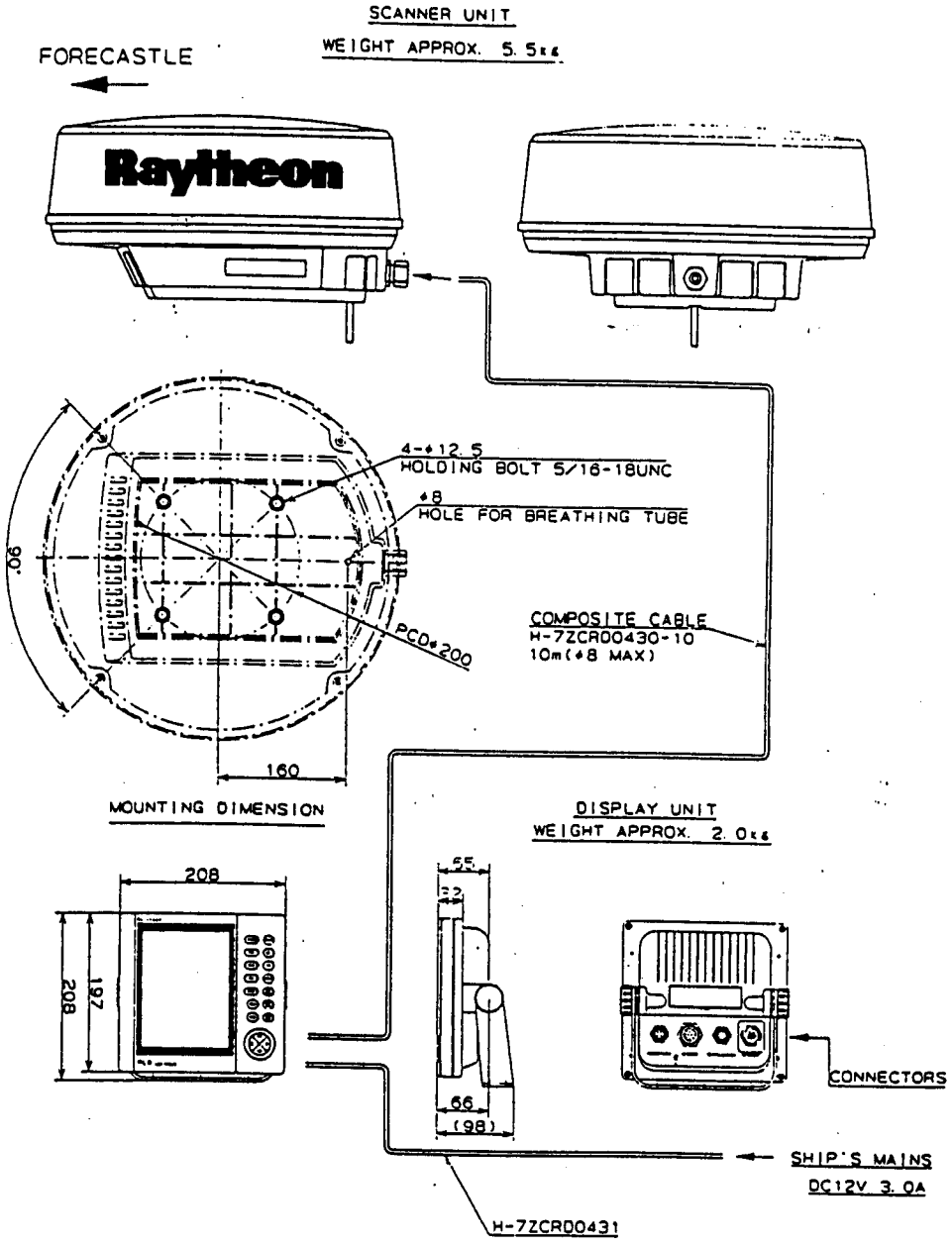


FIG. 6-1 RL9 RADAR SYSTEM

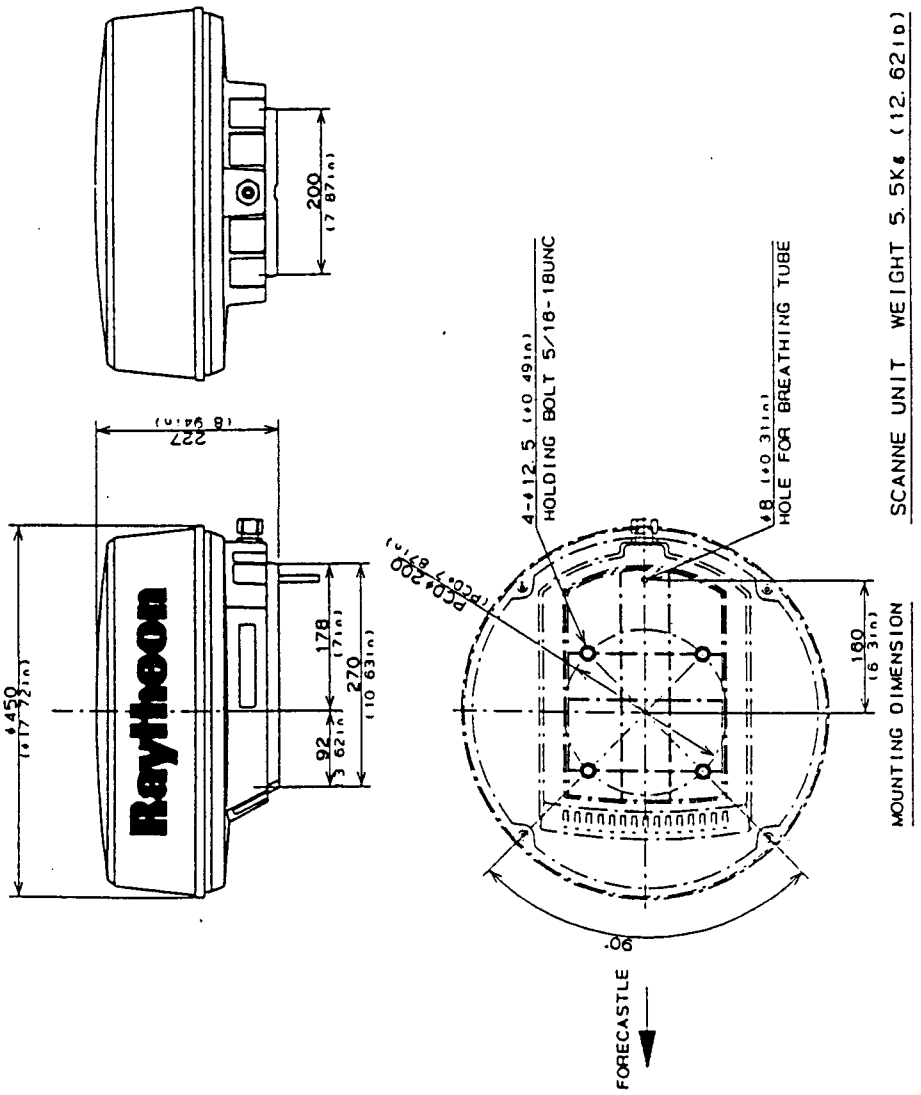


FIG. 6-2 RL9 RADOME UNIT

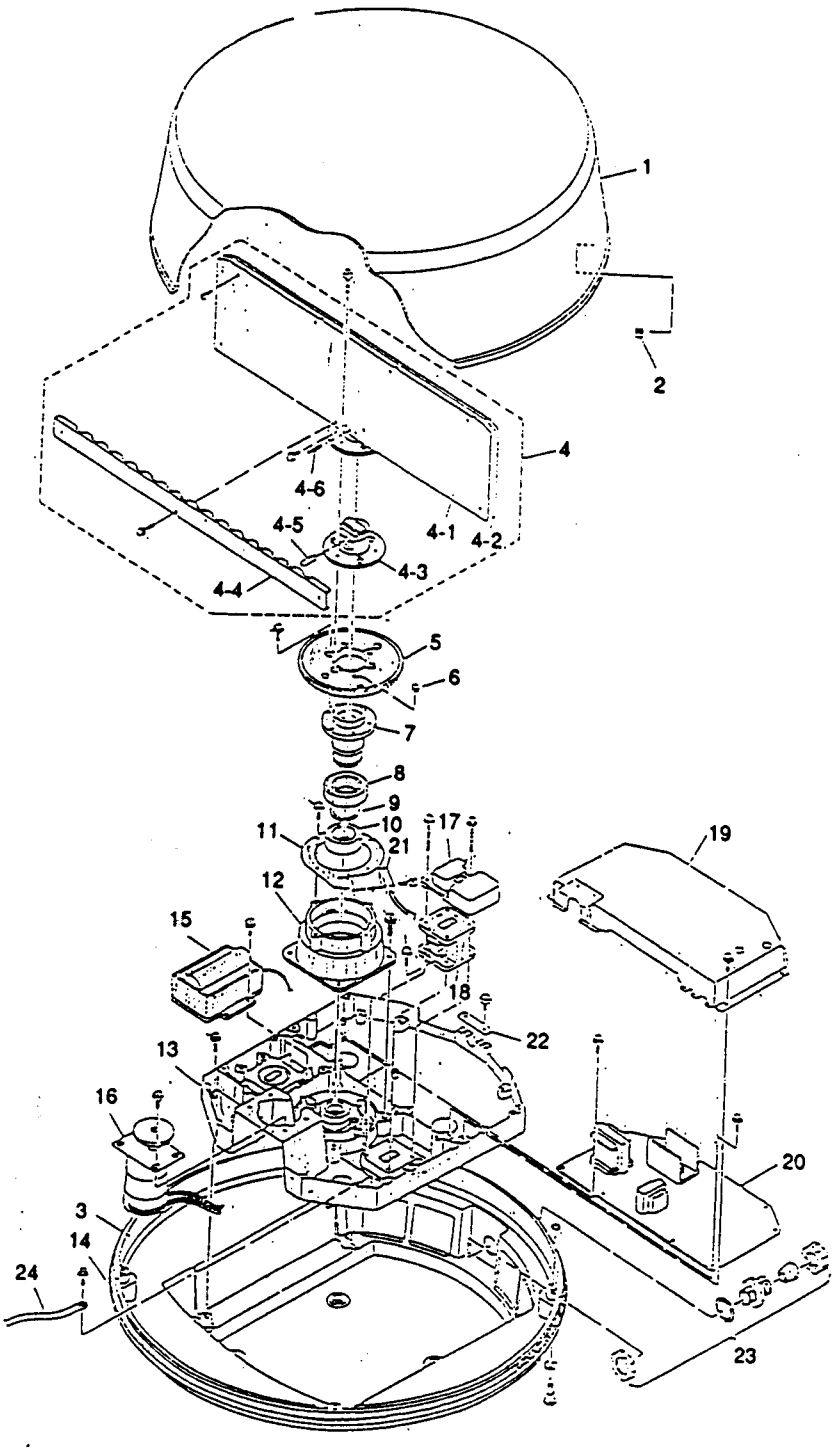
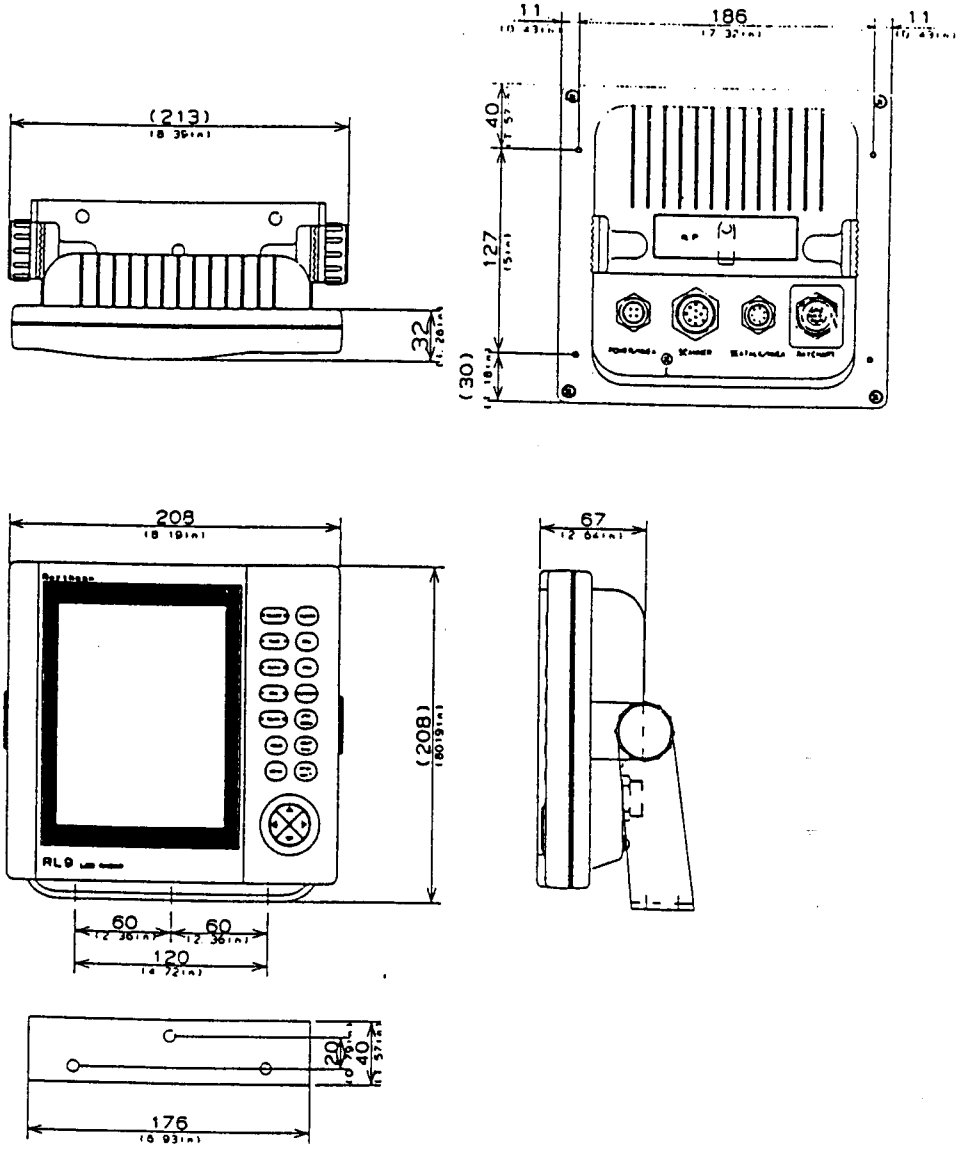


FIG. 6-4 ASSEMBLY DRAWING, RL9 RADOME SCANNER

TABLE 6-1
PARTS LIST
RADOME M52559

LOCATION	DESCRIPTION	SYMBOL	JRC P/N	RAYTHEON P/N
1	UPPER RADOME		MPBX17317	
2	NUT		MTLO3810A	
3	LOWER RADOME		MTV002343	
4	ANTENNA ASSY			
4-1	PCB, RADIATOR	PC101	MPAE00501	
5	GEAR		MTV002340	
6	MAGNET	MT101	5MPAB0001	
7	ROTARY JOINT		MPAB30298	
8	BEARING		BRGK01325	
9	O-RING		BRTG01192	
10	BEARING		BRGK01324	
11	PLATE, RETAINING		MTB144765	
12	HOUSING		MTC002285	
13	CHASSIS		MTC002283	
14	PACKING, RUBBER		MTT020323	
15	MAGNETRON	V-201	RMC-2	
16	MOTOR ASSY	M101	7BDRD0023	
17	MIC	E-301	NJT-1949	
18	DIODE LIMITTER	A-101	NJS-6933	
19	COVER, SHIELD		MTD300529	
20	PCB		MTC003326	
21	SHM SWITCH	S101	5KRAA00036	
22	PLATE RETAINING		MTC003327	
23	GLAND		BRJD05012	
24	ROPE		MPXP30478	



DISPLAY WEIGHT: 1.8Kg (4.13lb)
DIMENSIONS SHOWN IN MILLIMETERS AND INCHES

FIG. 6-5 RL9 DISPLAY UNIT

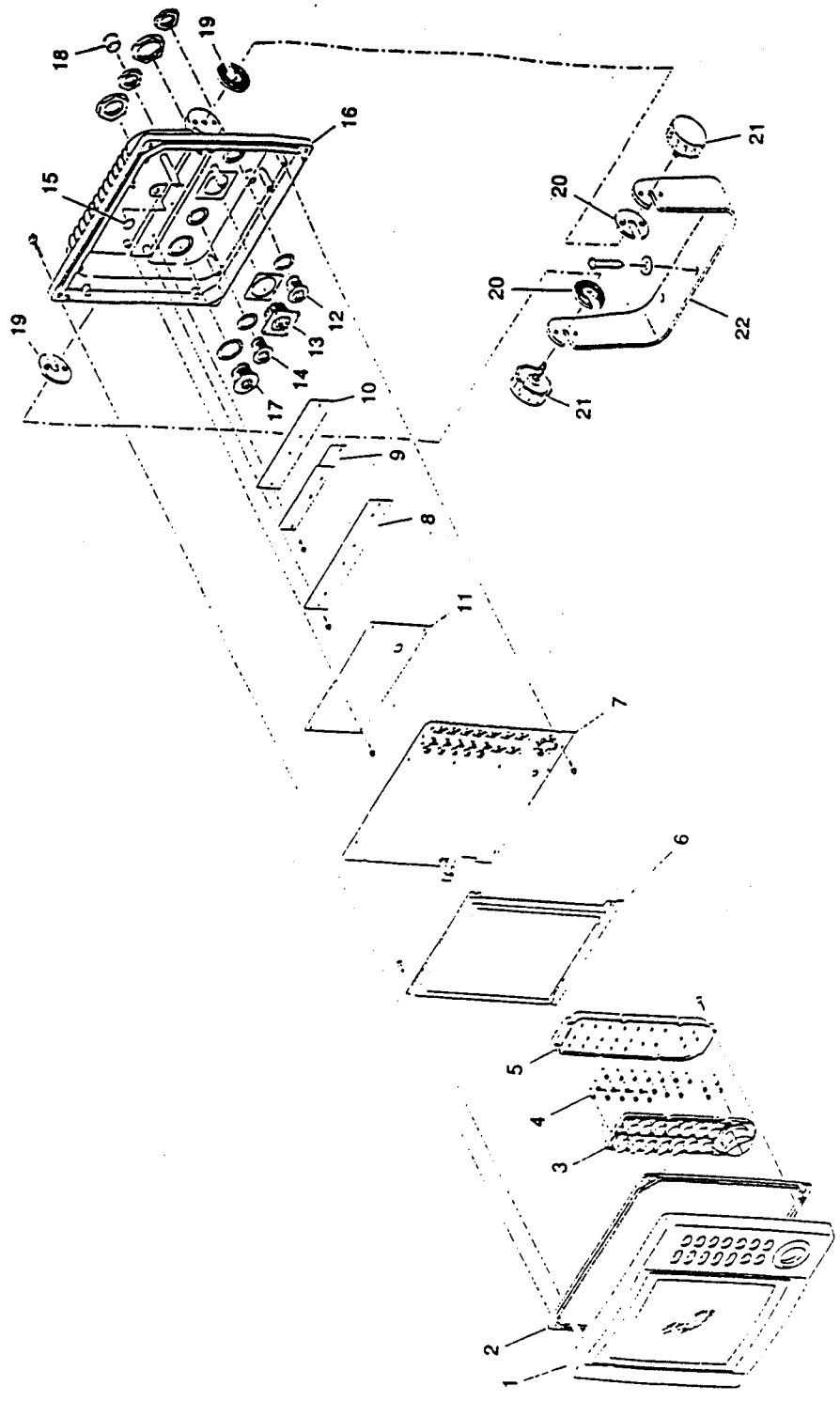


FIG. 6-7 ASSEMBLY DRAWING, RL9 DISPLAY UNIT

TABLE 6-2
PARTS LIST
DISPLAY UNIT M92558/M92585

LOCATION	DESCRIPTION	SYMBOL	JRC P/N	RAYTHEON P/N
1	BEZEL ASSY		MPBC31457	
2	PACKING, RUBBER		MTV301088	
3	RUBBER KEY		MTV301089	
4	SWITCH PIN		MTV301090	
5	LIGHT GUIDE		MTV301091	
6	LCD PANEL	A401	5EZCB00012	
7	PCB, MAIN		CMC-806 (STD)	
			CMC-807 (W/SEATALK)	
8	PCB, RAY CHART I/F (OPTION)		CMC-1322	
9	PLATE, RETAINING		MTB317496	
10	SHEET, INSULATION		7ZLRD00023	
11	PCB, POWER SUPPLY		CBD-1245	
12	CONNECTOR, POWER/NMEA	J401	5JWHZ00051	
13	CONNECTOR, SCANNER	J402	5JWHZ00054	
14	CONNECTOR, SEATALK/NMEA	J403	5JWHZ00009	
15	SHEET, BREATHING		MPXP30479	
16	CABINET		MTC300296	
17	CONNECTOR, RAYCHART (OPTION)	J404	5JWHZ00001	
18	CAP		MPKP30005	
19	WASHER, SERRATION		MTV301092	
20	WASHER, SERRATION		MTV301093	
21	KNOB		MPTG30053	
22	BRACKET		MTD300530	
	WIRE HARNESS	W1	7ZCRD0432	
	WIRE HARNESS	W2	7ZCRD0433	
	WIRE HARNESS	W3	7ZCRD0434	
	WIRE HARNESS	W4	7ZCRD0435	
	WIRE HARNESS	W5	7ZCRD0436	
	WIRE HARNESS	W6	7ZCRD0437	
	WIRE HARNESS (OPTION)	W8	7ZCRD0439	
	WIRE HARNESS (OPTION)	W9	7ZCRD0440	