

FURUNO

OPERATOR'S MANUAL

MARINE RADAR

MODEL MODEL 1621



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FIRST EDITION : FEB 1993
G : APR. 26, 1995

(CHINA) PUB. No. OME-33780
MODEL 1621



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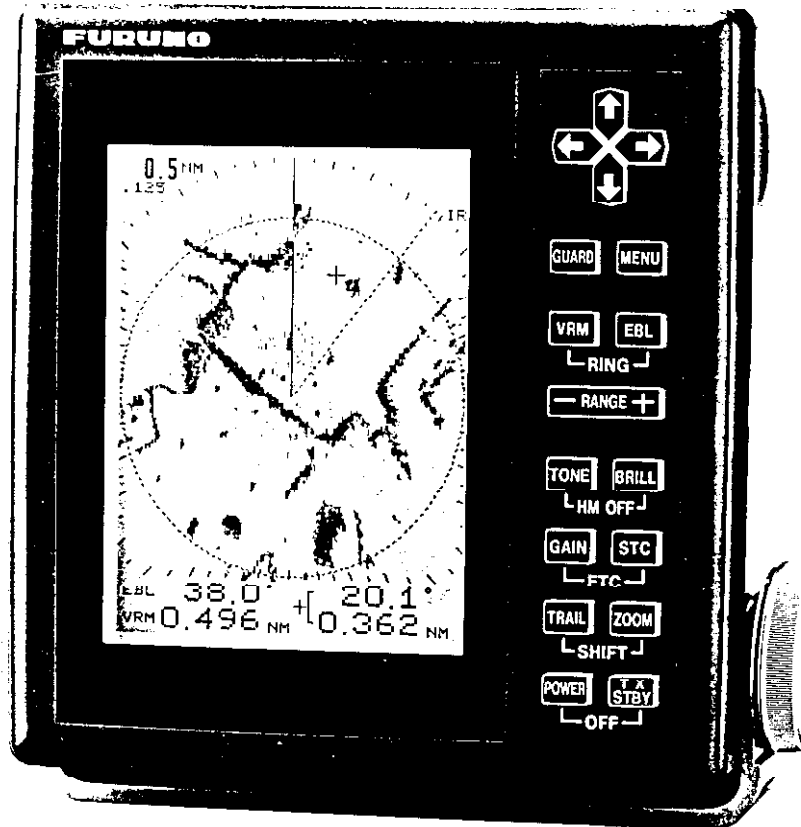
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MODEL 1621 Display Unit

FOREWORD

Congratulations on your choice of the FURUNO MODEL 1621 Marine Radar. We are confident you will see why the FURUNO name has become synonymous with quality and reliability.

For over 40 years FURUNO Electric Company has enjoyed an enviable reputation for innovative and dependable marine electronics equipment. This dedication to excellence is furthered by our extensive global network of agents and dealers.

Your radar is designed and constructed to meet the rigorous demands of the marine environment. However, no machine can perform its intended function unless properly installed and maintained. Please carefully read and follow the installation, operation and maintenance procedures set forth in this manual.

While this unit is generally easy to install by following the enclosed installation instructions, any purchaser who has doubts about his or her technical abilities may wish to have this unit installed by a FURUNO representative or other qualified technician.

We would appreciate hearing from you, the end-user, about whether we are achieving our purposes.

Thank you for considering and purchasing FURUNO equipment.

General Safety Information

Be sure to read all the safety information which follows before attempting to install, operate or maintain your radar.

“DANGER” and “CAUTION” notices appear throughout this manual. It is the responsibility of the user of this equipment to read, understand and follow these notices. If you have any questions regarding these safety instructions, please contact a FURUNO agent or dealer.

Operating Precautions

Navigation is a complex and detailed skill which requires knowledge, judgment and experience to perform effectively. Errors in navigation can lead to catastrophic injury or even death in some circumstances.

No single navigational aid (including this radar) should ever be relied upon as the exclusive method for navigating your vessel. The navigator is responsible for checking all aids available to confirm his position. Electronic aids are meant to assist (not replace) the navigator.

Features

Your radar has a large variety of functions, all contained in a remarkably small cabinet.

The main features of the MODEL 1621 are:

- Traditional FURUNO reliability and quality in a compact, lightweight and low-cost radar.
- Smartly styled, lightweight and compact radome antenna with precision 34 centimeter radiator.
- Durable brushless scanner motor.
- High definition 6" LCD raster-scan display.
- Targets can be displayed in black on white background or vice versa for optimal viewing under any lighting.
- On-screen alphanumeric readout of all operational information.
- Standard features include EBL (Electronic Bearing Line), VRM (Variable Range Marker), Guard Alarm, Display Shift, and Zoom.
- Echo trail simulates movement of radar targets.
- Watchman feature periodically transmits the radar to check for radar targets which may be entering (or exiting) the alarm zone.
- Operates on 10.2 V to 31.2 V DC power supply and consumes only 30 W.
- Economy mode reduces power consumption to 8 W maximum during stand-by periods.
- Ship's position in latitude and longitude (or Loran C Time Differences), range and bearing to a waypoint, ship's speed, heading and course can be shown in the bottom text area. (A navigation aid which can output such data in NMEA 0183 or FURUNO CIF format required.)

SPECIFICATIONS

SCANNER UNIT

Radiator	Parabola
Radiator Length	34 cm
Horizontal Beamwidth	6.2°
Vertical Beamwidth	30°
Sidelobe	less than -20 dB
Polarization	Horizontal
Antenna Rotation Speed	24 rpm nominal
Wind Resistance	Relative wind speed 51.5 m/s (100 kts)

TRANSCEIVER MODULE (contained in radome)

Transmitting Tube	Magnetron E3554, L, or MG5353
Frequency & Modulation	9410 MHz \pm 30 MHz, P0N (X band)
Peak Output Power	1.5 kW nominal

Pulselength & Pulse Repetition Rate

Item	Range (nm)										
	0.25	0.5	0.75	1	1.5	2	3	4	6	8	
Pulselength	0.12 μ s (Short)			0.3 μ s (Mid)			0.8 μ s (Long)				
Pulse Repetition Rate	Approx. 2100 Hz			Approx. 1200 Hz			Approx. 600 Hz				

Warm-up Time	1 min 30 sec
Modulator	FET switching method
I. F.	60 MHz

SPECIFICATIONS

Tuning	Automatic
Receiver Front End	MIC (Microwave IC)
Bandwidth	7 MHz
Duplexer	Circulator with diode limiter

DISPLAY UNIT

Indication System	PPI raster scan
Display (device)	6-inch diagonal LCD, STN semi-transparent, yellow mode

Range (nm)	0.25	0.5	0.75	1	1.5	2	3	4	6	8
Range Ring Interval (nm)	0.125	0.125	0.25	0.25	0.5	0.5	1	1	2	2
Number of Rings	2	4	3	4	3	4	3	4	3	4

Bearing Resolution	6.2°
Bearing Accuracy	Better than 1°
Range Discrimination	Better than 25 m
Range Ring Accuracy and Discrimination	0.9% of range in use or 8 m, whichever is larger
Minimum Range	Better than 37 m
Mark Indication	Heading Mark, Bearing Scale, Range Ring, VRM, EBL, Tuning Bar, Alarm Zone, Cursor, Waypoint (option)
Numeral/Character Indication	<p><u>Standard</u></p> <p>Electronic Bearing Line (EBL), Echo Stretch (ES), Rain Clutter Rejection (FTC), Alarm (GUARD), Interference Rejection (IR), Stand-by (ST-BY), Echo Trail Time (TRAIL), Variable Range Marker (VRM), Watchman (WATCHMAN), Zoom (ZOOM), Range, Range Ring Interval, Range and Bearing to Cursor (+)</p> <p><u>By navigation data input (optional navigator required)</u></p> <p>Course (CRS), Latitude and Longitude, Speed (SPD), Range and Bearing to Waypoint (WP)</p>

Interference Rejection Built-in

Zoom Built-in

ENVIRONMENT CONDITIONS

Vibration	Vibration Frequency	Total Amplitude
	5 to 12.5 Hz	±1.6 mm
	12 to 25 Hz	±0.38 mm
	25 to 50 Hz	±0.10 mm

Ambient Temperature Scanner unit: -25°C to +70°C
 Display unit: -15°C to +55°C

Humidity Relative humidity 95% or less at +40°C

Waterproofing Scanner unit: IEC IPX-5
 Display unit: IEC Pub no. 945 16.6

POWER SUPPLY & POWER CONSUMPTION

12 V or 24 V DC (10.2 V to 31.2 V DC), 30 W approx. (8 W maximum in economy mode)

PROTECTION FEATURES

Protection against reverse polarity, overvoltage, overcurrent, and internal fault

COMPASS SAFE DISTANCE

Unit	Standard Compass	Steering Compass
Display Unit	0.65 m	0.5 m
Scanner Unit	1.7 m	1.3 m

SPECIFICATIONS

EQUIPMENT LIST

Complete Set

No.	Name	Type	Code No.	Qty	Remarks
1	Scanner Unit	RSB-0060	000-085-440	1	5 kg (w/mntg. hardware)
2	Display Unit	RDP-105-S	000-085-439	1	1.5 kg (w/cover, hanger, knob)
3	Installation Materials (select one)	CP03-12800	000-085-442	1 set	5 m signal cable assy.
		CP03-12810	000-085-443		10 m signal cable assy. *
		CP03-12820	000-085-444		15 m signal cable assy.
		CP03-12830	000-085-445		20 m signal cable assy.
4	Spare Parts	SP03-09800	000-085-441	1 set	

* Standard supply

Installation Materials

No.	Name	Type	Code No.	Qty	Remarks
1	Signal Cable Assy. (5 m)	03S9144	008-129-608	1	Select one. Connectors fitted.
	Signal Cable Assy. (10 m)	03S9145	008-129-609		
	Signal Cable Assy. (15 m)	03S9146	008-129-611		
	Signal Cable Assy. (20 m)	03S9147	008-129-612		
2	Power Cable Assy.	03S9148	008-129-613	1	Connector fitted, fuse, 3.5 m
3	Tapping Screw	5×20 SUS304	000-802-081	4	For display unit

Spare Parts

No.	Name	Type	Code No.	Qty	Remarks
1	Fuse	FGBO 5A 125 VAC	000-549-064	2	

Option

No.	Name	Type	Code No.	Qty	Remarks
1	NMEA Cable	22S0021	000-109-517	1	Connector fitted, for connection of navigator
2	Signal Cable Assy. (30 m)	03S9175	000-130-034	1	Connectors fitted

PRINCIPLE OF OPERATION

What is radar?

The term "RADAR" is an acronym meaning **RA**dio **D**etection **A**nd **R**anging. It is a device which measures the time it takes for a pulsed signal to be reflected back from an object.

How ships determined position before radar

The use of echoes to determine position did not begin with radar. Ships would sound a short blast on their whistles, fire a shot, or strike a bell as an aid to navigation when running in fog near a rugged shoreline. The time between the origination of the sound and the returning of the echo indicated how far the ship was from the cliffs or the shore. The direction from which the echo was heard indicated the relative bearing of the shore.

How radar determines range and bearing to a target

Range

Radar determines the range to the target by calculating the time difference between the transmission of a radar signal and the reception of the reflected echo. It is a known fact that radar waves travel at a nearly constant speed of 162,000 nautical miles per second. Therefore the time required for a transmitted signal to travel to the target and return as an echo to the source is a measure of the range to the target. Note that the echo makes a complete round trip, but only half the time of travel is needed to determine the one-way range to the target. This radar automatically takes this into account in making the range calculation.

Bearing

The bearing to a target found by the radar is determined by the direction in which the radar scanner antenna is pointing when it emits an electronic pulse and then receives a returning echo. Each time the scanner rotates pulses are transmitted in the full 360 degree circle, each pulse at a slightly different bearing from the previous one. Therefore, if one knows the direction in which the signal is sent out, one knows the direction from which the echo must return.

Radar wave speed and scanner rotation speed

The speed of the radar waves out to the target and back again as echoes is extremely fast compared to the speed of rotation of the antenna. By the time radar echoes have returned to the scanner, the amount of scanner rotation after initial transmission of the radar pulse is extremely small.

The radar display

Targets are displayed on what is called a Plan Position Indicator (PPI). This display is essentially a polar diagram, with the transmitting ship's position at the center. Images of target echoes are received and displayed at their relative bearings, and at their distance from the PPI center.

With a continuous display of the images of targets, the motion of the transmitting ship is also displayed.

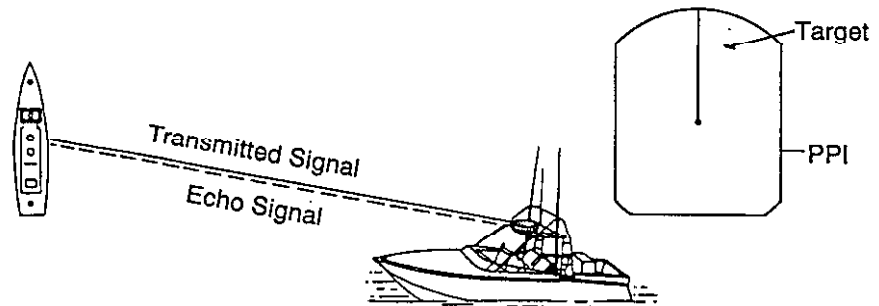


Figure 1-1 How radar works

OPERATIONAL OVERVIEW

This chapter describes how to operate your radar.

The functional and user-friendly layout of the control panel makes this radar easy and instinctive to use. If you change a control setting you will see the associated reaction almost immediately on the display.

To familiarize yourself with the controls of your radar, turn it on (presuming it is installed) and try operating some of the controls as you review this section.

The Control Panel

Examine the display unit. All controls are on the right-hand side, and the display is on the left-hand side. Several pairs of keys, when pressed together, perform the function which is inscribed just below them. For example, pressing the **POWER** and **TX STBY** keys together turns off the power.

The uncluttered control panel contains the radar's most often used functions. Less often used functions are stored in the menu, which you can display by pressing the **MENU** key.

Control description

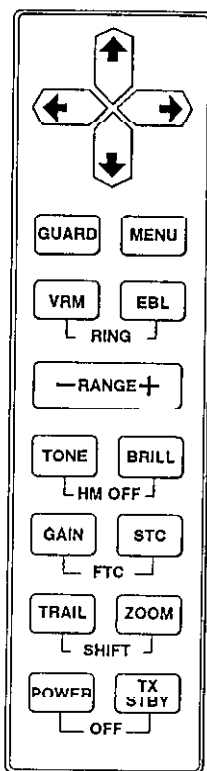


Figure 2-1 Front panel controls

Table 2-1 Control description

Key	Main Function	Secondary Function (when pressed together)
[↑], [↓], [←], [→]	Operate the EBL, VRM and cursor; set the guard zone, and select items on the menu.	
GUARD	Turn the guard zone on and off; silence the audible alarm.	
MENU	Open and close the menu.	
VRM	Turn the VRM (Variable Range Marker) on and off. (The VRM measures the range to a target.)	Turn the range rings on and off.
EBL	Turn the EBL (Electronic Bearing Line) on and off. (The EBL measures the bearing to a target.)	
RANGE	Select radar range, and change control setting.	
TONE	Adjust tone (contrast) of display.	Temporarily erase the heading mark.
BRILL	Adjust brilliance of display.	
GAIN	Adjust receiver sensitivity.	Turn the FTC (Fast Time Constant) circuit on and off. (It reduces rain clutter.)
STC	Suppress sea clutter caused by waves.	
TRAIL	Turn the radar echo trail function on and off. (This function simulates the movement of radar echoes.)	Shift the display backward by 1/3 of the range.
ZOOM	Turn the zoom function on and off. (The zoom function doubles the size of the area selected by the cursor.)	
POWER	Turn on the system.	Turn off the system.
TX STBY	Each press transmits the radar or places it in stand-by.	

Turning the Radar On and Off

■ **CAUTION:** The radar scanner emits high frequency radio radiation which can be harmful, particularly to your eyes. Never look directly into the scanner from a distance of less than two feet when the radar is in operation as you could injure the cornea of your eyes. Always make sure no person is near the scanner unit before turning on the radar.

Turning on the radar

After confirming there are no crew near the scanner unit, press the **POWER** key.

When you turn on the radar;

- The control panel lights.
- A timer displays the time remaining for warm up of the magnetron, counting down from 1:29 to 0:01. (The magnetron is the pulsed microwave radiation source for radar. It takes about one minute and thirty seconds to warm up before the radar can be operated.)
- It begins operation with last used settings (except at initial power application).

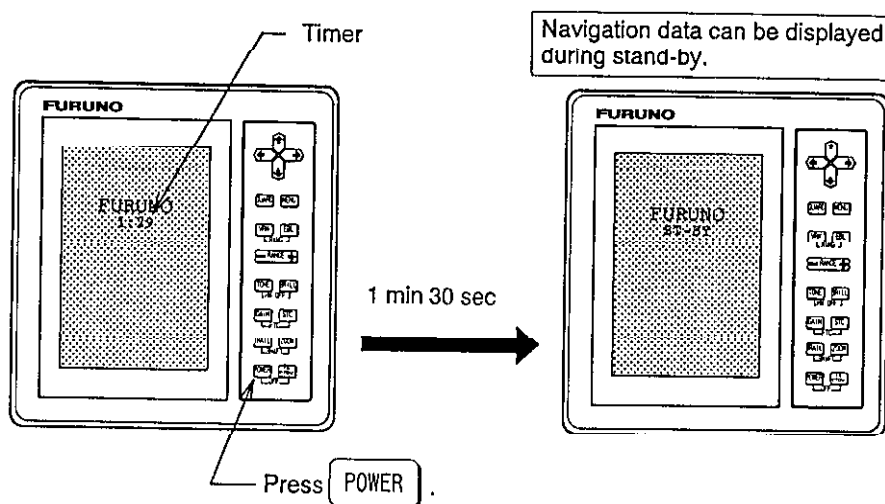


Figure 2-2 Display unit, showing location of timer

Turning off the radar

Press **POWER** and **TX STBY** keys together.

Transmitting & Stand-by

Transmitting

After the power is turned on and the magnetron has warmed up, "ST-BY" (Stand-By) appears at the screen center. This means the radar is now ready to be transmitted. In stand-by the radar is available for use at anytime – but no radar waves are being transmitted.

Press the **TX STBY** key to transmit the radar (and to rotate the radiator). When the radar is transmitting, any echoes from targets appear on the display. This radar displays echoes in four tones of gray according to echo strength.

What you will see on the display

If this is your first radar, you may want to take a closer look at the indications and marks which appear on the display. Table 2-2 describes indications and marks.

Table 2-2 Display indications and marks

Indication/Mark	Location	Function
Range	Top left-hand corner.	
Range Ring Interval	Below Range indication.	
Heading Mark	Solid radial line at 0 degrees. Always displayed.	Show your vessel's heading.
Cursor	The cursor is a "+" mark and always displayed.	Measure range and bearing to target, and set guard zone.
Range and Bearing to Cursor Intersection	Bottom right-hand corner.	
Sweep	Rotating radially around the display.	Tells the operator the radar is functioning properly. The sweep rotates synchronously with the scanner, so at any given time the direction in which the scanner is pointing is known. With every rotation echoes appear on the sweep as brighter spots of light, thus presenting a complete picture of the surrounding area.
Bearing Scale	Outermost ring (marked in degrees).	Measure bearing.

Stand-by

Placing the radar in stand-by helps extend component life and reduce power consumption. Therefore, when you won't be using the radar for an extended period of time, but you want to keep it in a state of readiness, place it in stand-by by pressing the **TX STBY** key. The display shows "ST-BY" or navigation data depending on the setting of the DISPL ON STBY sub menu.

Economy mode

In stand-by, the display is automatically turned off to reduce power consumption. This feature is called the "economy mode" and power consumption is 8 W maximum.

Navigation data display during stand-by

If a navigation aid inputs navigation data to this radar and "DISPL ON STBY" on the menu is set for "NAV," navigation data appears on the display during stand-by. Figure 2-3 shows a typical navigation data display during stand-by.

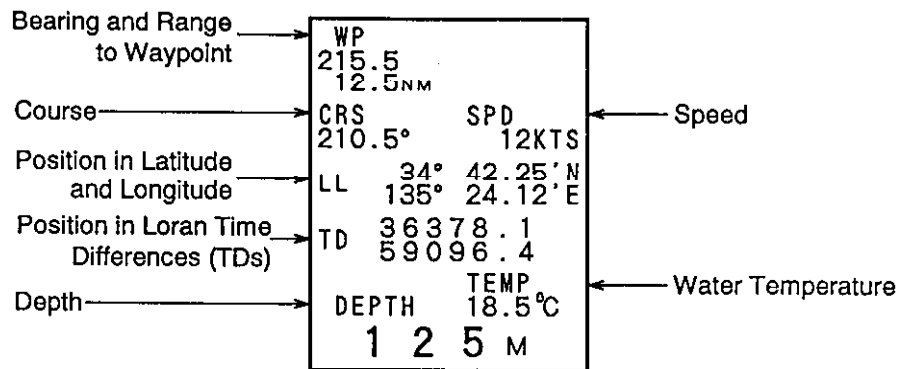


Figure 2-3 Typical navigation data display during stand-by

■ **NOTE:** Water depth (if input) can be displayed in either meters, feet or fathoms. Press the **EBL** key when in stand-by to select unit desired.

Basic Operation

Selecting a range

Ten ranges are available from 0.25 to 8 nautical miles. The range selected automatically determines the range ring interval, the number of range rings, pulselength, and pulse repetition rate, for optimal detection capability in short to long ranges.

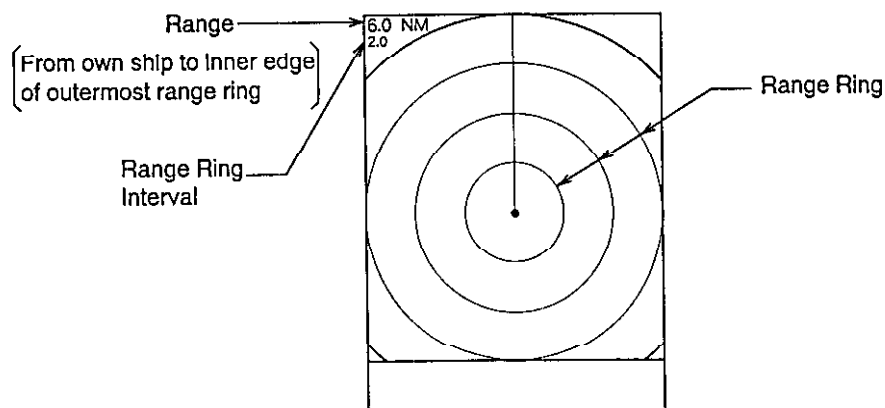


Figure 2-4 Display screen, showing location of range and range ring interval indications

To select a range;

Press the **RANGE** key. Note that pressing and holding down [+] or [-] increments or decrements the range upward or downward, respectively.

Tips for selecting range

- When navigating in or around crowded harbors, select a short range to watch for possible collision situations.
- If you select a lower range while on open water, increase the range occasionally to watch for vessels that may be heading your way.

Adjusting receiver sensitivity

The **GAIN** key adjusts the sensitivity of the receiver. It works in precisely the same manner as the volume control of a broadcast receiver, amplifying the signals received.

How to adjust the sensitivity

You can adjust the sensitivity manually, or let the unit do it automatically for you (by microprocessor). The proper setting is such that the background noise is just visible on the screen.

Adjust the sensitivity on the highest range – the background noise is clearer on that range. If you set up for too little sensitivity, weak echoes may be missed. On the other hand excessive sensitivity yields too much background noise; strong targets may be missed because of the poor contrast between desired echoes and the background noise on the display.

- 1) Transmit the radar on long range.
- 2) Press the **GAIN** key to select manual or automatic adjustment. One of the displays in Figure 2-5 appears.

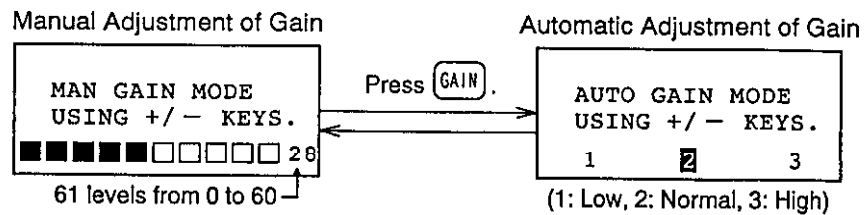


Figure 2-5 Manual and automatic GAIN adjustment displays

- 3) Press [+] and [-] to select level. Adjust so the background noise is just visible on the screen.

For manual adjustment, there are 61 levels, 0 to 60. Level is shown by both analog and digital displays. Each filled segment of the digital display is equal to six.

- 4) Press the **GAIN** key.

■ **NOTE:** Step 4 is optional; the gain adjustment display is automatically erased if the **GAIN** key is not pressed within 10 seconds after completion of step 3.

Adjusting the STC (reducing sea clutter)

Echoes from waves can be troublesome, covering the central part of the display with random signals known as “sea clutter.” The higher the waves, and the higher the scanner above the water, the further the clutter will extend. Sea clutter appears on the display as many small echoes which might affect radar performance. (See the left-hand figure in Figure 2-6.). When sea clutter masks the picture, adjust the STC (Sensitivity Time Control) to reduce the clutter.

How the STC works

The STC reduces the amplification of echoes at short ranges (where clutter is the greatest) and progressively increases amplification as the range increases, so amplification will be normal at those ranges where there is no sea clutter. The control is effective up to about 4 miles.

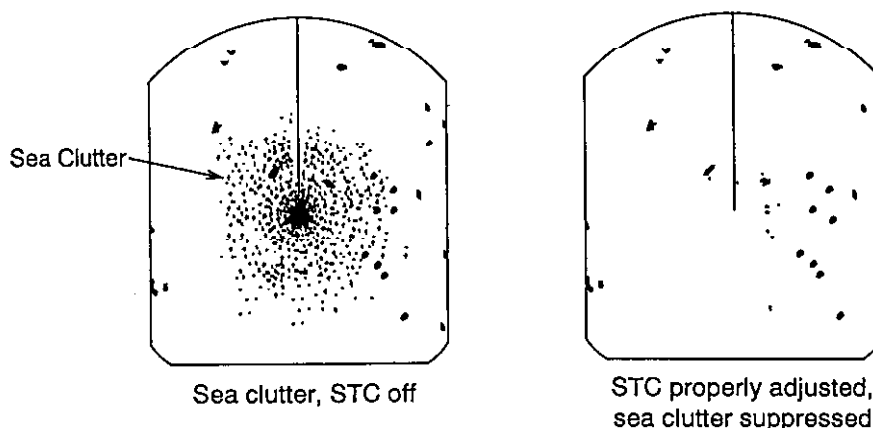


Figure 2-6 How the STC works

How to adjust the STC

You can adjust the STC manually, or let the unit do it automatically for you. The proper setting of the STC should be such that the clutter is broken up into small dots, and small targets become distinguishable. If the control is set too low, targets will be hidden in the clutter, while if it is set too high, both sea clutter and targets will disappear from the display. In most cases adjust the control until clutter has disappeared to leeward, but a little is still visible windward.

- 1) Confirm that the sensitivity is properly adjusted, and then transmit the radar on short range.
- 2) Press the **STC** key to select manual or automatic adjustment. One of the displays in Figure 2-7 appears.

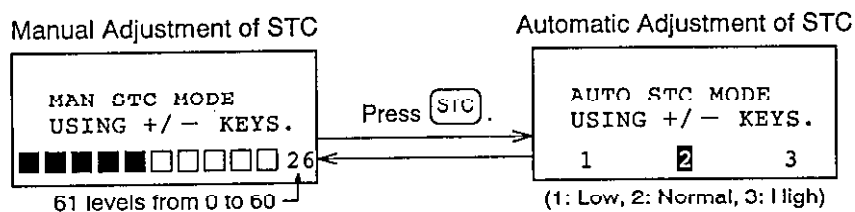


Figure 2-7 Manual and automatic STC adjustment displays

- 3) Press [+] and [-] to select level. Adjust so small targets are distinguishable but some clutter remains on the display.

For manual adjustment, there are 61 levels, 0 to 60. Level is shown by both analog and digital displays. Each filled segment of the digital display is equal to six.

4) Press the **STC** key.

■ **NOTE:** *Step 4 is optional; the STC adjustment display is automatically erased if the **STC** key is not pressed within 10 seconds after completion of step 3.*

Tip for adjusting the STC

A common mistake is to over adjust the circuit so all the clutter is removed. As an example set up for maximum STC. You will see how the center of the display becomes blank. This blank zone can be dangerous (targets may be missed), especially if the sensitivity is not properly adjusted. Always leave a little clutter visible on the display to be sure weak echoes will not be suppressed. If there is no clutter visible on the display, turn off the circuit.

Adjusting display brilliance

The **BRILL** key adjusts the brilliance of the display in five levels, including off.

Adjusting display tone

The **TONE** key adjusts the tone (contrast) of the display in 28 levels. Press the key followed by pressing [+] or [-] to select tone desired.

Erasing the heading mark

The heading mark continuously appears on the display and shows your vessel's heading. When this mark obscures a target echo, you can temporarily erase it by pressing and holding down **TONE** and **BRILL** together. Release the keys to redisplay the mark.

RADAR RECEIVER TUNING: *The radar receiver is automatically tuned each time you change from stand-by to transmit. Receiver circuit tuning condition is shown by the tuning bar, which you can display by opening the installation menu. Press and hold down [←] and [→] together (about 10 seconds) until the installation menu appears. Generally, the longer the tuning bar the better the tuning condition, however the length of the bar changes with number of radar echoes, range, and other factors. Press the **MENU** key to close the menu.*



Figure 2-8 Tuning bar

The Menu

The menu, comprised of 10 sub menus on two pages, contains less-often used functions which once preset do not require regular adjustment. The **MENU** key opens and closes the menu. You can select sub menus with [**↑**] and [**↓**]. Page automatically changes when those keys are pressed at page boundaries. Current settings are shown in reverse video. Figure 2-9 shows the menu.

PRESS ↑/↓ TO SELECT MENU ITEM, ←/→ TO CHANGE SETTING				
1	ECHO STRETCH	ON	OFF	
2	INT REJECT	ON	OFF	
3	NAV DATA	ON	OFF	
4	VIDEO	RVS	NOM	
5	WATCHMAN	OFF	5M	10M 20M
6	DIMMER	1	2	3 4

Menu, page 1

Menu, page 2

Figure 2-9 Menu

Menu description Table 2-3 describes the menu.

Table 2-3 Menu description

No.	Sub Menu	Function	Default Setting	See Page
1	ECHO STRETCH	Stretch echoes range-wise for better distinction. "ES" appears on the display when the circuit is on.	OFF	2-25
2	INT REJECT	Suppress radar interference. "IR" appears on the display when the circuit is on.	ON	2-17
3	NAV DATA	Display navigation data at the display bottom. Navigation input in NMEA 0183 or CIF format required.	OFF	2-24
4	VIDEO	Targets can be displayed in black on white background or vice versa.	NOM	
5	WATCHMAN	Transmit at preset intervals for about one minute to check for targets which might be entering (or exiting) the alarm zone.	OFF	2-26

(Continued)

OPERATIONAL OVERVIEW

No.	Sub Menu	Function	Default Setting	See Page
6	DIMMER	Adjust backlighting of control panel in four levels.	3	
7	DISP. ON STBY	Turn on or off navigation data display during stand-by.	OFF	2-6
8	TRAIL TIME	Select echo trailing time.	1 min	2-23
9	TRAIL BRILL	Adjust brilliance of echo trail afterglow.	LOW	2-23
10	RANGE (nm)	Deselect up to eight radar ranges. Ranges in use appear in reverse video. To deselect a range; 1) Press [←] and [→] to select unnecessary ranges. 2) Press the EBL key.	All ranges on.	

Basic menu operation

- 1) Press the **MENU** key to open the menu.
- 2) Press [↑] and [↓] to select menu.
- 3) Press [←] and [→] to select option.
- 4) Press the **MENU** key to close the menu.

Measuring Range and Bearing

In the basic radar system your ship is in the center of the display, and any target received appears in a map-like projection throughout 360 degrees. This allows the bearing and range from your vessel to a target appearing on the display to be measured.

Range

You can measure the range to a target three ways:

- by the range rings
- by the cursor, or
- by the VRM (Variable Range Marker).

Range rings

To get a rough measurement of the range to a target, use the range rings. Press and hold down both **VRM** and **EBL** to turn on (or off) the range rings. Count the number of rings between the center of the display and the target. Check the range ring interval and judge the distance of the echo from the inner edge of the nearest ring.

Cursor

To measure range by the cursor, press the arrow keys to place the cursor intersection on the inside edge of the target echo. The range to the target, as well as the bearing, appears at the bottom right-hand corner of the display.

VRM

- 1) Press the **VRM** key to display the VRM. (The VRM is the dashed ring.)
- 2) *When the VRM indication appears in reverse video and no later than 10 seconds after doing step 1, press [↑] and [↓] to place the VRM on the inside edge of the target.*
- 3) Press the **VRM** key.
- 4) Check the VRM readout at the bottom left-hand corner of the display to find the range to the target.

To erase the VRM, press and hold down the **VRM** key for about three seconds.

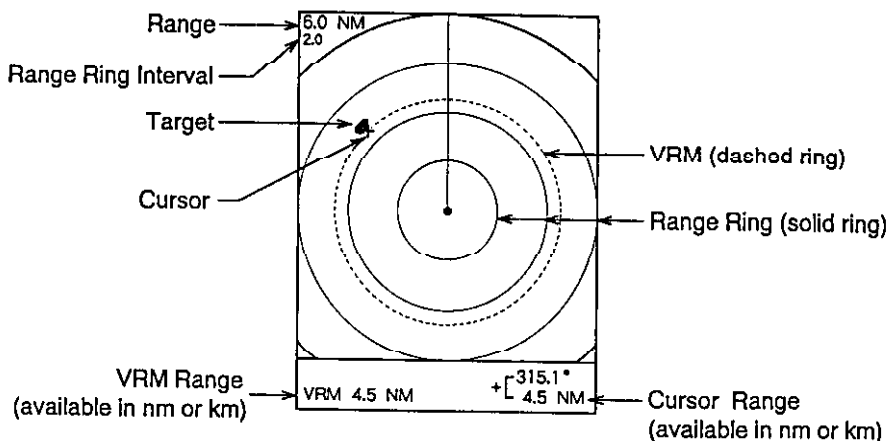


Figure 2-10 Measuring range by the cursor and the VRM

Note that the cursor range continuously varies with operation of the arrow keys. The VRM and its indication, however, are automatically fixed when the VRM key is pressed the second time, or 10 seconds elapses with no operation of [↑] or [↓].

■ **UNIT OF RANGE MEASUREMENT FOR VRM AND CURSOR:** You can display the range readout of the VRM and the cursor in nautical miles or kilometers. Refer to page 6-14 for further details.

Bearing

There are three ways to measure the bearing to a target:

- by the bearing scale (rough estimate)
- by the cursor, or
- by the EBL (Electronic Bearing Line).

Cursor

Press the arrow keys to bisect the target with the cursor intersection. The bearing to the target appears at the bottom right-hand corner of the display.

EBL

- 1) Press the **EBL** key to display the EBL.
- 2) When the EBL indication appears in reverse video and no later than 10 seconds after doing step 1, press [←] and [→] to bisect the target with the EBL.
- 3) Press the **EBL** key.
- 4) Check the EBL readout at the bottom left-hand corner of the display to find the bearing to the target.

To erase the EBL, press and hold down the **EBL** key for about three seconds.

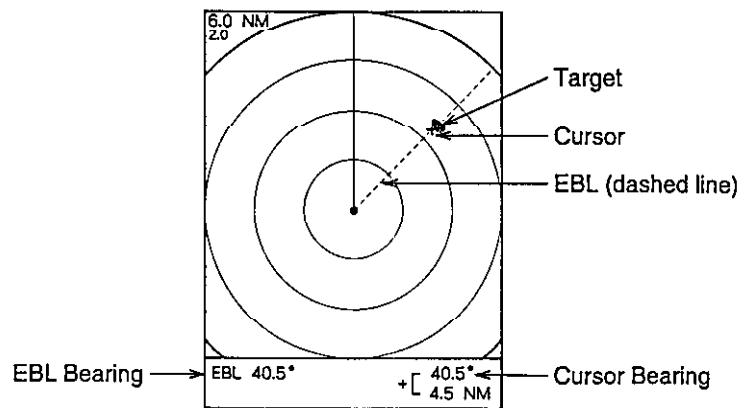


Figure 2-11 Measuring bearing by the EBL and the cursor

Note that the cursor bearing continuously varies with operation of the arrow keys. The EBL and its indication, however, are automatically fixed when the **EBL** key is pressed the second time, or 10 seconds elapses with no operation of [←] or [→].

Tips for measuring bearing

- Bearing measurements of smaller targets are more accurate; the center of larger target pips is not as easily identified.
- Bearings of stationary or slower moving targets are more accurate than bearings of faster moving targets.
- To minimize bearing errors keep echoes in the outer half of the picture by changing the range scale; angular difference becomes difficult to resolve as a target approaches the center of the display.

Target on collision course with your vessel?

You can use the EBL to determine if a radar target might be on a collision course with your vessel. Measure the bearing to the target with the EBL. If the target tracks along the EBL as it approaches the screen center it may be on a collision course with your vessel.

Reducing Interference

Types of Interference

Basically there are three types of interference which may hinder radar reception:

- **sea clutter** caused by echoes reflected off waves (mentioned earlier)
- **rain clutter** from precipitation, and
- **radar interference** from other shipborne radars operating nearby on the same frequency band as your radar.

The 1621 can suppress or eliminate those types of interference. For how to reduce sea clutter see page 2-9.

Rain clutter

The vertical beamwidth of the scanner is designed to see surface targets even when the ship is rolling. However, by this design the unit will also detect rain clutter (rain, snow, or hail) in the same manner as normal targets. Figure 2-12 shows the appearance of rain clutter on the display.

How to suppress rain clutter

- When only a slight amount of clutter is visible on the display, raise the STC slightly to distinguish targets from the clutter.
- In heavy storms or partial clutter, turn on the FTC (Fast Time Constant) circuit by pressing **GAIN** and **STC** together. The FTC circuit splits up these unwanted echoes into a speckled pattern, making recognition of solid targets easier. "FTC" appears at the top right-hand corner of the display when the circuit is on.

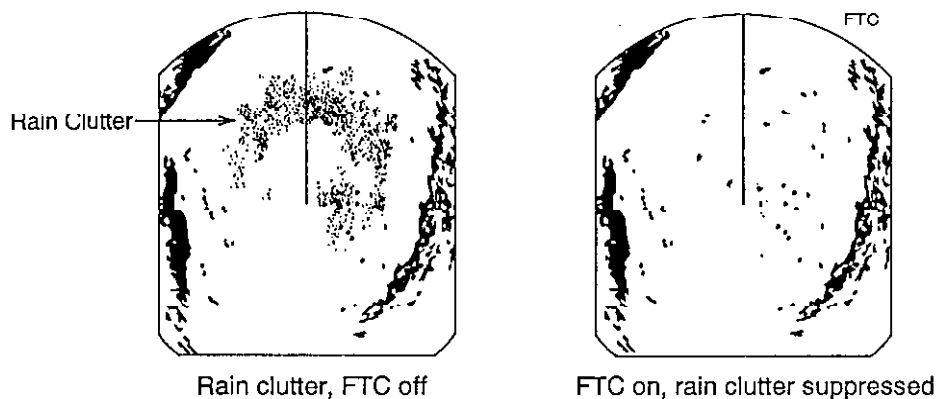


Figure 2-12 Effect of FTC

Other uses of the FTC

In addition to reducing clutter, the FTC can be used in fine weather to clarify the picture when navigating in confined waters. However, with the circuit activated the receiver is less sensitive. Therefore, turn off the circuit when its function is not required.

Radar interference

Radar interference may occur when near another shipborne radar operating in the same frequency band as your radar. Its on-screen appearance is many bright dots either scattered at random or in the form of dotted lines extending from the center to the edge of the display. Figure 2-13 illustrates interference in the form of "curved spokes." Interference effects are distinguishable from normal echoes because they do not appear in the same place on successive rotations of the scanner.

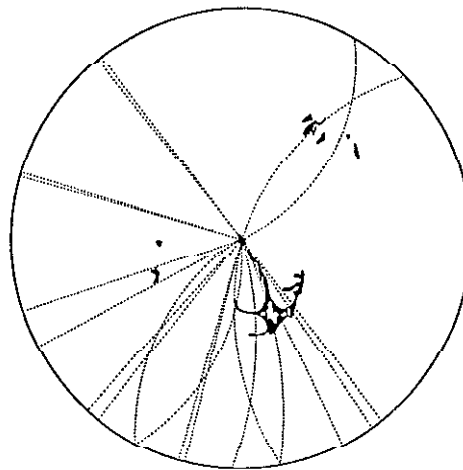


Figure 2-13 Radar interference

To reduce radar interference;

- 1) Press the **MENU** key to display the menu.
- 2) Press [↑] and [↓] to select "2 INT REJECT."
- 3) Press [←] and [→] to select "ON."
- 4) Press the **MENU** key again to close the menu. "IR" appears at the top right-hand corner of the display.

■ **NOTE:** *The interference rejection circuit is on in the default setting. We recommend you to use the radar with the circuit turned on to maintain a clear picture.*

Enlarging an Area of Interest (zoom)

The zoom feature allows you to double the size of the area between your vessel and an arbitrary location, to take a closer look at an area of interest without changing the range. Select location with the cursor, and then press the **ZOOM** key. "ZOOM" (blinking) appears at the top left-hand corner when the zoom function is on. To turn off zoom, press the key again.

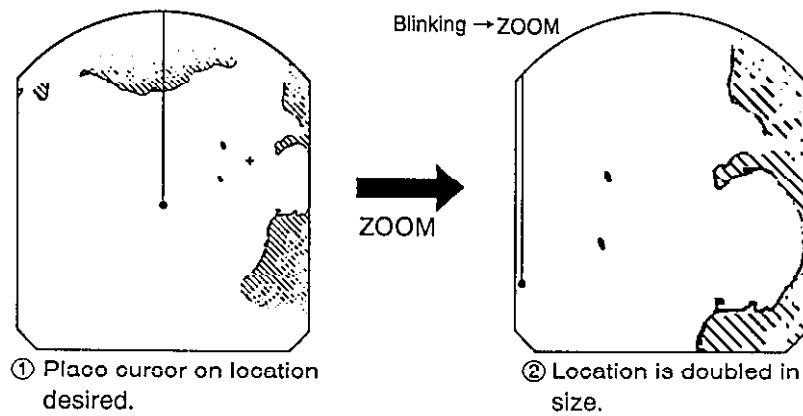


Figure 2-14 Zoom function

■ **NOTE:** The zoom function is inoperative when the display is shifted and vice versa.

Shifting the Display

Your vessel's position can be shifted backward by 1/3 of the range. The primary advantage of the shifted display is that for any range setting, the view ahead of your vessel can be extended without changing the range.

Press **TRAIL** and **ZOOM** together to turn (or off) the display shift function. "SHIFT" appears on the display when the display is shifted.

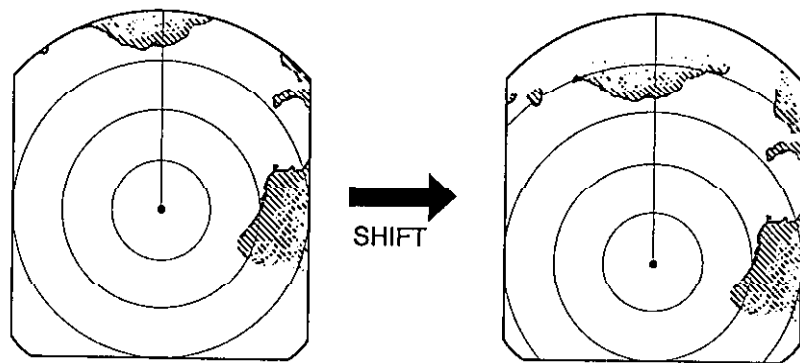


Figure 2-15 Shifting the display

Guard Alarm

The guard alarm allows the operator to set the desired range and bearing for a guard zone. When ships, islands, landmasses, etc. enter (or exit) the guard zone an audible alarm sounds to call the operator's attention. (Whether the alarm sounds on targets entering or exiting the zone depends on zone status after setting the zone.) The alarm is very effective as an anti-collision aid when using an autopilot or navigating in narrow channels.

■ **CAUTION:** *The alarm is a useful anti-collision aid, but does not relieve the operator of the responsibility to also keep a visual lookout for possible collision situations. The alarm should not be relied upon as the sole means for detecting possible collision situations.*

Setting the guard zone

To set the guard zone;

- 1) Mentally create the guard zone you want to display. See Figure 2-16 (1).
 - 2) Press the arrow keys to set cursor on top (bottom) left edge of the guard zone. Press the **GUARD** key. “*GUARD,” with asterisk blinking, appears at the top right-hand corner of the display. See Figure 2-16 (2). (The asterisk indicates the guard zone is partially set.)
 - 3) Press the arrow keys to set cursor on bottom (top) right edge of the guard zone. See Figure 2-16 (3).
 - 4) Press the **GUARD** key again. The asterisk disappears. See Figure 2-16 (4).
- **NOTE:** *When the guard zone is active, be sure the **GAIN** key is properly adjusted so the alarm does not overlook weak target echoes.*

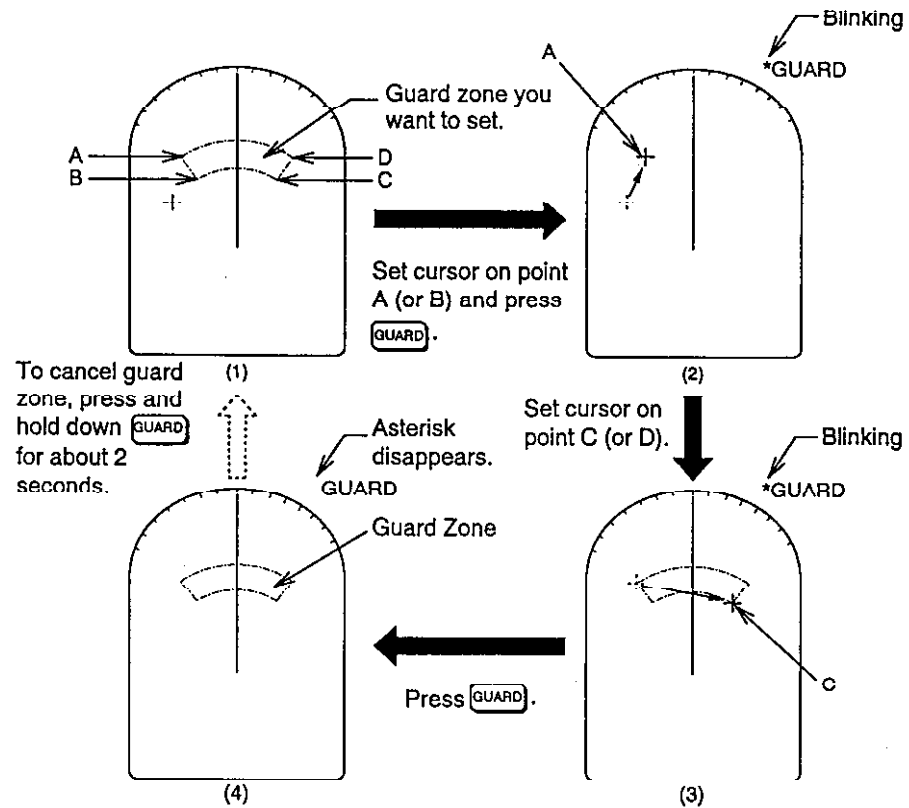


Figure 2-16 How to set the guard zone

Selection of guard zone type (guard in or guard out)

After the guard zone is set, the radar starts searching for targets inside the guard zone for about 8 to 12 seconds. When it finishes searching it displays the results at the top right-hand corner as follows.

Guard in

When no targets exist inside the zone, "G (IN)" appears. The audible alarm sounds only on targets which go into the guard zone.

Guard out

When there are targets inside the guard zone, the display shows "G (OUT)." The audible alarm sounds on all targets which go out of the zone or disappear.

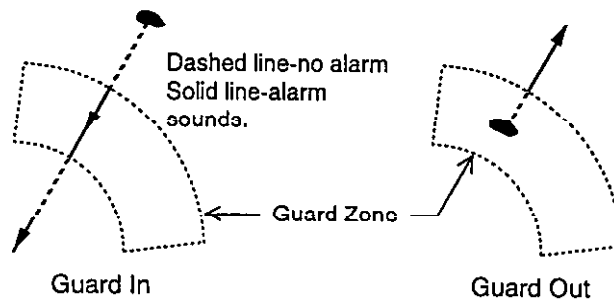


Figure 2-17 Guard in and guard out alarms

Silencing the audible alarm

Any ships, landmasses, etc. coming into (or going out of) the guard zone will trigger the audible alarm. You can silence the audible alarm by pressing the **GUARD** key. When this is done, “GUARD,” displayed in reverse video, replaces “G (IN)” or “G (OUT).”

Press the **GUARD** key again to reactivate the alarm. “GUARD” appears in normal video for about 10 seconds and then is replaced by “G (IN)” or “G (OUT).”

Canceling the guard zone

Press and hold down the **GUARD** key until the guard zone disappears.

Notes on the guard alarm

- When the radar range is less than one half of the guard zone range, the guard zone disappears from the display and “UP RANGE” appears. If this happens, raise the range to redisplay the guard zone.
- A target echo does not always mean a landmass, reef, ships or surface objects but can imply returns from sea surface or precipitation. As the level of these returns varies with environment, the operator should properly adjust the **STC** and **GAIN** keys and turn on the **FTC** if necessary to be sure the alarm system does not overlook target echoes within the guard zone.

Simulating Target Movement (echo trail)

You can simulate the movement of radar targets relative to your vessel. The trail of all targets is simulated in afterglow. This function is useful for alerting you to possible collision situations.

Starting echo trailing

Press the **TRAIL** key to start echo trailing. "TRAIL" and the echo trailing time appear at the top right-hand corner of the display.

■ **NOTE:** *If the range is changed during echo trailing, trailing begins anew with the newly selected range.*

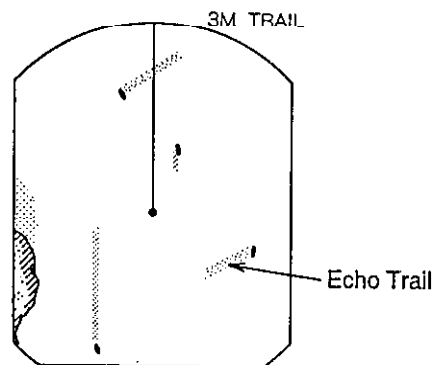


Figure 2-18 How the echo trail feature works

Selecting echo trailing time

Echo trailing time, in other words, trail length, can be selected on the TRAIL TIME sub menu. (The default setting is one minute.) The higher the setting the longer the trail.

Adjusting brilliance of afterglow

The brilliance of the afterglow can be set for high or low on the TRAIL BRILL sub menu.

Canceling echo trailing

Press the **TRAIL** key.

Displaying Navigation Data

Navigation data can be displayed at the screen bottom if this radar receives navigation input in NMEA 0183 or FURUNO CIF format. Navigation data include

- position in latitude and longitude or Loran-C time differences (TDs)
- bearing and range to a waypoint selected on the navigator
- course, and
- speed.

If a heading sensor or gyro is connected to this radar, the range and bearing to the waypoint selected on the navigator are shown and waypoint position is denoted by a dashed ring on the display.

■ **NOTE:** The **TONE** key changes position display to TDs or latitude and longitude. Press and hold down the key about three seconds to display TDs (or L/L).

To turn navigation data on or off;

- 1) Press the **MENU** key.
- 2) Press [↑] and [↓] to select "3 NAV DATA."
- 3) Press [←] and [→] to select ON or OFF.
- 4) Press the **MENU** key to close the menu.

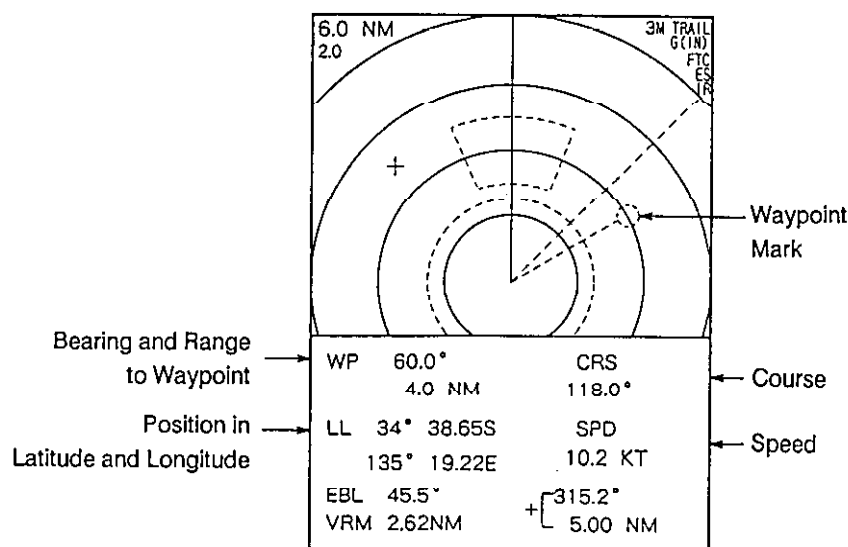


Figure 2-19 Typical navigation data display

Magnifying Long Range Echoes (echo stretch)

Normally, the reflected echoes from long range targets appear on the display as weaker and smaller blips even though they are compensated by the radar's internal circuitry. The echo stretch function magnifies these small blips in all ranges.

To turn the echo stretch on or off;

- 1) Press the **MENU** key.
- 2) Press [↑] and [↓] to select "1 ECHO STRETCH."
- 3) Press [←] and [→] to select ON or OFF. ("ES" appears at the top right-hand corner of the display when the circuit is on.)
- 4) Press the **MENU** key to close the menu.

■ **NOTE 1:** *This function magnifies not only targets but also sea clutter and radar interference. For this reason be sure the controls for adjustment of sea clutter and radar interference are properly adjusted before activating the echo stretch.*

■ **NOTE 2:** *Echo stretch is inoperative on ranges from 0.25 to 0.75 nautical miles. "ES" appears in reverse video when the echo stretch is turned on in those ranges.*

Watchman

The watchman function periodically transmits the radar for about one minute to check for targets in a guard zone. If it finds change in the zone from the previous transmission it sounds the audible alarm, cancels the watchman function, and transmits the radar continuously. This feature is useful when you do not need the radar's function continuously but want to be alerted to radar targets in a specific area.

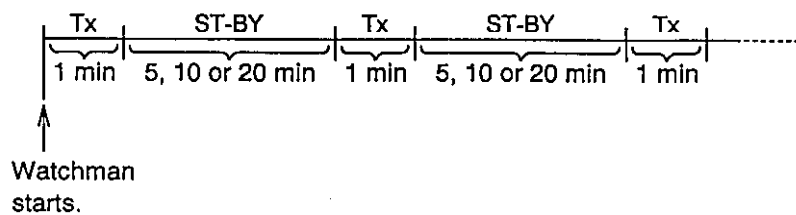


Figure 2-20 How watchman works

Turning on watchman

To turn on watchman;

- 1) Create a guard zone (usually 360 degrees) with the guard alarm function.
- 2) Press the **MENU** key.
- 3) Press [↑] and [↓] to select "5 WATCHMAN."
- 4) Press [←] and [→] to select transmitting interval desired; 5 minutes, 10 minutes or 20 minutes.
- 5) Press the **MENU** key again. Then,
 - "WATCHMAN" appears at the top center of the display, and
 - the radar transmits for one minute and then goes into stand-by.

How watchman works

- If there is no change inside the guard zone the radar automatically returns to stand-by.
- If the condition inside the guard zone changed from the previous transmission, the radar sounds the audible alarm, cancels the watchman function, and transmits continuously.

Canceling watchman

Press any key while the radar is transmitting. (Pressing a key during stand-by causes the radar to go to warm-up condition.)

Summary of Display Indications

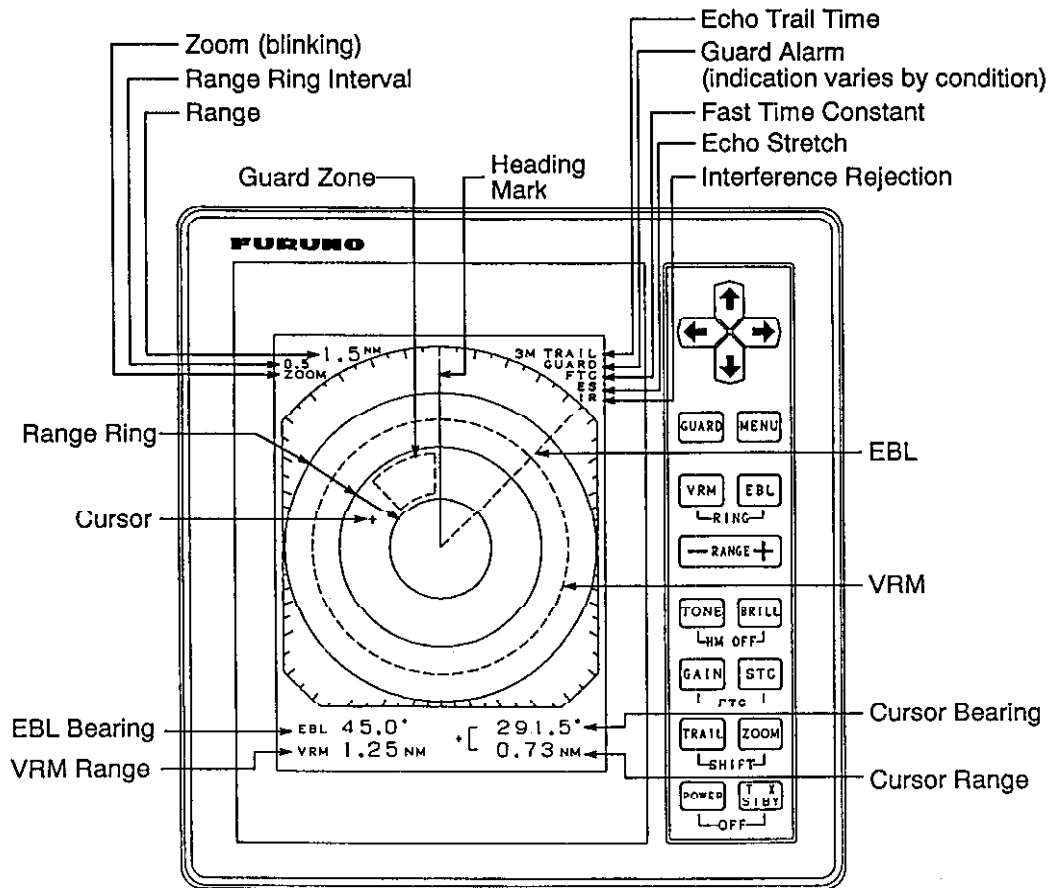


Figure 2-21 Display indications

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APPLICATION

As an aid to navigation, radar can be a very valuable tool. No other navigation aid can give you the ability to spot vessels coming at you in the fog, or tell you the location of the inlet to the harbor in the pitch black of night.

To help you understand better what your radar can (and cannot) do for you this chapter covers

- the characteristics of the radar wave
- target properties and radar wave reflection
- range and bearing resolution
- false echoes, and
- position fixing with radar.

The Radar Wave and Radar Horizon

How the radar wave travels

The radar wave tends to travel in straight lines at the speed of light. However, it is subject to bending or refraction in the atmosphere, the amount depending on region and density.

Super-refraction

Super-refraction is a condition in which there is an upper layer of warm dry air over a surface layer of cold, moist air. Radar waves bend downward and thus increase the ranges at which targets may be detected.

Sub-refraction

Sub-refraction is the reverse condition of super-refraction; a layer of cold air is above a layer of warm air. Radar waves bend upward and thus decrease the ranges at which targets may be detected.

Radar horizon

Radar is essentially a "line-of-sight" phenomenon. That means you have just about the same range to horizon with a radar as you do with your own eyes. However under normal atmospheric conditions, the radar horizon is 6% greater than the optical horizon. Therefore, if the target does not rise above the horizon the radar beam cannot be reflected from the target.

The distance to the horizon from the scanner, under normal conditions, is calculated by the following formula.

$$R_{\max} = 2.2 \times (\sqrt{h_1} + \sqrt{h_2})$$

Where R_{\max} : Radar horizon (mile), h_1 : Antenna height (meters), h_2 : Target height (meters)

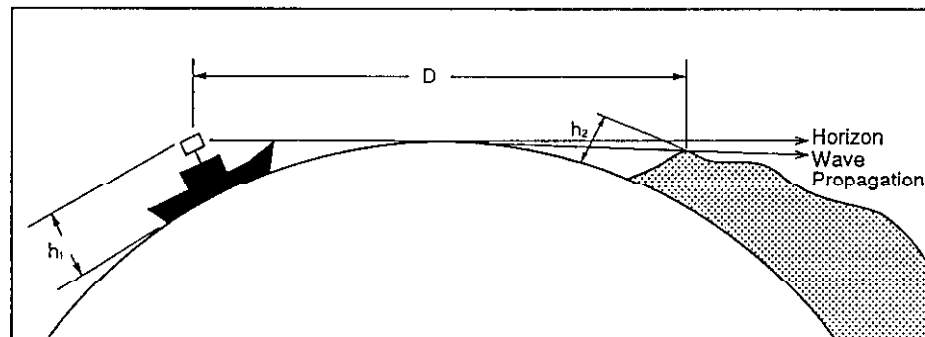


Figure 3-1 Radar horizon

Target Properties and Radar Wave Reflection

Generally, larger targets can be seen on the radar display at greater ranges, provided line-of-sight exists between the scanner and target. However, a large target with poor reflecting properties may not be detected as easily as a smaller target with better reflecting properties. For example, you might expect a lighthouse to be a good radar target because of its size. In actuality the return echo is weak since the conical shape diffuses most of the radiated energy.

A ship whose hull is made of conducting materials, such as steel, will return a relatively strong echo.

On the other hand, hulls made from wood or fiberglass return much weaker echoes.

Vertical surfaces, such as a cliff, are good targets provided they face the radar. Conversely, horizontal and smooth surfaces such as mudbanks, sandy beaches, and gently sloping hills make poor targets because they disperse rather than reflect most of the energy that strikes them.

The strongest radar echoes known come from built-up areas, docks, etc., because these targets are less subject to changes in aspect. These types of targets have three flat, smooth surfaces mutually at right angles. Some radar buoys are arranged this way so as to deliberately increase their detection range.

Range Resolution

Range resolution is a measure of the capability of a radar to display as separate pips the echoes received from two targets which are on the same bearing and are close together.

The main factor which affects range resolution is pulselength. Two targets on the same bearing, close together, cannot be seen as two distinct echoes on the display unless they are separated by a distance greater than one-half the pulselength.

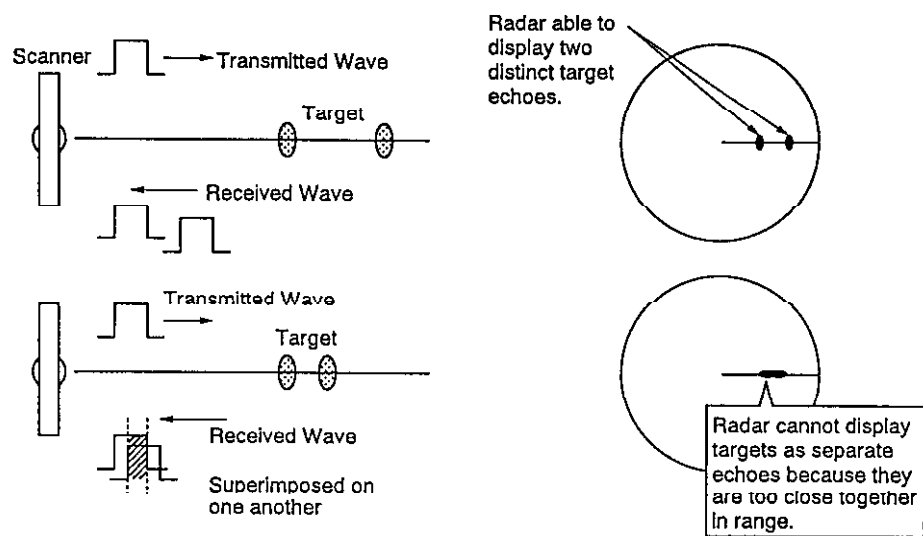


Figure 3-2 Range resolution

Bearing Resolution

Bearing resolution is a measure of the capability of a radar to display as separate targets the echoes received from two targets which are at the same range and are close together.

The principal factor which affects bearing resolution is horizontal beamwidth. Two targets at the same range must be separated by more than one beamwidth to appear as separate pips.

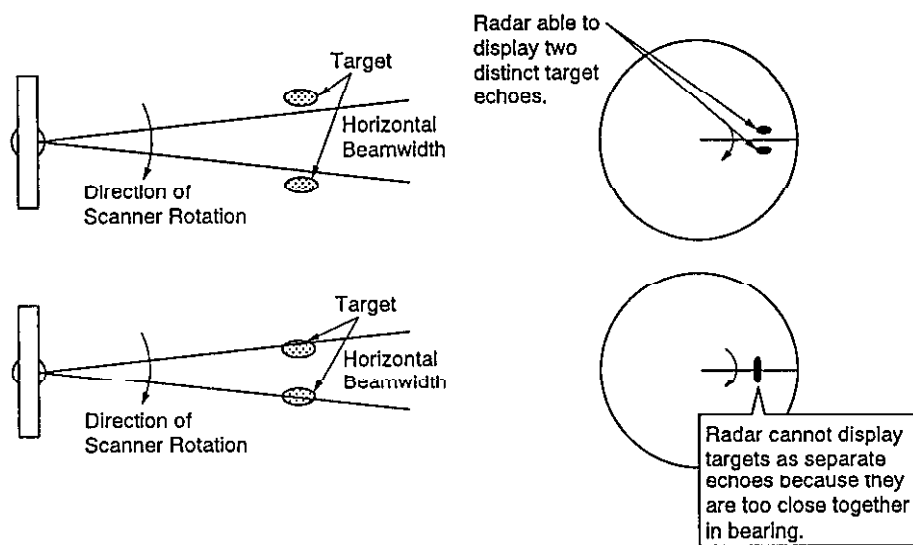


Figure 3-3 Bearing resolution

False Echoes

Occasionally false echoes appear on the screen at positions where there is no target. In some cases the effects can be reduced or eliminated. The operator should familiarize himself or herself with the appearance and effects of these false echoes, so as not to confuse them with echoes from legitimate contacts.

Multiple echoes

Multiple echoes occur when a short range, strong echo is received from a ship, bridge, or breakwater. A second, a third or more echoes may be observed on the display at double, triple or other multiples of the actual range of the target as shown in Figure 3-4. Multiple reflection echoes can be reduced and often removed by decreasing the sensitivity or properly adjusting the STC.

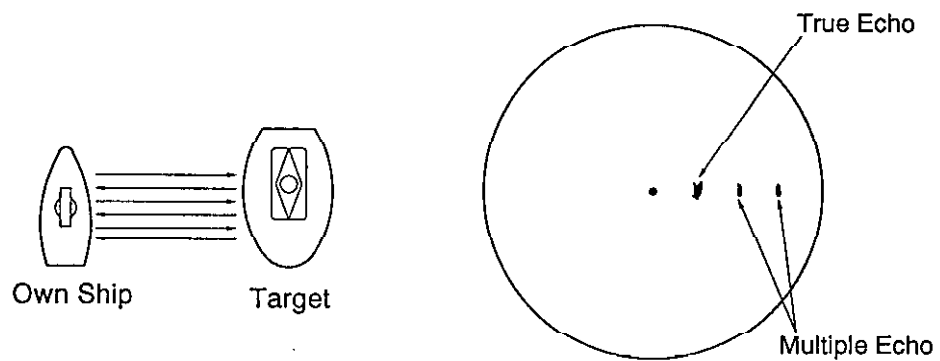


Figure 3-4 Multiple echoes

Side-lobe echoes

Every time the scanner rotates, some radiation escapes on each side of the beam — called “side-lobes.” If a target exists where it can be detected by the side-lobes as well as the main-lobe, the side-lobe echoes may be represented on both sides of the true echo at the same range, as shown in Figure 3-5. Side-lobes show usually only at short ranges and from strong targets. They can be reduced through careful reduction of the sensitivity or proper adjustment of the STC.

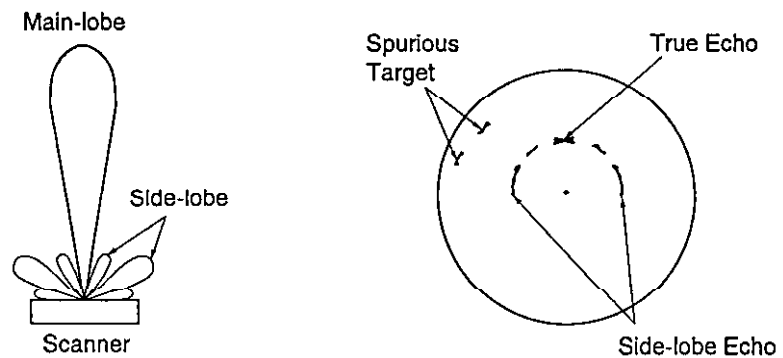


Figure 3-5 Side-lobe echoes

Blind and shadow sectors

Funnels, stacks, masts, or derricks in the path of antenna may reduce the intensity of the radar beam. If the angle subtended at the scanner is more than a few degrees a blind sector may be produced. Within the blind sector small targets at close range may not be detected while larger targets at much greater ranges may be detected. See Figure 3-6.

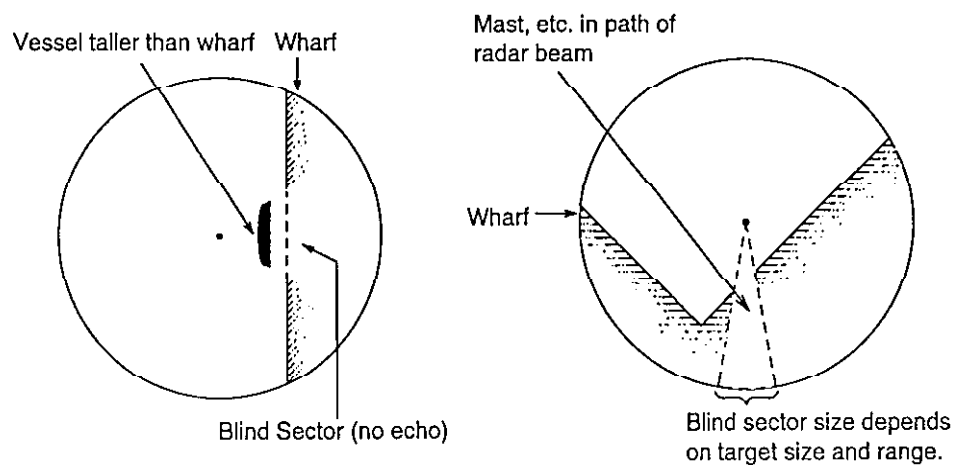


Figure 3-6 Blind and shadow sectors

Indirect echoes

Indirect echoes may be returned from either a passing ship or returned from a reflecting surface on your own ship, for example, a stack. In both cases, the echo will return from a legitimate contact to the antenna by the same indirect path. The echo will appear on the same bearing of the reflected surface, but at the same range as the direct echo. Figure 3-7 illustrates the effect of an indirect echo. Indirect echoes may be recognized as follows:

- they usually occur in a shadow sector
- they appear on the bearing of the obstruction but at the range of the legitimate contact
- when plotted, their movements are usually abnormal, and
- their shapes may indicate they are not direct echoes.

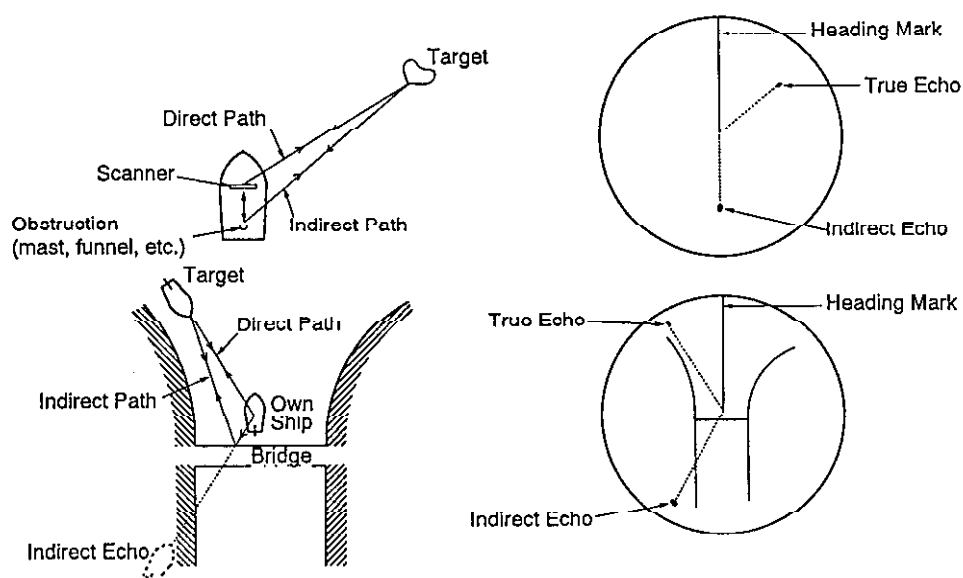


Figure 3-7 Indirect echoes

Position Fixing with Radar

This section describes how to fix your position using the radar. You will need a compass and a navigation chart.

By radar range

The simultaneous measurement of the ranges to two or more fixed objects is normally the most accurate method of obtaining a fix with radar alone. Preferably at least three ranges should be used. However the use of more than three range arcs may introduce excessive error because of the time lag between measurements, namely, you will be moving as you take successive measurements.

When obtaining a fix, it is best to measure the most rapidly changing range last because of a smaller time lag in the radar plot from the ship's actual position. For greater accuracy, the objects selected should provide arcs with angles of cut as close to 90 degrees as possible. Small, isolated, radar-conspicuous fixed objects whose associated range arcs intersect at angles approaching 90 degrees provide the most reliable and accurate position fixes. Objects at longer ranges are less accurate for position fixing because they may be below the radar horizon and because the width of the radar beam increases with range.

To fix your position by using radar range;

- 1) Measure the range to two or more prominent navigational marks which you can identify on the chart by the VRM.
- 2) Next, with the compass sweep out the ranges from the charted positions. The point of intersection of the arcs is your estimated position.

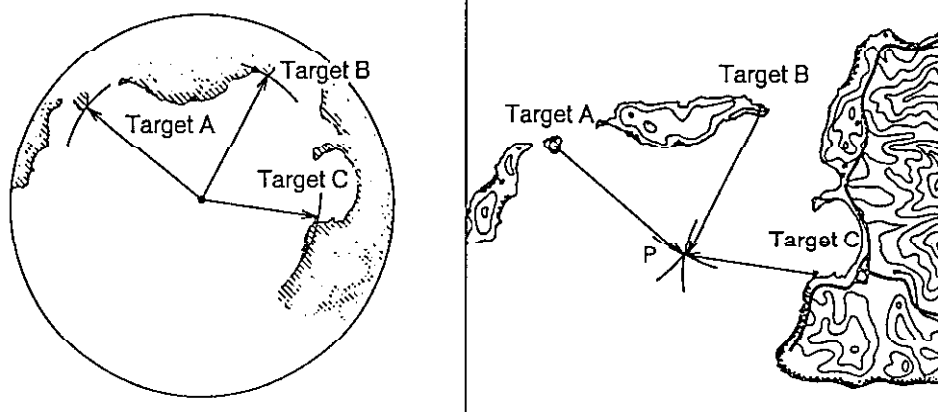


Figure 3-8 Position fixing using radar ranges

By range and bearing to a point on land

The advantage of position fixing by range and bearing to a point of land is the speed with which a fix can be obtained. A distinct disadvantage however is this method is based upon only two intersecting position lines, a bearing line and range, obtained from two points of land. If possible, the object used should be small, isolated and identified with reasonable certainty.

To fix your position using range and radar bearing;

- 1) Measure the relative bearing of the target with the EBL, noting the exact direction of the ship's heading when doing so.
- 2) Next, make allowance for compass deviation (true or magnetic) and find the true bearing of the target.
- 3) Sweep out the range to the target with the compass on the chart and plot the true bearing of the target. The point of intersection is your approximate position.

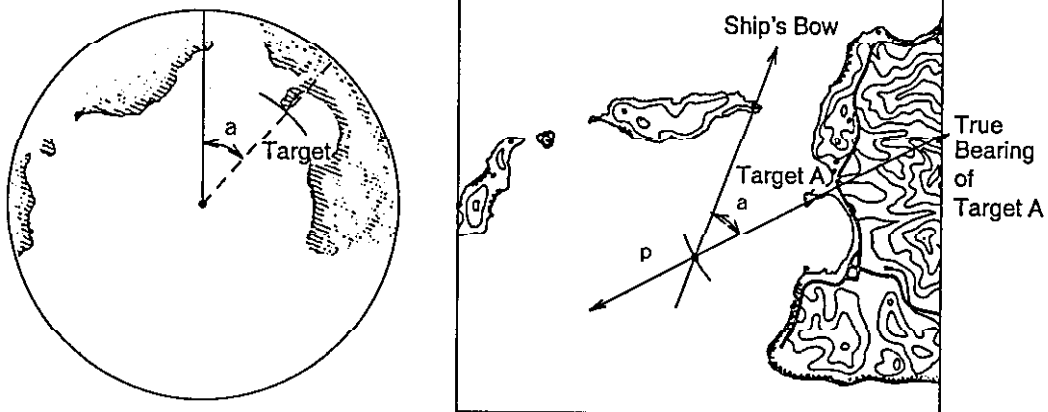


Figure 3-9 Position fixing using range and bearing to a point of land

By two bearings

Generally, fixes obtained from radar bearing are less accurate than those obtained from intersecting range arcs. The accuracy of fixing by this method is greater when the center bearings of small, isolated radar-conspicuous objects can be observed. Similar to position fixing using range and bearing, this method affords a quick means for initially determining approximate position. The position should then be checked against other means to confirm reliability.

To fix your position by using two radar bearings;

- 1) Measure the relative bearings for the two targets and then determine their true bearings.
- 2) Plot the two bearings on the chart. The point of intersection of the two bearings is your approximate position.

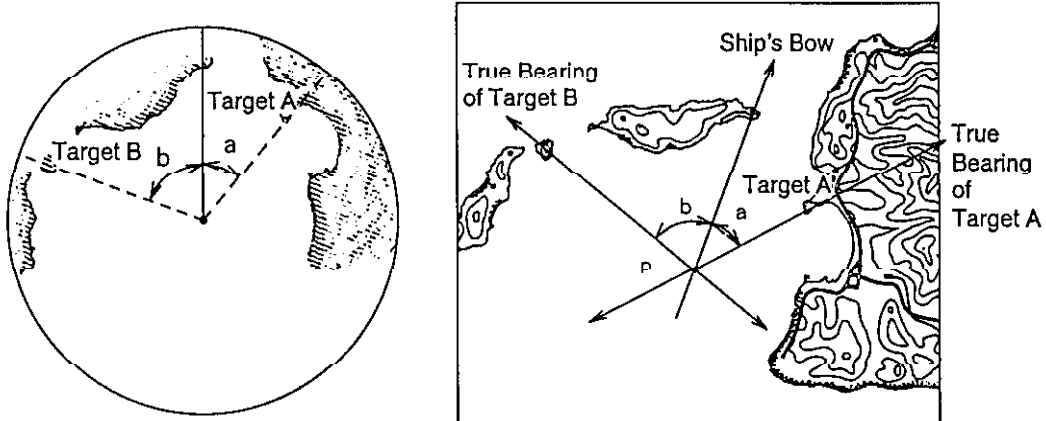


Figure 3-10 Position fixing using two bearings

Nautical Chart and Radar Picture

Under normal conditions, a picture which is very similar to a nautical chart can be obtained on the radar display. However, a radar cannot:

- show targets which are below the horizon.
- show a target which is hidden by a larger one.
- see around corners (for example, seawall).
- distinguish between two targets which are very close together, either in range or bearing. For example, a vessel towing another will probably appear as one vessel, as both will be covered by the beam at the same time.

The nautical chart and radar picture shown in Figure 3-11 are from the Kada Inland Sea in southwestern Japan.

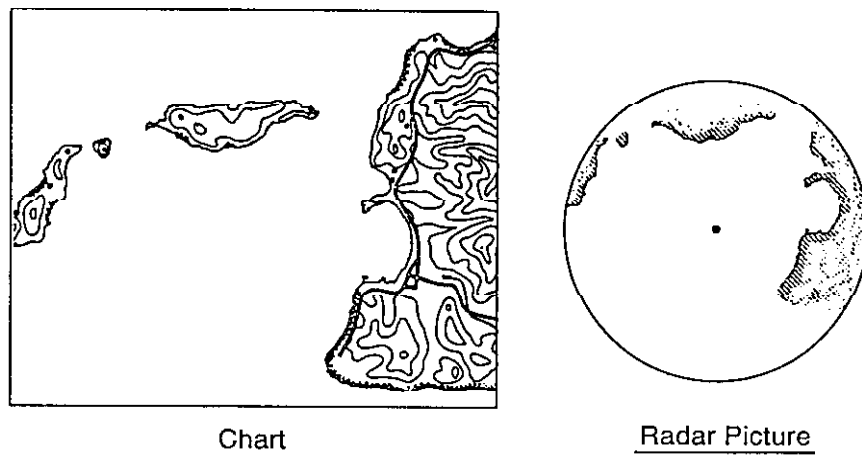


Figure 3-11 Nautical chart and associated radar picture

MAINTENANCE

This chapter tells you how to keep your radar in good working order. Before reviewing this chapter please read the safety information which follows.

- **Turn off the power before performing any maintenance procedures.**

- **DANGER: ELECTRICAL SHOCK HAZARD**

This equipment uses high voltage electricity which can endanger human life. At several places in the unit there are high voltages sufficient to kill anyone coming in direct contact with them. While the equipment has been designed with consideration for the operator's safety, precautions must always be exercised when reaching inside the equipment for the purpose of maintenance or service. For this reason, only qualified personnel totally familiar with electrical circuits and service manual should work inside the display unit or scanner unit.

- **CAUTION: RF RADIATION HAZARD**

The radar scanner emits high frequency radio radiation which can be harmful, particularly to your eyes. Never look directly into the scanner from a distance of less than two feet when the radar is in operation as you could injure the cornea of your eyes. Always make sure the radar is set to stand-by or is turned off before starting work on the scanner unit.

Routine Maintenance

Maintenance program

Regular maintenance is important for good performance. Always keep the equipment as free as possible from dirt, dust, and water splashes. Make sure all screws securing the components are properly tightened.

A maintenance program should be established and should at least include the items listed in Table 4-1.

Table 4-1 Maintenance program

Period	Item	Checkpoint	Remarks
3 to 6 months	Scanner unit fixing bolts	Check for tightness and corrosion.	Replace corroded bolts. Apply coat of anti-corrosive sealant to new bolts.
	Radome cleanliness	Foreign material (salt deposits, oil, etc.) on the radome face will cause a considerable drop in radar performance. Clean the radome with a freshwater-moistened cloth.	The only recommended cleaning agent is alcohol.
	Antenna connectors	Open the radome cover and visually check all connectors for proper seating and corrosion.	
	Radome gasket	Check for wear. Permanent damage to the scanner's internal circuitry will result if water leaks through the radome.	Replace if brittle or cracked.
	Radome cover	Check for cracks. Permanent damage to the scanner's internal circuitry will result if water leaks through the radome.	If a crack is found it should be temporarily repaired by using a small amount of sealing compound or adhesive. The unit should then be brought to your local dealer for permanent repairs.
	LCD	The LCD will, in time, accumulate a coating of dust which tends to dim the picture. Wipe lightly with a soft cloth.	DO NOT use chemical cleaners to clean any part of the display unit. They may remove paint and markings.
6 months to 1 year	Display unit connectors	Check for proper seating and corrosion.	

Replacing the fuse The 5A fuse in the power cable protects the equipment against reverse polarity of ship's mains, overcurrent, and equipment fault. If the fuse blows, find the cause before replacing it. Never use a fuse rated for more than 5A, since it may cause serious damage to the equipment and void the warranty.

Location of Parts

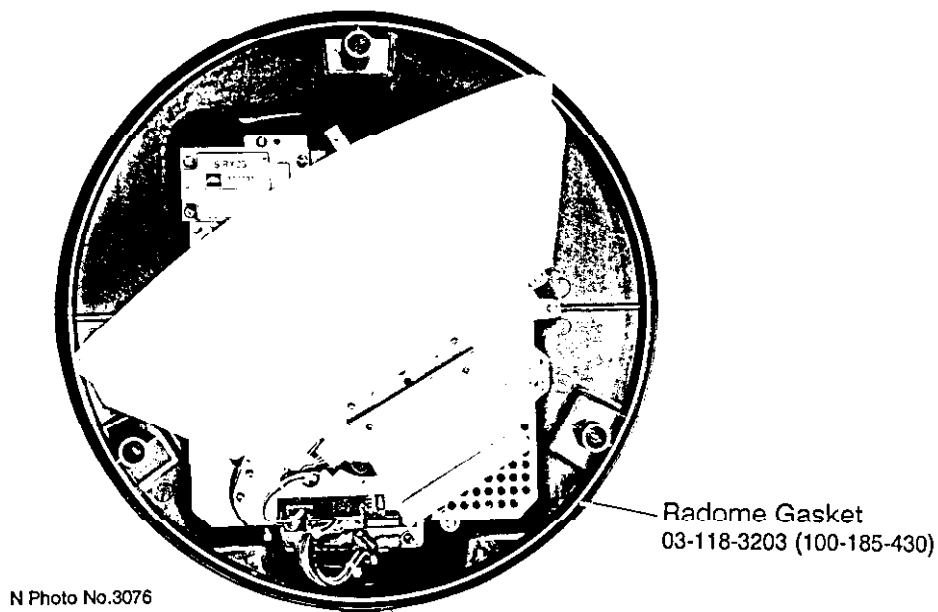


Figure 4-1 Scanner unit, radome opened

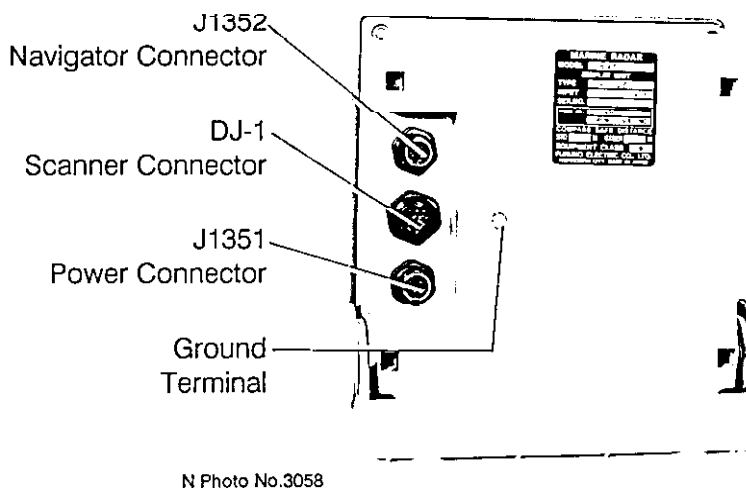


Figure 4-2 Display unit, rear view

TROUBLESHOOTING

This section provides troubleshooting information for both the user and the service technician.

Before reviewing this chapter please read the safety information which follows.

■ TO THE USER

If something appears to be wrong with your unit, check it by referring to the troubleshooting table. If you cannot restore normal operation, please do not attempt to check inside any unit. This equipment uses high voltage electricity which can cause severe injury or death. Any repair work is best left to a qualified technician.

■ TO THE SERVICE TECHNICIAN

Always make sure the electrical power is turned off before attempting to change a component or inspecting the inside of the equipment. A residual charge may also exist in capacitors, even with the equipment turned off. Therefore, always short all supply lines to the chassis with an insulated screwdriver or a similar tool before touching the circuit.

Troubleshooting Table

This section provides a troubleshooting table for use by both the user and the service technician.

Table 5-1 Troubleshooting table

IF...	BUT...	THEN...	
		User	Service Technician
you pressed the POWER key to turn on the radar	the panel does not light	<ul style="list-style-type: none"> • try raising the dimmer on menu. • battery may have discharged. • check fuse. 	<ul style="list-style-type: none"> • check panel section. • measure battery voltage. It should be 10.2 V to 31.2 V DC. • check DU Board (power section).
	nothing appears on the display (panel lights)	<ul style="list-style-type: none"> • try raising the tone. 	<ul style="list-style-type: none"> • check the I.C.D. If the tone can be adjusted the LCD is normal. • check DU Board.
	characters are distorted		<ul style="list-style-type: none"> • check DU Board.
the radar has warmed up and you pressed the TX STBY key to transmit the radar	the scanner does not rotate		<ul style="list-style-type: none"> • check scanner motor (B801) for obstruction. • check scanner drive gears. • check SD Board.
	characters, indications are abnormal		<ul style="list-style-type: none"> • check DU Board.
	"HD/BP SIG MISSING" appears (no heading or bearing pulse input from scanner)	<ul style="list-style-type: none"> • check signal cable for tight connection. 	<ul style="list-style-type: none"> • check signal cable for tight connection. • check SD Board. • check DU Board.

(Continued)

IF...	BUT...	THEN...	
		User	Service Technician
you adjusted sensitivity with both FTC and STC off ("0")	neither noise nor targets appear (indications and markers do)	<ul style="list-style-type: none"> • check signal cable for damage. 	<ul style="list-style-type: none"> • check SD Board. • check signal cable for short.
	neither indications nor marks appear (noise and targets do)	<ul style="list-style-type: none"> • check signal cable for damage. 	<ul style="list-style-type: none"> • check trigger line of signal cable for short. • check DU Board. • check SD Board. • check circulator (HY801). • measure magnetron voltage; <ol style="list-style-type: none"> 1) Transmit on max. range with scanner rotation suspended. (See note below.) 2) Measure voltage at test point TP804 #5(+) and #4(-) on SD Board in scanner unit. Voltage should be 1.3 V to 1.5 V DC. Replace magnetron if voltage is not within that range.
	the sweep is not synchronized with scanner rotation		<ul style="list-style-type: none"> • check scanner motor. • check SD Board. • check DU Board.
	there is no change in sensitivity		<ul style="list-style-type: none"> • measure magnetron voltage as described above. Replace magnetron if its voltage is not within range prescribed above. • MIC is out of tune.
a key is pressed	nothing happens		<ul style="list-style-type: none"> • key may be faulty. • check DU Board.

■ **NOTE:** To transmit the radar with scanner rotation suspended, turn on the power by pressing [↑] and **POWER** together. Press **TX STBY** after "ST-BY" appears on the display. After measuring voltage, press **POWER** and **TX STBY** together to turn off the power.

Location of Parts

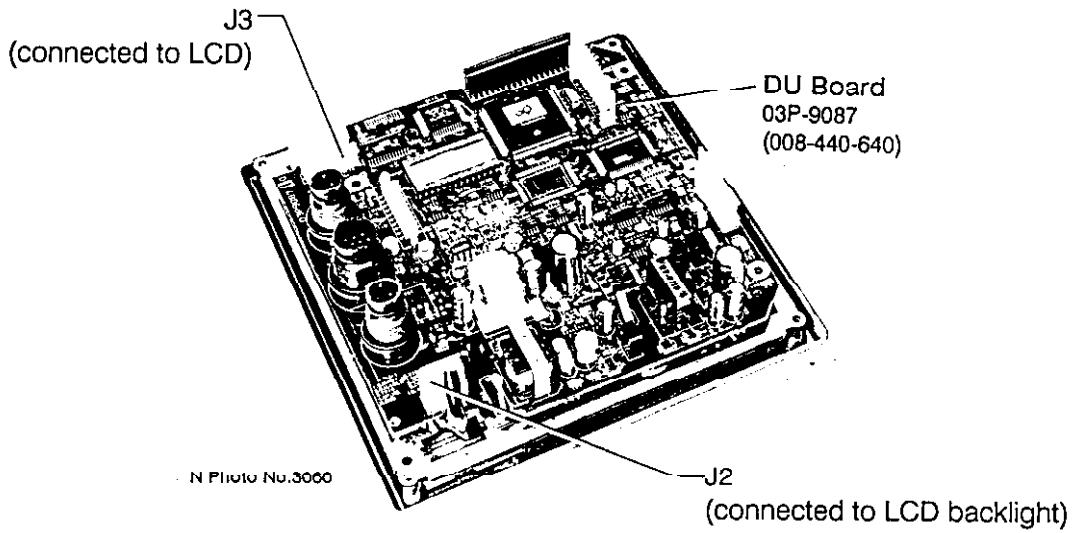


Figure 5-1 DU Board (display unit)

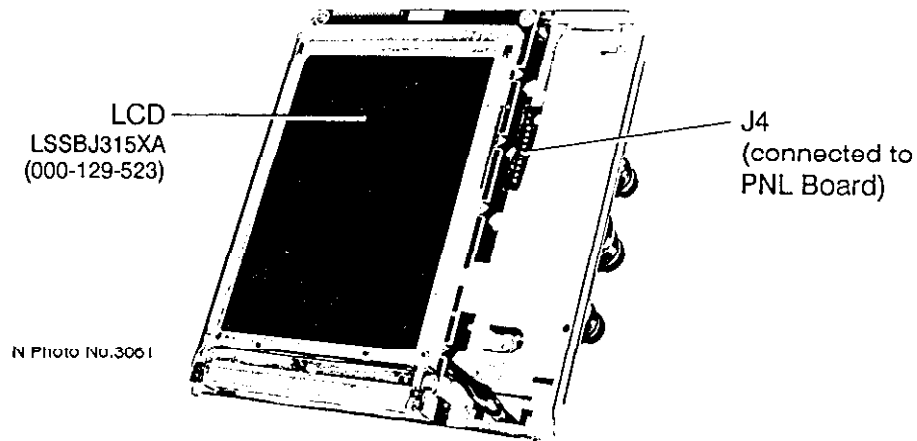


Figure 5-2 LCD panel

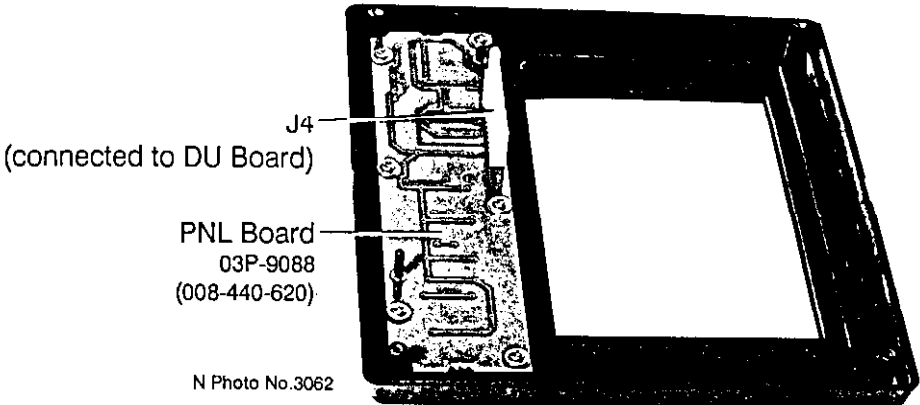


Figure 5-3 PNL Board

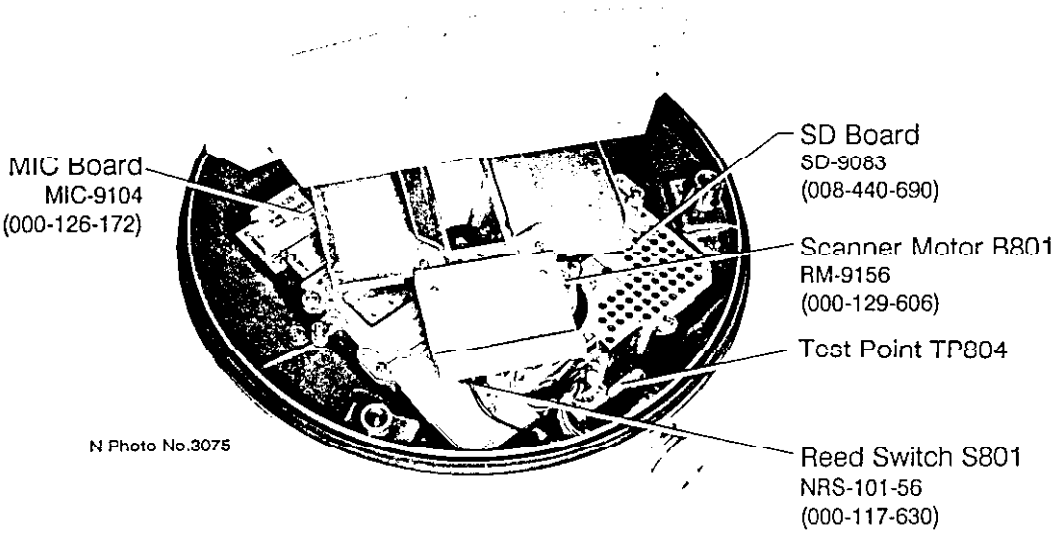
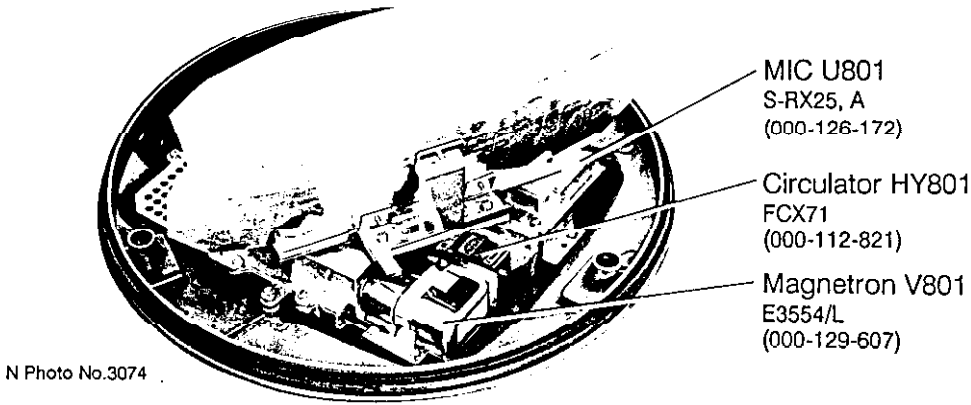


Figure 5-4 Scanner unit, inside views

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INSTALLATION

This chapter covers installation. Installation mainly consists of the following:

- siting and mounting the display unit and the scanner unit
- connection of the signal cable and the power cable
- establishing the ground
- connecting optional equipment, and
- adjustments.

Scanner Unit Installation

Mounting considerations

When selecting a mounting location for the scanner unit keep in mind the following points.

- Install the unit on top of the wheelhouse or on the radar mast on an appropriate platform. It should be placed where there is a good all-round view with, as far as possible, no part of the ship's superstructure or rigging intercepting the scanning beam. Any obstruction will cause shadow and blind sectors.
- Locate the unit at least two meters away from a direction finder antenna to prevent interference to the direction finder.
- In order to minimize the chance of picking up electrical interference, avoid where possible routing the signal cable near other onboard electrical equipment. Also avoid running the cable in parallel with power cables.
- The compass safe distance of 1.7 meters (standard compass) and 1.3 meters (steering compass) should be observed to prevent deviation of the magnetic compass.

Mounting

- 1) Open the radome cover carefully. Remove mounting hardware at the bottom of the radome base assembly; four each of M10 bolts, spring washers and flat washers. Save them to fix the radome base to the scanner platform.

■ **NOTE:** *The M10 bolts may be used to fasten the radome base to the scanner platform if the height of the platform is 10 mm or less.*

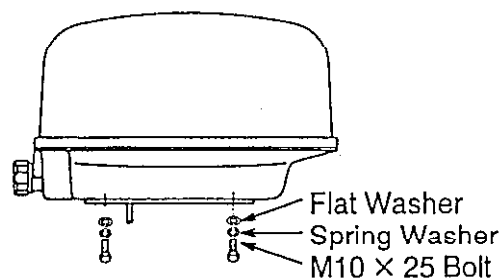


Figure 6-1 Scanner unit, showing location of mounting hardware

- 2) Loosen the radome fixing bolts (three). Carefully lift the radome over the insides of the dome. Remove the packing materials.

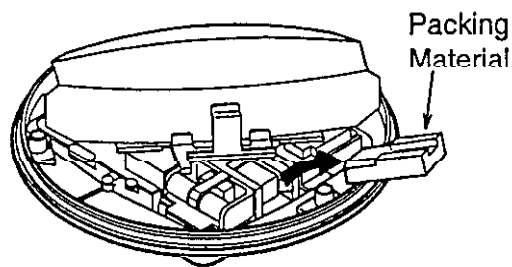


Figure 6-2 Scanner unit, cover removed, showing location of packing materials

Fixing holes

The mounting surface must be parallel with the ship's waterline and provided with five holes whose dimensions are shown in the outline drawing on page D-1. Four 12 mm holes for fixing, and one 20 mm hole for the vent tube.

There is a cable entry (cable gland) outside the scanner unit which should face the stern direction. The unit is adjusted so a target echo returned from the bow direction will be shown on the zero degree (heading marker) position on the screen. When drilling holes, be sure they are parallel with the fore and aft line.

Vent tube

Moisture can condense inside the radome, causing corrosion, if a means is not provided to keep moisture out of the radome. A vent tube fitted on the base of the radome allows the radome to "breathe" while not allowing entry of water from outside into the radome. Be sure the tube is kept free of foreign materials and is not pinched or kinked. The vent tube extends downward by 27 mm from the radome base. Ensure the vent tube extends downward before mounting the radome base.

- 3) Prepare a platform of 5 to 10 mm in thickness for the scanner unit. Find the cable entry on the radome base. Next, position the radome base so the cable entry faces the stern direction. This alignment must be as accurate as possible. Drill a hole of 20 mm diameter through the platform for the vent tube. Making sure the vent tube is in the correct position, fasten the radome base to the mounting surface with four each of M10×25 hex bolts, flat washers and spring washers removed at step 1. Do not overtighten the bolts; the tightening torque should be between 200 and 250 kg cm.

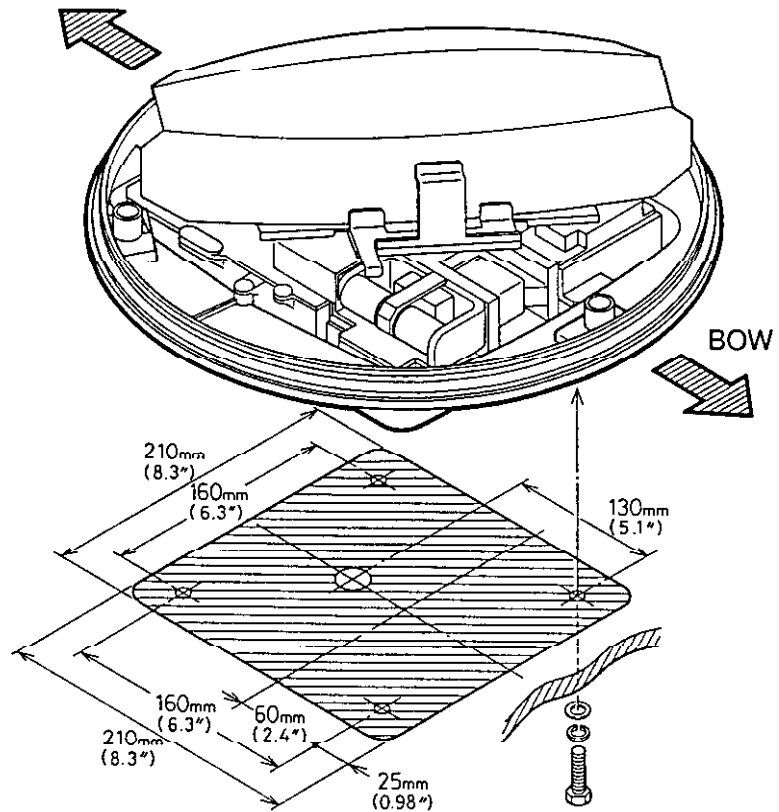


Figure 6-3 Mounting dimensions of scanner platform

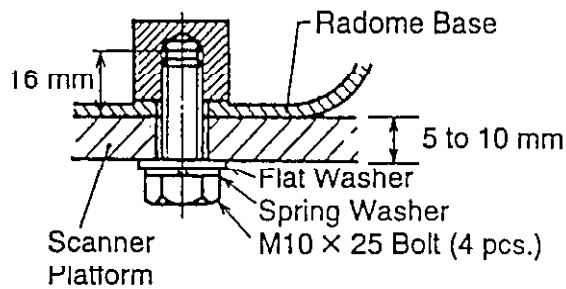


Figure 6-4 How to fasten radome base to platform

- 4) Drill a hole of at least 20 mm diameter through the deck or bulkhead to run the signal cable between the scanner unit and the display unit. Pass the cable through the hole. Then, seal the hole with sealing compound for waterproofing.

Referring to Figure 6-5, pass the cable through the hole at the rear of the radome. Pass cable through gasket and cable gland. Pass cable through gasket and cable gland, and then hand tighten cable gland. Fasten the shield to screw on the chassis to ground the unit.

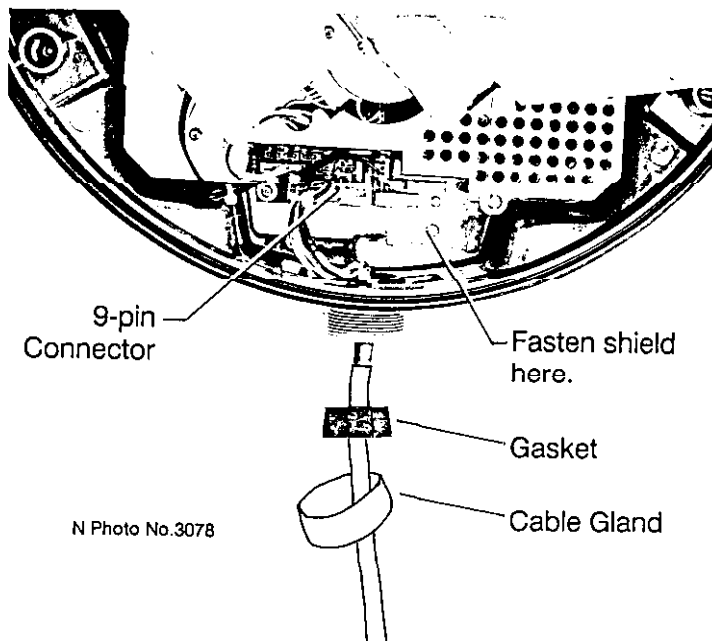


Figure 6-5 How to connect the signal cable to the scanner unit

- 5) Referring to Figure 6-5, connect the 9-pin connector.
- 6) Confirm the radome gasket is positioned as shown in Figure 6-6. Place the radome cover on the radome base assembly, facing the arrow on the scanner unit in the direction of the bow. Fasten the radome cover with the screws loosened at step 2.

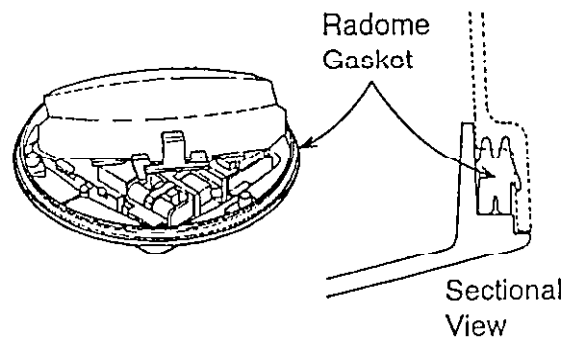


Figure 6-6 Proper position of radome gasket

Display Unit Installation

Mounting considerations

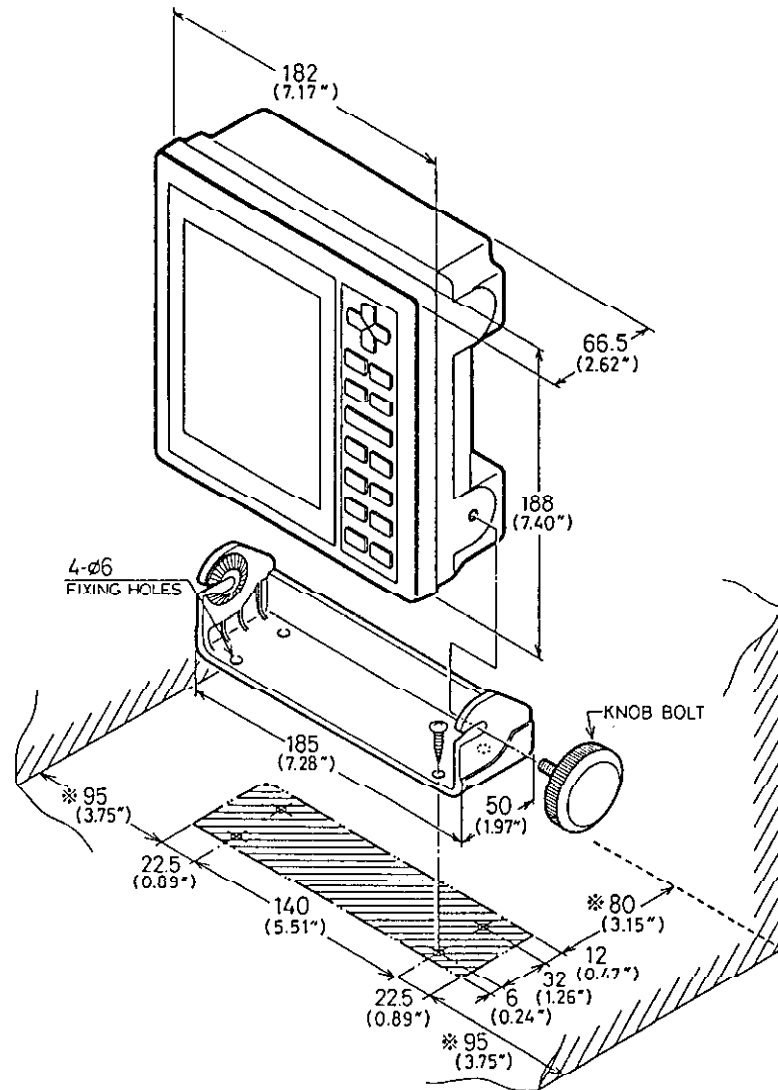
When selecting a mounting location for the display unit keep in mind the following points.

- The display unit is carefully constructed to be able to withstand the humidity and corrosive atmosphere common in a pilothouse, but it is not designed to be used outside, exposed to the environment.
- If this radar is to be installed on a small boat, the display unit must be mounted inside an enclosed cabinet to prevent corrosion of the connectors on the rear of the display unit. For maximum protection against corrosion by salt spray, tape the connectors and seal them with putty compounds.
- The display unit consumes only a moderate amount of power, so there is no need for forced air ventilation. However, you should provide adequate space behind and around the unit to permit circulation of air and to provide convenient access to the rear connectors.
- Even though the picture is quite legible even in bright sunlight, keep the display unit out of direct sunlight or at least shaded because of heat that can build up inside the cabinet.
- Locate the display unit in a position where you can view and operate it conveniently but where there is no danger of salt or fresh water spray or immersion.
- The orientation of the display unit should be so the radar screen is viewed while the operator is facing in the direction of the bow. This makes determination of your position much easier.
- Make sure you allow enough clearance both to get to the connectors behind the unit and to allow you to get your hands in on both sides to loosen or tighten the mounting knobs. Make sure you leave at least a foot or so of "service loop" of cables behind the unit so it can be pulled forward for servicing or easy removal of the connectors.
- The compass safe distance of 0.65 meters (standard compass) and 0.5 meters (steering compass) should be observed to prevent deviation of the magnetic compass.

Mounting

The display unit is designed to be mounted on a tabletop.

- 1) Fix the hanger to the mounting location with four M6 tapping screws (supplied).
- 2) Fit the knob bolts to the display unit.
- 3) Install the display unit in the hanger. Tighten the knob bolts securely.



※ :SERVICING CLEARANCE

Figure 6-7 Display unit outline drawing

Connections

Connect the signal cable, the power cable, and the ground wire as shown in Figure 6-8.

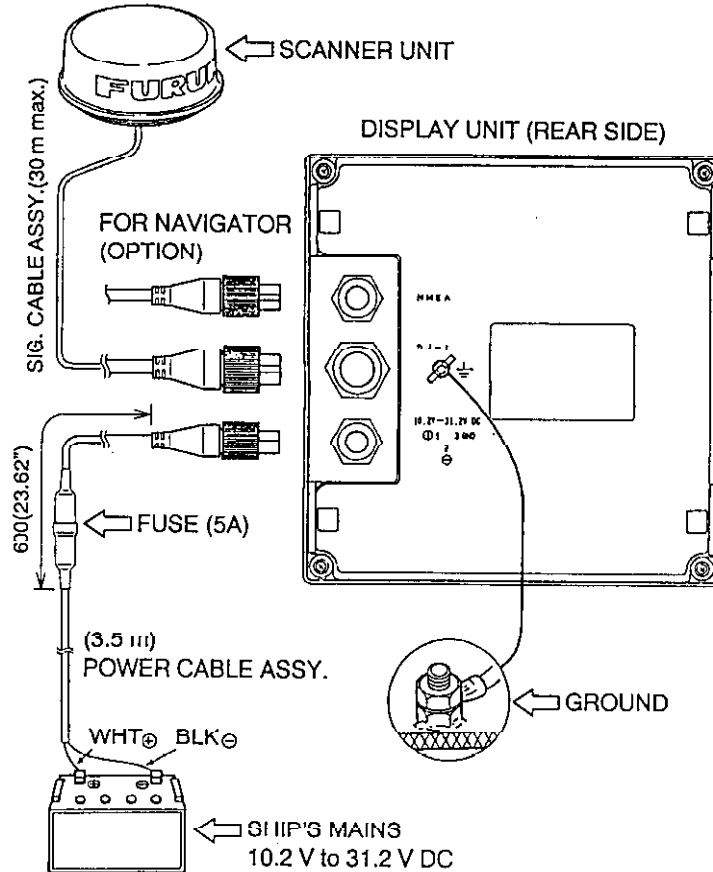


Figure 6-8 Connections

Navigator connection

If your navigator can output data in NMEA 0183 or FURUNO CIF data format, your vessel's position in latitude and longitude, the range and bearing to waypoint, speed, and course may be input to this radar, and be seen in the bottom text area.

You will need the NMEA Cable 22S0021 and a connector to connect the radar to the navigator. (Some navigators are equipped with a connection cable with connector.)

Connect the NMEA cable to the radar display unit as shown in Figure 6-9.

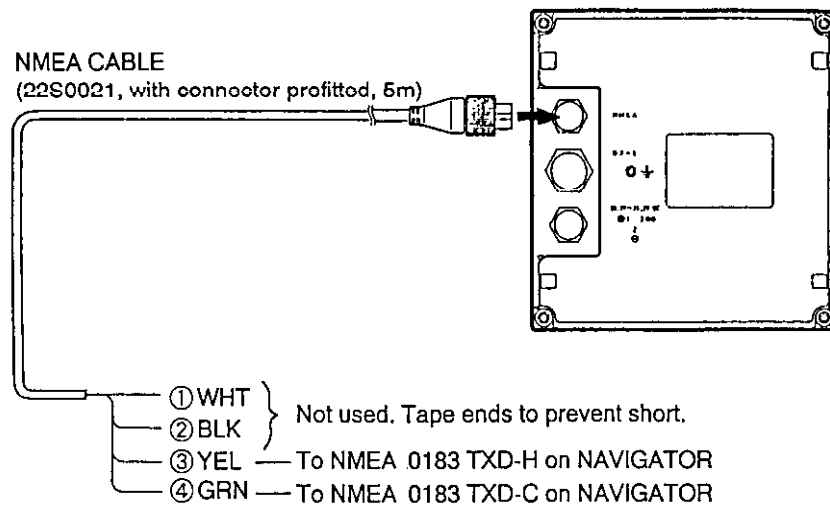


Figure 6-9 Navigator connection

Table 6-1a Connection terminal on external equipment

Model	FCV-665		FMV-605		FCV-581		T-2000		GP-1500/1250 LP-1300/1250		GP-1500/1250 LP-1300/1250	
Output Port	J12		J12		NMEA(J2)		I/F		OUTPUT		OUTPUT	
Connector Type	MJ-A4SPF※		MJ-A4SPF※		MJ-A4SPF※		MJ-A4SPF※		XM2A0901XM290903		XM2A0901XM290903	
Signal Name and Pin No.	Pin No	Signal Name	Pin No	Signal Name	Pin No	Signal Name	Pin No	Signal Name	Pin No	Signal Name	Pin No	Signal Name
	—		—		—		—		—		—	
	1	TXD-H	1	TXD-H	1	TXD-H	1	TXD-H	1	TXD-H	11	TXD-H
	2	TXD-C	2	TXD-C	2	TXD-C	2	TXD-C	2	TXD-C	12	TXD-C
							10	GND	10	GND	10	GND
									13	Jumper Wire	13	Jumper Wire
									14	Jumper Wire	14	Jumper Wire
Data Format	NMEA 0183		NMEA 0183		CIF/0183		CIF/0183		CIF/0183/0180		CIF/0183/0180	
Selection of Data Format	—		—		Menu		DIP Switch		Menu		Menu	
Remarks:	※ :Cable Assy. 22S0021		※ :Cable Assy. 22S0021		※ :Cable Assy. 22S0021		※ :Cable Assy. 22S0021					

Table 6-1b Connection terminal on external equipment

Model	GP-70		GP-500		GP-500		GP-50		LC-880/90M2		LC-90M2(M)	
Output Port	DATA-1/DATA-2		DATA OUT		DATA IN/OUT		DATA OUT		OUTPUT		OUTPIIT	
Connector Type	MJ-A6SPF※		MJ-A6SPF※		XM2A-1501		MJ-A65PF※		SRCN6A16-10P		SRCN6A16-10P	
Signal Name and Pin No.	Pin No	Signal Name	Pin No	Signal Name	Pin No	Signal Name	Pin No	Signal Name	Pin No	Signal Name	Pin No	Signal Name
		1	TXD-H	1	TXD-H	10	TXD-H	1	TXD-H 1	5	TXD-H	1
	2	TXD-C	2	TXD-C	11	TXD-C	2	TXD-C 1	6	TXD-C	2	TXD-C
	6	GND	6	GND	9	GND	3	TXD-H 2	10	GND	10	GND
							4	TXD-C 2				
							6	GND				
Data Format	CIF/0183/0180		CIF/0183		0183		CIF/0180S/0183		0180S/0183		CIF/0183	
Selection of Data Format	Menu		Monu		-		Menu		Menu		Menu	
Remarks:	※ :Cable Assy. 20S0093		※ :Cable Assy. 20S0093				※ :Cable Assy. 20S0083					

Adjustments

- **NOTE:** *To prevent possible personnel injury from radio frequency radiation hazards, be certain no one is near the scanner before turning on the radar.*

Initial procedure

Follow the procedure below to obtain proper radar picture.

- 1) Press the **POWER** key on the display unit. The display should light. In approximately 1 minute and 30 seconds, the message "ST-BY" will appear at the screen center.
- 2) When "ST-BY" appears press the **TX STBY** key. The radar will start transmitting, and you will probably see some targets around you, even though the radar is not yet properly adjusted.
- 3) Adjust the sensitivity to display a small amount of noise on the screen.
- 4) Press the [-] key several times to select the minimum range. Adjust the STC to display nearby radar targets clearly on the screen. Too much STC action will eliminate small targets, and too little STC action will cause the screen to be so full of targets and noise that it is hard to determine which target is which as compared to visual sightings.

Relative bearing alignment

You have mounted the scanner unit facing straight ahead in the direction of the bow. Therefore, a small but conspicuous target dead ahead visually should appear on the heading mark (zero degrees).

In practice, you will probably observe some small error on the display because of the difficulty in achieving accurate initial positioning of the scanner unit. The following adjustment will compensate for this error, up to ± 30 degrees.

- 1) Identify a suitable target (for example, ship or buoy) at a range between 1/8 to 1/4 miles, preferably near the heading mark. To minimize error, keep echoes in the outer half of the picture by changing the range.
- 2) Press and hold down [←] and [→] keys together (about 10 seconds) until the installation menu appears.

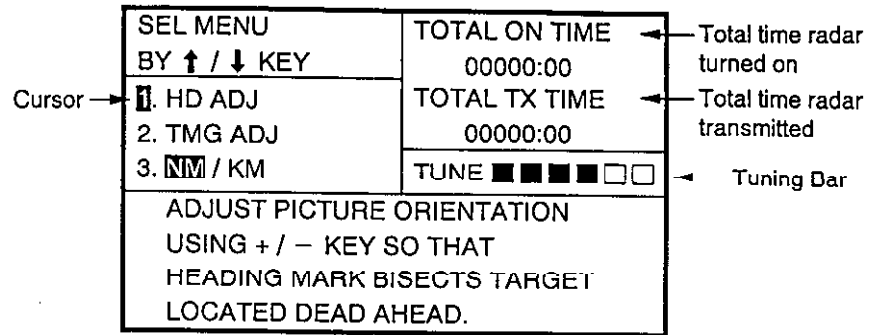


Figure 6-10 Installation menu

- 3) Press [↑] and [↓] to select “1. HD ADJ.”
- 4) The heading marker and adjustable sector markers appear. See Figure 6-11a.
- 5) Press [+] and [-] keys to bisect the target selected at step 2 with the heading marker. See Figure 6-11b.

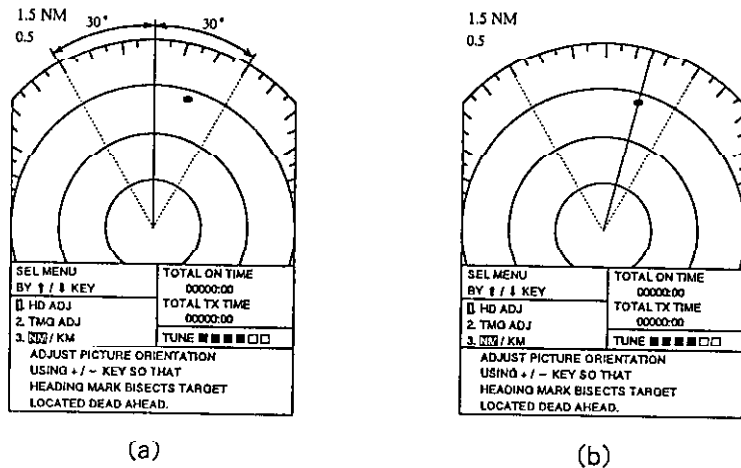


Figure 6-11 Heading marker and adjustable sector markers

- 6) As a final test, move the boat towards a small buoy and confirm that the buoy shows up dead ahead on the radar when it is visually dead ahead.
- 7) Press the **MENU** key to close the installation menu, or adjust sweep timing as shown on the next page.

Sweep timing

This adjustment ensures proper radar performance, especially on short ranges. The radar measures the time required for a transmitted echo to travel to the target and return to the source. The received echo appears on the display based on this time. Thus, at the instant the transmitter is fired, the sweep should start from the center of the display (sometimes called sweep origin.)

A trigger pulse generated in the display unit goes to the scanner unit through the signal cable to trigger the transmitter (magnetron). The time taken by the signal to travel up to the scanner unit varies, depending largely on the length of signal cable. During this period the display unit should wait before starting the sweep. When the display unit is not adjusted correctly, the echoes from a straight local object (for example, a harbor wall or straight pier) will not appear with straight edges – namely, they will be seen as “pushed out” or “pulled in” near the picture center. The range of objects will also be incorrectly shown.

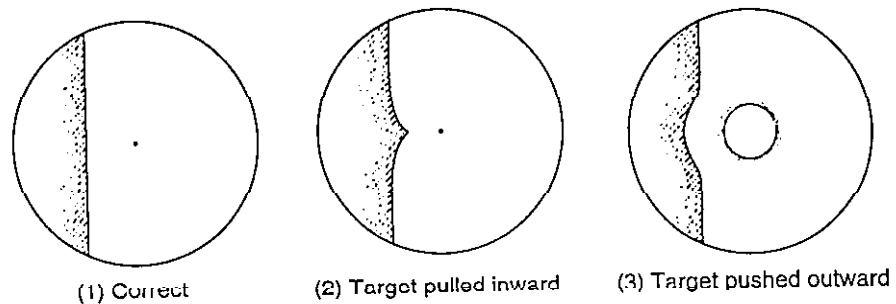


Figure 6-12 Examples of improper and correct sweep timings

- 1) Transmit the radar on the shortest range and adjust the sensitivity and STC.
- 2) Visually select a straight echo (harbor wall, straight pier).
- 3) If the installation menu is not already displayed, press and hold down [←] and [→] together (about 10 seconds).

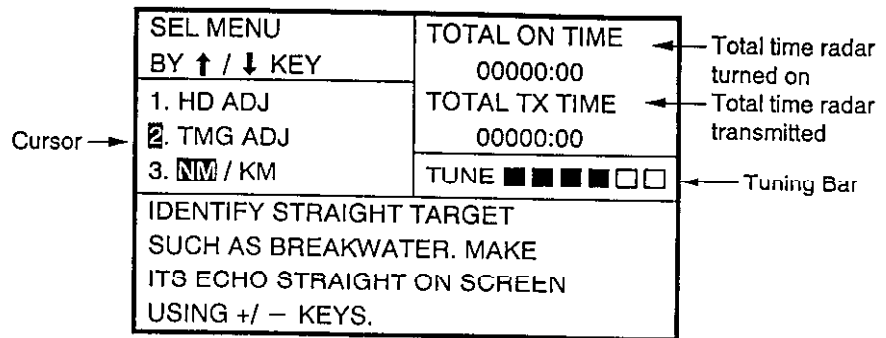


Figure 6-13 Installation menu

- 4) Press [↑] and [↓] to select “2. TMG ADJ.”
- 5) While looking at the target selected at step 2, press the [+] key if the target is pulled inward, or press the [-] key if the target is pushed outward.
- 6) Press the **MENU** key to close the installation menu, or select unit of range measurement for the VRM and the cursor as shown below.

Unit of range measurement for VRM and cursor

The unit of range measurement for the VRM and the cursor may be selected for nautical mile or kilometer.

- 1) If the installation menu is not already displayed, press and hold down [←] and [→] together (about 10 seconds).

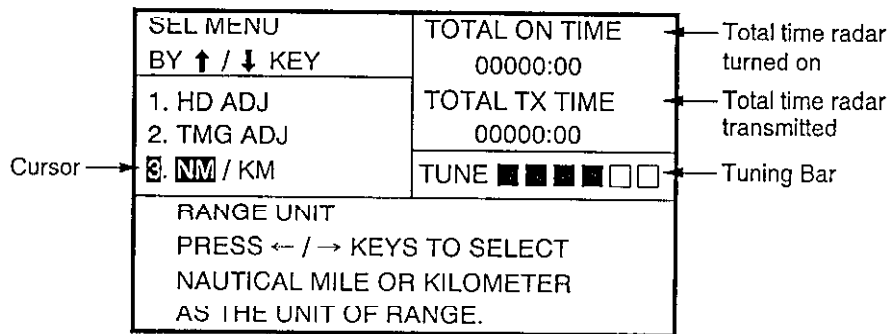


Figure 6-14 Installation menu

- 2) Press [↑] and [↓] to select “3. NM/KM.”
- 3) Press [→] or [←] to select unit desired.
- 4) Press the **MENU** key to close the installation menu.

Magnetron heater voltage

Magnetron heater voltage is formed at the SD Board of the scanner unit and preadjusted at the factory for use with any length of signal cable. Therefore no adjustment is required. However, verify heater voltage by following the procedure below.

- 1) Turn on the power. Do not transmit the radar.
- 2) Connect a multimeter, set to 10 V DC range, between #6(+) and #4(-) of test point TP804 on the SD Board in the scanner unit.
- 3) Confirm that the multimeter shows $8.0\text{ V} \pm 0.1\text{ V}$. If it does not, adjust potentiometer VR801 on the SD Board.

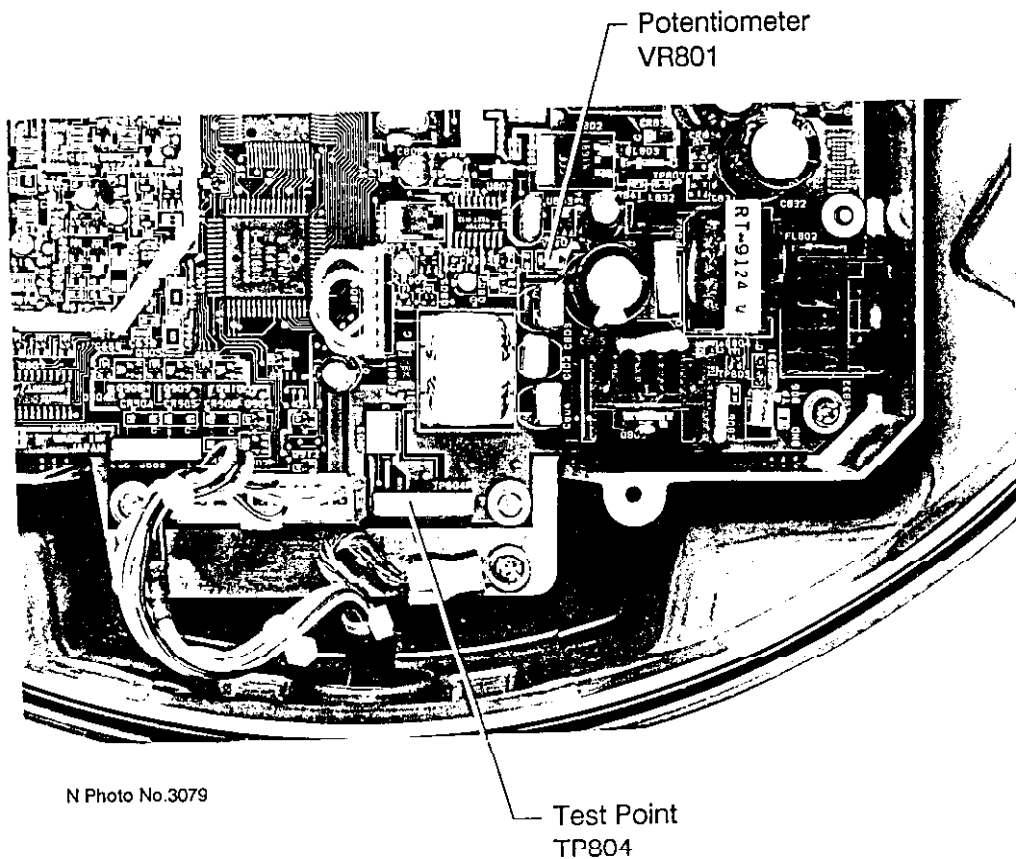


Figure 6-15 Scanner unit, inside view, SD Board

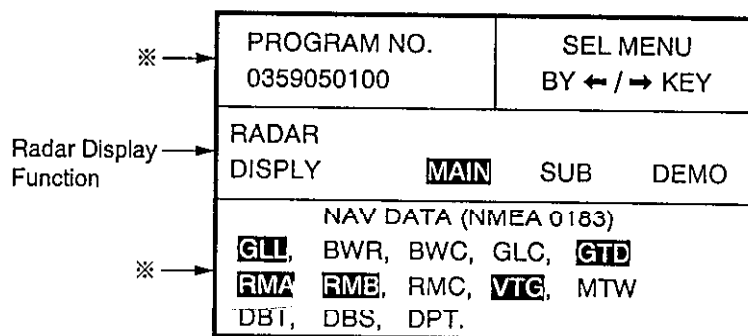
Selecting mode of operation (function)

The MODEL 1621 can function as

- the main radar
- a monitor (under development), or
- a demonstration model, simulating target echoes by an echo generator (optional EG Board required).

You can select radar function as follows.

- 1) Set the radar to stand-by.
- 2) Press and hold down [↑] and [↓] together (about 10 seconds) until the display shown in Figure 6-16 appears.



※ : For use by service technicians. This display shows ROM program number and what data (in reverse video) are being input by navigator.

Figure 6-16

- 3) Press [←] and [→] to select MAIN, SUB or DEMO.
- 4) Press the **MENU** key.

List Of Outline Drawings and Circuit Diagrams

Table D-1 Outline drawings

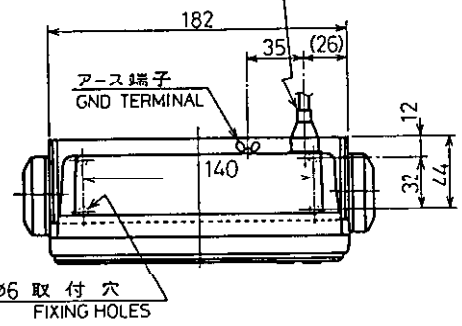
No.	Name	Type	Drawing No.	Page
1	Display Unit	RDP-105	C3378-G01	D-1
2	Radar Scanner Unit	RSB-0060	C3378-G02	D-2

Table S-1 Circuit diagrams

No.	Name	Type	Drawing No.	Page
1	Interconnection Diagram	MODEL 1621	C3378-C01	S-1
2	Display Unit	RDP-105	C3378-K02	S-2
3	Power Supply of DU Board	03P-9087	C3378-K04	S-3
4	Panel	03P-9088	C3378-K03	S-4
5	Scanner Unit	RSB-0060	C3378-K01	S-5
6	Power Supply of SD Board	SD-9083	C3378-K05	S-6

A
B
C
D

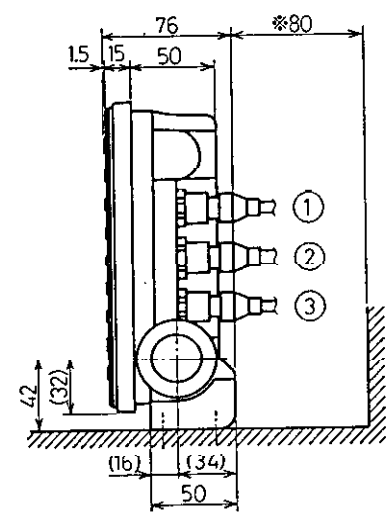
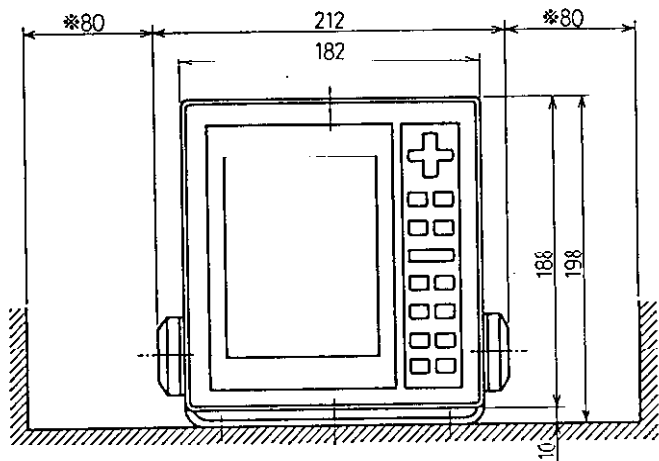
- コネクタ CONECTORS
上より FROM TOP
- ① 航法装置用ケーブルコネクタ
CONNECTOR FOR NAV AID
 - ② 空中線ケーブルコネクタ
CONNECTOR FOR SCANNER UNIT
 - ③ 電源ケーブルコネクタ
CONNECTOR FOR SHIP'S MAINS



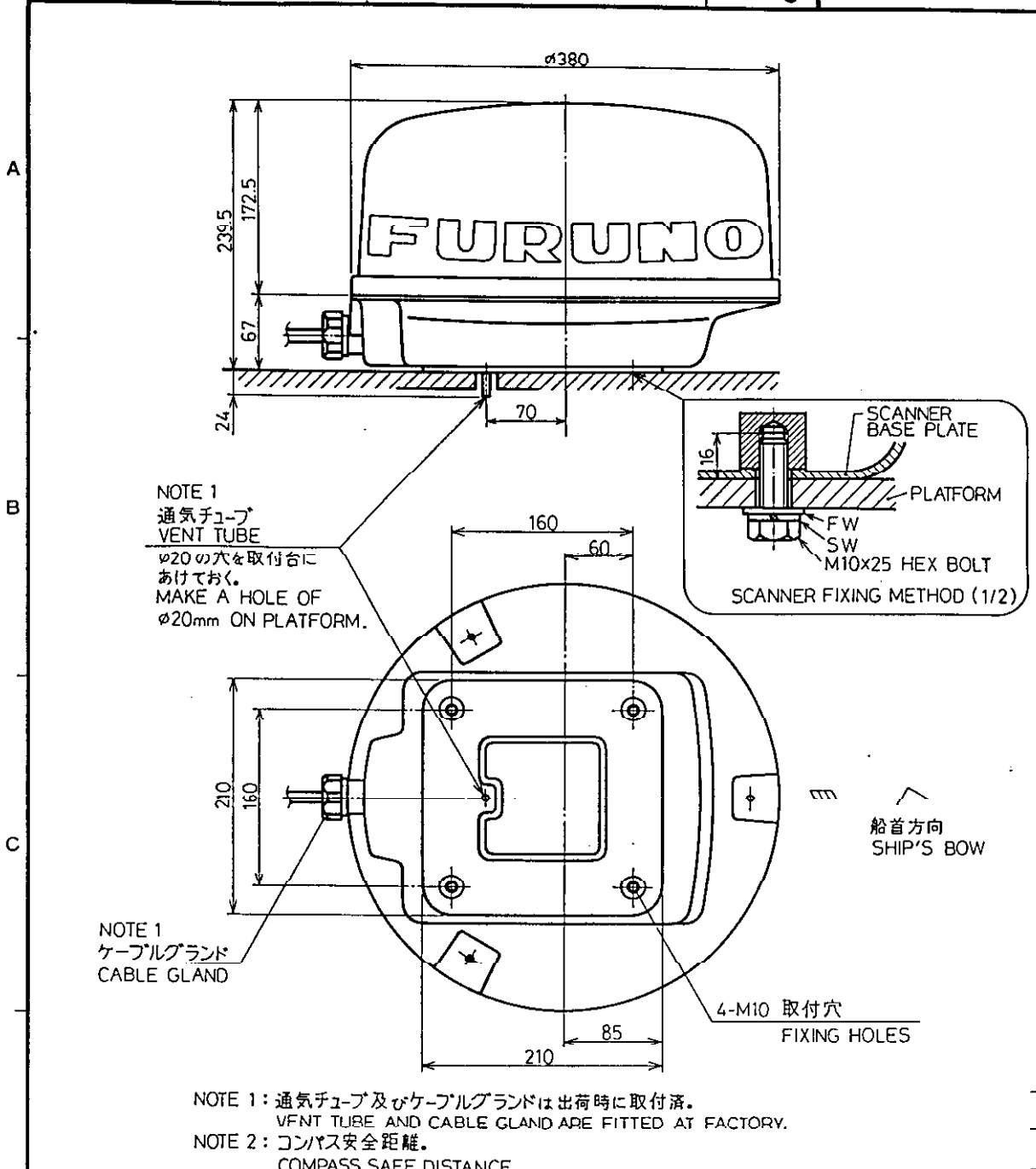
- 注 1. ※: 推奨サービス空間
2. 装備ケーブルはサービス時に指示部を十分引き出せる様 余裕をもたせる事。
- NOTE 1. ※: RECOMMENDED SERVICING CLEARANCE.
2. SUFFICIENT EXTRA CABLING SHOULD BE ALLOWED AT THE BACK OF THE UNIT SO THAT THE UNIT CAN BE DRAWN OUT, WITH THE CABLES CONNECTED FOR MAINTENANCE.

コンパス安全距離
COMPASS SAFE DISTANCE

スタンダード STANDARD	
ステアリング STEERING	

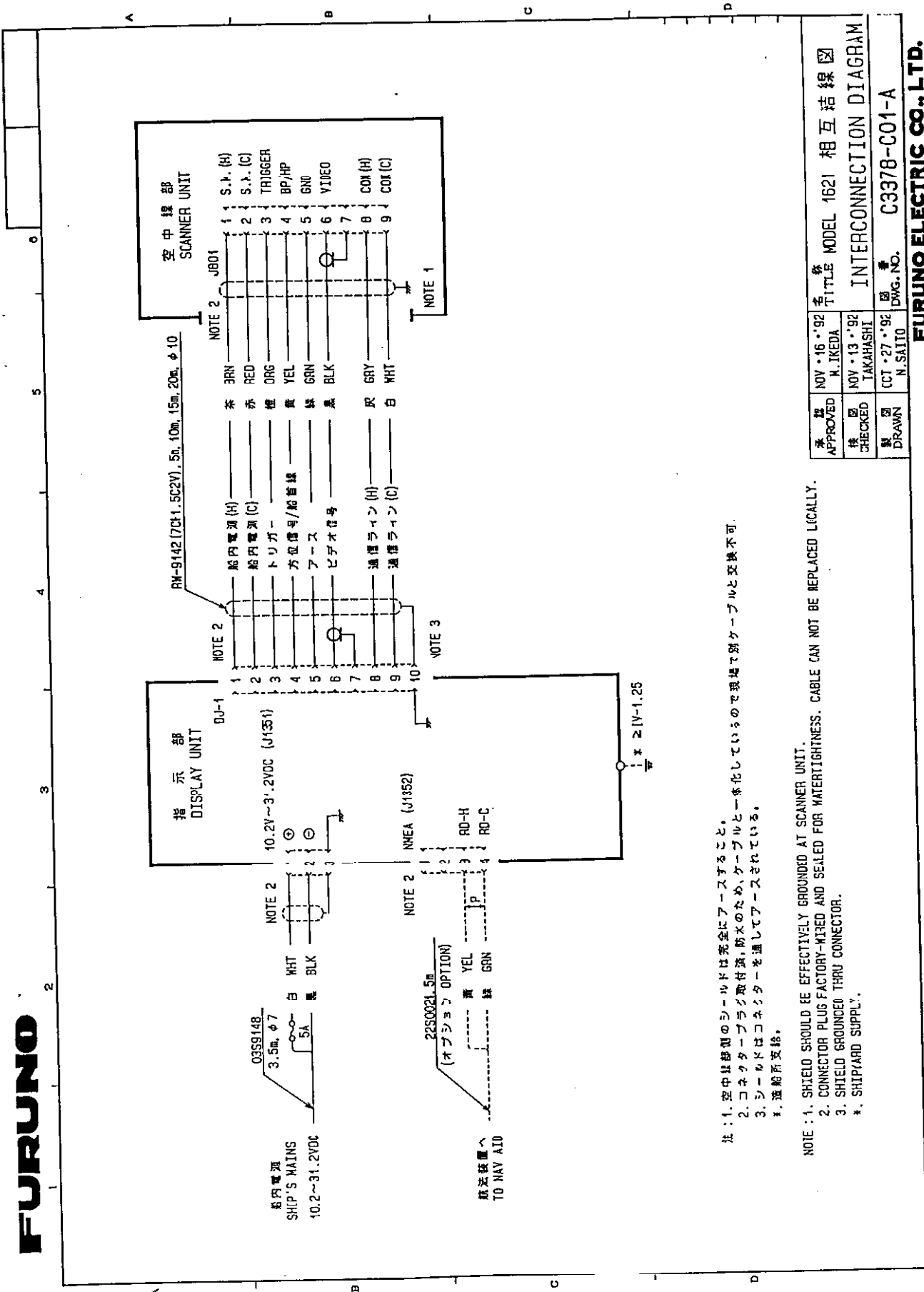


MODEL 1621	品番 ITEM	品名 NAME	材質 MATERIAL	数量 Q'TY	図番 DWG.NO.	摘要 REMARKS
承認 APPROVED	NOV. 6. '92 M. IKEDA	三角法 THIRD ANGLE PROJECTION				名称 TITLE RDP-105 指示部外寸図 DISPLAY UNIT
検図 CHECKED	NOV. 6. '92 T. TAKAHASHI	尺度 SCALE 1/4				
製図 DRAWN	OCT. 19. '92 N. SAITO	重量 WEIGHT 1.5 kg			図番 DWG.NO. C3378-G01-A	



スタンダード STANDARD	m
ステアリング STEERING	m

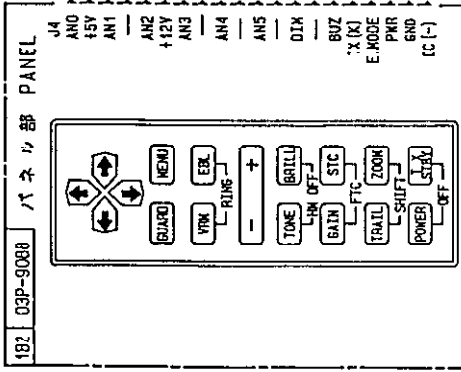
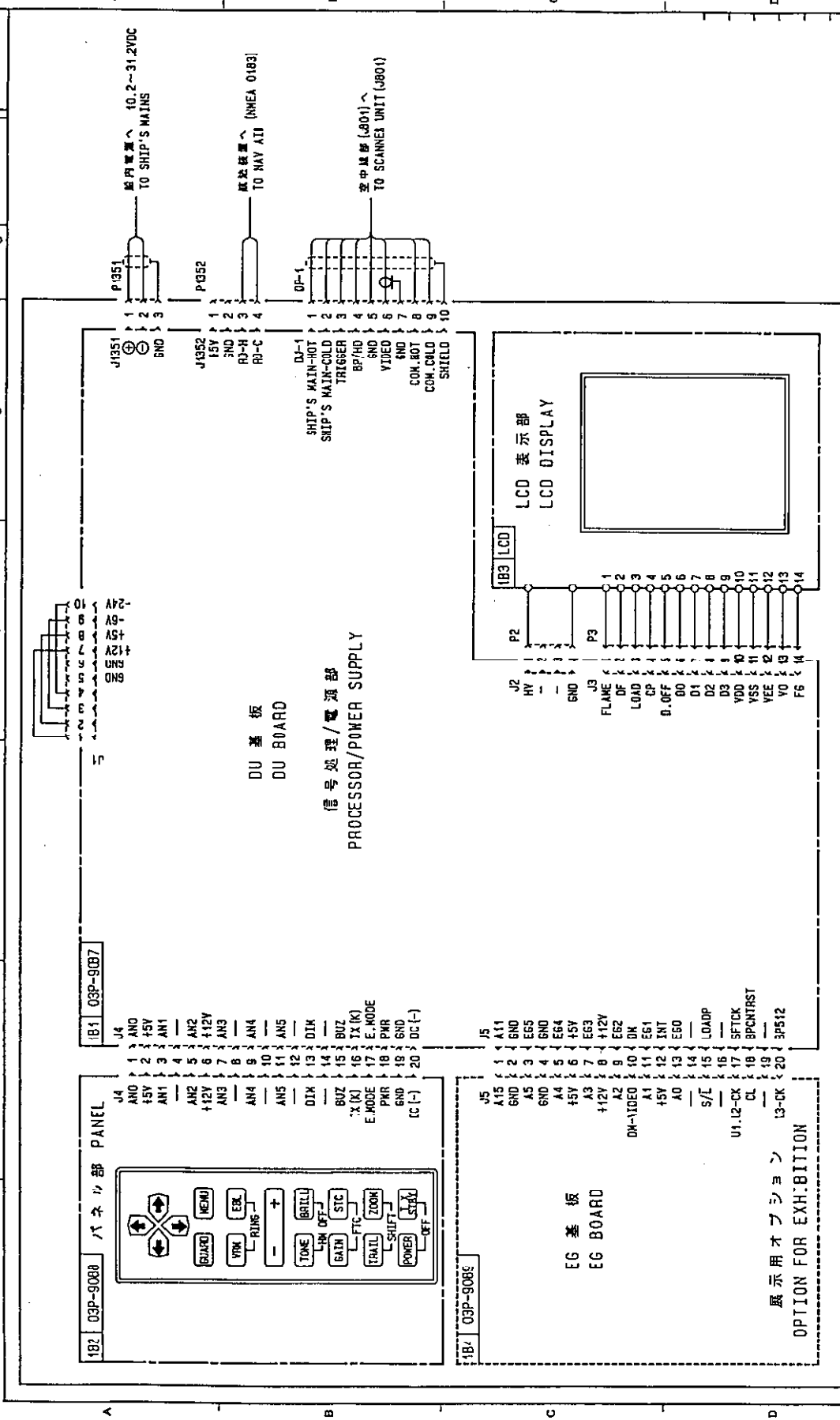
MODEL 1621		品番 ITEM	品名 NAME	材質 MATERIAL	数量 Q'TY	図番 DWG.NO.	概要 REMARKS
承認 APPROVED	DEC. 1. '92 M. JKEDA	三角法 THIRD ANGLE PROJECTION		名称 TITLE		レーダー空中線部外寸図	
検図 CHECKED	DEC. 1. '92 TAKAHASHI	尺度 SCALE	1/5	RSB-0060		RADAR SCANNER UNIT	
製図 DRAWN	DEC. 1. '92 N. SAITO	重量 WEIGHT	5 kg	図番 DWG.NO.		C3378-G02-A	



注: 1. 航空線部のシールドは完全にアースすること。
 2. コネクタープラグ取付済、防水のため、ケーブルと一体化しているので現場で別ケーブルと交換不可。
 3. シールドはコネクターを通してアースされている。
 * 造船所交換。

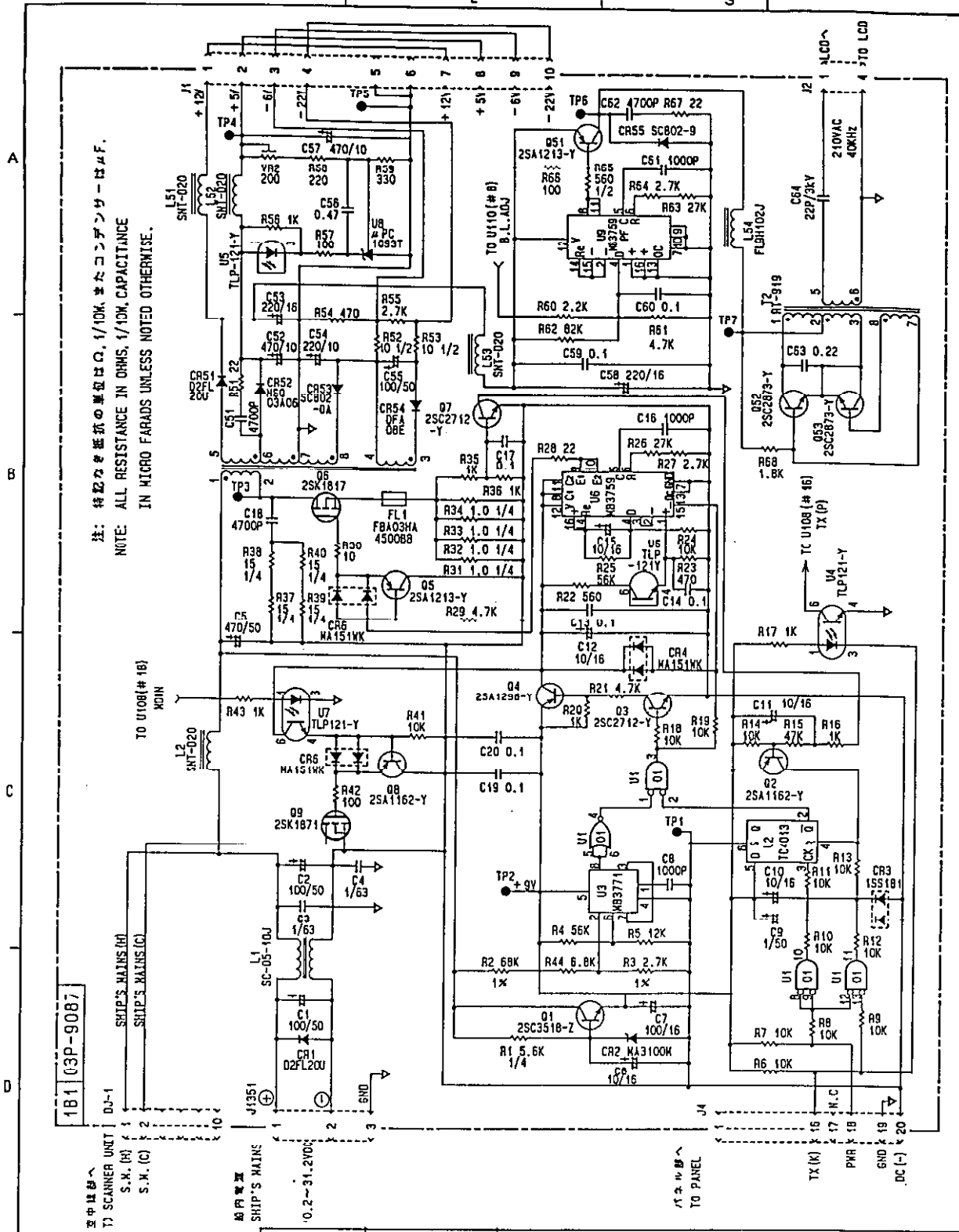
NOTE: 1. SHIELD SHOULD BE EFFECTIVELY GROUND AT SCANNER UNIT.
 2. CONNECTOR PLUG FACTORY-WIRED AND SEALED FOR WATER TIGHTNESS. CABLE CAN NOT BE REPLACED LOCALLY.
 3. SHIELD GROUNDED THRU CONNECTOR.
 *. SHIPYARD SUPPLY.

承認 APPROVED	NOV. 16 '92 M. IKEDA	各務 TITTLE	MODEL 1621 相互接続図
検図 CHECKED	NOV. 13 '92 TAKAHASHI	INTERCONNECTION DIAGRAM	
製図 DRAWN	OCT. 27 '92 N. SAITO	図番 DRG. NO.	C3378-C01-A



承認 APPROVED	NOV・16・'92 M. IKEDA	名称 TITLE	指示部 RDP-105
検閲 CHECKED	NOV・13・'92 TAKAHASHI	図番 DWG. NO.	C337B-K02-A
製図 DRAWN	OCT・27・'92 N. SAITO	図名 MODEL	1621

FURUNO ELECTRIC CO., LTD.



注: 特記なき抵抗の単位はΩ, 1/10K, またコンデンサ単位はμF.
 NOTE: ALL RESISTANCE IN OHMS, 1/10K, CAPACITANCE IN MICRO FARADS UNLESS NOTED OTHERWISE.

1B1 (3P-9087)

SCANNER UNIT
 S.K. (B)
 S.K. (C)

SHIP'S MAINS (B)
 SHIP'S MAINS (C)

J1351

SHIP'S MAINS
 0.2~31.2VDC

GND

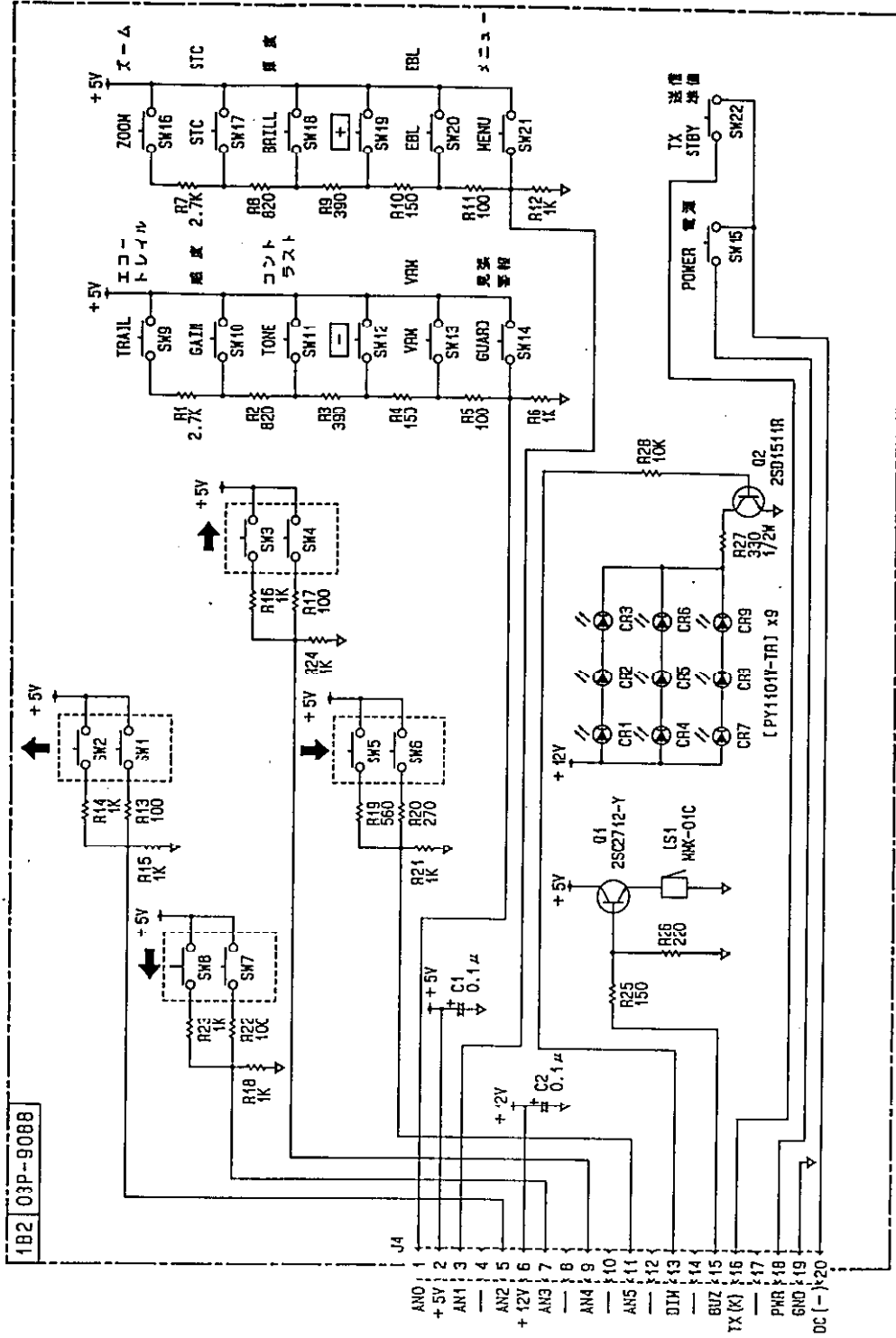
TO U108 (#18)
 MAIN

TO U110 (#8)
 B.L. ADV

TO PANEL

TX (K)
 PHR
 GND (-)
 DC (-)

承認 APPROVED	DEC · 14 · '92 M. IKEDA	名称 TITLE	DU基板電源部 POWER SUPPLY OF DU BOARD
検査 CHECKED	DEC · 14 · '92 TAKAHASHI	番 DWG. NO.	C3378-K04-A
製 DRAWN	DEC · 14 · '92 N. SAITO		

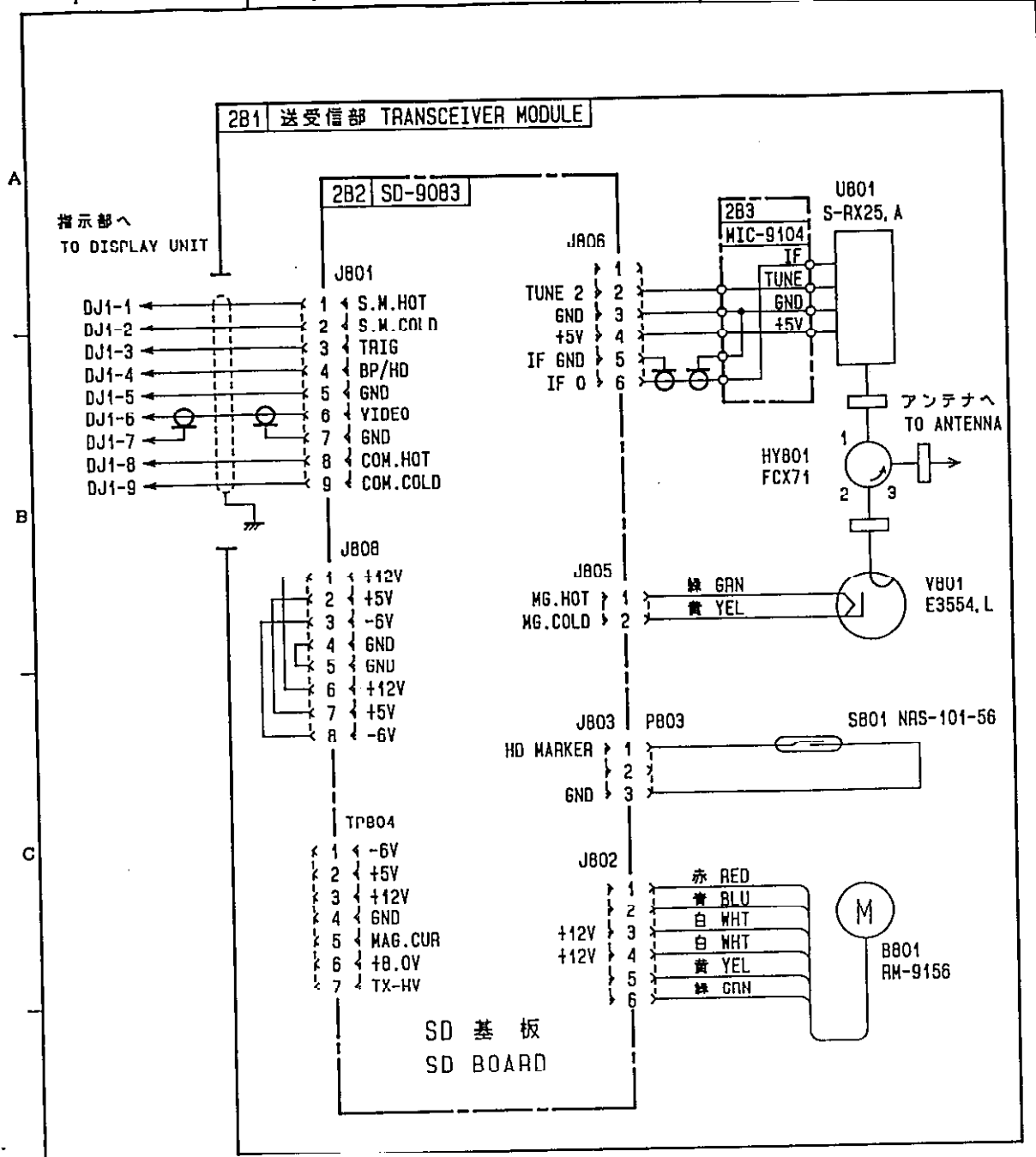


1B2 03P-9088

- J4 1 ANO
- 2 +5V
- 3 AN1
- 4 AN2
- 5 +12V
- 6 AN3
- 7 AN4
- 8 AN5
- 9 AN6
- 10 AN7
- 11 AN8
- 12 DIM
- 13 BUZ
- 14 TX (+)
- 15 TX (-)
- 16 PWR
- 17 GND
- 18 GND
- 19 GND
- 20 DC (-)

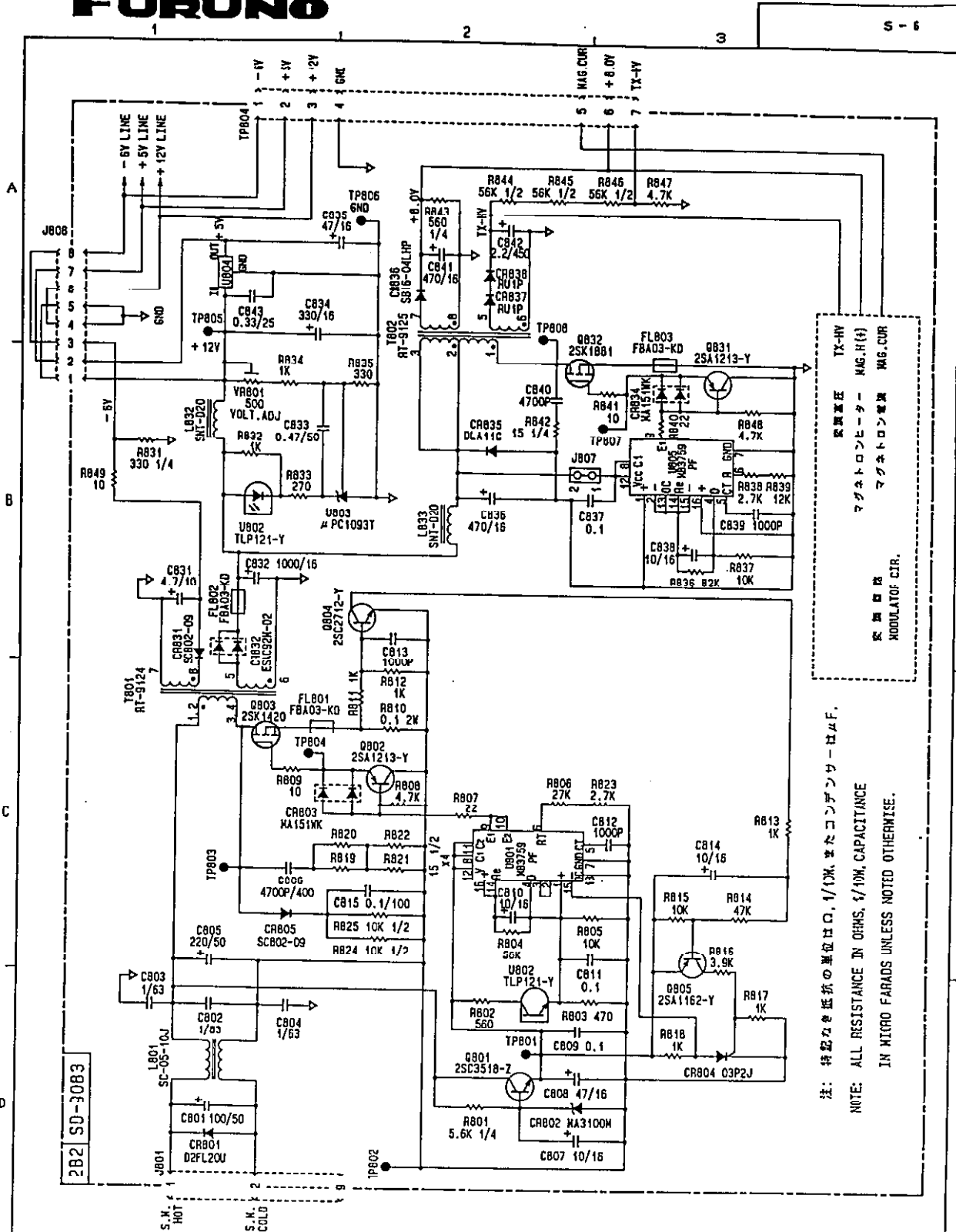
注: 特記なき抵抗の単位はΩ, 1/10K, またコンデンサはF.
 NOTE: ALL RESISTANCE IN OHMS, 1/10K, CAPACITANCE IN FARADS UNLESS NOTED OTHERWISE.

承認 APPROVED	DEC・14・'92 M.IKEDA	名称 TITLE	パネル部 PANEL
検 CHECKED	DEC・14・'92 TAKAHASI	03P-9088	
製 DRAWN	DEC・14・'92 N.SAITO	毎 DWC.NO.	C3378-K03-A



MODEL 1621

承認 APPROVED	NOV・16・'92 M.IKEDA	名称 TITLE	空中線部 RSB-0060
検 CHECKED	NOV・13・'92 TAKAHASHI	SCANNER UNIT	
製 DRAWN	OCT・27・'92 N.SAITO	番 DWG.NO.	C3378-K01-A



注: 特記なき抵抗の単位はΩ, 1/10K, またはコンデンサの単位はμF.
 NOTE: ALL RESISTANCE IN OHMS, 1/10K, CAPACITANCE
 IN MICRO FARADS UNLESS NOTED OTHERWISE.

承認	DEC. 14. '92	名称	SD基板電源部
検査	DEC. 14. '92	TITLE	SD-9083
検査	TAKAHASHI		POWER SUPPLY OF SD BOARD
製	DEC. 14. '92	番	C.3378-K05-A
	N.SAITO	DWG. NO.	