

MARINE RADAR

T-150

OPERATION MANUAL

SITEX®

DOC NO. T-150 7-95

Precautions

High voltage warning

Dangerous high voltages are present in the antenna unit and LCD display of this radar. Although the equipment has been designed to avoid danger in ordinary operation, take extreme care when inside the internal units of the equipment. Always turn OFF the ship's main switch before checking the circuits or replacing a component. Remember, some capacitors may take several minutes to discharge even after switching off the radar. Before touching the magnetron and/or LCD HV circuits, make sure to ground them with a clip lead.

Servicing close to the antenna unit

To prevent any additional accident as result of electrical shock, set a secure base for servicing at high places. To prevent an accidental rotation of antenna, turn OFF the unit power switch and follow the appropriate safety practices.

Microwave hazard

The microwaves radiated by radar antenna are harmful to a person (especially to one's eyes). Never look directly into an open waveguide radiating the power. Radar and other RF (radio-frequency) radiations can upset cardiac pacemakers. If a user with a cardiac pacemaker suspects a malfunction, immediately turn off the equipment power and move the person away from the antenna. Whenever it is necessary to work on the antenna unit, turn OFF the equipment power switch.

Fuses

Before starting your radar system, check the ship's main voltage and mount the 5-ampere fuse (included in the DC power cable package) in its holder.

Use a 5-ampere power fuse.

Magnetron preheating

When starting up your radar system for the first time or when restarting it after the two-month or longer power-off period, preheat the magnetron at least 30 minutes in the TX SAVE (Standby) mode.

Welcome to Marine radar

The MARINE RADAR is a "state of the art" navigation aid consisting of a transmitting and receiving antenna unit and a 7-inch liquid crystal display unit. Please read this manual thoroughly before installing and powering up this unit.

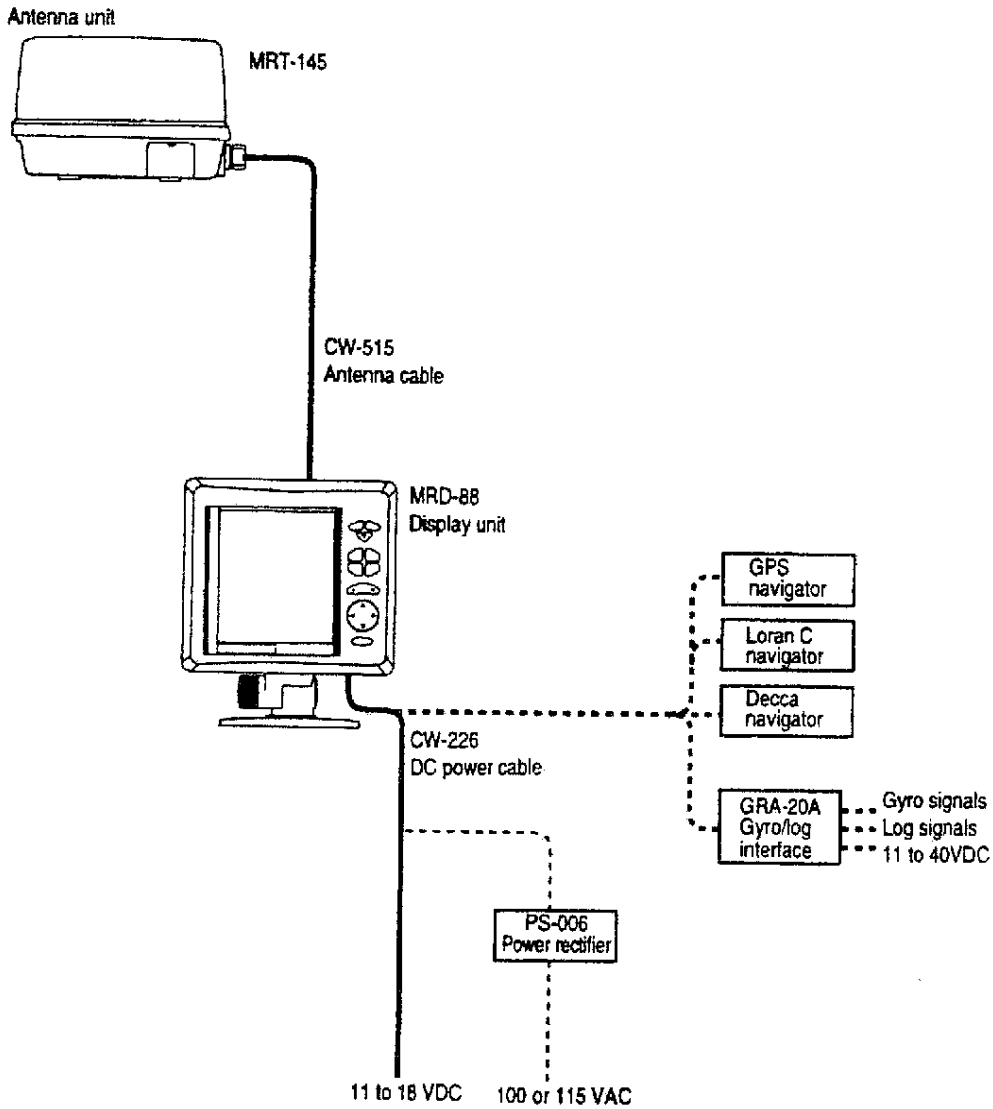
Important

This unit is only an aid to navigation. You must use accurate sea charts and other positioning devices to check the position, depth, other boats, obstructions and others conditions to insure safe navigation.

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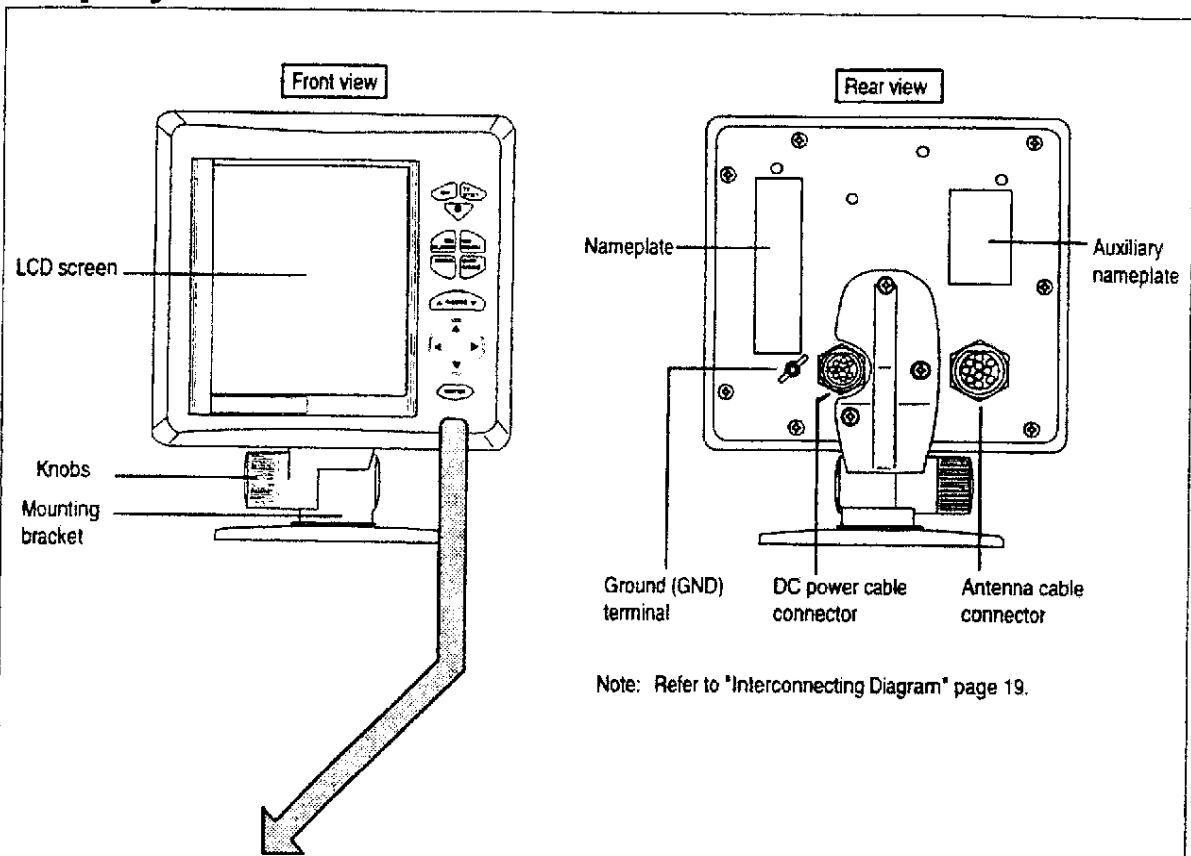
System Configuration



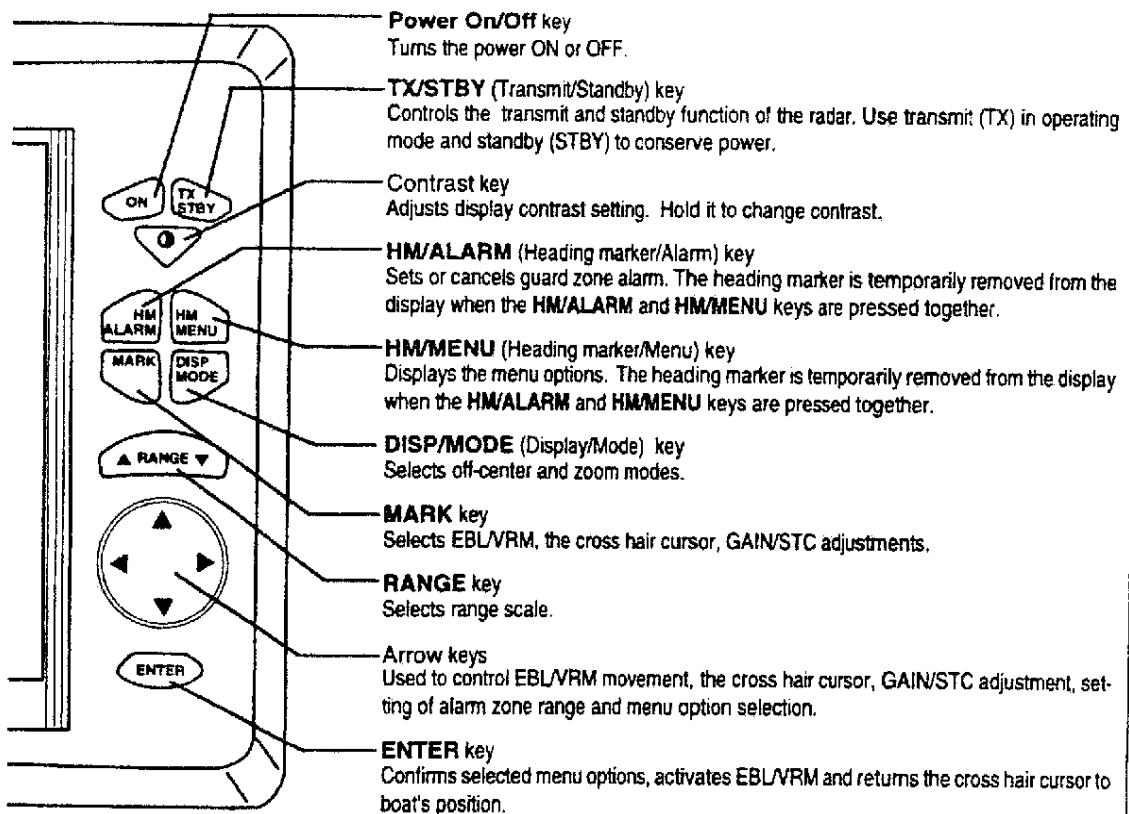
System model and configuration

Antenna unit	Display unit
MRT-145	MRD-88

Display unit



Note: Refer to "Interconnecting Diagram" page 19.



Menus

Press the key center or arrow!



Press by your finger.

Do not use a screwdriver or sharp object, or the key top can be damaged.

Type of menu

The MARINE RADAR has 6 menus: Initial menu, Menu 1 (ECHO), Menu 2 (DISPLAY), Menu 3 (MARK), Menu 4 (MODE) and Menu 5 (INTFC; Interface).

To operate menus

Initial menu

Hold down the **ENTER** key and press the power **ON** key.

- Cautions:**
1. Turn power off before using initial menu.
 2. Use care not to press **DISP/MODE** key and either **HM** keys simultaneously.

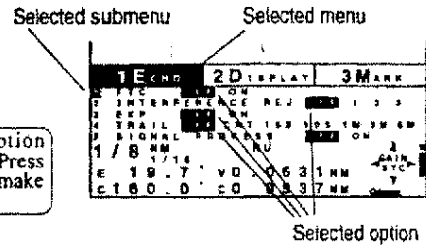
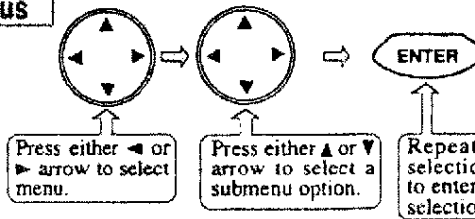
Menus 1 to 5

Press **HM MENU** key.

Note: Menu will not appear during 90 seconds timeout.

How to use menus

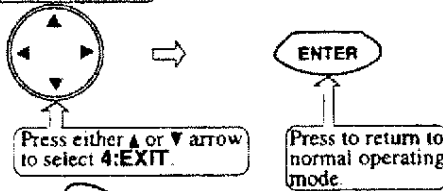
Menus 1 to 5



The operation differs in the initial menu. See below.

Returning to display mode.

Initial menu



Menus 1 to 5

Press **HM MENU** key to return to normal operating mode.

Initial Menu

Initial menu options must be reset anytime service has been done on this unit.

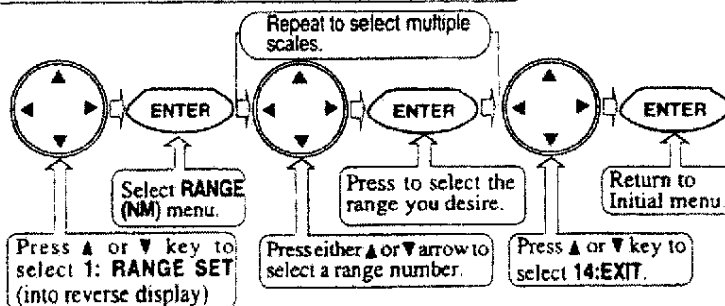
Initial menu functions.

With the initial menu you can select the following :

1. Create your own customized range scales.
2. Adjust the heading marker direction and trigger delay.
3. Check and adjust the radar tuning.
4. Exit the Initial menu.

- | | |
|---|------------------------------|
| 1 | RANGE SET |
| 2 | HM ADJUST
TX DELAY ADJUST |
| 3 | TUNE PRESET |
| 4 | EXIT |

Create your own customized range scale



RANGE (NM)	
1	1 / 8
2	1 / 4
3	1 / 2
4	3 / 4
5	1
6	1.5
7	2
8	3
9	4
10	6
11	8
12	12
13	16
14	EXIT

You can select one of reversely displayed ranges.

Adjusting the bearing and trigger delay

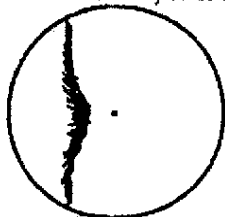
Turn the power supply On and wait for 90 seconds (for magnetron preheating), then start these adjustment.

Checking bearing of HM (Heading Marker)

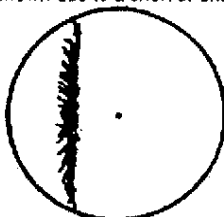
1. When your boat is stationary, find some stationary visible targets in the 2 to 4 NM range.
2. Measure the target bearing on the compass and on the radar screen. Correct the radar bearing if it deviates more than $\pm 1^\circ$ from the actual bearing.

Adjusting trigger delay

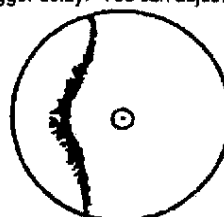
Depending on the length of antenna cable connecting the antenna unit and display, the radar image of a straight object such as breakwater and riverfront may be deformed as shown due to a short or excessive trigger delay. You can adjust it as follows.



Short delay
(Deformation toward center point)

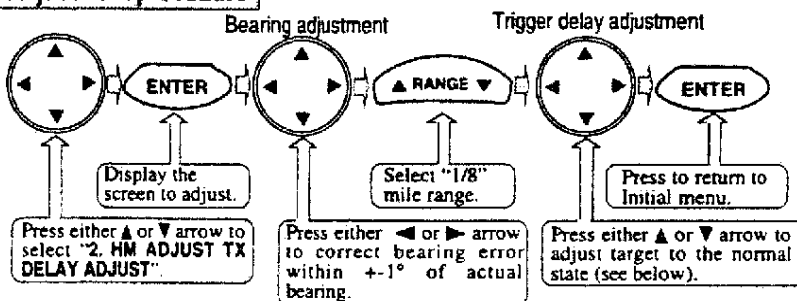


Normal



Excessive delay
(Deformation away from center point)

Adjustment procedure

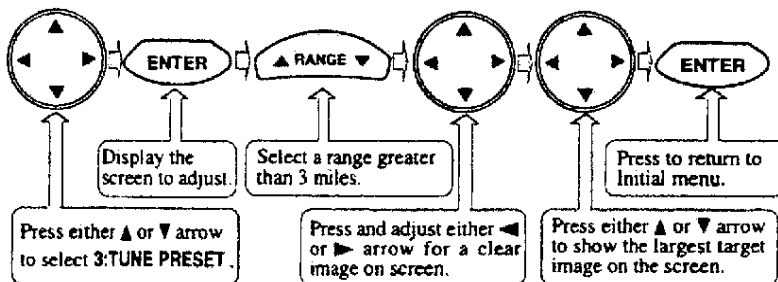


Normal trigger delay

- Straight targets such as a river bank or bridge is correctly displayed.
- A target with known distance is presented at correct position. Use VRM for range measurement.

Checking and adjusting tune

Turn the power supply On and wait 90 seconds (for magnetron preheating), then start this adjustment.



3:TUNE PRESET option blinks until finished.

```

1 RANGE SET
2 HM ADJUST TX DELAY ADJUST
3 TUNE PRESET
4 EXIT
    
```

Menu 1

Select Menu 1 (1:Echo) to:

1. Reduce rain or snow signal returns.
2. Reduce interference.
3. Expand the target.
4. Display target boat's trail.
5. Expand a small target located close to your boat.

1 ECHO	2 DISPLAY	3 MARK
1 FTC	OFF ON	
2 INTERFERENCE REJ	OFF 1 2 3	
3 EXP	OFF ON	
4 TRAIL	OFF CNT 15S 30S 1M 3M 6M	
5 SIGNAL PROCESS	OFF ON	

Reducing rain and snow images

Rain or snow image



When FTC is set to OFF



When FTC is set to ON

Rain, snow, fog and cloud can adversely affect displayed targets. Use the FTC mode to reduce the effects of these factors (it is still effective when the gain is lowered).

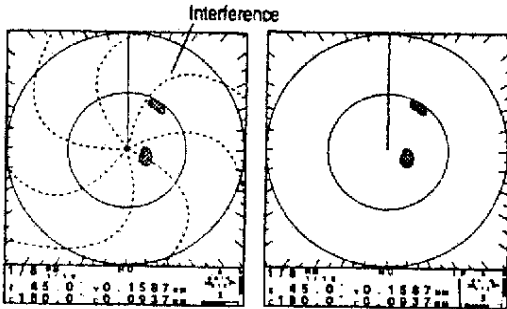
CAUTION

Excessive FTC will eliminate small targets. Turn FTC OFF to show a small target.

The letter F appears.

Rejecting interference

You can eliminate interference caused by radar signals from another boat.



When filter is set to OFF

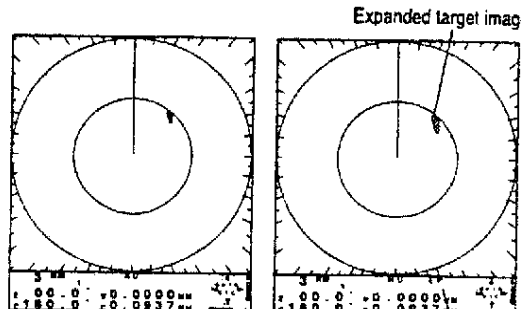
When filter is set to 3

The letters IR appear.

OFF	1	2	3
No	Weak	Middle	Strong

Expanding target

Use this mode to expand small and distant targets.



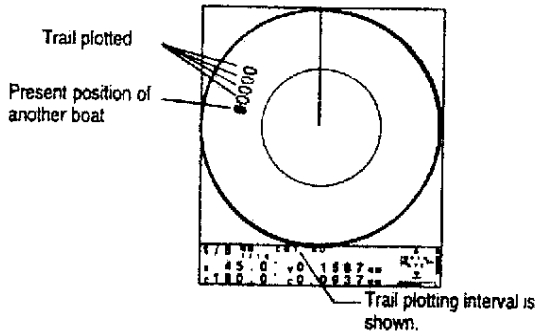
When EXP is set to OFF

When EXP is set to ON

The letters EP appear.

Displaying other boat's trail

Select an appropriate trail plotting interval to help determine the speed of target boat and help prevent a collision with it.



The trail is displayed in dark. Trail plotting starts when you change the scale range.

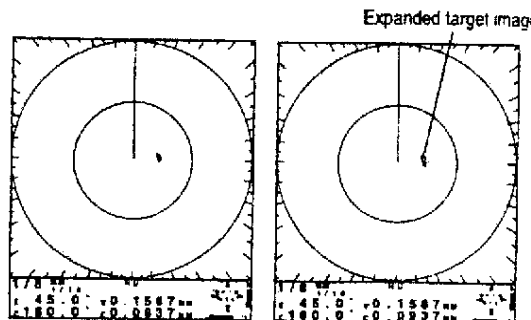
Trail plotting interval:

OFF (No plotting), CNT (Continuous plotting), 15S (15 second interval), 30S, 1M (1-minute interval), 3M, 6M

Expanding small targets close to your boat

Use this mode to help expand and display small targets located close to your boat.

Caution: Noise may be increased.



When SIGNAL PROCESS is OFF

When SIGNAL PROCESS is ON

Menu 2

Select Menu 2 (2:Display) to:

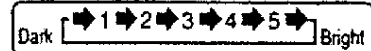
1. Adjust the backlighting of operation panel keys.
2. Adjust the intensity of LCD backlight.
3. Select a display data option.
4. Display the bearing scales.

1	ECHO	2	DISPLAY	3	MARK	
1	PANEL BRILL	1	2	3	4	5
2	BACK LIGHT BRILL	1	2	3	4	5
3	DATA	OFF	LL	LOP	HDG/SPD	WP
4	SCALE	OFF	ON			

Adjusting brightness of operation panel

Initial setup: Level 2

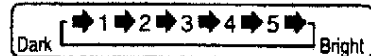
Adjust the brightness of operation panel to an appropriate level for evening and night time navigation.



Adjusting brightness of LCD Backlight

Initial setup: Level 4

Adjust the brightness of LCD backlight to display clear images.



Displaying a navigation data using the navigator

If your boat has a GPS or Loran C navigator unit, complete the setup on Menu 5 and you can display your position (longitude and latitude or Loran C LOP), course/speed and distance/bearing to the waypoint (waypoint set on the navigator).

When set to
OFF

When set to
LL

Your position (longitude and latitude) read from the navigator is shown.

When set to
LOP

Your position (Loran C LOP) read from the navigator is shown.

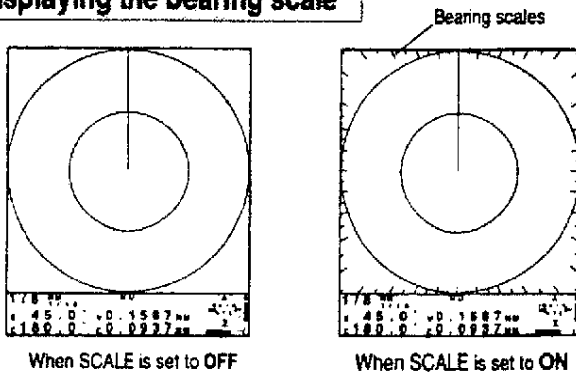
When set to
HDG/SPD.

Your course and speed read from the navigator is shown.

When set to
WP

Your distance and bearing to the waypoint (set on the navigator) is shown.

Displaying the bearing scale



For reference, bearing scales in units of 5 degrees are displayed.

Menu 3

Select Menu 3 (3:Mark) to:

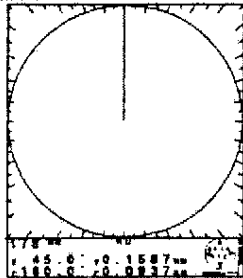
1. Display the range rings.
2. Change the measuring unit of VRM (Variable Range Marker).
3. Change the measuring unit of cross hair cursor.
4. Change the alarm angle (360, 180 or 90 degrees).

1 ECHO	2 DISPLAY	3 MARK
1 RINGS	OFF ON	
2 VRM	NM km	
3 CURSOR	NM km LAT/LONG	
4 ALARM	360 180 / 90°	

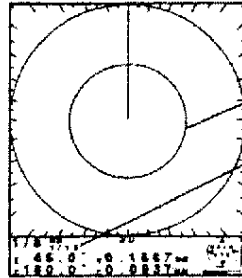
This is shown only when bearing signals are entered from gyro compass or GPS navigator.

Displaying range rings

Use to estimate the distance to the target.



When RINGS are set to OFF



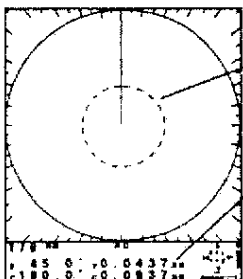
When RINGS are set to ON

Range, ring interval, and No. of markers

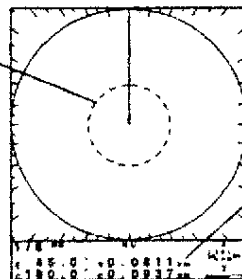
Range	1/8	1/4	1/2	3/4	1	1.5	2	3	4	6	8	12	16
Ring interval	1/16	1/16	1/8	1/4	1/4	1/2	1/2	1	1	1.5	2	3	4
No. of markers	2	4	4	3	4	3	4	3	4	4	4	4	4

Changing VRM unit

The VRM unit is NM (nautical miles) or "km" (kilometers).



When VRM is set to NM

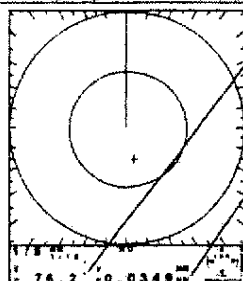


When VRM is set to km

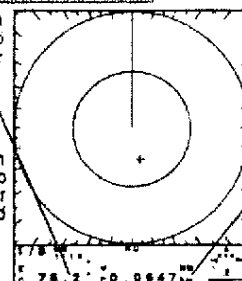
NOTE:

Range and range rings units are in NM only.

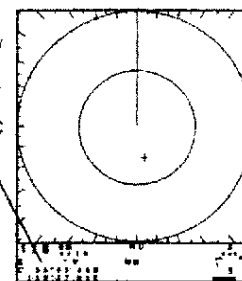
Changing cross hair cursor position data



When CURSOR is set to NM

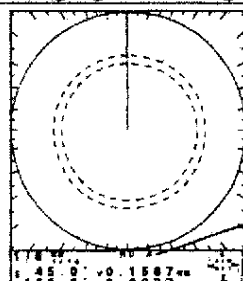


When CURSOR is set to km

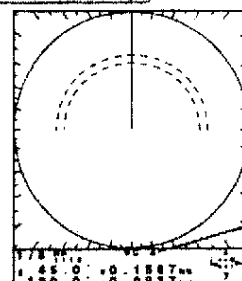


When CURSOR is set to LAT/LONG

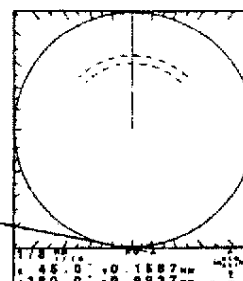
Changing alarm angle (360°, 180° or 90°)



When ALARM is set to 360°



When ALARM is set to 180°



When ALARM is set to 90°

Menu 4

- Select Menu 4 (4:Mode) to:
1. Select the radar display mode.
 2. Display zoom or off-center presentation.

3 MARK	4 MODE	5 INTFC
1 MODE HU NU CU		
2 DISP MODE KEY SET		
ZOOM OFFCTR (V D U R L)		

They are shown only when bearing signals are entered from gyro compass or GPS navigator.

Selecting the radar display mode

To change the radar display mode, you must be interfaced with a gyro log or GPS or Loran C navigator unit, and complete the setup in Menu 5. You can select HU (Head Up), NU (North Up) or CU (Course Up) mode.

CAUTIONS

Your navigator takes much longer time to update bearing data as compared with a gyro log interface. The position of fixed targets on the display such as land or boat will fluctuate because bearing data from the navigator cannot follow the steering of boat. This is especially evident at slow speeds, use HU in slow speed applications.

HU (Head Up) mode
 Boat heading
 Land
 The letters HU appear.
 Bow direction ↑

NU (North Up) mode
 Boat heading
 Land
 The letters NU appear.
 True north ↑

CU (Course Up) mode
 Boat heading
 Land
 The letters CU appear.
 Course to waypoint ↑

Your boat's heading is always to the top of screen. You can see the relative bearing of land and other targets.

You must be interfaced with a gyro compass or GPS navigator. The radar picture will correspond to the navigation chart, and the target bearing is equal to true north bearing

You must be interfaced with a gyro compass or GPS navigator. The course to waypoint is to the top of screen. You follow the shortest course to the waypoint by steering to the top of screen. Fixed targets may move as you drift due to current.

Displaying zoom or off-center image

DISP MODE

You can preset ZOOM or OFF CTR (off-centering) displays with the DISP MODE key. ZOOM mode displays an image that is expanded from its cross hair cursor position, and OFF CTR shifts your boat's position so that you can view a long distance without changing the range scale. You can shift the position to any point (V), downward (D), upward (U), right (R) or left (L).

Zoom Up image ZOOM

Cross hair cursor position

Switched to the next lower range and scale is displayed reversely.

The display is zoomed up from cross hair cursor position

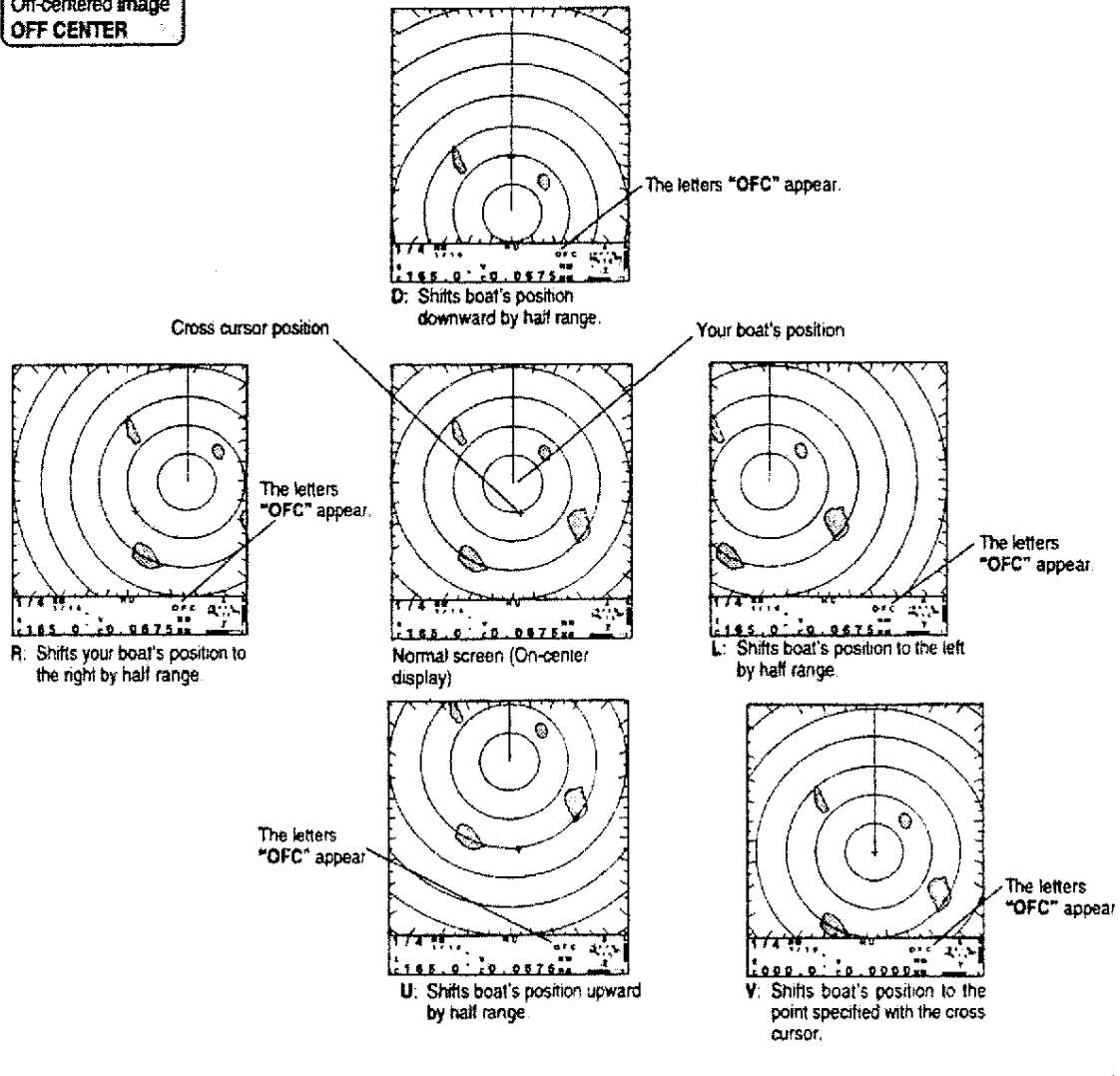
The letters "ZM" appear

Normal screen

Zoom up screen

You cannot use ZOOM mode during 1/8 mile range mode.

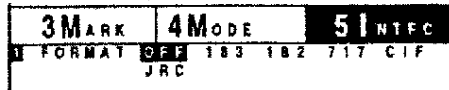
**Off-centered image
OFF CENTER**



Menu 5

Select Menu 5 (5:Interface) to:

1. Display the present position by interfacing a navigator and selecting the format.



Reading data from navigator unit

Select one of the following formats to match the data format transmitted by the attached GPS or Loran C navigator:

- OFF Use this option if no navigator unit is attached.
- 183 NMEA 0183, Version 2.0 format
- 182 NMEA 0182 (standard auto pilot format)
- 717 Koden 717 format
- CIF CIF format
- JRC JRC format

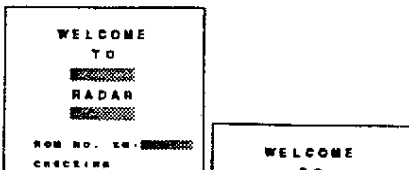

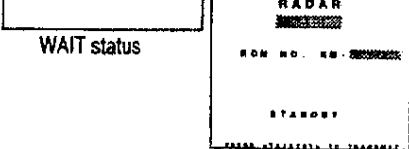

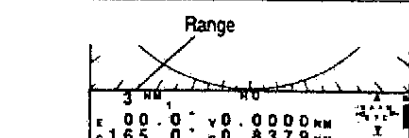

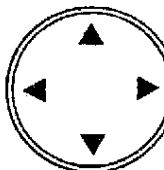


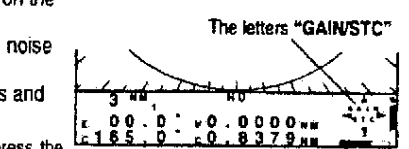



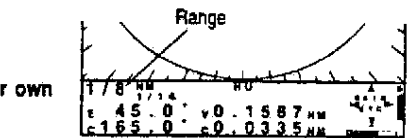
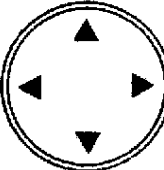


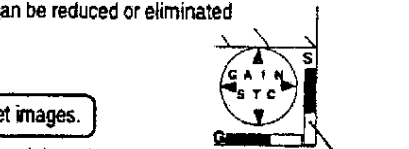
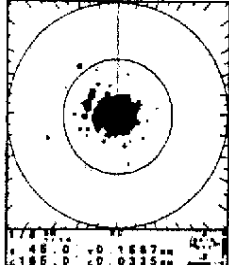
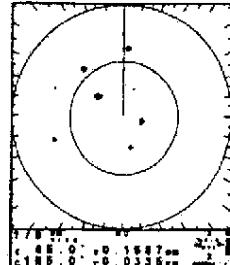
For data (sentence), information that can be read in NMEA 0183 format, see the "NEMA 0183 input data format" section

If no sentence is included in the data or if no data is received, the message "xxx.x" is shown in the data display area.

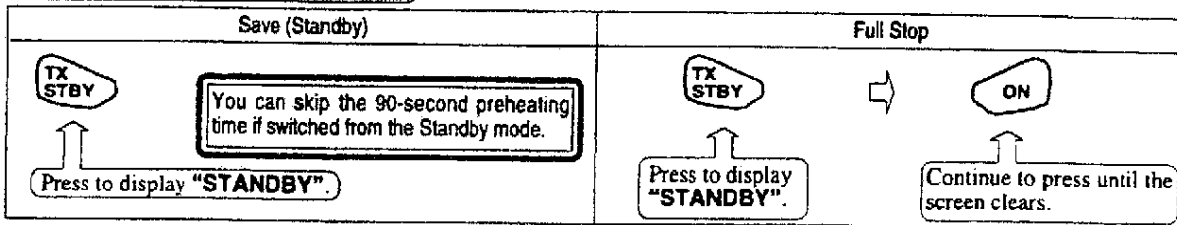
Operating Instruction

Press the key center or arrow! **Press by your finger.** Do not use a screwdriver or sharp object, or the key top can be damaged.

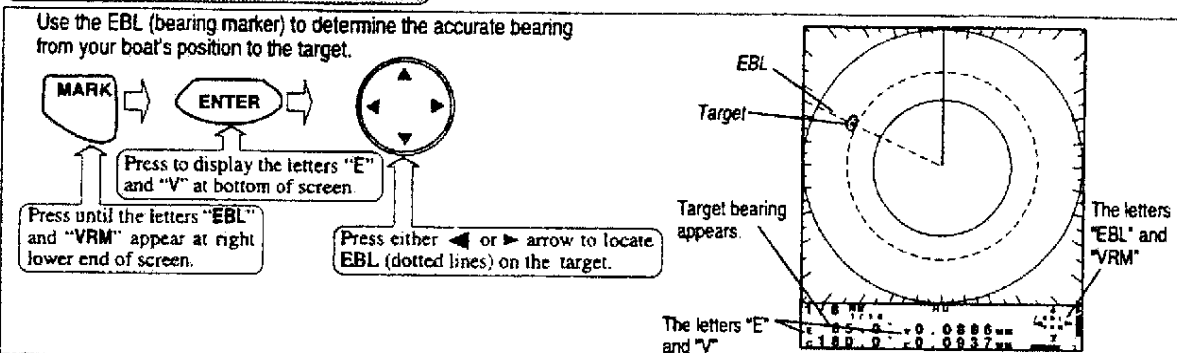
Getting Started

 <p>Power</p>	<p>Press the power ON key, and a tone will sound momentarily.</p> <ul style="list-style-type: none"> The power key will turn ON and "WAIT" will appear on the display. The 90-second magnetron preheating timer will start. 	 <p>WAIT status</p>
 <p>Transmission/ Standby</p>	<p>When "STANDBY" message appears, pressing this key will select the Transmission mode. This key selects TX and STBY modes alternately when pressed.</p>	 <p>STANDBY mode</p>
 <p>Range</p>	<p>Use it to set a 3-mile or longer range.</p>	
 <p>Contrast</p>	<p>Adjust the image contrast on screen within eight levels.</p>	
 <p>Gain (Sensitivity)</p>	<p>Adjust the gain until a small amount of noise appears on the screen.</p> <p>Press  arrow to increase the gain (the targets and noise increase).</p> <p>Press  arrow to decrease the gain (both the targets and noise decrease).</p> <p>If the letters "GAIN/STC" do not appear on the screen, press the MARK key until they appear.</p>	 <p>The letters "GAIN/STC"</p> <p>Sensitivity indicator</p>
 <p>Range</p>	<p>Select the working range you desire.</p> <p>Press  arrow to increase the scale range, and press  arrow to decrease it.</p> <p>Select a range from 13 levels (see the "Create your own customized range scale" of Initial Menu section).</p>	
<h3>Reducing sea clutter</h3>		
 <p>STC</p>	<p>Sea clutter appears as small dots near the center of the screen when the sea is rough. The clutter usually stretches to windward and can be reduced or eliminated by adjusting STC control.</p> <p>Press  arrow to increase the STC gain.</p> <p>Press  arrow to reduce the STC gain.</p>	 <p>STC indicator</p>
 <p>When STC is OFF</p>	 <p>When STC is ON</p>	<p>Rain, snow, fog and clouds are usually displayed as obscure images. FTC can reduce them. Also, you can reduce them by slightly lowering the gain. For FTC operations, see "Reducing rain and snow images" of Menu 1.</p>

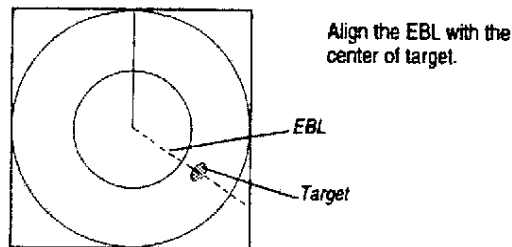
Stopping transmission



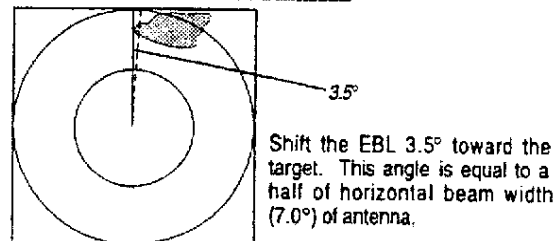
Determining the Bearing



Small target



Point of island or land mass



Measuring range of target using VRM

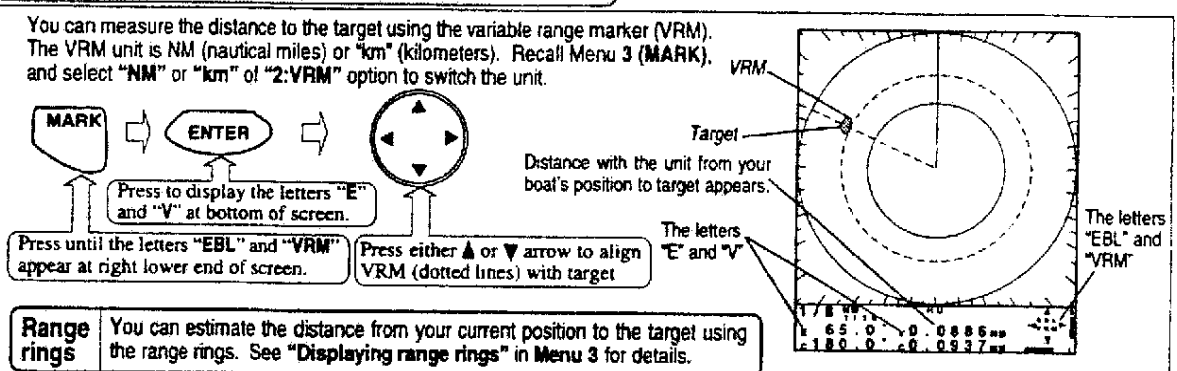


Image of a strong target

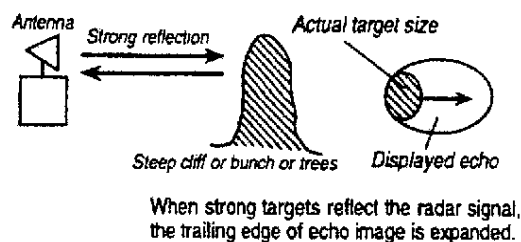
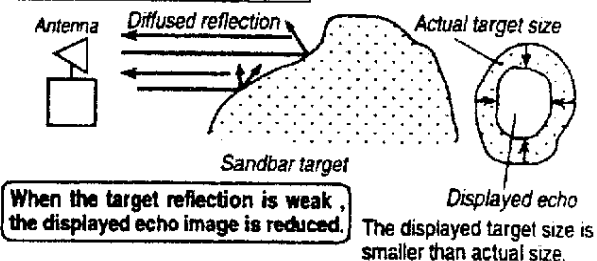


Image of a weak target



Measurement using cross hair cursor

You can also measure the actual bearing and distance from your boat's position to target by using the cross hair cursor. The position identified by the cross hair cursor is in degrees and "NM", degrees and "km", or latitude and longitude. Recall Menu 3 (MARK) and select "3:CURSOR" option to switch the display data.

MARK

Press until the letters "CUR" appear at the right lower end of screen

Press either \leftarrow , \rightarrow , \uparrow or \downarrow arrow to locate the cross hair cursor onto target, and its position data will appear.

Cross hair cursor

Data at the cross hair cursor position appears.

The letters "CUR"

The letter "C"

Examples of position data display using cross hair cursor:

Bearing ($^{\circ}$) and distance (NM) from boat's position

Bearing ($^{\circ}$) and distance (km) from boat's position

Latitude (N) and longitude (E) at cross hair cursor position

Setting guard zone alarm

Your radar can sound an intermittent tone to warn you a target has entered a preset guard zone. You can set a 360-, 180-, or 90-degree guard zone. Recall Menu 3 (MARK) and select a "4:ALARM" option.

HM ALARM

Press it. The letters "ALM SET" will appear at right lower end of screen, and the reversed letter "A" will appear at bottom of screen.

Press either \leftarrow , \rightarrow , \uparrow or \downarrow arrow to set the position of guard zone. Use either \leftarrow or \rightarrow arrow to adjust bearing, and use \uparrow or \downarrow key to adjust distance.

HM ALARM

Press it. The alarm will turn ON, and the alarm will sound when the target stays 8 seconds or more in the guard zone.

Guard zone (360 degrees)

Reversed display letter "A"

The letters "ALM SET"

The letters "A"

Clearing alarm

HM ALARM **HM MENU** **MARK** **TX STBY** Press any of these keys to clear the guard zone alarm. The letter "A" will disappear from bottom of screen.

Available alarm range

- The proximity alarm may not work if target signal is weak.
- You can set an alarm zone as follows:

CAUTION

If the alarm zone is outside of the minimum or maximum range, the letter "A" is reversely displayed blinks. If this occurs, set the alarm again.

Minimum range		Maximum range	
	Internal ring of zone is set near the center of ring		Outer ring of zone is within the screen.
	During On-center mode Within the range used		During Off-center or Zoom mode 360° mode
			180° mode
			90° mode

Removing HM line



The header marker (HM) is off the screen when two keys are pressed simultaneously.

Switching between on-center, zoom, and off-center images



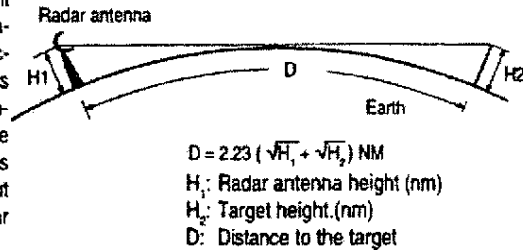
Image display changes each time you press the key. See Menu 4 for details.

Display Interpretation

The capability of a radar varies depending on where the radar is mounted, the radars performance, weather condition, and the skill of the operator. The following paragraphs describe these conditions that affect the capability of radar, the correct interpretation of the radar picture.

Radar horizon

The radio waves used for the radar are called microwaves, that travel straight like light. Light is generally refracted toward the ground surface due to temperature, humidity, the atmospheric pressure change in the air and other factors, so that we can set a visual range more than the physical horizon. This is called optical horizon as compared to the physical horizon. Otherwise, microwaves have a similar characteristic, and this is called radar horizon. Since microwaves are longer than light in terms of wavelength, the radar horizon is farther than the optical horizon by about 6% and the physical horizon by about 15%. A target farther from the radar horizon is not detectable. The radar horizon changes according to the radar antenna height and target height.

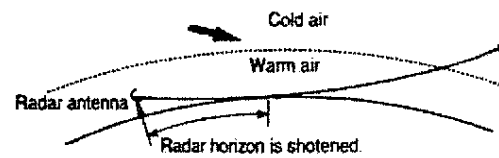


Variation of detectable range due to a change of ambient conditions

As temperature and humidity change in the air, the refractive index of radar radio waves change, consequently causing the detectable range of the radar to vary somewhat.

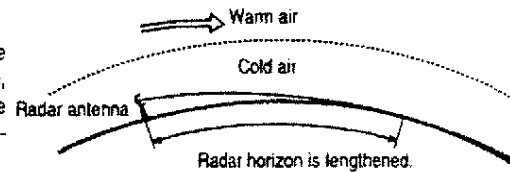
Sub-refraction

When cold air flows over the warm surface, the radar radio waves are curved upward as shown in the figure. This phenomenon is called sub-refraction. As a result, the detectable range of the radar is reduced. This phenomenon is likely to occur in the polar regions, or in warm sea currents where cold air from the polar regions flows into the sea.



Super-refraction

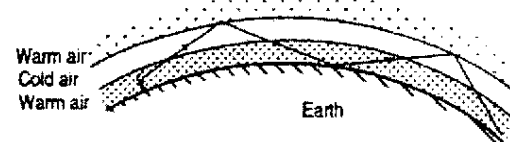
When the air being warmed up inland flows into the cold sea, radio waves are curved downward. This phenomenon is called super-refraction. In this case, the detectable range of the radar increases. This phenomenon is apt to be produced in the warm coastal regions, and it becomes noticeable as the temperature difference becomes larger.



Ducting

If air layers having a different temperature or a different atmospheric pressures are produced alternately in the altitudes, a distant target exceeding the visible range of the radar is detectable. This phenomenon is caused when air layers having a different temperature contact each other. The radio waves are not refracted, but reflected on the boundary where the two layers differ.

As a result, radio waves can be propagated farther than the curvature of the earth. The passage where the radio waves travel is called a Duct. The abnormal propagation of radio waves through this duct is called ducting.

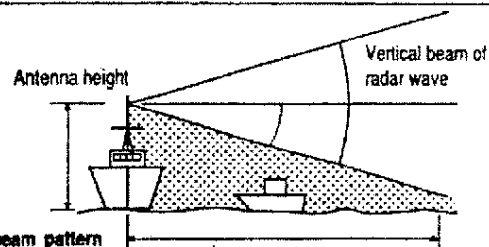


Minimum detectable range

The minimum distance the radar can detect a target is called "Minimum Detectable Range". This minimum range varies depending on factors such as transmission pulse width, RF leakage time and height of antenna. The following paragraphs describe these factors that affect the Minimum Detectable Range.

Height of antenna

Height of antenna affects the short range target detection. If the antenna is mounted at a relatively high level from the sea surface, the radar wave may skip closer targets causing the radar to fail in detection of these closer targets. Vertical beam width of the antenna pattern is also involved as shown in Figure below. Wider beam results in better short range detection, shortening the detectable range d_1 as shown in Figure right.



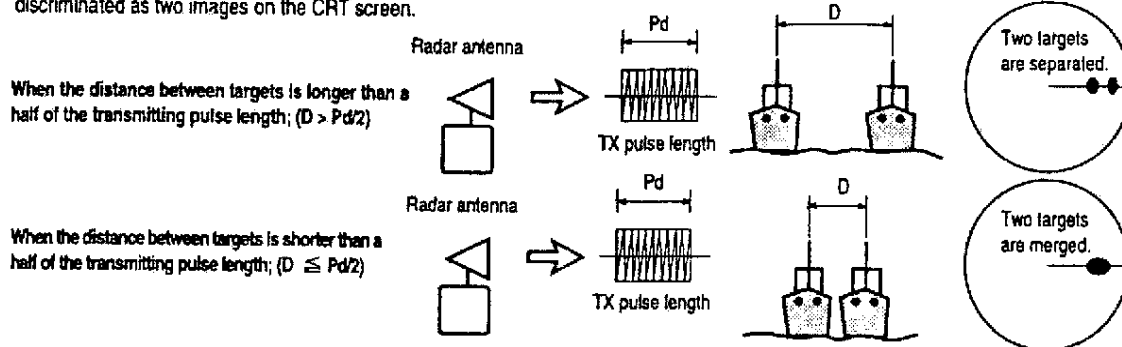
Antenna height and vertical beam pattern affecting detection of short range target.

Transmission pulse width

In most radar systems, the radar transmission pulse width is automatically selected to short or long depending on the range scale. In short range, a short pulse width is used to improve the close target detection as well as picture definition. In long range, long pulse width is used to achieve good long range performance.

Range resolution

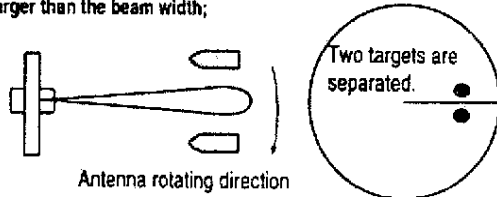
The range resolution is defined as the minimum distance between two targets in the same bearing which are discriminated as two images on the CRT screen.



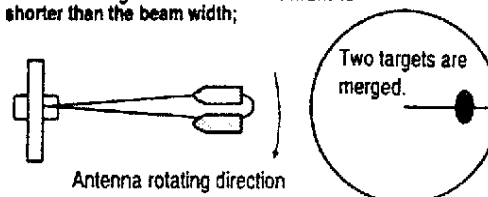
Bearing resolution

The bearing resolution is defined as the minimum bearing where the two targets of the same distance are displayed separately as two independent images on the screen, and it is determined by the antenna horizontal beam width.

When the targets distance in azimuth is larger than the beam width;



When the targets distance in azimuth is shorter than the beam width;



How to interpret the radar picture

To interpret the radar picture, an operator should be familiar with the radar video presentation caused by the wanted and unwanted effects. For instance, those echoes produced from bridges, sand beaches, waves and boat's wake may be shown in a different presentation from those viewed by the operator. For correct interpretation of the radar picture, it is highly recommended that the operator practice using the radar in good weather conditions.

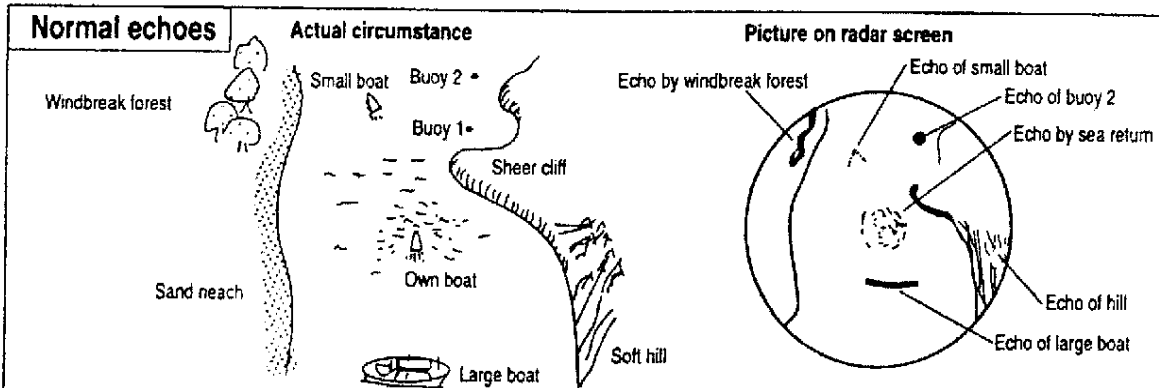


Figure above shows an example of typical radar pictures. As shown in this figure, the portions being radiated by radar waves are shown on the radar screen. No 1 buoy blocked by the cape is not detected.

The echo of the large boat is painted similar to its original profile because of short distance. On the other hand, the echo of the small boat is shown as a spot, because its reflection area is small.

The hill in the 90° to 130° direction on the starboard side has a deep forest zone, and its echoing area is large. It is represented as wide spreading echoes on the screen. Since the sand beach located on the port side is deep, but is not topographic, strong echoes are not obtainable, thus, it is shown as a weak echo.

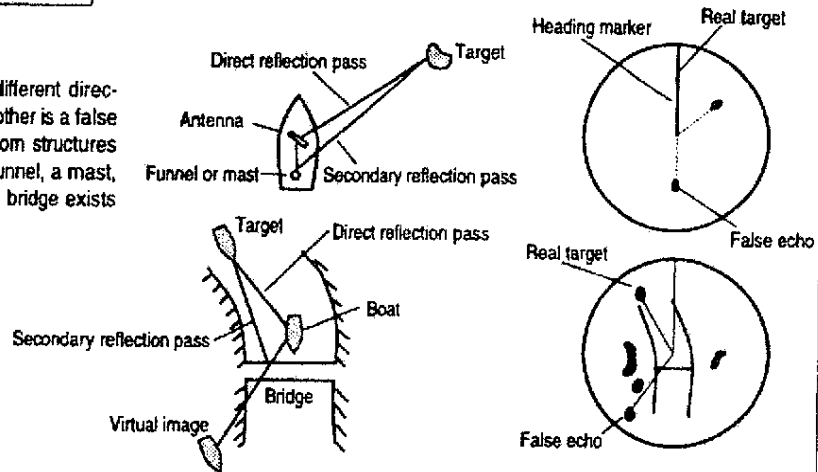
The windbreak forest produces strong echoes, and it is shown on the screen as massive echoes with high contrast. The reflection intensity of the signals differ according to their profiles. They are represented as a collective group of spot echoes in general. The boat's wake is shown stronger than that viewed by human eyes.

False echoes

False echoes may appear according to the surrounding circumstances. Examples of false echoes and causes of these echoes are described below.

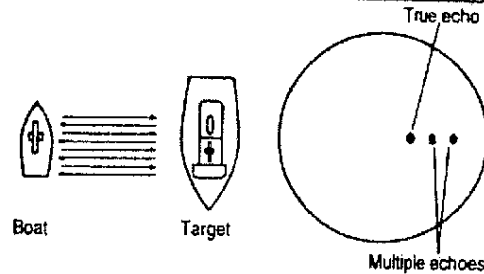
False echoes caused by reflection

A close target may appear in two different directions. One is a real echo, while the other is a false one produced by reflected waves from structures near the radar antenna, such as a funnel, a mast, etc. If a large structure, like an iron bridge exists nearby, a false echo may appear.



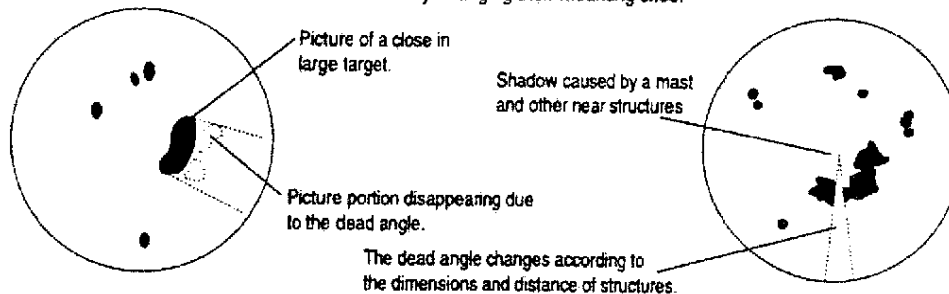
False echoes caused by multiple reflection

When a boat passes near a large boat, radio waves are repeatedly reflected between own boat and a nearby boat, causing several echoes at regular distances to appear in the same bearing. These false echoes produced by multiple reflection are called multiple echoes. In this case, the real target is closest. Because multiple echoes soon disappear when your boat moves from the reflection target or the boat direction has changed, even if these multiple echoes are produced, the true image is easily detected.



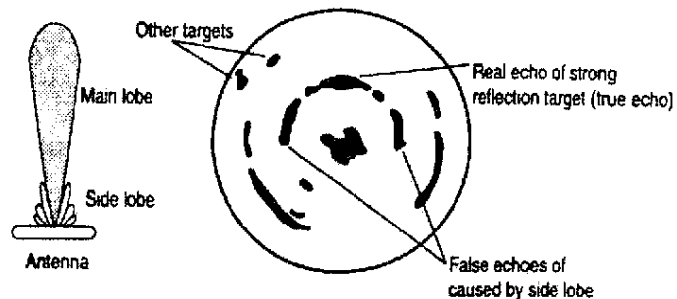
Shadow and dead angle

If the funnel, mast, post and other structures are located near an antenna or if a tall obstacle is present, a shadow is produced from the rear of these structures to the target. No target will appear due to the shadow up to a good distance in an extreme case. This range is called dead range, and the shadow can be produced entirely or partially. Since the dead angle due to the funnel, mast, etc. is detectable during the installation of the antenna, it can be eliminated by changing their mounting sites.



False echoes caused by side lobes

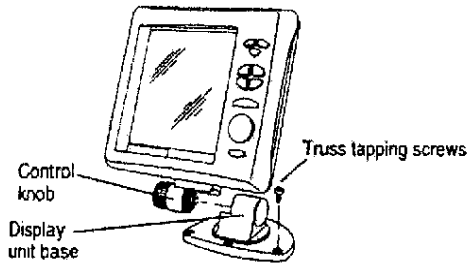
The radiation beams emitted from the antenna comprise side lobes in addition to the main lobe. Since the sidelobe energy is very low, it does not affect distant targets. A false echo due to the sidelobes is produced from a close in target with strong reflection. A false echo caused by the side lobes appears as an arc. It is eliminated by slightly reducing the gain or by changing the FTC level.



Installation

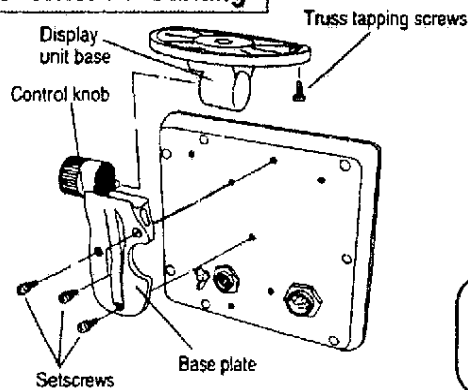
Installing display unit

Table-top mounting



1. Mount the display base to the frame using four truss tapping screws.
2. Carefully mount the display unit on the base.
3. Plug the antenna cable, DC power cable and ground lead into connector sockets at the rear display panel. (See "interconnecting diagram" for details.)

Overhead mounting



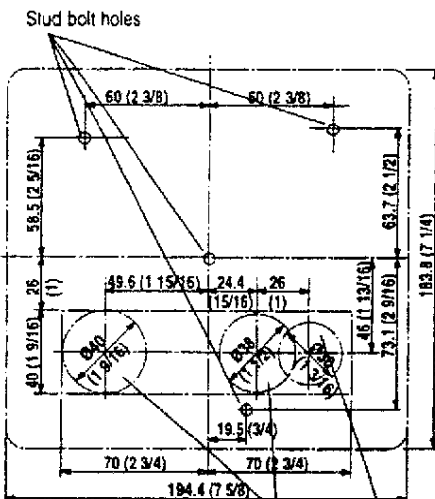
1. Remove three setscrews from the base plate, and remove the mount plate.
2. Turn the mount plate upside down, and mount it to the rear panel of display unit (see Figure).
3. Mount the display unit base to the ceiling using four truss tapping screws.
4. Mount the display unit on the display unit base.
5. Plug the antenna cable, DC power cable and ground lead into connector sockets at the rear display panel. (See "interconnecting diagram" for details.)



CAUTION

For stability, when overhead mounting the display unit base, use the four hexagonal head screws and nuts supplied. If this is not possible, you can substitute these screws and nuts with truss tapping screws.

Surface mounting



If service clearance is available inside of the console, you can mount the display unit directly onto the console.

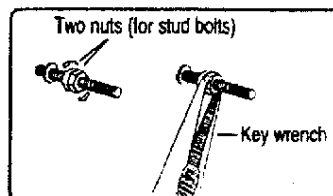
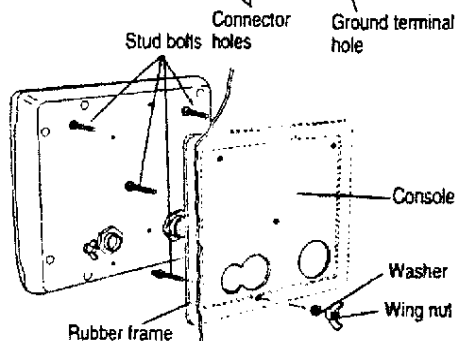
CAUTION: Select a rigid flat surface for mounting.

1. Drill the screw holes, connector holes and ground terminal hole on the mount surface of the console (see Figure).
2. Remove three setscrews from the base plate, and remove the mount plate from the rear panel of display unit.
3. Mount and tighten four stud bolts on the rear panel of display unit.

NOTE: Mount and tighten the first nut to an intermediate position of stud bolt, and mount and tighten the second nut to the first nut position.

Tighten the second nut with a key wrench (but do not force it, or the plastic parts in the hole will be damaged).

4. Fix the rubber frame to the mount surface of the display unit (the rubber frame has a dual-side adhesive tape for easy mounting).
5. Mount the display unit in the correct position to match the holes (that you have drilled through in Step 1). Tighten wing nuts with washers from the rear side of the console.
6. Plug the antenna cable and DC power cable into connector sockets at the rear display panel. (See "interconnecting diagram" for details.)



Installing antenna unit

Cautions

Install the antenna unit at a place where:

- No funnel or mast exists in the direction of the bow.
- No funnel or ventilator exists around the antenna unit.
- The installation place is close to the center line of your boat.

Installation

Unit: mm (inch)

1. Drill through four bolt holes using "Template for antenna unit mounting" attached.
2. Carefully place the antenna unit on the mount base, and tightening the bolts from the bottom of mount base.

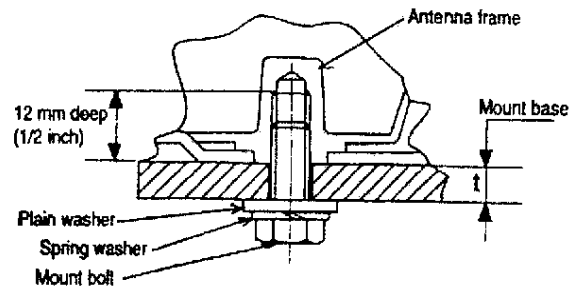
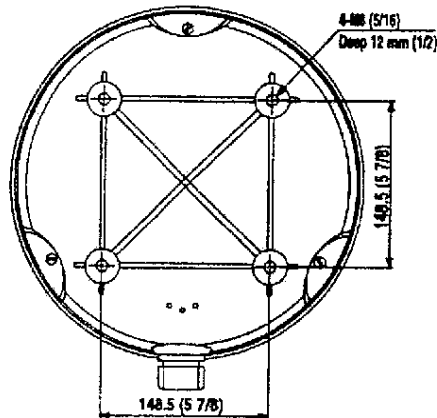


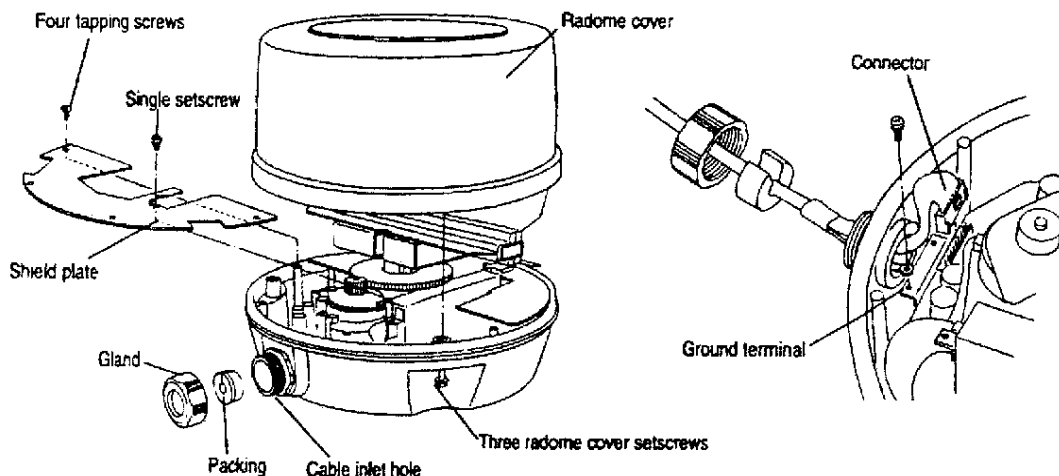
Table 1

Thickness of mount base (t)	Required length of bolts
9mm to 13mm	M8 × 25U
14mm to 18mm	M8 × 30U
19mm to 23mm	M8 × 35U

3. Use bolts having an appropriate length depending on the thickness of mount base (see Table 1). The system has the standard M8x25U mount bolts available for the typical 9- to 13-mm thick mount base.
4. We recommend to use the 9- to 13-mm thick base for antenna mounting. As the screw depth is 12 mm maximum, the internal parts of antenna unit may be damaged if the base thickness is insufficient or if the bolt length is too large. Use the appropriate bolts defined on Table 1.

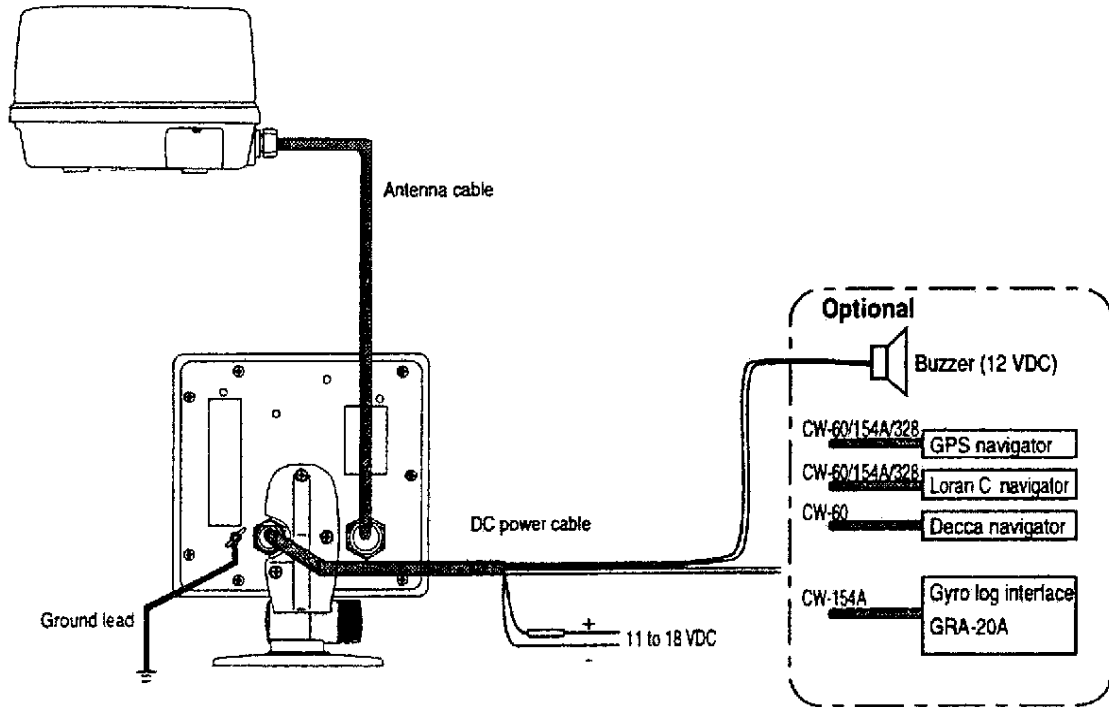
Installation procedure

1. Loosen three setscrews and remove the radome cover.
2. Remove four tapping screws and a single setscrew, and remove the shield plate.
3. Insert and pass the antenna cable through the gland, packing and cable holes (in this sequence).
4. Plug the cable end connector onto the socket J1 on the PC board E17-1000, and connect and fix the ground terminal to the cable band plate using setscrews.
5. Tighten and fix the gland.
Caution: If it is loose, a problem may occur due to water intrusion. Tighten it securely.
6. Mount the shield plate (that you have removed in Step 2).
7. Mount the radome cover, and fix it by evenly tightening three setscrews.



Interconnecting diagram

Both the DC power cable and antenna signal cable have water-resistant connectors on the display unit. Insert these connectors into sockets until they click, and fix them securely. Any water leakage will cause a system malfunction or overheating due to corrosion of connector parts and is excluded from the warranty.



Ground lead

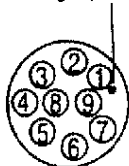
Always connect the ground lead (a 3-mm dia conductive wire) between the display unit and your boat's frame ground. This can reduce noise interference to system units.

DC power cable

The DC power cable is used for:

- Power supply from the boat's source to display unit
- Data input from gyro log interface or GPS navigator to display unit
- Signal output to the buzzer

Marking of pin 1

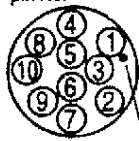


Pin No.	Lead color	Signal name
1	Red	Positive boat's power supply
2	Black	Negative boat's power supply
3	Blue	Serial data (SIG) input
4	Green	Serial data (RETURN) input
5	Brown	Not used
6	Yellow	Not used
7	White	Buzzer 1 (+12V, 30 mA)
8	Purple	Buzzer 2 (Open collector)
9	Shielded	

Antenna cable

Antenna side pin No.
1 2 3 4 5 6 7 8 9

Display unit side pin No.



Antenna socket	Cable color	Display socket	Signal name
1	Brown	1	12 V
2	Red	2	0 V
3	Orange	3	TRIGGER
4	Yellow	4	AZIMUTH
5	Coaxial lead	5	IF OUT
6	Coaxial shield	6	IF GND
7	Gray	7	S IN/OUT
8	White	8	HM
9	Green	9	GND
GND terminal	Shielded	10	GND

Marking of pin 1


Troubleshooting Guide

Consult to our sales agency for any technical support.

No operation at all during power-on

Check the power connector for poor connection. Check the power lines for open. Also, check the fuse and source voltage.

Nothing appears during power-on.

Continue pressing the  contrast key until a clear image or message appears.

The screen appears but no image appears at all.

Make sure that the antenna signal cable is connected to the display unit.

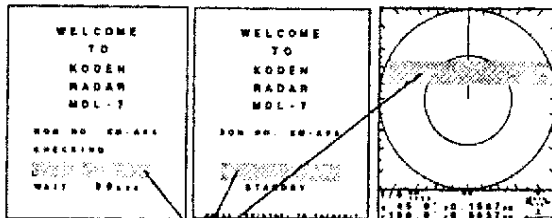
Press the  key to select the GAIN/STC mode, and minimize the STC but maximize the GAIN (sensitivity).

No data (including your boat's data) appears.

1. Check the GPS or Loran C navigator for an operation error. Also, check the cable connection between the navigator and your radar system.
2. Make sure that "1:FORMAT" option is set other than "OFF" on Menu 5.

If ERROR message appears

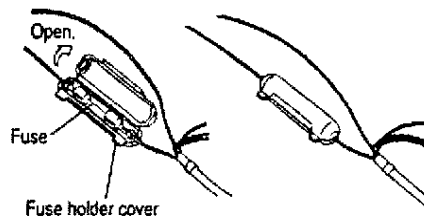
If the letters "ERROR" appear during power-on or during operation, your radar system stops. In such case, press the power ON key to turn the power OFF. Call to the nearest sales agency and inform the on-screen error message to us for quick solution.



The "ERROR" message display positions

The "ERROR" messages	
ANT ERROR	The antenna unit or antenna cable has failed.
AZIMUTH ERROR	The antenna motor has stopped.
BACK UP ERROR	The backup battery has discharged.
RAM ERROR	The random access memory (RAM) chips have failed.
ROM ERROR	The read only memory (ROM) chips have failed.
SHM ERROR	The antenna rotation has stopped.

Replacing the fuse



Open the fuse holder cover, and replace the fuse.
Close the fuse until it clicks.

Specifications

Major specification

Specifications subject to change without notice.

Antenna unit	
Aerial	0.9 feet (radome type)
Output power	1.5 kW (1 kW at 1/8, 1/4, 1/2 and 3/4 nautical mile ranges)
Frequency	9410 ± 30 MHz
Emission type	P0N
Beam width	Horizontal: 7 °, vertical: 25 °
Sidelobe	Better than -20 dB
Rotation	24 r.p.m.
Spurious	Better than -40 dB
Pulse width (μsec) / PRF (Hz)	0.1 μsec/2200 Hz: 1/8, 1/4, 1/2, 3/4 nautical mile 0.3 μsec/1100 Hz: 1, 1.5, 2 nautical mile 0.8 μsec/550 Hz: 3, 4, 6, 8, 12, 16 nautical mile
IF center frequency	60 MHz
IF band width	6 MHz: 0.1 μsec or 0.3 μsec 3 MHz: 0.8 μsec
Magnetron type	E3561 or MG5353
Receiver	MIC
Modulator	FET drive
Overall noise figure	9 dB
Environmental condition	Temperature: -15°C to 55 °C (5°F to 131°F) Relative humidity 95 % at 35°C (95°F) Wind velocity 100 knots
Display unit	
Display	7 inch Non glare mono LCD (usual picture area: 110 x 128 mm)
Video level	4 levels
Presentation mode	Head-up, north-up and course-up available by interfacing navigator or fluxgate compass with
Range scale	1/8, 1/4, 1/2, 3/4, 1, 1.5, 2, 3, 4, 6, 8, 12, 16 nautical miles
Range ring	1/16, 1/8, 1/8, 1/4, 1/2, 1, 2, 4, 8, 12 nautical miles
Off center	Sweep center can be moved in any direction
Echo trail interval	15, 30 seconds, 1, 3, 6 minutes, continuous
Alarm	90°, 180°, 360°
Range discrimination	Better than 50 m
Bearing accuracy	Better than ±1%
Navigation data display	Boat position (Latitude/longitude, loran C LOP coordinates), heading, speed, bearing to waypoint
Function	Gain, STC, FTC, heading marker OFF, auto tune, interference rejection, target expansion, zoom, VRM, EBL
Input data format	NMEA-0183, NMEA-0182, KODEN717, CIF, JRC
Memory protection	By built-in battery
Power supply	11 to 18 VDC
Power consumption	30 W or less
Environmental condition	Temperature: 0°C to +50°C (32°F to 122°F) Relative humidity: 95% at 35°C (95°F)

Standard equipment

No.	Article	Type	Remarks	Weight/length	Quantity
1	Antenna unit	MRT-145		4.5 kg (9 15/16 lbs)	1
2	Display unit	MRD-88		1.3 kg (2 7/8 lbs)	1
3	Antenna cable	CW-515	With 10-pin and 9-pin connectors	10 m (32 13/16 ft)	1
4	DC power cable	CW-226	With 9-pin connector and fuse	2 m (6 9/16 ft)	1
5	Fuse	F7161 5A	For spare (12 VDC)		2
6	Installation material		Refer to installation material list		1 set
7	Operation manual				1

Installation material list

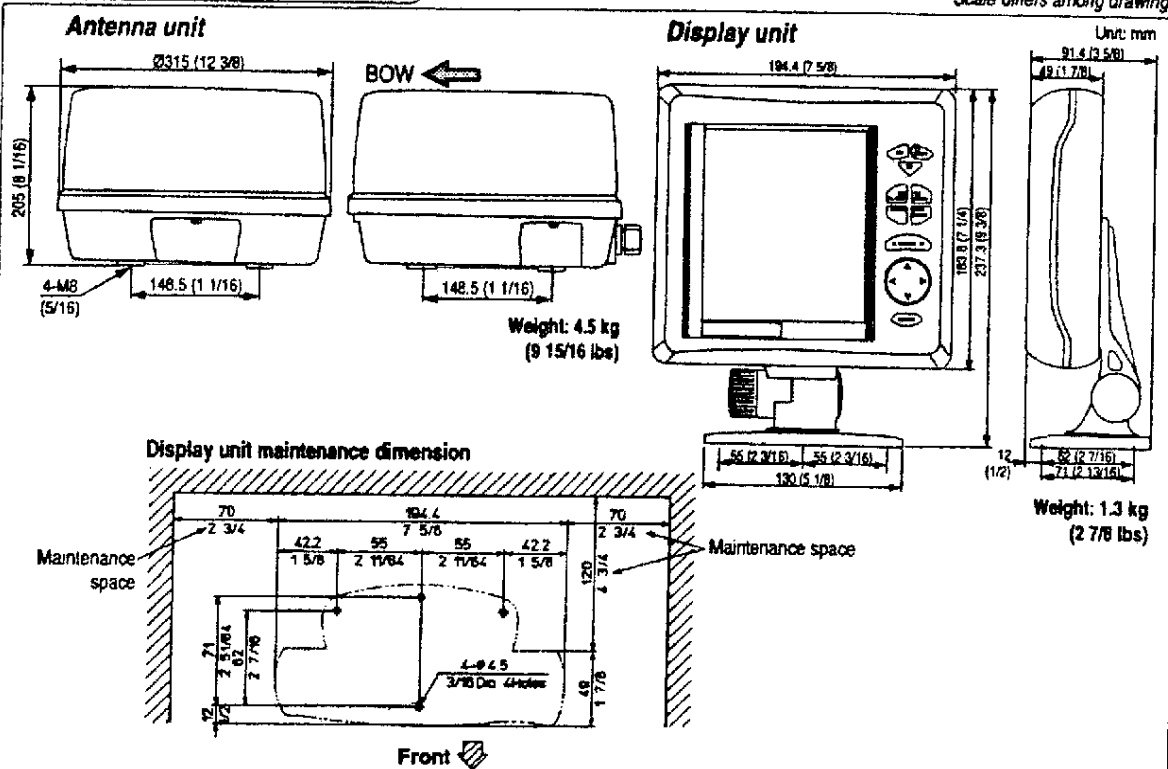
No.	Article	Type	Remarks	Quantity
1	Trass tapping screw	TPT4 x 16U	For display unit table-top mounting or overhead mounting	4
	Hexagonal head screw	B4 x 40U		4
	Nut	N 4U		4
	Plain screw	2W4U		4
2	Rubber frame	N1003810	For display unit surface mounting	1
	Washer	0TW4U		4
	Stud bolt	M4 x 40U		4
	Wing nut	WN4U		4
	Nut	N4U		2
				For stud bolt mounting
3	Hexagonal head screw	B8 x 25U	For antenna mounting	4
	Plain washer	2W8U		4
	Spring washer	SW8U		4

Option

No.	Articles	Type	remarks	Weight/length
1	Gyro log interface	GRA-20A		
2	Connecting cable	CW-60	With BNC connector	10 m (32 13/16 ft)
		CW-154A	With 6-pin connector	5 m (16 3/8 ft)
		CW-328	With 6-pin connector	5 m (16 3/8 ft)
3	Power rectifier	PS-006		8 kg (17 5/8 lbs)
4	AC power cable	VV-208	Both end plain, for power rectifier	3 m (9 13/16 ft)

Outline and dimensions

Scale differs among drawings.



NMEA-0183 Input data format Ver. 1.5/2.0

Input sentences

The following input data formats are available for displaying own boat's position readings or presenting north-up or course-up mode.

Priority of data

Latitude/longitude: **GGA** > **GLL**
 Loran C LOPs: **GLC** > **GTD**
 Waypoint data: **BWC** > **RMB** > **WPL**
 Heading: **HDT** > **HDG** > **HDM** > **VHW** > **HSC** > **HCC** > **VTG**
 Speed: **VHW** > **VTG**

Descriptions	Contents of data field
	<p> \$ - - BWC, hhmmss.ss, XXXX.XX, N/S, XXXXX.XX, E/W, XXX.X, T, ----- ----- ----- ----- ----- ----- ----- ----- Sentence format Waypoint latitude Waypoint longitude Bearing (true) ----- ----- ----- ----- ----- ----- ----- ----- Talker device UTC of position fix Latitude (N or S) Longitude (E or W) Start of sentence (hours, minutes, seconds) </p> <p> XXX.X, M, XXX.X, N, *hh <CR> <LF> ----- ----- ----- ----- ----- ----- ----- ----- Bearing (magnetic) Checksum Distance to waypoint (nautical mile) </p>
GGA (Ver. 2.0)	<p>Global Positioning System Fix Data</p> <p> \$ - - GGA, , XXXX.XX, N/S, XXXXX.XX, E/W, X, , , , , , , *hh <CR> <LF> ----- ----- ----- ----- ----- ----- ----- ----- Sentence format Latitude Longitude Longitude (E or W) Checksum ----- ----- ----- ----- ----- ----- ----- ----- Talker device GPS quality indicator Start of sentence (0: fix not available, 1= GPS fix, 2: DGPS fix) </p>
GLC (Ver. 2.0)	<p>Geographic Position, Loran C</p> <p> \$ - - GLC, XXXX, , , XXXXX.X, a, XXXXX.X, a, , , , , , *hh <CR> <LF> ----- ----- ----- ----- ----- ----- ----- ----- Sentence format TD1 (microsecond) TD2 (microsecond) Checksum ----- ----- ----- ----- ----- ----- ----- ----- Talker device GRI (microseconds/10) Signal status, in order of priority Signal status, in order of priority </p> <div style="border: 1px solid black; padding: 5px; width: fit-content;"> <p> a: Signal status B= Bnkn warning C= Cycle warning S= S/R warning A= Valid </p> </div>
GLL (Ver. 2.0)	<p>Geographic Position, Latitude/Longitude</p> <p> \$ - - GLL, XXXX.XX, N/S, XXXXX.XX, E/W, , A *hh <CR> <LF> ----- ----- ----- ----- ----- ----- ----- ----- Sentence format Latitude Longitude Longitude (E or W) Checksum ----- ----- ----- ----- ----- ----- ----- ----- Talker device A= É Á É^ L Á </p>
GTD (Ver. 1.5)	<p>Geographical Position, Loran C TDs</p> <p> \$ - - GTD, XXXXX.X, , XXXXX.X, , *hh <CR> <LF> ----- ----- ----- ----- ----- ----- ----- ----- Sentence format TD 2, micro-seconds Checksum ----- ----- ----- ----- ----- ----- ----- ----- Talker device TD 1, micro-seconds </p>
HCC (Ver. 1.5)	<p>Compass Heading</p> <p> \$ - - HCC, XXX.X *hh <CR> <LF> ----- ----- ----- ----- ----- ----- ----- ----- Sentence format Checksum ----- ----- ----- ----- ----- ----- ----- ----- Talker device Compass heading Start of sentence </p>

<p>HDG (Ver. 2.0)</p>	<p>Heading, Deviation & variation</p> <p>\$ - - HDG, XXX.X, , , , *hh <CR> <LF></p> <p>Talker device Sentence format Magnetic sensor heading Checksum</p> <p>Start of sentence</p>
<p>HDM (Ver. 1.5)</p>	<p>Heading, Deviation & variation</p> <p>\$ - - HDM, XXX.X, M *hh <CR> <LF></p> <p>Talker device Sentence format Heading (Magnetic) Checksum</p> <p>Start of sentence</p>
<p>HDT (Ver. 2.0)</p>	<p>Heading, True</p> <p>\$ - - HDT, XXX.X, T *hh <CR> <LF></p> <p>Talker device Sentence format Heading (True) Checksum</p> <p>Start of sentence</p>
<p>HSC (Ver. 2.0)</p>	<p>Heading Steering Command</p> <p>\$ - - HSC, XXX.X, T, XXX.X, M *hh <CR> <LF></p> <p>Talker device Sentence format Commanded heading (True) Commanded heading (Magnetic) Checksum</p> <p>Start of sentence</p>
<p>RMB (Ver. 2.0)</p>	<p>Recommended Minimum Navigation Information</p> <p>\$ - - RMB, , , , , XXXX.XX, N/S, XXXXX.XX, E/W, XXX.X, XXX.X, , *hh <CR> <LF></p> <p>Talker device Sentence format Destination waypoint latitude Latitude (N or S) Destination waypoint longitude Longitude (E or W) Range to destination (Nautical mile) Bearing to destination (True bearing) Checksum</p> <p>Start of sentence</p>
<p>VHW (Ver. 2.0)</p>	<p>Water Speed and Heading</p> <p>\$ - - VHW, XXX.X, T, XXX.X, M, XX.X, N, XX.XX, K *hh <CR> <LF></p> <p>Talker device Sentence format Heading (True bearing) Heading (Magnetic) Speed (knots) Speed (km per hour) Checksum</p> <p>Start of sentence</p>
<p>VTG (Ver. 2.0)</p>	<p>Course and Ground Speed</p> <p>\$ - - VTG, XXX, T, XXX, M, XX.X, N, XX.X, K *hh <CR> <LF></p> <p>Talker device Sentence format Course (True bearing) Course (Magnetic bearing) Speed over ground (knots) Speed over ground (km per hour) Checksum</p> <p>Start of sentence</p>
<p>WPL (Ver. 2.0)</p>	<p>Waypoint Location</p> <p>\$ - - WPL, XXXX.XX, N/S, XXXXX.XX, E/W, *hh <CR> <LF></p> <p>Talker device Checksum Latitude Latitude (N or S) Longitude Longitude (E or W) Checksum</p> <p>Start of sentence</p>

CERTIFICATE OF LIMITED WARRANTY

Providing you present a valid proof of purchase, SI-TEX warrants all parts of each new product against defect in material and workmanship under normal use and will repair or exchange any parts proven to be defective at no charge for a period of two years for parts and one year for labor from the date of purchase, except as provided below under Limited Warranty Exceptions.

Defects will be corrected during normal working hours by an authorized SI-TEX dealer, service center, or at the SI-TEX office in St. Petersburg, Florida. There will be no charge for labor for a period of one year from the date of purchase, except as provided below under Limited Warranty Exceptions.

This Warranty and Proof of Purchase must be made available to the authorized SI-TEX service location or dealer at the time of service.

LIMITED WARRANTY EXCEPTIONS

SI-TEX will not be responsible for equipment which has been subjected to water or lightning damage, accident, abuse, or misuse, nor any equipment on which the serial number label has been removed, altered or mutilated. SI-TEX assumes no responsibility for damage incurred during installation.

This Limited Warranty is effective only with respect to the original purchaser. Any cost associated with transducer replacement, other than the cost of the transducer itself, is specifically excluded from this Limited Warranty. Travel cost incurred will not be accepted for SI-TEX products. THERE ARE NO WARRANTIES WHICH EXTEND BEYOND THE DESCRIPTION OF THE FACE HEREOF.

SPECIFIC EXCLUSIONS

Charges for overtime, stand-by, holiday, and per diem are specifically excluded from the Limited Warranty. Chart paper, stylus, stylus belt, lamps, and fuses are consumable items and are not covered by this Limited Warranty. Installation workmanship or materials, except as provided directly by SI-TEX, are not covered by this Limited Warranty. SI-TEX equipment or parts thereof which have been repaired or altered except by an authorized SI-TEX dealer or service center are not warranted in any respect.

Transducer, software update, battery, microphone, magnetron, and microwave components and water damage on water resistant VHF radio are items excluded from the two-year warranty and are covered by warranty for a period of one year for both parts and labor. SI-TEX will not, at any time, assume any costs or labor charges for checkout or external line fuse replacement or problems not found to be at fault in equipment itself.

THERE ARE NO WARRANTIES OR GUARANTEES EXPRESSED OR IMPLIED WHICH EXTEND BEYOND THE DESCRIPTION ON THE FACE HEREOF, INCLUDING WARRANTIES OF FITNESS FOR A PARTICULAR PURPOSE AND MERCHANTABILITY. SI-TEX HAS NO OTHER LIABILITY TO PURCHASE FOR DIRECT OR CONSEQUENTIAL DAMAGE OR ANY THEORY INCLUDING ABSOLUTE LIABILITY, TORT, OR CONTRACT. THIS LIMITED WARRANTY CANNOT BE ALTERED OR MODIFIED IN ANY WAY AND SHALL BE INTERPRETED IN ACCORDANCE WITH THE LAWS OF THE STATE OF FLORIDA. THIS WARRANTY IS LIMITED TO THE CONTINENTAL U.S.A., ALASKA, HAWAII, AND CANADA.

HOW TO OBTAIN SERVICE UNDER THIS WARRANTY

To provide better flexibility, SI-TEX gives you the option of obtaining service under this warranty by either:

- a) Contacting an authorized SI-TEX service station (The closest service station may be found by contacting your dealer of purchase.) OR
- b) Shipping your equipment prepaid via UPS or truck with insurance prepaid to SI-TEX at the address provided below. SI-TEX will, whenever possible, make all repairs covered by Limited Warranty within two weeks of receiving the equipment in Florida and return same to you, freight prepaid.
- c) You must present a copy of your Purchase Sales Slip at the time you request warranty service.

Shipping/Mailing Address:

SI-TEX

Koden America, Inc.

11001 Roosevelt Blvd., Suite 800

St. Petersburg, FL 33716

727-576-5734

SI-TEX offers a complete line of quality marine electronics including echo sounders, electronic charting systems, radars, autopilots, GPS/WAAS/Loran receivers, SSB receivers, VHF radios, and integrated systems.

For more information, contact your SI-TEX dealer or the main office, located in St. Petersburg, Florida.

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