KODEN

OPERATION MANUAL

MARINE RADAR

MD-3420Mk2/3441

93141732-00

Important Notice

Manual handling	Keep this manual in a safe place where you can access quickly. This manual must be passed to a new owner of the MARINE RADAR when it is transferred.

The radar system is effective to locate other ships, land, and other navigation obstacles when the visibility is bad because of the fog or during night. However, the stormy weather can cause the high-intensity display of rain, snow and waves. The target images may be lost due to such noise, and radar targeting may be difficult due to large shaking of your ship. Since this unit is a fishing and navigational aid, use the regular sea charts and other position measuring devices (or instruments) together with this unit to check the position, depth, presence of other ships, obstructions and other conditions to ensure safe navigation.

Pictorials

This manual uses the following pictorials for easy understanding of safety instructions. Always follow these instructions carefully.

 **WARNING**	Always follow this instruction to prevent personal injury or death.
 **CAUTION**	Follow this safety instruction to avoid personal injury or damage to your property.
	Symbol "△" is a CAUTION or WARNING label indicating a safety instruction. (This symbol is an Electrical Shock warning label.)
	Symbol "⊘" is an instruction that you must not violate. (This symbol instructs NOT to disassemble the system components.)
	Symbol "●" is an operation instruction that you must follow. (This symbol shows the main power OFF instruction.)

WARNING <For System Operators>

Always follow this instruction to prevent personal injury or death.

	**Keep away from the rotating antenna.**	Before activating the antenna, evacuate personnel in the area near to the antenna to prevent accidents. The radome antenna, however, is an exception to the above warning.
	**Keep away from the operating antenna.**	Your radar antenna is radiating the high-frequency and high-power microwaves harmful to your eyes. Never approach the antenna within 3 meters.
	**Proximity alarm is not 100% reliable.**	The proximity alarm sounds when you are close to an obstacle. However, the alarm system may not detect driftwood or a small obstacle. Keep watch yourself to ensure safe navigation.
	**Turn power OFF during abnormality.**	If smoke or a smell of burning occurs, a fire or an electrical short circuit may result. Turn the power switch OFF and shut down the power supply immediately. Never try to repair the system yourself. Call for service.
	**Do not open the cabinet.**	High voltage exists in the instrument. Contact with it may cause personal injury or death.

	**Avoid excessive shocks to the display unit.**	Breaking of the display (cathod ray tube) can cause personal injuries due to scattering glasses or implosion. Therefore, strong shocks must not be applied to surface of the display.
	**Do not use in poor ventilation.**	If you cover it or use in an enclosed place, it may malfunction or become damaged due to an overheating. Use only where there is enough ventilation.

Installation Cautions <For Service Personnel>

Follow the installation instructions to avoid personal injury and system malfunction.

Installation in rigid position	Mount your system on a rigid frame or ceiling. Otherwise, your mounting may loosen.
Use correct installation materials.	Use the installation materials in the standard accessory pack only. If the bolt and screw strength is insufficient, your system may become loose and become damaged.
Keep away from direct sunlight.	Keep your system away from direct sunlight as it may become damaged or burnt due to overheating.
Keep away from water.	Take care not to get water on your system as it may become damaged or you may receive an electrical shock.
Keep away from heat source.	Keep your system away from a heat source or it may malfunction, become damaged, or burn.
Use correct power source.	Operate your system with the specified power voltage. An incorrect power supply may cause a malfunction, fire or personal injury.

Maintenance Cautions <For Maintenance Personnel>

Use the following safety precautions during internal inspection.

Discharge capacitors.	A high voltage may remain in the capacitors of the high-tension circuit several minutes after you have turned the power switch off. Wait at least five minutes or discharge them to the ground before starting your inspection.
Check that power is OFF.	To prevent an electrical injury due to erroneous power switching, make sure that the main power supply and the system power switch are both off. Also attach a safety label showing that service is in progress.
Avoid EMI.	Take care not to damage the ESDs (Electrostatic Sensitive Devices) due to static electricity from carpet and cloths.
Avoid dust.	Wear a safety mask so as not to breath in dust during inspection or cleaning inside your system instruments.

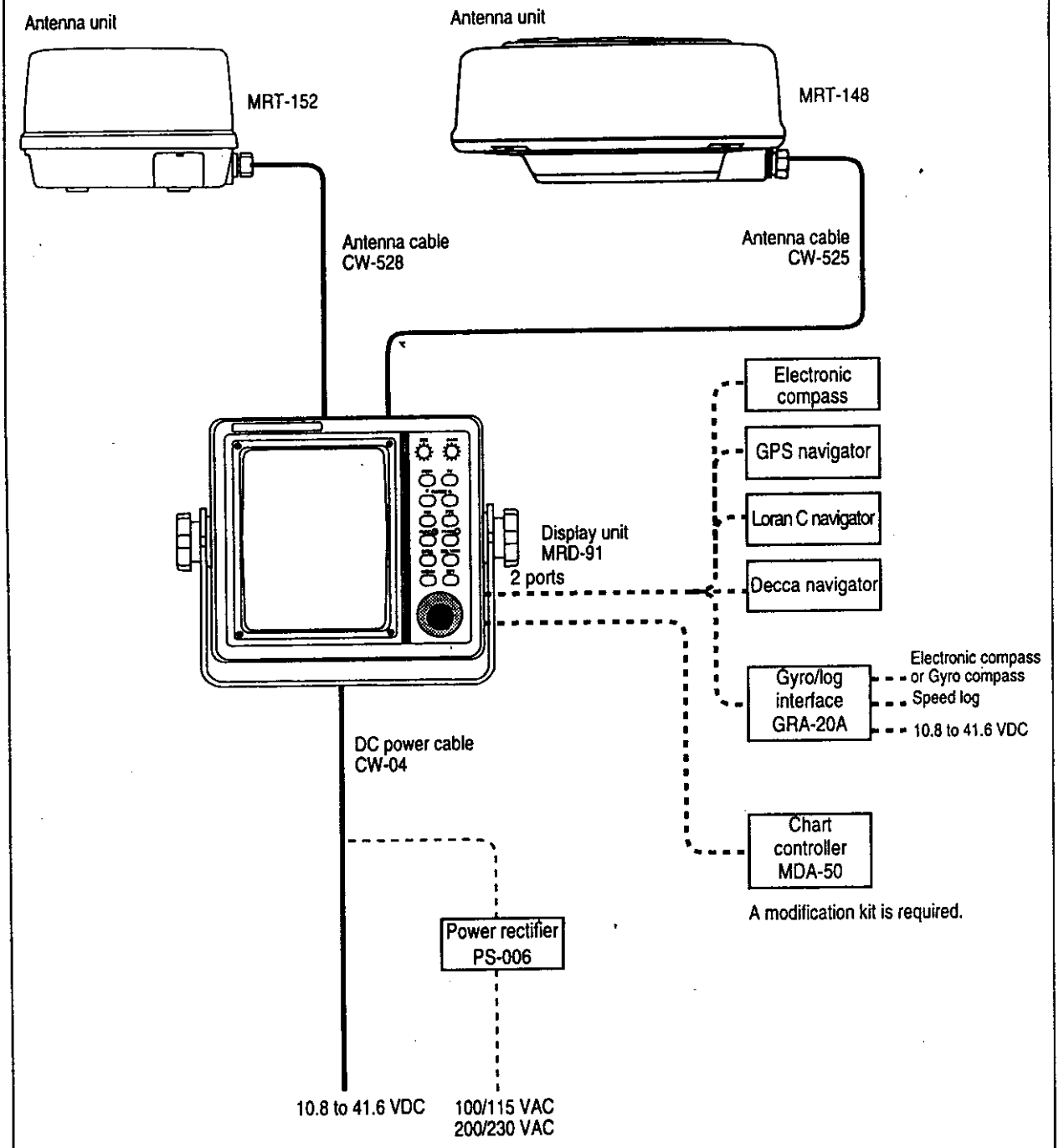
Operation Notes <For Operators>

Observe the following operation notes, otherwise the system failure or deterioration can result. And periodical inspection and maintenance are required for keeping the system in an optimum condition.

Backup important data.	Save or log important data in a backup memory or log sheets. The initial setup data and your storage data may be lost when the internal battery expires or when you service the electrical circuits.
Preheat the magnetron.	Preheat the magnetron in **STANDBY** mode more than 30 minutes if you turn on its power supply for first time, if you have not used it more than two months, or if you have replaced the magnetron.
Keep away magnetic substances.	Keep away magnetic substances such as magnets or magnetized tools from the display unit, otherwise dislocation of displayed image can result.

Table of Contents

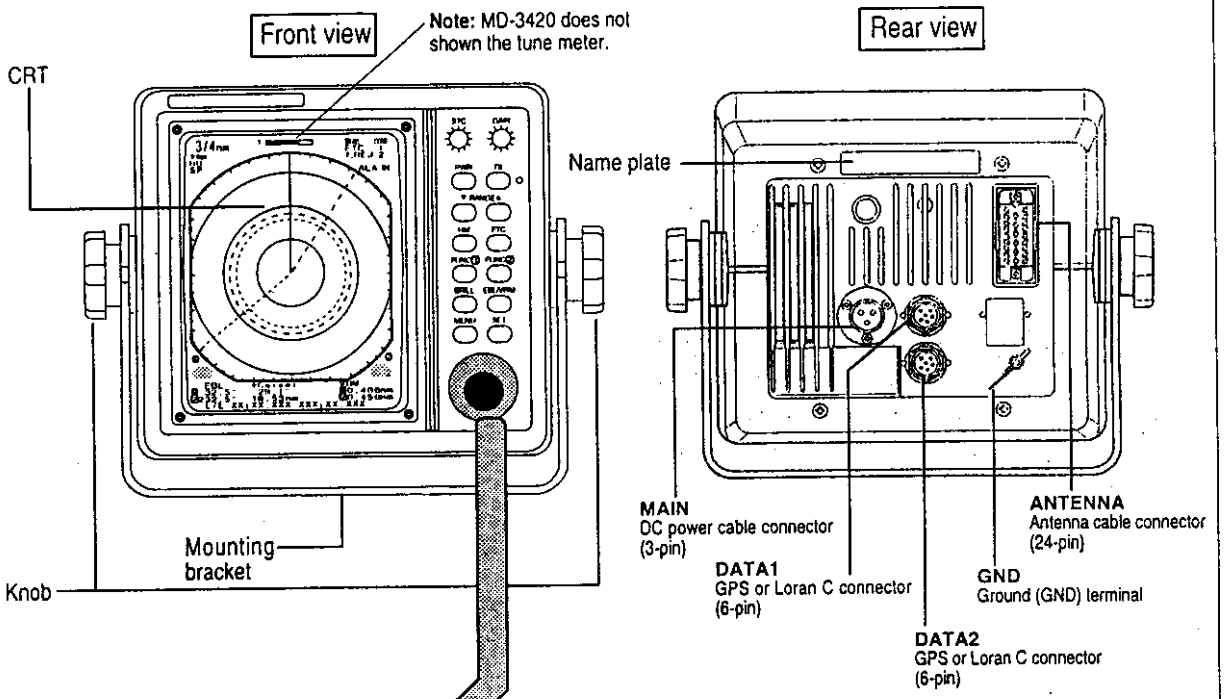
System Configuration



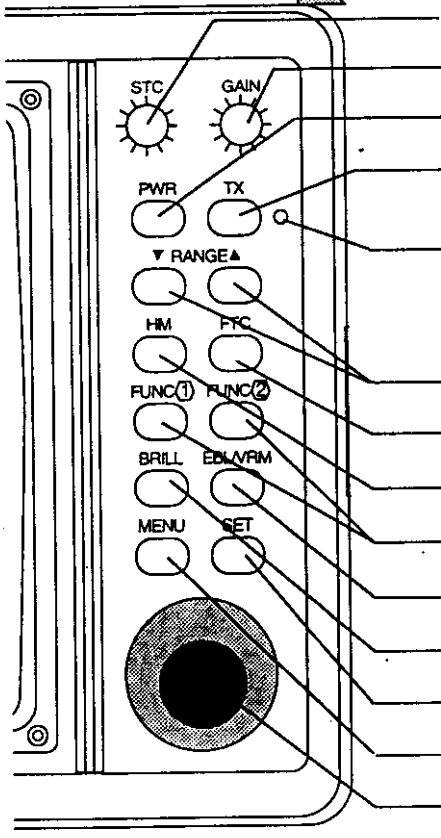
System model and configuration

Type	Antenna unit	Display unit
MD-3420Mk2	MRT-152	MRD-91
MD-3441	MRT-148	MRD-91

Display Unit



Note: Refer to "Interconnecting diagram" on pages 26 and 27.



STC control
Reduces the sea clutter reflection.

GAIN control
Adjusts the radar sensitivity.

Power (PWR) key
Turns the power on or off. Hold down several seconds to turn it off.

Transmit/Standby (TX) key
Switches between radar transmit and standby modes. Use transmit (TX) in operating mode and standby to conserve power.

LED lamp (for save mode indication)
During radar transmit ..... Off
During alarm Off ..... Orange LED lights (if WAIT) or green LED lights (if STANDBY)
During Alarm Transmit Off ..... Green LED lights but not transmit. (Save mode)
During Alarm Transmit On ..... Red LED lights and intermittent transmit starts. (Save mode)

RANGE keys
Selects range scale.

FTC key
Reduces rain and snow images.

Heading (HM) key
Temporarily removes the heading marker when pressed.

Function (FUNC) 1/2 key
Assigns two different functions.

EBL/VRM key
Turns the bearing and distance markers on or off.

Brilliance (BRILL) key
Adjusts the screen brilliance. Hold down the key to change the brilliance.

SET key
Enters various menu setup and second distance marker selection.

MENU key
Calls the Menu.

Pointing device (PD)
Moves a cross-hair cursor, bearing and distance markers, and alarm range, and selects various options

Operating Instructions

Press the key center or arrow!

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

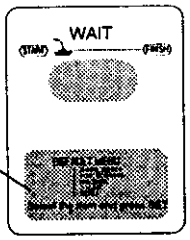
Getting Started

PWR TX Orange LED lights.

Power

Press the PWR key to turn the power on, and the orange LED will come on.
- The power turns on and **"WAIT"** appears on the display.
- The 120-second magnetron preheating timer starts.

Default menu



Keep pressing down the PWR key to turn the power off.

TX

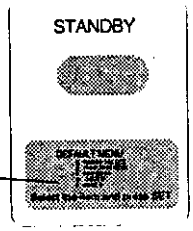
Transmission/ Standby

When **"STANDBY"** appears, press the TX key. This key selects the TX and STBY modes alternately when pressed.

Transmission standing-by

Default menu

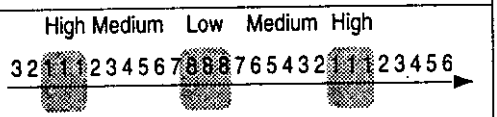
READY status



BRILL

Brilliance

Adjust the image brilliance in eight levels.



GAIN

GAIN

Increase the gain until noise just appears on the screen.
Rotate the control CW to increase the gain (and more target noise appears).
Rotate it CCW to decrease the gain (and target noise level drops).

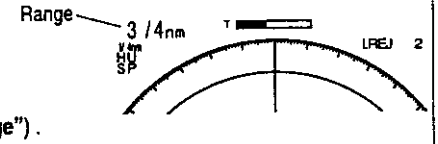
CAUTION Too low sensitivity eliminates small targets from screen.

▼ RANGE ▲

Range

Select the working range you desire.
Press ▲ arrow to increase the scale range, and press ▼ arrow to decrease it.

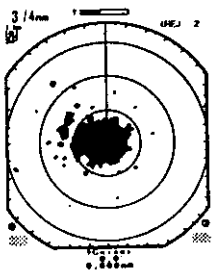
Select a range from 15 levels (see the **"Selecting range"**).



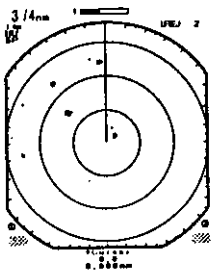
Reducing sea clutter

STC

When sea clutter reflections are too large to locate the target, adjust the STC control.
Sea clutter reflections increase when waves are high and close to you. These images often appear to windward. The STC can eliminate most of these returns.
CAUTION: Excessive STC eliminates small target images.



When STC is OFF



When STC is ON

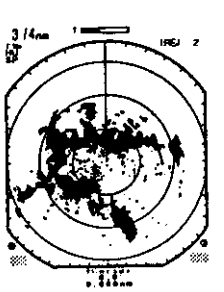
Reducing rain and snow images

FTC

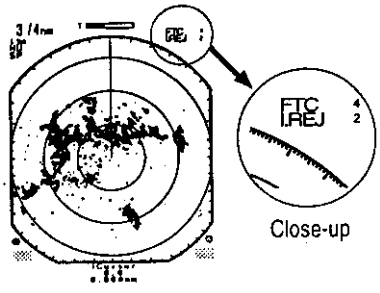
When rain or snow affects displayed targets, press the FTC to reduce the reflections. The FTC switches five filtering levels when pressed.
They are: Level 1 (Lowest filtering), Level 2, Level 3, Level 4 (Highest filtering), and OFF.

(Lowest filtering) (Highest filtering)

Rain, snow, fog and cloud can adversely affect on the displayed targets. Use the FTC key to reduce the affection. Also, try to rotate the GAIN control CCW.
CAUTION: Excessive FTC eliminate small targets. Turn FTC OFF to show a small target.



When FTC is OFF



When FTC is ON

Close-up

Stopping transmission

Save (Standby)	Full Stop
TX **TX/STBY** switches the **TX** and **STBY** modes when pressed. You can skip the 120-second preheating time if already transmitted. Press to display "**STANDBY**".	PWR Continue to press until the screen clears.

Determining the bearing using EBL

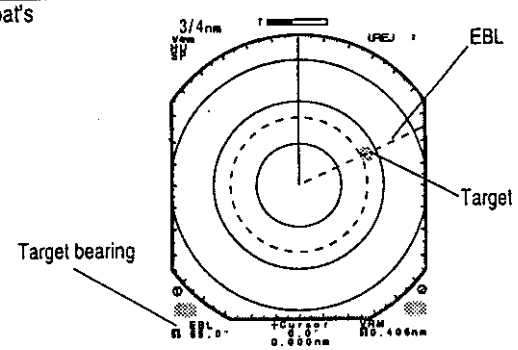
Use the EBL (bearing marker) to determine the accurate bearing from your boat's position to the target.

EBL/VRM

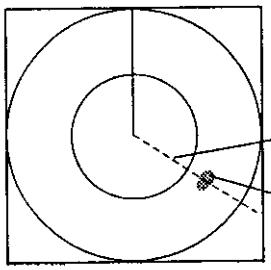
Press until the letters "**EBL**" and "**VRM**" appear at bottom of screen.

Press right or left end of key to locate **EBL** (dotted lines) on the target.

EBL/VRM | Press again to clear **EBL** and **VRM** markers and values from screen.

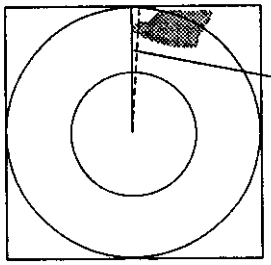


Small target



Align EBL with the center of target.

Point of island or land mass



Shift EBL X degrees toward target. This angle is equal to a half of horizontal beam width of antenna.

Measuring range of target using VRM

You can measure the distance to the target using the variable range marker (VRM). The range is in nm (nautical miles) or "km" (kilometers). Recall Menu **2 (MARK)**, and select "**nm**" or "**km**" from "**3 VRM UNIT**" option to switch the unit.

EBL/VRM

Press until letters "**EBL**" and "**VRM**" appear at bottom of screen.

Press top or bottom end of key to locate **VRM** (dotted lines) on the target.

EBL/VRM | Press again to clear **EBL** and **VRM** markers and values from screen.

Range rings | You can estimate the distance from your position to the target using the Range rings. See "**Displaying the range rings**" in **Menu 2** for details.

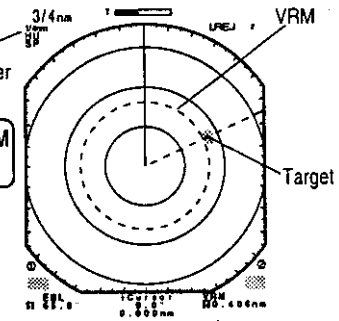
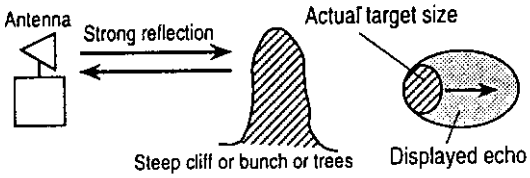
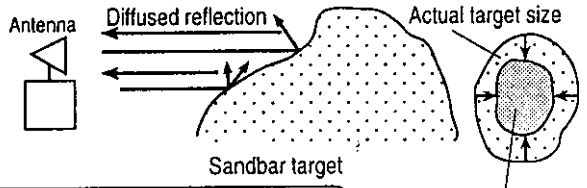


Image of strong target



When strong targets reflect the radar signal, the trailing edge of echo image expands.

Image of weak target



When the target reflection is weak, the displayed echo image is reduced.

Displayed target size is smaller than the actual size

Switching EBL/VRM, cross-hair cursor, 2nd EBL/VRM, parallel cursor, and floating EBL/VRM display

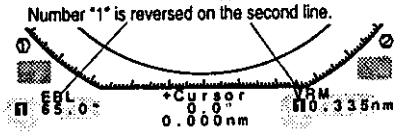
You can select the 2nd **EBL/VRM**, Parallel cursor, or Floating **EBL/VRM** from **"2. MARK"** option of Main menu or from **"2. FUNCTION KEYS"** option of Default menu. Also, switch the pointing device (PD) accordingly.

Using the EBL/VRM

EBL/VRM

Press to display "EBL" and "VRM" on screen. Press again to clear them.

Letters "EBL" and "VRM" appear on the first line.
Number "1" is reversed on the second line.

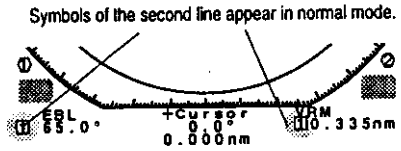


Using cross-hair cursor

SET

Press to display second line symbols in normal mode.

Symbols of the second line appear in normal mode.



Using the function selected from **"2 2nd MARK"** option of MENU 2 (**MARK**).

SET

Press to recall the function assigned to Main menu.

Selected function appear on the first line.
Symbols of the second line are reversed.

Second line symbols
2: EBL2/VRM2
P: Parallel cursor
F: Floating EBL/VRM

Using Function 1 selected from Default menu

FUNC①

Press to recall function 1. Press again to clear it..

The function assigned to FUNC 1 key

Assigned function appears on the first line.
Symbols are reversed on the second line.

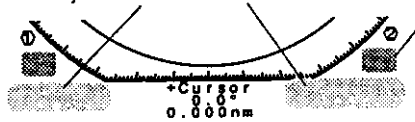
Using Function 2 selected from Default menu

FUNC②

Press to recall function 2. Press again to clear it.

Assigned function appears on the first line.
Symbols are reversed on the second line.

The function assigned to FUNC 2 key



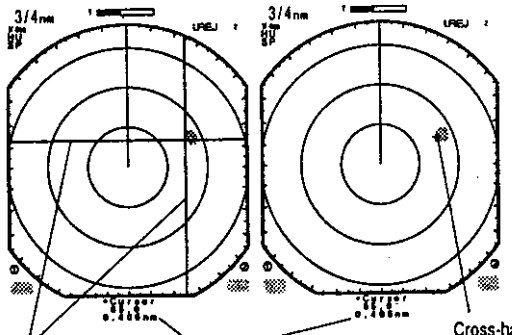
Measurement using cross-hair cursor

You can also measure the actual bearing and distance from your position to target by using the cross-hair cursor. The position indicated by the cursor is in nm (nautical miles), km (kilometers), or L/L (latitude and longitude). Recall **MENU 2 (MARK)** and select **"4 +CURSOR UNIT"** option to switch the display data.

Enable the cross-hair cursor.
(See the above section for details.)

Press the pointing device (PD) to move the cross-hair cursor center of the screen.

Locate the cross-hair cursor onto target using the PD (pointing device). The position data will appear at the bottom center of screen.



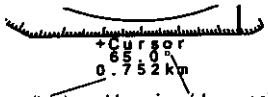
Cross-hair cursor when the PD is being pressed

Position data of cross-hair cursor

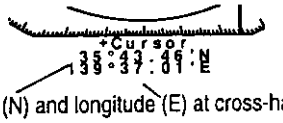
Cross-hair cursor

Position data examples of cross-hair cursor

Distance (nm) and bearing (degrees) from your position



Distance (km) and bearing (degrees) from your position



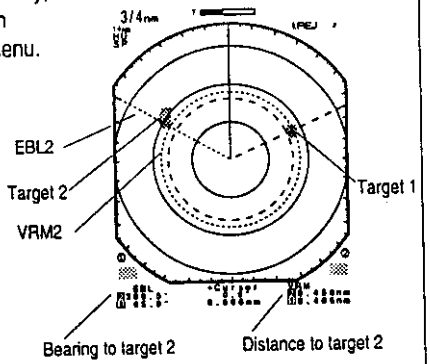
Latitude (N) and longitude (E) at cross-hair cursor position

Latitude and longitude are indicated if reference L/L data is already entered in navigator system.

Bearing and distance measurement using 2nd EBL and VRM

Usually use the First **EBL** and **VRM** for measurement. To measure two targets simultaneously, use the 2nd **EBL** and **VRM**. If you have set two pairs of **EBL** and **VRM** and you sail so that two targets close to the **VRMs**, you can sail to the same position. You can select the 2nd **EBL/VRM** from Main menu or Default menu.

- From Main menu, select **"2. MARK"** option and select **"EBL/VRM"** from **"2. 2nd MARK"**. The marks always appear on screen.
- From Default menu, select **"2. FUNCTION KEYS"** option and assign **EBL2/VRM2** to **Function 1** or **Function 2**.



Enable the EBL2/VRM2. (See the above section for details.)

Press right or left end of key to locate **EBL** (dotted lines) on the target.

Press top or bottom end of key to locate **VRM** (dotted lines) on the target.

Bearing and distance measurement using parallel cursors

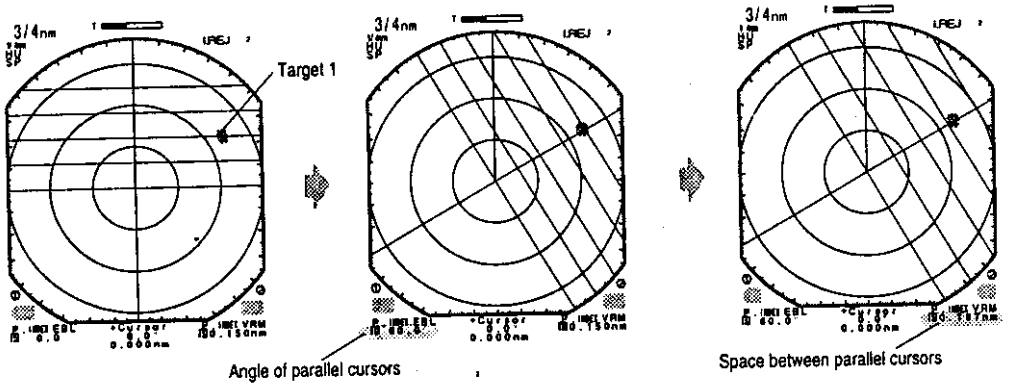
You can also measure the actual bearing and distance from your position to target using parallel cursors. You can use them if **parallel cursors** are already selected from Main menu or Default menu.

- From Main menu, select **"2. MARK"** option and select **"P. INDEX"** from **"2. 2nd MARK"**. Parallel cursors always appear on screen.
- From Default menu, select **"2. FUNCTION KEYS"** option and assign **PARA INDEX LINE (Parallel cursors)** to **FUNC 1** or **FUNC 2**.

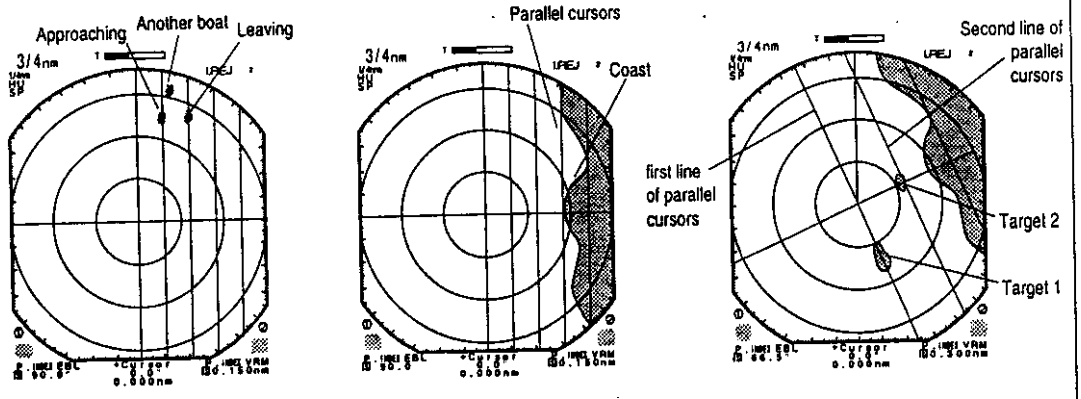
Enable parallel cursors. (See the above section for details.)

Press right or left end of key to adjust the angle of parallel cursors.

Press top or bottom end of key to adjust the space between parallel cursors.



Display examples of parallel cursors



You can measure the bearing of another boat.
Align cursors with the heading, and you can determine if another boat is sailing toward you or away from you.

You can sail in a fixed distance from a straight coast.
Align cursors with the coast, and you can measure the distance to the coast and sail in a fixed distance from it.

You can measure distance between two points.
Align the first line of parallel cursors with target 1 and align the second line with target 2. You can now measure the distance between them.

Measuring bearing and distance between 2 points using Floating EBL/VRM

You can measure the bearing and distance between any two points on the screen using **Floating EBL/VRM**. You can use them if Floating EBL/VRM is already selected from Main menu or Default menu.

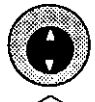
- From Main menu, select **"2. MARK"** option and select **"FLT EBL/VRM"** from **"2. 2nd MARK"**. **Floating EBL/VRM** always appear on screen.
- From Default menu, select **"2. FUNCTION KEYS"** option and assign **Floating EBL/VRM** to **Function 1** or **Function 2**.

Enable cross-hair cursor. (See the above section for details.)

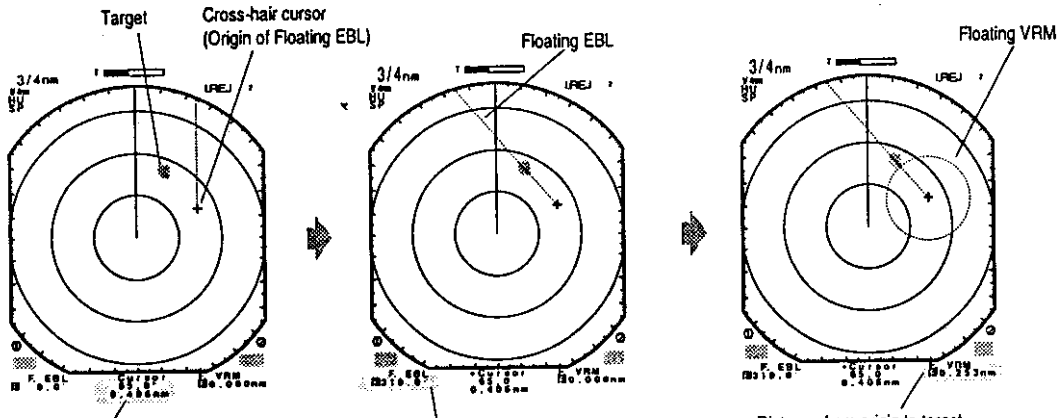
Locate the cross-hair cursor onto origin of Floating EBL/VRM using the PD (pointing device). The position data appears at bottom center of screen.

Enable Floating EBL/VRM. (See the above section for details.)

Press right or left end of key to align Floating EBL (dotted lines) with target.

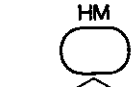


Press top or bottom end of key to align Floating VRM (dotted lines) with target.



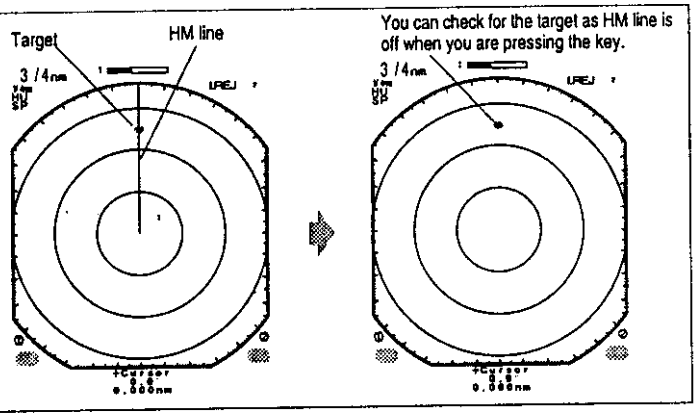
Removing HM line

When the header marker (HM) overlaps the target, you can remove HM line temporarily.



HM line is off the screen when the key is being pressed.

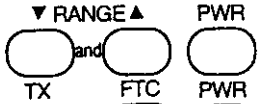
CAUTION: The target can be covered by the header marker (HM). Press the HM key frequently to check for the target.



Simulation

The simulation image allows you to learn how to operate cross-hair cursor, EBL/VRM, EBL2/VRM2, parallel cursors, and floating EBL/VRM. Connecting the external simulator allows you to practice operations such as off-centering, zooming and alarm. You can start simulation by simply connecting the power cable. No antenna connection is required. To exit the simulation, turn the power key off first, then turn it on again.

When using the internal simulator.



When using the external simulator.

Hold down two keys and press the PWR key

Press to call the simulator image without waiting for 120-sec preheating time.

Press to display the simulator image.

Simulator Image

Menus

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

Types of menu

The Marine Radar has 3 menus: Default menu, Main menu, and Maintenance menu.

Calling a menu

Default menu

Press the TX key to enter the standby mode.

Note: The Default menu always appears during radar STANDBY or ready (WAIT).

Main menu

Press the MENU key to call the menu.

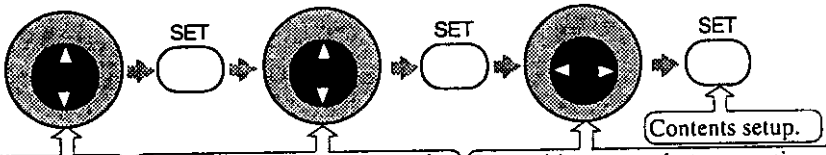
Maintenance menu

Hold down FUNC(1) key and press the PWR key.

Note: If already power ON, turn it OFF first, then turn it ON again.

How to use menus

Main menu

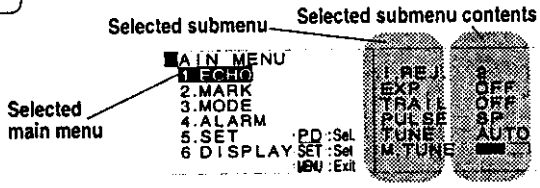


Press either top or bottom section of pointing device (PD) to reverse the selected option.

Press either top or bottom section of pointing device (PD) to the selected submenu.

Press either top or bottom section of pointing device (PD) to the selected submenu contents.

The Default and Maintenance menus have different operation procedures depending on your selection.



Returning to display mode

Main menu

Press the MENU key until the menu modes are released.

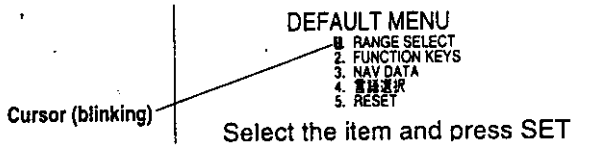
The Default and Maintenance menus have different operation procedures depending on your selection.

Default menu

Important! If you have replaced a battery, always select "5. RESET" from the Default menu.

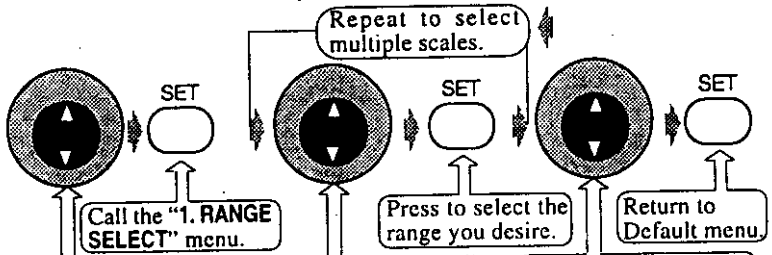
Default menu functions can:

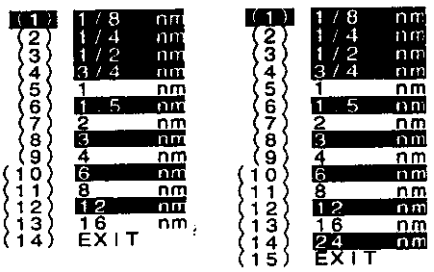
1. Select a customized range scale.
2. Assign functions to "Function 1" and "Function 2" keys.
3. Turn navigation display on or off.
4. Select the language used on the display.
5. Reset set values.



Selecting range and unit used

Select the distance unit for range and fixed range marker, and choose the item number.



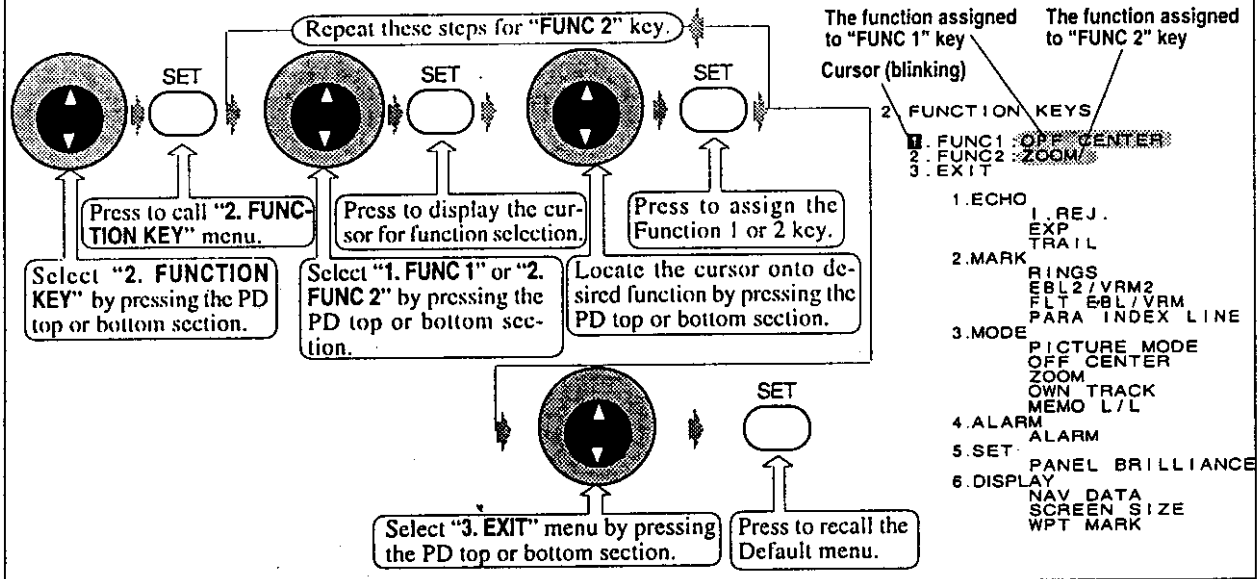


MD-3420Mk2 **MD-3441**

Customized operating ranges.

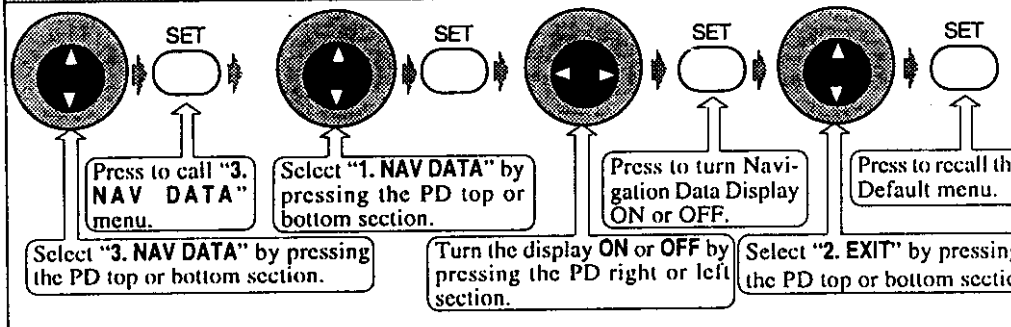
Assigning "FUNC 1" and "FUNC 2" keys

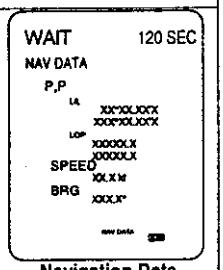
Initial setup: FUNC 1: OFF CENTER
FUNC 2: ZOOM



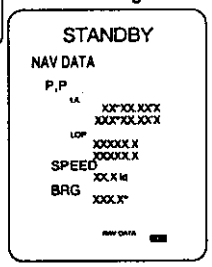
Calling Navigation Data screen

Initial setup: OFF





Navigation Data screen during WAIT

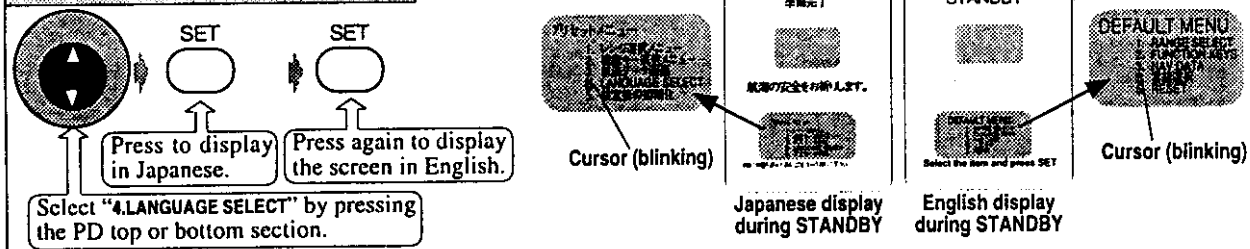


Navigation Data screen during STANDBY

When ON is selected for NAV DATA, pressing the TX key displays the radar image and navigation image alternately.

SET Press to clear the Navigation Data screen.

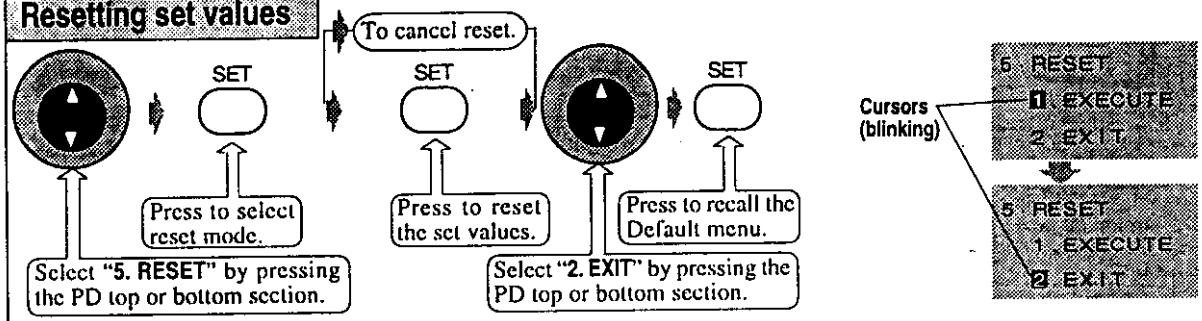
Selecting a display language



Japanese display during STANDBY

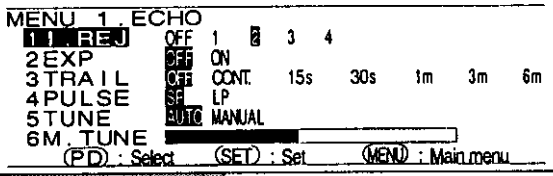
English display during STANDBY

Resetting set values



Main Menu 1 (1. ECHO)

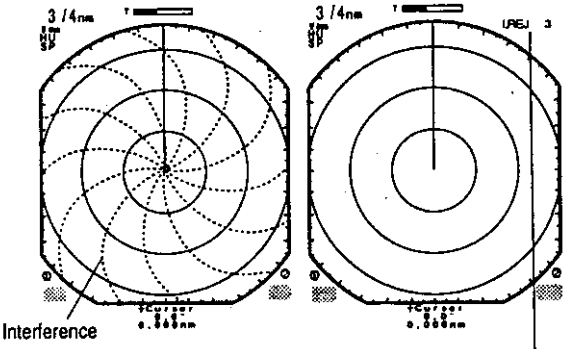
Select Main Menu 1 (1. Echo) to:
1. Reduce interference.
2. Expand target.
3. Display target boat's trail.
4. Switch transmit pulse width.
5. Select Auto or Manual tune.
6. Start Manual tune.



Reducing interference

Initial setup: 2

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

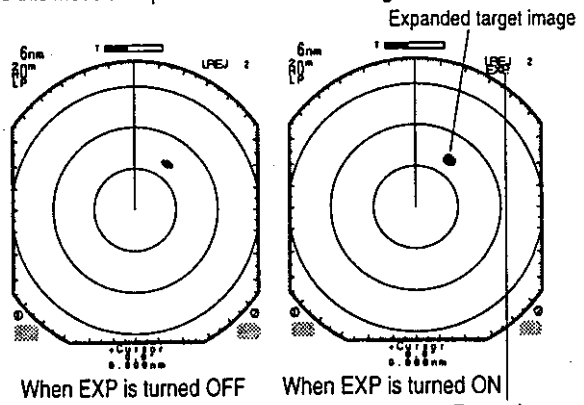


OFF 1 2 3 4
No Weak ——— Strong

Expanding target

Initial setup: OFF

Use this mode to expand small and distant targets.

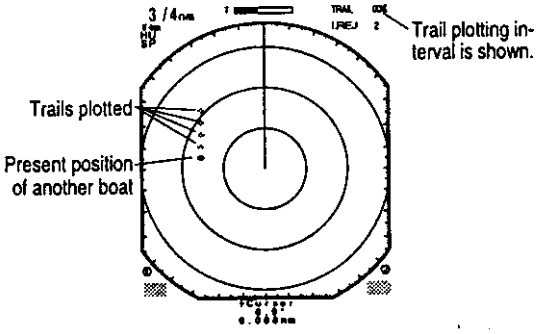


No target is expanded in 2-nm range or less.

Displaying other boat's trail

Initial setup: OFF

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



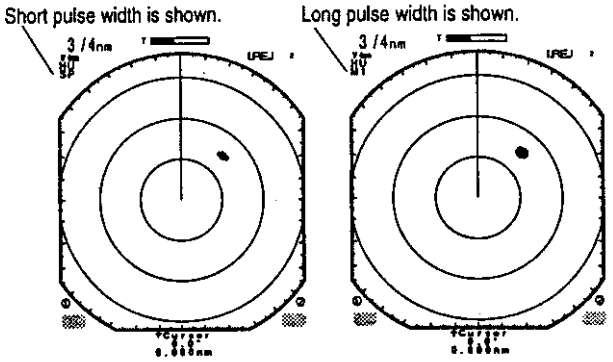
The trail is displayed in dark. Trail plotting starts when you change the scale range.

Trail plotting interval:
OFF, CONT, 15 sec., 30 sec., 1 min., 3 min., 6 min.

Changing pulse width

Initial setup: SP

Select an appropriate transmit pulse width to display clear target.



The distance resolution is improved and the sharp target is shown.

The long-distance detection power is improved and the clear target is shown.

The range in which transmit pulse width can be switched.
MD-3420: 3/4 to 2 nm
MD-3441: 3/4 to 4 nm

Selecting auto or manual tune

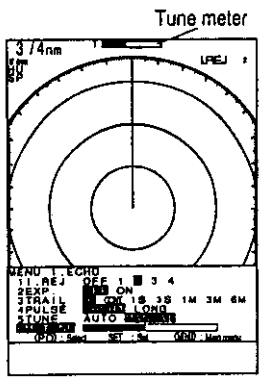
Initial setup: Auto tune

Select the Auto tune for automatic tuning. (Select the Manual mode for manual fine-tuning.)

CAUTION: The MD-3420Mk2 supports auto tune mode only.

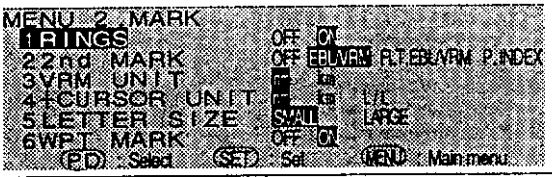
Starting manual tuning

Manual tune to display radar images as much as possible by pressing the PD right or left section. The tune meter adjusts accordingly.



Main Menu 2 (2. MARK)

Select Main Menu 2 (2. MARK) to:
1. Display the range rings.
2. Select a marker (EBL2/VRM2, Floating EBL/VRM, or Parallel Cursors).
3. Change the measuring unit of VRM (Variable Range Marker).
4. Change the measuring unit of cross-hair cursor.
5. Change the marker value.
6. Turn target display on or off.



Displaying the range rings

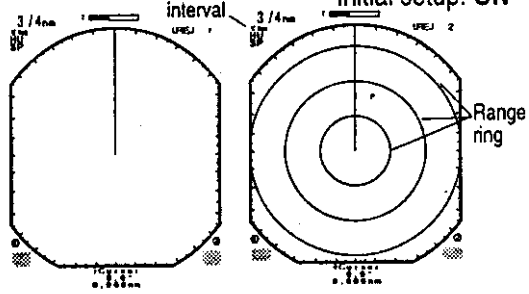
Use to estimate the distance to the target.

( ): MD-3441 only used.

Range, ring interval, and number of markers

Range (nm)	Ring interval (nm)	No. of markers
1/8	1/16	2
1/4	1/8	2
1/2	1/4	2
3/4	1/4	3
1	1/4	4
1.5	1/2	3
2	1/2	4
3	1	3
4	1	4
6	2	3
8	2	4
12	3	4
16	4	4
24	6	4
(32)	(8)	(4)

Initial setup: ON



When RINGS are turned OFF When RINGS are turned ON

Selecting a marker (EBL2/VRM2, floating EBL/VRM or parallel cursors)

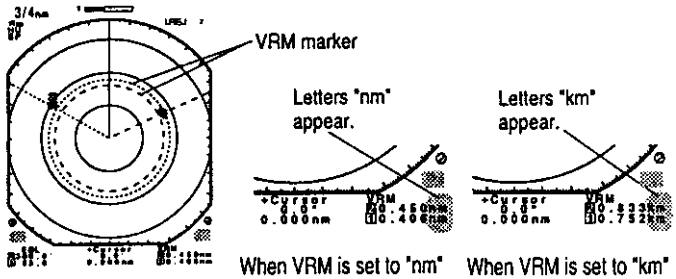
Initial setup: EBL/VRM

You can select a desired marker (EBL2/VRM2, floating EBL/VRM or parallel cursors).
See "Switching EBL/VRM, cross-hair cursor, second EBL/VRM, parallel cursor, and floating EBL/VRM, display" on page 6.

Changing the VRM measuring unit

Initial setup: nm

You can select the measuring unit of VRM (Variable Range Maker), floating VRM, and parallel cursor in either "nm" (nautical miles) or "km" (kilometers).



When VRM is set to "nm" When VRM is set to "km"

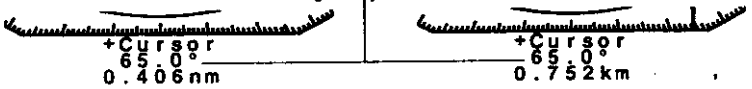
Changing cross-hair cursor position data

Initial setup: nm

Distance from your boat to cross-hair cursor and letters "nm" appear.

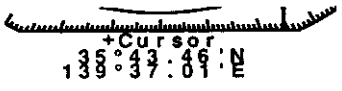
Distance from your boat to cross-hair cursor and letter "km" appear.

Bearing from your boat to cross-hair cursor



When cursor is set to "nm" When cursor is set to "km"

The position data (Lat/Long) at cross-hair cursor is shown. You must be receiving Lat/Long data from GPS or Loran C navigator.

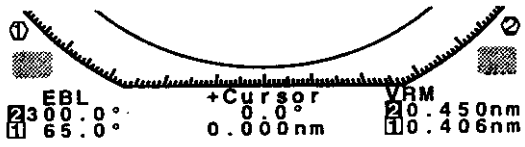


When cursor is set to L/L

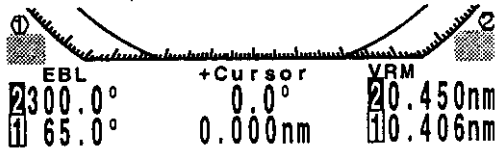
Changing bearing and distance data size

Initial setup: SMALL

You can display the large bearing and distance data of EBL/VRM, cross-hair cursor, EBL2/VRM2 and floating EBL/VRM, the large bearing and space data of and parallel cursors.



When size is set to Small

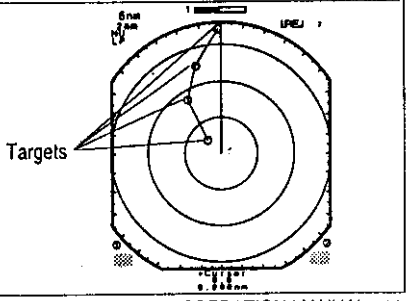


When size is set to Large

Turning target display ON or OFF

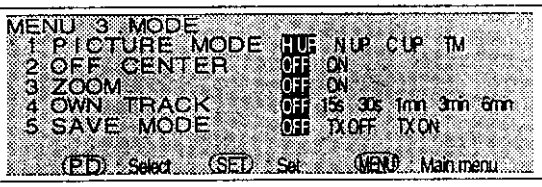
Initial setup: OFF

You can display up to 4 waypoints (including the next waypoint) if you receive your position, waypoint position, course data from GPS or Loran C navigator. When you passed a waypoint, the next waypoint is added.



Main Menu 3 (3. MODE)

Select Main Menu 3 (3. MODE) to :
1. Select the radar display mode.
2. Display off-center presentation.
3. Display zoom presentation.
4. Display your boat's trail.
5. Select Power Save mode.



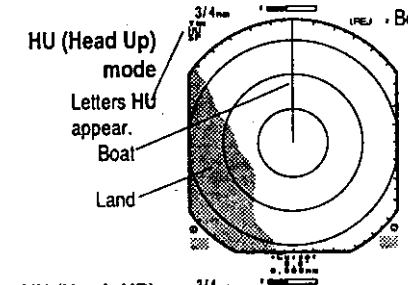
Selecting the data display mode

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

CAUTIONS

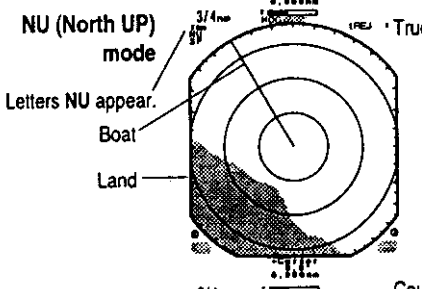
Your navigator takes a much longer time to update bearing data as compared with a gyro log interface. The position of fixed targets on the display such as land or boat will fluctuate because bearing data from the navigator cannot follow the steering of boat. This is especially evident at slow speeds,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

HU (Head Up) mode



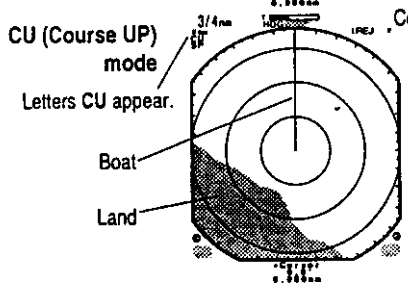
Your boat's heading is always to the top of screen. You can see the relative bearing of land and other targets.

NU (North UP) mode



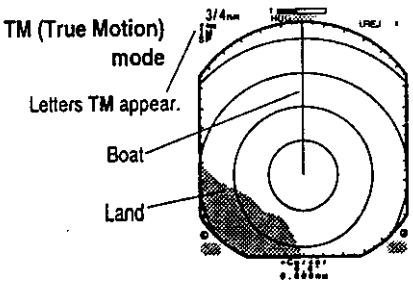
You must be interfaced with a gyro compass or GPS navigator. The radar picture will correspond to the navigation chart, and the target bearing is equal to true north bearing.

CU (Course UP) mode



Your 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.

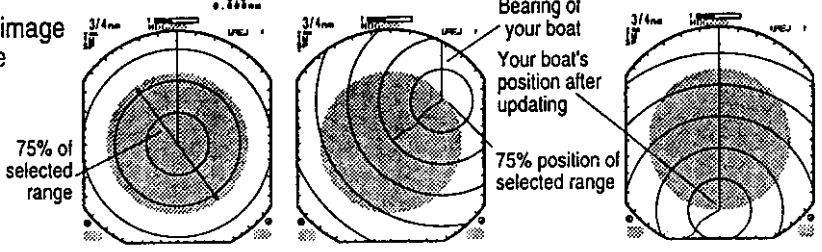
TM (True Motion) mode



You must be interfaced with a gyro compass or GPS navigator. The chart including your boat position is shown as if it is shown from the sky. Fixed targets including land are always shown at the fixed positions. Your boat and other boats are shown in true speeds and bearings. It is helpful to avoid a collision. Fixed targets may move as you drift due to current.

Resetting of your boat's position

Radar image change



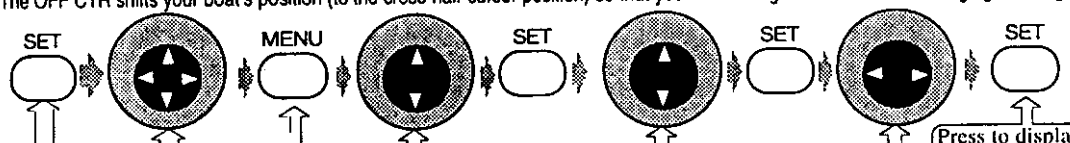
FUNC(1) FUNC(2) or

Press to reset your boat's position, when own ship's position is within 75% of the range scale in use.

You need to set up the FUNC 1 or FUNC 2 key to reset key. Refer to **"Assigning FUNC 1 and FUNC 2 keys"** on page 10.

Displaying off-center image

The OFF CTR shifts your boat's position (to the cross-hair cursor position) so that you read a long distance without changing the range scale.



Press to call the Main Menu.

Select "3: MODE" by pressing the PD top or bottom section.

Select "2: OFF CENTER" by pressing the PD top or bottom section.

Set cursor to ON by pressing the PD right or left section.

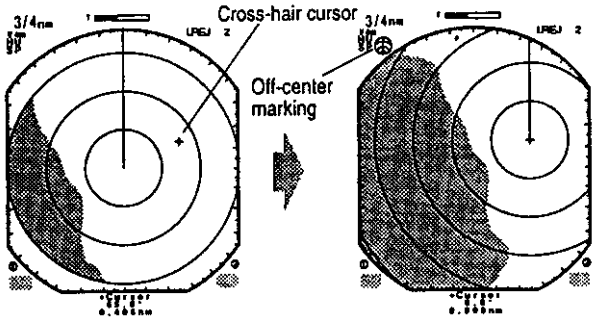
Press to display an off-center image and off-center marking from cross-hair cursor position.

Locate cross-hair cursor at the zoom image center position using the PD. The position data appears at screen bottom center.

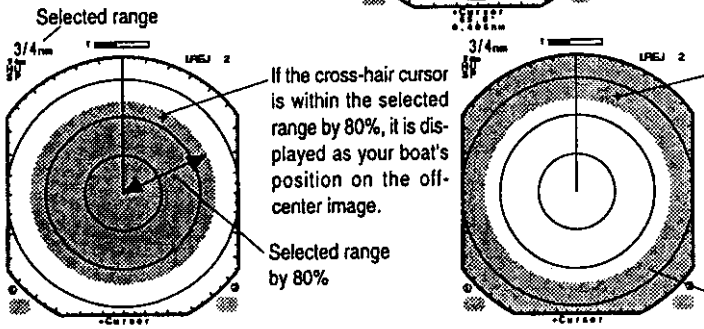
Press to display a cross-hair cursor. See **"Switching EBL/VRM, cross-hair cursor, second EBL/VRM, parallel cursor, and floating EBL/VRM display"** on pages 6.

If the off-center or zoom marking already appears, clear it first, then display the off-center image.

The off-center function is not available when the Max. Range is selected.



Notes during off-center image display

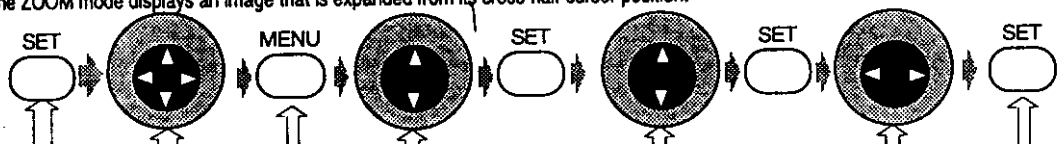


If the cross-hair cursor is within the selected range by 80%, it is displayed as your boat's position on the off-center image.

If the cross-hair cursor is outside of selected range by 80%, an intersection between the line from cross-hair cursor to your boat and the selected range is shown as your boat's position on the off-center image.

Displaying zoom image

The ZOOM mode displays an image that is expanded from its cross-hair cursor position.



Press to call the Main Menu.

Select "3: MODE" by pressing the PD top or bottom section.

Select "3: ZOOM" by pressing the PD top or bottom section.

Set cursor to ON by pressing the PD right or left section.

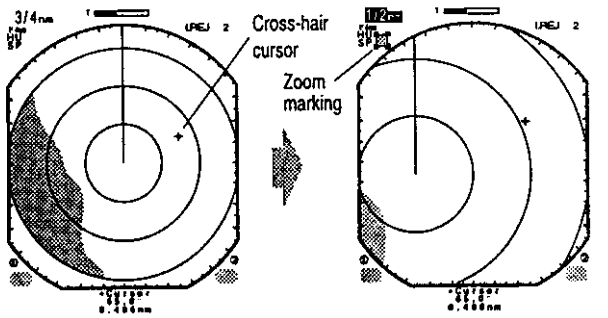
Press to display a zoom image from cross-hair cursor position.

Locate cross-hair cursor at the zoom image center position using the PD. The position data appears at screen bottom center.

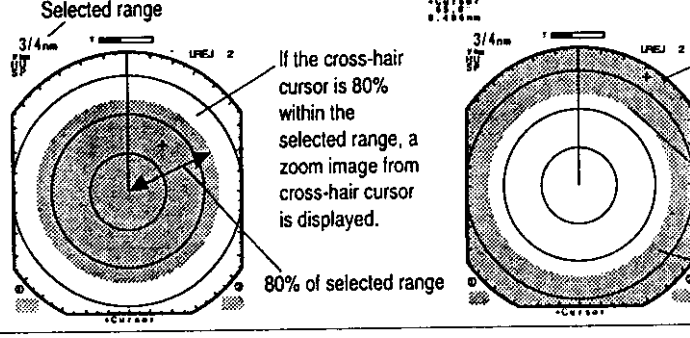
Press to display a cross-hair cursor. See **"Switching EBL/VRM, cross-hair cursor, second EBL/VRM, parallel cursor, and floating EBL/VRM display"** on pages 6.

If the off-center or zoom marking already appears, clear it first, then display the zoom image.

Zoom is not available when the minimum range is selected.



Notes during zoom image display



If the cross-hair cursor is 80% within the selected range, a zoom image from cross-hair cursor is displayed.

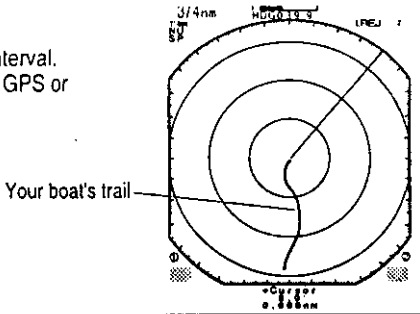
If the cross-hair cursor is outside the 80 % of selected range, no zoom image is shown.

Displaying your boat's trail

Initial setup: OFF

You can display your boat's in any of NU, CU, and TM modes by setup of trail plotting interval. You must be receiving bearing and Lat/Long data, or bearing and boat's speed data from GPS or Loran C navigator. See "NMEA0183 Input Data Formats Ver. 1.5/2.0" for data details.

Trail plotting interval:
OFF, CNT, 15 sec., 30 sec., 1 min., 3 min., 6 min.



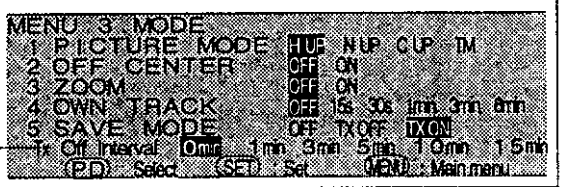
Selecting Power Save mode

Initial setup: OFF

Select the Power Save mode to turn CRT display power OFF during standby.
OFF ..... Suppresses the Power Save mode.
Transmit OFF ..... Selects Power Save mode. When you press the TX key to clear radar image, the green transmit LED illuminates.
Transmit ON ..... Selects Power Save mode. When you set an alarm and press TX key to clear radar image, the red LED illuminates. Signals are transmitted when antenna rotates 10 times. When a target enters or exit the alarm range, the CRT display power turns ON automatically. The buzzer sounds and the LED goes out.

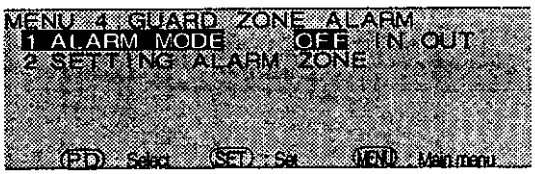
TX

Transmit OFF ... Green LED light.
Transmit ON ..... Red LED light.



Main Menu 4 (4. Alarm)

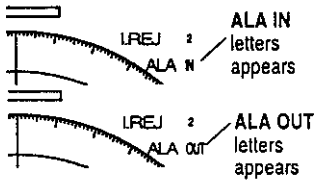
Select Main Menu 4 (4. **Alarm**) to:
1. Turn alarm off, or select guard zone.
2. Set a guard zone.



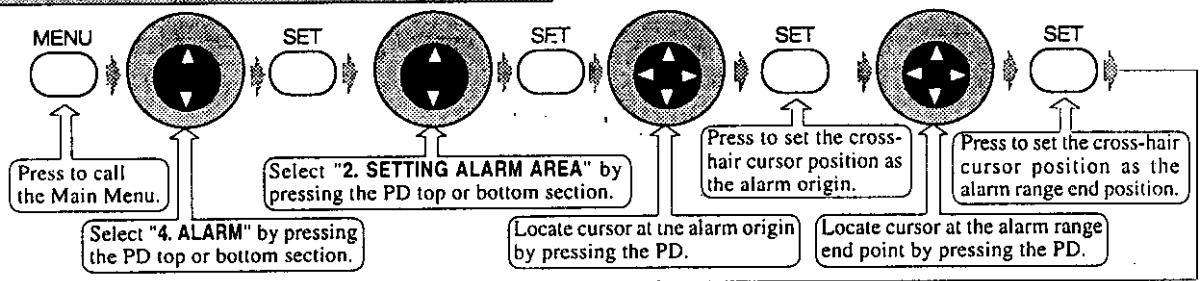
Turning alarm off or selecting guard zone

Initial setup: OFF

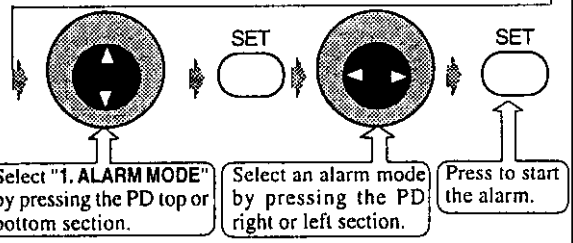
Select a guard zone, and select the IN or OUT alarm.
OFF ..... **Turns the alarm off.**
ALA IN (Intrusion) .... This alarm is activated when a target enters into the preset guard zone and stays there until the antenna completes its three consecutive rotations.
ALA OUT (Retreat) ... This alarm is activated when every target has left the preset guard zone.



Turning alarm off or selecting guard zone



CAUTION:
A weak signal from target cannot trigger the alarm.



To temporarily turn off the alarm.

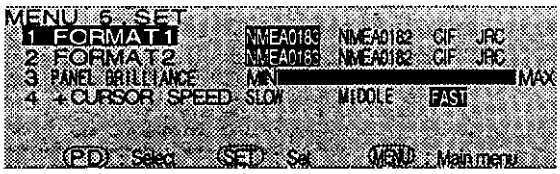
HM

Press the HM key while the alarm is activated.

Normal display ..... Turned on when the alarm is detected, or during the guard zone setup.
Alternate display of reversed and normal screen ... Turned on when the guard zone is moved out of the screen by the range switching, zooming or off-centering operation.
Continuous on and off of normal display ..... Turned on as long as the alarm continues.

Main Menu 5 (5. SET)

Select Main Menu 5 (5. SET) to:
1. Select Format 1 of signals at DATA1 connector.
2. Select Format 2 of signals at DATA2 connector.
3. Adjust control panel brilliance.
4. Change cross-hair cursor shift speed.



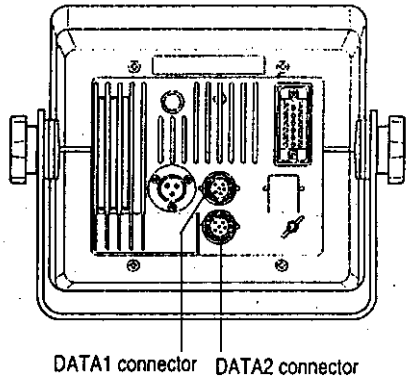
Receiving data from navigator unit

This unit has two signal input connectors: DATA1 and DATA2 on the rear panel.
DATA1 connector ..... Select Format 1.
DATA2 connector ..... Select Format 2.
Do not connect GPS or Loran C navigator to both the DATA1 and DATA2 connectors.

Use one of the following data formats to receive data from GPS or Loran C navigator:
NMEA0183 ..... Meets the NMEA 0183 Version 2.0.
NMEA0182 ..... Meets the NMEA 0182 format (usually used for auto pilot systems).
CIF ..... CIF format
JRC ..... JRC
For the data (sentences) read in NMEA 0183 format, see "NMEA 0183 Input Data Format."

If data has no sentence or if no data can be received, "xxx.x" appears in data display field.

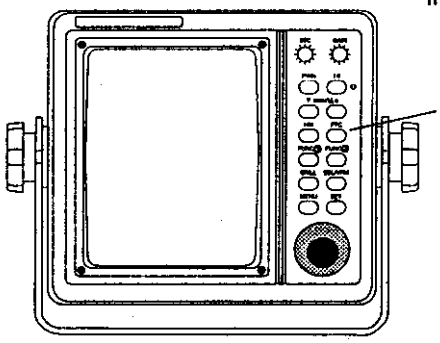
If no navigator unit is connected, no navigation data is shown even when you select a format.



Adjusting control panel brilliance

Initial setup: MAX

You can adjust the control panel brilliance.



Changing cross-hair cursor shift speed

Initial setup: FAST

You can change the cross-hair cursor shift speed on the screen.

Main Menu 6 (6. DISPLAY)

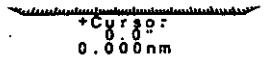
Select Main Menu 6 (6. DISPLAY) to:
1. Select navigation display data.
2. Change image size.
3. Turn function key symbol display on or off.
4. Turn Main Menu function display on or off.

Displaying navigation data by connecting a navigator unit

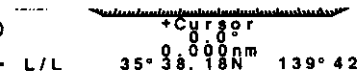
Initial setup:**OFF**

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

When set to **OFF**

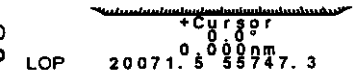


When set to **L/L**



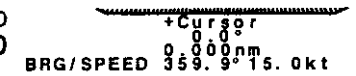
Your position (longitude and latitude) read from the navigator is shown

When set to **LOP**



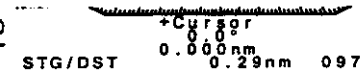
Your position (Loran C LOP) read from the navigator is shown.

When set to **BRG/SPD**



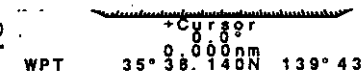
Your course and speed read from the navigator is shown.

When set to **STG/DIST**



Your distance and bearing to waypoint read from the navigator is shown. They are:
Relative beating:..... HU
True bearing: ..... NU, CU, or TM

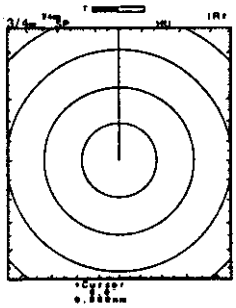
When set to **WPT**



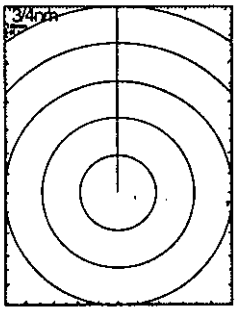
Your waypoint position read from the navigator is shown.

Changing radar image size

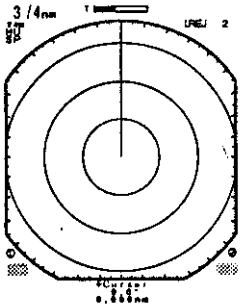
Initial setup:**SMALL**



When set to LARGE 1



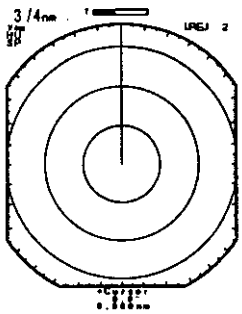
When set to LARGE 2



When set to SMALL

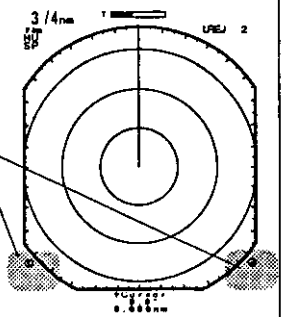
Turning function key display on/off

Initial setup:**ON**



When turned OFF

Symbols

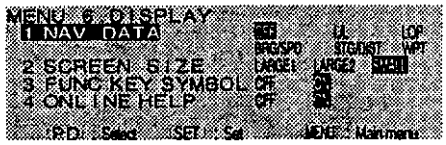


When turned ON

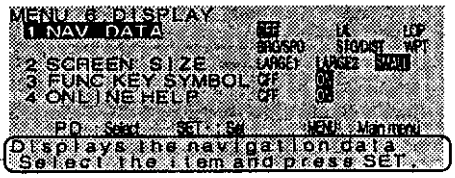
Turning menu function display on/off

Initial setup:**ON**

When turned **OFF**



When turned **ON**

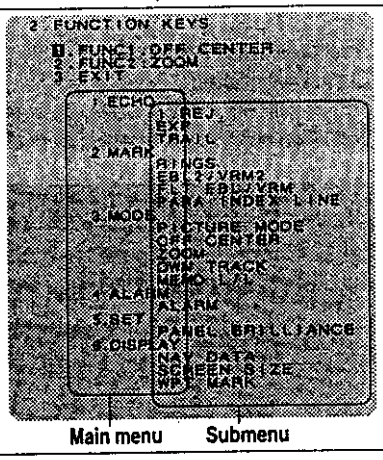


Operation function display

Function keys on Main Menu

You can assign some Main menu options to Function keys ① and ②. Assign the frequently used functions.
The DEFAULT menu has "2. FUNCTION KEY" option as shown. Go to Page 10 for function assignment.

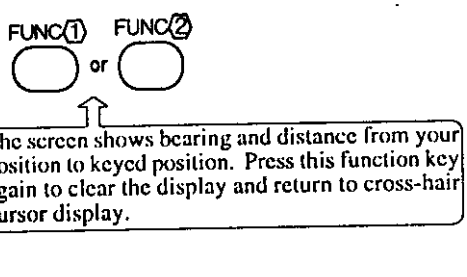
You can change your selection from Main menu by using Function key ① or ② Also, you can change these key assignments from the Main menu.

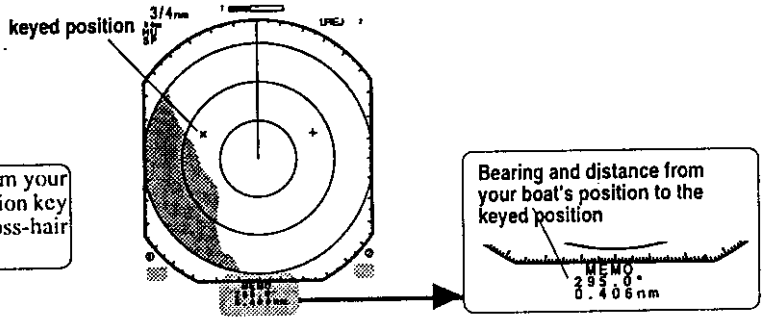


	When you press Function key 1 or 2
I. REJ.	Switches the elimination levels between 1, 2, 3, 4 and OFF.
EXP	Turns the image expansion on and off.
TRAIL	Switches the trail plotting interval between OFF, CNT (Continuous), 15S (15-sec interval), 30S, 1M (1-min interval), 3M and 6M.
RINGS	Turns fixed marker display on and off.
EBL2/VRM2	Turns EBL2/VRM2 display on and off.
FLT EBL/VRM	Turns floating EBL/VRM display on and off.
PARA INDEX LINE	Turns parallel cursor on and off.
PICTURE MODE	Switches the image modes between HU (Head Up), NU (North Up), CU (Course Up) and TM (True Motion).
OFF-CENTER	Displays an off-center image from preset cross-hair cursor position.
ZOOM	Displays a zoom-up image from preset cross-hair cursor position.
OWN TRACK	Switches your boat's track between OFF, 15S, 30S, 1M, 3M and 6M.
MEMO L/L	Saves your boat's position when pressed, and shows bearing and position from your position.
ALARM	Switching between Alarm Range Setup, Alarm Setup and OFF modes.
PANEL BRILLIANCE	Adjusts the control panel brilliance in eight levels.
NAV DATA	Switches navigation display modes from OFF, Lat/Long, LOP, Bearing/Speed, WP/Distance, to WP position sequentially.
SCREEN SIZE	Switches radar image size between Large 1, Large 2, and Small.
WPT MARK	Turns waypoint mark display on and off.

Position memory

Once you have assigned the Position Memory function to Function 1 or 2 key, you can save the key press position by simply pressing the key. The screen shows the bearing and distance from your boat's position to the keyed position. Symbol "X" shows the keyed position.



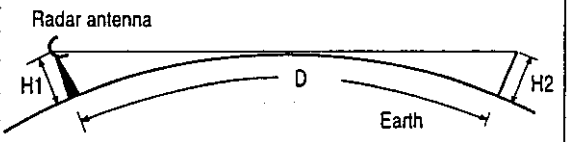


Display Interpretation

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 further than the optical horizon by about 6% and the physical horizon by about 15%. A target further from the radar horizon is not detectable. The radar horizon changes according to the radar antenna height and target height..



$D = 2.23 (\sqrt{H_1} + \sqrt{H_2})$ NM

H_1: Radar antenna height (nm)

H_2: Target height. (nm)

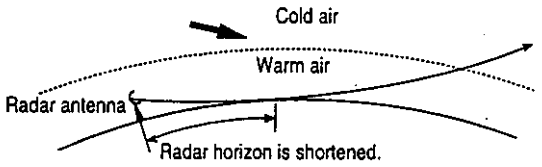
D: Distance to the target

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.

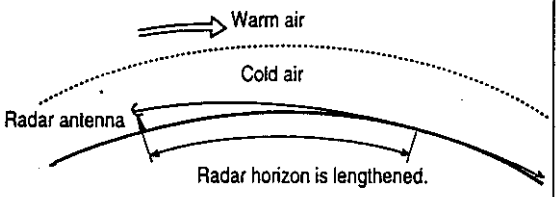
Sub-refraction

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.



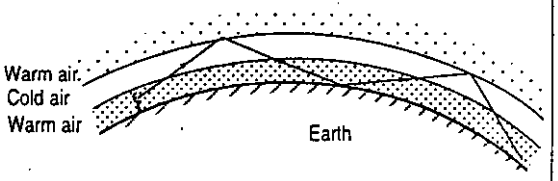
Super--refraction

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 with increasing 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.



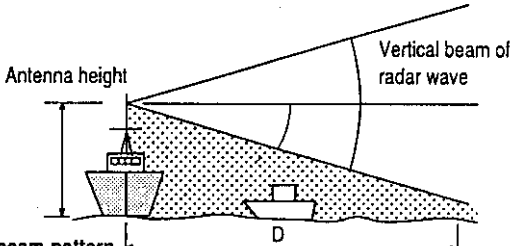
As a result, radio waves can be propagated farther than the curvature of the earth. The passage where the radio waves travel is called a Duct. The abnormal propagation of radio waves through this duct is called ducting.

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 right. Wider beam results in better short range detection, shortening the detectable range D as shown in Figure right.



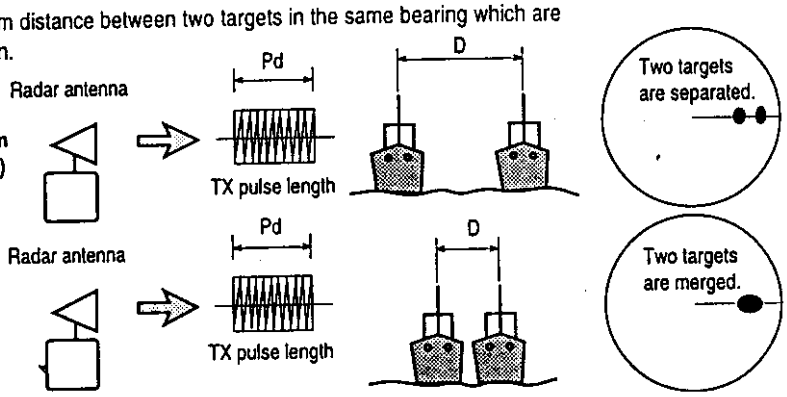
Antenna height and vertical beam pattern affecting detection of short range target.

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.

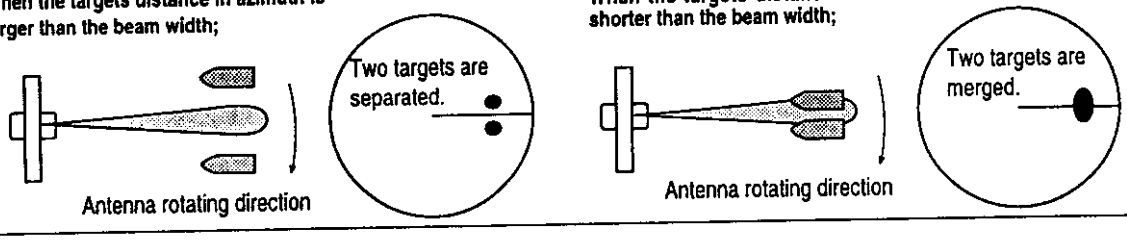


When the distance between targets is longer than a half of the transmitting pulse length; (D > Pd/2)

When the distance between targets is shorter than a half of the transmitting pulse length; (D ≦ Pd/2)

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.



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.

Normal echoes

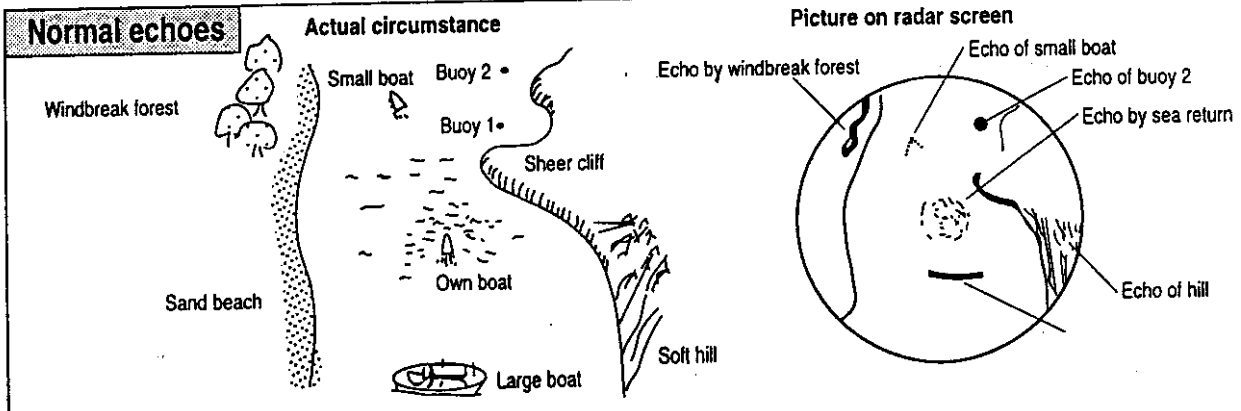


Figure above shows an example of typical radar pictures. As shown in this figure, the portions being radiated by radar waves are shown on the radar screen. No.1 buoy blocked by the cape is not detected.

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.

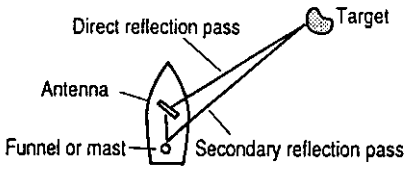
The windbreak forest produces strong echoes, and it is shown on the screen as massive echoes with high contrast. The reflection intensity of the signals differ according to their profiles. They are represented as a collective group of spot echoes in general. The boat's wake is shown stronger than that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

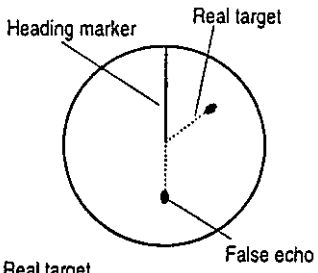
False echoes

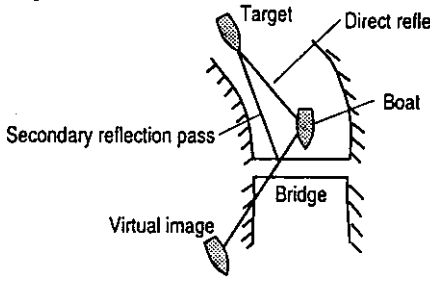
False echoes may appear according to the surrounding circumstances. Examples of false echoes and causes of these echoes are described below.

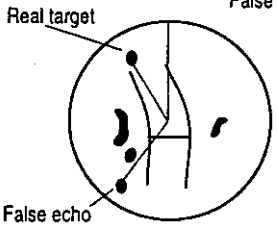
False echoes caused by reflection

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.



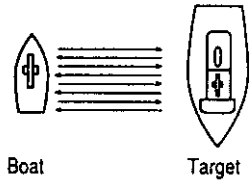


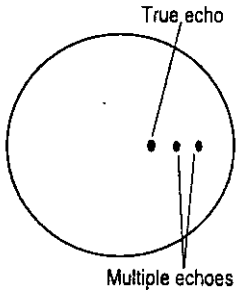




False echoes caused by multiple reflection

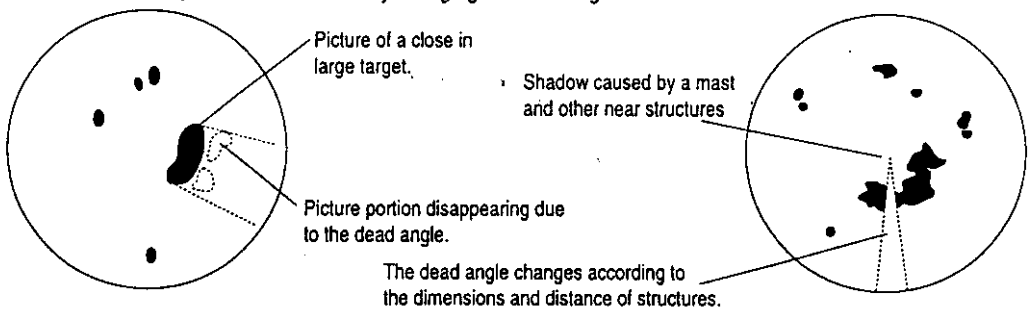
When a boat passes near a large boat, radio waves are repeatedly reflected between own boat and a nearby boat, causing several echoes at regular distances to appear in the same bearing. These false echoes produced by multiple reflection are called multiple echoes. In this case, the real target is closest. 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.





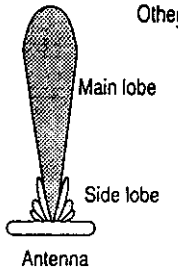
Shadow and dead angle

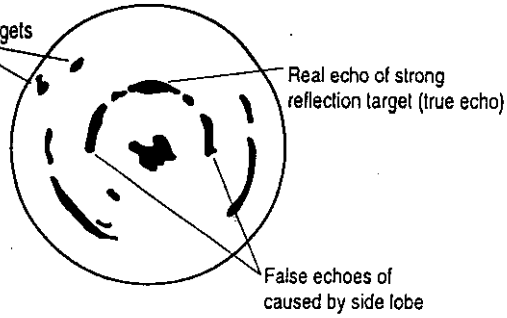
If the funnel, mast, post or other structures are located near an antenna or if a tall obstacle is present, a shadow is produced from the rear of these structures to the target. No target will appear due to the shadow up to a good distance in an extreme case. This range is called dead range, and the 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 the 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.





Maintenance

Never attempt to connect or disconnect the cable connections while the equipment is energized.

Routine maintenance

Monthly check

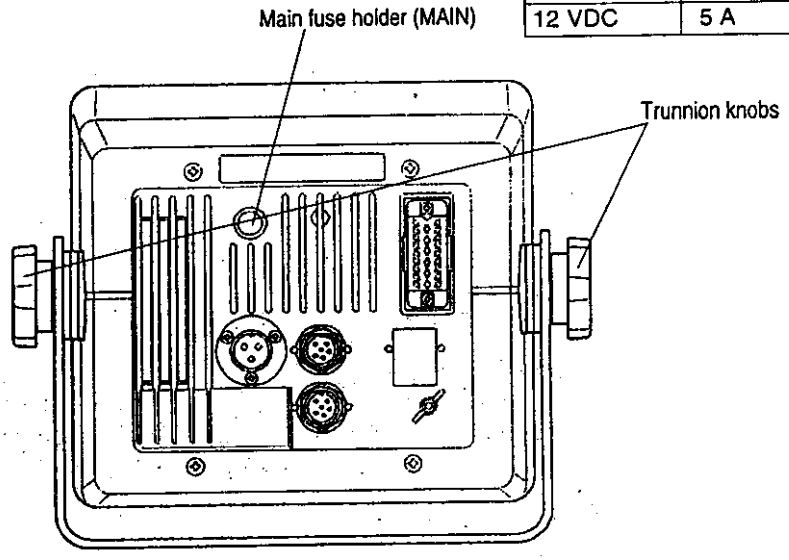
1. Check the surface of radome for filth, paint, caked salt, or scratches.
2. Clean the surface with a clean soft cloth soaked with fresh water or neutral cleanser.
3. If the display screen is dirty, which results in reduced contrast, clean the screen with a cloth soaked with antistatic agent.
   Do not use dry cloth as it causes static charging which accumulates dusts.

Replacing fuse

Fuse holder is located on the rear panel of the display unit.

1. If it is difficult to access the fuse holder caused by narrow space installation, loosen two trunnion knobs and draw the display unit toward you.
2. Turn the fuse holder cap counterclockwise all the way and take out the blown fuse.
3. Insert a new one.
4. Fit the fuse holder cap by the reverse procedure of step 2 above.
5. Restore the display unit by reverse procedure of step 1 above.

24/32 VDC	3 A
12 VDC	5 A



Location of fuse holder

Troubleshooting Guide

Consult 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 circuit. Also, check the fuse and source voltage.

Nothing appears during power-on

Continue pressing the **BRILL** 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.

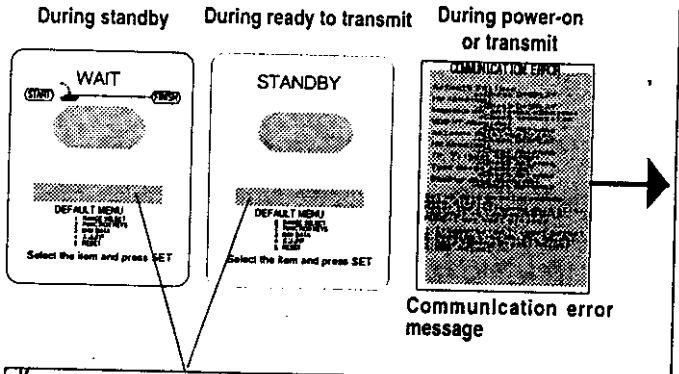
Rotate the **STC** control fully counterclockwise (CCW) but rotate the **GAIN** control fully clockwise (CW).

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

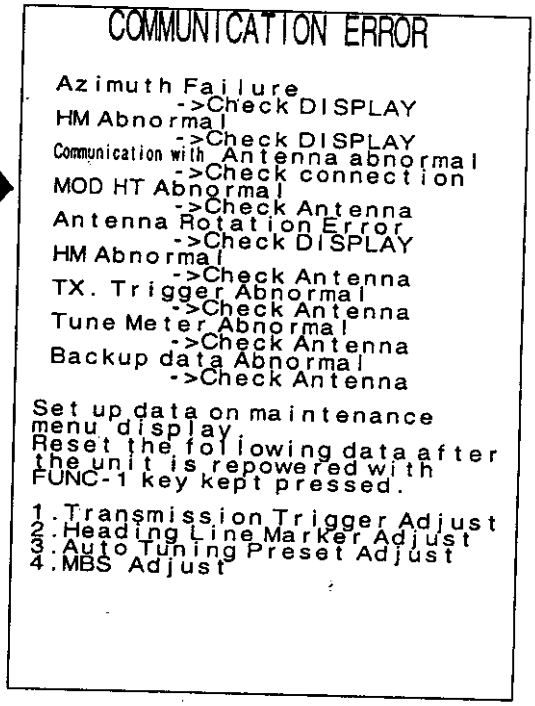
1. Check the GPS or Loran C navigator and GPS track display for an operation error. Also, check the cable connection between the navigator and your radar system.
2. Make sure that the NMEA0183 format WPL, BWC, BOD or WDC sentences are output from the GPS or Loran C navigator or GPS track display. For sentence output, see navigator or GPS track display manual.
3. Make sure that the format selected from "**1. FORMAT 1**" or "**2. FORMAT 2**" of Main Menu 5 (**5. SET**) matches the format of navigator or GPS track display.
4. Make sure that the navigation display data has been set correctly.
5. Make sure that "**1. NAV DATA**" is not OFF on Main Menu 6 (**6. DISPLAY**).

If ERROR message appears

If letters "**ERROR**" appear in preheat, standby or transmission mode, an entire radar function will be interrupted. In such a case, turn off the radar then turn it on. If the "**ERROR**" display still persists on the screen, please contact your local service agent for repair. In such a case, please make sure to inform of the on-screen error message correctly.



If error message appears during power-on	
RAM ERROR	A RAM (Random Access Memory) error occurs.
ROM ERROR	A ROM (Read-Only Memory) error occurs.



Specifications

Major specification

Specifications subject to change without notice.

Antenna unit

Model		MD-3441	MD-3420Mk2
Aerial		1.5 feet (radome)	0.9 feet (radome)
Peak power output		4 kW	2 kW
Transmitting frequency		9410 ± 30 MHz	9445 ± 30 MHz
Beam width	Horizontal	4.7 °	7 °
	Vertical	25°	
Sidelobes		Better than - 20 dB	
Rotation		24 rpm	30 rpm
Pulse length (µsec)/ PRF (Hz)	S	0.1 / 2000	0.1/2200
	M1	0.25 /2000	0.3/1100
	M2	0.5 / 1000	0.8/550
	L	1.0 / 500	———
IF center frequency		60 MHz	
IF bandwidth	S, M1	6 MHz	
	M2, L	3 MHz	
Magnetron type		MG5388C or MAF1421BN	M1516
Noise figure		6 dB nominal	10 dB nominal
Operating temperature		- 25 ° to + 55°C (- 13 ° to 131 °F)	- 15 ° to + 55°C (5 ° to 131 °F)
Operation in wind (relative)		100 knots	
Water resistance		IPX5 (IEC 529)	

Display unit

Display	7-inch monochrome green high resolution CRT
Effective diameter	100 mm
Resolution	480 x 640 pixels
Video level	4 levels
Presentation modes	Head up, *north up, **course up, ***true motion
Range scales (nm)	1/8 1/4 1/2 3/4 1 1.5 2 3 4 6 8 12 16 24 (32)
Rings interval (nm)	1/16 1/8 1/4 1/4 1/4 1/2 1/2 1 1 2 2 3 4 6 (8) ( ) : MD-3441
Off-center	Sweep origin can be moved in any direction
Echo trail interval	Continuous, 15, 30 sec., 1, 3, 6 min., OFF
Alarm	IN and OUT alarms
Minimum range	Better than 20 m (66 feet) on 1/8 nm range
Range discrimination	Better than 20 m (66 feet)
Range accuracy	Better than 7 m (23 feet) or 0.8 % of the maximum range of the scale in use, whichever is the greater
Bearing accuracy	Better than ± 1 °
Navigation data display	Boat position (Latitude/longitude, Loran C LOP) or bearing/speed
Other functions	Gain, STC, FTC, heading marker off, interference rejection, target expansion, zoom, two VRMs, two EBLs (0.1° step), floating EBL/VRM, cursor position (latitude/longitude), parallel cursor, stearing/distance of target (true/ relative), distance unit (nm/km), signal processing, waypoint display, location memory, intermittent transmission
Input data format	NMEA-0183 (BOD, BWC, GGA, GLL, GTD, HCC, HDM, HDT, HSC, VHW, VTG, WDC, WPL), NMEA-0182, CIF, JRC
Power supply	10.8 to 41.6 VDC
Power consumption	50 W or less (at 24 VDC) / 35 W or less (at 24 VDC)
Pre-heat time	120 sec
Operating temperature	– 15 ° to + 55 °C (5 ° to 131 °F)

* North up, **course up mode : Bearing data from electronic compass, gyro compass or a navigator is required.
***True motion : Speed data form speed log, and Bearing data from electronic compass, gyro compass or a navigator is required.

Standard equipment

Note: 15 m (49 3/16 ft) and 20 m (66 ft) cables are also available.

No.	Articles	Type	Remarks	Weight/length	Quantity
1	Antenna unit	MRT-148	1.8 feet, MD-3441	6.9 kg (15.5 lb)	1
		MRT-152	0.9 feet, MD-3420Mk2	4.0 kg (8.9 lb)	
2	Display unit	MRD-91	With vinyl cover	4.5 kg (10.0 lb)	1
3	Hood	MRH-100			1
4	Antenna cable	CW-525	With 24-pin and 14-pin connectors, MD-3441	10 m (32 13/16 ft)	1
		CW-528	With 24-pin and 9-pin connectors, MD-3420Mk2	10 m (32 13/16 ft)	
5	DC power cable	CW-04	With 3-pin connector and one end plain	3 m (9 13/16 ft)	1
6	Spare part kits		See Spare part kits		1 set
7	Installation materials		See Installation materials list		1 set
8	Operation manual				1

Spare parts kits

No.	Articles	Type	Remarks	Quantity
1	Fuse	3 A, F-7142	24/32 VDC	2
		5 A, F-7142	12 VDC	2

Installation materials

No.	Articles	Type	Remarks	Quantity
1	Truss tapping screw	TPT5 x 20U	For display unit mounting	4
2	Hexagonal bolt	B10 x 25U	For antenna unit (MRT-148) mounting	4
	Plain washer	2W10U		4
	Spring washer	SW10U		4
3	Hexagonal bolt	B8 x 25U	For antenna unit (MRT-152) mounting	4
	Plain washer	2W8U		4
	Spring washer	SW8U		4

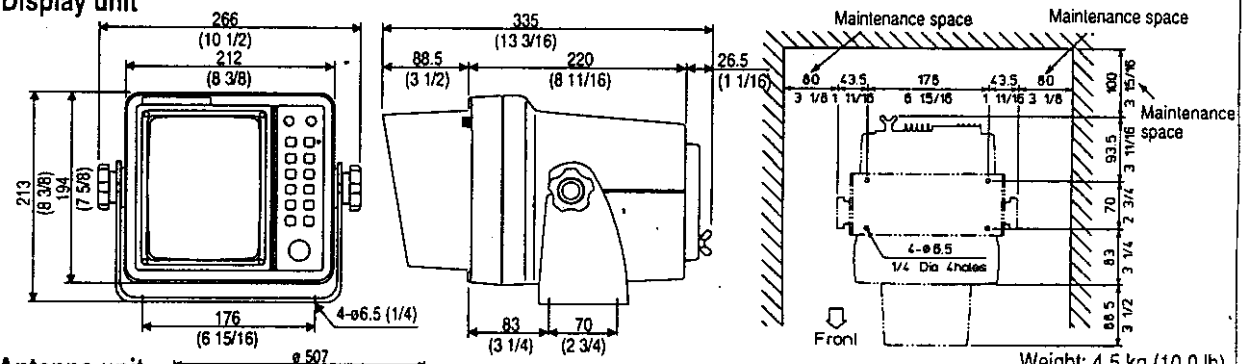
Options

No.	Articles	Type	Remarks	Weight/length
1	Gyro/log interface	GRA-20A	With power cable and connecting cable	1.7 kg (3.75 lb)
2	EMI filter	MRF-110		0.52 kg (1.15 lb)
3	Magnifying lens	MRL-110		0.43 kg (0.95 lb)
4	Connecting cable	CW-153A	With 6-pin connectors	5 m (16 3/8 ft)
		CW-154A	With 6-pin connector and one end plain	5 m (16 3/8 ft)
		CW-155	With BNC and 6-pin connectors	5 m (16 3/8 ft)
		CW-327/351	With 6-pin connectors	5 m (16 3/8 ft)
5	Chart controller	MDA-50	With bracket and cables	2.5 kg (5.6 lb)
6	Power rectifier	PS-006	With two 10A fuses	8 kg (18.0 lb)
7	AC power cable	VV-2D8	Both end plain	3 m (9 13/16 ft)

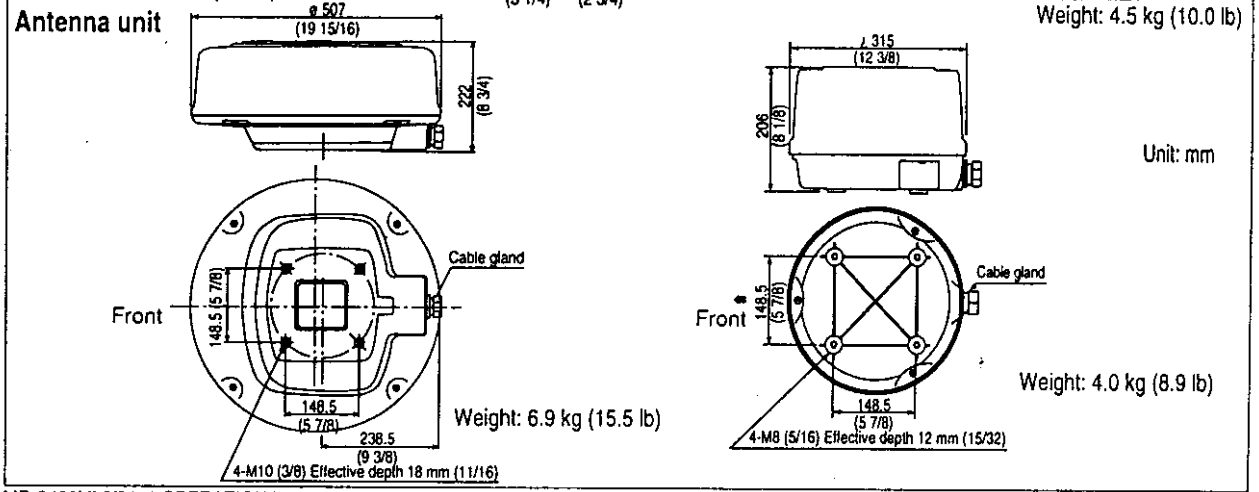
Outline and dimensions

Scale differs among drawings.

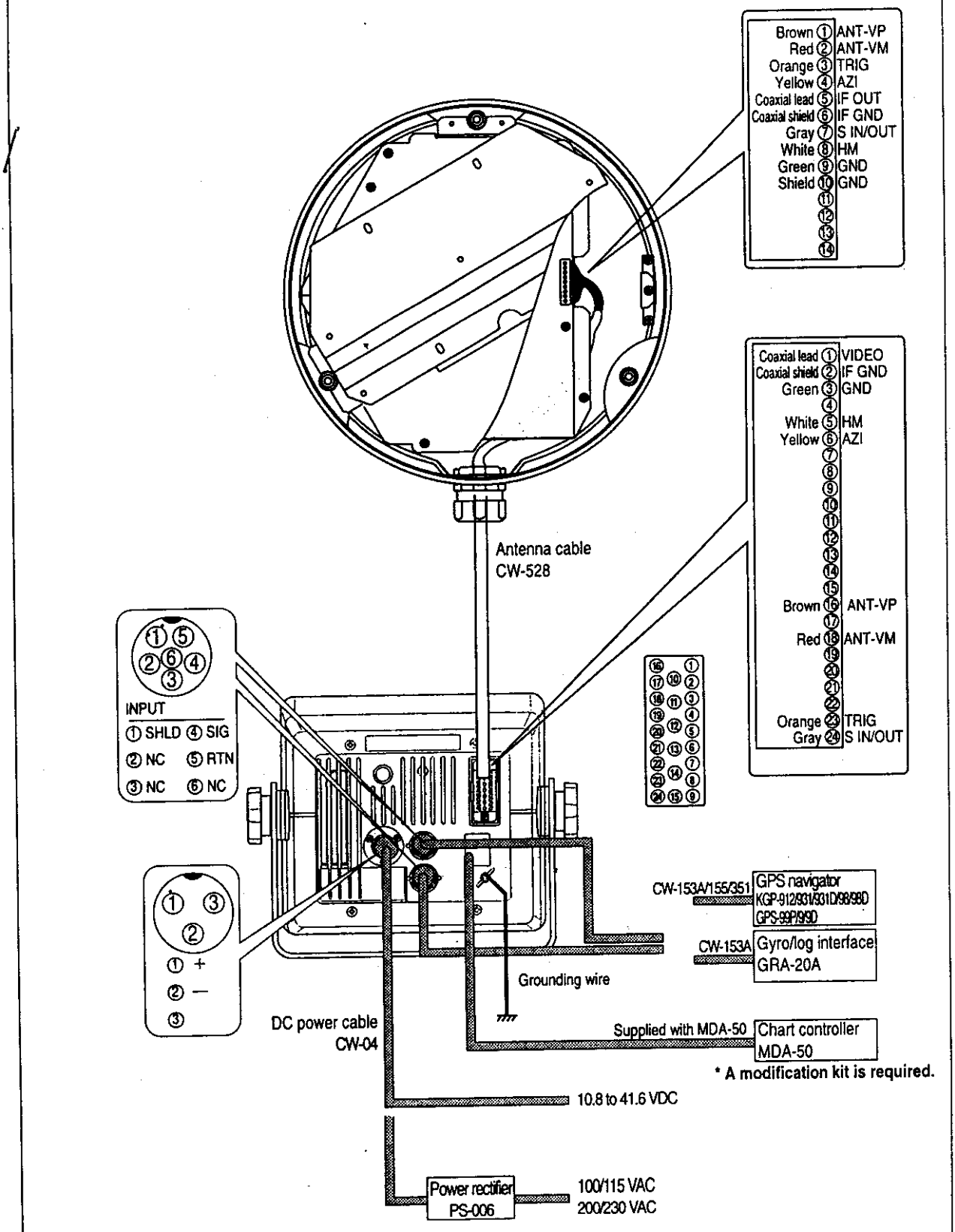
Display unit



Antenna unit



Interconnecting diagram (MD-3420)

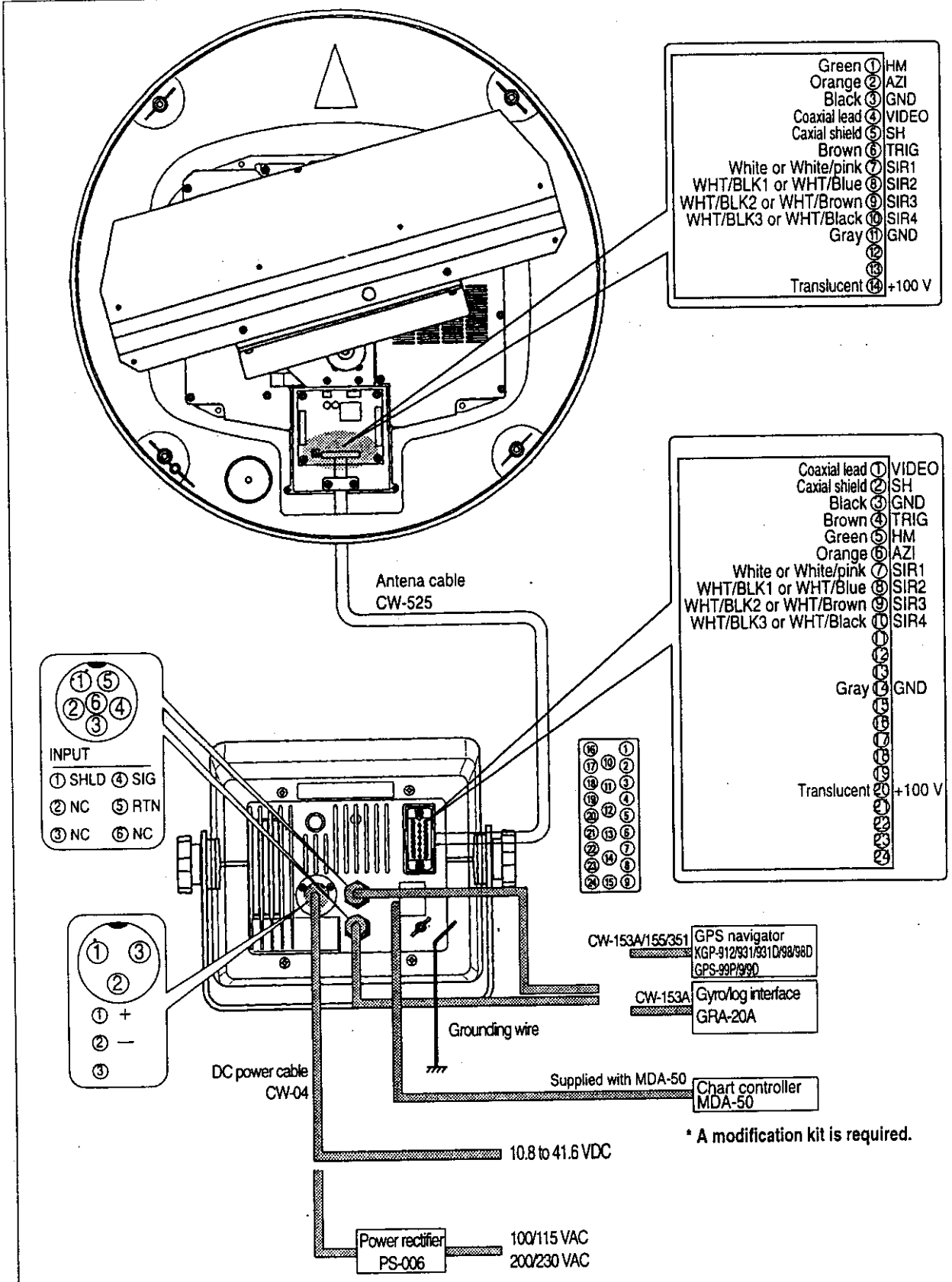


Note: 1. Always connect the ground lead (a 3-mm dia conductive wire) between the display unit and your boat's frame ground. This can reduce noise interference to the system units.

2. Connection method to the power rectifier varies depending on the given voltage level (100 VAC, 115 VAC, 200 VAC, 230 VAC). For the detail, refer to attach on the power rectifier, **"Outline, dimensions & circuit of the rectifier"**.

Interconnecting diagram (MD-3441)

⚠ Never attempt to connect or disconnect the connectors while the display unit is turned on. A power cable must be connected after the installation of the system is completed.



Note: 1. 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 the system units.

2. Connection method to the power rectifier varies depending on the given voltage level (100 VAC, 115 VAC, 200 VAC, 230 VAC). For the detail, refer to attach on the power rectifier, **"Outline, dimensions & circuit of the rectifier"**.

Installation

Installing antenna unit (MD-3420Mk2)

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" supplied.
2. Carefully place the antenna unit on the mount base, and tighten the bolts from the bottom of mount base.

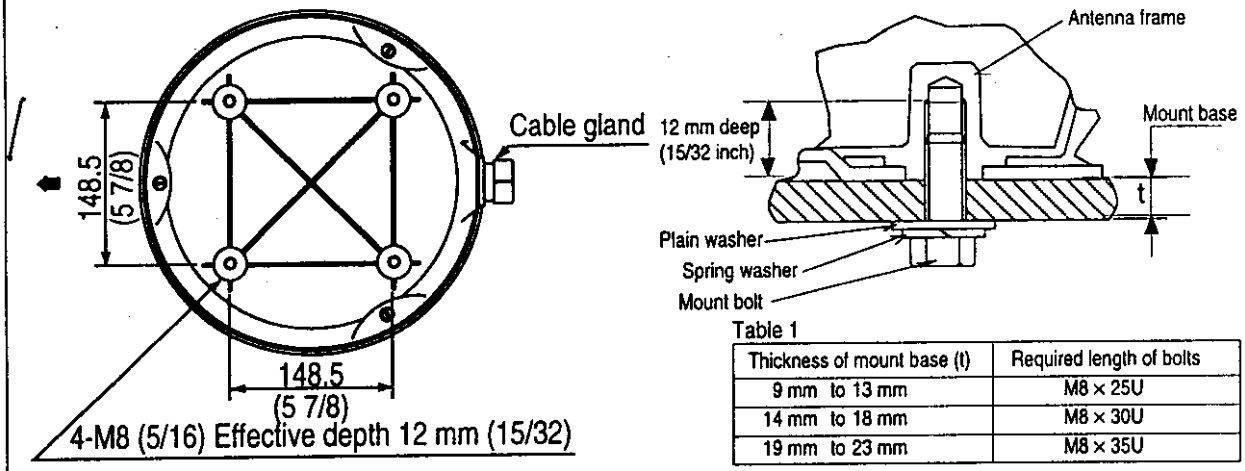


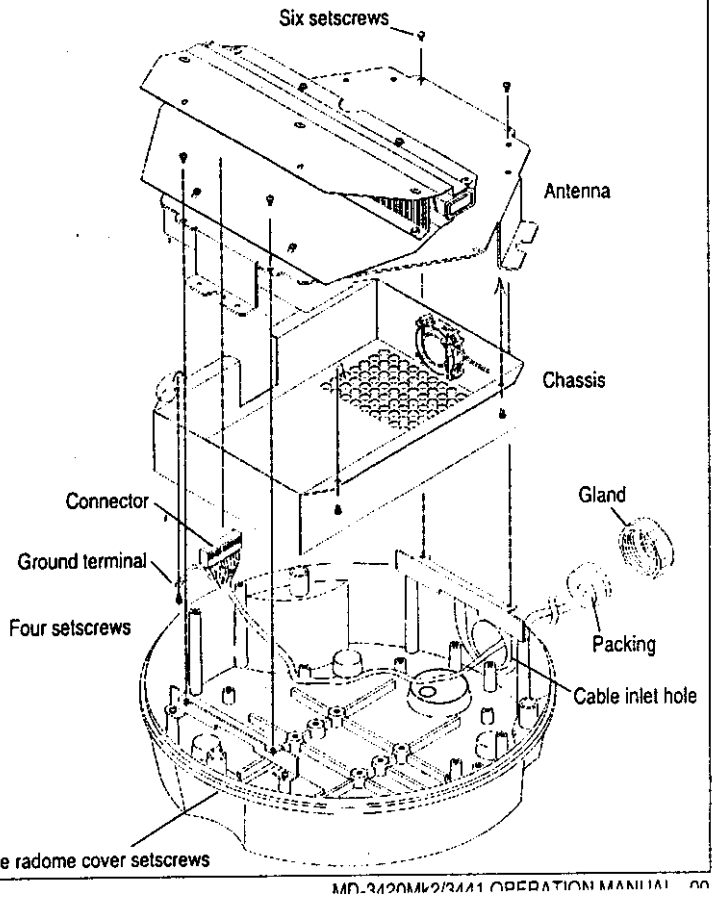
Table 1

Thickness of mount base (t)	Required length of bolts
9 mm to 13 mm	M8 × 25U
14 mm to 18 mm	M8 × 30U
19 mm to 23 mm	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 is too long. Use the appropriate bolts defined in Table 1.

Installation procedure

1. Loosen the three setscrews and remove the radome cover.
2. Remove six setscrews, and remove the chassis including antenna.
3. Remove four setscrews, and separate the chassis and the shield cover.
4. Insert and pass the antenna cable through the gland, packing and cable holes (in this sequence).
5. Plug the cable end connector onto the socket J1 on the PC board **E36-100**
6. Tighten and fix the gland.
   Caution: If it is loose, a problem may occur due to water intrusion. Tighten it securely.
7. Mount the ground terminal and the shield cover to the chassis (that you have removed in Step 3) simultaneously.
8. Mount the chassis to the antenna (that you have removed in Step 2)
9. Mount the radome cover, and fix it by evenly tightening three setscrews.



Installing antenna unit (MD-3441)

Cautions

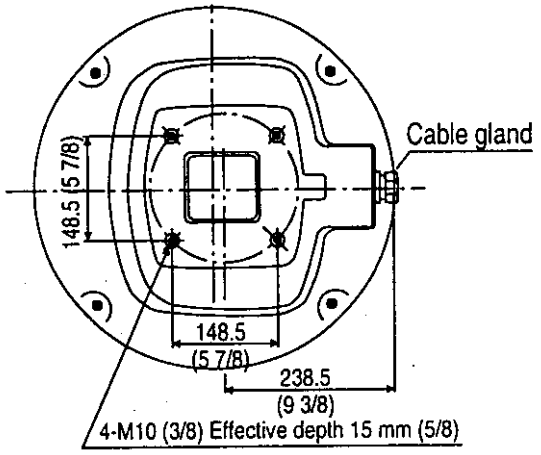
Install the antenna unit at a place where:

- 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" supplied.
2. Carefully place the antenna unit on the mount base, and tighten the bolts from the bottom of mount base.



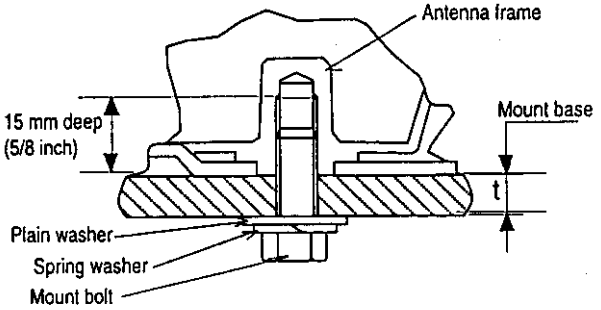


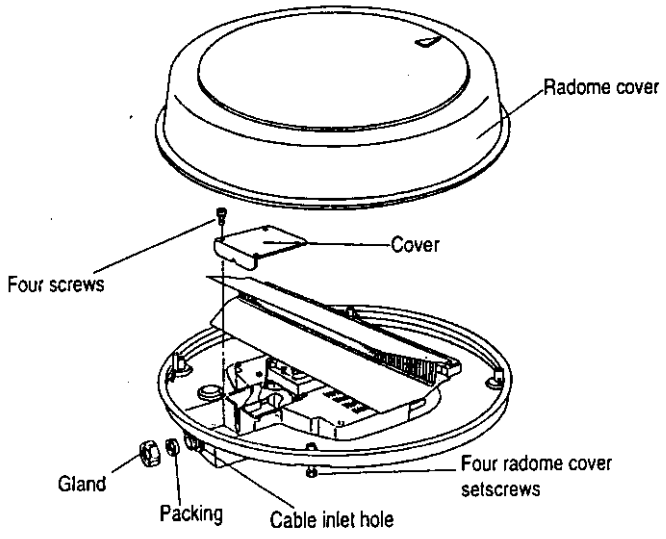
Table 1

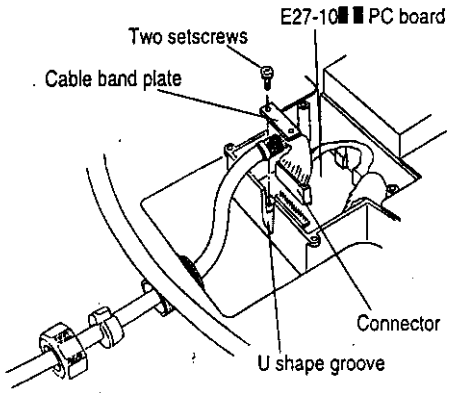
Thickness of mount base (t)	Required length of bolts
5 mm to 10 mm	M10 × 25U
11 mm to 15 mm	M10 × 30U
16 mm to 20 mm	M10 × 35U

3. Use bolts having an appropriate length depending on the thickness of mount base (see Table 1).
   The system has the standard M10 x 25U mount bolts suitable for the typical 5 to 10 mm thick mount base.
4. We recommend to use the 5 to 10 mm thick base for antenna mounting. As the screw depth is 15 mm maximum, the internal parts of antenna unit may be damaged if the base thickness is insufficient or if the bolt is too long. Use the appropriate bolts defined in Table 1.

Installation procedure

1. Loosen the four setscrews and remove the radome cover.
2. Remove four screws, and remove the cover.
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 **J103** on the PC board **E27-10**■■, and place the shield portion of the cable into the U shape groove and fix the cable band plate firmly by two setscrews.
   Note: In order to secure good grounding, do not cover shield portion with insulating object such as vinyl tape.
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 cover (that you have removed in Step 2).
7. Mount the radome cover, and fix it by evenly tightening four setscrews.
   Caution: If it is loose, a problem may occur due to water intrusion. Tighten it securely.





Installation adjustment (MAINTENANCE MENU 1)

Cautions

1. In case of MD-3420, always reset the unit in Maintenance menu if the unit has been serviced (including installation, movement and battery replacement).
2. In case of MD-3441, always reset the unit in Maintenance menu if the unit has been serviced (including installation and movement).
3. If the I/O printed circuit board (E27-10■ ■) on the antenna fails, your setting will be lost. Thus, it is advised to record the settings separately (for the MD-3441).
4. Take extreme care to avoid an electrical shock as a high voltage exists in the antenna and display units.
5. The display unit is always connected to the boat's power supply even when you have turned off the unit.
6. Use a fuse having the specified ratings.
7. Preheat the magnetron at least 30 minutes in standby mode when you turn on the unit for the first time or you have replaced the magnetron.

Keep the unit in Transmit mode approximately 30 minutes before adjustment.

Calling a menu

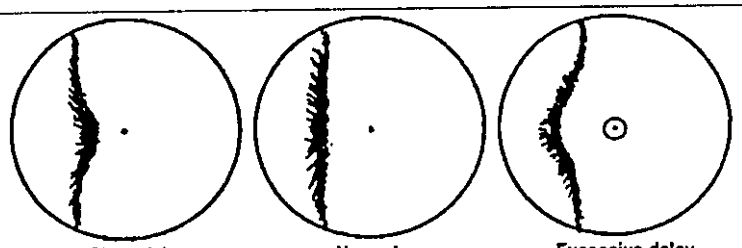
Hold down FUNC(1) key and press the PWR key.

Note: If already power ON, turn it OFF first, then turn it ON again.

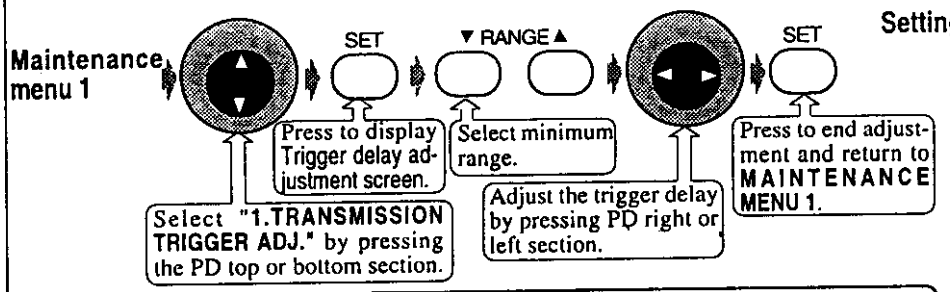
Select the Maintenance menu to adjust:
1. The transmit trigger.
2. The heading line marker.
3. The Auto Tune preset.
4. The MBS (MD-3441 only used).

Adjusting trigger delay

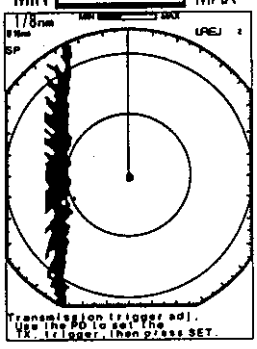
Depending on the length of antenna cable from the antenna unit to the display, the radar image of a straight object (such as breakwater and riverfront) may be deformed as shown due to a short or excessive trigger delay. You can adjust it as follows.



Short delay (Deformation toward center point) | Normal | Excessive delay (Deformation away from center point)



Setting: MIN ▭ MAX



Trigger delay adjustment

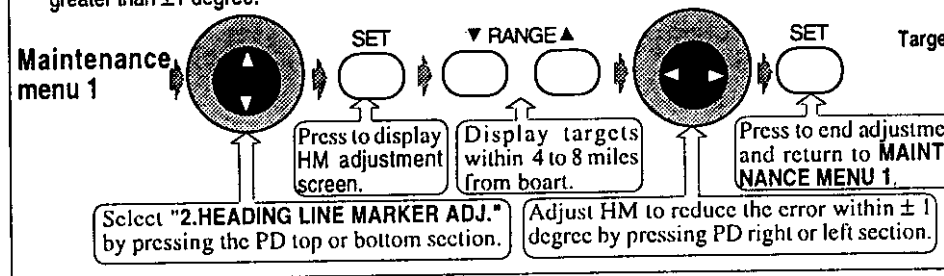
Normal trigger delay adjustment

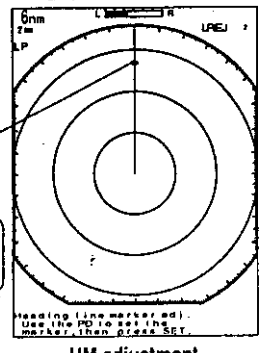
- Straight targets such as a river bank or bridge should be correctly displayed.
- A target with known distance is presented at correct position. Use VRM for range measurement.

Adjusting header marker (HM)

Setting: L ▭ R

1. Stop your boat, and select a stationary target you can visually check. (The target should be 4 to 8 nautical miles from your boat.)
2. Determine the target bearing using the compass, and check for a bearing error. Adjust the HM if error is greater than ±1 degree.





HM adjustment

Auto Tune Preset

CAUTION

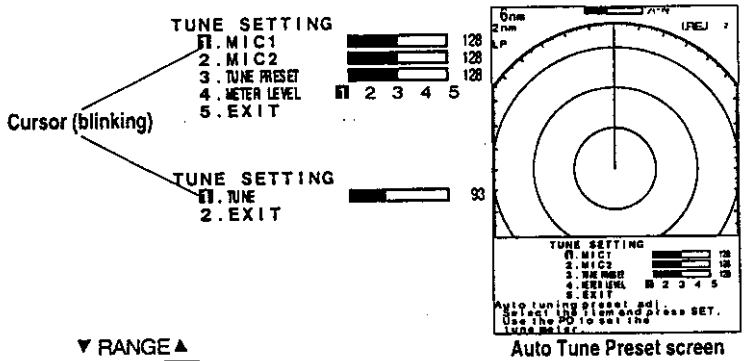
This adjustment must be carried out only when the magnetron, MIC, I/O PC board (MD-3441 only used) or IF Amplifier is replaced.

* An improper tuning presetting may lead to a malfunction of the auto tuning.
* When the setting parameters such as MIC 1, MIC 2 and TUNE PRESET are not properly set, no radar picture may be shown on the screen.
* The aerial is kept stationary and no radar picture is displayed when the tune meter presetting (3. TUNE PRESET" on the TUNE SETTING menu) is in progress

Select Auto Tune Preset menu for:

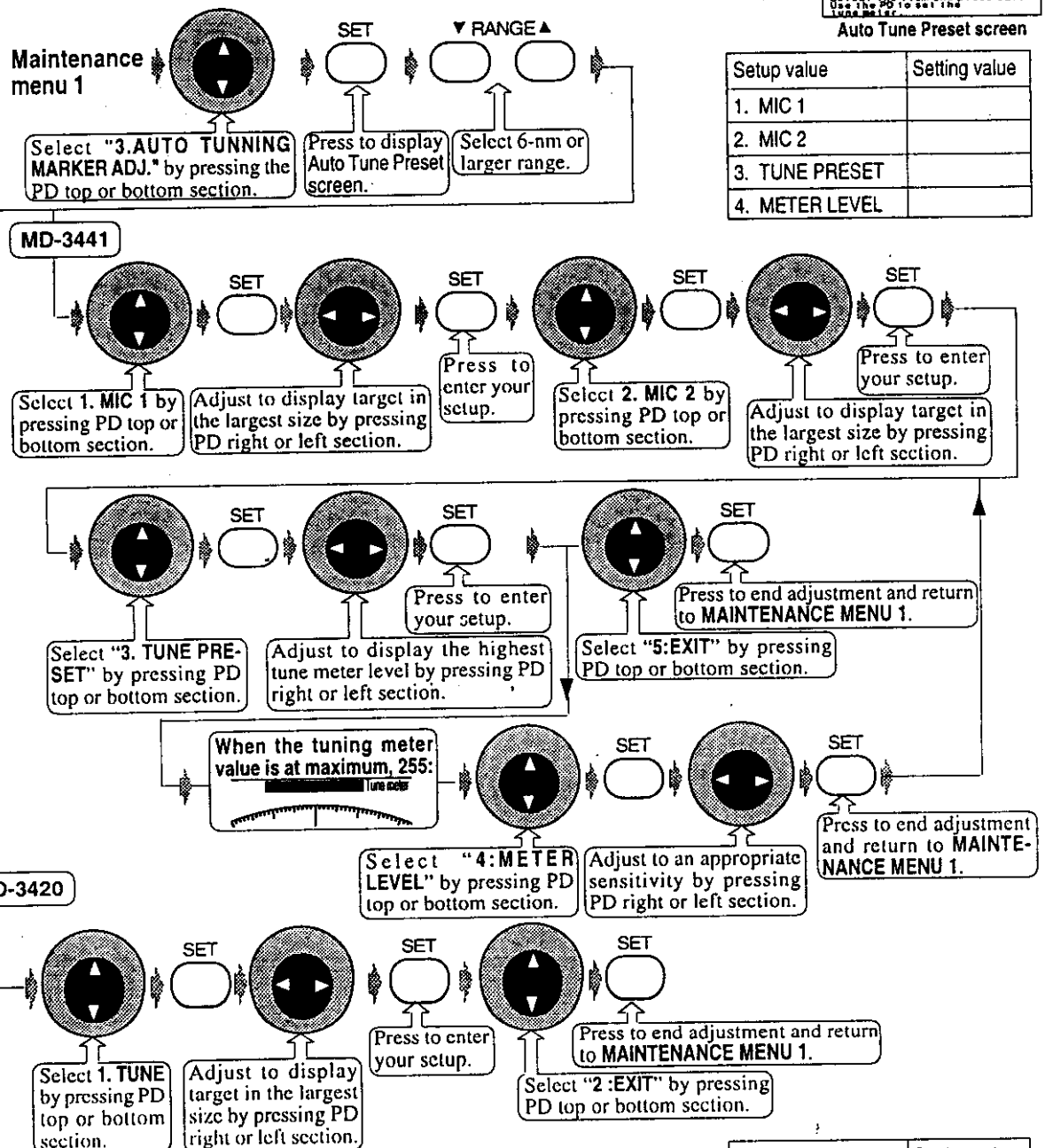
MD-3441
1. Rough tuning
2. Fine tuning
3. Tune meter adjustment
4. Adjustment of tune meter sensitivity

MD-3420
1. Tune adjustment



Auto Tune Preset screen

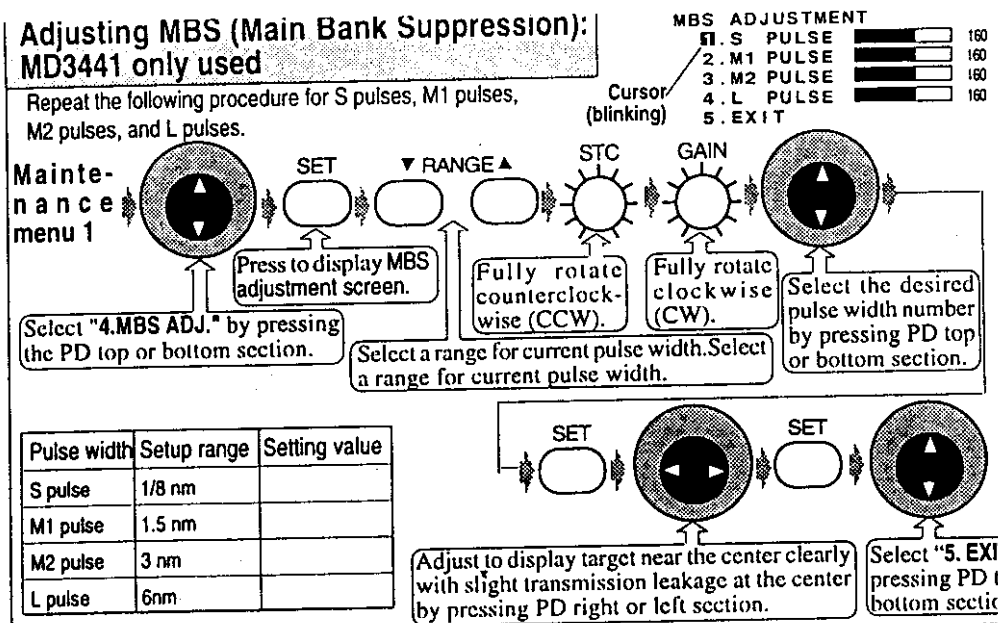
Setup value	Setting value
1. MIC 1	
2. MIC 2	
3. TUNE PRESET	
4. METER LEVEL	

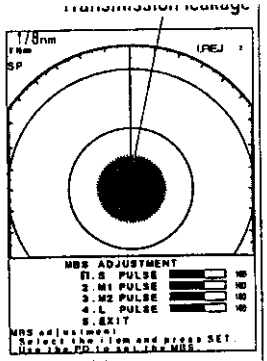


Setup value	Setting value
1. TUNE	

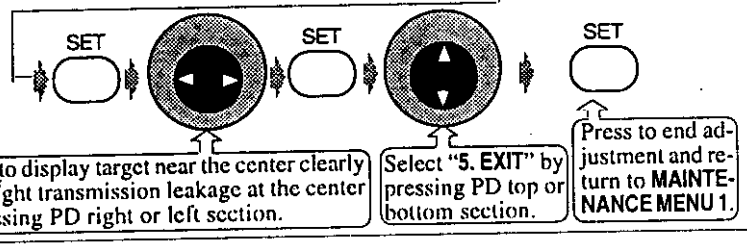
Adjusting MBS (Main Bank Suppression): MD3441 only used

Repeat the following procedure for S pulses, M1 pulses, M2 pulses, and L pulses.



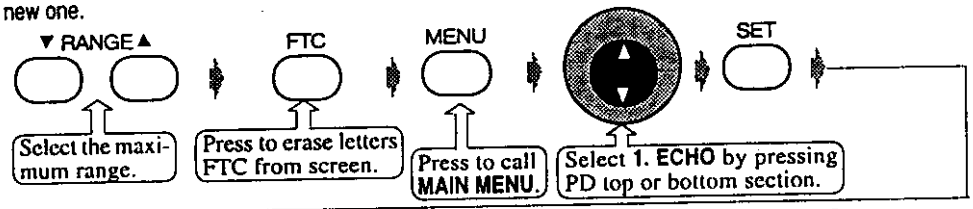

MBS Adjustment screen

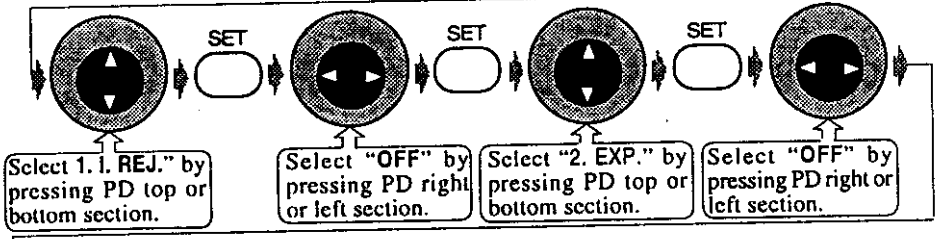
Pulse width	Setup range	Setting value
S pulse	1/8 nm	
M1 pulse	1.5 nm	
M2 pulse	3 nm	
L pulse	6nm	



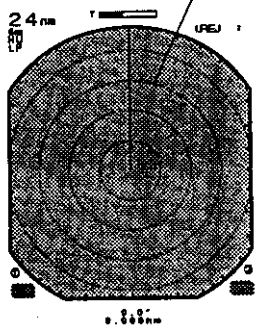
Adjusting noise level

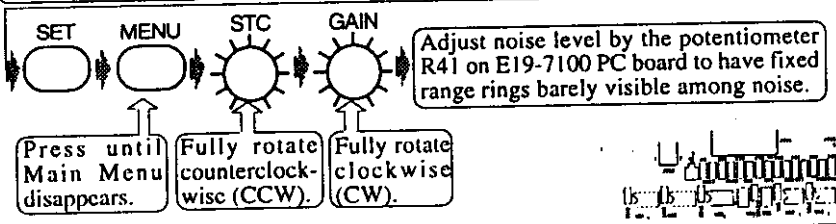
Noise level has been factory-set; however, make sure to readjust the noise level when you replace the MIC, IF unit, or magnetron with a new one.

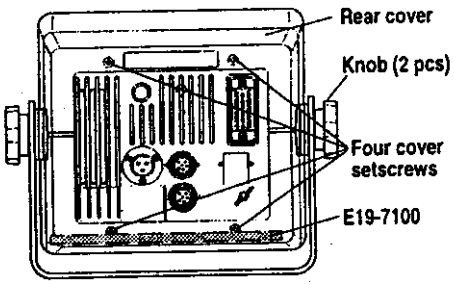


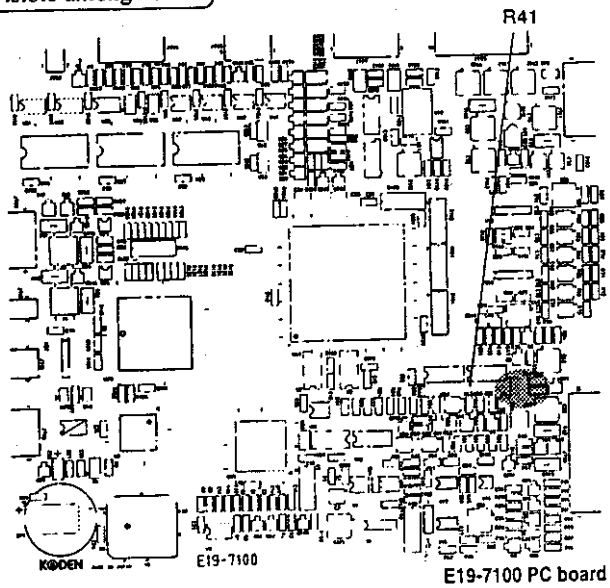


Fixed range rings barely visible among noise









E19-7100 PC board

Adjusting the potentiometer R41 on E19-7100 PC board

1. Disconnect all cables from the display unit rear panel.
2. Remove two knobs.
3. Remove four cover setscrews, and remove the rear cover.
4. Temporarily connect cables you have disconnected in Step 1.
5. Adjust the noise level by rotating potentiometer R41 on the E19-7100 PC board mounted at the bottom of display unit.
6. Reassemble controls, rear cover, and cables in the reverse procedure above.