FURUNO

OPERATOR'S MANUAL

MODEL 1833C MARINE RADAR
MODEL 1933C MARINE RADAR
MODEL 1943C MARINE RADAR
MODEL 1953C MARINE RADAR
COLOR VIDEO PLOTTER GD-1900C

NAVnet

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Your Local Agent/Dealer

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(HIMA) M1833C SER & GD1900C

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OME35030E00

⚠ SAFETY INSTRUCTIONS

⚠ WARNING

ELECTRICAL SHOCK HAZARD
Do not open the equipment.

Only qualified personnel should work inside the equipment.

Turn off the radar power switch before servicing the antenna unit. Post a warning sign near the switch indicating it should not be turned on while the antenna unit is being serviced.

Prevent the potential risk of being struck by the rotating antenna and exposure to RF radiation hazard.

Wear a safety belt and hard hat when working on the antenna unit.

Serious injury or death can result if someone falls from the radar antenna mast.

Do not disassemble or modify the equipment.

Fire, electrical shock or serious injury can result.

Turn off the power immediately if water leaks into the equipment or the equipment is emitting smoke or fire.

Continued use of the equipment can cause fire or electrical shock.

Use the proper fuse.

Fuse rating is shown on the power cable. Use of a wrong fuse can result in damage to the equipment.

Keep heater away from equipment.

Heat can alter equipment shape and melt the power cord, which can cause fire or electrical shock.

⚠ WARNING

Radio Frequency Radiation Hazard

The radar antenna emits electromagnetic radio frequency (RF) energy which can be harmful, particularly to your eyes. Never look directly into the antenna aperture from a close distance while the radar is in operation or expose yourself to the transmitting antenna at a close distance.

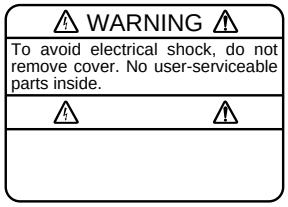
Distances at which RF radiation levels of 100 and 10 W/m^2 exist are given in the table below.

Note: If the antenna unit is installed at a close distance in front of the wheel house, your administration may require halt of transmission within a certain sector of antenna revolution. This is possible - Ask your FURUNO representative or dealer to provide this feature.

MODEL		Distance to 100 W/m^2 point	Distance to 10 W/m^2 point
MODEL 1833C		Nil	Worst case 0.50 m
MODEL 1933C		Worst case 0.20 m	Worst case 3.00 m
MODEL 1943C		Nil	Worst case 2.50 m
MODEL 1953C	XN-12A	Nil	Worst case 2.50 m
	XN-13A		Worst case 2.30 m

⚠ CAUTION

A warning label is attached to the equipment. Do not remove the label. If the label is missing or damaged, contact a FURUNO agent or dealer.



Name: Warning Label (1)
Type: 86-003-1011-0
Code No.: 100-236-230

TABLE OF CONTENTS

FOREWORD

A Word to the Owner of the Model 1800C/1900C Series Marine Radar, GD-1900C Color Video Plotter

FURUNO Electric Company thanks you for purchasing the Model 1800C/1900C Series Marine Radar, GD-1900C Color Video Plotter. We are confident you will discover why the FURUNO name has become synonymous with quality and reliability.

For over 50 years FURUNO Electric Company has enjoyed an enviable reputation for quality and reliability throughout the world. This dedication to excellence is furthered by our extensive global network of agents and dealers.

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

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

Thank you for considering and purchasing FURUNO.

The example screens shown in this manual may not match the screens you see on your display. The screen you see depends on your system configuration and equipment settings.

Features

The 1800C/1900C series of radars and video plotters work within our new product-network system called the “NavNet.” Each product has an IP address to communicate with NavNet compatible products within the network, using TCP/IP protocol through an Ethernet 10BASE-T network.

The main features are as follows:

- The 1800C/1900C series of radars and video plotters consists of the following models:

Model	Output	Range	Radar Antenna
Marine Radar Model 1833C	4 kW	36 nm	2 ft Radome
Marine Radar Model 1933C	4 kW	48 nm	3.5 ft Open
Marine Radar Model 1943C	6 kW	64 nm	4 ft Open
Marine Radar Model 1953C	12 kW	72 nm	4/6 ft, Open
Color Video Plotter GD-1900C	—	—	—

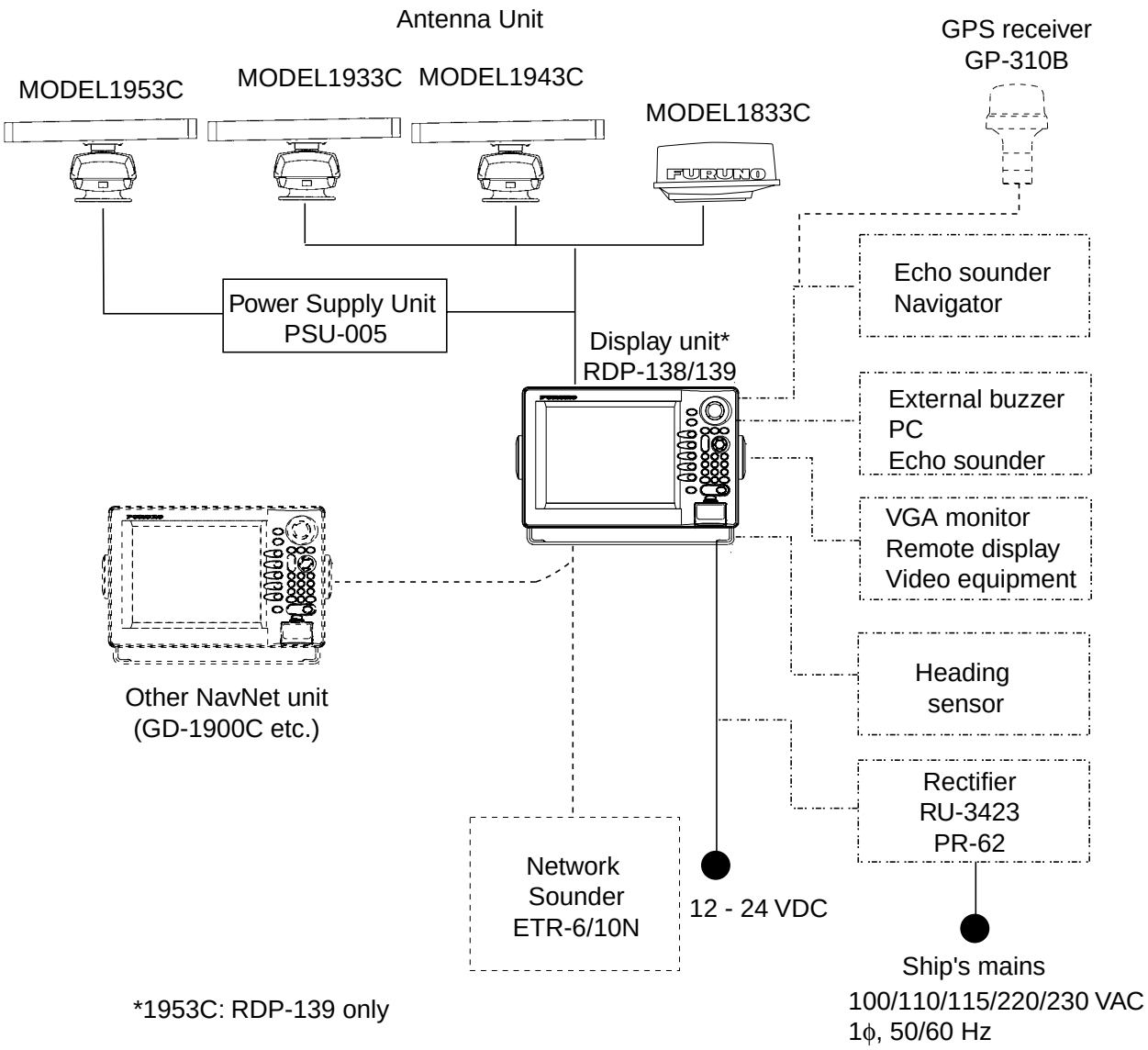
- Bright 10.4” screen visible even under direct sunlight.
- User friendly operation with combination of discrete keys, soft keys, alphanumeric keys and trackball.
- Accepts FURUNO and Nav-charts™ (NAVIONICS) charts, or C-MAP charts, depending on specification.
- Fast chart redraw.
- Built-in NavNet interface circuit board.
- Video input (video recorder, CCD device, etc.) available with installation of optional PIP Board.
- 12-channel GPS Receiver GP-310B with highly accurate position fixing optionally available.
- User programmable function keys.
- Video sounder picture available with connection of the optional Network Sounder ETR-6/10N.

SYSTEM CONFIGURATIONS

All NavNet products incorporate a “network circuit board” to integrate each NavNet product on board through an optional LAN cable (Ethernet 10BASE-T). Each NavNet product is assigned an IP address to enable transfer of images between other NavNet products. For example, video plotter pictures can be transferred to a radar and vice versa. Pictures received via the NavNet may be adjusted at the receiving end.

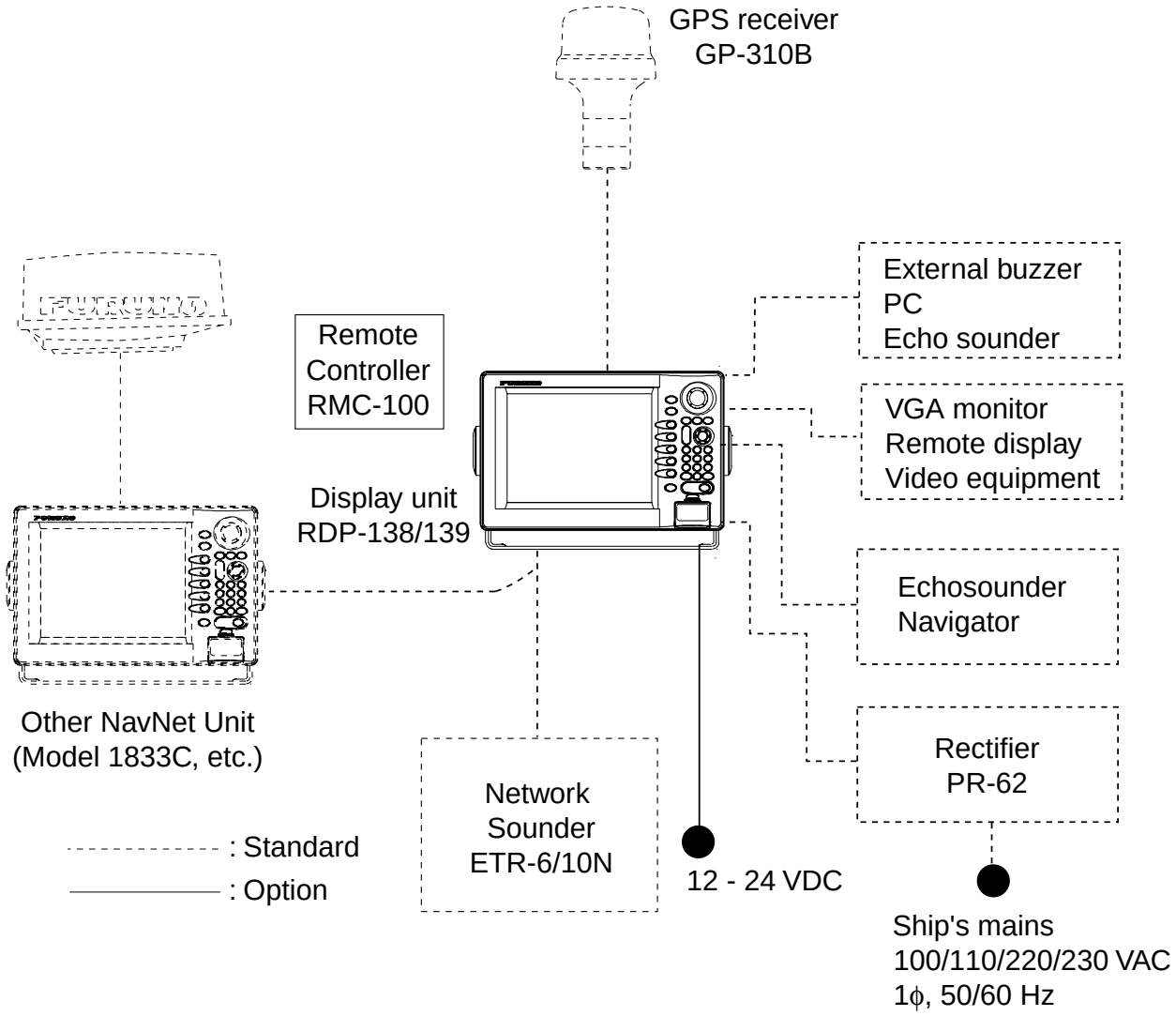
A NavNet system may consist of up to four NavNet display units or three display units and one network sounder. For a system incorporating three or more products, a “hub” is required to process data.

NavNet system (Model 1833C/1933C/1943C/1953C)



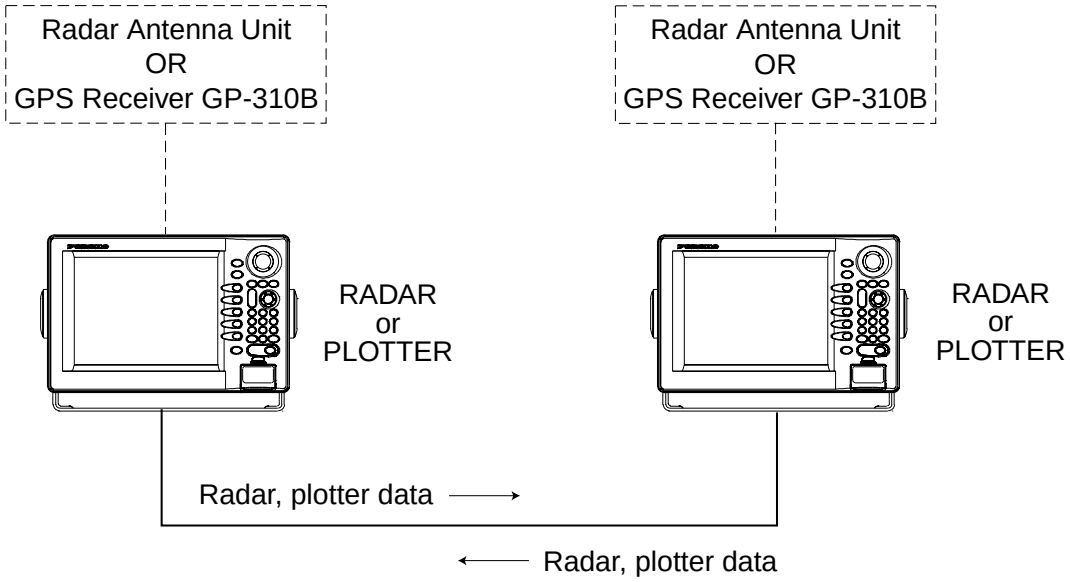
NavNet system (Model 1833C/1933C/1943C/1953C)

Single-unit NavNet system (GD-1900C)



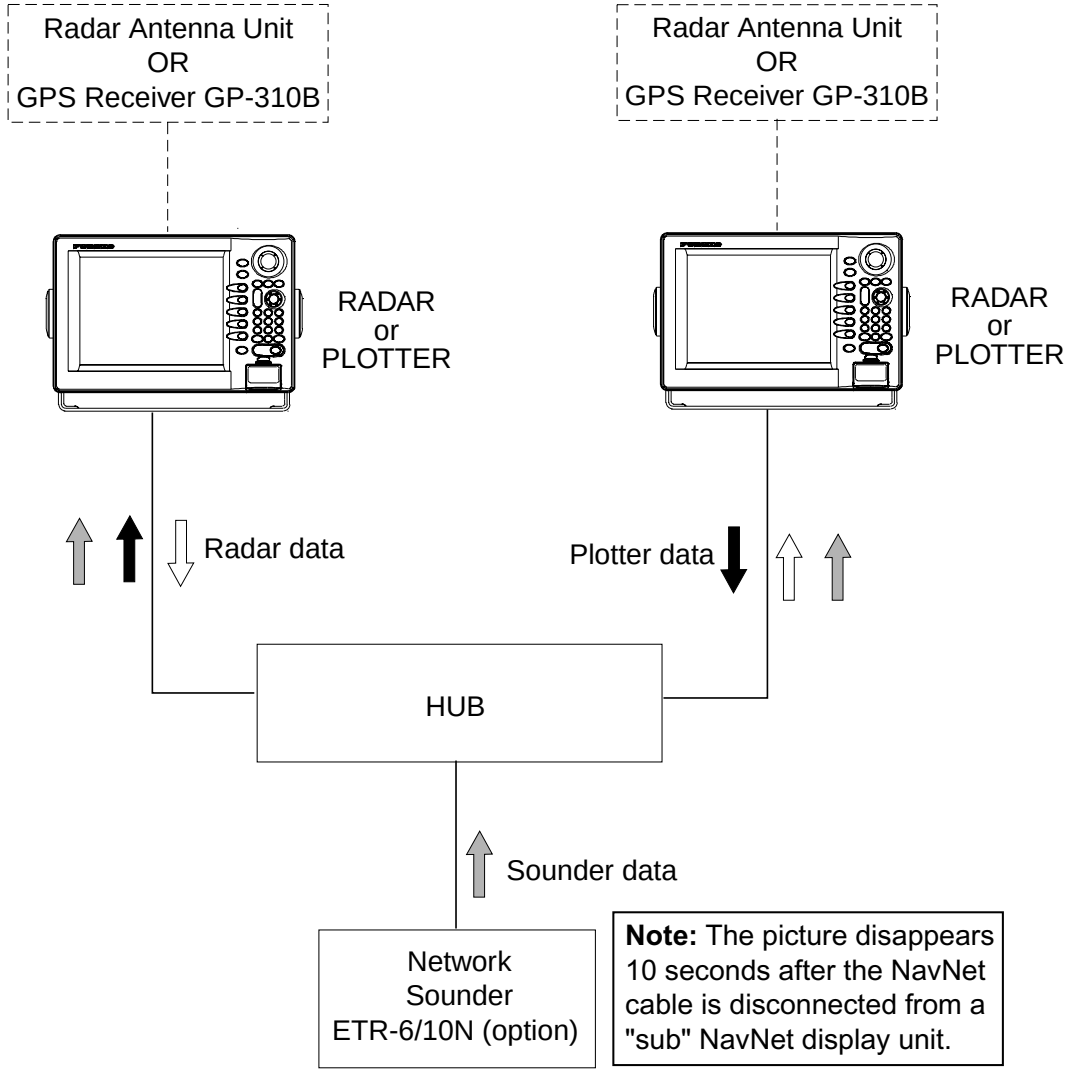
Single-unit NavNet system (GD-1900C)

Two-unit NavNet system



Two-unit NavNet system

Three-or-more-unit NavNet system (Max. 4 NavNet capable display units)



Three-or-more-unit NavNet system

1. OPERATIONAL OVERVIEW

This chapter provides the basic information needed to get you started using your radar, video plotter. The following topics are presented:

- Control overview
- Chart card insertion
- Power on/off
- Brilliance and hue adjustments
- Display selection
- MOB (Man OverBoard) mark entry
- Data boxes
- Function keys
- Simulation display

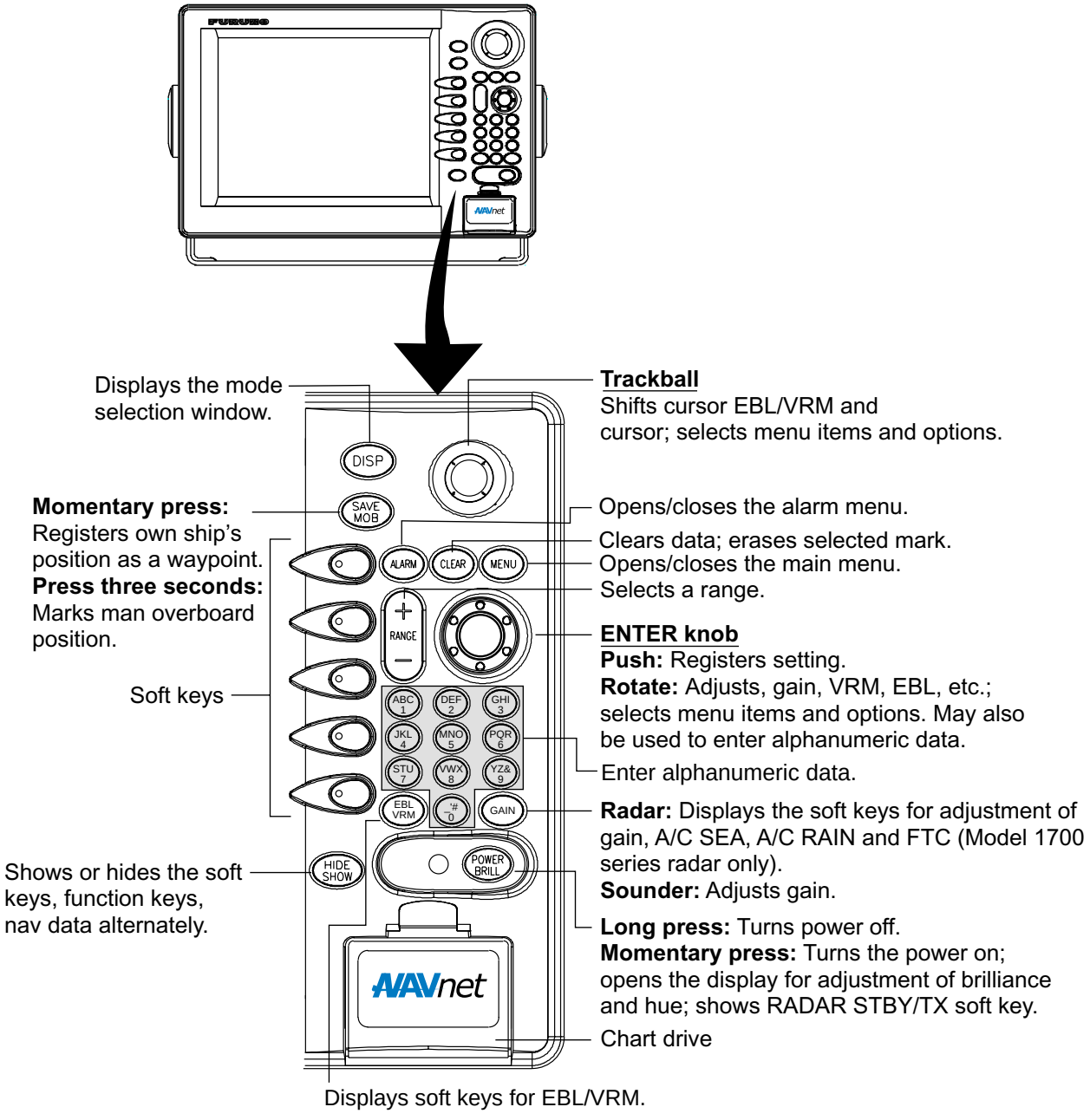
NOTICE
The brilliance of the LCD is adjustable to match a wide variety of lighting conditions. However, its maximum setting may not be sufficiently bright to permit viewing of the display with polarized sunglasses.
The high-resolution model may show afterglow after several hours of continuous use in the same mode. This is not a sign of malfunction.

1.1 Operating Controls

1.1.1 Display unit controls

Overview of display unit controls

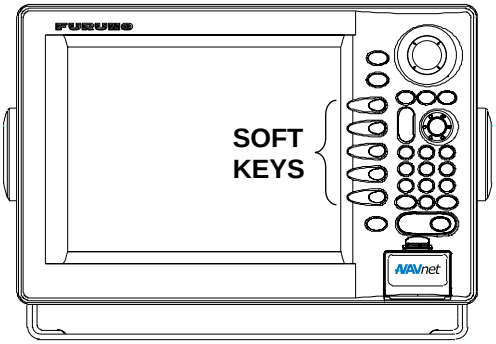
The radar, video plotter, sounder and chart systems are operated with the controls of the display unit (and the remote controller). Ten keys are labeled and they provide the function shown on their labels. The five soft keys provide various functions according to current operating mode. The [ENTER] knob mainly functions to register selections on the menu and adjust the EBL, VRM and gain. The trackball's main function is to move the cursor across the screen. When you correctly execute an operation, the unit generates a beep. Invalid operation causes the unit to emit three beeps.



Control panel

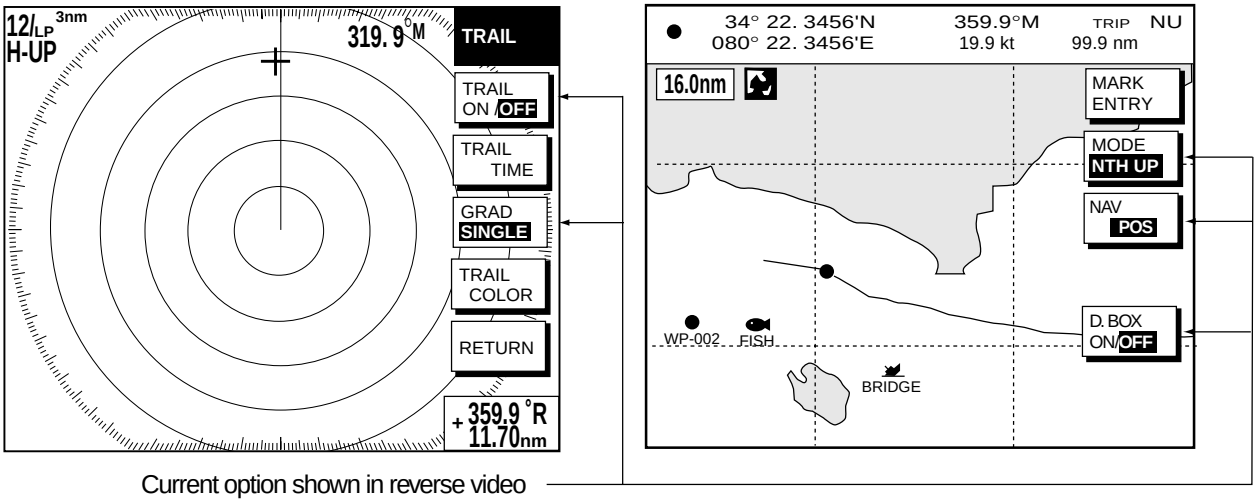
Soft keys

The function of the five soft keys changes according to the operation. Their labels for their current functions are shown on the screen to the left of the keys. To hide or show the soft keys, press the [HIDE/SHOW] key. Each press of the key shows preset soft keys, user function keys or turns off navigation information (at the top of the screen).



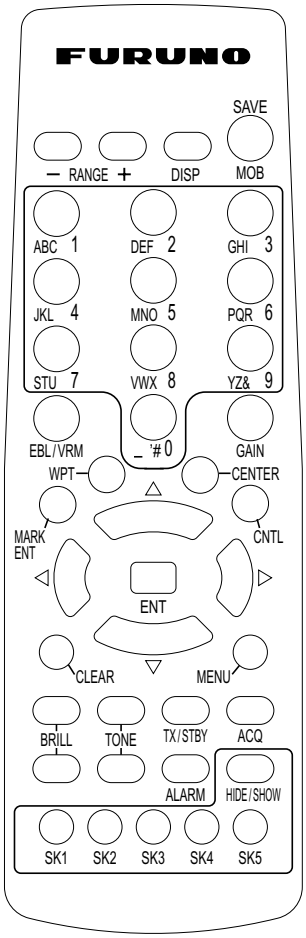
Display unit

Some soft keys show the current station of the soft key function in reverse video as shown below.



Radar and plotter displays

1.1.2 Remote controller



Remote controller

Operating distance
90°: Up to 5 m
±45°: Up to 3 m

Replace the batteries (AA) when the distance from which the display unit can be operated shortens.

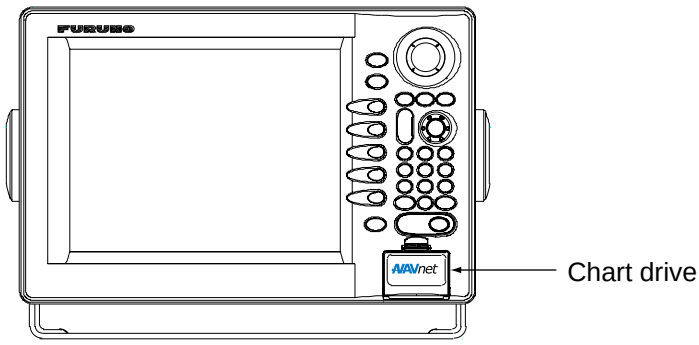
Note: The remote controller may become damaged if dropped. Mishandling of the remote controller is not covered by the warranty.

Key	Function	Key	Function
RANGE	Same as RANGE key on display unit.	ENT	Same as ENTER knob on display unit.
DISP	Same as DISP key on display unit.	CLEAR	Same as CLEAR key on display unit.
SAVE MOB	Same as SAVE/MOB key on display unit.	MENU	Same as MENU key on display unit.
Ten keys	Enter alphanumerics.	BRILL	Adjusts display brilliance.
EBL/VRM	Same as EBL/VRM key on display unit.	TONE	Not used.
GAIN	Same as GAIN key on display unit.	TX/STBY	Toggles radar between standby and transmit.
WPT	Displays “alphabet” WPT list on plotter display.	ACQ	Acquires radar target. (Requires radar source equipped with ARP.)
MARK ENT	Same as MARK ENTRY soft key.	ALARM	Same as ALARM key on the display unit.
CENTER	Returns own ship to screen center on plotter display.	HIDE/SHOW	Same as HIDE/SHOW key on display unit.
CNTL	Switches control between displays on combination displays.	SK1 – SK5 (soft keys)	Same as soft keys on display unit.

1.2 Inserting a Chart Card

Your unit reads FURUNO and Nav-Charts™ (NAVIONICS) chart cards, or C-MAP chart cards, depending on the type of display unit you have. Insert the appropriate chart card for your area as follows:

1. Open the chart drive.



Display unit

2. Insert desired chart card groove side up.
3. Close the lid to protect the chart drive.

Note 1: Do not remove a card while the chart is being drawn. This may cause the equipment to freeze.
Note 2: Do not insert or remove a card while the power is on. This may cause the equipment to freeze.
Note 3: For multiple display units, do not use the same chart card type in more than one display unit.
Note 4: A card remover is supplied to ease removal of chart cards. Attach the card remover to the right-hand side hole of the card and pull it to remove the card. You can leave the remover attached to the card while the card is in the chart drive. Push the remover leftward until it contacts the recessed area on the card.

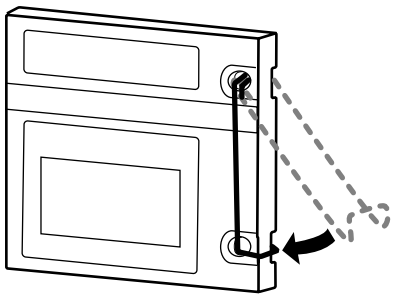
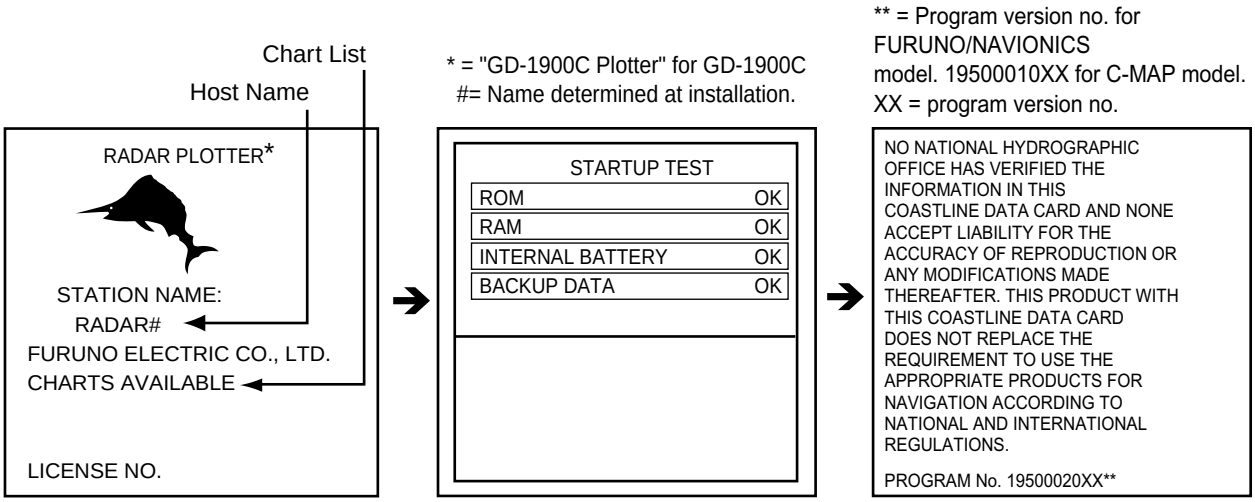


Chart card and card remover

1.3 Turning the Unit On/Off

Press the [POWER/BRILL] key to turn the unit on. A beep sounds and the equipment proceeds in the sequence shown below, displaying product information, startup test results and the chart usage disclaimer. The startup test checks the ROM, RAM, internal battery and backup data for proper operation, displaying the results for each as OK or NG (No Good). If NG appears an appropriate message appears on the screen. For any NG, try to press any key to go to the chart disclaimer screen, then perform the diagnostic test as shown in the paragraph “7.6 Diagnostics.”



Startup sequence

For start up with the radar display, the magnetron takes from one minute to two minutes and thirty seconds (depending or radar model) to warm up before the radar can be operated. The time remaining for warm up of the magnetron is counted down at the center of the display.

You may press any key at the chart disclaimer screen to show the last-used display, or wait several seconds to let the equipment do it for you.

To turn the unit off, press and hold down the [POWER/BRILL] key until the screen goes dark (approx. 3 sec.). To protect the LCD attach the hard cover. Note that the network sounder will be turned off approx. three minutes after turning off the power.

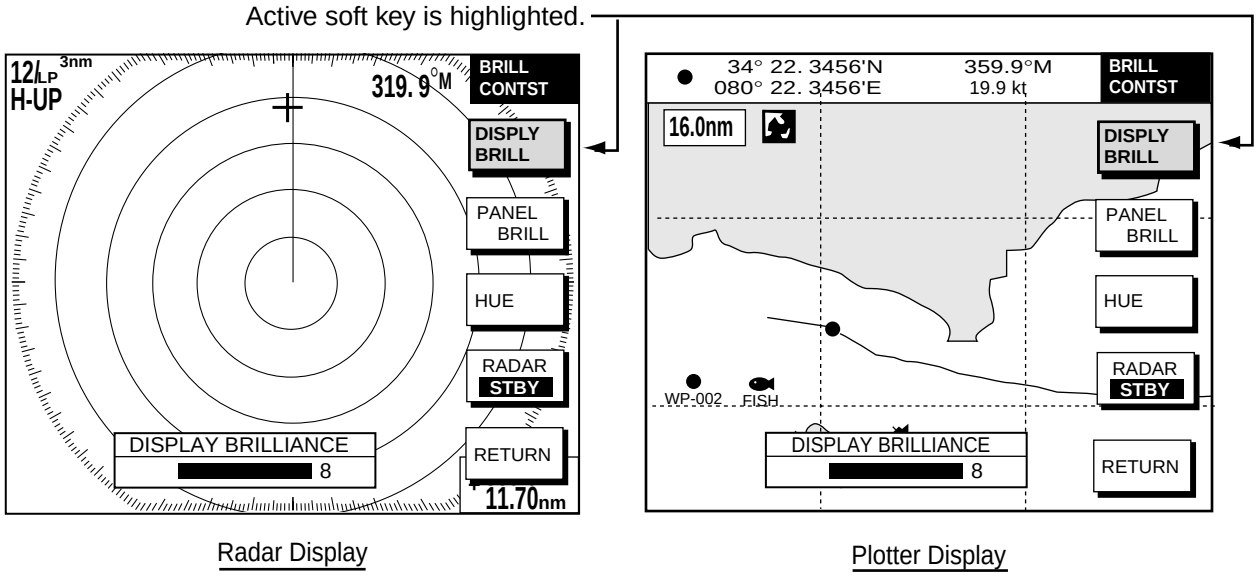
Note: The first time you turn on the power (or any time the power is applied after a memory reset), you are asked if you want to start the simulation mode, which provides simulated operation of the equipment. Push the [ENTER] knob to start the simulation mode, or press the [CLEAR] key to start normal operation. For further details about the simulation mode, see the paragraph “1.10 Simulation Display.”

1.4 Display Brilliance, Panel Brilliance, Hue

You can adjust display brilliance, panel brilliance and hue as shown below.

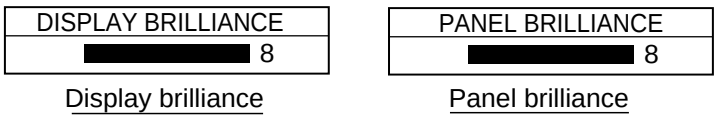
1.4.1 Display brilliance, panel brilliance

1. Press the [POWER/BRILL] key momentarily. A set of soft keys for adjustment of brilliance and hue appear.



Brilliance adjustment soft keys

2. Press the DISPLY BRILL or PANEL BRILL soft key as appropriate. An adjustment window appears at the bottom of the screen. This window shows the name of the item selected for adjustment plus current brilliance level, by bar graph.



Display brilliance and panel brilliance windows

3. Adjust the [ENTER] knob, clockwise to raise the setting or counterclockwise to decrease it. You may also use the soft key pressed at step 2. Eight levels of display brilliance and panel brilliance are available.
4. Hit the RETURN soft key to finish.

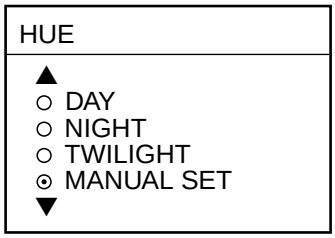
Note 1: If the unit is turned off with minimum brilliance, the screen will be dark at the next power-up. Press the [POWER/BRILL] key consecutively to adjust the brilliance.

Note 2: This equipment does not have a contrast control.

1.4.2 Hue

You may select the colors for the radar, plotter and overlay displays as below.

1. Press the [POWER/BRILL] key momentarily.
2. Press the HUE soft key to show the hue setting window.



Hue window

3. Operate the trackball to select hue desired, referring to the table below. MANUAL SET follows the color settings on the CHART DETAILS menu for the plotter and the RADAR DISPLAY SETUP menu for the radar.

	Night	Day	Twilight
Characters	Red	Black	Green
Radar ring	Red	Green*	Green*
Radar echo	Orange	Red	Yellow
Background	Black	White	Blue
Landmass (plotter)	Light-Yellow	Yellow	Light-Yellow

* = Red on C-MAP display unit.

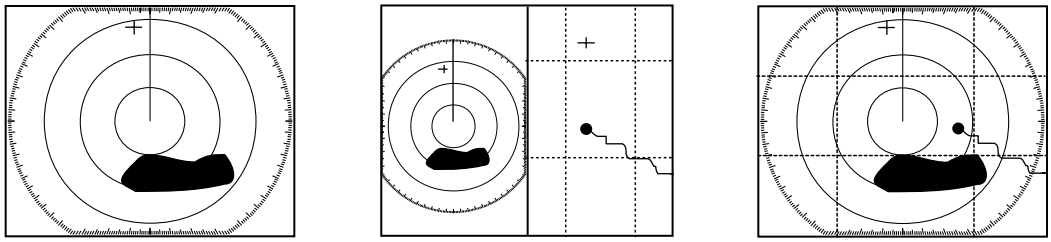
4. Hit the RETURN soft key to finish.

Note: When using the overlay screen, the own ship track will be hidden if the radar background and own ship track are blue and the “MANUAL SET” hue setting is used. In this case, set HUE to other position and then return to “MANUAL” to show the own ship track in black.

1.5 Selecting a Display

1.5.1 Display modes

If you have a radar, navigator, network sounder and external video source (video recorder, etc., optional PIP board required) six full-screen displays are available: radar, plotter, echo sounder, nav data, overlay, and external video. In addition to the full-screen display, you can divide the screen into halves and thirds to show two and three sets of images on a combination display.



Full screen (radar)

Combination screen (radar + plotter)

Overlay screen (plotter + radar only, Requires L/L data)

Display screens

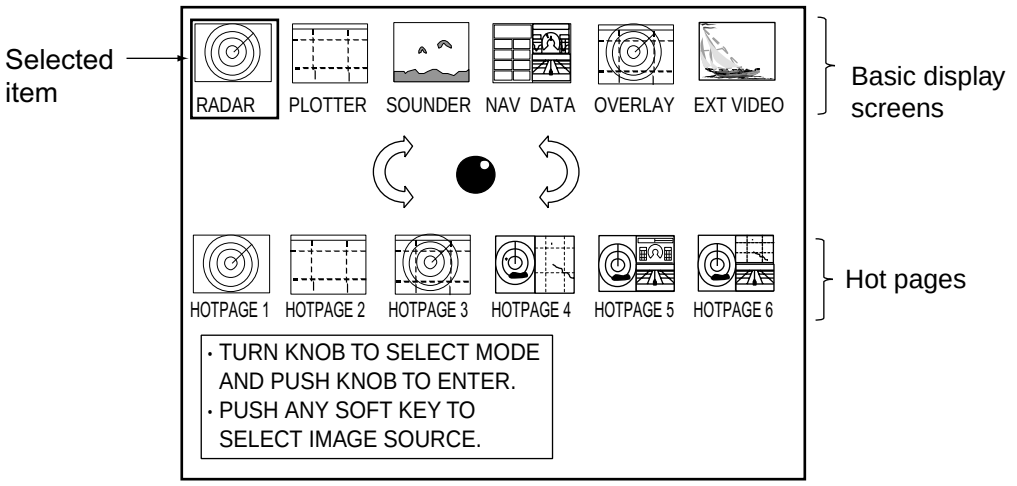
The table below shows the displays available with each screen type.

Screen type and available display screen

Full screen	Combination screen options (half- or thirds-screen)	Overlay screen options
Plotter, radar, sounder, nav data, external video, overlay	Plotter, radar, sounder, compass, highway, compass/highway, nav data, overlay, external video	Radar + plotter

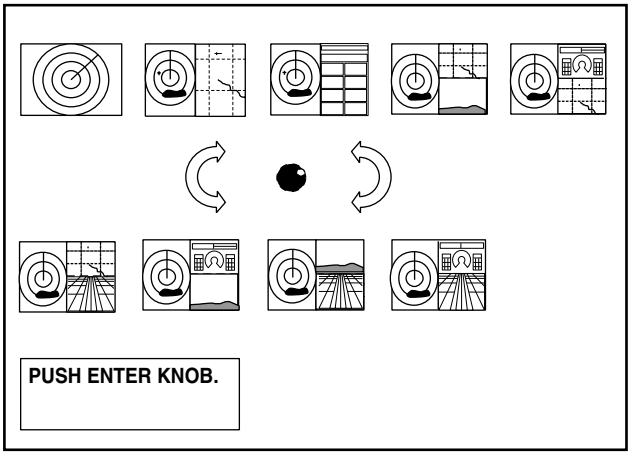
1.5.2 Selecting a display

1. Press the [DISP] key to show the display selection window. The icons of modes not available are marked with an “X.” HOTPAGE 1-HOTPAGE 6 are user-arrangeable displays called “hot pages,” which you can configure as you like. For further details, see the paragraph “5.6 Hot Page Setup.”



Display screen selection window

2. Rotate the [ENTER] knob to select a basic display screen or a hot page screen.
3. Push the [ENTER] knob.
4. If you selected a basic display screen, a group of appropriate combination displays appear. In the example below, the radar combination screens are shown.

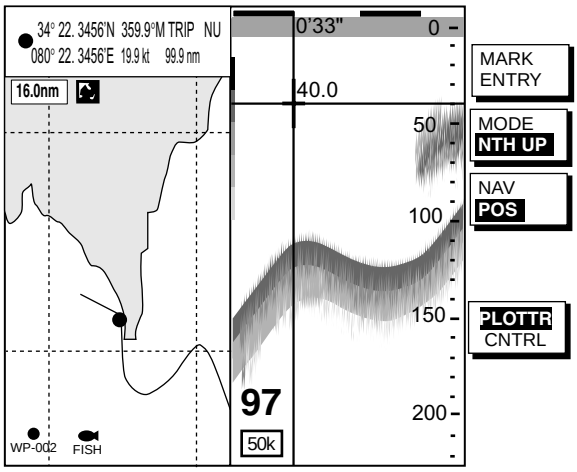


Radar combination screen selection window

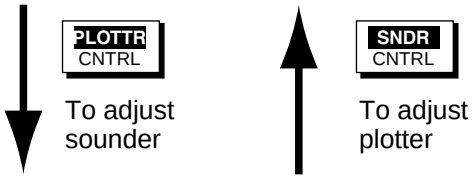
5. Rotate the [ENTER] knob to select display desired.
6. Push the [ENTER] knob to finish.

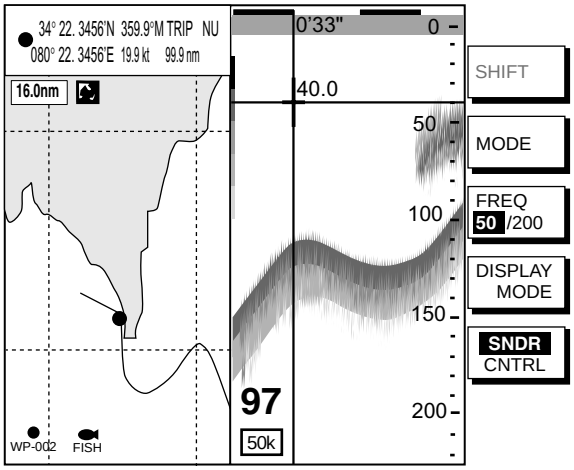
1.5.3 Switching control in combination and overlay screens

A soft key is provided in relevant combination and overlay screens to switch control between displays. In the example below, the PLOTTR CNTRL and SNDR CNTRL soft keys enable switching control between the plotter and sounder screens in the plotter/sounder combination display.



Plotter display selected





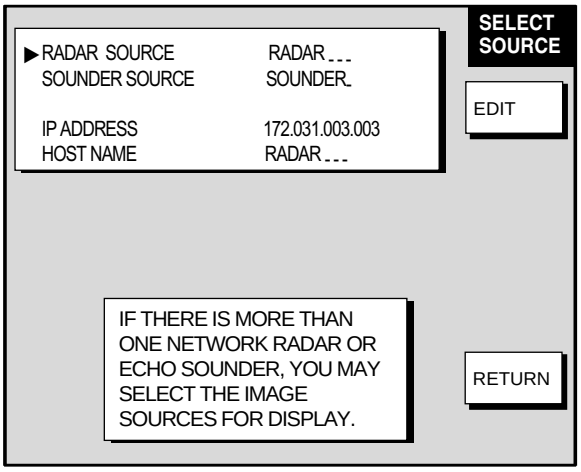
Sounder display selected

How to switch control between modes in the plotter/sounder combination display

1.5.4 Selecting image source

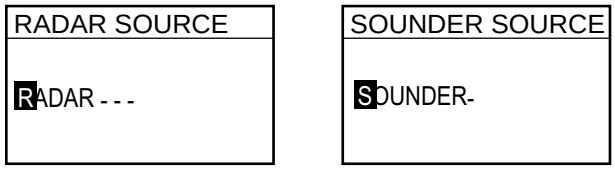
When more than one network radar or network sounder is connected to the equipment, you may select an image source for each as shown below. This is not necessary when only one network radar or network sounder is connected.

1. Press the [DISP] key.
2. Press any soft key to show the following display.



Select source menu

3. Use the trackball to select RADAR SOURCE or SOUNDER SOURCE as appropriate, then press the EDIT key.



Radar source Sounder source

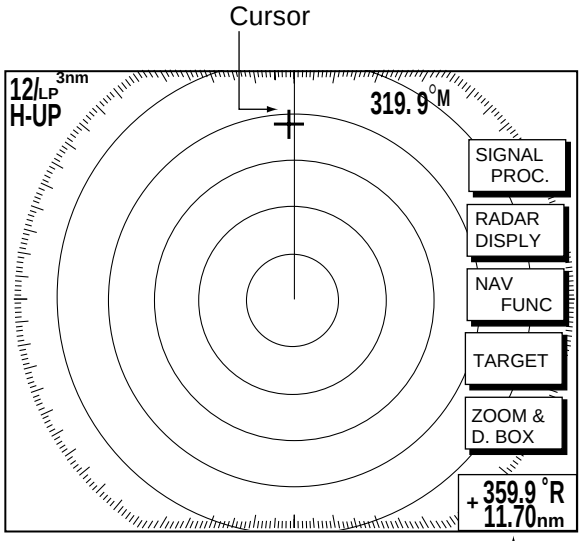
Radar source and sounder source windows

4. Use the trackball and alphanumeric keys to enter source name: Adjust the trackball to select location and enter character with the alphanumeric keys.
5. Push the [ENTER] knob to set.
6. Press the [DISP] key to finish.
7. Turn the power off and on again.

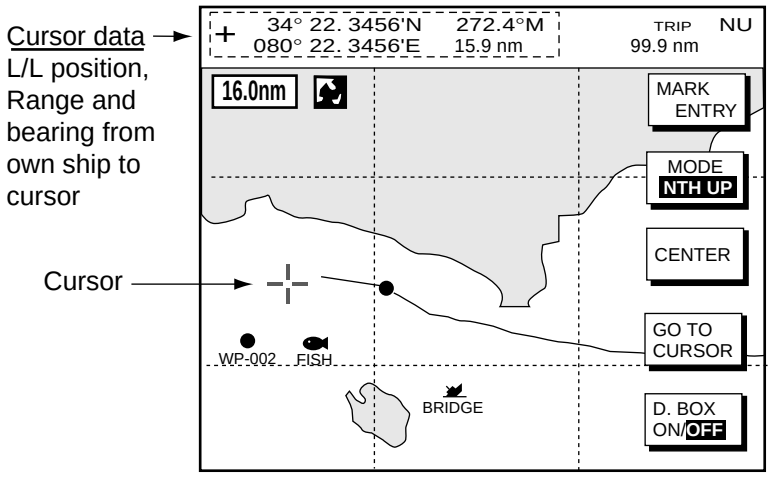
Note: Source names are determined at installation. For example, the source names for radars in a two radar system might be “RADAR” and “RADAR1”.

1.6 Trackball, Cursor

The trackball functions to shift the cursor, for measurement of range and bearing to a location (radar) and latitude and longitude position (plotter). Roll the trackball to shift the cursor. The cursor moves in the direction of trackball rotation.



Radar Display

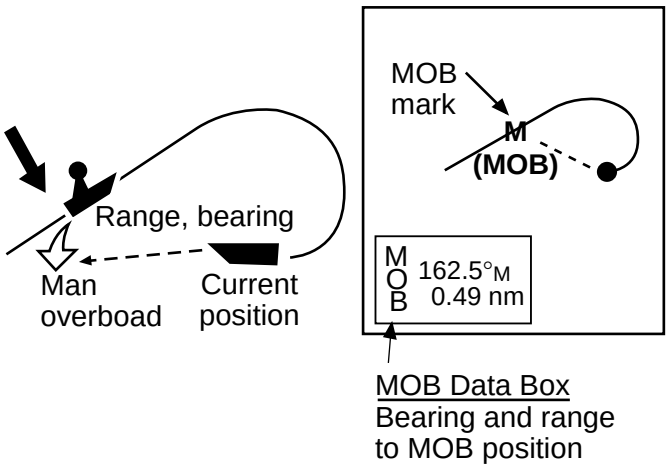


Plotter Display

Cursor, cursor data

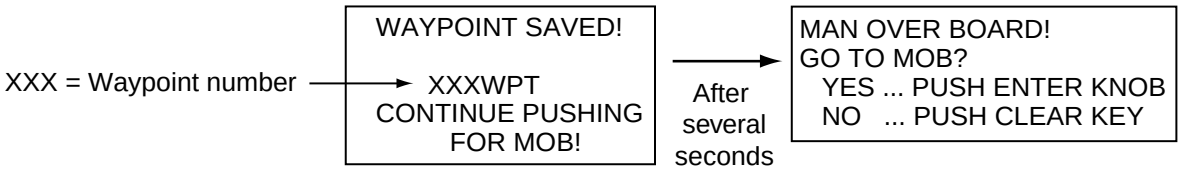
1.7 Entering the MOB Mark, Setting MOB as Destination

The MOB (Man Overboard) mark functions to mark man overboard position. You can inscribe this mark from any mode, except while playing back data or conducting any test. Note that this function requires position data.



MOB concept

1. Press and hold down the [SAVE/MOB] key for about three seconds when someone falls overboard. The display shows the waypoint number being saved (youngest empty waypoint number, 001-999) followed by the MOB confirmation window.



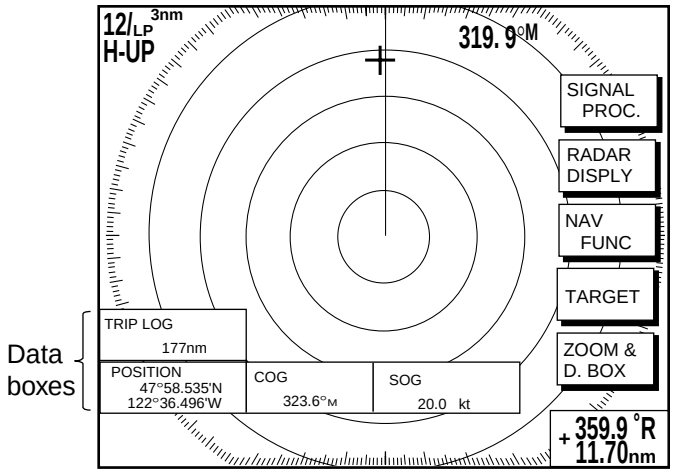
MOB mark messages

2. Push the [ENTER] knob to select the MOB position as the destination, or press the [CLEAR] key to only mark current ship's position as a waypoint. If you select the MOB position as destination;
   - A full-screen radar, plotter or overlay appears depending on the display in use.
   - The MOB mark "MOB" appears at the MOB position and a light-blue line runs between it and current position. This line shows the shortest course to the MOB position.
   - Range and bearing to the MOB position are shown in the MOB data box.

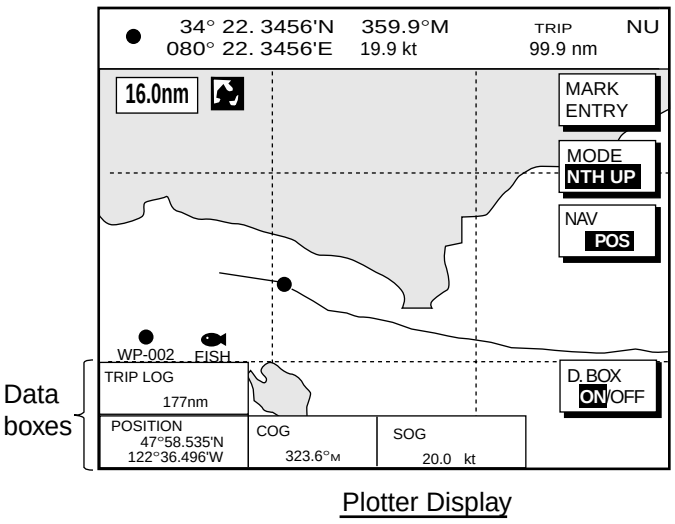
To erase an MOB mark from the plotter display, you must first erase its corresponding waypoint. Place the cursor on the MOB mark, then press the [CLEAR] key followed by pushing the [ENTER] knob to erase the waypoint. Then, repeat to erase the MOB mark.

1.8 Data Boxes

Data boxes, providing navigation data, may be shown on any full-screen display. Up to six data boxes (two in case of large characters) may be shown, and the default data boxes are position (in latitude and longitude), course over ground, speed over ground and trip log. The user may choose which data to display, where to locate it, and show or hide it as desired. In addition, data boxes may be set independently for each display mode (plotter, radar, sounder). For how to select data for the data boxes, see the paragraph “5.5 Data Boxes Setup.”



Radar Display



Plotter Display

Data boxes

1.8.1 Showing, hiding data boxes with soft key

Plotter: D. BOX ON/OFF

Radar: ZOOM & D. BOX → D. BOX ON/OFF (EBL/VRM data box, cursor data box also shown/hidden)

Sounder: AUTO/D. BOX→D. BOX ON/OFF

1.8.2 Rearranging data boxes

You may select the location for data boxes as follows:

1. Using the trackball, place the cursor inside the data box you wish to move. As the cursor enters the box it changes to a hand. Push the [ENTER] knob, and the hand changes to a fist, meaning the box is correctly selected.
2. Use the trackball to move the data box to the location desired, then push the [ENTER] knob.

1.8.3 Temporarily erasing a data box

If a data box is obscuring a desired object you may temporarily erase the box. Use the trackball to place the cursor inside the data box you wish to erase, then press the [CLEAR] key. To redisplay the box, press the D. BOX soft key twice to display it.

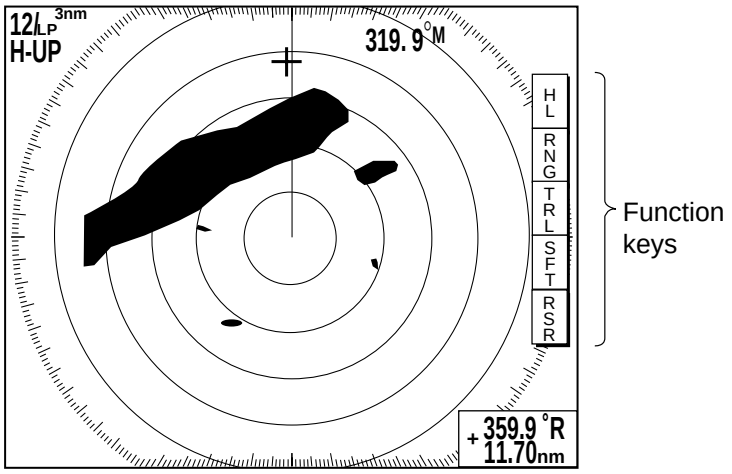
1.9 Function Keys

The function keys provide for one-touch execution of a desired function. The default function key settings are as shown in the table below.

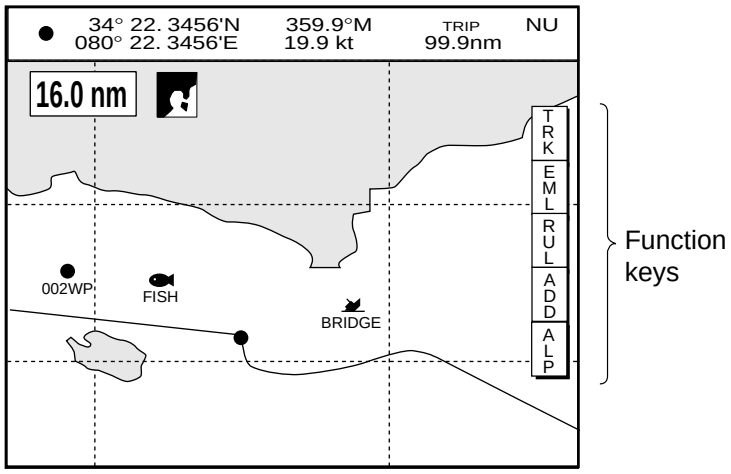
Function Key	Default Setting, Key Label		
	Radar	Plotter	Sounder
#1	Heading line on/off, HL	Track on/off, TRK	TLL output, TLL
#2	Rings on/off, RNG	Edit mark/line, EML	Clutter, CLT
#3	Echo trail, TRL	Ruler, RUL	Signal level, SLV
#4	Offcenter, SFT	Add new waypoint, ADD	Noise limiter, NL
#5	Radar source, RSR	Waypoint alphanumeric list, ALP	Picture advance, PA

1.9.1 Executing a function

1. Press the [HIDE/SHOW] key to replace the preset soft key labels with the function key labels.



Radar Display



Plotter Display

Function keys

2. Press function key desired.

Note: Function keys can be individually programmed for the plotter, radar and sounder displays. For further details see the following:

Radar: paragraph 5.2.3
Plotter: paragraph 5.3.2
Sounder: paragraph 5.9.4

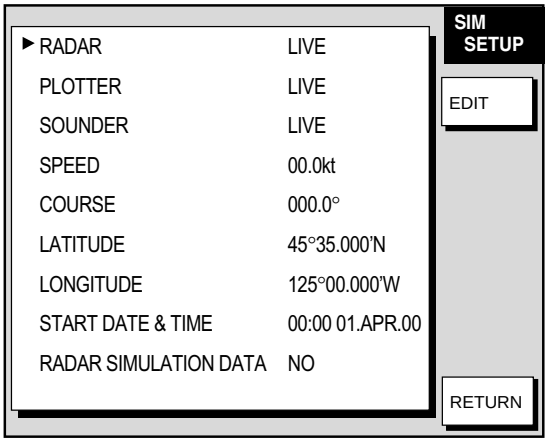
1.10 Simulation Display

The simulation display, for use by service technicians for demonstration purposes, provides simulated operation to help acquaint you with the many features your unit has to offer. It allows you to view and control a simulated plotter, radar and sounder picture, without position-fixing equipment, network radar or a network sounder. Most controls are operative, thus you may practice setting destination, enter waypoints, measure range and bearing to a target, etc.

The simulation icon (SIM) appears when any simulation mode is active.

To start the simulation display;

1. Press the [MENU] key.
2. Press the SYSTEM CONFIGURATION, SYSTEM SETUP and SIMULATION SETUP soft keys in that order.



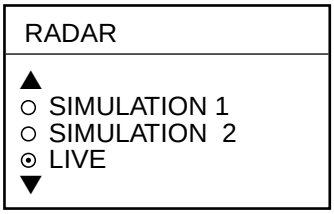
Simulation setup menu

3. Follow appropriate procedure on the next several pages.

Radar

NavNet display unit-generated echoes

1. Select RADAR, then press the EDIT soft key.



2. Select SIMULATION 1, then push the [ENTER] knob.
3. Press the [MENU] key to close the menu.

NavNet radar antenna-generated echoes (not available with the GD-1900C)

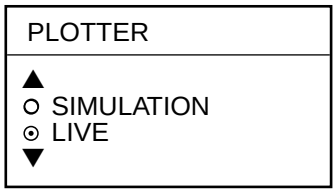
1. Select RADAR SIMULATION DATA, then press the EDIT soft key.
2. Select YES, then push the [ENTER] knob to erase simulation data and get new data. The message “Now getting demo data. Do not turn off display unit.” appears while the unit is receiving radar data.

   Note: If the network radar could not be found “Radar source is not found. Cannot get demo data.” appears. And if the radar is not active, the message “Radar is not active. Cannot get demo data.” is displayed. Check that the radar is plugged in and its signal cable is firmly fastened.

3. Select RADAR, then press the EDIT soft key.
4. Select SIMULATION 2, then push the [ENTER] knob.
5. Press the [MENU] key to close the menu.

Plotter

1. Select PLOTTER, then press the EDIT soft key.

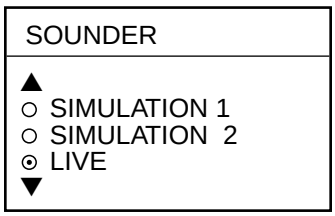


2. Select SIMULATION, then push the [ENTER] knob.
3. Select SPEED, then press the EDIT soft key.
4. Enter speed (setting range, 0-99 kt, default speed, 0 kt) with the alphanumeric keys, then push the [ENTER] knob.
5. Select COURSE, then press the EDIT key.
6. Select “8 FIGURE” to trace the simulated ship’s track in a figure-eight course, or enter your own course at DIRECTION. To enter course, use the trackball to select digit, and enter value with the alphanumeric keys.
7. Press the ENTER soft key.
8. Select LATITUDE, then press the EDIT soft key.
9. Enter latitude (setting range, 85°N-85°S, default setting, 45°35.000’N), then push the [ENTER] knob.
10. Select LONGITUDE, then press the EDIT soft key.

11. Enter longitude (setting range, 180°E-180°W, default setting, 125°00.000'W), then push the [ENTER] knob.
12. Select START DATE & TIME, then press the EDIT soft key.
13. Enter start date and time, then push the [ENTER] knob.
14. Press the [MENU] key to close the menu.

Sounder

1. Select SOUNDER, then press the EDIT soft key.



2. Select SIMULATION 1 (internally generated echoes) or SIMULATION 2 (network sounder-generated echoes), then push the [ENTER] knob.

   Note 1: If the network sounder could not be found "Sounder source is not found. Cannot get simulation data." appears. And if the sounder is not active, the message "Sounder is not active. Cannot get simulation data." is displayed. Check that the sounder is plugged in and its signal cable is firmly fastened.

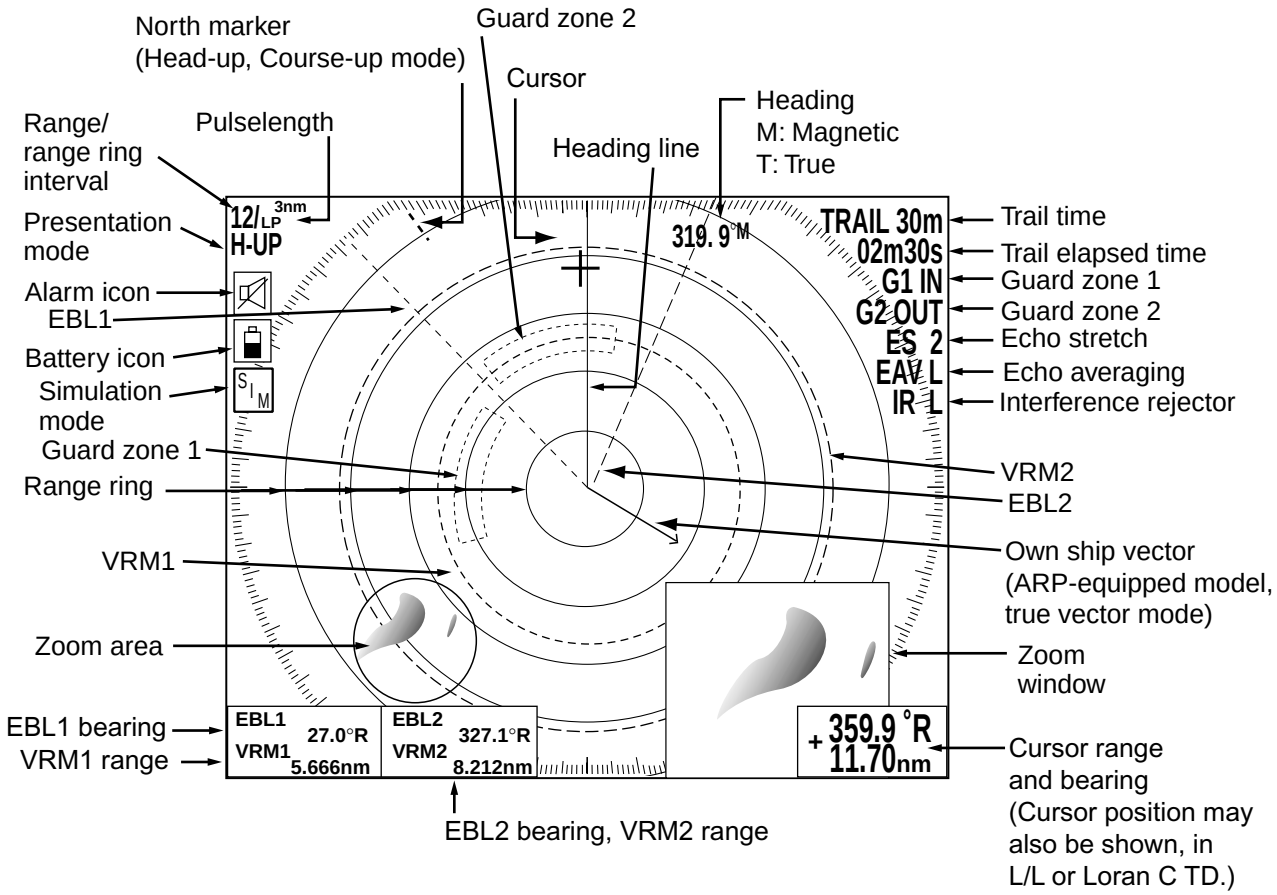
   Note 2: The gain, shift, range and mode of the SIMULATION 1 mode picture cannot be adjusted.

3. Press the [MENU] key to close the menu.

2. RADAR OPERATION

This chapter covers radar operation, including the ARP (Auto Plotter) function. ARP requires a Model 1800/1900 series network radar equipped with the ARP circuit board.

2.1 Radar Display



Radar display

2.2 Transmitting, Stand-by

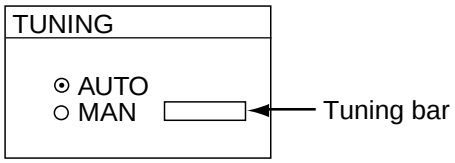
1. Confirm that the network radar is plugged in.
2. Press the [DISP] key to select a radar display.
3. Press the [POWER/BRILL] key momentarily.
4. Press the RADAR STBY soft key to highlight TX on its label.
5. Press the RETURN soft key.

When the radar picture is not required, but you want keep it in a state of readiness, press the RADAR TX soft key to highlight STBY on its label.

2.3 Tuning

The radar receiver can be tuned automatically or manually, and the default tuning method is automatic. If you require manual tuning, do the following:

1. Press the [MENU] key to display the main menu.
2. Press the RADAR DISPLAY SETUP soft key.
3. Select TUNING, then press the EDIT soft key.



Tuning window

4. Choose MAN.
5. Adjust the [ENTER] knob until the tuning bar is at its longest position.
6. Press the [MENU] key to close the menu.

Note: If the auto setting does not provide satisfactory tuning, ask your dealer how to re-adjust tuning.

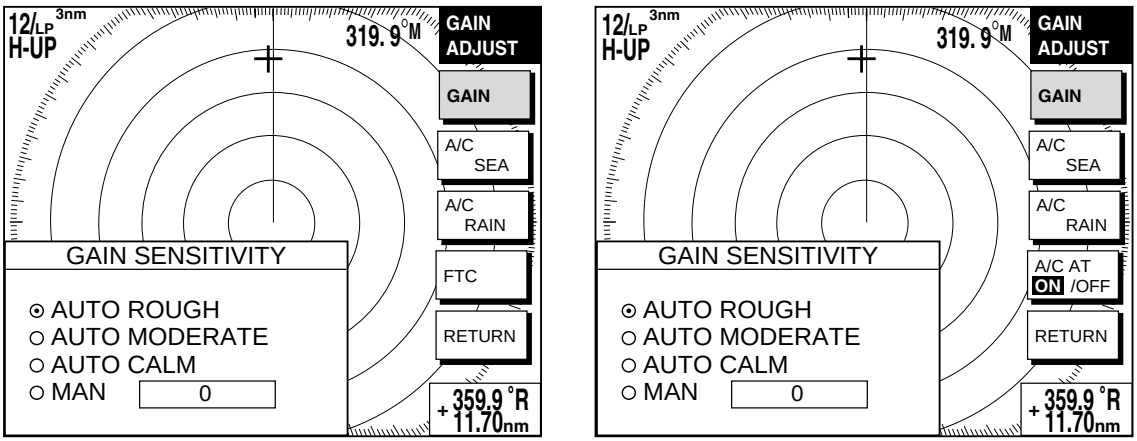
2.4 Adjusting the Gain

The [GAIN] key adjusts the gain sensitivity of the radar receiver. It works in a manner similar to that of volume control of a broadcast receiver, which amplifies received signals.

The proper setting is such that the background noise is just visible on the screen. If your gain setting is too low, weak echoes may be missed. On the other hand, excessive gain yields too much background noise; strong targets may be missed because of the poor contrast between desired echoes and the background noise on the display.

To adjust the receiver sensitivity, transmit on long range, and then do the following:

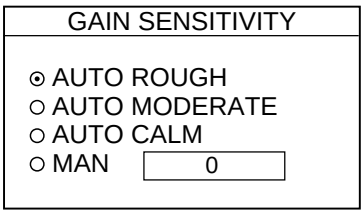
1. Press the [GAIN] key to show the “gain adjustment” soft keys, and the last-used adjustment window appears. The example below shows the gain sensitivity adjustment window. The gain soft keys shown depend on radar source as shown below.



Model 1700 series　　Model 1800/1900 series

Gain adjustment soft keys

2. Press the GAIN soft key to show the gain sensitivity setting window.



Gain sensitivity window

3. Use the trackball to select AUTO ROUGH, AUTO MODERATE, AUTO CALM, or MAN (manual) as appropriate. Select an AUTO option according to the sea state.
4. For manual adjustment, rotate the [ENTER] knob to adjust, while observing the radar echo. The range of adjustment is 0-100.
5. Press the [GAIN] key on the front panel or the RETURN soft key to finish.

Adjusting the FTC (When the radar source is the 1700 series radar)

To suppress rain clutter from heavy storms or scattered rain clutter, adjust the FTC.
In addition to reducing clutter, the FTC can be used in fine weather to clarify the picture when navigating in confined waters. However, with the circuit active the receiver is less sensitive. Therefore, turn off the FTC, by setting it for “0”, when its function is not required.

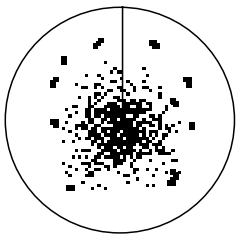
1. Press the [GAIN] key.
2. Press the FTC soft key to show the FTC window.
3. Rotate the [ENTER] knob to adjust. The range of adjustment is 0-100(%). Do not overadjust the FTC – weak target echoes may be missed.
4. Press the [GAIN] key on the front panel or RETURN soft key to finish.

2.5 Reducing Sea Clutter

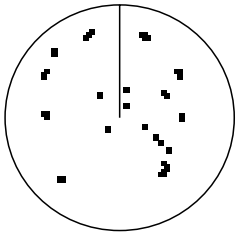
2.5.1 How the A/C SEA works

Echoes from waves can be troublesome, covering the central part of the display with random signals known as “sea clutter”. The higher the waves and the higher the antenna above the water, the further the clutter will extend. Sea clutter may affect radar performance because real targets are sometimes hidden by the echoes of small waves. (See the left-hand figure in the figure below.) When sea clutter masks the picture, adjust the A/C SEA to reduce the clutter.

The A/C SEA reduces the amplification of echoes at short ranges (where clutter is the greatest) and progressively increases amplification as the range increases, so amplification will be normal at those ranges where there is no sea clutter.



Sea clutter at screen center



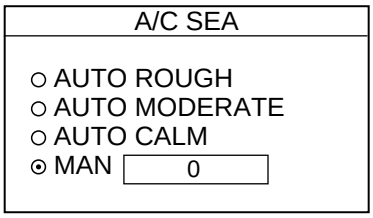
A/C SEA adjusted; sea clutter suppressed

Effect of A/C SEA

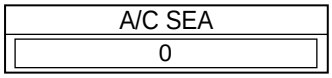
2.5.2 Adjusting the A/C SEA

A/C SEA should be adjusted so that the clutter is broken up into small dots, and small targets become distinguishable.

1. Press the [GAIN] key.
2. Press the A/C SEA soft key to show the A/C SEA setting window.



Model 1700 series radar



Model 1800/1900 series radar

A/C SEA setting window

3. **When the radar source is the Model 1700 series,** use the trackball to select AUTO ROUGH, AUTO MODERATE, AUTO CALM, or MAN (manual) as appropriate. Select an AUTO option according to the sea state.
4. For manual adjustment, rotate the [ENTER] knob to adjust. The range of adjustment is 0-100. Do not overadjust – weak echoes may be missed.

5. **When the radar source is the Model 1800/1900 series,** A/C SEA and A/C RAIN can be automatically adjusted. Press the A/C AT ON/OFF soft key to select ON or OFF as appropriate. When turned on, it overrides A/C SEA and A/C RAIN settings.
6. Press the [GAIN] key on the front panel or RETURN soft key to finish.

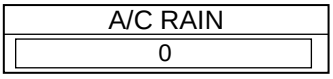
2.6 Reducing Precipitation Clutter

The vertical beamwidth of the antenna is designed to see surface targets even when the ship is rolling. However, by this design the unit will also detect precipitation clutter (rain, snow, hail, etc.) in the same manner as normal targets. Precipitation clutter shows as random dots on the screen.

2.6.1 Adjusting the A/C RAIN

When echoes from precipitation mask solid targets, adjust the A/C RAIN to split up these unwanted echoes into a speckled pattern, making recognition of solid targets easier.

1. Press the [GAIN] key.
2. Press the A/C RAIN soft key to show the A/C RAIN window.



A/C RAIN setting window

3. Rotate the [ENTER] knob to adjust the A/C RAIN. The current level is shown on the A/C RAIN level bar in the A/C RAIN window, and the range of adjustment is 0 to 100(%). Do not overadjust – weak echoes may be missed.
4. Press the [GAIN] key on the front panel or RETURN soft key to finish.

2.7 Range Scale

The range setting determines the size of the area (in nautical miles) that will appear on your display. In addition, the range setting will also automatically adjust the range ring interval so that accurate range measurements may be made while operating on any range setting.

The range, range ring interval and pulselength appear at the top left-hand corner of the display.

Press the [RANGE (+ or -)] key to change the range scale.

Range scales (nm, sm)

Range	0.125	0.25	0.5	0.75	1	1.5	2	3	4	6	8	12	16	24	36	48	64	72
Ring Interval	0.0625	0.125	0.125	0.25	0.25	0.5	0.5	1	1	2	2	3	4	6	12	12	16	18
No. of Rings	2	2	4	3	4	3	4	3	4	3	4	4	4	4	3	4	4	4

Range scales (km)

Range	0.25	0.5	0.75	1	1.5	2	3	4	6	8	12	16	24	36	48	64	72
Ring Interval	0.125	0.25	0.25	0.25	0.5	0.5	1	1	2	2	3	4	6	12	12	16	18
No. of Rings	2	2	3	4	3	4	3	4	3	4	4	4	4	3	4	4	4

Note 1: Maximum range depends on the network radar as shown below.

Model 1722/1722C: 24 nm
Model 1732/1732C/1742/1742C/1833/1833C: 36 nm
Model 1762/1762C/1933/1933C: 48 nm
Model 1943/1943C: 64 nm
Model 1953C: 72 nm

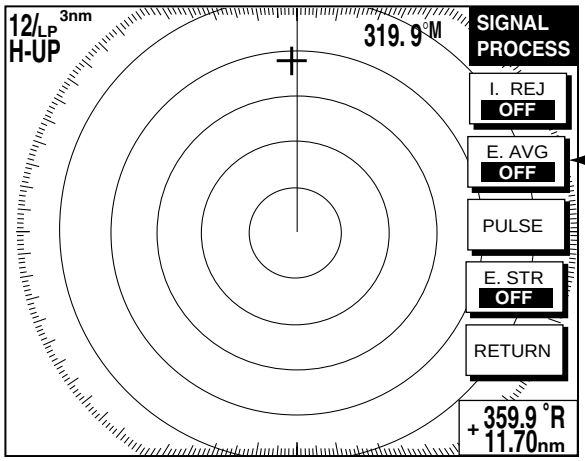
Note 2: You may choose which ranges to use from the RADAR RANGE SETUP menu. For details see paragraph 5.2.2. This function is not available with the GD-1900C.

2.8 Pulselength

The pulselength in use is displayed at the upper left corner of the display. Appropriate pulselengths are preset to individual range scales. Therefore, you are not usually required to select them. If you are not satisfied with the current pulselength setting, however, it is possible to change it for the ranges shown below. Generally, select a longer pulse for longer detection range and shorter pulse for better range discrimination.

1.5 nm, 1.5 sm, 3 km: Short pulse, medium pulse
3 nm, 3 sm, 6 km: Medium pulse, long pulse

1. If not displayed, press the [HIDE/SHOW] key to show the radar soft keys.
2. Press the SIGNAL PROC. soft key.



Shown when radar source is the Model 1800/1900 series radar. Not shown otherwise.

Signal process soft keys

3. Choose the 1.5 nm or 3 nm with the RANGE key.
4. Press the PULSE soft key to select the pulselength setting. SHORT or MEDIUM for 1.5 nm, 1.5 sm, 3 km and MEDIUM or LONG for 3 nm, 3 sm, 6 km.
5. Press the RETURN soft key to finish.

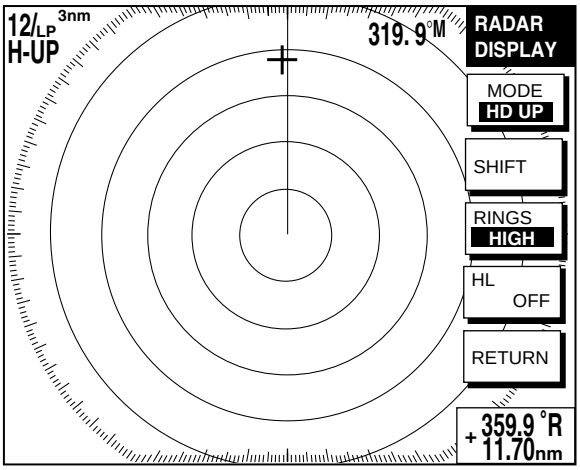
2.9 Presentation Mode

This unit provides four radar presentation modes: head-up, course-up, north-up and true motion.

Heading data is required for modes other than head-up.

2.9.1 Selecting a presentation mode

1. If not displayed, press the [HIDE/SHOW] key to show the radar soft keys.
2. Press the RADAR DISPLY soft key to show the RADAR DISPLAY soft keys.



Radar display soft keys

3. Press the MODE soft key. Each pressing of the key changes the presentation mode and the presentation mode indication in the sequence of North-up, True Motion, Head-up, and Course-up.

Function	Indicator on display	Soft key label
North-up	N-UP	NTH UP
True Motion	TR-M	TRUE M
Head-up	H-UP	HD UP
Course-up	C-UP	CSE UP

4. Press the RETURN soft key to finish.

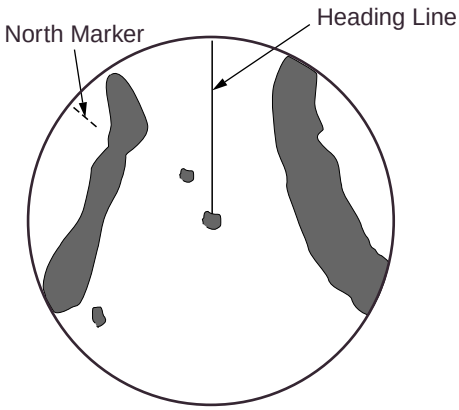
Note: When heading data is lost, the presentation mode automatically goes to head-up, the heading indication at the screen top shows "- - -.-°" and the audio alarm sounds. Press the [ALARM] key to acknowledge the alarm. The message "HEADING DATA MISSING" appears. Restore compass signal to show heading indication. Use the MODE soft key to select presentation mode if necessary. The audio alarm may be silenced with the [CLEAR] key.

2.9.2 Description of presentation modes

Head-up

A display without azimuth stabilization in which the line connecting the center with the top of the display indicates own ship's heading. Targets are painted at their measured distances and in their directions relative to own ship's heading.

The short line on the bearing scale is the north marker.

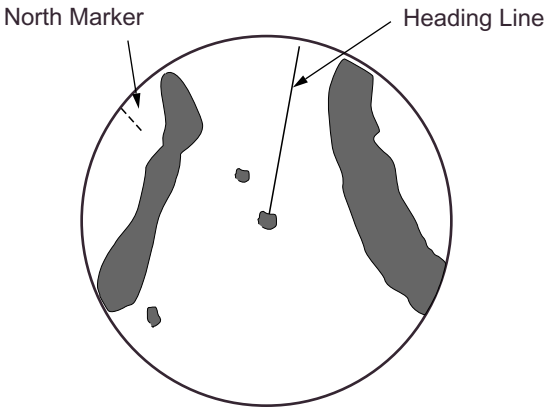


Head-up presentation mode

Course-up

The radar picture is stabilized and displayed with the currently selected course at the top of the screen. As you change heading, the ship's heading line moves. If you select a new course, the picture resets to display the new course at the top of the display.

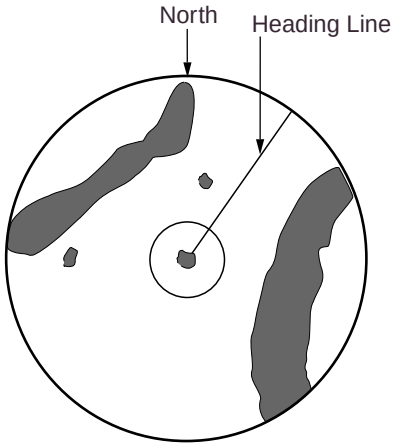
Targets are painted at their measured distances and in their directions relative to the intended course which is maintained at the 0-degree position. The heading line moves in accordance with ship's yawing and course changes.



Course-up presentation mode

North-up

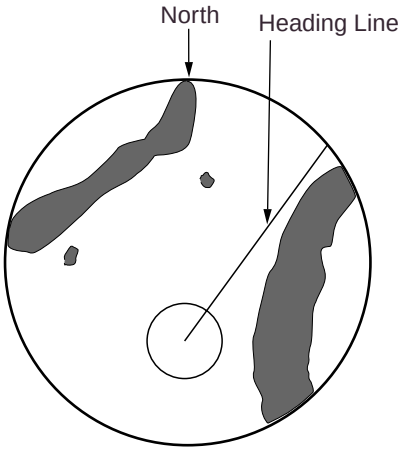
In the north-up mode, targets are painted at their measured distances and in their true (compass) directions from own ship. North is maintained at the top of the screen. The heading line changes its direction according to ship's heading.



North-up presentation mode

True motion

Fixed radar targets maintain a constant position on the screen, while your own ship moves across the radar image at the correct speed and heading. A map-like image is displayed, with all moving vessels traveling in true perspective to each other and to fixed landmasses. As your ship's position approaches the edge of the screen, the radar display is automatically reset to reveal the area ahead of your ship. You can manually reset your ship's position at any time by pressing the RADAR DISPLY soft key followed by the SHIFT soft key.



True motion presentation mode

2.10 Measuring the Range

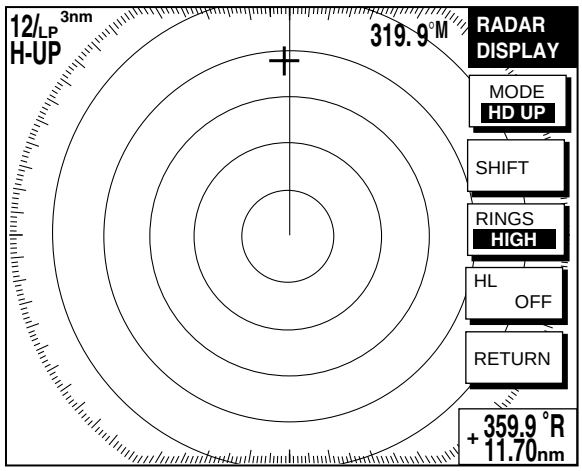
You can measure the range to a radar target three ways: by the range rings, by the cursor, and by the VRM (Variable Range Marker).

2.10.1 Measuring range by range rings

Count the number of rings between the center of the display and the target. Check the range ring interval and judge the distance of the echo from the inner edge of the nearest ring.

To turn the range rings on, do the following:

1. If not displayed, press the [HIDE/SHOW] key to show the radar soft keys.
2. Press the RADAR DISPLY soft key.

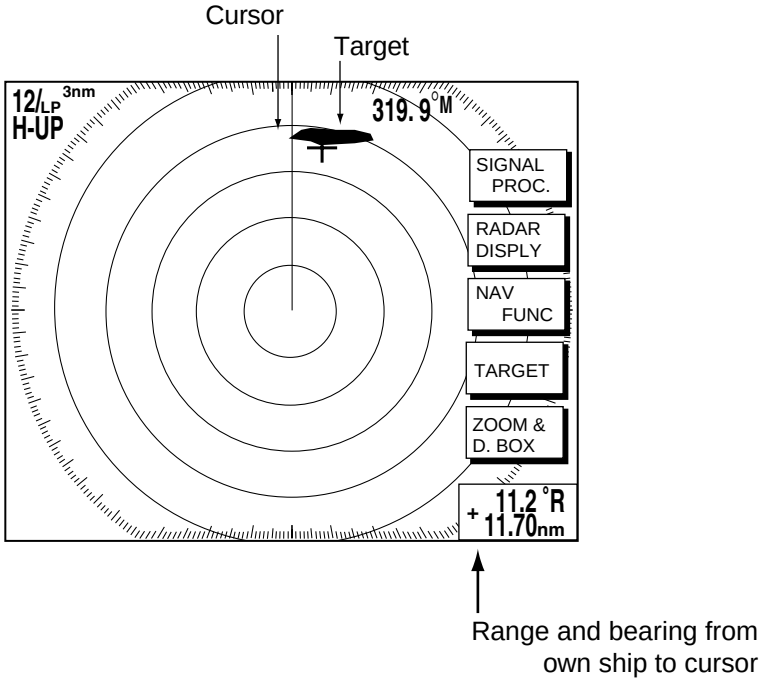


Radar display soft keys

3. Press the RINGS soft key to turn the rings on and select desired brilliance.
4. Press the RETURN soft key to finish.

2.10.2 Measuring range by cursor

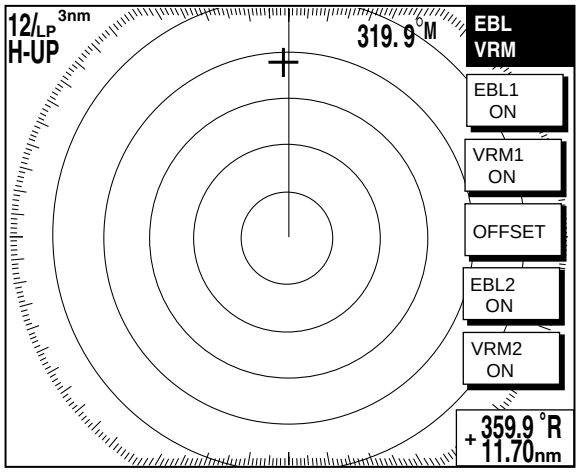
Operate the trackball to place the cursor intersection on the inside edge of the radar target. The range to the target, as well as the bearing, appears to the right of “+” at the bottom of the display.



How to measure range to a target with the cursor

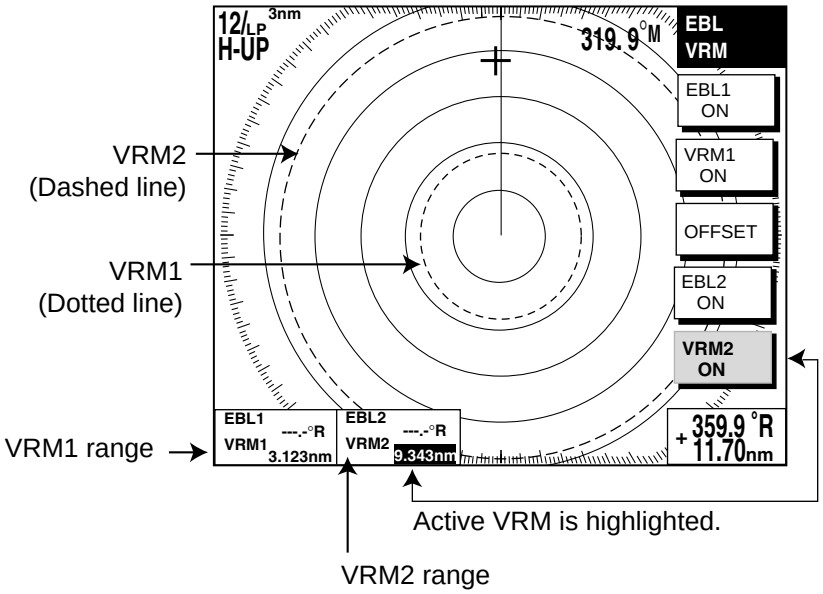
2.10.3 Measuring range by VRM

1. Press the [EBL/VRM] key to display the EBL/VRM soft keys.



EBL/VRM soft keys

2. Press the VRM1 ON (dotted ring VRM) or VRM2 ON (dashed ring VRM) soft key to select the desired VRM. The selected VRM's indication, at the bottom of the screen, is highlighted.
3. Rotate the [ENTER] knob the place the VRM on the inside edge of a radar target. Read the VRM indication to find range to the target.



4. You may hide the EBL/VRM soft keys by pressing the [EBL/VRM] key.

How to measure range with the VRM

2.10.4 Erasing a VRM, VRM indication

Press appropriate VRM soft key, then press the [CLEAR] key. The VRM is erased and its indication becomes blank.

2.10.5 Erasing EBL/VRM data boxes

Press the EBL or VRM soft key associated with the EBL/VRM data box you wish to erase. Press the [CLEAR] key once or twice to erase the data box.

2.10.6 Hiding EBL/VRM data boxes

Press the ZOOM & D. BOX and D. BOX ON/OFF soft keys to show or hide the EBL/VRM data boxes.

2.10.7 Moving EBL/VRM data boxes

When an EBL/VRM data box is obscuring a target you want to see, you can move it to another location as shown below. This cannot be done when the EBL/VRM soft keys are shown.

1. Press the [EBL/VRM] key to turn off the EBL/VRM soft keys.
2. Using the trackball, place the cursor inside the data box you wish to move. As the cursor enters the box it changes to a “hand.” Push the [ENTER] knob, and the hand changes to a fist, meaning the box is correctly selected.
3. Use the trackball to move the data box to the location desired, then push the [ENTER] knob.

2.11 Measuring the Bearing

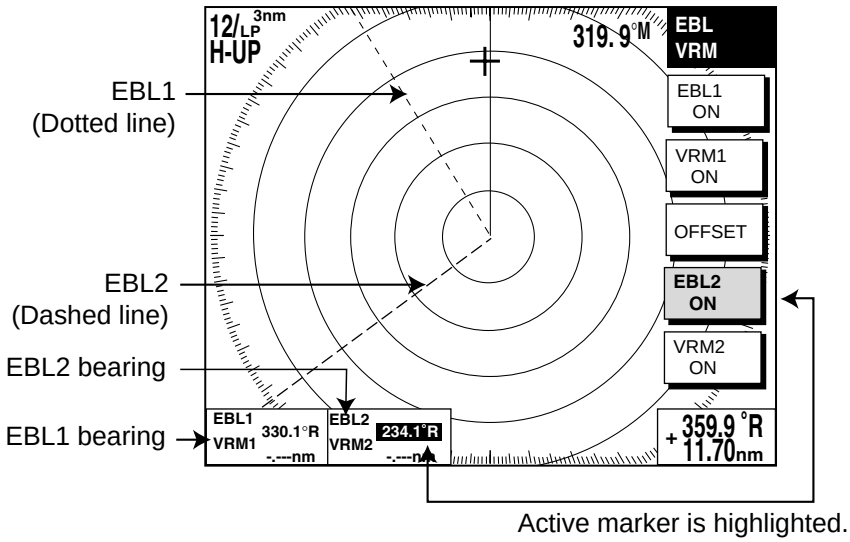
There are two ways to measure the bearing to a target: by the cursor, and by the EBL (Electronic bearing Line).

2.11.1 Measuring bearing by cursor

Use the trackball to place the cursor at the center of the target. The bearing to the target appears in the range and bearing box at the bottom right-hand corner on the screen.

2.11.2 Measuring bearing by EBL

1. Press the [EBL/VRM] key.
2. Press the EBL1 ON (dotted line EBL) or EBL2 ON (dashed line EBL) soft key to select the desired EBL. The selected EBL’s indication, at the bottom of the screen, is highlighted.
3. Rotate the [ENTER] knob to bisect the radar target with the EBL. Read the EBL indication to find the bearing to the target.



How to measure bearing with the EBL

4. You may hide the EBL/VRM soft keys by pressing the [EBL/VRM] key.

Note: The bearing to a target may be shown relative to own ship's heading (Relative) or True bearing (requires heading data). This may be done with "EBL REFERENCE," which is in the RADAR DISPLAY SETUP menu.

2.11.3 Erasing an EBL, EBL indication

Press appropriate EBL soft key, then press the [CLEAR] key. The EBL is erased and its indication becomes blank.

2.11.4 Erasing EBL/VRM data boxes

Press the EBL or VRM soft key associated with the EBL/VRM data box you wish to erase. Press the [CLEAR] key once or twice to erase the data box.

2.11.5 Hiding EBL/VRM data boxes

Press the ZOOM & D. BOX and D. BOX ON/OFF soft keys to show or hide the EBL/VRM data boxes.

2.11.6 Moving EBL/VRM data boxes

When an EBL/VRM data box is obscuring a target you want to see, you can move it to another location as shown below. This cannot be done when the EBL/VRM soft keys are shown.

1. Press the [EBL/VRM] key to turn off the EBL/VRM soft keys.
2. Using the trackball, place the cursor inside the data box you wish to move. As the cursor enters the box it changes to a "hand." Push the [ENTER] knob, and the hand changes to a fist, meaning the box is correctly selected.
3. Use the trackball to move the data box to the location desired, then push the [ENTER] knob.

2.12 Erasing the Heading Line, North Marker

The heading line indicates the ship's heading in all presentation modes. It is a line from the own ship position to the outer edge of the radar display area and appears at zero degrees on the bearing scale in head-up mode; it changes its orientation in the north-up, course-up and true motion modes with ship’s movement.

The north marker appears as a short dashed line. In the head-up and course-up modes the north marker moves around the bearing scale as the ship’s heading moves.

To temporarily erase the heading line and north marker, press the RADAR DISPLY soft key followed by the HL OFF soft key. Release the key to redisplay the markers. (If the radar soft keys are not shown, hit the [HIDE/SHOW] key to display them.)

2.13 Reducing Noise Interference

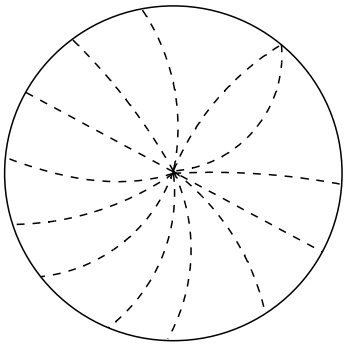
Noise, appearing on the displays as random “speckles,” can be reduced as follows:

1. Press the [MENU] key to open the menu.
2. Press the RADAR DISPLAY SETUP soft key.
3. Select NOISE REJECTION, then press the EDIT soft key.
4. Select OFF, LOW or HIGH as appropriate.
5. Press the ENTER soft key.
6. Press the [MENU] key to close the menu.

2.14 Rejecting Radar Interference

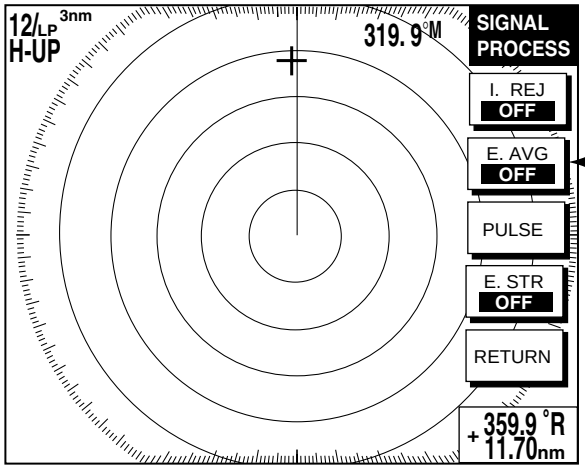
Radar interference may occur when near another shipborne radar that is operating in the same frequency band as your radar. Its on-screen appearance looks like many bright dots either scattered at random or in the form of dotted lines extending from the center to the edge of the display. Interference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

Be sure to turn off the interference rejector when no interference exists – weak targets may be missed.



Radar interference

1. If not displayed, press the [HIDE/SHOW] key to show the radar soft keys.
2. Press the SIGNAL PROC. soft key.



Shown when radar source is the Model 1800/1900 series radar. Not shown otherwise.

SIGNAL PROCESS soft keys

3. Press the I. REJ soft key successively to choose the interference rejection level desired; LOW, MED, HIGH or OFF.
4. Press the RETURN soft key to finish.

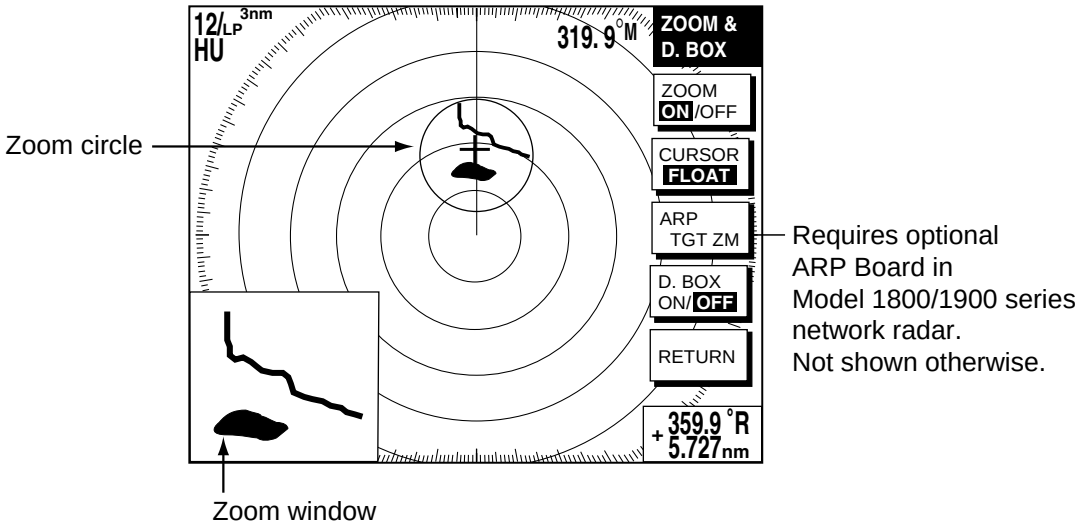
The display shows IR L (Low), IR M (Medium) or IR H (High) when the interference rejector is on.

2.15 Zoom

The zoom feature allows you to double the size of the area selected with the “zoom circle.” It is available on any range but is inoperative in true motion and when the display is shifted.

2.15.1 Zooming in on radar targets

1. If not displayed, press the [HIDE/SHOW] key to show the radar soft keys.
2. Use the trackball to set the cursor where you want to zoom.
3. Press the ZOOM & D. BOX soft key to show ZOOM & D. BOX soft keys.
4. Press the ZOOM ON/OFF soft key to select ON. A solid circle, called the “zoom circle,” appears on the display.
5. To release the cursor, press the CURSOR FLOAT soft key. (The solid circle changes to a dashed one.) To relocate the zoom circle, select location with the trackball, then press the CURSOR LOCK key.
6. To quit the zoom function, press the ZOOM ON/OFF soft key to select OFF.



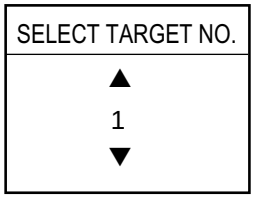
Zoom

2.15.2 Zooming in on ARP, TTM targets

You may zoom in on TTM (Tracked Target Message) and ARP targets. TTM targets can come from a NavNet connected radar, or from other ARP radar that is outputting the TTM message. (TTM is a NMEA 0183 data sentence that is an available output from some ARP capable radar.) Target numbers must be turned on to use this function. This can be done by enabling the target ID number option in the ARP SETUP menu.

1. If not displayed, press the [HIDE/SHOW] key to show the radar soft keys.
2. Press the ZOOM/D. BOX soft key to show ZOOM & D. BOX soft keys.
3. Press the ZOOM ON/OFF soft key to select ZOOM ON.

4. Press the ARP TGT ZM soft key.



Target no. selection window

5. Use the [ENTER] knob to select number (1-10), then push the [ENTER] knob. If the target number does not exist several beeps sound and the zoom function is cancelled.

.

To cancel, press the CURSOR LOCK soft key.

Note: The zoom window blends in with the background when the background color for the radar picture is white. If the window is difficult to see, change the background color.

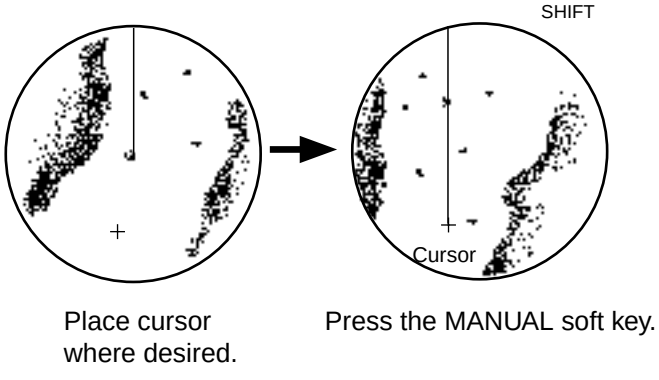
2.16 Shifting the Picture

Own ship position, or sweep origin, can be displaced manually or automatically to expand the view field without switching to a larger scale.

2.16.1 Manual shift

The sweep origin can be shifted in any presentation mode to a point specified by the cursor by up to 50% of the range in use in any direction.

1. Locate the cursor anywhere within the effective radius of the display.
2. If not displayed, press the [HIDE/SHOW] key to show the radar soft keys.
3. Press the RADAR DISPLY soft key.
4. Press the SHIFT soft key.
5. Press the MANUAL soft key to shift. The heading line shifts to the cursor location. SHIFT appears at right-hand corner of the display.
6. To cancel shift, press the RADAR DISPLY, SHIFT and OFF soft keys.



Shifting the picture manually

2.16.2 Automatic shift

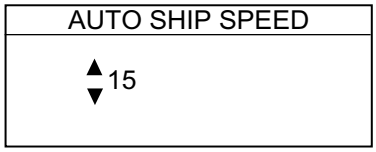
The amount of automatic shift is calculated according to ship's speed, and the amount of shift is limited to 50% of the range in use. For example, if you set the shift speed setting for 15 knots and the ship is running at 10 knots the amount of shift will be about 34%. The formula for determining shift amount is as shown below.

$$\frac{\text{Ship's speed}}{\text{Shift speed setting}} \times 0.5 = \text{Amount of shift(\%)}$$

Automatic shift mode is only available in the head-up mode.

Setting automatic shift maximum speed

1. If not displayed, press the [HIDE/SHOW] key to show the radar soft keys.
2. Press the RADAR DISPLY soft key.
3. Press the SHIFT soft key to show the shift soft keys.
4. Press the AUTO S.SPD soft key to display the auto ship speed setting window.



Auto ship speed setting window

5. Adjust the trackball or [ENTER] knob to set the maximum speed of your vessel, and then push the [ENTER] knob or the ENTER soft key to set. The setting range is 1-999 kt and the default setting is 15 kt.

Automatic shift

Press the AUTO key to automatically shift the sweep origin. To cancel shift, press the RADAR DISPLY, SHIFT and OFF soft keys.

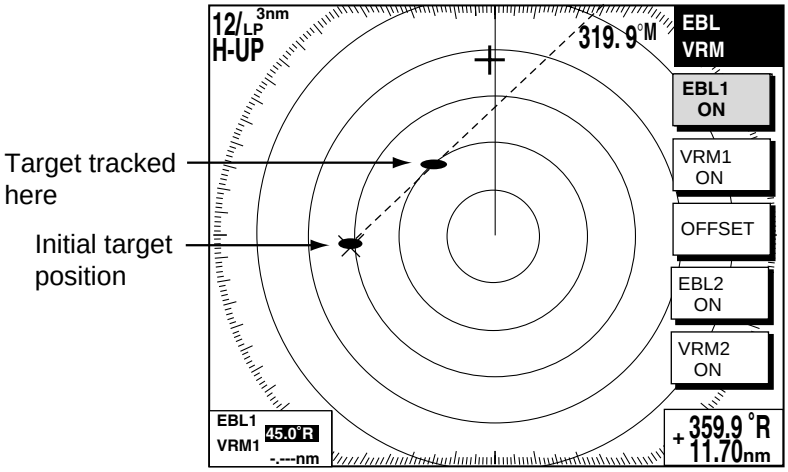
2.17 Using the Offset EBL

The offset EBL can be used to predict a potential collision course. It can also be used to measure the range and bearing between two targets.

2.17.1 Predicting collision course

The procedure below may be used to check if a radar target is on a potential collision course with your vessel.

1. Press the [EBL/VRM] key to show the EBL/VRM soft keys.
2. Press the EBL1 ON soft key to turn on the EBL1.
3. Press the OFFSET soft key. The origin of EBL1 moves to the cursor position, which is marked with an “X.”
4. Use the trackball to place the cursor on the radar target which looks like it might be on a collision course with own ship.
5. Push the [ENTER] knob to fix the origin position.
6. After waiting for a few minutes (at least three minutes), rotate the [ENTER] knob so the EBL bisects the target at the new position. If the target tracks along the EBL towards the center of the display (your ship’s position), the target may be on a collision course with your vessel.
7. To cancel the offset EBL, press the OFFSET soft key.

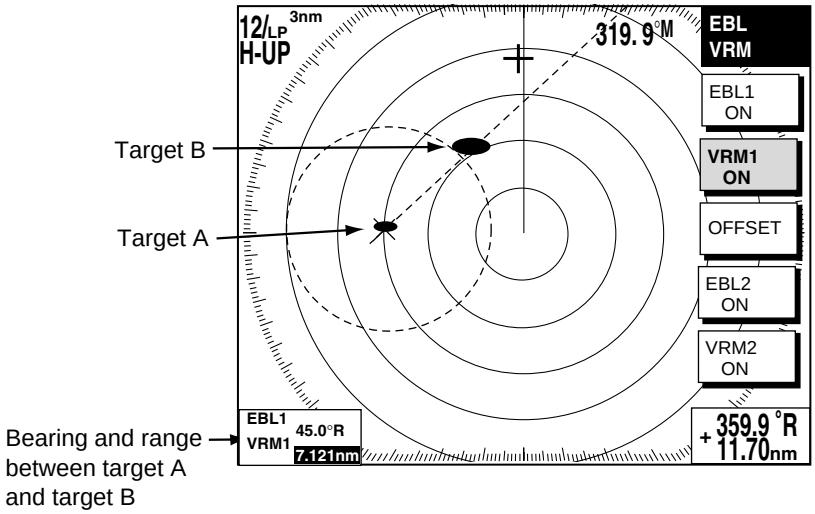


Predicting collision course with the offset EBL

2.17.2 Measuring range & bearing between two targets

The procedure which follows shows how to measure the range and bearing between two targets, using the targets “A” and “B” in the figure below as an example.

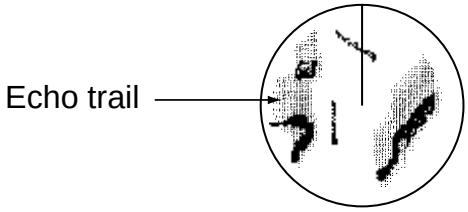
1. Operate the trackball to place the cursor on the target “A.”
2. Press the [EBL/VRM] key to show the EBL/VRM soft keys.
3. Press the EBL1 ON soft key to turn on the EBL1.
4. Press the OFFSET soft key. The origin of EBL1 moves to the cursor position, which is marked with an “X.”
5. Rotate the [ENTER] knob so the EBL bisects the target “B.”
6. Push the [ENTER] knob, then press the VRM1 ON soft key.
7. Rotate the [ENTER] knob to place the VRM1 on the inner edge of the target “B.”
8. Look at the indications for VRM1 and EBL1 to find the range and bearing between the two targets.
9. To cancel the offset EBL, press the OFFSET key.



Measuring range and bearing between two targets

2.18 Echo Trails

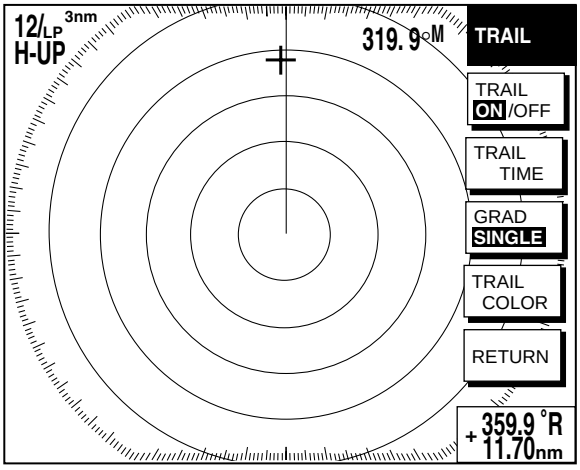
Echo trails are simulated afterglow of target echoes that represent their movements relative or true to own ship. This function is useful for alerting you past possible collision situations.



Sample echo trails

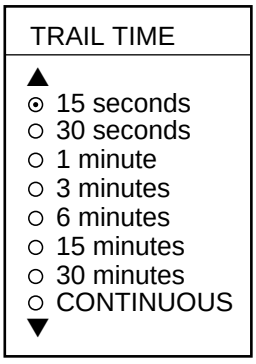
2.18.1 Trail time

1. If not displayed, press the [HIDE/SHOW] key to show the radar soft keys.
2. Press the TARGET soft key.
3. Press the TRAIL soft key.



Trail soft keys

4. Press the TRAIL TIME soft key to show the trail time window.



Trail time window

5. Use the trackball to select time desired.
6. Press the ENTER soft key.
7. Press the RETURN soft key twice to finish.

2.18.2 Starting echo trails

1. If not displayed, press the [HIDE/SHOW] key to show the radar soft keys.
2. Press the TARGET soft key.
3. Press the TRAIL soft key.
4. Press the TRAIL ON/OFF soft key to select ON.
5. Press the RETURN soft key twice to finish.

“TRAIL,” the echo trail time selected and elapsed time appear at the top right-hand corner of the display. Then, afterglow starts extending from all targets. Trails are restarted when the range or mode is changed and zoom or shift is turned on.

For continuous trails, the maximum continuous trail time is 99 minutes and 59 seconds. When the elapsed time clock counts up to that time, the elapsed time display resets to zero and trails begin again.

To turn off echo trail, press the TRAIL ON/OFF soft key to select OFF at step 4 in the above procedure.

2.18.3 Trail gradation

The echo trails can be shown in single or multiple gradations. Multiple gradation paints the trails thinner with time, like the afterglow on an analog PPI radar.

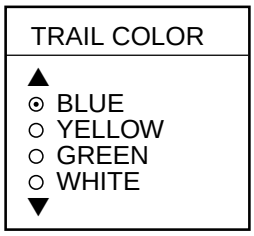
1. If not displayed, press the [HIDE/SHOW] soft key to show the radar soft keys.
2. Press the TARGET and TRAIL soft keys.
3. Press the GRAD soft key to select SINGLE or MULTI as appropriate.
4. Press the RETURN soft key twice to finish.

Multitone and monotone trails

2.18.4 Trail color

Trails may be shown target trails in blue, yellow, green or white.

1. If not displayed, press the [HIDE/SHOW] key to show the radar soft keys.
2. Press the TARGET, TRAIL and TRAIL COLOR soft keys in that order.



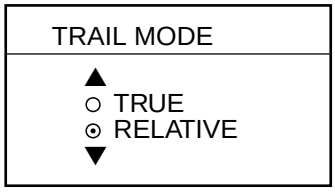
Trail color window

3. Use the trackball to select the color desired, then press the ENTER soft key.
4. Press the RETURN soft key twice.

2.18.5 Echo trail mode

Echo trails can be shown in Relative or True motion. (True trails require heading and speed inputs.)

1. Press the [MENU] key.
2. Press the RADAR DISPLAY SETUP key.
3. Choose TRAIL MODE, then press the EDIT soft key.

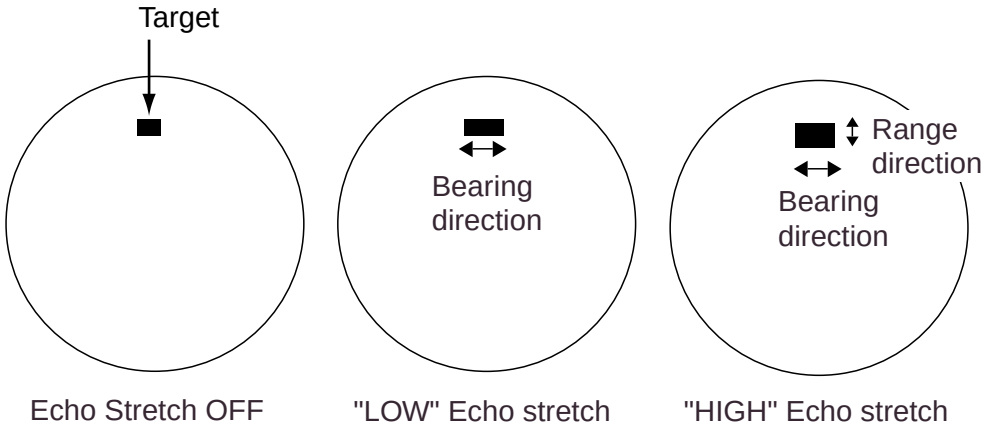


Trail mode window

4. Select TRUE or RELATIVE as appropriate, then press the ENTER soft key.
5. Press the [MENU] key to close the menu.

2.19 Echo Stretch

Normally, the reflected echoes from long range targets appear on the display as weaker and smaller blips even though they are compensated by the radar's internal circuitry. The echo stretch function magnifies these small blips in all ranges. Two types of echo stretch are available: ES LOW which stretches echoes in bearing direction and ES HIGH which stretches them in both range and bearing directions.



Types of echo stretch

This function magnifies not only targets but also sea clutter and radar interference. For this reason, be sure sea clutter and radar interference are properly suppressed before activating the echo stretch.

1. If not displayed, press the [HIDE/SHOW] key to show the radar soft keys.
2. Press the SIGNAL PROC. soft key.
3. Press the E. STR soft key to select HIGH, LOW or OFF as appropriate.
4. Press the RETURN soft key to finish.

The display shows ES H (High) or ES L (Low) when the echo stretch is on.

2.20 Echo Averaging

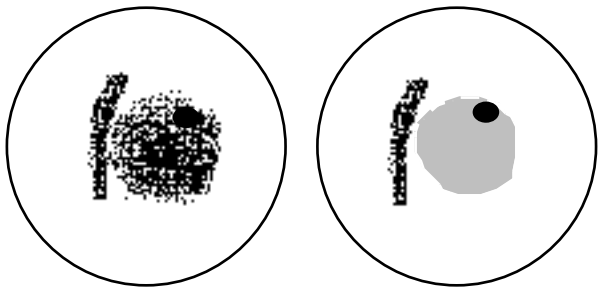
The echo average feature, which requires a Model 1800/1900 series network radar, effectively suppresses sea clutter. Echoes received from stable targets such as ships appear on the screen at almost the same position during every rotation of the antenna. On the other hand, unstable echoes such as sea clutter appear at random positions.

To distinguish real target echoes from sea clutter, echo average performs scan-to-scan correlation. Correlation is made by storing and averaging echo signals over successive picture frames. If an echo is solid and stable, it is presented in its normal intensity. Sea clutter is averaged over successive scans resulting in the reduced brilliance, making it easier to discriminate real targets from sea clutter.

To properly use the echo average function, it is recommended to first suppress sea clutter with the A/C SEA control and then do the following:

1. If not displayed, press the [HIDE/SHOW] key to display the radar soft keys.
2. Press the SIGNAL PROC. soft key.
3. Press the E. AVG soft key to select desired echo averaging.
   - OFF: No averaging
   - LOW: Helps distinguish targets from sea clutter and suppresses brilliance of unstable echoes.
   - MED: Distinguishes small stationary targets such as navigation buoys.
   - HIGH: Stably displays distant targets.
4. Press the RETURN soft key to finish.

The display shows EAV L, EAV M or EAV H when echo averaging is on.



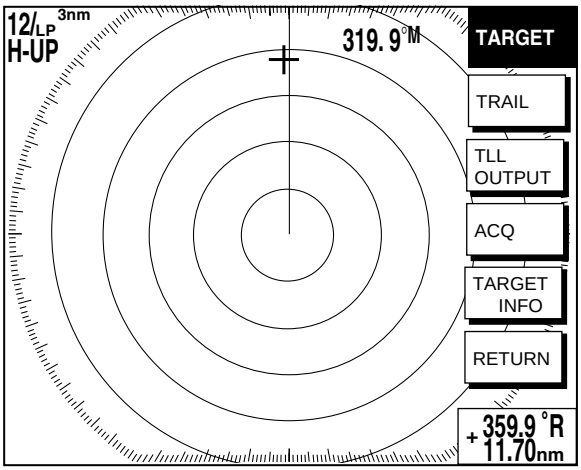
(a) Echo average OFF (b) Echo average ON

Effect of echo averaging

2.21 Outputting TLL Data

Target position data can be output to units of the network and shown on their plotter screen with the TTL mark (ⓧ). This function requires position and heading data.

1. Operate the trackball to place the cursor on the target whose position you wish to output.
2. If not displayed, press the [HIDE/SHOW] key to display the radar soft keys.
3. Press the TARGET soft key.



Requires ARP circuit board in Model 1800/1900 series NavNet radar. Not shown otherwise.

TARGET soft keys

4. Press the TLL OUTPUT soft key to output target position data. The TTL mark appears on the plotter screen at the target's position the moment the TLL OUTPUT soft key was pressed. Further, that position is recorded as a waypoint on all NavNet units, under the youngest empty waypoint number on each NavNet unit.
5. Press the RETURN soft key to finish.

Note: The screen of the TLL recipient may be temporarily interrupted when receiving TLL from another NavNet display unit. Press any key to restore normal operation.

2.22 Guard Alarm

The guard alarm allows the operator to set the desired range and bearing for a guard zone. When ships, islands, landmasses, etc. violate the guard zone, an audio alarm sounds and the offending target blinks to call the operator's attention.

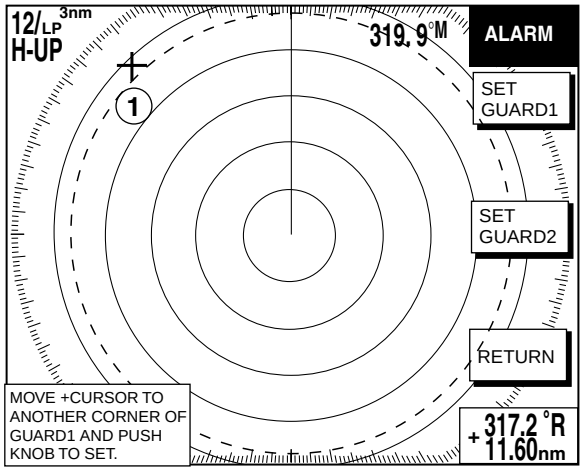
⚠ CAUTION

- **The alarm should not be relied upon as the sole means for detecting possible collision situations.**
- **A/C SEA, A/C RAIN and GAIN controls should be properly adjusted to be sure the alarm system does not overlook target echoes.**

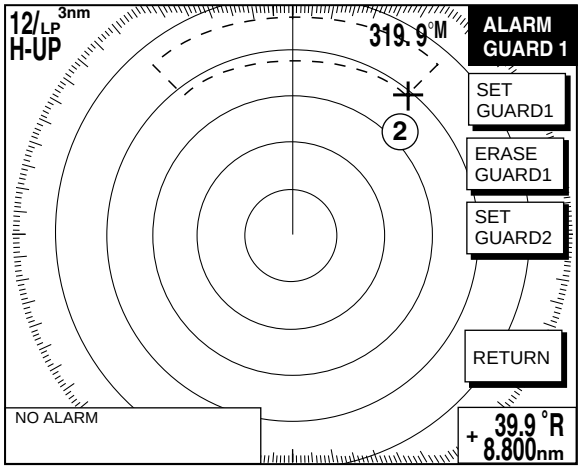
2.22.1 Setting a guard alarm zone

To set a guard alarm zone, set the radar to transmit and do the following:

1. Press the [ALARM] key.
2. Use the trackball to set the cursor on the top left corner (or top right corner) of the guard zone you want to set, then press the SET GUARD1 or SET GUARD2 soft key, depending on which guard zone you want to set.
3. Use the trackball to set the cursor on the bottom right corner (or top left corner) of the guard zone area, then push the [ENTER] knob.
4. Press the RETURN soft key to finish.



(1) Drag cursor to top (or bottom) corner for guard zone and press the SET GUARD1 or SET GUARD2 soft key.



(2) Drag cursor diagonally to bottom (or top) corner for guard zone and press the [ENTER] knob.

How to set a guard alarm zone

The equipment then searches for targets inside the guard zone to determine guard alarm type. If a target is found inside the guard zone, the guard zone type becomes an “Outward guard alarm,” and any target exiting the guard zone will trigger the audio alarm. If no target is found, the guard zone type becomes an “Inward guard alarm,” and any targets entering the guard zone will trigger the audio alarm. The guard alarm type is shown as G1(G2) IN or G1(G2) OUT.

Note 1: When the radar range is less than the guard zone range, the audio alarm sounds and the alarm icon appears (in red). Press the [CLEAR] key to silence the alarm. Press the [ALARM] key and the message “GUARD1(2) IS OUTSIDE RADAR RANGE” appears. Reselect appropriate range.

Note 2: If the network radar is set to standby while the guard alarm is active, the guard alarm is cancelled. The guard alarm is redisplayed when the radar is set to transmit again.

Note 3: If the network radar is set to standby while the radar picture is not displayed, the alarm icon appears in red and the alarm sounds. Press the [ALARM] key and the message “STBY MODE HAS BEEN SELECTED. GUARD/WTCHMN CANCELED.” or “GUARD/WATCHMAN CANCELED. STBY/TX SELECTED.” appears.

2.22.2 When the alarm is violated…

Any radar target violating the guard zone will flash, the audio alarm sounds, and the alarm icon appears in red. Additionally the message “TARGET ENTERED INTO GUARD1(GUARD2)” or “TARGET LEFT FROM GUARD1(GUARD2)” is displayed at the bottom of the screen. Press the [CLEAR] key to silence the alarm. When this is done, the color of the speaker icon changes to background color and “G1(G2) ACK” replaces G1(G2) IN(OUT) at the top right corner of the display. This means the alarm is temporarily deactivated. To reactivate the alarm, press the SET GUARD1 or SET GUARD2 soft key as appropriate.

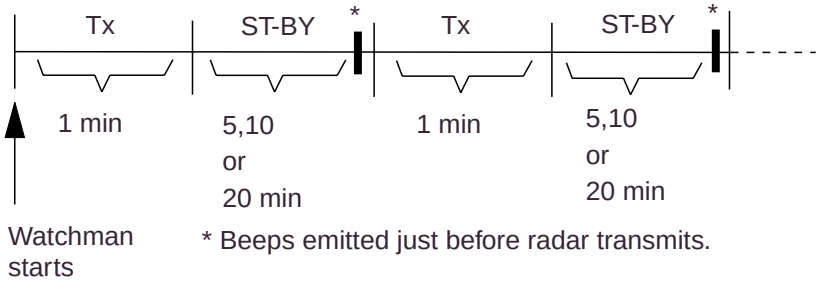
2.22.3 Cancelling the guard alarm

1. Press the [ALARM] key to show the ALARM menu.
2. Press the ERASE GUARD1 or ERASE GUARD2 soft key as appropriate.
3. Press the RETURN soft key to finish.

2.23 Watchman

2.23.1 How watchman works

The watchman function periodically transmits radar pulses for one minute to check for targets in a guard zone. If a target is found in the zone, watchman is cancelled, the audio alarm sounds and the radar continues transmitting. If no target is found the radar goes into standby for the number of minutes specified on the RADAR DISPLAY SETUP menu. This feature is useful when you do not need the radar's function continuously but want to be alerted to radar targets in a specific area. "WTCH" appears at the top left corner when Watchman is active.



How watchman works

2.23.2 Turning on/off watchman

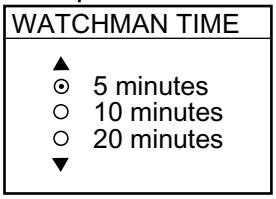
1. Set a guard zone. (See the paragraph 2.22.)
2. If not displayed, press the [HIDE/SHOW] key to display the radar soft keys.
3. Press the NAV FUNC soft key.
4. Press the W. MAN ON/OFF soft key to select ON or OFF as appropriate.
5. Press the RETURN soft key to finish.

Note: When the watchman is activated and no guard zone is active, the message "PLEASE SET GUARD ZONE. PUSH ANY KEY TO CONTINUE." appears. Press any key and then set a guard zone.

2.23.3 Setting watchman stand-by interval

The watchman standby interval, that is, the number of minutes the radar is in standby, can be set to 5, 10 or 20 minutes as follows:

1. Press the [MENU] key.
2. Press the RADAR DISPLAY SETUP soft key.
3. Select WATCHMAN TIME, then press the EDIT soft key.

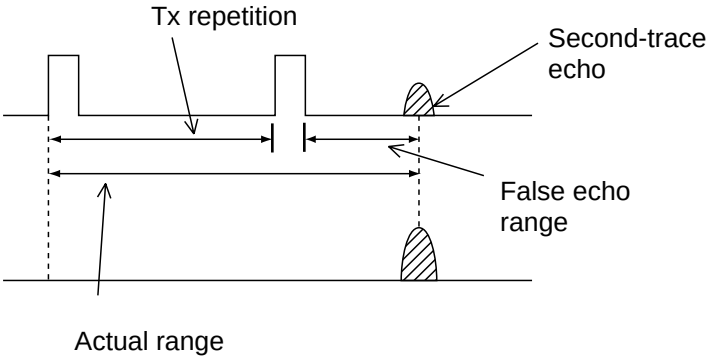


Watchman window

4. Select time desired, then press the ENTER soft key.
5. Press the [MENU] key to close the menu.

2.24 Suppressing Second-trace Echoes

In certain situations, echoes from very distance targets may appear as false echoes (second-trace echoes) on the screen. This occurs when the return echo is received one transmission cycle later, or after a next radar pulse has been transmitted.



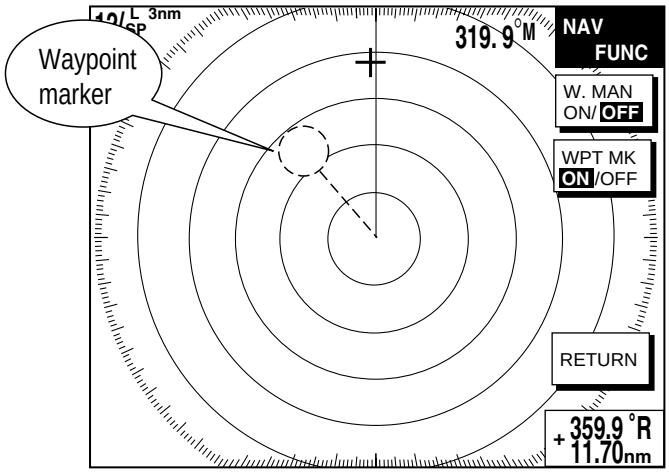
Second-trace echoes

To activate or deactivate the second-trace echo rejector do the following:

1. Press the [MENU] key.
2. Press the RADAR DISPLAY SETUP soft key.
3. Use the trackball to select 2ND ECHO REJECTION, then press the EDIT soft key.
4. Choose ON or OFF as appropriate, then press the ENTER soft key.
5. Press the [MENU] key to close the menu.

2.25 Waypoint Marker

A waypoint marker, showing the location of the destination waypoint set on the plotter, may be inscribed on the radar display.



Waypoint marker

1. If not already shown, press the [HIDE/SHOW] key to display the radar soft keys.
2. Press the NAV FUNC soft key.
3. Press the WPT MK ON/OFF soft key to select ON or OFF as appropriate.
4. Press the RETURN soft key to finish.

2.26 ARP, TTM Operation

When the radar source is an ARP-equipped Model 1800/1900 series network radar, you can manually and automatically acquire and track ten targets. Once a target is acquired automatically or manually it is automatically tracked within 0.1 to 32 nm. If the FURUNO heading sensor PG-1000 is used, the data sentence "RMC" is necessary.

Alternatively, you can display the tracks of other ships by receiving the data sentence TTM (Tracked Target Message) via the NETWORK or NMEA port on the display unit. However, targets cannot be acquired.

Usage precautions for ARP

⚠ WARNING

No one navigational aid should be relied upon for the safety of vessel and crew. The navigator has the responsibility to check all aids available to confirm position. Electronic aids are not a substitute for basic navigational principles and common sense.

- This auto plotter automatically tracks an automatically or manually acquired radar target and calculates its course and speed, indicating them by a vector. Since the data generated by the auto plotter are based on what radar targets are selected, the radar must always be optimally tuned for use with the auto plotter, to ensure required targets will not be lost or unwanted targets such as sea returns and noise will not be acquired and tracked.
- A target does not always mean a land-mass, reef, ships or other surface vessels but can imply returns from sea surface and clutter. As the level of clutter changes with environment, the operator should properly adjust the A/C SEA, A/C RAIN and GAIN controls to be sure target echoes are not eliminated from the radar screen.

⚠ CAUTION

The plotting accuracy and response of this auto plotter meets IMO standards. Tracking accuracy is affected by the following:

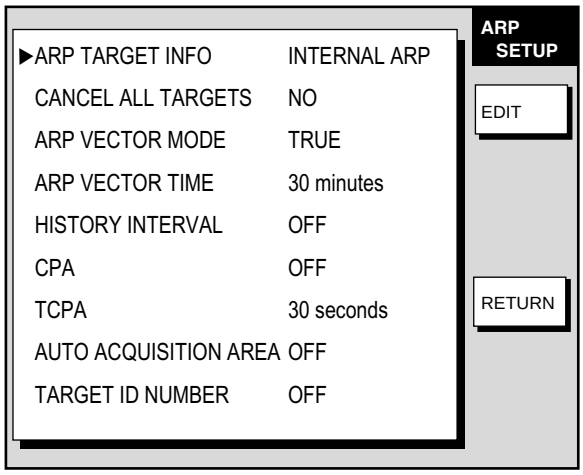
- Tracking accuracy is affected by course change. One to two minutes is required to restore vectors to full accuracy after an abrupt course change. (The actual amount depends on gyrocompass specifications.)
- The amount of tracking delay is inversely proportional to the relative speed of the target. Delay is on the order of 15-30 seconds for high relative speed; 30-60 seconds for low relative speed.

Display accuracy is affected by the following:

- Echo intensity
- Radar transmission pulsewidth
- Radar bearing error
- Gyrocompass error
- Course change (own ship or target)

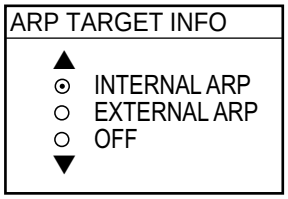
2.26.1 Activating/deactivating ARP, TTM

1. Press the [MENU] key followed by the ARP SETUP soft key to show the ARP SETUP menu.



ARP setup menu

2. Select ARP TARGET INFO, then press the EDIT soft key to show the ARP target info window.



ARP target info window

3. Select INTERNAL ARP, EXTERNAL ARP or OFF as appropriate.

   INTERNAL ARP: The radar source must be an ARP-equipped Model 1800/1900 series NavNet radar. Select this item also for a NavNet unit being fed ARP targets.

   EXTERNAL ARP: Receive TTM data sentence via NMEA or NETWORK port. Target tracks are shown but targets cannot be acquired.

   OFF: Turns off the ARP or TTM display.

4. Press the ENTER soft key.
5. Press the [MENU] key to close the menu.

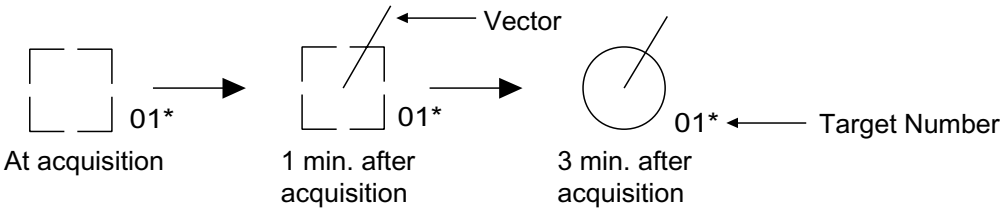
2.26.2 Acquiring and tracking targets (ARP)

Ten targets may be acquired and tracked manually and automatically. When you attempt to acquire an 11th target, the message “ARP FULL – ALREADY TRACKING 10 TARGETS!” appears for five seconds. To acquire another target, terminate tracking of an unnecessary target as shown in the paragraph “2.26.4 Terminating tracking of ARP targets.”

Manual acquisition

1. If not already shown, press the [HIDE/SHOW] key to show the radar soft keys.
2. Press the TARGET soft key.
3. Place the cursor on the target to acquire.
4. Press the ACQ soft key.
5. Press the RETURN soft key to finish.

The plot symbol changes over time as below. A vector appears about one minute after acquisition, indicating the target’s motion trend.



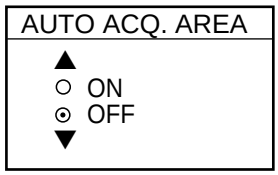
** = Target number shown when TARGET ID NUMBER is turned on in the ARP SETUP menu.*

ARP plot symbols

Automatic acquisition

The ARP can acquire up to ten targets automatically by setting an automatic acquisition area. When automatic acquisition is selected after acquiring targets manually, only the remaining capacity for targets may be automatically acquired. For example, if seven targets have been manually acquired, three targets may be automatically acquired.

1. Press the [MENU] key to show the main menu.
2. Press the ARP SETUP soft key to show the ARP SETUP menu.
3. Operate the trackball to select AUTO ACQUISITION AREA.
4. Press the EDIT soft key to show the automatic acquisition area window.

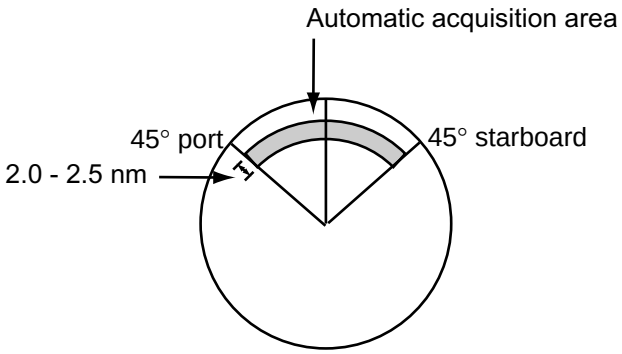


Automatic acquisition area window

5. Select ON, then press the ENTER soft key.

6. Press the [MENU] key to close the menu. An acquisition area of 2.0 to 2.5 miles in range and ±45º on either side of the heading line in bearing appears.

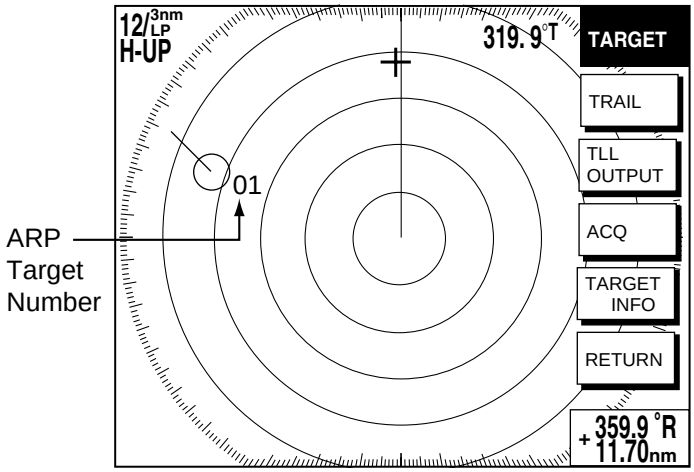
Note: Targets being tracked in automatic acquisition are continuously tracked when switching to manual acquisition.



Automatic acquisition area

2.26.3 Displaying target number (ARP, TTM)

Target number can be shown for ARP and TTM targets as below.



ARP target number

1. Press the [MENU] key.
2. Press the ARP SETUP soft key.
3. Select TARGET ID NUMBER.
4. Press the EDIT soft key.
5. Select ON or OFF as appropriate.
6. Press the ENTER soft key.
7. Press the [MENU] key to close the menu.

2.26.4 Terminating tracking of ARP targets

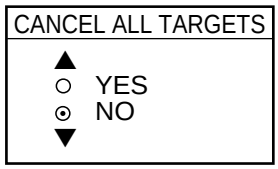
When ten targets have been acquired, no more acquisition occurs unless targets are cancelled. If you need to acquire additional targets, you must first cancel one or more individual targets, or all targets, using one of the procedures below.

Terminating tracking of selected targets

1. Place the cursor on the target to terminate tracking.
2. Press the [CLEAR] key to terminate tracking and erase the target.

Terminating tracking of all targets

1. Press the [MENU] key followed by the ARP SETUP soft key.
2. Select CANCEL ALL TARGETS.
3. Press the EDIT soft key.



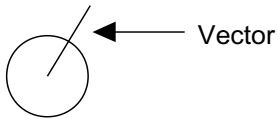
Cancel all targets window

4. Select YES.
5. Press the ENTER soft key.
6. Press the RETURN soft key followed by the [MENU] key to close the menu.

2.26.5 Setting vector attributes (ARP)

What is a vector?

A vector is a line extending from a tracked target which shows estimated speed and course of the target. The vector tip shows an estimated position of the target after the selected vector time elapses. It can be useful to extend the vector length (time) in order to evaluate the risk of collision with any target.

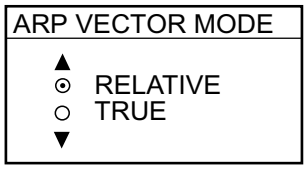


Vector

Vector reference, vector time

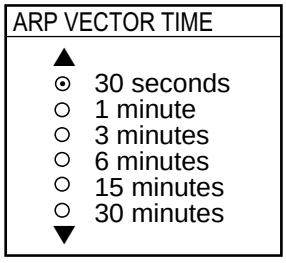
You may reference the vectors to North (True, requires heading and speed data) or ship's heading (relative) as desired. Vector time can be set to 30 seconds, 1, 3, 6, 15 or 30 minutes.

1. Press the [MENU] key followed by the ARP SETUP soft key to show the ARP SETUP menu.
2. Operate the trackball to select ARP VECTOR MODE.
3. Press the EDIT soft key to show the ARP vector mode window.



ARP vector mode window

4. Select TRUE or RELATIVE as appropriate.
5. Press the ENTER soft key.
6. Select ARP VECTOR TIME, then press the EDIT soft key to show the ARP vector time window.



ARP vector time window

7. Operate the trackball to select vector time among 30 sec, 1 min, 3 min, 6 min, 15 min and 30 min.
8. Press the ENTER soft key.
9. Press the [MENU] key to close the menu.

2.26.6 Displaying past position (ARP)

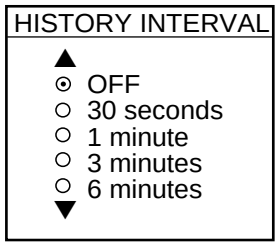
This ARP can display time-spaced dots (maximum ten dots) marking the past positions of any targets being tracked. You can evaluate a target's actions by the spacing between dots. Below are examples of dot spacing and target movement.

(a) Ship turning (b) Ship running straight (c) Ship reduced speed (d) Ship increased speed

Past position displays

To turn the past position display on or off:

1. Press the [MENU] key followed by the ARP SETUP soft key.
2. Operate the trackball to select HISTORY INTERVAL.
3. Press the EDIT soft key to show the history interval window.



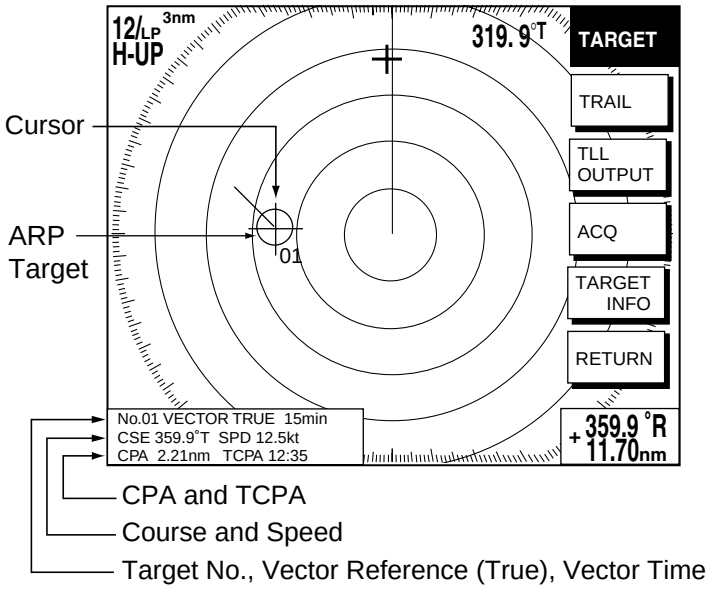
History interval window

4. Operate the trackball to select history interval among 30 sec, 1 min, 3 min and 6 min, or select OFF to turn off the past position display.
5. Press the ENTER soft key.
6. Press the [MENU] key to close the menu.

2.26.7 ARP, TTM target data

You can show motion trends (range, bearing, course, speed, CPA and TCPA) for ARP or TTM targets. Note that TARGET ID NUMBER, in the ARP SETUP menu, must be turned on to display this data.

1. Place the cursor on the target whose data you want to see.
2. If not already displayed, press the [HIDE/SHOW] key to show the radar soft keys.
3. Press the TARGET and TARGET INFO soft keys. The data of the selected target appears at the bottom left-hand corner of the display. (If an EBL/VRM data box is displayed the ARP (TTM) data box will be under it.)
4. Press the RETURN soft key to finish.
5. To erase ARP/TTM target data, select the corresponding target with the cursor, then press the [CLEAR] key.



ARP target data

2.26.8 CPA/TCPA alarm (ARP)

When the predicted CPA of any target becomes smaller than a preset CPA alarm range or its predicted TCPA less than a preset TCPA alarm limit, an audio alarm sounds and the speaker icon appears (in red). In addition, the target plot symbol of the offending target changes to a triangle and flashes together with its vector. You may silence the audio alarm with the [CLEAR] key. Press the [ALARM] key and the message “COLLISION ALARM” appears. Press the CLEAR ALARM soft key to acknowledge the alarm. The flashing of the triangle plot symbol continues until you intentionally terminate tracking of the target. The ARP continuously monitors the predicted range at the Closest Point of Approach (CPA) and predicted time to CPA (TCPA) of each track to own ship.

This feature helps alert you to targets which may be on a collision course with own ship. However, it is important that gain, A/C SEA, A/C RAIN and other radar controls are properly adjusted and the ARP is set up so that it can track targets effectively.

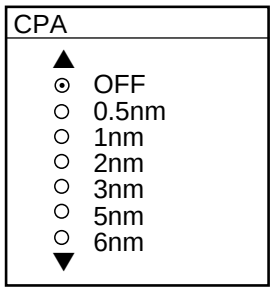
CPA/TCPA alarm ranges must be set up properly taking into consideration the size, tonnage, speed, turning performance and other characteristics of own ship.

⚠ CAUTION

The CPA/TCPA alarm should never be relied upon as the sole means for detecting the risk of collision. The navigator is not relieved of the responsibility to keep visual lookout for avoiding collisions, whether or not the radar or other plotting aid is in use.

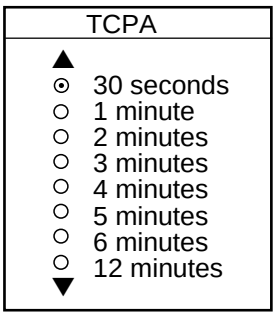
Follow the steps shown below to set the CPA/TCPA alarm range:

1. Press the [MENU] key followed by the ARP SETUP soft key.
2. Operate the trackball to select CPA.
3. Press the EDIT soft key to show the CPA window.



CPA window

4. Select a CPA limit desired from 0.5 nm, 1 nm, 2 nm, 3 nm, 5 nm and 6 nm with the trackball.
5. Press the ENTER soft key. The ARP SETUP menu reappears.
6. Operate the trackball to select TCPA.
7. Press the EDIT soft key to show the TCPA window.

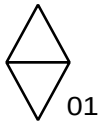


TCPA window

8. Select a TCPA limit from 30 sec, 1 min, 2 min, 3 min, 4 min, 5 min, 6 min and 12 min.
9. Press the ENTER soft key.
10. Press the [MENU] key to close the menu.

2.26.9 Lost target alarm (ARP)

When the system detects a lost target, the target symbol becomes a diamond and tracking is discontinued after one minute.



Lost target mark

Canceling a lost target

1. Place the cursor on the target.
2. Press the [CLEAR] key.

2.27 Interpreting the Radar Display

2.27.1 General

Minimum and maximum ranges

Minimum range

The minimum range is defined by the shortest distance at which, using a scale of 1.5 or 0.75 nm, a target having an echoing area of 10 m^2 is still shown separate from the point representing the antenna position. It is mainly dependent on the pulselength, antenna height, and signal processing such as main bang suppression and digital quantization. It is best to use the shortest possible range as long as the clarity and definition of the picture remain good.

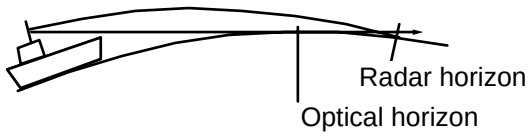
Maximum range

The maximum detecting range of the radar, Rmax, varies considerably depending on several factors such as the height of the antenna above the waterline, the height of the target above the sea, the size, shape and material of the target, and atmospheric conditions.

Under normal atmospheric conditions, the maximum range is equal to the radar horizon or a little shorter. The radar horizon is longer than the optical one by about 6% because of the diffraction property of the radar signal. Rmax is given in the following equation.

$R_{max} = 2.2 \times (\sqrt{h1} + \sqrt{h2})$

where Rmax: radar horizon (nautical miles)
h1: antenna height (m)
h2: target height (m)



Radar horizon

For example, if the height of the antenna above the waterline is 9 meters and the height of the target is 16 meters, the maximum radar range is;

$R_{max} = 2.2 \times (\sqrt{9} + \sqrt{16}) = 2.2 \times (3 + 4) = 15.4$ nm

It should be noted that the detection range is reduced by precipitation (which absorbs the radar signal).

Radar resolution

There are two important factors in radar resolution (discrimination): bearing resolution and range resolution.

Bearing resolution

Bearing resolution is the ability of the radar to display the echoes received from two targets, which are at the same range and close together, as separate targets. Bearing resolution is directly proportional to the antenna length, and inversely proportional to the radar's wavelength.

Range resolution

Range resolution is the ability to display the echoes received from two targets, which are on the same bearing and close to each other, as separate targets.

Bearing accuracy

One of the most important features of the radar is how accurately the bearing of a target can be measured. The accuracy of bearing measurement basically depends on the narrowness of the radar beam. However, the bearing is usually taken relative to the ship’s heading, and thus, proper adjustment of the heading marker at installation is an important factor in ensuring bearing accuracy. To minimize error when measuring the bearing of a target, select a range which will put the target as far out to the edge of the radar screen as possible.

Range measurement

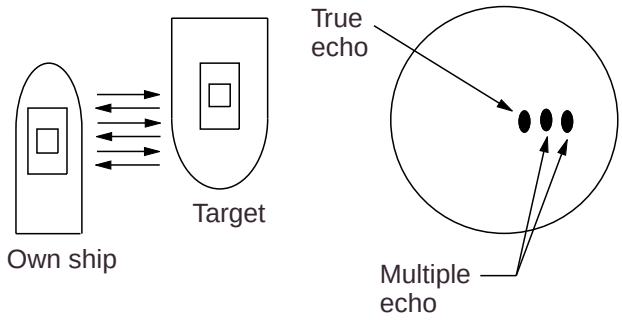
Measurement of the range to a target is also a very important function of the radar. There are three means of measuring range: the fixed range rings, the trackball and the variable range marker (VRM). The fixed range rings appear on the screen with a predetermined interval and provide a rough estimate of the range to a target. The trackball is rolled to place the cursor on the leading edge of the target. Range and bearing to the target is shown at the bottom right-hand corner of the display. The variable range marker’s diameter is increased or decreased so that the marker touches the inner edge of the target, allowing the operator to obtain more accurate range measurements.

2.27.2 False echoes

Occasionally echo signals appear on the screen at positions where there is no target or disappear even if there are targets. False target situations may be recognized, however, if you understand why they are displayed. Typical false echoes are shown below.

Multiple echoes

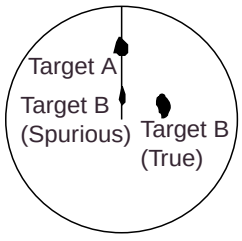
Multiple echoes occur when a transmitted pulse returns from a solid object like a large ship, bridge, or breakwater. A second, a third or more echoes may be observed on the display at double, triple or other multiples of the actual range of the target as shown below. Multiple reflection echoes can be reduced and often removed by decreasing the gain (sensitivity) or properly adjusting the [A/C SEA] control.



Multiple echoes

Sidelobe echoes

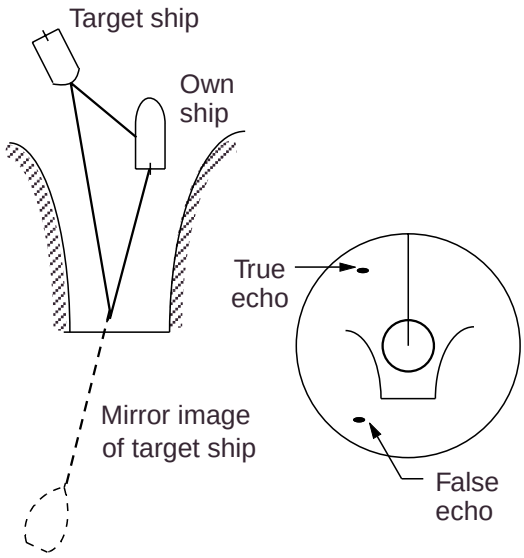
Every time the radar pulse is transmitted, some radiation escapes on each side of the beam. This stray RF is called a “sidelobe.” If a target exists where it can be detected by the sidelobes as well as the main lobe, the side echoes may be represented on both sides of the true echo at the same range. Sidelobes show usually only on short ranges and from strong targets. They can be reduced through careful reduction of the gain or proper adjustment of the A/C SEA control.



Sidelobe echoes

Virtual image

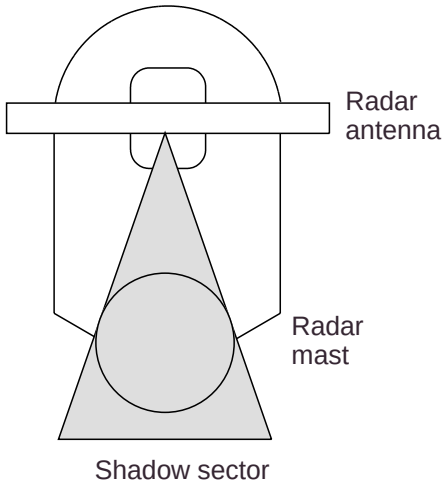
A relatively large target close to your ship may show at two positions on the screen. One of them is the true echo directly reflected by the target and the other is a false echo which is caused by the mirror effect of a large object on or close to your ship as shown in the figure below. If your ship comes close to a large metal bridge, for example, such a false echo may temporarily be seen on the screen.



Virtual image

Shadow sectors

Funnels, stacks, masts, or derricks in the path of the antenna block the radar beam. If the angle subtended at the antenna is more than a few degrees, a non-detecting sector or blind spot may be produced. Within this sector, targets can not be detected.

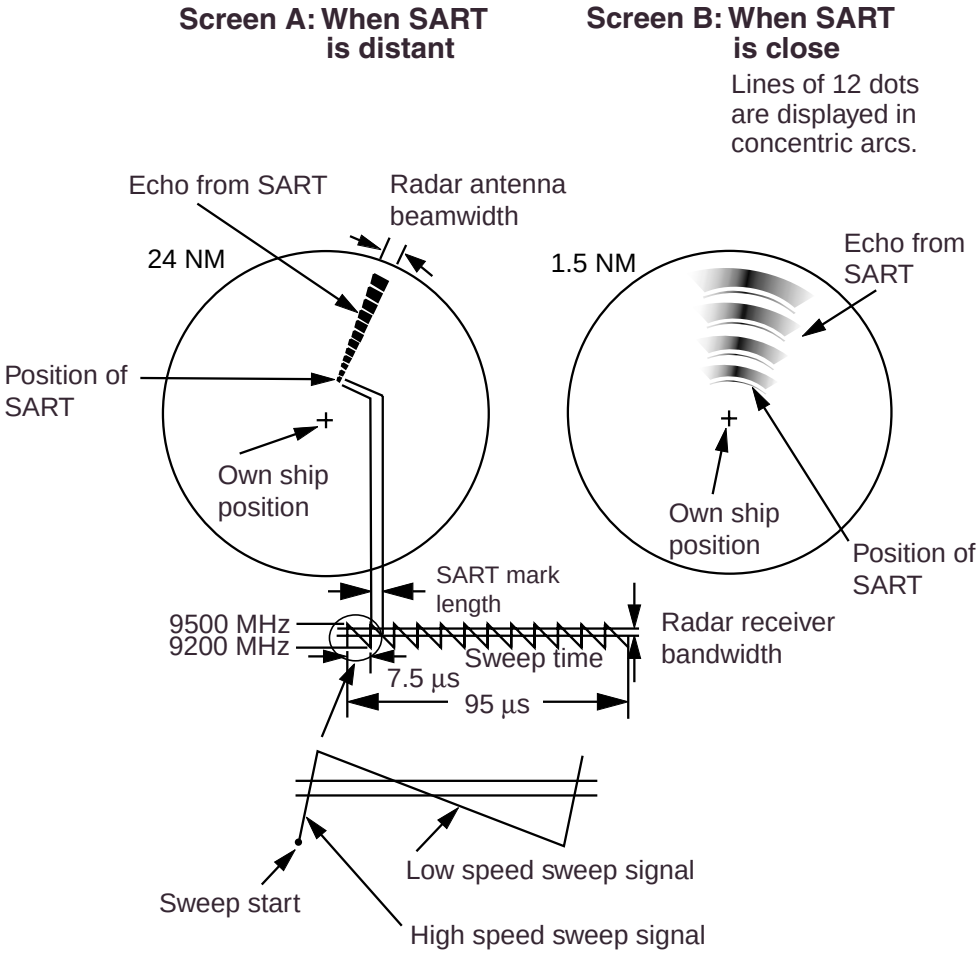


Shadow sectors

2.27.3 SART (Search and Rescue Transponder)

A Search and Rescue Transponder (SART) may be triggered by any X-Band (3 cm) radar within a range of approximately 8 nm. Each radar pulse received causes it to transmit a response which is swept repetitively across the complete radar frequency band. When interrogated, it first sweeps rapidly (0.4 μs) through the band before beginning a relatively slow sweep (7.5 μs) through the band back to the starting frequency. This process is repeated for a total of twelve complete cycles. At some point in each sweep, the SART frequency will match that of the interrogating radar and be within the pass band of the radar receiver. If the SART is within range, the frequency match during each of the 12 slow sweeps will produce a response on the radar display, thus a line of 12 dots equally spaced by about 0.64 nautical miles will be shown.

When the range to the SART is reduced to about 1 nm, the radar display may show also the 12 responses generated during the fast sweeps. These additional dot responses, which also are equally spaced by 0.64 nm, will be interspersed with the original line of 12 dots. They will appear slightly weaker and smaller than the original dots.



Appearance of SART signal on the radar display

General procedure for detecting SART response

1. Use the range scale of 6 or 12 nm as the spacing between the SART responses is about 0.6 nm (1125 m) to distinguish the SART.
2. Turn off the automatic clutter suppression (if applicable).
3. Turn off the Interference Rejector.

General remarks on receiving SART

SART range errors

When responses from only the 12 low frequency sweeps are visible (when the SART is at a range greater than about 1 nm), the position at which the first dot is displayed may be as much as 0.64 nm beyond the true position of the SART. When the range closes so that the fast sweep responses are seen also, the first of these will be no more than 150 meters beyond the true position.

Radar bandwidth

This is normally matched to the radar pulselength and is usually switched with the range scale and the associated pulselength. Narrow bandwidths of 3-5 MHz are used with long pulses on long range and wide bandwidths of 10-25 MHz with short pulses on short ranges.

Any radar bandwidth of less than 5 MHz will attenuate the SART signal slightly, so it is preferable to use a medium bandwidth to ensure optimum detection of the SART.

Radar sidelobes

As the SART is approached, sidelobes from the radar antenna may show the SART responses as a series of arcs or concentric rings. These can be removed by the use of the [A/C SEA] control although it may be operationally useful to observe the sidelobes as they may be easier to detect in clutter conditions and also they will confirm that the SART is near to the ship.

Gain

For maximum range SART detection the normal gain setting for long range detection should be used, that is, with background noise speckle visible.

A/C SEA control

For optimum range SART detection, this control should be set to the minimum. Care should be exercised as wanted target in sea clutter may be obscured. Note also that in clutter conditions the first few dots of the SART response may not be detectable, irrespective of the setting of the anti-clutter sea control. In this case, the position of the SART may be estimated by measuring 9.5 nm from the furthest dot back towards own ship.

Some sets have automatic/manual anti-clutter sea control facilities in which case the operator should switch to manual.

A/C RAIN control

This should be used normally (to break up areas of rain) when trying to detect a SART response which, being a series of dots, is not affected by the action of the anti-clutter rain circuitry. Note that racon responses, which are often in the form of a long flash, will be affected by the use of this control.

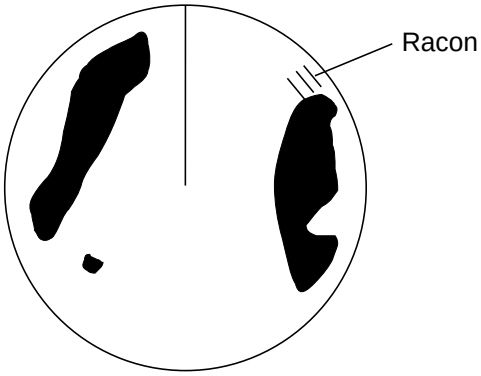
Some sets have automatic/manual anti-clutter rain control facilities in which case the operator should switch to manual.

Note: This SART information is excerpted from IMO SN/Circ 197 Operation of Marine Radar for SART Detection.

2.27.4 Racon (Radar Beacon)

A racon is a radar transponder which emits a characteristic signal when triggered by a ship's radar (usually only the 3 centimeter band). The signal may be emitted on the same frequency as that of the triggering radar, in which case it is superimposed on the ship's radar display automatically.

The racon signal appears on the PPI as a radial line originating at a point just beyond the position of the radar beacon or as a Morse code signal (see figure below) displayed radially from just beyond the beacon.



Appearance of racon signal on the radar display