FURUNO

OPERATOR'S MANUAL

MARINE RADAR

MODEL1722/1732/1742/1752/1762
MODEL MODEL1722C/1732C/1742C/1752C/1762C

NAVnet

FURUNO ELECTRIC CO., LTD.
NISHINOMIYA, JAPAN

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PUB.No. OME-3494

(DAMI) MODEL1722/C SER.

Your Local Agent/Dealer

FIRST EDITION : APR. 2001

E   : DEC. 07,2001

00080918200

OME34940E00

⚠ SAFETY INSTRUCTIONS

⚠ WARNING

**ELECTRICAL SHOCK HAZARD
Do not open the equipment.**

Only qualified personnel should work inside the equipment.

Do not disassemble or modify the equipment.

Fire, electrical shock or serious injury can result.

Immediately turn off the power at the switchboard if the equipment is emitting smoke or fire.

Continued use of the equipment can cause fire or electrical shock. Contact a FURUNO agent for service.

Keep heater away from equipment.

A heater can melt the equipment's power cord, which can cause fire or electrical shock.

Use the proper fuse.

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

⚠ 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 about replacement.

⚠ WARNING ⚠
To avoid electrical shock, do not remove cover. No user-serviceable parts inside.
⚠   ⚠
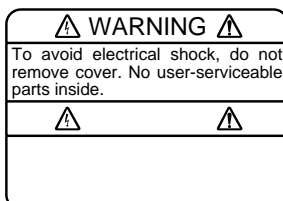
Name: Warning Label (1)
Type: 86-003-1011-0
Code No.: 100-236-230

⚠ 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 trans-mitting 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
1722	Nil	Worst case 0.50 m
1732	Nil	Worst case 0.50 m
1742	Nil	Worst case 1.00 m
1752	0.15 m	Worst case 2.00 m
1762	0.20 m	Worst case 3.00 m

⚠ CAUTION

No one navigation device should ever be solely replied upon for the navigation of a vessel.

Always confirm position against all available aids to navigation, for safety of vessel and crew.

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FOREWORD

A Word to the Owner of the MODEL1722/1722C Series Marine Radar

FURUNO Electric Company thanks you for purchasing the MODEL1722/1722C Series Marine Radar. 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 radar is designed and constructed to meet the rigorous demands of the marine environment. However, no machine can perform its intended function unless properly installed and maintained. Please carefully read and follow the 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.

Features

The MODEL1722/1722C series 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 10 Base-T network.

The main features are

- Bright 7" screen visible even under direct sunlight.
- User friendly operation with combination of discrete keys, soft keys and cursor pad.
- Accepts FURUNO and Nav-charts™ (NAVIONICS) or C-MAP charts.
- Fast chart redraw.
- Built-in NavNet interface circuit board.
- 12-channel GPS Receiver GP-310B with highly accurate position fixing optionally available.
- User programmable function keys.
- Video sounder picture available with connection to optional network sounder.
- ARP function (when connecting with MODEL1833/1833C series)

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 display units and one ETR. For a
system incorporating three or more products, a "hub" is required to process data.

Single unit NavNet system

Antenna Unit
(ex. MODEL 1722/1722C)

GPS receiver
GP-310B

E/S
Navigator

Display Unit
RDP-130 (monochrome)
RDP-131 (color)

External buzzer
PC
Echo sounder

Remote
Controller
RMC-100

Heading
sensor

Other NavNet unit
(GD-1700 etc.)

Network sounder
ETR-6/10N

Rectifier*
PR-62
RU-3423

12-24 VDC

Ship's mains
100/110/220/230 VAC
1φ, 50/60 Hz

*PR-62: MODEL1722/1722C/1732/1732C
 RU-3423: MODEL1742/1742C/1762/1762C
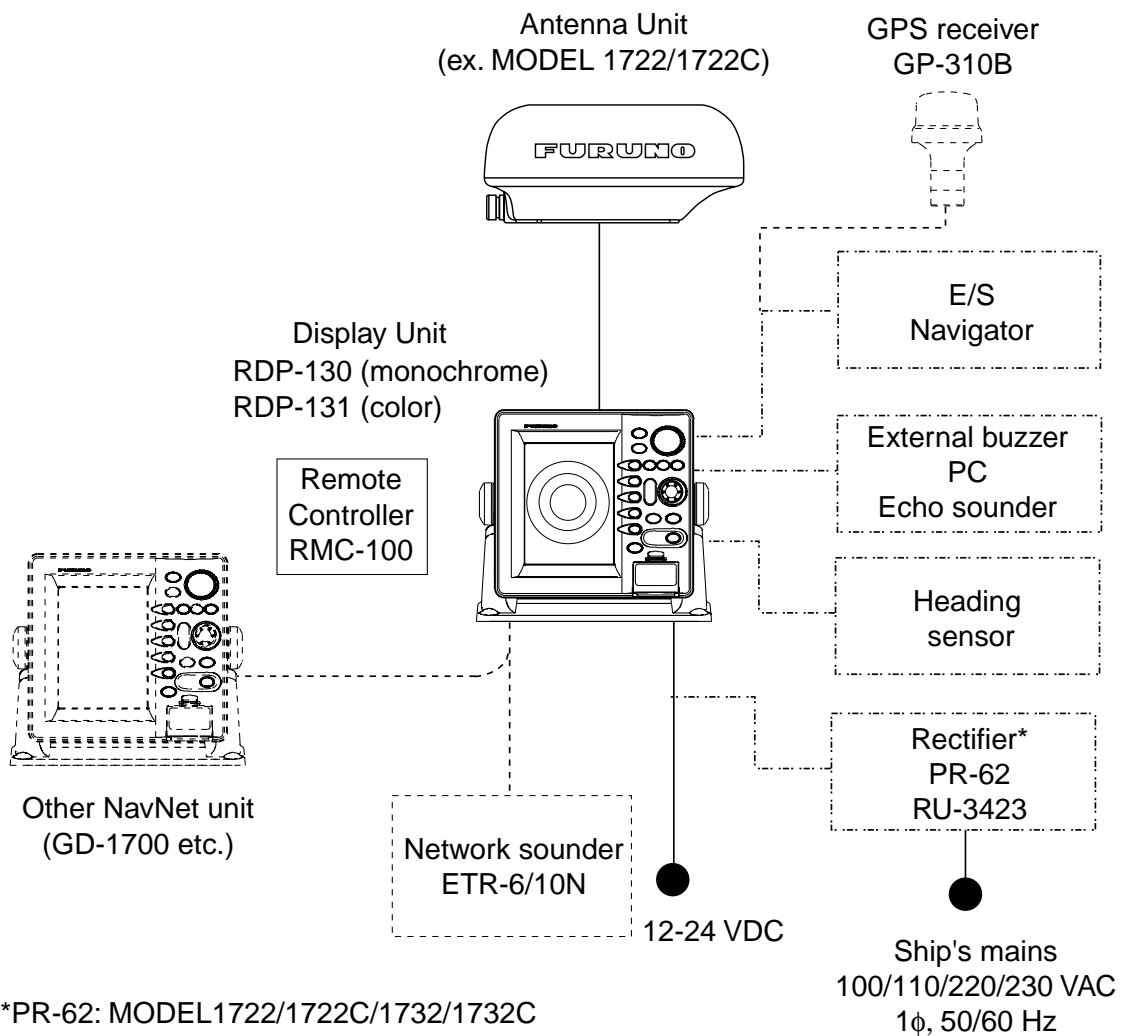
Single-unit NavNet system

Two-unit NavNet system
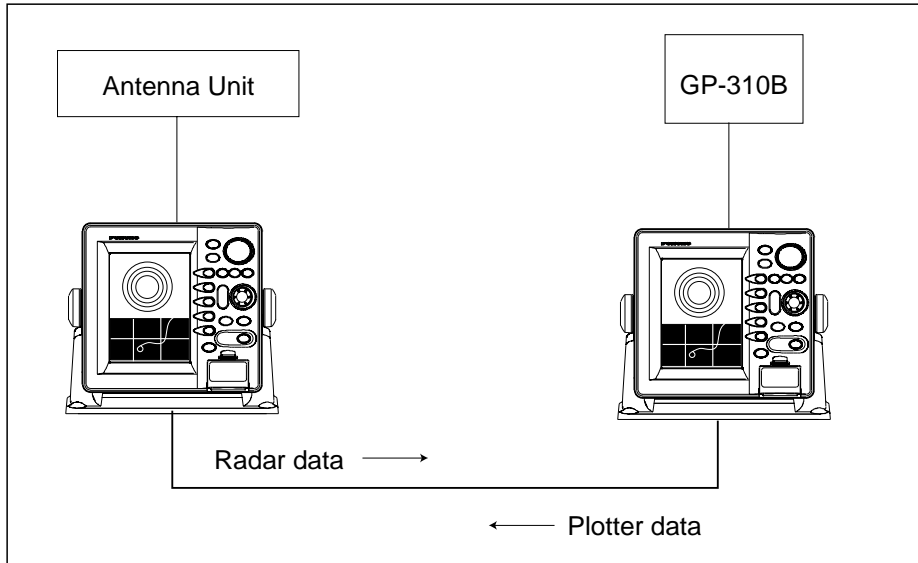
Two-unit NavNet system

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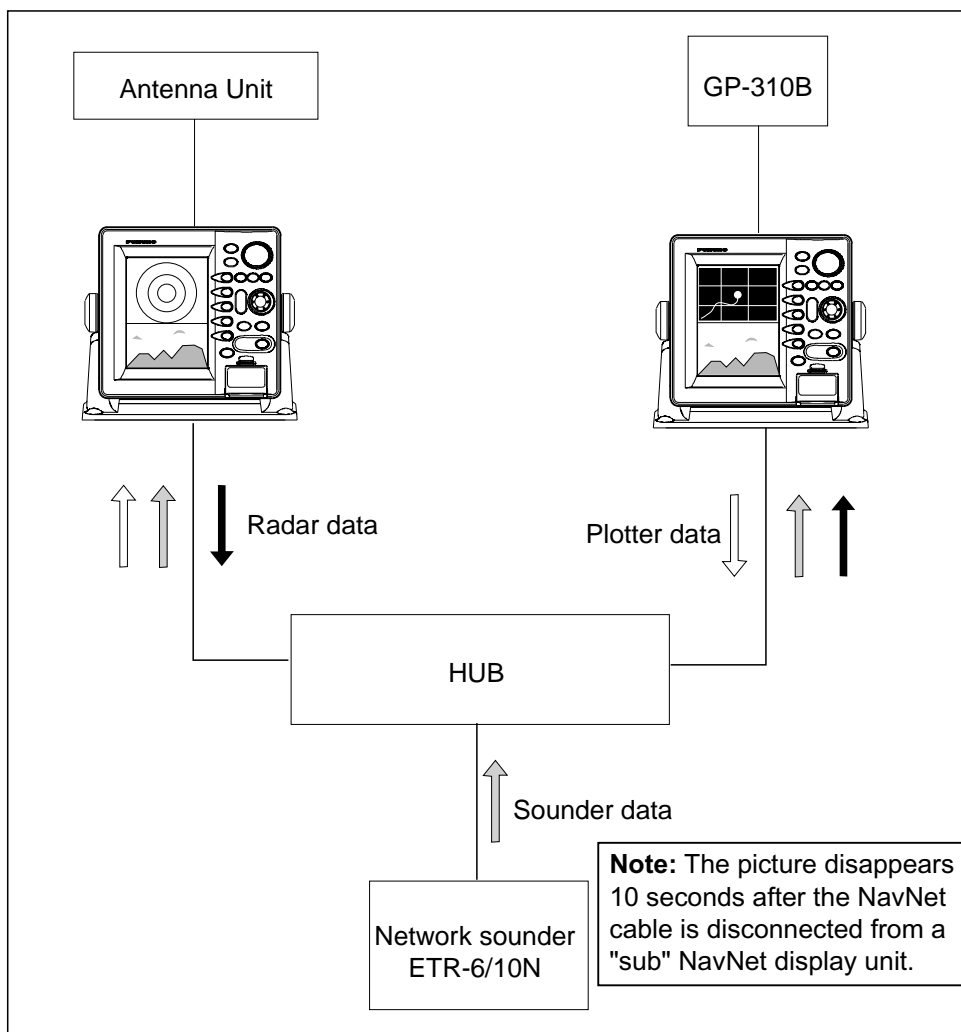
Three-or more unit NavNet system

1. OPERATIONAL OVERVIEW

This chapter provides basic information needed to get you started using your radar. The follow topics are presented:

- Control overview
- Chart card insertion
- Power on/off
- Contrast, brilliance and hue (Color series only) adjustments
- Display selection
- 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.

1.1 Operating Controls

1.1.1 Display unit controls

Overview of display unit controls

The radar systems are mainly operated with controls of the display unit (and 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 enter alphanumeric data. The cursor pad's main function is to move the cursor across the screen. Whenever you operate a key, a single beep confirms operation. Invalid operation causes the unit to emit three beeps.

Selects display mode.

Momentary press: Registers own ship's position as a waypoint.
Press three seconds: Marks man overboard position.

Soft keys

Shows or hides the soft keys, function keys, nav data alternately.

Cursor pad
Selects menu items and options; shifts cursor. Press, release and press again to change setting consecutively.

Opens/closes the alarm menu.
Clears data; erases selected mark.
Opens/closes the main menu.

Selects a range.

ENTER knob
Push: Registers options on menus.
Rotate: Selects character; adjusts sensitivity (sounder, radar); chooses menu items and options.
Displays the soft keys for EBL/VRM.
Radar: Displays the soft keys for adjustment of gain, A/C SEA, A/C RAIN and FTC.
Sounder: Adjusts gain.

Long press: Turns power on/off.
Momentary press: Opens the display for adjustment of brilliance, etc. For radar, switches STBY and TX.

Chart slot

Control panel

Soft keys

The five soft keys' functions change 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).
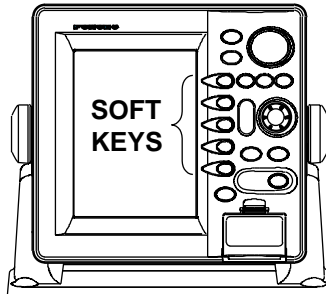
Display unit

Some soft keys show the current state of the soft key function in reverse video as shown below.
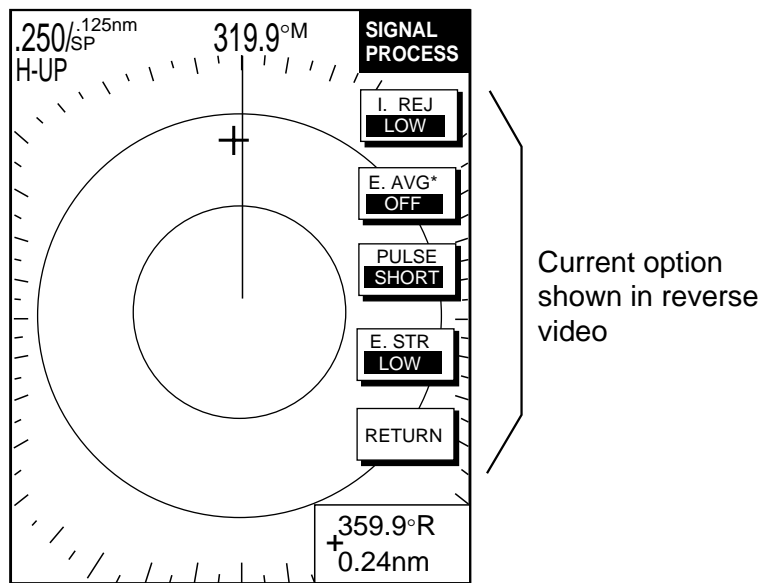
*: Only when MODEL 1833/C series are used as radar source.

Plotter display

[ENTER] knob

The [ENTER] knob functions to

- Register data
- Enter alphanumeric data such as waypoint name
- Select menu items and options
- Adjust setting

Clockwise rotation of the knob selects an alphabet, symbol or numeric, in one of the sequences shown below. After you have selected desired alphanumeric character push the [ENTER] knob to register your selection.
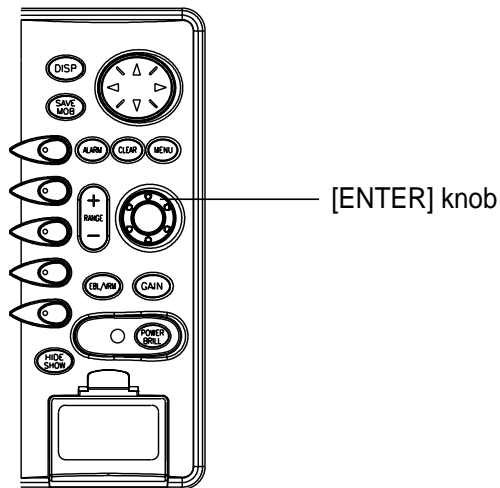
ENTER knob

Alphabet, symbol, numeric

A ⇆ B ⇆ C ⇆ D ⇆ E ⇆ F ⇆ G ⇆ H ⇆ I ⇆ J ⇆ K ⇆ L ⇆ M ⇆ N ⇆ O ⇆ P ⇆ Q ⇆
R ⇆ S ⇆ T ⇆ U ⇆ V ⇆ W ⇆ X ⇆ Y ⇆ Z ⇆ & ⇆ _ ⇆ ' ⇆ # ⇆ 0 ⇆ 1 ⇆ 2 ⇆ 3 ⇆
4 ⇆ 5 ⇆ 6 ⇆ 7 ⇆ 8 ⇆ 9

Numerics

0 ⇆ 1 ⇆ 2 ⇆ 3 ⇆ 4 ⇆ 5 ⇆ 6 ⇆ 7 ⇆ 8 ⇆ 9

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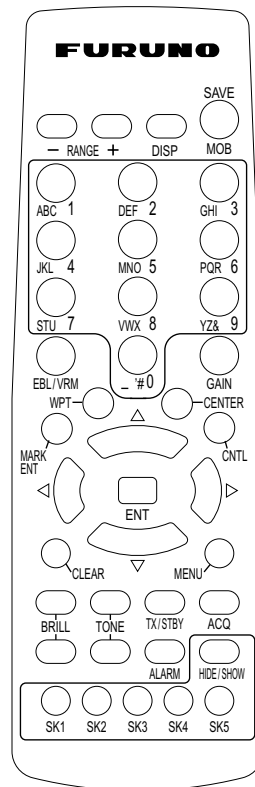
Operating distance
90°: Up to 5 m
±45°: Up to 3 m

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.

Remote controller

Key	Function	Key	Function
RANGE	Same as RANGE key on display unit.	CLEAR	Same as CLEAR key on display unit.
DISP	Same as DISP key on display unit.	MENU	Same as MENU key on display unit.
SAVE MOB	Same as SAVE MOB key on display unit.	BRILL	Adjusts display brilliance.
Ten keys	Enter alphanumerics.	TONE	Adjusts display contrast.
EBL/VRM	Same as EBL/VRM key on display unit.	TX/STBY	Toggles radar between standby and transmit.
GAIN	Same as GAIN key on display unit.	ACQ	Acquires radar target. (Requires radar source equipped with ARP.)
WPT	Displays "alphabet" WPT list on plotter display.	ALARM	Same as ALARM key on the display unit.
MARK ENT	Same as MARK ENTRY soft key.	HIDE/SHOW	Same as HIDE/SHOW key on display unit.
CENTER	Returns own ship to screen center on plotter display.	SK1 – SK5 (soft keys)	Same as soft keys on display unit.
CNTL	Switches control between displays on combination displays.	ENT	Same as ENTER knob on display unit.

1.2   Inserting a Chart Card

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

1. Open the chart card slot lid.
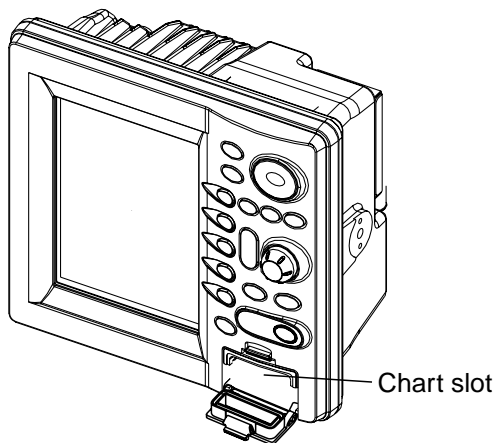
Display unit

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

Note 1: Do not insert or remove the chart card while turning power on. This may cause the equipment to freeze.

Note 2: Do not remove a card while the chart is being drawn. This may cause the equipment to freeze.

Note 3: A card remover is supplied to ease removal of chart cards. Attach the card remover to the right-hand side hole on the card and pull to remove card. You can leave the card remover attached to the card while the card is in the card slot - push the card remover leftward until it contacts the recessed area in the card.

Note 4: For multiple display units, do not use the same chart card type in more than one display unit.
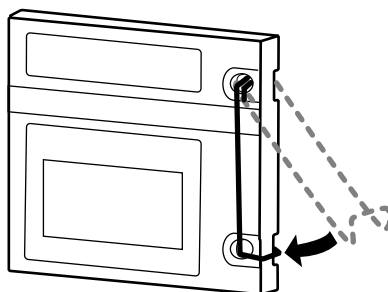
Chart card and card remover

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 the product information screen, startup test results and the chart usage disclaimer, in that order. 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 referring to the paragraph "7.6 Diagnostics."

Chart List
Host Name

** = Program version no.
(Two program version numbers.
One for NAVIO and one for C-MAP.)

RADAR PLOTTER

STATION NAME:
   RADAR
FURUNO ELECTRIC CO., LTD.
CHARTS AVAILABLE
FLYBRDG = ANB01004
RADAR   = ANB01003

STARTUP TEST	
ROM	OK
RAM	OK
INTERNAL BATTERY	OK
BACKUP DATA	OK

NO NATIONAL HYDROGRAPHIC OFFICE HAS VERIFIED THE INFORMATION IN THIS COASTLINE DATA CARD AND NONE ACCEPT LIABILITY FOR THE ACCURACY OF REPRODUCTION OR ANY MODIFICATIONS MADE THEREAFTER. THIS PRODUCT WITH THIS COASTLINE DATA CARD DOES NOT REPLACE THE REQUIREMENT TO USE THE APPROPRIATE PRODUCTS FOR NAVIGATION ACCORDING TO NATIONAL AND INTERNATIONAL REGULATIONS.

PROGRAM No. 03591730**

Product information   Startup test   Chart disclaimer

The magnetron in the antenna unit takes about one minutes and thirty seconds to warm up before the radar can be operated. The time remaining for warm up of the magnetron appears at the center of the display, counting down from 1:30 to 0:01.
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: You are asked if you want to start the simulation mode, which provides simulated operation of the equipment, the first time you turn on the power (or any time power is applied after a memory reset) the message shown below is displayed. 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 "1.8 Simulation Display."

START
SIMULATION MODE?
YES ... PUSH ENTER KNOB
NO   ... PUSH CLEAR KEY
         TO SKIP.

1.4   Cursor Pad, Cursor

The cursor pad mainly functions to shift the cursor, for measurement of range and bearing to a location (radar) and latitude and longitude position (plotter). Operate the cursor pad to shift the cursor. The cursor moves in the direction of the arrow or diagonal pressed, on the cursor pad.

For the plotter display, the cursor can be turned off with the CENTER soft key. This also returns own ship marker to the screen center.
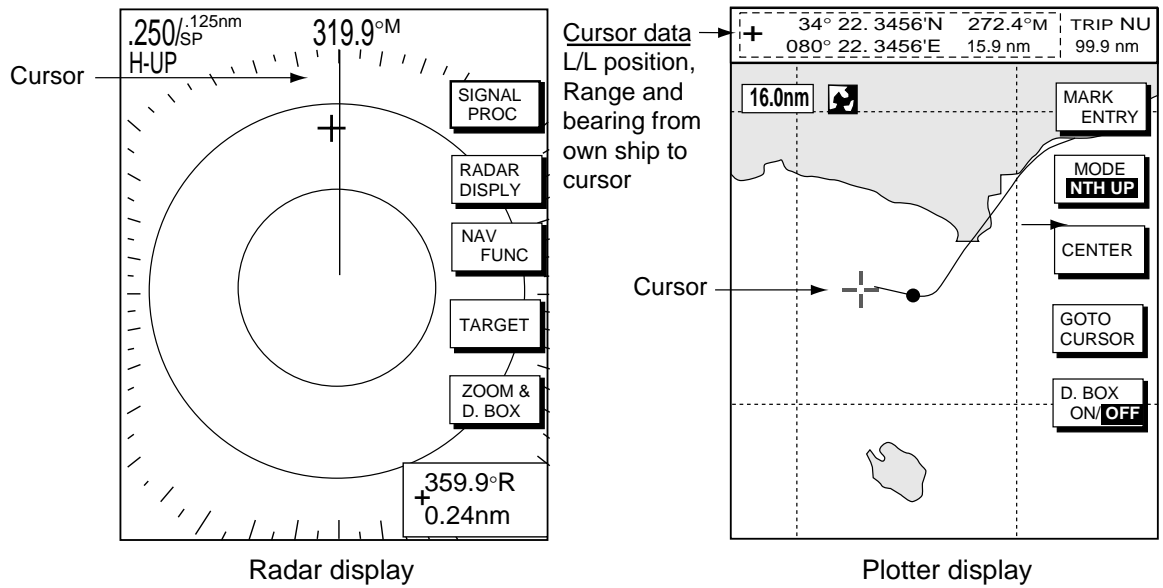
Cursor, cursor data

1.5 Display Brilliance, Panel Brilliance, Contrast, Hue

You can adjust display brilliance, panel brilliance, contrast and hue (MODEL1722C series only) as shown below.

1.5.1 Display brilliance, panel brilliance

1. Press the [POWER/BRILL] key momentarily. A set of soft keys for adjustment of brilliance, contrast and hue (MODEL1722C series only) appear. The last-used adjustment window appears. In the example below the display brilliance adjustment window is shown.
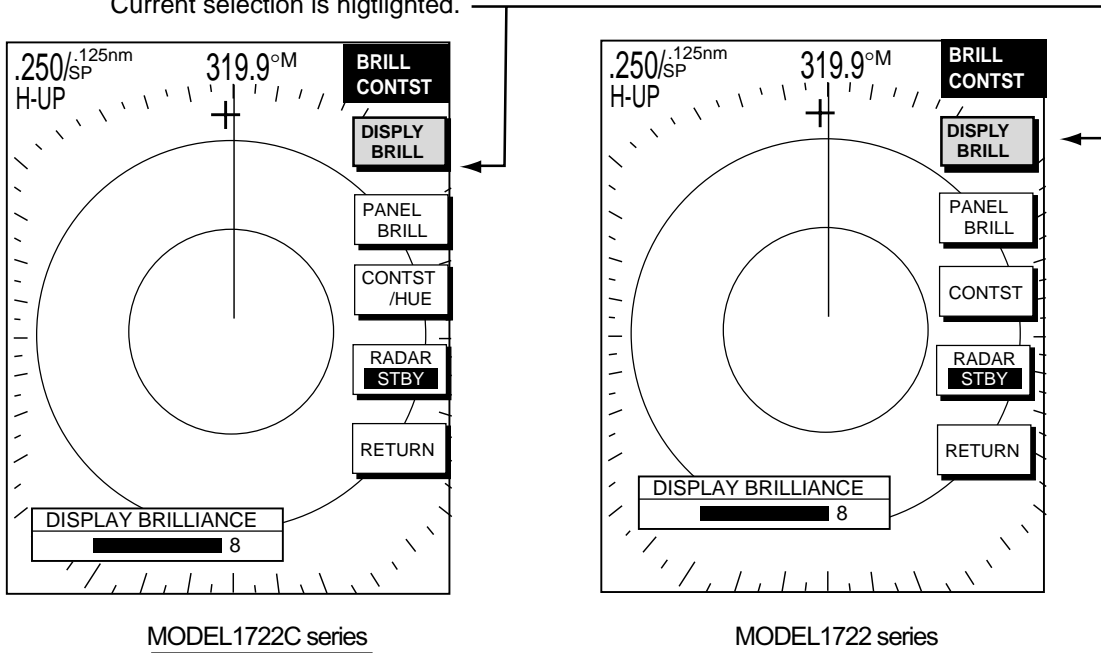
MODEL1722C series   MODEL1722 series

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   Panel brilliance

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, in which case the item selected is adjusted cyclically, from low to high. Eight levels of display brilliance and panel brilliance are available.
4. Hit the RETURN soft key to finish.

   The display brilliance can be adjusted by pressing the [POWER/BRILL] key. If the unit is turned on with minimum display brilliance, press the [POWER/BRILL] key consecutively to adjust the brilliance.

1.5.2   Contrast

1. Press the [POWER/BRILL] key momentarily.
2. Press the CONTST (monochrome) or CONTST/HUE (color) soft key.
3. **For MODEL1722C series,** two soft keys appear at the pressing of the CONTST/HUE soft key: CONTST and HUE. Press the CONTST soft key to adjust the contrast.

```
┌──────────────────────────────┐
│           CONTRAST            │
│  ██████████████████ 8         │
└──────────────────────────────┘
```

Contrast window

4. Adjust the [ENTER] knob, clockwise to raise the setting or counterclockwise to decrease it. You may also use the CONTST soft key, in which case the item selected is adjusted cyclically, from low to high. 16 levels (monochrome) and 10 levels (color) of contrast are available.
5. Press the RETURN soft key to finish.

1.5.3   Hue (MODEL1722C series)

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

```
┌──────────────────────────────┐
│ HUE                          │
├──────────────────────────────┤
│ ▲                            │
│ ○ DAY                        │
│ ○ NIGHT                      │
│ ○ TWILIGHT                   │
│ ◉ MANUAL SET                 │
│ ▼                            │
└──────────────────────────────┘
```
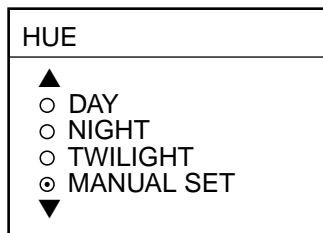
Hue window

4. Operate the cursor pad or [ENTER] knob to select hue desired, referring to the table below. MANUAL SET follows the color settings on the RADAR DISPLAY SETUP for the radar, CHART DETAILS menu for the plotter and SOUNDER MENU for the sounder.

	Day	Night	Twilight	Applicable mode
Characters	Black	Red	Green	Plotter, radar, sounder
Radar ring	Green*	Red	Green*	Radar
Radar echo	Orange	Red	Yellow	Radar
Background	White	Black	Blue	Plotter, radar
Landmass	Yellow	Light Yellow	Dim Yellow	Radar

*: Red on C-map

5. 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" 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.

1.6   Selecting a Display

1.6.1   Display modes

If you have a navigator and network sounder connected, four full-screen displays are available: radar, plotter, and video sounder and navigation data. (MODEL1722C series have five screens, those mentioned above plus the overlay screen.) In addition to the full-screen display, you can divide the screen into half-screen combination displays to show two sets of images (data).
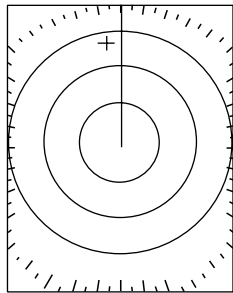
Full screen
(Ex. radar)
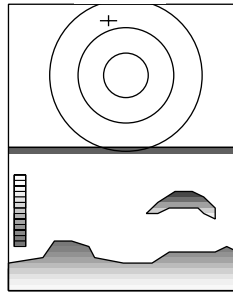
Combination screen
(Ex. radar + sounder)
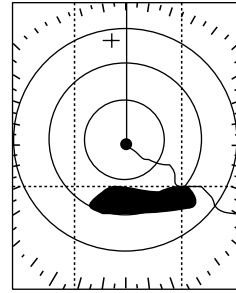
Overlay screen
(Radar and plotter,
color model only.
Requires L/L data)

Display screens

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

Screen type and available display screen

Full screen	Combination screen options	Overlay screen options (Color series only)
Radar, plotter, sounder, nav data	Radar, plotter, echo sounder, compass, highway, compass/highway, nav data, overlay	Radar + plotter

1.6.2   Selecting a display

1. Press the [DISP] key to show the full-screen selection window. The icons of modes not available are marked with "X" mark. PAGE1-PAGE5 are user-arrangeable displays called "hot pages," which you can configure as you like. For further details, see "5.5 Hot Page Setup."
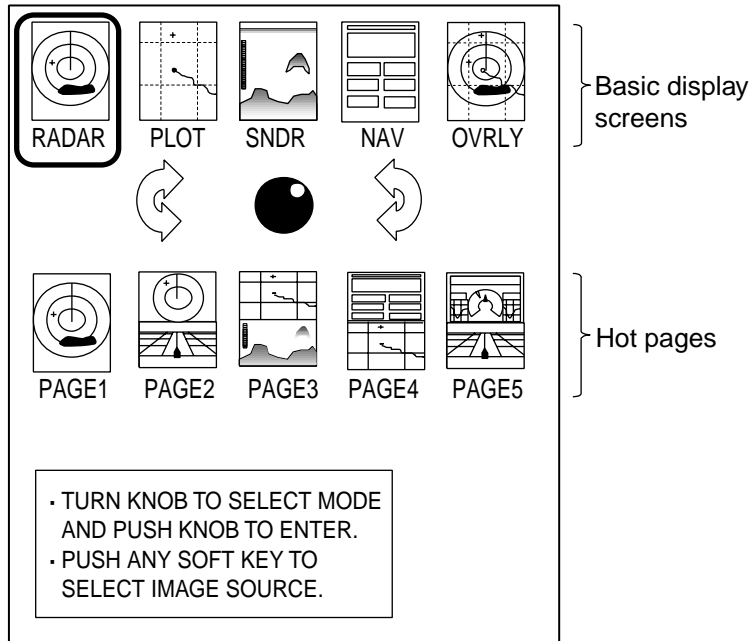
Full-screen selection window ("overlay" for color model)

2. Rotate the [ENTER] knob to select a basic display screen or a hot page screen.
3. Push the [ENTER] knob. If you selected a basic display screen, a set of combination display screens corresponding to the basic display screen that was selected appear. In the example below, radar combination displays are shown.
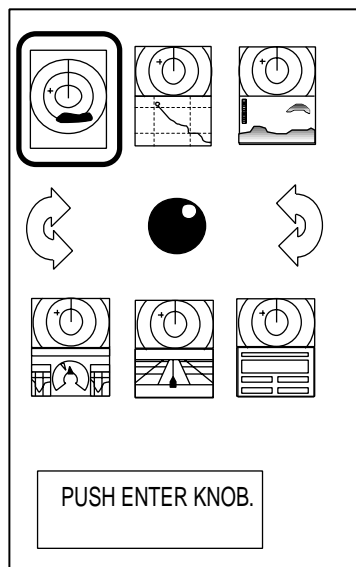
Radar combination screen selection window

4. Operate the [ENTER] knob to select the combination screen display desired and push it to set.

1.6.3   Switching control in combination and overlay screens

A soft key is provided in relevant combination and overlay screens (color series only) to switch control between displays. In the example below, the RADAR CNTRL and PLOTTR CNTRL soft keys enable switching control between the radar and plotter screens in the plotter/radar combination display.

Radar display selected   Plotter display selected
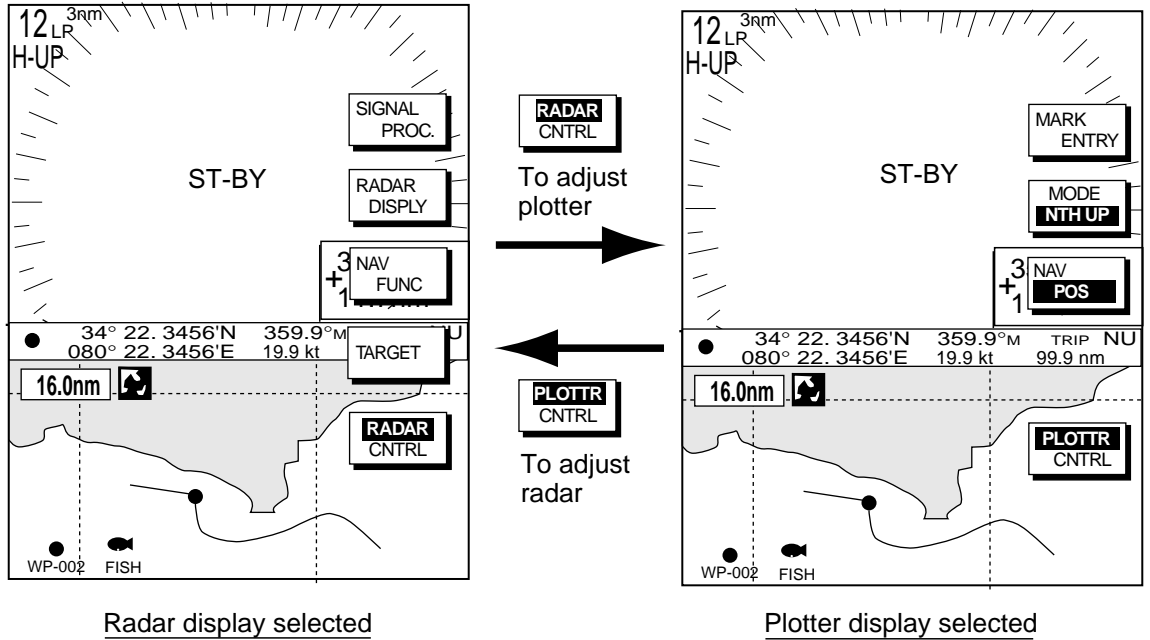
How to switch control between modes in the plotter/radar combination display

1.6.4 Selecting radar source

When other network radar is connected to the equipment, you may select an image source as shown below. This is not necessary when no other network radar is connected. Select one host name for the source though there are two or three radar units on the net.

Note: Turn the power off whenever changing the source.

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

```
                          SELECT
                          SOURCE
 ▶ RADAR  SOURCE
      RADAR - - -
   SOUNDER SOURCE*         EDIT
      SOUNDER.


   IP ADDRESS
      172.031.003.001
   HOST NAME
      RADAR - - -


 IF THERE IS MORE THAN
 ONE NETWORK RADAR OR
 ECHO SOUNDER, YOU MAY     RETURN
 SELECT THE IMAGE
 SOURCES FOR DISPLAY.
```
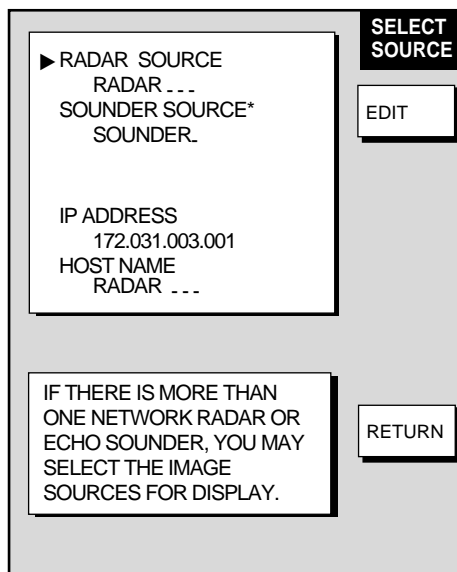
*: Do not change this setting.

Select source menu

3. Use the cursor pad to select RADAR SOURCE and press the EDIT key.

```
 RADAR SOURCE

 RADAR - - -
```
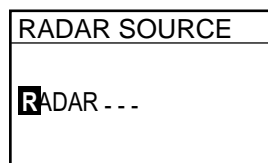
Radar source

Radar source and sounder source windows

4. Use the cursor pad and [ENTER] knob to enter source host name: ◀ or ▶ to select position and rotate the [ENTER] knob to select character.
5. Press the [ENTER] soft key or [ENTER] knob.
6. Confirm that the correct host name is entered.
7. Press the [DISP] key to finish.
8. Turn the power off and on again.

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

1.7 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, trip log and cursor position. 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 (radar, plotter, sounder). For how to select data for the data boxes, see paragraph "5.5 Data Boxes Setup".
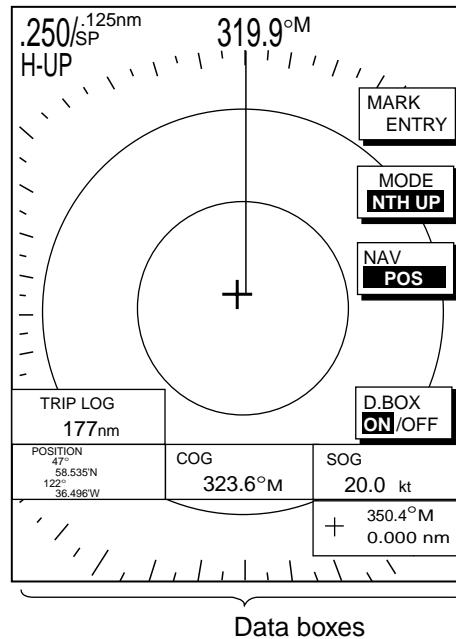
Plotter display, showing data boxes

1.7.1 Showing, hiding data boxes with soft key

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

1.7.2 Rearranging data boxes

You may select the location for data boxes as follows:

1. Using the cursor pad, move the cursor to 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 cursor pad to drag the data box to the location desired and push the [ENTER] knob.

1.7.3 Temporarily erasing a data box

You may temporarily erase a data box. Use the cursor pad to place the cursor inside the data box you wish to erase and press the [CLEAR] key. To redisplay the box, press the ZOOM & D.BOX soft key D.BOX soft key to display it.

1.8   Function Keys

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

Function Key	Default Setting, Key Label		
	Radar	Plotter	Echosounder
#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

1.8.1   Executing a function

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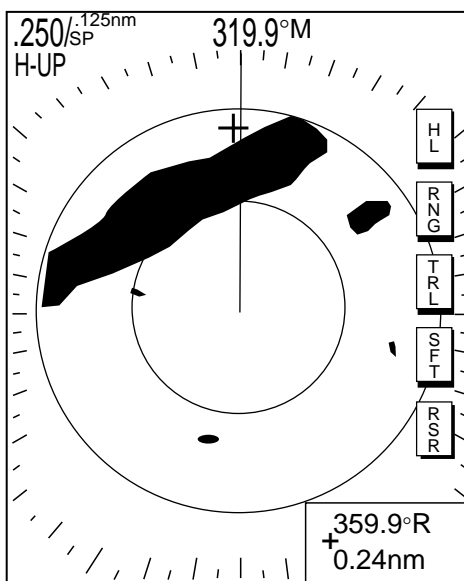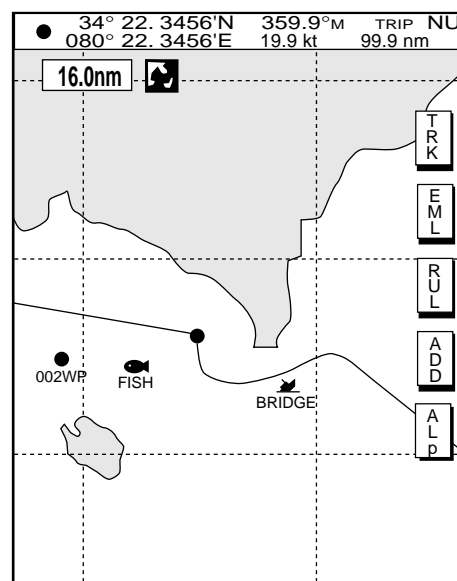
Function keys

2. Press function key desired.

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

Radar: paragraph 5.2.3
Plotter: paragraph 5.3.2

1.9   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 ($\boxed{S_{|M}}$) 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.

```
                                          SIM
                                          SETUP
       ► RADAR
            LIVE
         PLOTTER
            LIVE                          EDIT
         SOUNDER
            LIVE
         SPEED
            00.0kt
         COURSE
            000.0°
         LATITUDE
            45°35.000'N
         LONGITUDE
            123°00.000'W
         START DATE & TIME
            00:00 01.APR.01
         RADAR SIMULATION DATA            RETURN
            NO
```
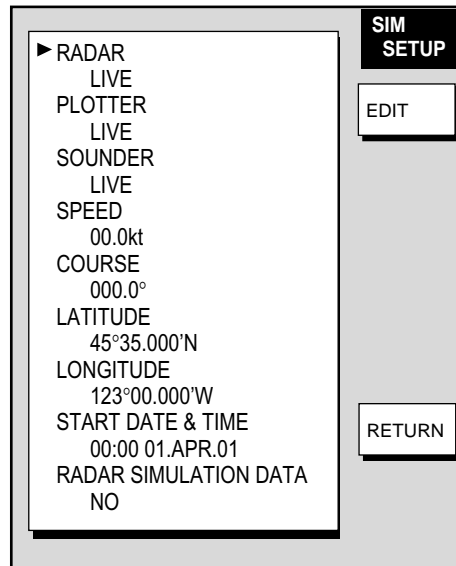
Simulation setup menu

2.   Follow appropriate procedure shown below.

Radar

Internally generated echoes

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

```
       RADAR

       ▲
       ○ SIMULATION 1
       ○ SIMULATION  2
       ⊙ LIVE
       ▼
```
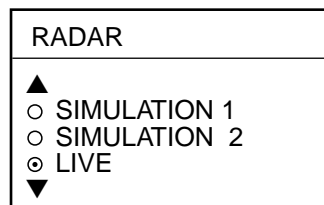
2.   Select SIMULATION 1 and press the [ENTER] knob.
3.   Press the [MENU] key to close the menu.

Antenna unit-generated echoes

1. Select RADAR SIMULATION DATA, then press the EDIT soft key.
2. Select YES and 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. Wait one minute after the message disappears. Actual time may be longer depending on the system configuration. 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 press the [ENTER] knob.
5. Press the [MENU] key to close the menu.

Plotter

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

```
┌─────────────────────────┐
│ PLOTTER                 │
│                         │
│ ▲                       │
│ ○ SIMULATION            │
│ ⊙ LIVE                  │
│ ▼                       │
└─────────────────────────┘
```
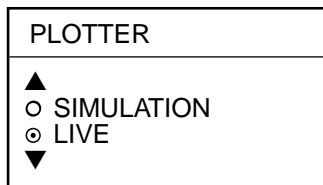
2. Select SIMULATION, then press the [ENTER] knob.
3. Select SPEED and press the EDIT soft key.
4. Enter speed (setting range, 0-99 kt, default speed, 0 kt) with the alphanumeric keys and push the [ENTER] knob.
5. Select COURSE and press the EDIT key.
6. Select "8 FIGURE" to trace the simulated ship's track in a figure-eight course, or enter your own course at DIRECTION. Use the trackball to select digit and enter value with the alphanumeric keys.
7. Press the ENTER soft key.
8. Select LATITUDE and press the EDIT soft key.
9. Enter latitude (setting range, 85°N-85°S, default setting, 45°35.000'N) and push the [ENTER] knob.
10. Select LONGITUDE and press the EDIT soft key.
11. Enter longitude (setting range, 180°E-180°W, default setting, 125°00.000'W) and push the [ENTER] knob.
12. Select START DATE & TIME and push the EDIT soft key.
13. Enter start date and time and push the [ENTER] knob.
14. Press the [MENU] key to close the menu.

Sounder

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

```
SOUNDER
▲
○ SIMULATION 1
○ SIMULATION  2
⊙ LIVE
▼
```
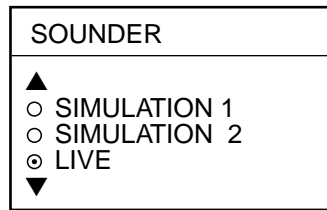
2. Select SIMULATION 1 (internally generated echoes) or SIMULATION 2 (network sounder-generated echoes), then press the [ENTER] knob.

   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 (Automatic Plotter) function. ARP requires connection of MODEL1833/1833C series network radar equipped with the ARP circuit board.

2.1 Radar Display

Cursor
Heading
M: Magnetic
T: True
Pulselength
Heading line
North marker

Range/range ring interval — .250/SP .125nm
Presentation mode — H-UP
Alarm icon
Battery icon
Zoom area
Guard zone 1
Zoom window

319.9°M

TRAIL 30m — Trail time
02m30s — Trail elapsed time
G1 IN — Guard zone 1
G2 OUT — Guard zone 2
ES L — Echo stretch
EAV L — Echo averaging*
IR L — Interference rejector
Guard zone 2
VRM2
EBL1
VRM1
EBL2
Range ring
Own ship vector* (ARP-equipped model, true vector mode)

* = Radar source Model 1833/1833C series radar

EBL1 range
VRM1 range

| EBL1 27.0°R | EBL2 327.1°R | +359.9°R |
| VRM1 0 .158nm | VRM2 0 .225nm | 0.18nm |

EBL2 bearing, VRM2 range

Cursor range and bearing (Cursor position may also be shown, in L/L or Loran C TD.)

Radar display

2.2   Transmitting, Stand-by

1. Turn the power on. The products information appears and is then followed by the radar screen. You can display the radar screen at once by pressing the any key.
2. Press the [POWER/BRILL] key momentarily.
3. Press the RADAR STBY soft key to highlight TX on its label.
4. When the radar picture is not required, but you want to keep it in a state of readiness, press the [POWER/BRILL] key momentarily followed by RADAR TX soft key.
5. Press the RETURN soft key to finish.

2.3   Tuning

The radar receiver can be tuned automatically or manually, and the default tuning method is automatic. To adjust manually or switch to automatic 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 and press the EDIT soft key.

TUNING
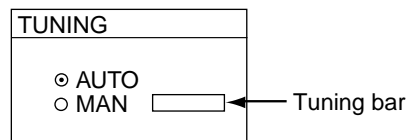
⊙ AUTO
○ MAN [____] ◄——— Tuning bar

Tuning window

4. Choose MAN or AUTO as appropriate.
5. For manual tuning, adjust the [ENTER] knob until the tuning bar is at its longest position.
6. Press the RETURN soft key.
7. Press the [MENU] key to close the menu.

Note: If the auto setting does not provide satisfactory tuning, see the installation manual for how to adjust tuning.

2.4   Adjusting the Gain

The [GAIN] key adjusts the sensitivity of the radar receiver. It works in a manner similar to the 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 gain, transmit on long range, and then do the following:

1. Press the [GAIN] key. The last-used "adjustment window" is displayed. In the example below, the gain sensitivity adjustment is shown.

Item selected for adjustment is highlighted. ─┐
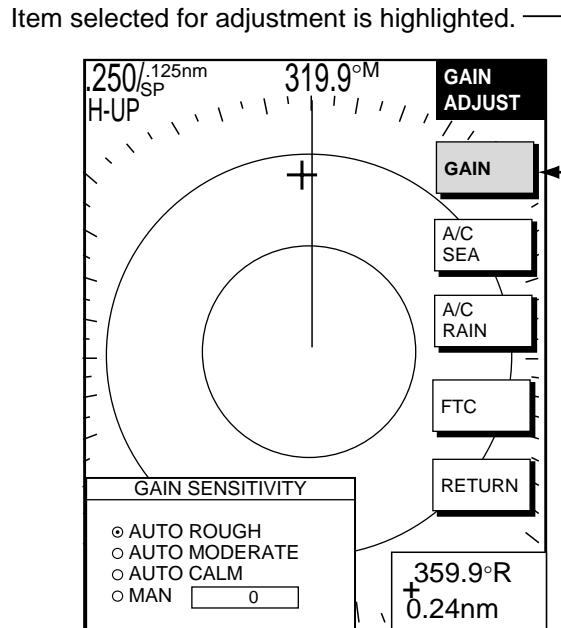
Gain adjustment soft keys

2. If the gain sensitivity window is not displayed, press the GAIN soft key to show it.
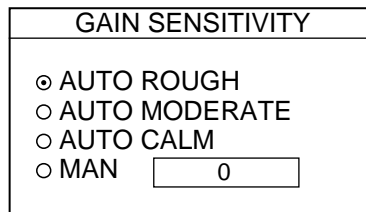
Gain sensitivity window

3. Press ▲ or ▼ 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(%).
5. Press the [GAIN] key on the front panel or the 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 is 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.
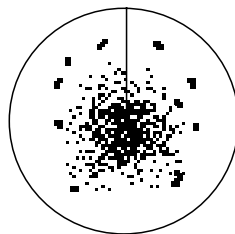
Sea clutter at
screen center
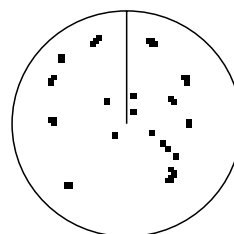
A/C SEA adjusted;
sea clutter suppressed

Effect of A/C SEA

2.5.2 Adjusting 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.

```
        A/C SEA

  ○ AUTO ROUGH
  ○ AUTO MODERATE                    A/C SEA
  ○ AUTO CALM
  ⊙ MAN  [    0   ]              [        0        ]
```
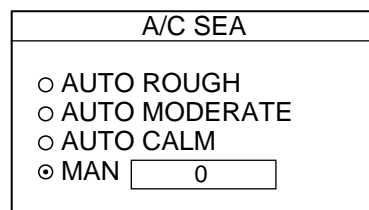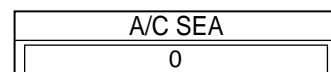
Model 1722/C series radar   Model 1833/C series radar

A/C SEA setting window

3. **When the radar source is the Model 1722/C series radar,** press ▲ or ▼ to select AUTO ROUGH, AUTO MODERATE, AUTO CALM, or MAN (manual) as appropriate. Select an AUTO option according to sea state.
4. For manual adjustment, rotate the [ENTER] knob to adjust while observing radar echoes. The range of adjustment is 0-100(%). Do not overadjust the A/C SEA – weak target echoes may be missed.

5. **When the radar source is the Model 1833/C series radar,** A/C SEA and A/C RAIN can be automatically adjusted. Press the A/C AT 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 rain 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. This 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.
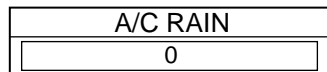
A/C RAIN
0

A/C RAIN setting window

3. Rotate the [ENTER] knob to adjust the A/C RAIN affect. 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 the A/C RAIN – weak target echoes may be missed.
4. Press the [GAIN] key on the front panel or RETURN soft key to finish.

2.6.2   Adjusting the FTC

To suppress rain clutter from heavy storms or scattered rain clutter, adjust the FTC. The FTC splits up these unwanted echoes into a speckled pattern, making recognition of solid targets easier.

Note: 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.

FTC is available when the radar source is the MODEL1722 series radar.

1. Press the [GAIN] key.
2. Press the FTC soft key to show the FTC window.

FTC
0
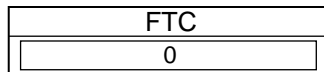
FTC setting window

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.

2.7 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
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
No. of Rings	2	2	4	3	4	3	4	3	4	3	4	4	4	4	3	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
Ring Interval	0.125	0.25	0.25	0.25	0.5	0.5	1	1	2	2	3	4	6	12	12	16
No. of Rings	2	2	3	4	3	4	3	4	3	4	4	4	4	3	4	4

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

Model 1722, 1722C: 24 nm
Model 1732, 1732C, 1742, 1742C, 1752, 1752C, 1833, 1833C: 36 nm
Model 1762, 1762C, 1933, 1933C: 48 nm
Model 1943, 1943C: 64 nm

Note 2: You may choose which ranges to use from the RADAR RANGE SETUP menu. For details see paragraph 5.2.2.

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 1.5 and 3 nm (sm) ranges (3 and 6 kilometer ranges) as 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: Middle pulse, long pulse

1. Press HIDE/SHOW to show soft the radar soft keys.
2. Set the range to 1.5 or 3 nm, whichever you want to set.
3. Press the SIGNAL PROC. soft key.
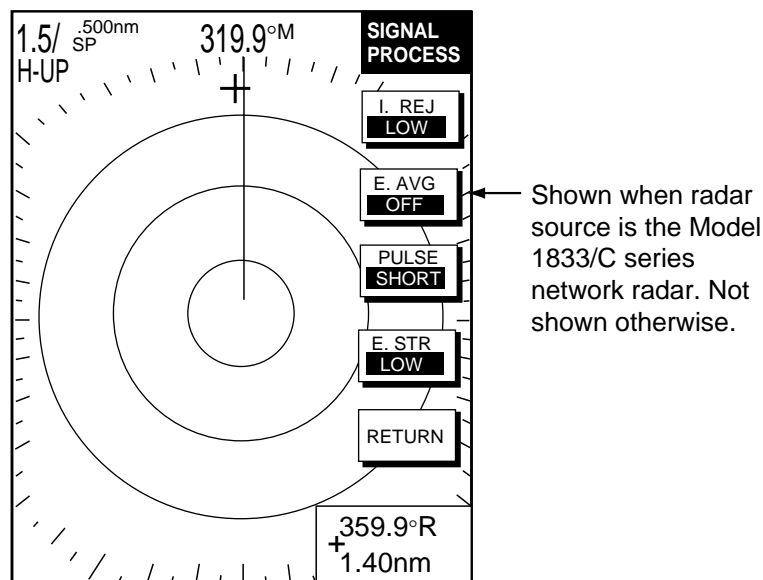
Signal process soft keys

3. 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.
4. 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. (When you use the network radar, input the radar source.)

2.9.1   Selecting a presentation mode

1. Press HIDE/SHOW to show soft the radar soft keys.
2. Press the RADAR DISPLY soft key to show the RADAR DISPLAY soft keys.

MODEL1722C series   MODEL1722 series
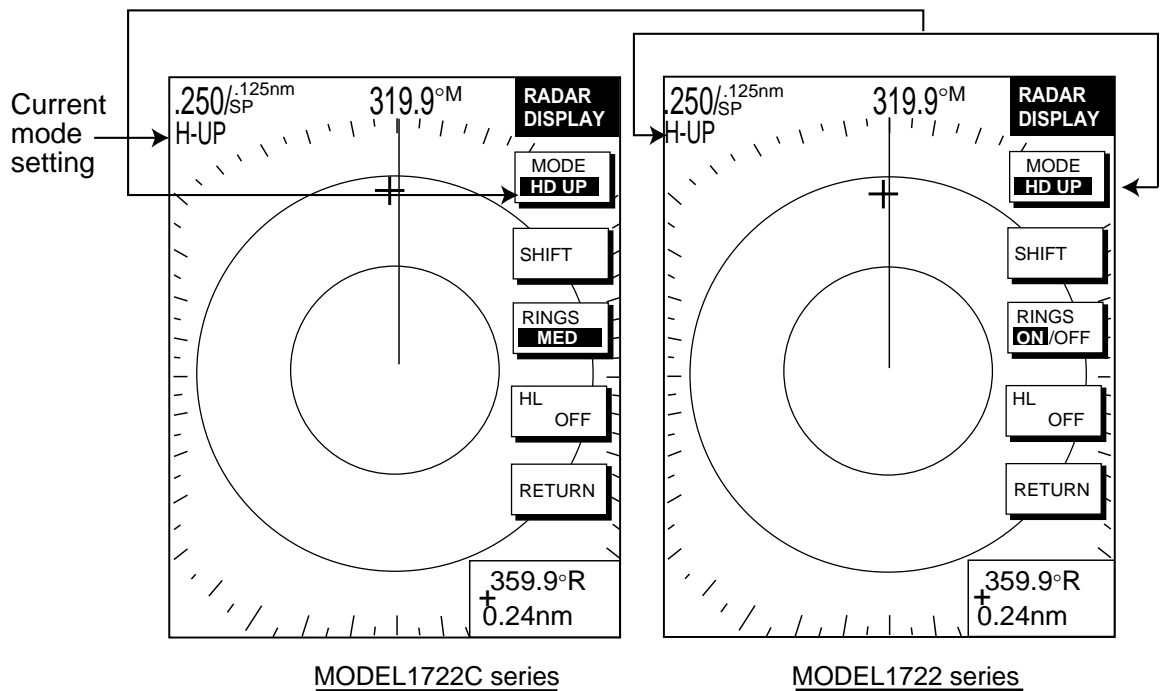
Radar display soft keys

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.
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 (HU)

A display without azimuth stabilization in which the line connecting the center with the top of the display indicates own ship's heading. The 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.
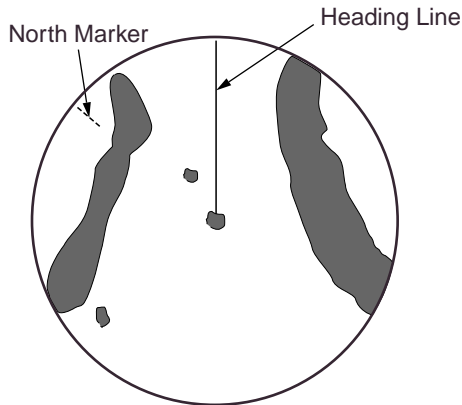
Head-up presentation mode

Course-up (CU)

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 marker moves. If you select a new course, the picture resets to display the new course at the top of the display.
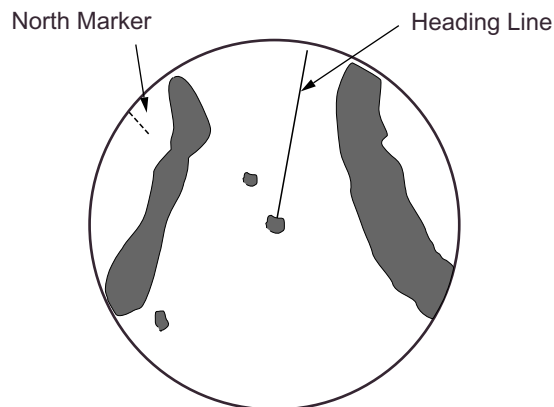
Course-up presentation mode

North-up (NU)

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 the ship's heading.

North   Heading Line
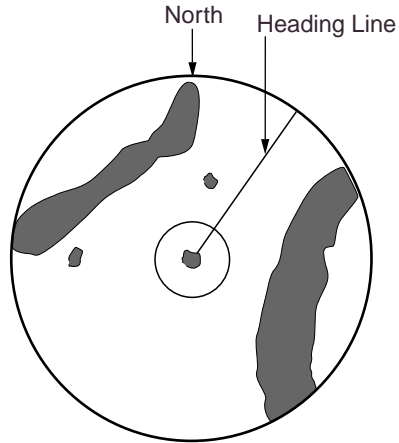
North-up presentation mode

True motion (TM)

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 DISPLAY soft key followed by the SHIFT soft key.

North   Heading Line
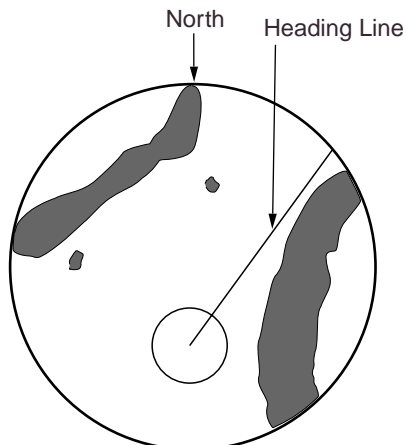
True motion presentation mode

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.
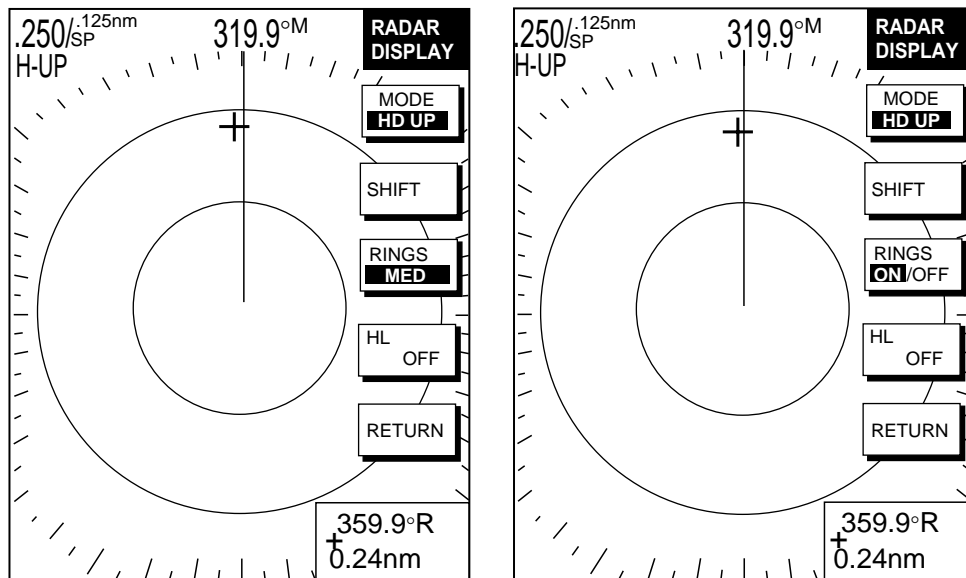
MODEL1722C series   MODEL1722 series

Radar display soft keys

3. Press the RINGS soft key to select ON (MODEL1722 series) or desired brilliance (MODEL1722C series) among LOW, MED and HIGH.
4. Press the RETURN soft key to finish.

2.10.2   Measuring range by cursor

Operate the cursor pad 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.
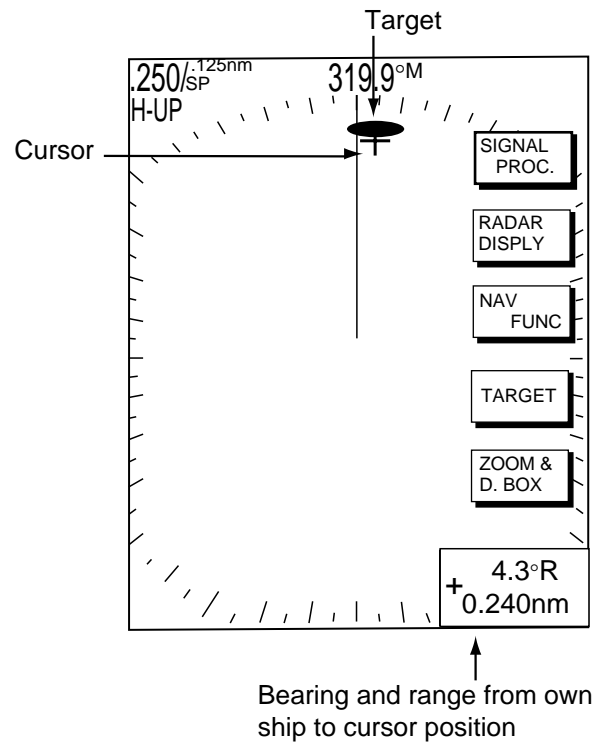
How to measure range and bearing to a target with the cursor

2.10.3 Measuring range by VRM

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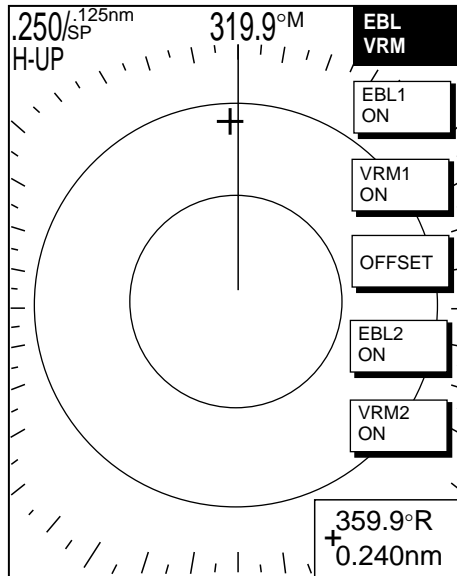
EBL/VRM soft keys

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.
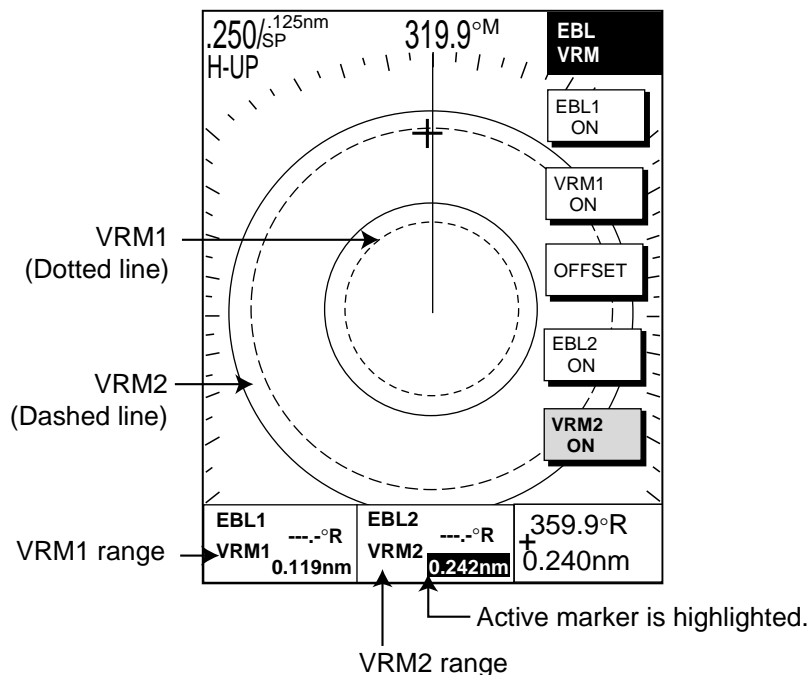
How to measure range with the VRM

2.10.4 Erasing a VRM, VRM indication

Press appropriate VRM soft key and 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 that you need 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 erase the EBL/VRM soft keys if shown.
2. Using the cursor pad, 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 data box is correctly selected.
3. Use the cursor pad to drag the data box to the location desired and 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 cursor pad to locate the cursor to 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, next to the "+" mark.

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
4. You may hide the EBL/VRM soft keys by pressing the [EBL/VRM] key.
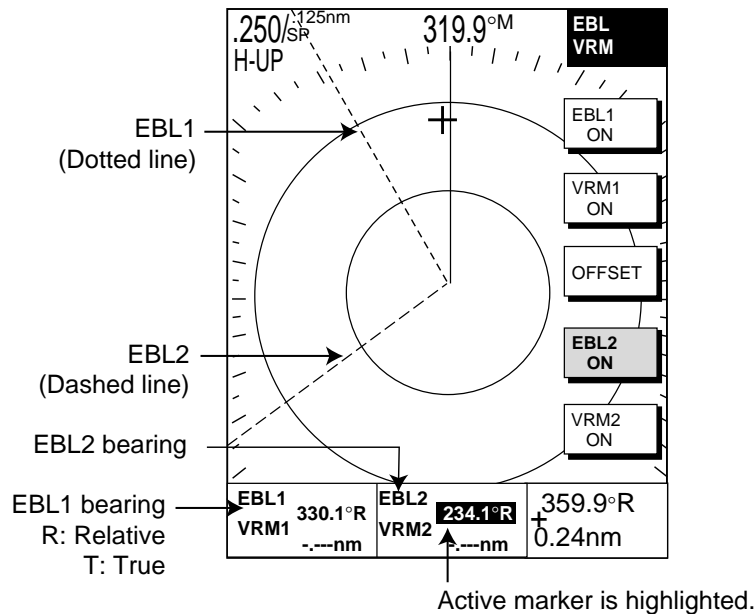
How to measure bearing with the EBL

Note: Bearing can be shown Relative to ship's heading (relative) or in reference to North (True). This setting may be changed by changing the EBL REFERENCE setting, which is in the RADAR DISPLAY SETUP menu. See the paragraph "5.2.1 Radar display setup."

2.11.3 Erasing an EBL, EBL indication

Press appropriate EBL soft key and 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 that you need 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 erase the EBL/VRM soft keys if appears.
2. Using the cursor pad, 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 data box is correctly selected.
3. Use the cursor pad to drag the data box to the location desired and push the [ENTER] knob.

2.12 Erasing the Heading Line, North Marker

The heading line indicates the ship's heading in all presentation modes. The heading line 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 depending on the ship orientation in north-up, course-up and true motion modes.

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.

2.13 Reducing Noise

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 and press the EDIT soft key.
4. Select OFF, HIGH or LOW as appropriate.
5. Press the ENTER soft key or the [ENTER] knob.
6. Press the [MENU] key to close the menu.

2.14 Reducing 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 rejection circuit when no interference exists – weak targets may be missed.
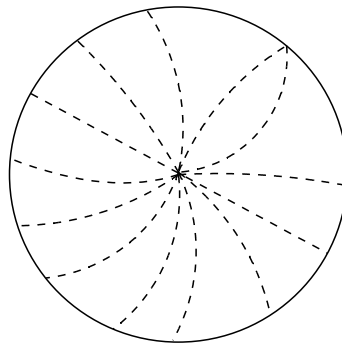
Radar interference

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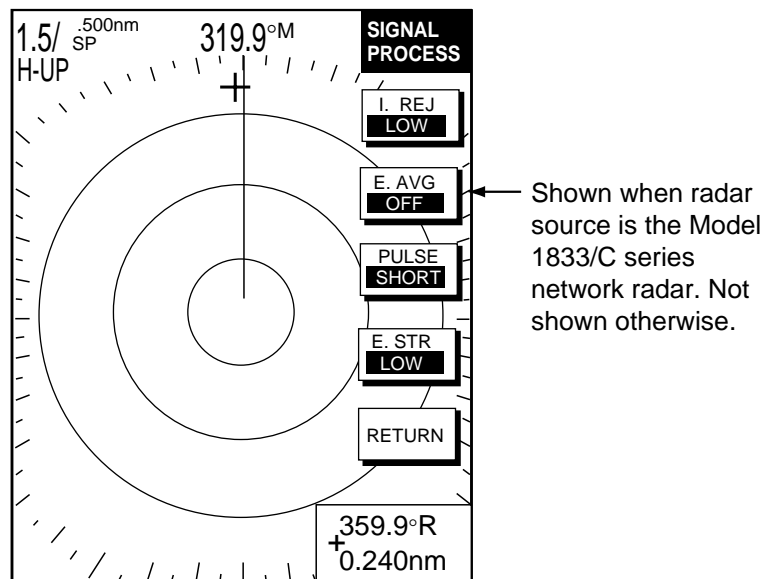
Signal process soft keys

3. Press the I. REJ soft key 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 rejecter is on.

2.15   Zoom

The zoom feature allows you to double the size of the area selected with the zoom circle, which appears at the bottom right- or left-hand corner on the display. The zoom feature 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. Press the ZOOM & D. BOX soft key to show ZOOM & D. BOX soft keys.
3. Press the ZOOM ON/OFF soft key to select ON. A solid circle, called the "zoom circle," appears on the display.
4. Use the cursor pad to set the cursor where you want to zoom.
5. Press the CURSOR FLOAT soft key to fix the zoom cursor position. (The solid circle changes to a dashed one.)
6. To release the cursor, press the CURSOR FLOAT soft key. (The dashed circle changes to a solid one.) Relocate the zoom cursor, then press the CURSOR LOCK key.
7. To quit the zoom function, press the ZOOM ON/OFF soft key to select OFF.
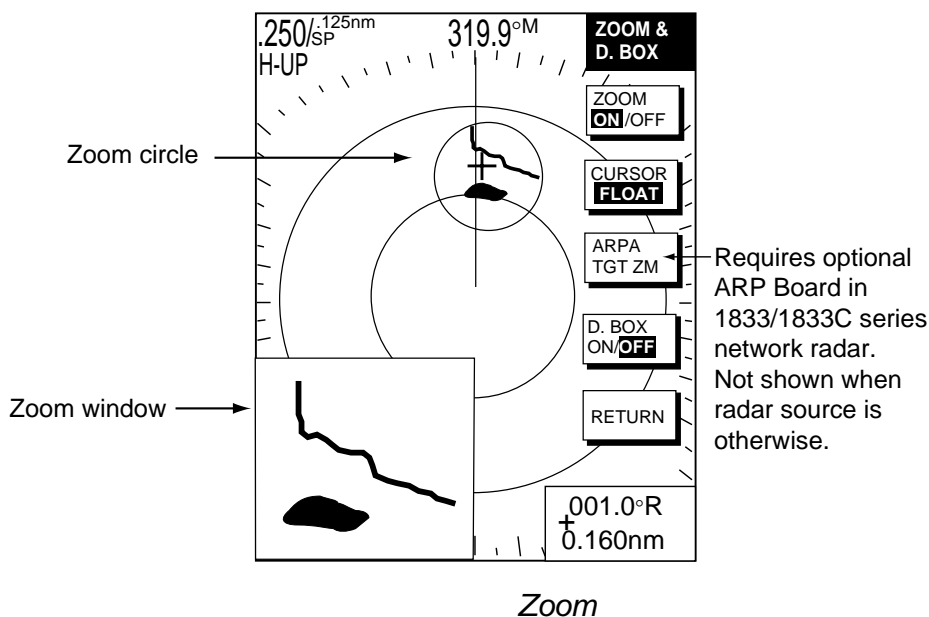
Zoom

2.15.2   Zooming ARP, TTM targets

You may zoom in on TTM targets coming into the display. TTM targets can come from a NAVNET connected RADAR, or from other ARP RADAR that is outputting the TTM message. Note: TTM stands for Tracked Target Message. It is a NMEA 0183 data sentence that is an available output from some ARP capable RADAR. TTM target numbers must be displayed to zoom in on tracked targets. 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 soft key to select ZOOM ON.
4. Press the ARP TGT ZM soft key.

```
SELECT TARGET NO.
       ▲
       1
       ▼
```
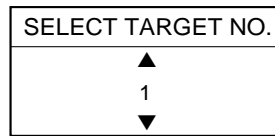
Target no. selection window

5. Use the [ENTER] knob to select number (1-10) and then push the [ENTER] knob. If the target does not exist several beep sounds 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 60% 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. Press the RETURN soft key to finish.
7. To cancel shift, press the RADAR DISPLY, SHIFT and OFF soft keys in that order.

Place cursor   Press the MANUAL soft key.
where desired.
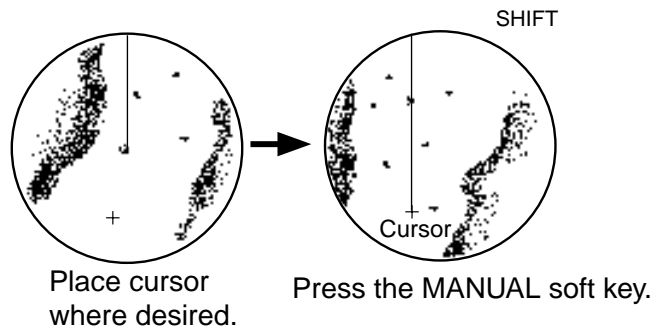
Shifting the picture manually

2.16.2   Automatic shift

The amount of shift is automatically calculated with speed. The maximum shift amount is limited to 60% 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 40%. The formula for determining shift amount is as shown below.

$$\frac{\text{Ship's speed}}{\text{Shift speed setting}} \times 0.6 = \text{Amount of shift(\%)}$$

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.
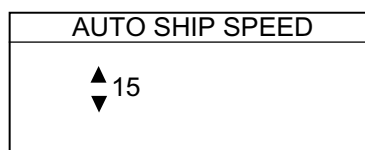
Auto ship speed setting window

5. Adjust the cursor pad 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 DISPLAY, SHIFT and OFF soft keys.

2.17 Using the Offset EBL

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

2.17.1 Predicting a collision course

The procedure below may be used to check if a radar target is on a 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 and an "X" appears at the cursor position.
4. Use the cursor pad 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.
7. To cancel the offset EBL, press the OFFSET soft key.
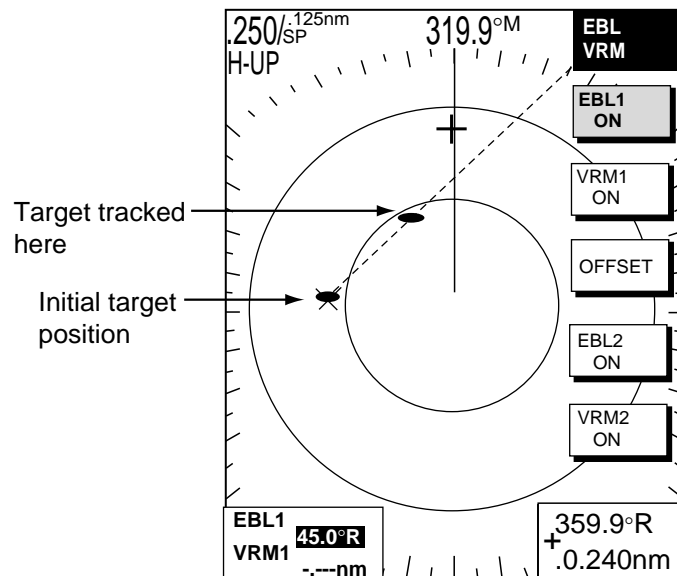
Predicting collision course with the offset EBL

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 cursor pad 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 and VRM1 moves to the cursor position, which is marked with an "X."
5. Rotate the [ENTER] knob so the EBL bisects the target "B".
6. Press the [ENTER] knob.
7. Press the VRM1 ON soft key and then 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.
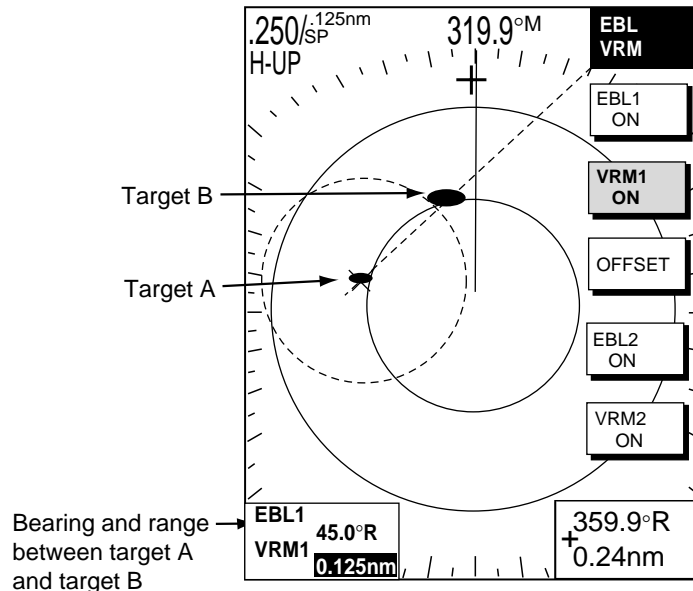
Measuring range and bearing between two targets

2.18 Echo Trails

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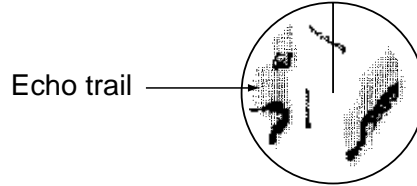
Echo trail

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.

MODEL1722C series   MODEL1722 series
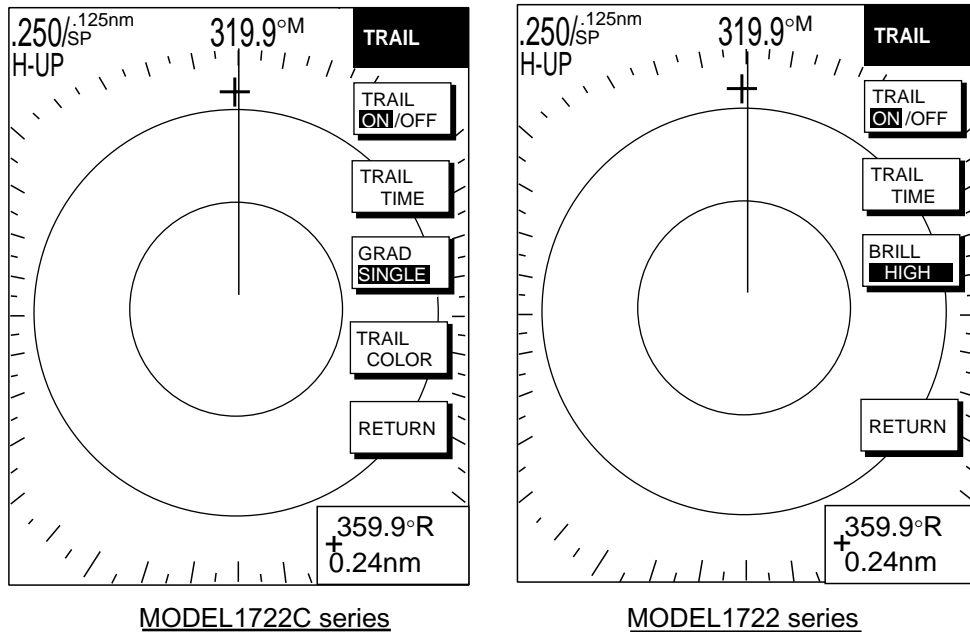
Trail soft keys

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

TRAIL TIME

▲
⊙ 15 seconds
○ 30 seconds
○ 1 minutes
○ 3 minutes
○ 6 minutes
○ 15 minutes
○ 30 minutes
○ CONTINUOUS
▼
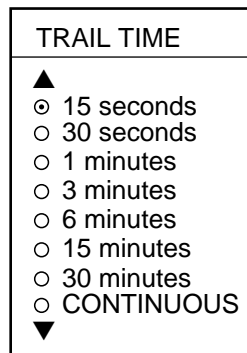
Trail time window

5. Use the cursor pad to select time desired.
6. Press the ENTER soft key to finish.

2.18.2 Starting echo trails

1. If not displayed, press the [HIDE/SHOW] key to display the radar soft keys.
2. Press the TARGET and TRAIL soft keys.
3. Press the TRAIL ON/OFF to select ON.
4. 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 trail begins again.

To turn off echo trail, press the TRAIL ON/OFF soft key to select OFF at step 3 n the above procedure.

Note: No echo trails are shown where a tx sector blanking area is set.

2.18.3 Trail brilliance (MODEL1722 series)

Trail brilliance can be selected to high or low as below.

1. If not displayed, press the [HIDE/SHOW] key to display the radar soft keys.
2. Press the TARGET and TRAIL soft keys.
3. Press the BRILL soft key to select HIGH or LOW.
4. Press the RETURN soft key twice to finish.

2.18.4 Trail gradation (MODEL1722C series)

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] key to display 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.

Multitone   Monotone

Multitone and monotone trails

4. Press the RETURN soft key twice to finish.

2.18.5   Trail color (MODEL1722C series)

The MODEL1722C series may be shown echo trails in blue, yellow, green or white.

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

```
┌─────────────────────┐
│  TRAIL COLOR        │
├─────────────────────┤
│  ▲                  │
│  ⊙ BLUE             │
│  ○ YELLOW           │
│  ○ GREEN            │
│  ○ WHITE            │
│  ▼                  │
└─────────────────────┘
```

Trail color window

3. Use the cursor pad to select the color desired.
4. Press the ENTER soft key.
5. Press the RETURN soft key twice to finish.

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.
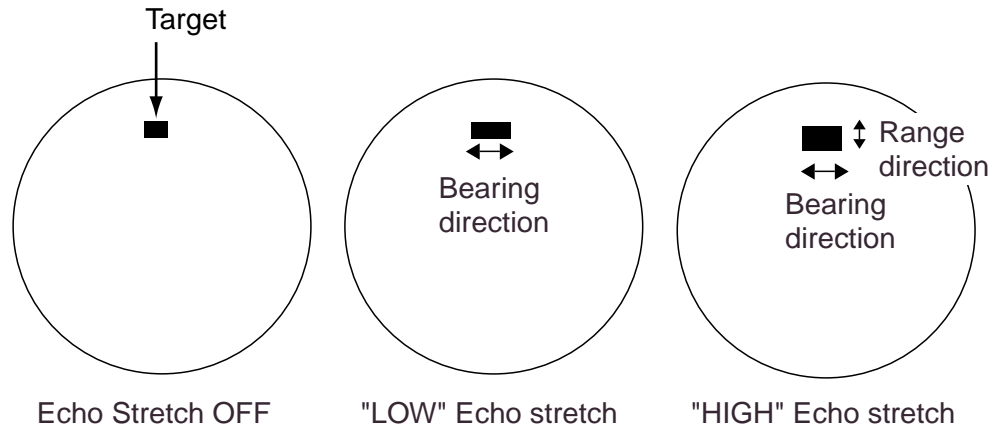
Types of echo stretch

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 display 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, available with selection of a Model 1833/C series network radar as radar source, 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.

   The display shows EAV L, EAV M or EAV H when echo averaging is on.
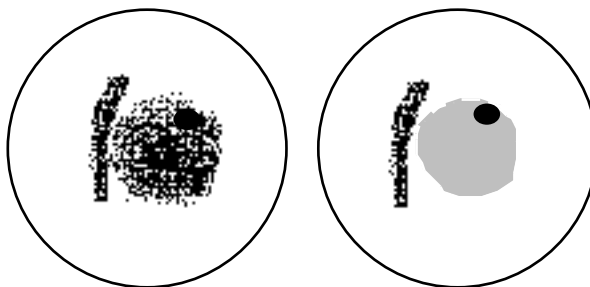
(a) Echo average OFF   (b) Echo average ON

Effect of echo averaging

4. Press the RETURN soft key to finish.

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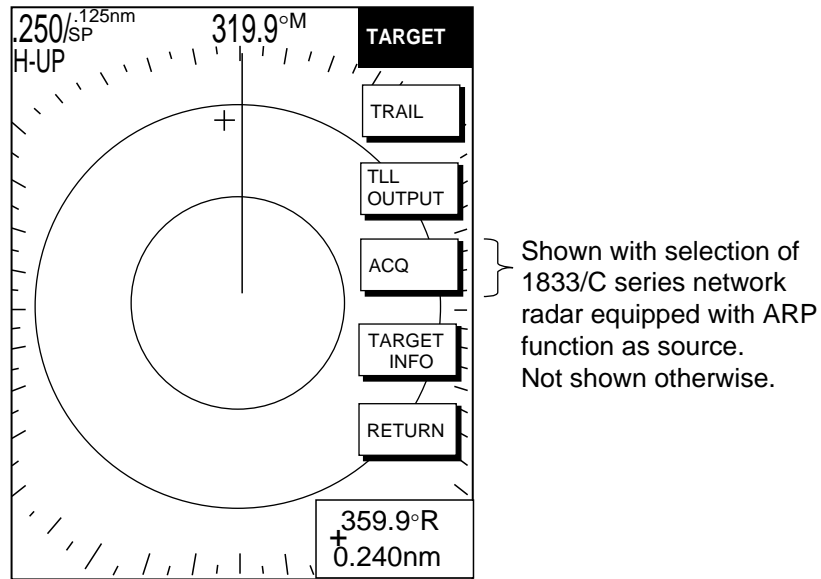
TARGET soft keys

4. Press the TLL OUTPUT soft key to output target position data.
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 cursor pad 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 cursor pad to set the cursor on the bottom right corner (or top left corner) of the guard zone area and push the [ENTER] knob.
4. Press RETURN soft key to finish.
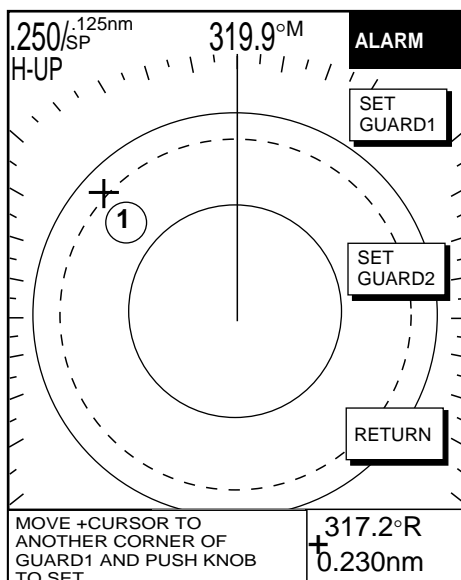
(1) Drag cursor to top (or bottom) corner for guard zone and press the SET GUARD1 or SET GUARD2 soft key.
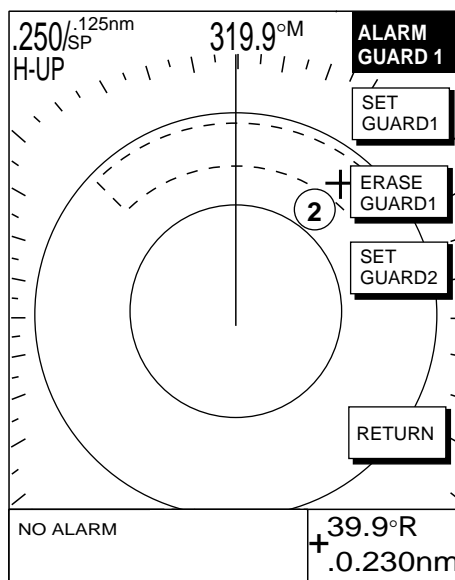
(2) Drag cursor diagonally to bottom (or top) corner for guard zone and press the [ENTER] knob.

How to set a guard alarm zone

2. RADAR OPERATION

The equipment then searches for targets inside the guard zone to determine the 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 an 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 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 is displayed (red on the color model). 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 (red on the color model) 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 (red on the color model). Additionally the message "TARGET ENTERED INTO GUARD1(GUARD2)" or "TARGET LEFT FROM GUARD1(GUARD2)" is displayed at the bottom of the screen, depending on the guard zone type. Press the [CLEAR] key to silence the alarm. When this is done, "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 Canceling 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.

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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 selected 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.

| Tx | ST-BY * | Tx | ST-BY * |
| 1 min | 5,10 or 20 min | 1 min | 5,10 or 20 min |

Watchman starts

* Beeps emitted just before radar transmits.
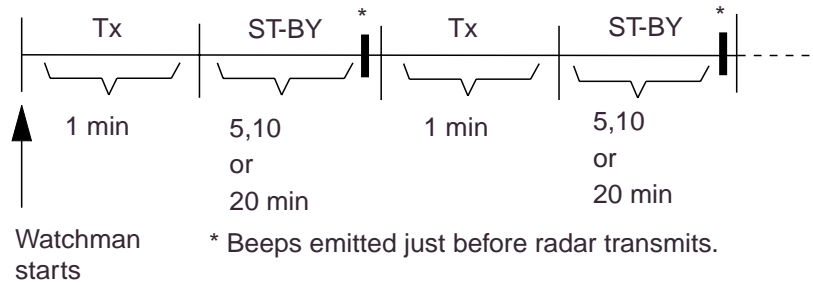
How watchman works

2.23.2 Turning on/off watchman

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

Note: When the watchman is activated and no guard zone is active, the message "PLEASE SET GUARD ZONE. PRESS 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 period 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 and press the EDIT soft key.

```
WATCHMAN TIME
   ▲
 ⊙  5 minutes
 ○  10 minutes
 ○  20 minutes
   ▼
```
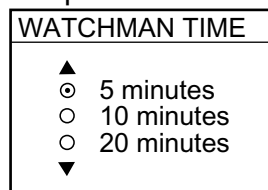
Watchman window

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

2.24   Waypoint Marker

A waypoint marker, showing waypoint position output from a navigation device, may be inscribed on the radar display. You may show or hide this marker as desired.
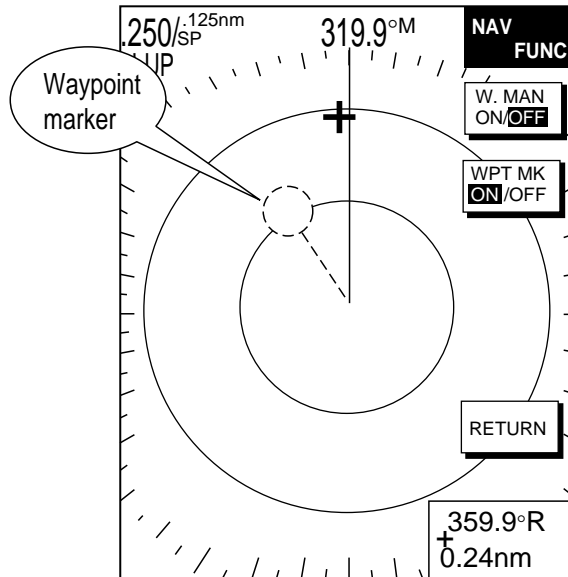
Waypoint marker

1. If not displayed, 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.

2.25 ARP (option), TTM operation

When the radar source is ARP-equipped Model 1833/C series network radar, you can manually and automatically acquire and track 10 targets. Once a target is acquired automatically or manually it is automatically tracked within 0.1 to 32 nm. When the FURUNO heading sensor PG-1000 is connected, RMC sentence (NMEA) is required for true heading data.

Alternatively, you can display the tracks of other ships by receiving the data sentence "TTM" through the NETWORK or NMEA port. 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)

2.25.1   Activating/deactivating ARP, TTM

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

```
                                    ARP
                                    SETUP
  ► ARP TARGET INFO
           INTERNAL ARP
    CANCEL ALL TARGETS           EDIT
           NO
    ARP VECTOR MODE
           TRUE
    ARP VECTOR TIME
           30 minutes
    HISTORY INTERVAL
           OFF
    CPA
           OFF
    TCPA
           30 seconds
    AUTO ACQUISITION AREA        RETURN
           OFF
    TARGET ID NUMBER
           OFF
```
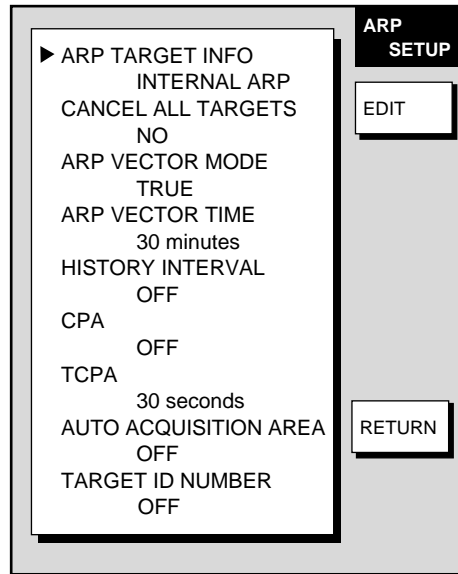
ARP setup menu

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

```
  ARP TARGET INFO
         ▲
     ⊙  INTERNAL ARP
     ○  EXTERNAL ARP
     ○  OFF
         ▼
```
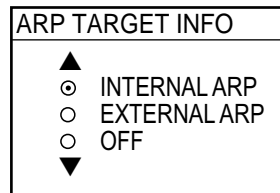
ARP target info window

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

    INTERNAL ARP: The radar source must be the MODEL1833/C series radar.
    Select this item also for a NavNet unit being fed ARP targets.

    EXTERNAL ARP: Receive TTM data sentence via NETWORK or NMEA 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.

2.25.2   Acquiring and tracking targets (ARP only)

Ten targets may be acquired and tracked manually and automatically. When you attempt to acquire an eleventh 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 2.25.4.

Manual acquisition

1. If not displayed, press the [HIDE/SHOW] key to display the radar soft keys.
2. Press the TARGET soft key.
3. Place the cursor on the target to acquire and press the ACQ soft key.
4. Press the RETURN soft key.

The plot symbol changes its shape according to its status as below. A vector appears about one minute after acquisition, indicating the target's motion trend.

At acquisition   1 min. after acquisition   3 min. after acquisition   Vector   Target Number
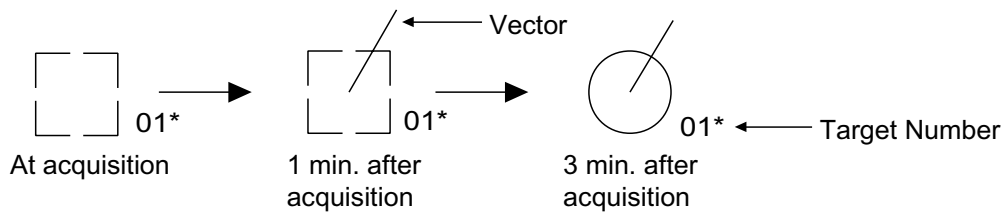
* = Target number shown when TARGET ID NUMBER is turned on in the ARP SETUP menu.

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 cursor pad to select AUTO ACQUISITION AREA.
4. Press the EDIT soft key to show the automatic acquisition area window.

AUTO ACQ. AREA
▲
⊙ OFF
○ ON
▼
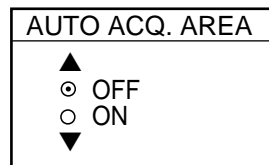
Automatic acquisition area window

5. Select ON.
6. Press the ENTER soft key.

7. Press the [MENU] key to close the menu. An acquisition area of 2.0 to 2.5 miles in range and ±45⁰ 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.
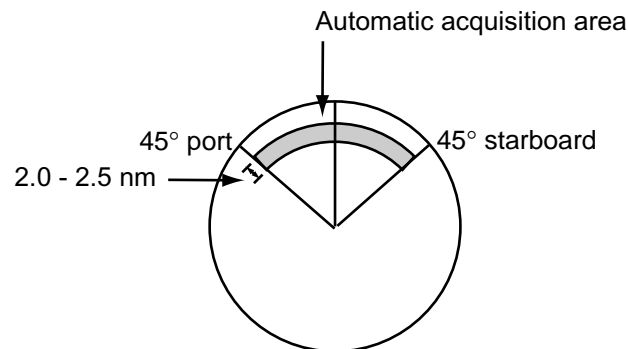
Automatic acquisition area

2.25.3   Displaying target number (internal, external ARP)

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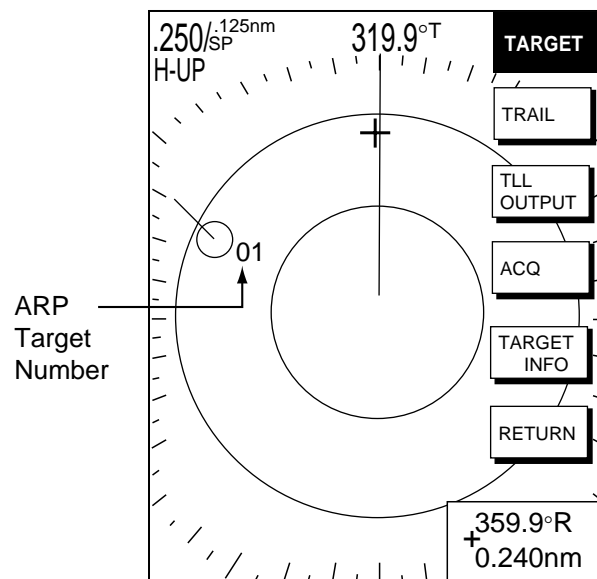
ARP target number

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 (default setting) as appropriate.
6. Press the ENTER soft key.
7. Press the [MENU] key to close the menu.

2.25.4 Terminating tracking of ARP targets

When 10 targets have been acquired, no more targets may be acquired unless targets are cancelled. If you need to acquire additional targets, you must first cancel one or more individual targets, or all of the 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 erase 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
       ▲
    ○  YES
    ⊙  NO
       ▼
```

Cancel all targets window

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

2.25.5 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 in order to evaluate the risk of collision with any target.
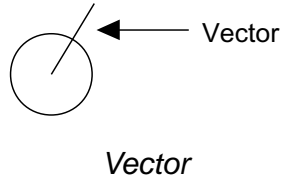
Vector

Vector reference, vector time

You may reference the vectors to North (True) 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 cursor pad to select ARP VECTOR MODE.
3. Press the EDIT soft key to show the vector mode window.

```
ARP VECTOR MODE
   ▲
   ⊙  RELATIVE
   ○  TRUE
   ▼
```
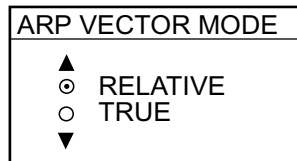
Vector mode window

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

```
ARP VECTOR TIME
   ▲
   ⊙  30 seconds
   ○  1 minute
   ○  3 minutes
   ○  6 minutes
   ○  15 minutes
   ○  30 minutes
   ▼
```
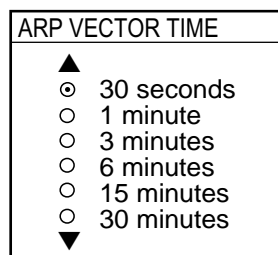
ARP vector time window

7. Operate the cursor pad 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.

2.25.6 Displaying past position display (ARP)

This ARP can display time-spaced dots (maximum 10 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
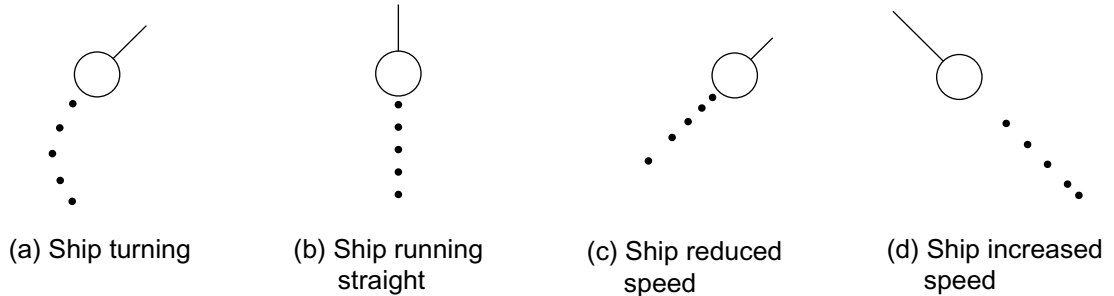
Past position displays

To turn the past position display on or off:

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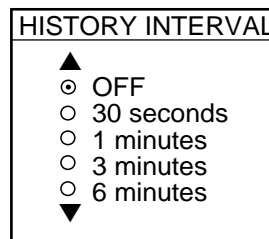
History interval window

4. Operate the cursor pad to select plotting 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.

2.25.7   ARP, TTM target data

This ARP calculates motion trends (range, bearing, course, speed, CPA and TCPA) of all target been tracked. You can show this data for a tracked target as below. TARGET ID NUMBER, in the ARP SETUP menu, must be turned on to show ARP target data.

1. Place the cursor on the target whose data you want to see.
2. If not displayed, press the [HIDE/SHOW] key to display 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 data box will be under it.)
4. Press the RETURN soft key to finish.
5. To erase the ARP target data box, select the corresponding target with the cursor and press the [CLEAR] key.
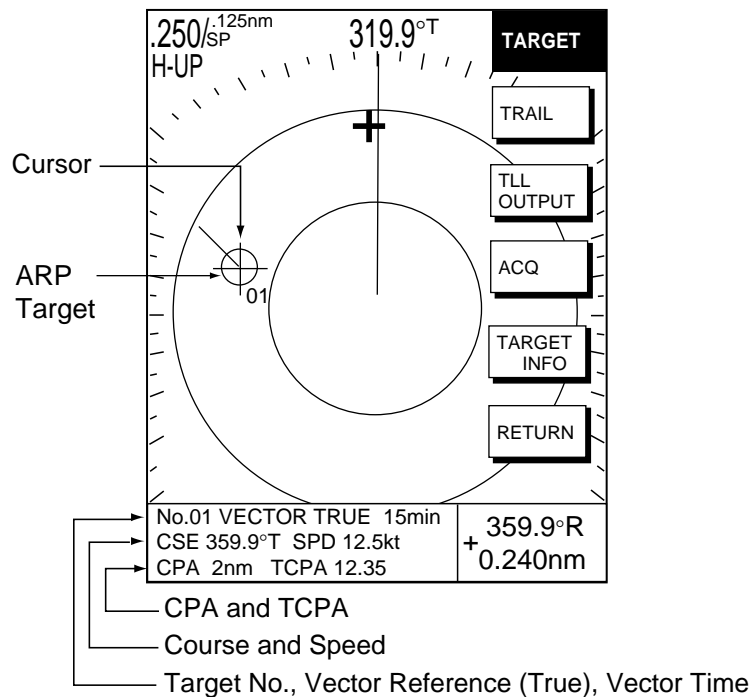
ARP target data

2.25.8 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, which you may silence with the [CLEAR] key. In addition, the target plot symbol of the offending target changes to a triangle and flashes together with its vector. 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 target to own ship.

Provided that this feature is used correctly, it will help prevent the risk of collision by alerting you to threatening targets. 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.
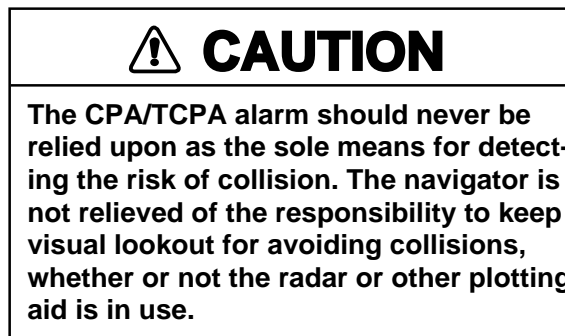
Follow the steps shown below to set the CPA/TCPA alarm range:

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

```
           CPA
     ▲
     ⊙  OFF
     ○  0.5nm
     ○  1nm
     ○  2nm
     ○  3nm
     ○  5nm
     ○  6nm
     ▼
```
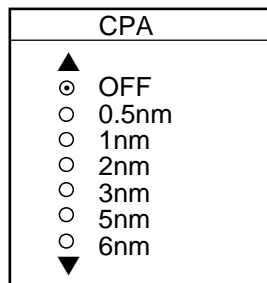
CPA window

4. Select a CPA limit desired by the cursor pad.
5. Press the ENTER soft key. The ARP SETUP menu reappears.
6. Press the cursor pad to select TCPA.
7. Press the EDIT soft key to show the TCPA window.

```
┌─────────────────────┐
│        TCPA         │
│  ▲                  │
│  ⊙  30 seconds      │
│  ○  1 minute        │
│  ○  2 minutes       │
│  ○  3 minutes       │
│  ○  4 minutes       │
│  ○  5 minutes       │
│  ○  6 minutes       │
│  ○  12 minutes      │
│  ▼                  │
└─────────────────────┘
```
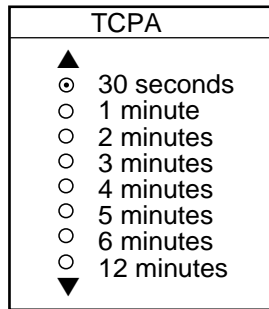
TCPA window

8. Select a TCPA limit.
9. Press the ENTER soft key.
10. Press the [MENU] key to close the menu.

2.25.9 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.

2.26   Interpreting the Radar Display

2.26.1   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.

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)
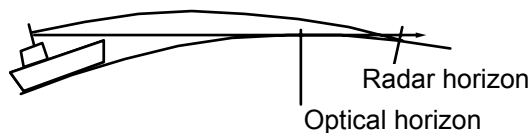
Radar horizon

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).

<u>Radar resolution</u>

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.

<u>Bearing accuracy</u>

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.

<u>Range measurement</u>

Measurement of the range to a target is also a very important function of the radar. Generally, there are two means of measuring range: the fixed range rings 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 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.

2.26.2 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.
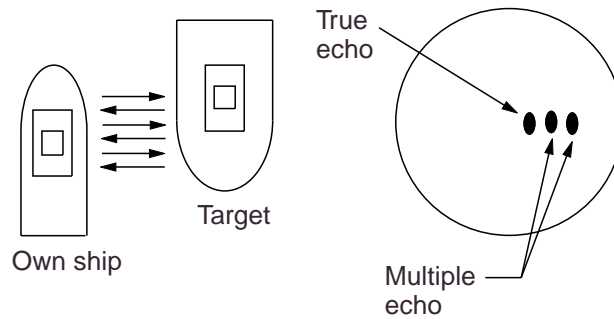
Multiple echoes

Sidelobe echoes

Every time the radar pulse is transmitted, some radiation escapes on each side of the beam. This stray RF is called sidelobe. If a target exists where it can be detected by the side lobes as well as the main lobe, the side echoes may be represented on both sides of the true echo at the same range. Sidelobes appear 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

2. RADAR OPERATION
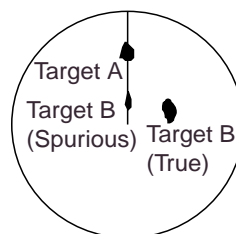
Virtual image

A relatively large target close to your ship may be shown 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.
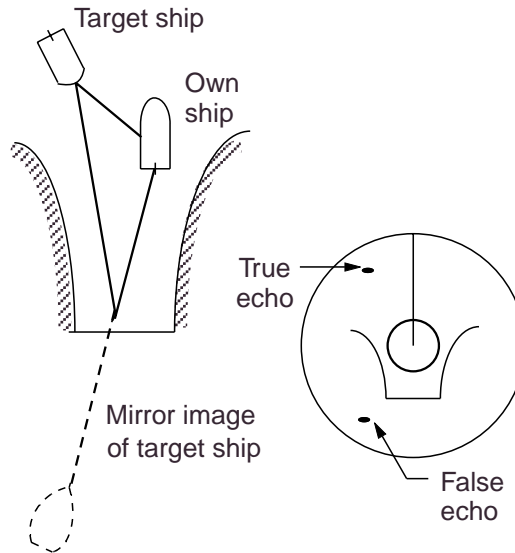
Virtual image

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.
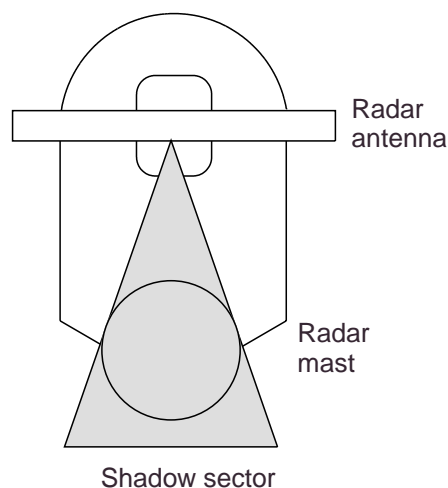
Shadow sectors

2.26.3 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.
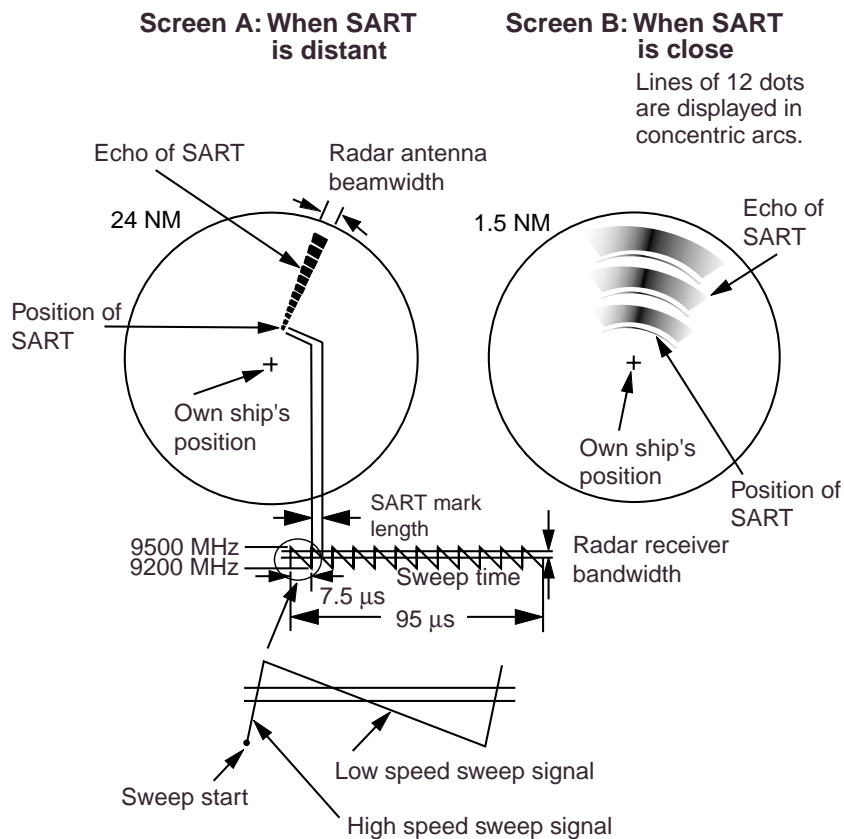
Appearance of SART signal on the radar display

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 side lobes

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.

2.26.4   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.
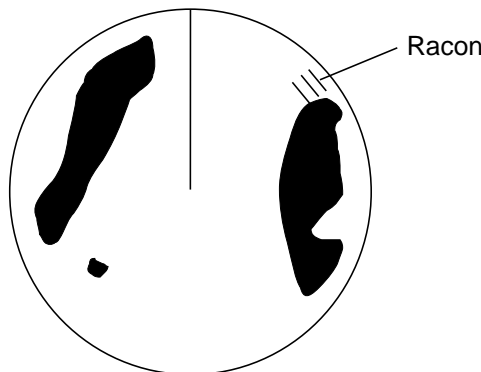
Appearance of racon signal on the radar display

3. PLOTTER OPERATION

3.1 Plotter Displays

You may show the plotter display over the entire screen, in the overlay screen (MODEL1722C series), or in a combination screen. Press the [DISP] key to show the screen selection window, and then rotate the [ENTER] knob to select PLOT, NAV or OVRLY (overlay) as appropriate.

3.1.1 Full-screen plotter display

Nav data window
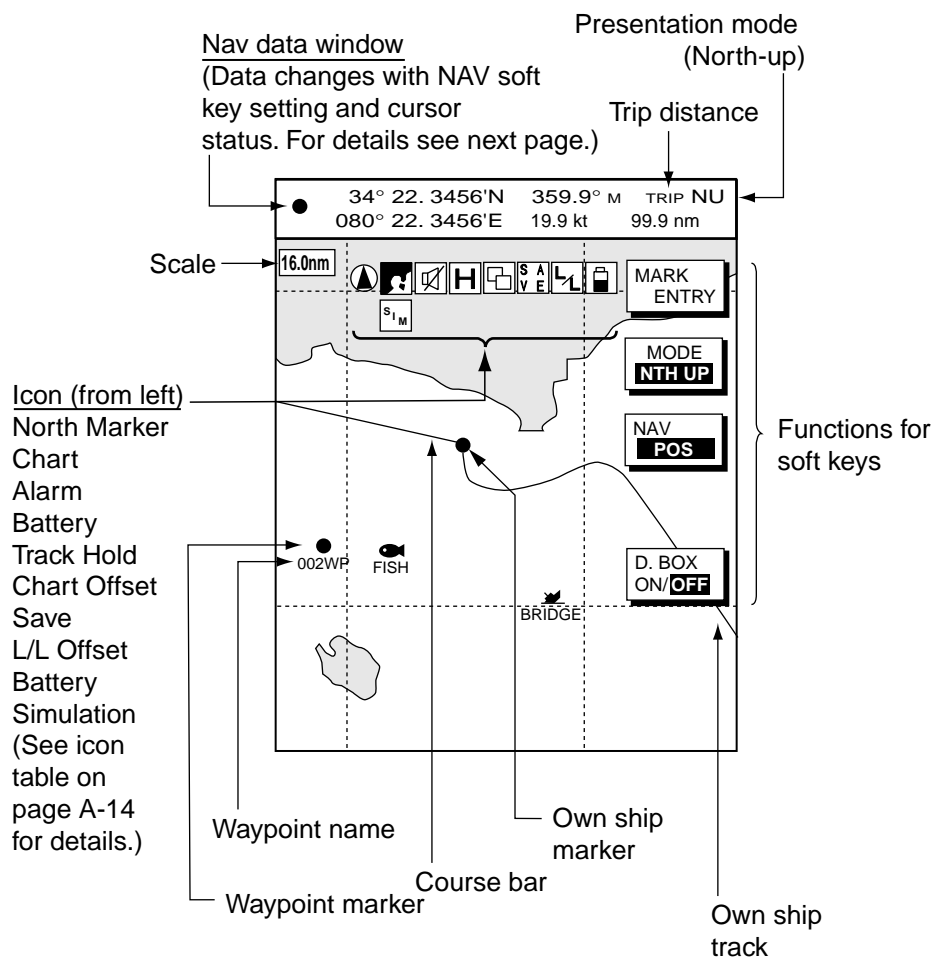(Data changes with NAV soft key setting and cursor status. For details see next page.)

Presentation mode (North-up)

Trip distance

Scale

34° 22. 3456'N   359.9° M   TRIP NU
080° 22. 3456'E   19.9 kt   99.9 nm

16.0nm

MARK ENTRY

MODE NTH UP

NAV POS

Functions for soft keys

D. BOX ON/OFF

Icon (from left)
North Marker
Chart
Alarm
Battery
Track Hold
Chart Offset
Save
L/L Offset
Battery
Simulation
(See icon table on page A-14 for details.)

002WP   FISH

BRIDGE

Waypoint name

Own ship marker

Course bar

Waypoint marker

Own ship track

Full-screen plotter display

Note: The own ship marker blinks when the GP-310B loses the GPS signal. For the NavNet display units receiving the GPS signal, the message "No GPS fix!" appears approx. one minute after the signal is lost and is accompanied by the audio alarm. For the NavNet display unit connected to the GP-310B, the visual alarm is released soon after loss and the audio alarm sounds five minutes later.

Nav data window

The data shown in the nav data window depends on the status of the NAV soft key and the cursor.

Latitude and longitude of cursor intersection

Presentation Mode

Latitude, Longitude | Bearing to Cursor

+ **34°24. 3456'N**   **359. 9**°M   **TRIP**   **NU**
   124°24. 3456'W   **59.9nm**   **99. 9nm**

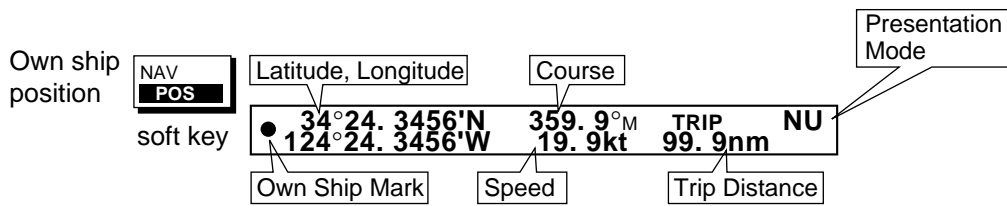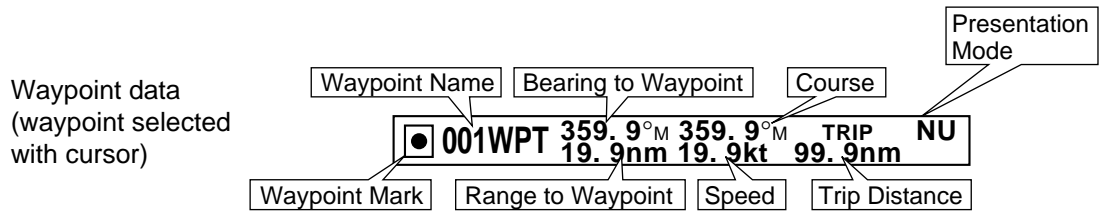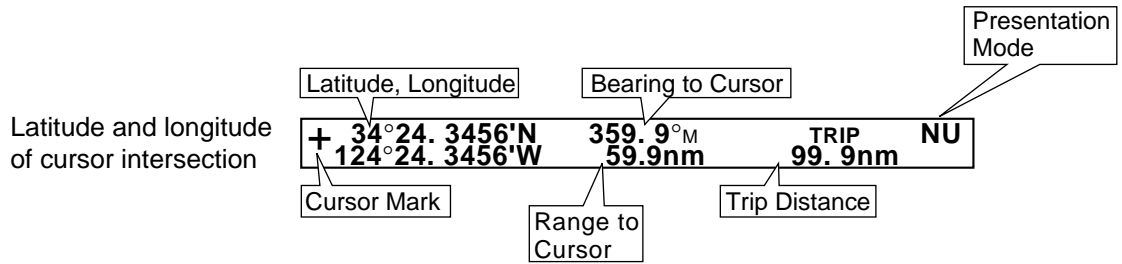Cursor Mark   Range to Cursor   Trip Distance

Waypoint data (waypoint selected with cursor)

Presentation Mode

Waypoint Name | Bearing to Waypoint | Course

⊙ **001WPT 359. 9**°M **359. 9**°M   **TRIP**   **NU**
       19. 9nm 19. 9kt   **99. 9nm**

Waypoint Mark | Range to Waypoint | Speed | Trip Distance

Own ship position

| NAV |
| **POS** |

soft key

Presentation Mode

Latitude, Longitude | Course

● **34°24. 3456'N**   **359. 9**°M   **TRIP**   **NU**
   124°24. 3456'W   **19. 9kt**   **99. 9nm**

Own Ship Mark | Speed | Trip Distance

Destination waypoint data

| NAV |
| **WPT** |

soft key

Time-to-Go to Destination

Waypoint Name | Bearing to Waypoint

⊙ **001WPT 359. 9**°M TTG**4D02H23M**   **NU**
       19. 9nm ETA**1st 13:45**

Presentation Mode

Waypoint Mark | Range to Waypoint | Estimated Time of Arrival

Own ship speed and course

| NAV |
| **S/C** |

soft key

Presentation Mode

Course, Speed | Bearing to Waypoint

CSE **359. 9**°   BRG   **359. 9** °M   TMP**79. 9°F**   **NU**
SOG**19. 9kt**   RNG   **99. 9nm**   DPT   **345 ft**

Range to Waypoint   Water Temp., Depth*   ** Requires appropriate sensor.*

Turns off nav data window

| NAV |
| **OFF** |

soft key

Contents of nav data window