

FURUNO

OPERATOR'S MANUAL

GPS/PLOTTER/SOUNDER

MODEL GP-1600F



FURUNO ELECTRIC CO., LTD.
NISHINOMIYA, JAPAN

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9-52, Ashihara-cho,
Nishinomiya, Japan

Telephone: 0798-65-2111
Telefax: 0798-65-4200

• Your Local Agent/Dealer

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SAFETY INSTRUCTIONS

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



DANGER

This notice indicates a potentially hazardous situation which, if not avoided, will result in death or serious injury.



WARNING

This notice indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.



CAUTION

This notice indicates a potentially hazardous situation which, if not avoided, could result in minor or moderate injury, or property damage.

WARNING



Hazardous voltage. Do not open the equipment.

This equipment uses high voltage electricity which can shock. Only qualified personnel should work inside the equipment.

Do not disassemble or modify the equipment.

Fire, electrical shock or serious injury can result.

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

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

Do not place liquid-filled containers on the top of the equipment.

Fire or electrical shock can result if a liquid spills into the equipment.

Keep heater away from equipment.

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

Do not operate the unit with wet hands.

Electrical shock may result.

CAUTION

Use the proper fuse.

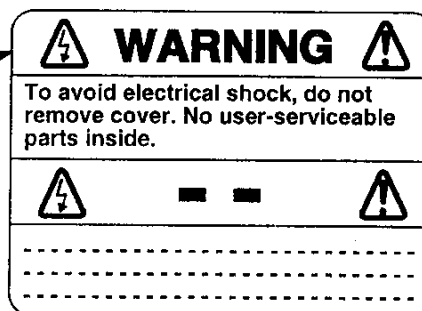
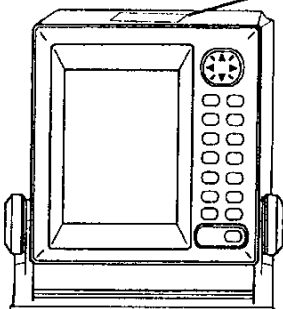
Use of a wrong fuse can result in fire or permanent equipment damage.

Power the equipment with the proper power supply.

Powering the equipment with a wrong power supply can cause permanent equipment damage.

GPS position and velocity accuracies are controlled by the U.S. Department of Defense. Position may be degraded up to 100 meters.

WARNING Label attached



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

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A Word to GP-1600F Owners

Congratulations on your choice of the FURUNO GP-1600F GPS/PLOTTER/SOUNDER. We are confident you will see why the FURUNO name has become synonymous with quality and reliability.

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

This equipment is designed and constructed to meet the rigorous demands of the marine environment. However, no machine can perform its intended function unless operated and maintained properly. Please carefully read and follow the recommended procedures for operation and maintenance.

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

Thank you for considering and purchasing FURUNO equipment.

Features

The GP-1600F is a totally integrated GPS receiver, video plotter and video sounder. It mainly consists of a display unit, antenna unit and a dual frequency transducer.

Navigation information is displayed on a bright 6-inch LCD. On-screen information include position, range and bearing to cursor position, range bearing and TTG to waypoint, ETA to waypoint, etc.

A high sensitivity receiver tracks up to eight satellites simultaneously. An 8-state Kalman filter ensures optimum accuracy in determination of vessel position, course and speed.

The main features of the GP-1600F are

- Comprehensive navigation data displays.
- Bright 6-inch LCD with temperature compensated tone and brilliance control.
- Automatic coastline chart loading.
- Position display in latitude and longitude, Loran C LOPs or Decca LOPs.
- Outputs steering information to FURUNO autopilots (FAP-50/55/300/330).
- Improved position accuracy with connection of DGPS beacon receiver (option).
- FURUNO and NAVIONICS chart cards.
- Memory capacity: 2,000 points of track, 100 marks, 100 event marks, 200 waypoints and 20 routes.
- Alarms: Arrival, Anchor Watch, Cross-track Error, Speed, Water Temperature, Depth, and Trip.
- Man overboard feature records latitude and longitude coordinates at time of man overboard and provides continuous updates of range and bearing to that point.
- "Highway" display shows graphic presentation of cross track error (XTE).

1. OPERATIONAL OVERVIEW

1.1 System Configuration

The GP-1600F mainly consists of a display unit, a GPS antenna and a transducer. The memory card drive provides for replay of electronic charts. An autopilot can be connected for automatic steering to destination. External sensors, such as a temperature indicator, can also be connected. Installation of external sensor requires a connector assembly (option). Refer to the installation manual.

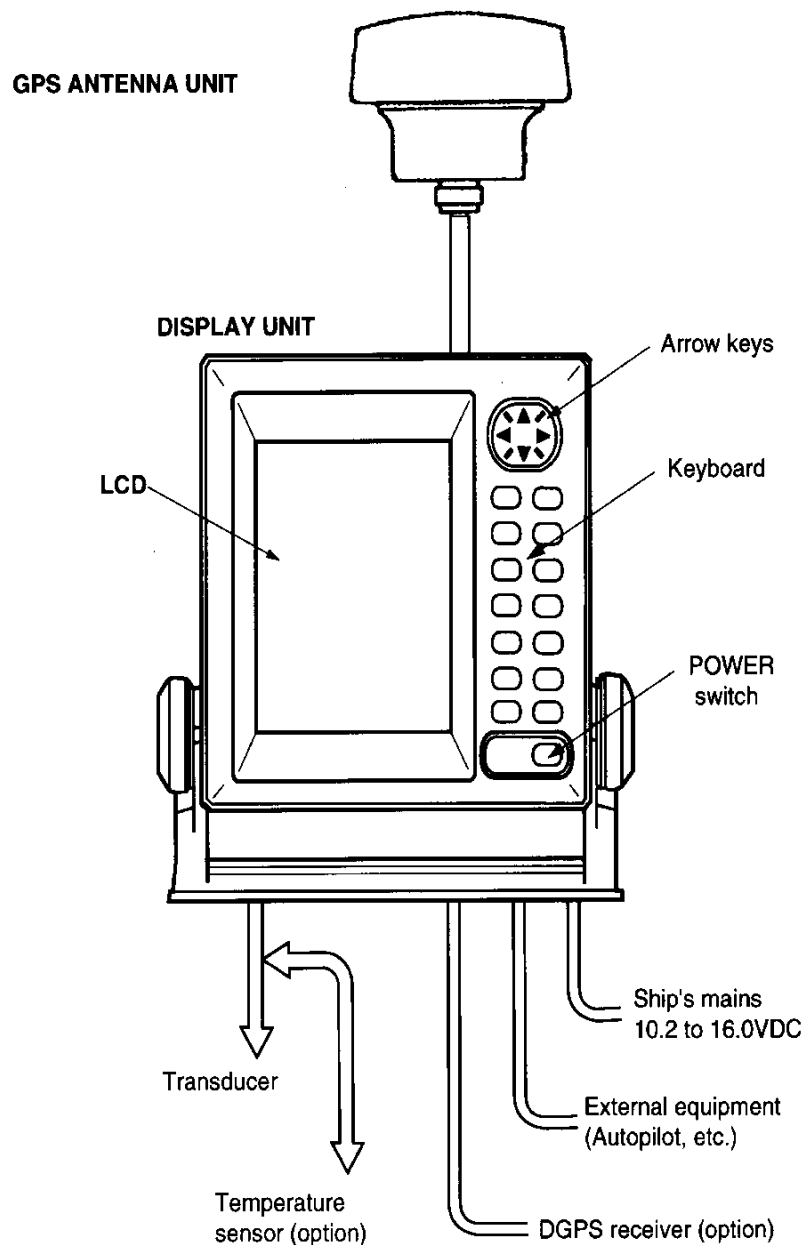


Figure 1-1 System configuration

1.2 Control Description

All operations of the GP-1600F are carried out with the controls on the front panel of the display unit. All controls respond immediately to your command and the unit emits a beep to signify it has accepted your command. (Invalid key input emits several beeps.)

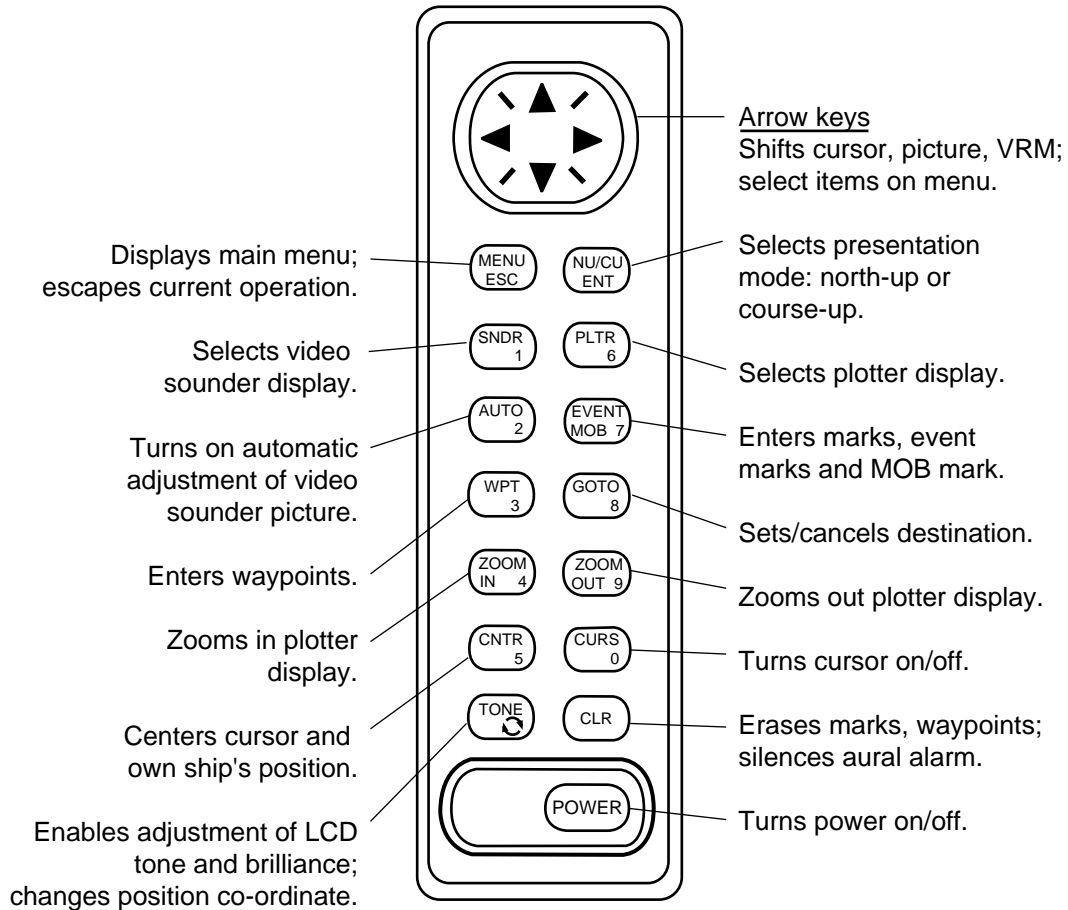


Figure 1-2 Front panel controls

1.3 Inserting Chart Cards

Note: Turn the power off before inserting a chart card. This enables automatic loading of chart.

- 1) Open the memory card slot cover by unfastening two screws.
- 2) Insert the chart card label side up, arrow forward.

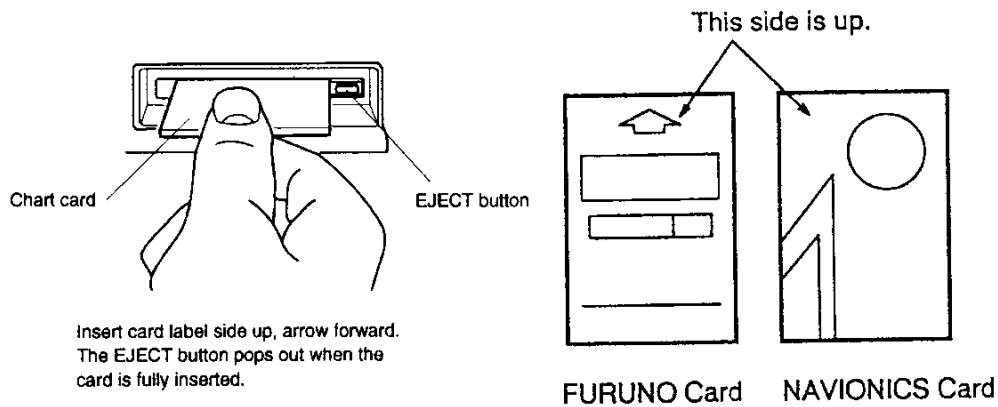
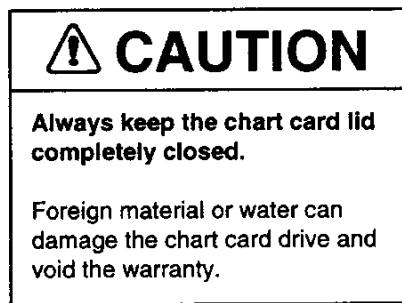


Figure 1-3 How to insert chart card

3) Close the cover and fix it.



1.4 Turning On/Off the Power

Press the [POWER] key to turn the power on/off. When the unit is turned on, it proceeds in the sequence shown in Figure 1-4. About 20 seconds after the start-up sequence is completed, the GPS receiver status indication "ACQ" (at the bottom right-hand corner) changes to 2D (or 3D). ACQ means the receiver is acquiring the GPS signal, and 2D (or 3D) means the ship's position is calculated correctly.

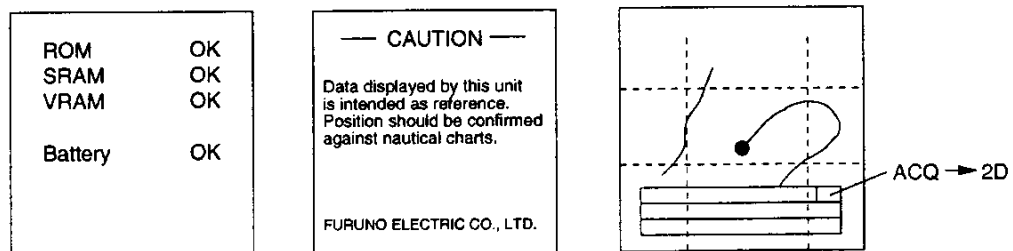


Figure 1-4 Start-up sequence

Note 1: Wait several seconds between power applications.

Note 2: Other GPS receiver status indications may appear on the display depending on receiving status. For further details, see the table on page 6-5.

Note 3: The "DEMO" icon appears when the display is in the demonstration mode. To return to normal mode, turn off the power and then turn it on while pressing and holding down the [ENT] key.

1.5 Selecting Chart Scale

Press the [ZOOM IN] or [ZOOM OUT] key to select suitable chart scale. Display range appears at the center of the display momentarily when the zoom keys are pressed.

1.6 Adjusting Tone and Brilliance

- 1) Press the [TONE] key. The tone and brilliance setting display appears.

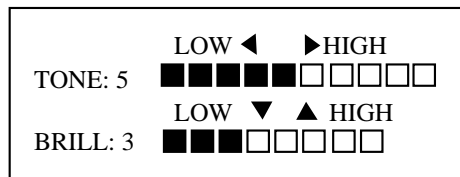


Figure 1-5 Tone and display brilliance setting display

- 2) Operate the [◀] or [▶] key to adjust display tone.
- 3) Press the [▲] or [▼] key to adjust display brilliance.

1.7 Plotter Displays

The [PLTR] key selects a plotter display among normal plotter, plotter/video sounder, data, graphic and highway.

Normal plotter display (North-up presentation)

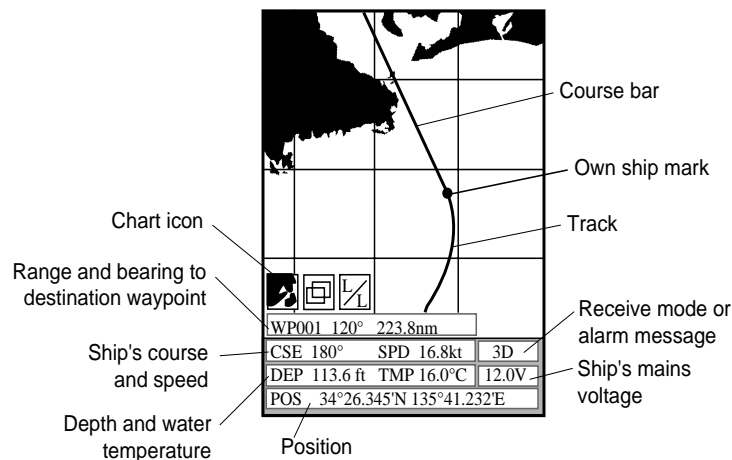


Figure 1-6 Plotter display, north-up presentation

Note: The presentation mode on the plotter displays is selected by the [NU/CU ENT] key. See page 2-2.

Plotter/video sounder display

This display provides a plotter display on the left 2/3 of the screen and the normal video sounder display on the right 1/3. It is useful for searching for fish schools at cruising speed.

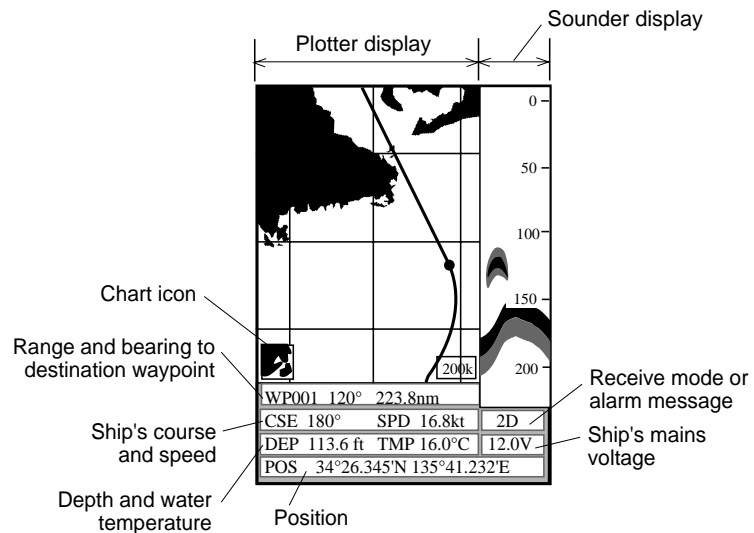


Figure 1-7 Plotter/video sounder display

Digital data display

This display provides position, course, speed, depth, water temperature (optional sensor required), range, bearing and XTE (Cross Track Error – the amount in nautical miles your boat is off intended course) to destination.

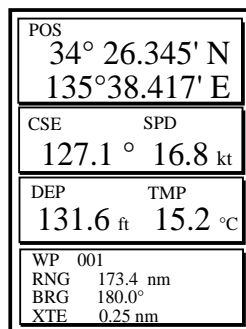


Figure 1-8 Digital data display

Graphic data display, autopilot connection

This display provides position, range and bearing to destination waypoint, trip distance, Estimated Time of Arrival (ETA) at destination, Time-To-Go to destination (TTG), and XTE scale, which shows the amount (in nautical miles) and direction to steer to return to intended course. The XTE scale in Figure 1-9 shows you should steer right by 0.3 nautical miles to return to intended course.

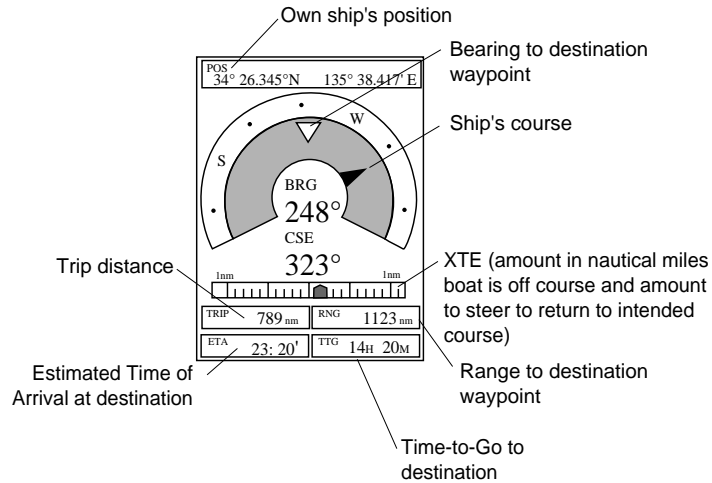


Figure 1-9 Graphic data display, with autopilot connection

Highway display

The highway shows graphic presentation of ship's cross track error (XTE). The scale can be changed by the [ZOOM IN] or [ZOOM OUT] key. The width of the "highway" is changed by the setting of the XTE alarm (page 4-2).

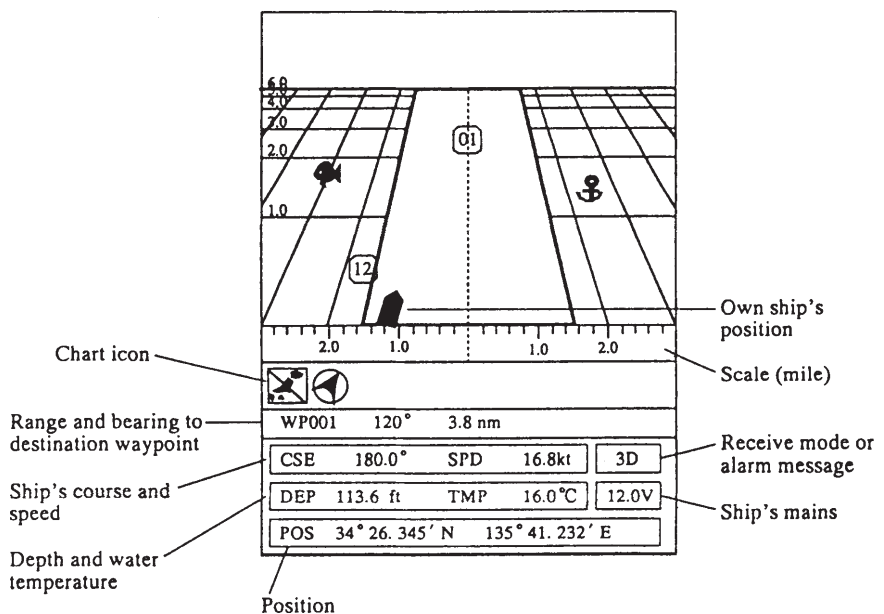


Figure 1-10 Highway display

1.8 Plotter Display Icons

Various icons appear on the display to alert you to operating status. These icons are as follows:

Chart icons. See page 2-4.

Chart position offset applied.

L/L L/L position offset applied.

H Track recording/plotting turned off.

Alarm setting violated.

Low voltage of internal battery

DE MO Demonstaration mode

Figure 1-11 Plotter display icons

1.9 Video Sounder Displays

Five video sounder displays are available: normal, marker zoom, bottom zoom, bottom-lock and A-scope display. You may select a video sounder display with the [SNDR] key.

Normal video sounder display

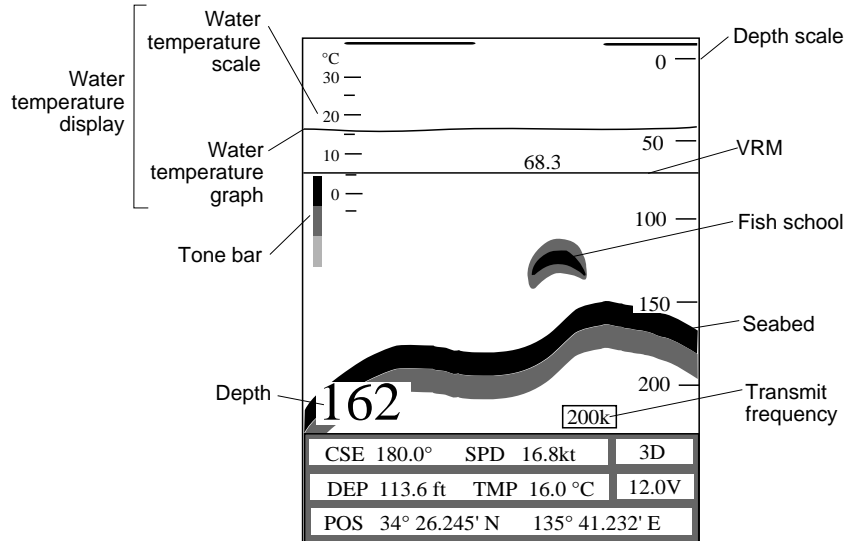


Figure 1-12 Normal video sounder display

Note: The water temperature display requires a triducer or water temperature sensor (option).

Marker zoom display

This display provides an expanded view of the area within the Variable Range Marker (VRM) and the zoom marker. It is useful for judging the size of midwater fish.

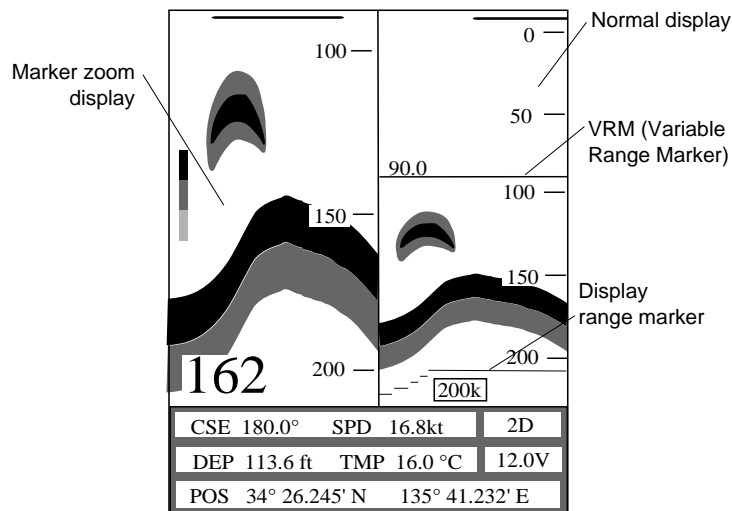


Figure 1-13 Marker zoom display plus normal display

Bottom zoom display

This display is useful for discerning the shape and material of the seabed. The seabed is automatically tracked so bottom echoes locate on the lower half of the screen.

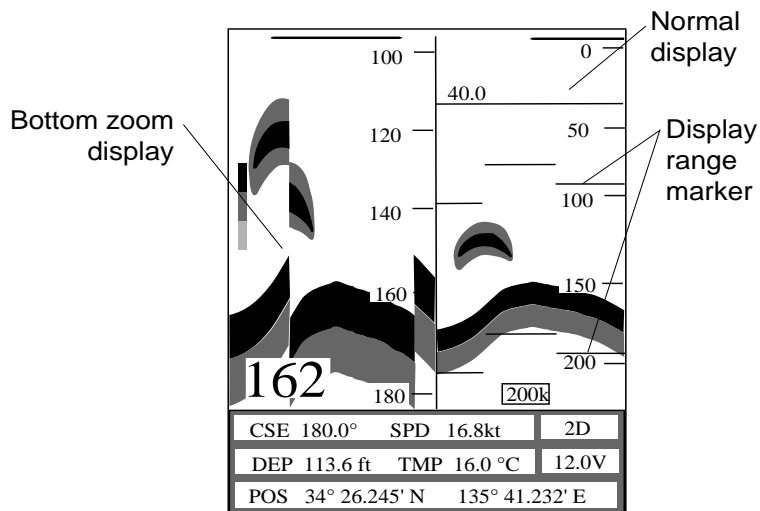


Figure 1-14 Bottom zoom display plus normal display

Bottom-lock display

The bottom-lock display provides an expanded "wide" or "narrow" view (distance depends on unit of measurement) of the area above the seabed. This display is useful for discriminating fish near the seabed.

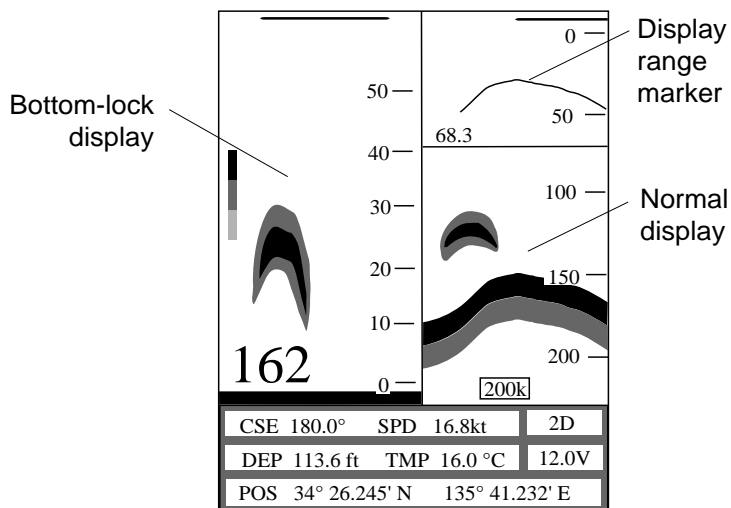


Figure 1-15 Bottom-lock display plus normal display

Note: The expansion marker should be turned on in the SNDR SETUP menu.

A-scope display

This display shows echoes at each transmission with amplitudes and tone proportional to their intensities, on the right 1/3 of the screen. It is useful for estimating the kind of fish school and seabed composition.

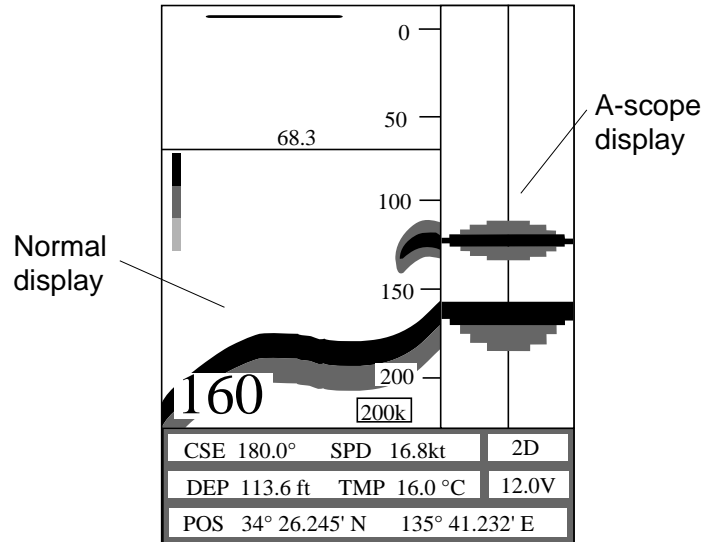


Figure 1-16 A-scope display (right side)

1.10 Menu Operation

Most major operations are carried through menus.

Basic menu operation

- 1) Press the [MENU ESC] key to display the MAIN menu.

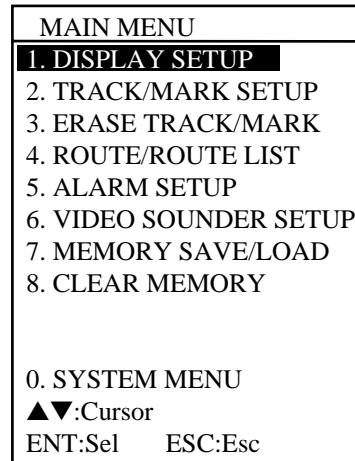


Figure 1-17 MAIN menu

- 2) Press appropriate numeric key or press [▲]/[▼] key and [NU/CU ENT] key to select menu. The highlighted cursor shifts with key operation.
- 3) Press [▲] or [▼] key to select menu item.
- 4) Press [◀] or [▶] key to select option.
- 5) Press the [ESC] key to close menu.

Note: In some cases it may be necessary to press the [NU/CU ENT] key after selecting option.

Entering numeric data

The entry of leading zero is necessary; trailing zero is optional. For example, to enter 050, press [0] [5].

Clearing wrong numeric data

Press the [CLR] key.

1.11 Menu Displays

Plotter menu

SELECT PLOTTER MODE	
▲ Plotter	
Plotter/Sounder	
Data	
Graphic	
▼ Highway	
PLTR:Sel	ESC:Close

Video sounder menu

SELECT SOUNDER MODE	
▲ Normal	
Marker Zoom	
Bottom Zoom	
Bottom Lock	
▼ A-Scope	
50kHz	200kHz
SNDR:Sel	ESC:Close

Auto mode menu










AUTO MODE	
▲ Cruise	
Fish	
▼ Manual	
Low	High
▲ Gain	15 30 60
Range	120 200 400 800 ft
▼ Shift	0 ft

Waypoint menu

SELECT WPT MODE	
▲ Own Position	
Cursor	
WPT List	
▼ Event to WPT	
ENT:Sel	ESC:Cancel

by Own Position, Cursor

LAT:	34° 25.070' N
LONG:	136° 39.242' W
No:	01
MARK:	_ _
CMNT:	22JUN95 00
◀▶:Cursor	▼:Column
ENT:Enter	MENU:Sel Mode

    
   
◀▶▲▼:Cursor
ENT:Enter ESC:Escape

▲ ABCDE FGHIJ KLMNO PQRST UVWXY
Z, -! ? / & = # 12345 67890
abcde fghij klmno pqrst uvwxy
z
ENTER
COMMENT : 22JUN95 00
▲▼◀▶:Cursor
ENT:Enter ESC:Escape

by WPT list

WAYPOINT LIST		
No	LAT/LONG	COMMENT
001	34° 45.567' N 135° 23.321' W	BUOY
002	34° 45.231' N 135° 33.456' W	ANK
010	34° 42.316' N 135° 21.678' W	PORT
▲▼:Cursor	CLR:Delete WPT	
ENT:Edit	MENU:Sel Mode	

Edit = Waypoint: 010
34° 43.216' N 135° 21.678' W
MARK: _ _
CMNT: PORT
◀▶:Cursor ▼:Column
ENT:Enter ⌚:N/S,E/W
ESC:Escape

by Event list

EVENT LIST		
No	LAT	LONG
001	34° 45.678' N	135° 35.321' W
002	34° 45.231' N	135° 35.456' W
▲▼:Cursor		
ENT:Enter	MENU:Sel Mode	

Destination waypoint menu

SELECT GOTO MODE	
▲ WPT List	
EVENT List	
ROUTE List	
▼ Cursor/Route Plan	
CLR : Release	
ENT:Sel	ESC:Cancel

by WPT list

WAYPOINT LIST		
No	LAT/LONG	COMMENT
001	34° 45.567' N 135° 23.321' W	BUOY
002	34° 45.231' N 135° 33.456' W	ANK
010	34° 42.316' N 135° 21.678' W	PORT
▲▼:Cursor	⌚: Page change	
ENT:Enter	CLR : Release	
	MENU:Sel Mode	
* :In use		

by Event list

EVENT LIST		
No	LAT	LONG
001	34° 45.678' N	135° 35.321' W
002	34° 45.231' N	135° 35.456' W
▲▼:Cursor	⌚: Page change	
ENT:Enter	CLR : Release	
	MENU:Sel Mode	

by Route list

ROUTE/ROUTE LIST (REVERSE)			
No	PTS	TOTAL	TTG
01	5	1234.56nm	10:40
* 02	20	2345.67nm	22:36
▲▼:Sel ROUTE	CLR: Release		
⌚: FORWARD/REVERSE			
ENT: Set	MENU: Sel Mode		
* :In use			

MAIN MENU	
1. DISPLAY SETUP	
2. TRACK/MARK SETUP	
3. ERASE TRACK/MARK	
4. ROUTE/ROUTE LIST	
5. ALARM SETUP	
6. VIDEO SOUNDER SETUP	
7. MEMORY SAVE/LOAD	
8. CLEAR MEMORY	
0. SYSTEM MENU	
▲▼:Cursor	
ENT:Sel ESC:Esc	

1

DISPLAY SETUP			
LAND PATTERN	1	2	3 OFF
PLACE NAME	BRT	DIM	OFF
GRID	BRT	DIM	OFF
COURSE BAR	BRT	DIM	OFF
TIME MARK	BRT	DIM	OFF
WPT MARK SIZE	L	S	
CURSOR SIZE	L	S	
SECTOR INFO	ON	OFF	
LIGHTS FLASH	ON	OFF	
▼▲◀▶:Cursor ESC:Esc			

2

TRACK/MARK SETUP	
EVENT SHAPE	▲ ▼ ○ ☆
MARK SHAPE	● □ ◇ × ◻ ◻ ◻
LINE TYPE	— — — — —
MARK	BRT DIM
MARK SIZE	L S
PLOT	ON OFF
PLOT INTVL	TIME DIST AUTO
00° 10 00.10nm	
▲▼◀▶:Cursor ESC:Esc	

3

ERASE TRACK/MARK	
MARK ERASE	NO YES
TRACK ERASE	NO YES
MARK USED	0/100 PT
TRACK USED	0/2000 PT
▲▼:Cursor ▶:Go ESC:Esc	

4

ROUTE/ROUTE LIST			
No	PTS	TOTAL	TTG
01	5	1234.56nm	10:40
* 02	20	2345.67nm	22:36
▲▼:Cursor ENT:Sel ESC:Esc			
CLR:Deleat Route			
*:In use			

5, page 1

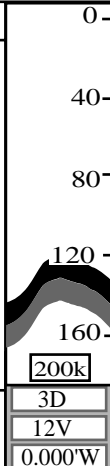
ALARM SETUP		1/2
ARRIVAL	ARRIVAL ANCHOR	OFF
	Range	00.500nm
XTE	ON	OFF
	Range	00.250nm
SPEED	WITHIN OVER	OFF
	Speed	11.0 ~ 15.0kt
TEMP	WITHIN OVER	OFF
	Temp	+11.0 ~ +15.0°C
TRIP	ON	OFF
	Range	005.00nm
▲▼◀▶:Cursor		
ESC:Esc		

5, page 2

ALARM SETUP		2/2
FISH	ON	OFF
	Range	011.0 ~ 015.0 ft
BOTTOM	ON	OFF
	Range	011.0 ~ 015.0 ft
▲▼◀▶:Cursor		
ESC:Esc		

6

VIDEO SOUNDER SETUP	
CLUTTER	0 1 2 3 4 5
	AUTO
ADVANCE	STOP 1/8 1/4
	1/2 1/1 2/1
NOISE LM	OFF NL1
	NL2 NL3
DEPTH AL	ON OFF
TEMP GRP	ON OFF
BRT ECHO	ON OFF
ZOOM	x2 x3
	x4 x5
▲▼◀▶:Cursor	
ESC:Esc	



7

MEMORY SAVE/LOAD	
SAVE MEMORY	NO YES
LOAD MEMORY	NO YES
▲▼◀▶:Cursor ▶:Go ESC:Esc	

8

CLEAR MEMORY	
ENT	: YES
ESC	: NO

System setup menu

0

SYSTEM MENU
1. SELF TEST
2. PLTR SETUP
3. SOUNDER SETUP
4. UNIT SETUP
5. SENSOR SETUP
6. NMEA SETUP
7. GPS SETUP
8. DGPS SETUP
9. CHART POSN CALIB
▲▼:Cursor
ENT:Sel ESC:Esc

1

SELF-TEST
1. GPS MONITOR DISPLAY
2. MEMORY, I/O PORT TEST
3. PANEL TEST
4. DISPLAY TEST
▲▼:Cursor
ENT:Sel ESC:Esc

2

PLTR SETUP
NAVAID OWN LC DC ALL
SCALE SCALE RANGE
SMOOTHING 00 (00~15)
SPD AVERAG 00 min
BEARING TRUE MAG
MAG CALIB AUTO MAN
06.9° W 00.0° E
EVNT METHOD EVENT MARK
POSITION L/L LOP
DISP LC DC
Chain:Sec 7970:11-26
LOP CALIB +000.0µs
+000.0µs
↻ :E/W
▼▲ :Cursor ESC:Esc

3

SNDR SETUP
EXP MARKER ON OFF
TVG 0 1 2 3 4
5 6 7 8 9
ECHO LEVEL +00
(-20 ~ +20)
BTM-LOCK NARROW WIDE
ES-STOP ON OFF
▼▲◀▶:Cursor
ESC:Esc

4

UNIT SETUP
DISTANCE nm km sm
DEPTH m ft fa
TEMP °C °F
▲▼◀▶:Cursor ESC:Esc

5

SENSOR SETUP
SPD SENSOR STW SOG
TEMP SENSOR OWN NMEA
SPD CALIB +00%(-50 ~ +50)
TEMP CALIB +00.0 °C
DEPTH CALIB +0.0 ft
▼▲ :Cursor ↻ :+/-
ESC:Esc

6

NMEA SETUP
FORMAT 183V1.5 183V2.0
EXT DEVICE REM PILOT
▲▼◀▶:Cursor ESC:Esc

7

GPS SETUP
GPS SMOOTHING
Posn 000 (000 ~ 999)
Spd 000 (000 ~ 999)
GEODETIC WGS-84 OTHER(002)
POS CALIB 00.000°N 00.000°E
UNHEALTH RSTR DISABLED (03)
TIME DIFF +00: 00
▼▲:Cursor ↻: N/S, E/W, +/-
ENT:Ent ESC:Esc

8

DGPS SETUP
DGPS ON OFF
RTCM VER 1.0 2.0
BYTE FORM 8-6 8-8
FIRST BIT MSB LSB
PARITY BIT EVEN ODD NONE
STOP BIT 1 2
BIT RATES 7 8
BAUD RATES 300 600 1200
2400 4800 9600
RS TYPE 422 232C
▼▲◀▶:Cursor
ENT:Sel ESC:Esc

9

CHART POSN CALIB
POSN CALIB OFF ON
CALIB 00.000°N 00.000°E
GEODETIC WGS-84
ENT:Ent ESC:Esc

2. PLOTTER OPERATION

2.1 Plotter Displays

The plotter display traces the ship's track on the display using position data fed from the GPS navigator. The track is continuously plotted, even when viewing the video sounder display.

Selecting plotter displays

- 1) Press the [PLTR] key. The following menu appears.

SELECT PLOTTER MODE	
▲	Plotter
	Plotter/Sounder
	Data
	Graphic
▼	Highway
PLTR:Sel	ESC:Close

Figure 2-1 Plotter display selection menu

- 2) Press the [PLTR] key or the [▲]/[▼] key to select display desired.
- 3) Press the [MENU ESC] key. The menu disappears. When the [MENU ESC] key is not pressed, the menu disappears after 10 seconds.

Plotter display description

Normal plotter display: This display traces the ship's track on the screen. Coastline charts, provided on chart cards (option), display the coastline of your area. Navigation data is digitally displayed.

Plotter/Sounder display: This display provides the plotter display on the left 3/4 of the screen and video sounder picture on the right 1/4. It is useful for monitoring the seabed while cruising.

Digital data display: This display provides digital navigation data.

Graphic data display: This display provides navigation data in graphic form. Own ship's direction and drift are graphically shown.

Highway display: The highway display provides a 3D view of ship's course line forward of own ship. It is useful observing cross track error.

2.2 Presentation Mode

Two type of display orientations are provided for the plotter display and plotter/sounder display: north-up and course-up.

North-up

North is at the top of the display. This mode is useful for long-range navigation.

Course-up

Ship's course is at the top of the display. This mode is useful for finding course error and the relation between own ship and waypoint.

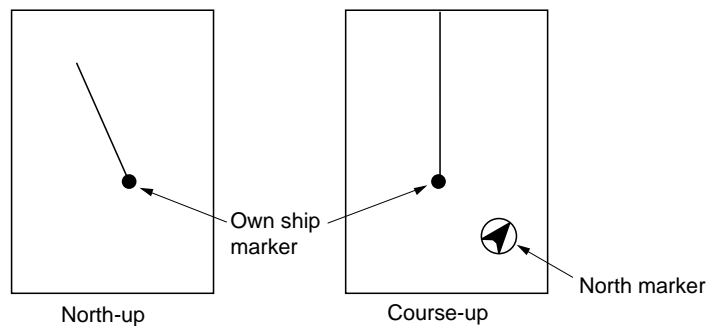


Figure 2-2 North-up and course-up presentation modes

Selecting presentation mode

Press the [NU/CU ENT] key more than one second.

Each time that keying sequence is repeated the presentation mode changes to either course-up or north up. The north-up mark appears at the bottom of the display and the own ship mark's shape is a triangle when course-up is selected.

Note: NAVIONICS chart does not provide course-up presentation display.

2.3 The Cursor

Cursor function

The cursor functions to

- find latitude and longitude of a location
- find range and bearing from your ship to cursor position, and
- enter and erase marks and waypoints.

Turning cursor on/off, shifting the cursor

The [CURS] key turns the cursor on/off alternately. You can shift the cursor by operating the [Arrow] keys. The cursor moves in the direction of the [Arrow] key pressed. When the cursor reaches an edge of the screen, the display is scrolled.

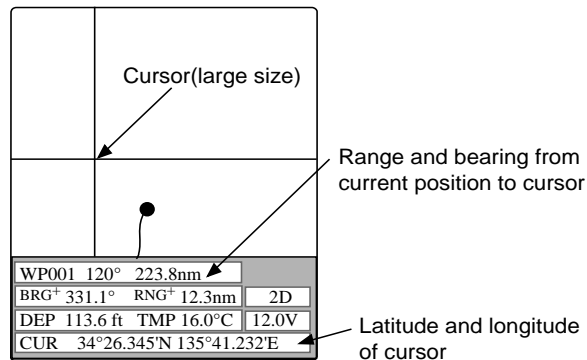


Figure 2-3 Display, showing location of cursor data




Note: The size of the cursor can be set for large or small on the DISPLAY SETUP menu.

2.4 Chart Cards

The chart cards contain nautical charts. When you insert a suitable chart card in the drive and your boat is near land, a chart appears with the land portion arranged according to the land pattern setting on the DISPLAY SETUP menu.

When a wrong card is inserted or the wrong chart scale is selected, the land will be hollow. Insert the proper card and select a suitable chart scale. Chart icons appear to help you select suitable chart scale. Table 2-1 explains the chart icons and their meanings.

Table 2-1 Chart icons and their meanings

Icon	Meaning
	Proper card is not inserted or chart scale is too small (chart is overenlarged). Press the [ZOOM IN] key to adjust chart scale.
	Chart scale is too large. Press the [ZOOM OUT] key to adjust chart scale. This icon appears only with FURUNO charts.
	Suitable chart scale is selected.

Indices and chart enlargement (FURUNO charts only)

When the [ZOOM OUT] key is pressed, you will see several frames. These frames are called indices and they show you what parts of the chart can be enlarged in the current chart scale. The areas circumscribed with smaller frames can be enlarged, but the area enclosed by the largest frame cannot.

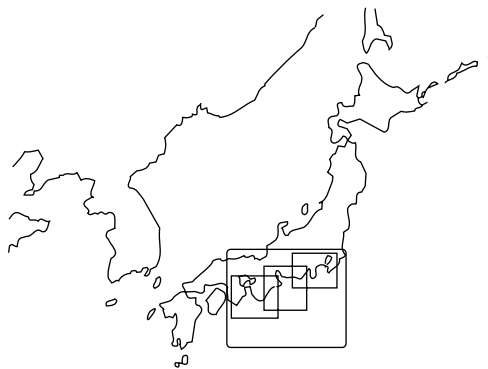


Figure 2-4 Sample chart (Japan and South Korea)

Notice on Chart Display

A chart will not be displayed in the following conditions:

- When the chart scale is too large or too small.
- When scrolling the chart outside the indices.

When this happens, the message "No Chart" appears for a couple of seconds.

The icon  also appears, at the bottom left corner on the screen.

2.5 Chart Symbols

Chart symbols and their meanings

The table below shows chart symbols and their meanings, for FURUNO digital charts.

Table 2-2 FURUNO digital chart symbols









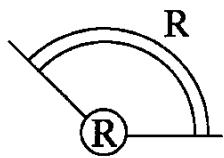
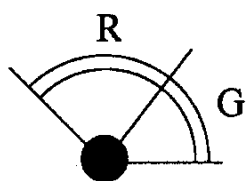
Symbol	Description	Symbol	Description
	Summit	•	Position of Sounding
	Wreck	×	Obstruction
	Lighthouse		Fishing Reef
	Lighted Buoy	□	Platform
	Buoy		Anchorage
	Radio Station		

Table 2-3 Newly designed *FURUNO* digital chart symbols
(Additional symbols)

Type	Color	Symbol																
Lighthouse	Red	Ⓡ																
	Green	Ⓞ																
	White	Ⓜ																
	Others	●																
Lighted-buoy	Red	Ⓡ																
	Green	Ⓞ																
	White	Ⓜ																
	Others	Ⓡ																
Foghorn		★																
Arc presentation (Lighthouse)		 <p>The arc is viewable range and alphabet is lighting color.</p> <table border="1"> <tr> <td>Red</td> <td>R</td> <td>Light blue</td> <td>C</td> </tr> <tr> <td>Green</td> <td>G</td> <td>Yellow</td> <td>Y</td> </tr> <tr> <td>White</td> <td>W</td> <td>Blue</td> <td>B</td> </tr> <tr> <td>Orange</td> <td>O</td> <td></td> <td></td> </tr> </table>	Red	R	Light blue	C	Green	G	Yellow	Y	White	W	Blue	B	Orange	O		
	Red	R	Light blue	C														
Green	G	Yellow	Y															
White	W	Blue	B															
Orange	O																	
		 <p>For multiple colors</p>																

Difference between FURUNO chart and NAVIONICS chart

Table 2-4 FURUNO chart versus NAVIONICS chart

Item	FURUNO	NAVIONICS
Dot scrolling capability	YES	YES
Course-up display	YES	NO
Lighthouse data presentation	YES *3	YES
Zoom at cursor position	YES	*1
Range at Equator	1, 1.5, 2, 3, 4, 5, 6, 8, 12...8192 nm	0.125, 0.25, 0.5, 1, 2, 3, 4, 8...1024 nm
Chart offset data entry	YES	NO
Centering	YES	*2

*1 NAVIONICS chart may not center cursor perfectly.

*2 NAVIONICS chart may not center own ship's position perfectly.

A NAVIONICS chart may disappear for some time when the display is scrolled.

*3 Using newly designed chart cards containing lighthouse data. Chart cards for North America area are completed, and others are under production in.

Lighthouse and buoy data display

You can find data of lighthouses and buoys by placing the cursor on them.

Lighthouse and buoy data are abbreviated on the display as shown in Figure 2-5.

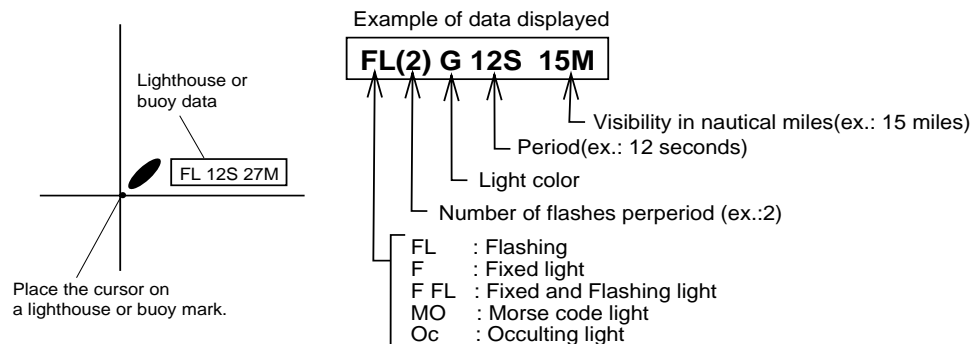


Figure 2-5 Interpretation of buoy/lighthouse data

2.6 Shifting the Plotter Display

Centering ship's position

- 1) Press the [CURS] key to turn off the cursor if it is currently displayed.
- 2) Press the [CNTR] key.

Note: NAVIONICS chart may not center ship's position perfectly.

Centering a location

- 1) Press the [CURS] key to turn on the cursor if it is not currently displayed.
- 2) Operate the [Arrow] keys to set the cursor on the location you want to center.
- 3) Press the [CNTR] key.

Note: NAVIONICS chart may not center cursor position perfectly.

Scrolling the display

- 1) Press the [CURS] key to turn off the cursor if it is currently displayed.
- 2) Operate the [Arrow] keys to scroll the display in direction desired.

The display is scrolled when the cursor reaches an edge of the screen.

2.7 Entering Waypoints

In navigation terminology, a waypoint is a particular location on a voyage whether it be a starting, intermediate or destination point. A waypoint is the simplest piece of information the GP-1600F requires to get you to a destination, in the shortest distance possible.

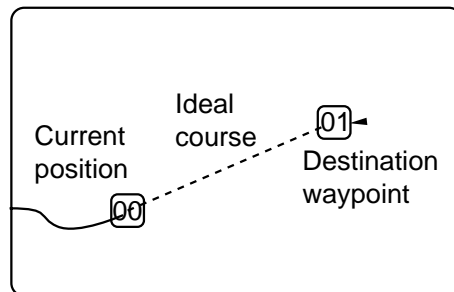


Figure 2-6 Waypoint 01 selected as destination

This unit has 200 waypoints into which you can enter position information. There are four methods by which you can enter a waypoint:

- by the cursor
- through the waypoint list (manual input of latitude and longitude)
- by own ship's position
- by event position

Entering waypoints by the cursor

- 1) Press the [WPT] key.
The menu for selection of waypoint entry method appears.

SELECT WPT MODE	
▲	Own Position
	Cursor
	WPT List
▼	Event to WPT
ENT:Sel	ESC:Cancel

Figure 2-7 Display for selection of waypoint entry method

- 2) Press the [▼] or [▲] key to select Cursor and press [NU/CU ENT] key. The cursor location confirmation message window appears.

Note: The above menu disappears after 10 seconds if no key is pressed.

- 3) Operate the [Arrow] keys to place the cursor on the position desired. Then press [NU/CU ENT] key. The display shows the waypoint entry window.

LAT: 34° 25.070' N)	Cursor position
LONG: 136°39.242' E)	
No: 001	Youngest empty waypoint number assigned automatically.
MARK: _ _	
CMNT: 22JUN95 00	
◀▶:Cursor ▼:Column	
ENT:Enter MENU:Sel Mode	

Figure 2-8 Display for entry of waypoint number

- 4) The cursor is on the first digit on the "No." line. The unit will automatically save the waypoint under the youngest empty waypoint. However, you may change the number, if desired.

Note: If you want to mark the waypoint with the standard waypoint mark (octagon with waypoint number in center) and do not need to change the comment (date), press the [NU/CU ENT] key to enter waypoint and escape.

- 5) To enter a special mark at the waypoint position, press the [▼] key to place the cursor on the MARK line. The following display appears.


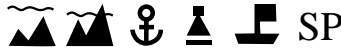


◀▶▲▼:Cursor ENT:Enter ESC:Escape

Figure 2-9 Window for selection of waypoint mark

- 6) Operate the [Arrow] keys to select a mark and then press the [NU/CU ENT] key. The display for entry of waypoint comment appears.

ABCDE FGHIJ KLMNO PQRST UVWXY Z,-!/?/&=# 12345 67890 abcde fghij klmno pqrst uvwxy z ENTER
COMMENT : 22JUN95 00
◀▶▲▼:Cursor ENT:Enter ESC:Escape

Figure 2-10 Characters available for waypoint comment

Note: The date is attached to a comment automatically. You may erase the data and enter your own comment, which may contain ten characters. You may also change comments on the waypoint list.

- 7) To store date as comment, press the [▼] key several times to select ENTER and press the [NU/CU ENT] key. To change comment, operate the [Arrow] keys to select character.
- 8) Press the [NU/CU ENT] key.
- 9) Repeat steps 7 and 8 to complete the comment.
 Press the [CLR] key to correct wrong character. The character left of the cursor is erased.
- 10) To terminate the comment, operate the [Arrow] keys to select ENTER. To cancel the comment entered, press the [MENU ESC] key.
- 11) Press the [NU/CU ENT] key.
- 12) Press the [MENU ESC] key to escape.

Entering waypoints at own ship's position

- 1) Press the [WPT] key.
 The menu for selection of waypoint entry method appears.
- 2) Press the [▲] key to select Own Position.
- 3) Press the [NU/CU ENT] key.
- 4) Change waypoint number, if desired.
- 5) Press the [▼] key to select mark shape and enter a comment as explained in "Entering waypoints by the cursor," or press the [NU/CU ENT] key to enter waypoint and escape.

Entering waypoints through the waypoint list

- 1) Press the [WPT] key.
- 2) Press the [▼] key to select WPT List.
- 3) Press the [NU/CU ENT] key. The waypoint list appears.

WAYPOINT LIST		
No	LAT/LONG	COMMENT
001	34° 45.567' N 135° 23.321' W	BUOY
002	34° 45.231' N 135° 33.456' W	ANK
010	34° 42.316' N 135° 21.678' W	PORT
▲▼:Cursor CLR:Delete WPT		
ENT:Edit MENU:Sel Mode		

Figure 2-11 Sample waypoint list

- 4) Press the [▲] or [▼] key to select vacant waypoint number.
- 5) Press the [NU/CU ENT] key. The editor display appears.

Edit = Waypoint: 010	
34° 43.216 'N 135° 21.678'W	
MARK: _ _	
CMNT: PORT	
◀▶:Cursor	▼:Column
ENT:Enter	☉:N/S,E/W
ESC:Escape	

Figure 2-12 Waypoint editor display

- 6) Enter latitude and longitude. (For South latitude or East longitude, press the [TONE] key before entering latitude or longitude.)
- 7) Press [▼] key to select a mark shape and enter a comment as explained in "Entering waypoints by the cursor," or press the [NU/CU ENT] key to enter waypoint and escape.

Entering waypoints by event position

- 1) Press the [WPT] key.
- 2) Press the [▼] key to select Event to WPT.
- 3) Press the [NU/CU ENT] key. The event list appears.
- 4) Press the [▲] or [▼] key to select event position to enter as a waypoint.
- 5) Press the [NU/CU ENT] key.
- 6) Change waypoint number, select waypoint mark and enter comment, or press the [NU/CU ENT] key to save waypoint under waypoint number shown, date and standard waypoint mark.
- 7) Press the [MENU ESC] key twice to escape.

2.8 Changing Waypoint Data

You may change the latitude and longitude position and comments of waypoints you have entered, through the waypoint list.

- 1) Press the [WPT] key.
The menu for selection of waypoint entry method appears.
- 2) Press the [▲] key to select WPT List.
- 3) Press the [NU/CU ENT] key. The waypoint list appears.
- 4) Operate the [▲] or [▼] key to select waypoint number to change.
- 5) Press the [NU/CU ENT] key. The confirmation window appears.

OVER WRITE ENT:YES ESC:NO

Figure 2-13 Window for over writing waypoint data

- 6) Press the [NU/CU ENT] key. The Editor display appears.
- 7) Press the [NU/CU ENT] key. To change position, operate the [◀] or [▶] key to select digit in position to change and press appropriate numeric key.
- 8) Press the [▼] key to go to the MARK line. Select mark and press the [NU/CU ENT] key.
- 9) The comment entry display appears. Change the comment by selecting appropriate characters, selecting ENTER and pressing the [NU/CU ENT] key, or press the [NU/CU ENT] key to keep the original comment.

2.9 Erasing Waypoints

The GP-1600F provides two ways by which you can erase waypoints:

- by the cursor, or
- through the waypoint list.

Erasing waypoints by the cursor

- 1) Press the [CURS] key to turn on the cursor.
- 2) Operate the [Arrow] keys to place the cursor on the waypoint you want to erase.
- 3) Press the [CLR] key.

Erasing waypoints through the waypoint list

- 1) Press the [WPT] key.
- 2) Press the [▲] key to select WPT List.
- 3) Press the [NU/CU ENT] key. The waypoint list appears.
- 4) Press the [▲] or [▼] key to select waypoint number.
- 5) Press the [CLR] key. The confirmation window appears.
- 6) Press the [NU/CU ENT] key.

2.10 Setting/Canceling Destination Waypoint

The GP-1600F offers three methods by which you can set destination:

- by waypoint in waypoint list
- by event list (discussed later in this chapter)
- by route list (discussed later in this chapter).

When you select a destination waypoint, range and bearing from own ship to that point appear at the bottom of the display.

Setting destination by waypoint number

- 1) Press the [GOTO] key.
The following menu appears.

SELECT GOTO MODE	
▲	WPT List
	EVENT List
	ROUTE List
▼	Cursor/Route Plan
CLR: Release	
ENT:Sel	ESC:Cancel

Figure 2-14 Destination waypoint selection menu

- 2) Press the [▲] key to select WPT List.
- 3) Press the [NU/CU ENT] key. The waypoint list appears.

WAYPOINT LIST		
No	LAT/LONG	COMMENT
001	34° 45.567' N 135° 23.321' W	BUOY
002	34° 45.231' N 135° 33.456' W	ANK
010	34° 42.316' N 135° 21.678' W	PORT
▲▼	:Cursor	↻ : Page change
ENT	:Edit	CLR:Release
		MENU:Sel Mode
*	: In use	

Figure 2-15 Waypoint list

- 4) Operate the [▲] or [▼] keys to select a waypoint number.
- 5) Press the [NU/CU ENT] key.
 - A dashed line runs between waypoint selected and own ship's position.
 - The range and bearing to the destination appear at the bottom of the display.

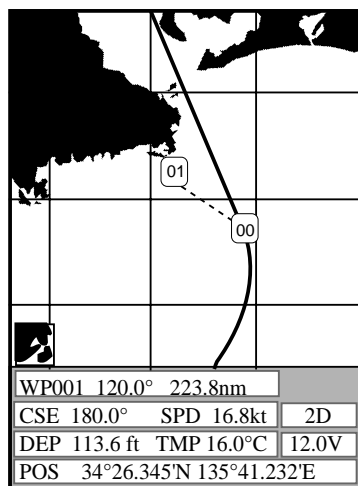


Figure 2-16 Appearance of display when destination is selected by waypoint

Setting destination by event position

- 1) Press the [WPT] key.
- 2) Press the [▼] key to select Event List.
- 3) Press the [NU/CU ENT] key. The event list appears.
- 4) Press the [▼] or [▲] key to select event point.
- 5) Press the [NU/CU ENT] key.

Cancelling destination waypoint

- 1) Press the [GOTO] key.
- 2) Press the [CLR] key.
- 3) Press the [NU/CU ENT] key.
- 4) Press the [MENU ESC] key twice.

2.11 Entering Routes

Often a trip from one place to another involves several course changes, requiring a series of route points (waypoints) which you navigate to, one after another. The sequence of waypoints leading to the ultimate destination is called a route. The GP-1600F can automatically advance to the next waypoint on a route, so you do not have to change the destination waypoint repeatedly.

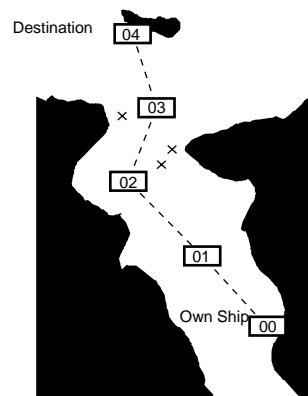


Figure 2-17 Sample route

You can store up to 20 routes. They are numbered from 01 to 20 on the route list. A route may consist of 30 points.

A route can be constructed two ways: through the route list or by using the cursor.

Entering routes by cursor

- 1) Press the [GOTO] key.
The destination waypoint menu appears.

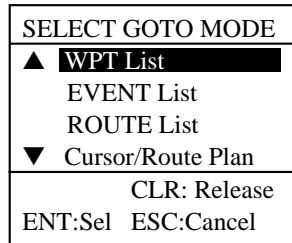


Figure 2-18 Display for selection of destination

- 2) Press the [▼] key to select Curosr/Route Plan.
- 3) Press the [NU/CU ENT] key.
- 4) Operate the [Arrow] keys to place the cursor on location for destination waypoint.
- 5) Press the [NU/CU ENT] key. To clear entry, press the [CLR] key.
- 6) Repeat steps 4 and 5 to complete the route.

Note: Any route waypoints you enter here will also be entered on the waypoint list.

- 7) Press the [NU/CU ENT] key.
- 8) Select route number.

If you do not want to store the route permanently, press the [MENU ESC] key to escape.

- 9) Press the [NU/CU ENT] key.

A dashed line connects all waypoints including own ship's position. The range and bearing to the first waypoint appear at the bottom of the display.

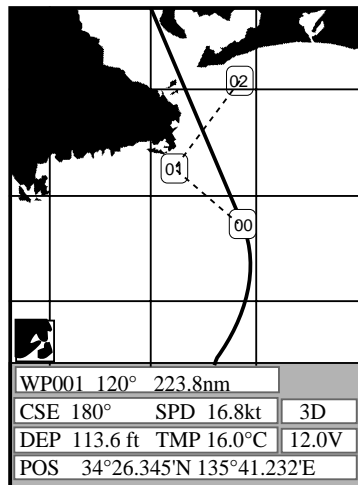


Figure 2-19 Appearance of cursor-created route selected for navigation

Entering routes through the route list

One advantage of this method is that you can use waypoints you have already entered.

- 1) Press the [MENU ESC] key.
- 2) Press the [4] key to display the ROUTE/ROUTE LIST.

ROUTE/ROUTE LIST			
No	PTS	TOTAL	TTG
01	5	1234.56nm	10:40
* 02	20	2345.67nm	22:36

▲▼ :Cursor	ENT: Sel	ESC: Esc
CLR:	Delete Route	
* :	In use	

Figure 2-20 ROUTE/ROUTE LIST

- 3) Press the [▲] or [▼] key to select route number.
- 4) Press the [NU/CU ENT] key. The route entry screen appears.

ROUTE LIST LEG: -.-.-.- nm		
-.-.-	-.-.-	-.-.-
-.-.-	-.-.-	-.-.-
-.-.-	-.-.-	-.-.-
-.-.-	-.-.-	-.-.-
-.-.-	-.-.-	-.-.-
WAYPOINT LIST		
No	LAT/LONG	COMMENT
001	34° 45.567' N 135° 23.321' E	BUOY
* 002	34° 45.567' N 135° 23.321' E	ANK
005	34° 42.316' N 135° 21.678' E	PORT
◀▶:Cursor		ENT:Sel
⊙:Skip CLR>Delete		ESC:Esc

Figure 2-21 Route entry screen

- 5) Press the [NU/CU ENT] key to enable entry of waypoints.
- 6) Press the [▼] or [▲] key to select waypoint number.
- 7) Press the [NU/CU ENT] key. The waypoint number selected appears and the cursor shifts to next column.
- 8) Repeat steps 6 and 7 to complete the route.
- 9) When the route is completed, press the [MENU ESC] key three times to escape.

2.12 Setting Trial Speed

The TTG between legs on the route is calculated based on the trial speed, which is entered in the route/route list. The default speed is 10 knots. To enter a different speed, do the following:

- 1) Press the [MENU ESC] key.
- 2) Press the [4] key to select ROUTE/ROUTE LIST. The route/route list appears.
- 3) Place the cursor on waypoint 01 and press the [▲] key, or place the cursor on waypoint 20 and press the [▼] key.
- 4) Press ten keys to set the trial speed.
- 5) Press the [▼] or [▲] key to escape.
- 6) Press the [NU/CU ENT] key.
- 7) Press the [MENU ESC] key twice to escape.

2.13 Following a Route

Following a route is the process by which you use a registered route for navigation. Your displays navigation information to guide you from one waypoint to the next, as it automatically switches from one waypoint to another in sequence.

- 1) Press the [GOTO] key.
- 2) Press the [MENU ESC] key.
- 3) Press the [▼] key to select ROUTE List.
- 4) Press the [NU/CU ENT] key. The route list appears.
- 5) Press the [▼] or [▲] key to select route which you want to follow.
- 6) If you want to navigate the waypoints of the route in the order reverse of which they were entered, press the [↺] key. Direction selected appears at the top of the display.
- 7) Press the [NU/CU ENT] key. An asterisk appears to the left of route selected.

Route appearance on the display

- A dashed line connects all waypoints including own ship's position.
- Range and the bearing to the first waypoint appear at the bottom of the display.

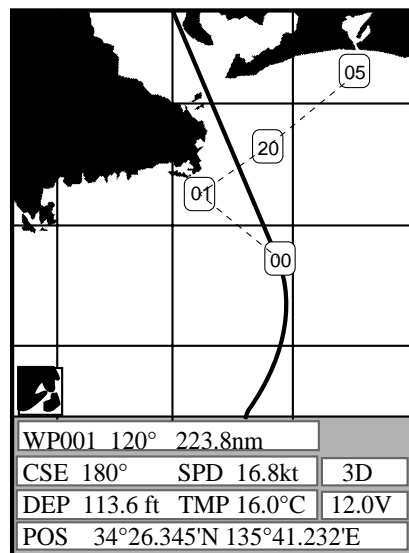


Figure 2-22 Appearance of waypoint-created route selected for navigation

2.14 Skipping/Restoring Route Waypoints

Skipping route waypoints

There are times when you won't need to follow all waypoints in a route. You can skip route waypoints temporarily as follows.

- 1) Press the [MENU ESC] key.
- 2) Press the [4] key. The route/route list appears.
- 3) Press the [▲] or [▼] keys to select route number.
- 4) Press the [NU/CU ENT] key. The confirmation message appears.
- 5) Press the [NU/CU ENT] key.
- 6) Press the [Arrow] keys to select waypoint to skip.
- 7) Press the [↻] key to skip that point temporarily. The route waypoint number becomes dim.
- 8) Press the [NU/CU ENT] key.
- 9) Press the [MENU ESC] key twice to escape.

Restoring route waypoints

When you want to restore a route waypoint, press the [↻] key in step 7 of the above procedure. Waypoint number appears in normal brilliance.

2.15 Cancelling Route Navigation

- 1) Press the [GOTO] key.
- 2) Press the [CLR] key.
- 3) Press the [NU/CU ENT] key.
- 4) Press the [MENU ESC] key twice to escape.

2.16 Erasing Route Waypoints

- 1) Press the [MENU ESC] key.
- 2) Press the [4] key. The route/route list appears.
- 3) Press the [▲] or [▼] key to select route number.
- 4) Press the [NU/CU ENT] key twice.

- 5) Operate the [Arrow] keys to select route waypoint which you want to erase.
- 6) Press the [CLR] key.
- 7) Press the [MENU ESC] key several times to escape.

Note: To erase entire route, erase all waypoints.

2.17 Entering Marks

You can inscribe marks on the display to denote important locations; for example, buoy, fishing point, wreck. Further, marks can be connected with lines to depict important areas such as a hot fishing spot or danger area.

Enabling entry of marks

The [EVENT MOB] key enters marks. When the key is pressed a mark, an event mark or MOB mark appears on the display depending on menu setting.

To enable entry of marks on the display, do the following:

- 1) Press the [MENU ESC] key.
- 2) Press the [0] key to select SYSTEM MENU.
- 3) Press the [2] key to select PLTR SETUP.

PLTR SETUP	
NAVAID	OWN LC DC ALL
SCALE	SCALE RANGE
SMOOTHING	00 (00~15)
SPD AVERAG	00 min
BEARING	TRUE MAG
MAG CALIB	AUTO MAN
	06.9° W 00.0° E
EVNT METHOD	EVENT MARK
POSITION	L/L LOP
DISP	LC DC
Chain:Sec	7970:11-26
LOP CALIB	+000.0µs
	+000.0µs
	↻:E/W
▼▲ :Cursor	ESC:Esc

Figure 2-23 PLTR SETUP menu

- 4) Press the [▼] or [▲] key to select EVNT METHOD.
- 5) Press the [▶] key to select MARK.
- 6) Press the [MENU ESC] key.

Entering marks

To enter a mark at ship's position;

- 1) Press the [CURS] key to turn off the cursor.
- 2) Press the [EVENT MOB] key. A mark is placed at ship's position.

To enter a mark at cursor location;

- 1) Press the [CURS] key to turn on the cursor.
- 2) Press the [EVENT MOB] key. A mark is placed at cursor location.

The mark currently selected on the TRACK/MARK SETUP menu appears at the cursor location (or current ship's position).

2.18 Changing Mark Attributes

Changing mark size

You may change the size of marks to small or large.

- 1) Press the [MENU ESC] key. The main menu appears.
- 2) Press the [2] key to select TRACK/MARK SETUP.

TRACK/MARK SETUP	
EVENT SHAPE	△ ▽ ○ ☆
MARK SHAPE	● □ ◇ × ⊕ ⊞
LINE TYPE	- — - - -
MARK	BRT DIM
MARK SIZE	L S
PLOT	ON OFF
PLOT INTVL	TIME DIST AUTO
	00° 10 00.10nm
▲▼◀▶:Cursor ESC:Esc	

Figure 2-24 TRACK/MARK SETUP menu

- 3) Press the [▼] or [▲] keys to select MARK SIZE.
- 4) Press the [◀] or [▶] key to select L or S.
- 5) Press the [MENU ESC] key.

Changing mark shape

You may select the shape of marks on the TRACK/MARK SETUP menu.

- 1) Press the [MENU ESC] key.
- 2) Press the [2] key to select TRACK/MARK SETUP.
- 3) Operating the [Arrow] keys, select MARK SHAPE and shape desired.
- 4) Press the [MENU ESC] key.

2.19 Erasing Marks

Marks can be erased individually or collectively. How to erase marks collectively will be discussed later.

- 1) Press the [CURS] key to turn on the cursor.
- 2) Operate the [Arrow] keys to place the cursor on the mark to erase.
- 3) Press the [CLR] key.

2.20 Connecting Marks

Marks can be connected with solid or dashed lines. This feature is useful for denoting important areas.

- 1) Press the [MENU ESC] key.
- 2) Press the [2] key to select TRACK/MARK SETUP.
- 3) Operate the [Arrow] keys to select LINE TYPE to other than "single dot."
- 4) Press the [MENU ESC] key.
- 5) Press the [CURS] key to turn on the cursor.
- 7) Press the [Arrow] keys to place the cursor on location desired for mark.
- 8) Press the [EVENT MOB] key.
- 9) Repeat steps 7 and 8 to continue entering and connecting marks.

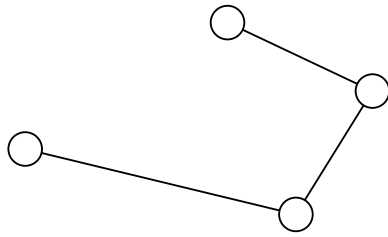


Figure 2-25 Marks connected with lines

To return to individual entry of marks, set LINE TYPE to "single dot" in step 3 of the above procedure and then press the [MENU ESC] key.

2.21 Entering Event Marks

The event mark is used to mark present position. It is useful for denoting important locations, such as good fishing spots or wrecks. You may enter 100 event marks.

The GP-1600F saves and numbers event positions from 001 to 100, 001 being the latest. When the event position memory becomes full several beeps are released when the [EVENT MOB] key is pressed. To enter event marks, erase unnecessary event marks.

Enabling entry of event marks

To enable entry of event marks, do the following

- 1) Press the [MENU ESC] key.
- 2) Press the [0] key to select SYSTEM MENU.
- 3) Press the [2] key to select PLTR SETUP.
- 4) Press the [▼] or [▲] key to select EVNT METHOD.
- 5) Press the [►] key to select EVENT.
- 6) Press the [MENU ESC] key to escape.

Entering event marks

Press the [EVENT MOB] key. The event mark appears at present position, in the shape selected on the TRACK/MARK SETUP menu.

2.22 Erasing Event Marks

- 1) Press the [CURS] key to turn on the cursor.
- 2) Press the [Arrow] keys to place the cursor on the event mark you want to erase.
- 3) Press the [CLR] key.

2.23 Setting Event Position as Destination

- 1) Press the [GOTO] key. (If the EVENT List appears, go to step 5.)
- 2) Press the [MENU ESC] key.
- 3) Press the [▼] or [▲] key to select EVENT List.
- 4) Press the [NU/CU ENT] key. The event list appears.
- 5) Operate the [▼] or [▲] keys to select an event number.
- 6) Press the [NU/CU ENT] key.

2.24 Changing Event Mark Shape

- 1) Press the [MENU ESC] key.
- 2) Press the [2] key to select TRACK/MARK SETUP.
- 3) Press the [Arrow] keys to select EVENT MARK and shape desired.
- 5) Press the [MENU ESC] key to close the menu.

2.25 The MOB Function

The MOB (Man OverBoard) function can be enabled on the DISPLAY SETUP menu. When enabled, the [EVENT MOB] key functions to mark man overboard position. The range and bearing to the MOB position are continuously updated on the display, to help you navigate to the MOB position.

Entering MOB mark

Press the [EVENT MOB] key over 3 seconds.

The MOB mark appears at own ship's position along with a flag. The MOB position is automatically selected as destination and the range and bearing from own ship's to the MOB position are displayed.

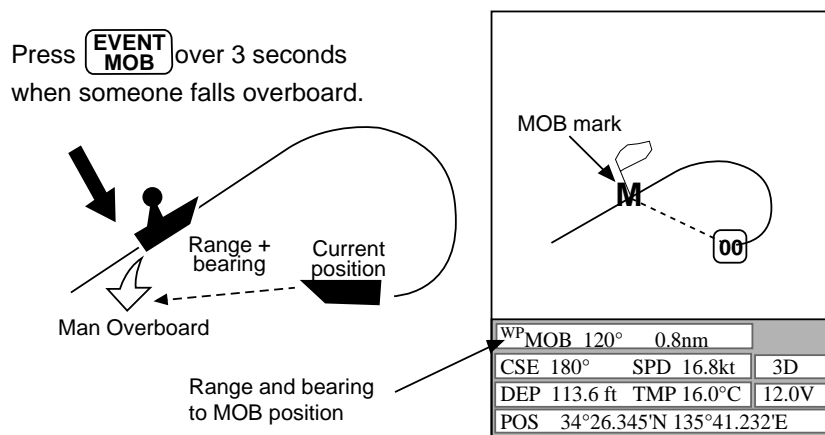


Figure 2-26 The MOB function

Canceling MOB position as destination

- 1) Press the [GOTO] key.
- 2) Press the [CLR] key. The confirmation window appears.
- 3) Press the [NU/CU ENT] key.

Note: To erase the MOB mark, clear the memory. For further details, see page 6-10.

2.26 Stopping Plotting of Track

When your boat is at anchor or returning to port you probably won't need to record its track. You can stop recording the track, to conserve the track memory, as follows:

- 1) Press the [MENU ESC] key.
- 2) Press the [2] key to select TRACK/MARK SETUP. The track/mark setup window appears.
- 3) Operate the [Arrow] keys to select PLOT.
- 4) Press the [▶] key to select OFF.
- 5) Press the [MENU ESC] key to close the menu.

"H" appears on the screen, and own ship mark becomes hollow. (Note that "H" does not appear on the navigation display.) To resume recording, turn on "PLOT" at step 4 in the above procedure.

2.27 Changing Track Plotting Interval

In drawing the track, first the ship's position (fed from the GPS navigator) is stored into this unit's memory at an interval of time, distance or automatic recording. A shorter interval provides better reconstruction of the track, but the storage time of the track is reduced. When the track memory becomes full, the oldest track is erased to make room for the latest.

- 1) Press the [MENU ESC] key.
- 2) Press the [2] key to select TRACK/MARK SETUP.
- 3) Operate the [Arrow] keys to select AUTO, TIME or DIST on the PLOT INTVL line. DIST plots ship's track only when the boat is moving, thus no track is saved to the memory when your boat is dead in water. AUTO changes with chart scale automatically.
- 4) For time or distance, enter interval.
- 5) Press the [MENU ESC] key to close the menu.

2.28 Erasing All Track, Marks

You can erase all track and marks (except MOB mark) as follows:

- 1) Press the [MENU ESC] key.
- 2) Press the [3] key to select ERASE TRACK/MARK.

ERASE TRACK/MARK	
MARK ERASE	NO YES
TRACK ERASE	NO YES
MARK USED	0/100 PT
TRACK USED	0/2000 PT
▲▼:Cursor	▶:Go ESC:Esc

Figure 2-27 ERASE TRACK/MARK menu

- 3) Operate the [Arrow] keys to select MARK ERASE or TRACK ERASE.

Note: MARK ERASE erases event marks also.

- 4) Press the [▶] key to select YES.
- 5) Press [NU/CU ENT] key. The cursor automatically moves to NO on appropriate line.
- 6) Press the [MENU ESC] key.

3. VIDEO SOUNDER OPERATION

3.1 Principle of Operation

The Video Sounder of the GP-1600F determines the distance between its transducer and underwater objects such as fish, lake bottom or seabed and displays the results on the screen. It does this by utilizing the fact that an ultrasonic wave transmitted through water travels at a nearly constant speed of 4800 feet (1500 meters) per second. When a sound wave strikes an underwater object such as fish or sea bottom, part of the sound wave is reflected back toward the source. Thus by calculating the time difference between the transmission of a sound wave and the reception of the reflected sound wave, the depth to the object can be determined.

The entire process begins in the display unit. Transmitter power is sent to the transducer as a short pulse of electrical energy. The electrical signal produced by the transmitter is converted into an ultrasonic signal by the transducer and transmitted into the water. Any reflected signals from intervening objects (such as a fish school) are received by the transducer and converted back into an electrical signal. It is then amplified in the amplifier section, and finally, displayed on the screen.

The picture displayed is made up of a series of vertical scan lines, one for each transmission. Each line represents a "snapshot" of what has occurred beneath the boat. The series of snapshots are accumulated side by side across the screen, and the resulting contours of the bottom and fish between the bottom and surface are displayed.

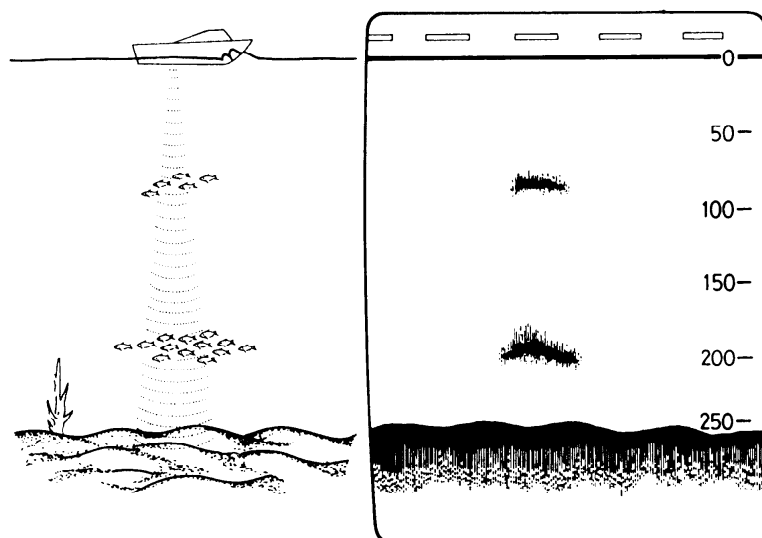


Figure 3-1 Typical video sounder display

3.2 Video Sounder Displays

The GP-1600F provides four types of video sounder displays and two transmission frequencies. Each display and frequency has its advantages and disadvantages. You should choose them according to current sea area and target fish.

Normal video sounder displays

50 kHz display

The lower the transmission frequency the wider the coverage and the longer the detecting range. The 50 kHz display, because of its wide beamwidth, is useful for long range detection and general sounding. It is especially useful for discerning seabed hardness; the wider the seabed echo the harder the seabed.

200 kHz display

The narrow beamwidth of the 200 kHz transducer provides a sharp, clear cut picture, making it perfect for detailed observation of small fish schools. However, signal loss is higher and sounding ability is lower than the 50 kHz transducer.

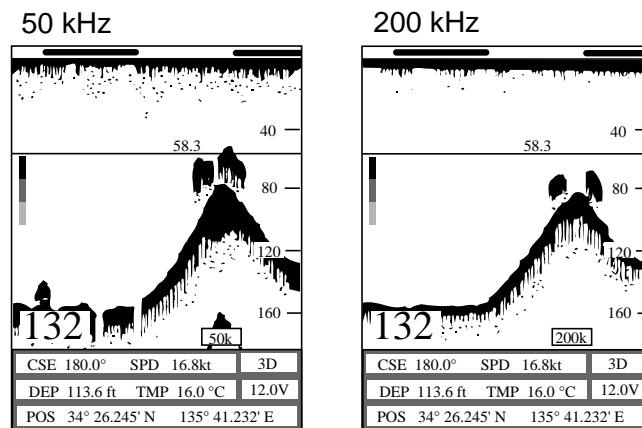


Figure 3-2 Comparison of 50 and 200 kHz video sounder pictures

Zoom displays

Three types of the zoom displays are available: bottom-lock, bottom zoom, and marker zoom.

Bottom-lock

The bottom-lock expansion display provides a compressed normal display on the right side and a "narrow" or "wide" layer (distance depends on unit of measurement) in contact with the seabed onto the rest of the screen with the seabed contour displayed by a straight line on the bottom-lock display. This display offers excellent bottom fish discrimination, which is vital for bottom trawling.

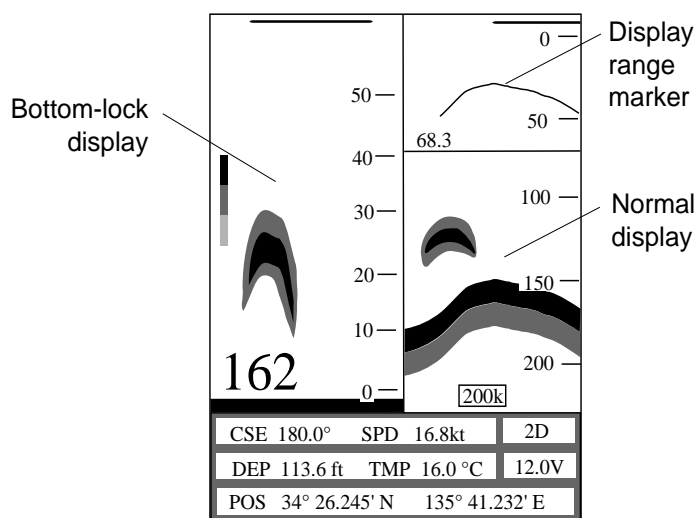


Figure 3-4 Bottom-lock display

Note: For the bottom-lock expansion display, the seabed contour must be steadily and distinctly plotted. Adjust the gain or select automatic operation. You may select the bottom-lock expansion range (wide or narrow) on the SOUNDER SETUP menu in the SYSTEM menu.

Bottom zoom

The bottom zoom display expands bottom and bottom fish echoes two, three, four or five times on the left half of the screen. The zone expanded is indicated by the zoom range markers on the normal display.

The zone automatically moves so that the bottom echoes locate on the lower half screen.

This mode is useful for observing hardness of the bottom closely together with bottom fish. Many fishermen find the place where bottom fish are likely to be, from the shape of bottom profile and length of bottom echoes. The length of the bottom echo is an indi-

cation of bottom hardness: the longer the echo, the harder the bottom. In addition, as you become acquainted with this mode, you may find a small school of bottom fish which might otherwise be overlooked on the other displays.

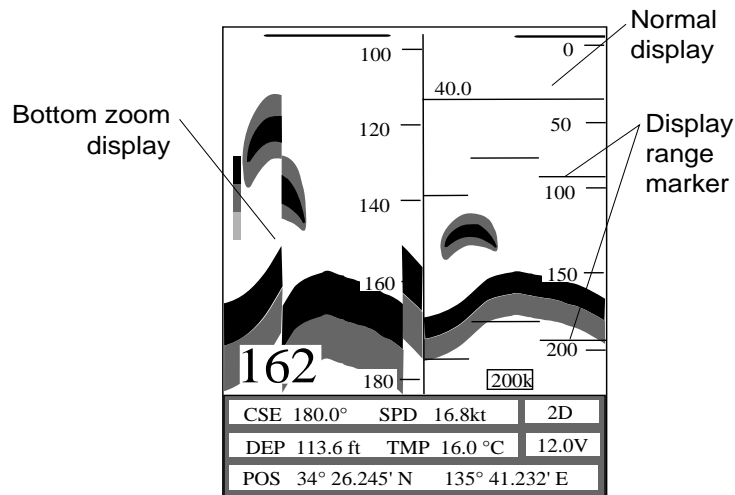


Figure 3-5 Bottom zoom display

Note: The zoom range can be selected on the VIDEO SOUNDER SETUP menu.

Marker zoom

This mode expands any location on the normal display to full vertical size of the screen on the left half of the screen. You may specify the portion to expand with the VRM and the display range marker.

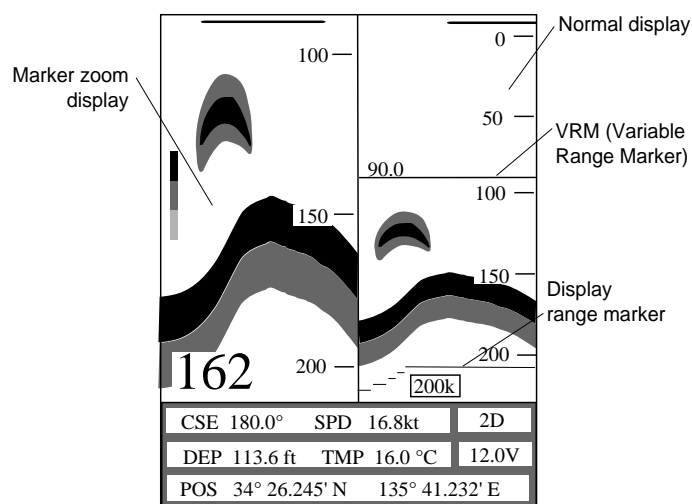


Figure 3-6 Marker zoom display

A-scope

This display shows echoes at each transmission with amplitudes and tones proportional to their intensities, on the right 1/3 of the screen. It is useful for estimating the kind of fish school and seabed composition.

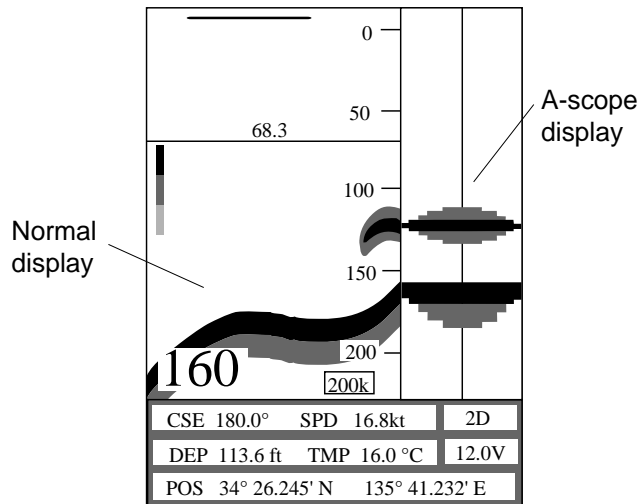


Figure 3-7 A-scope display

How to select video sounder displays

1) Press the [SNDR] key. The following displays appears.

SELECT SOUNDER MODE	
▲	Normal
	Marker Zoom
	Bottom Zoom
	Bottom Lock
▼	A-Scope
◀	50kHz
	200kHz ▶
SNDR:Sel ESC:Close	

Figure 3-8 Video sounder display selection screen

- 2) Press the [SNDR] key again (or [▼]/[▲]) to select sounder display mode.
- 3) Press the [◀] or [▶] key to select operating frequency.
- 4) Press the [MENU ESC] key.

3.3 Automatic Video Sounder Operation

The video sounder can be operated either automatically or manually. Automatic operation is useful when you are preoccupied with other tasks and do not have the time to adjust the display.

How it works

The automatic function automatically selects the proper gain and range scale according to depth. It works as follows:

- Range changes automatically to locate the bottom on the lower half of the screen. It jumps to one step shallower range when bottom echoes reach a half way point of the full scale from the top and to one step deeper range when they come to the lower edge of the scale.
- The gain is automatically adjusted to display the bottom echo in reddish brown.
- Clutter level (on the VIDEO SOUNDER SETUP menu) is automatically adjusted.

Two types of automatic modes

Two types of automatic modes are available: cruise and fish. Cruise is for tracking the seabed, and fish is for searching fish schools. Since "Cruise" uses a higher clutter rejection setting than "Fish," it is not recommended for fish detection – weak fish echoes may be deleted by clutter rejection.

How to enable automatic video sounder operation

- 1) Press the [AUTO] key to select automatic mode desired.

AUTO MODE	
▲	Cruise
	Fish
▼	Manual

Figure 3-9 AUTO display

3.4 Manual Video Sounder Operation

Manual operation is useful for observing fish schools and the seabed using fixed gain setting.

The gain, range and range shifting functions used together give you the means to select the depth you can see on the screen. The basic range can be thought of as providing a "window" into the water column and the range shifting as moving the "window" to the desired depth.

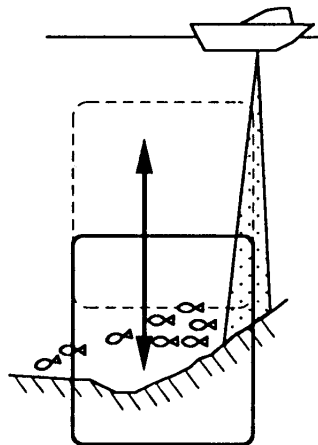


Figure 3-10 Basic range and range shifting concept

Manually adjusting the video sounder picture

- 1) Press the [AUTO] key to display the AUTO MODE menu.
- 2) Press the [▼] key to select "Manual."

AUTO MODE	
▲ Cruise	
Fish	
▼ Manual	
	Low ◀ ▶ High
▲ Gain	■ □ □ □ □
Range	15 30 60
	120 200 400 800 ft
▼ Shift	60 ft

Figure 3-11 Gain, range and shift adjustment display

- 3) Press the [▼] key to select Gain.

Normally, set the gain to the point where excessive noise does not appear on the screen. As a general rule of thumb, use a higher gain setting for greater depths and a lower setting for shallower waters. See Figure 3-12 for examples of proper and improper gain settings.

4) Press the [◀] or [▶] key to set level.

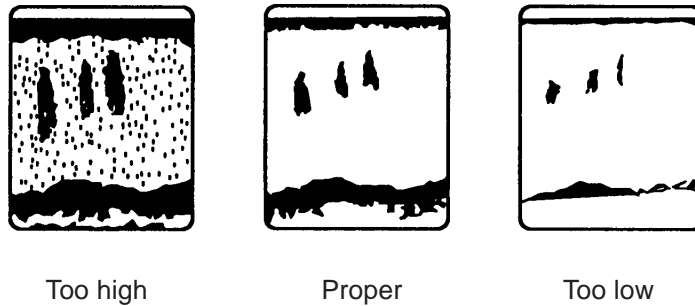


Figure 3-12 Examples of proper and improper gain

5) Press the [▼] key to select Range.

6) Press the [◀] or [▶] key to select basic range desired.

7) Press the [▼] key to select Shift.

8) Press the [◀] or [▶] key to select shift the basic range, if desired.

9) Press the [MENU ESC] key.

3.5 Suppressing Low Level Noise

When medium tone dots appear on a large part of the screen mainly due to water contamination or unit's internal noise, adjust CLUTTER on the VIDEO SOUNDER SETUP menu to eliminate the dots.

When the video sounder mode is Auto, the clutter suppression setting is fixed at AUTO.

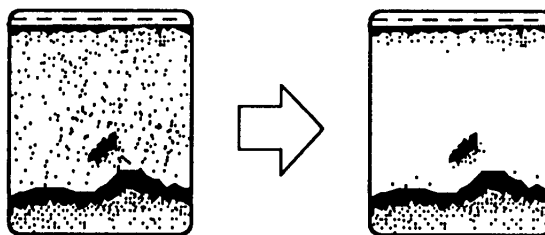


Figure 3-13 How the clutter function works

1) Press the [MENU ESC] key.

2) Press the [6] key to display the VIDEO SOUNDER SETUP menu.

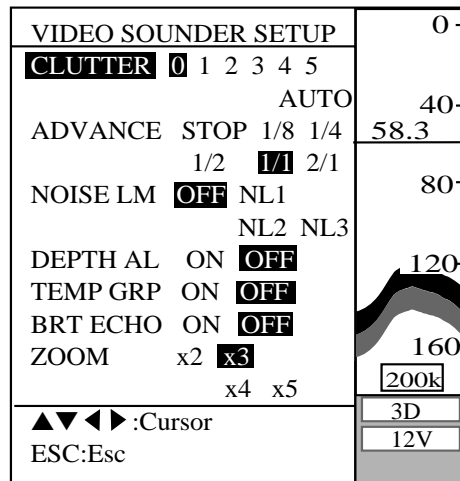


Figure 3-14 VIDEO SOUNDER SETUP menu

- 3) Press the [▲] key to select CLUTTER.
- 4) Press the [◀] or [▶] key to change the setting; the higher the number the higher the degree of suppression.
- 5) Press the [MENU ESC] key.

3.6 Selecting Picture Advance Speed

When selecting a picture advance speed, keep in mind that a fast advance speed will expand the size of the fish school horizontally on the screen and a slow advance speed will contract it.

- 1) Press the [MENU ESC] key.
- 2) Press the [6] key to display the VIDEO SOUNDER SETUP menu.
- 3) Press the [▼] or [▲] key to select ADVANCE.
- 4) Press the [◀] or [▶] key to select advance speed desired, or STOP to suspend advancement of the picture.
- 5) Press the [MENU ESC] key.

3.7 Suppressing Interference

Interference from other acoustic equipment operating nearby or other electronic equipment may show itself on the display as depicted in the figure below.

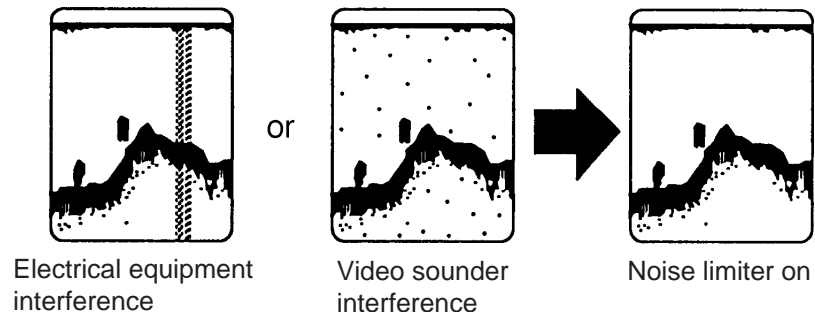


Figure 3-15 How the noise limiter function works

To suppress interference, do the following:

- 1) Press the [MENU ESC] key.
- 2) Press the [6] key to display VIDEO SOUNDER SETUP menu.
- 3) Press the [▼] or [▲] key to select NOISE LM.
- 4) Press the [◀] or [▶] key to select degree of suppression desired; the higher the number the greater the degree of suppression..
- 5) Press the [MENU ESC] key.

3.8 Knowing Depth Change by Depth Alert Alarm

The DEPTH ALert function alerts you to change in depth. Depth change direction is given by alarm interval; the longer the interval the greater the change in depth.

To turn on or off the depth alert, do the following:

- 1) Press the [MENU ESC] key.
- 2) Press [6] key to display VIDEO SOUNDER SETUP menu.
- 3) Press the [▼] or [▲] key to select DEPTH AL.
- 4) Press the [◀] or [▶] to select ON or OFF.
- 5) Press the [MENU ESC] key.

3.9 Displaying the Water Temperature Graph

By connecting a water temperature indicator, a water temperature graph can be displayed.

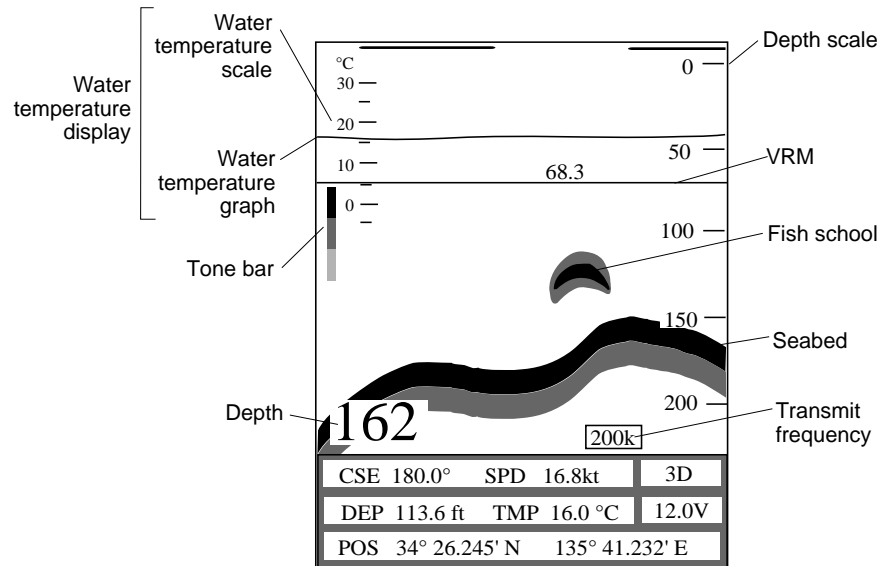


Figure 3-16 Water temperature graph

To turn on/off the water temperature graph;

- 1) Press the [MENU ESC] key.
- 2) Press [6] key to display VIDEO SOUNDER SETUP menu.
- 3) Press the [▼] or [▲] key to select TEMP GRP.
- 4) Press the [◀] or [▶] to select ON or OFF.
- 5) Press the [MENU ESC] key.

3.10 Brightening Fish Echoes

The BRT ECHO feature displays fish echoes in light tone and seabed echoes in dark tone. This feature is useful for distinguishing fish echoes close to the seabed.

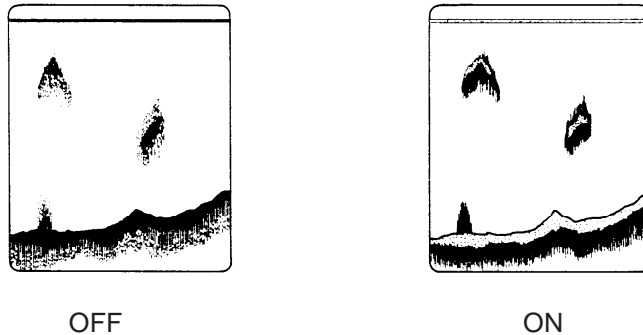


Figure 3-17 Bright echo display

To turn on/off the bright echo;

- 1) Press the [MENU ESC] key.
- 2) Press the [6] key to display VIDEO SOUNDER SETUP menu.
- 3) Press the [▼] or [▲] key to select BRT ECHO.
- 4) Press the [◀] or [▶] to select ON or OFF.
- 5) Press the [MENU ESC] key.

3.11 Selecting Zoom Ratio

The ZOOM function set the marker zoom display ratio by two, three, four or five times the normal picture.

To select zoom ratio, do the following;

- 1) Press the [MENU ESC] key.
- 2) Press the [6] key to display VIDEO SOUNDER SETUP menu.
- 3) Press the [▼] key to select ZOOM.
- 4) Press the [◀] or [▶] to select zoom ratio desired.
- 5) Press the [MENU ESC] key.

3.12 Measuring Depth by the VRM

The VRM, which is always displayed, measures depth. Place it on the object you wish to know the depth by pressing the [▲] or [▼] key. Depth is digitally displayed above the VRM.

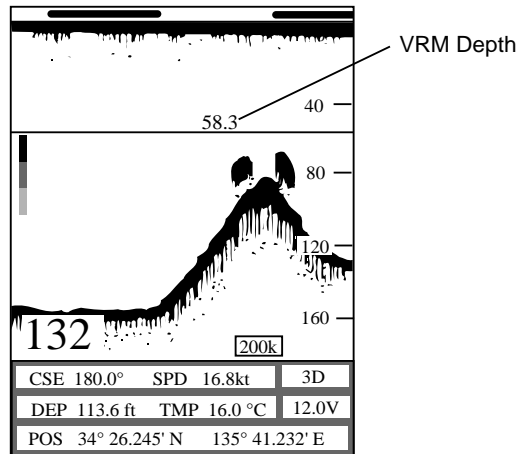


Figure 3-18 Location of VRM depth indication

3.13 Fish and Bottom Alarms

Fish alarm

This alarm alerts you by aural and visual alarms when a fish echo is within the preset alarm range.

Bottom alarm

This alarm function alerts you when the seabed enters into the specified alarm zone.

Setting the fish and bottom alarms

- 1) Press the [MENU ESC] key.
- 2) Press the [5] key to select ALARM SETUP.
- 3) Press the [▼] or [▲] key to select FISH or BOTTOM. (If you are on page 1 of the menu, press [▼] several times to go to page 2.
- 4) Press the [▶] key to turn on the alarm.
- 5) Enter alarm range with numeral keys.

6) Press the [MENU ESC] key.

When echo corresponding to active alarm enters alarm range, aural and visual alarms are released.

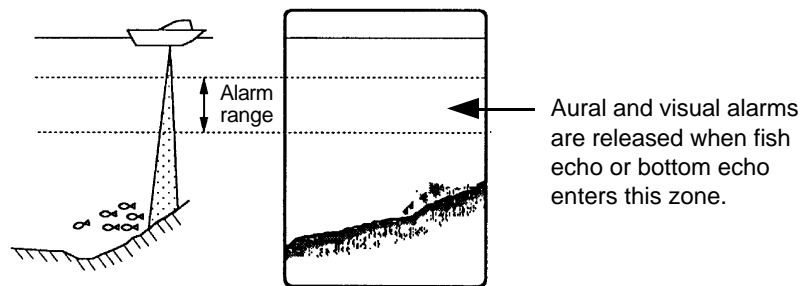
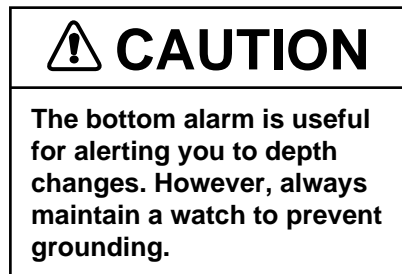


Figure 3-19 How the fish and bottom alarms work



Removing the aural and visual alarms

Press the [CLR] key. The aural alarm is silenced and the visual alarm disappears. The alarms will be released the next time the alarm setting is violated.

3.14 Correcting Water Temperature Readout

In some instances the water temperature readout may be off by a few degrees. You can correct it as follows.

- 1) Press the [MENU ESC] key.
- 2) Press the [0] key to select the SYSTEM SETUP menu.
- 3) Press the [5] key to select SENSOR SETUP.
- 4) Press the [Arrow] keys to select TEMP CALIB.
- 5) Enter correction with numeral keys.
- 6) Press the [MENU ESC] key.

3.15 SOUNDER SETUP Menu

The SOUNDER SETUP menu contains several items related to video sounder operation. You can adjust them to suit your operating needs.

Keying sequence: [MENU ESC] [0] [3]

SNDR SETUP	
EXP MARKER	ON OFF
TVG	0 1 2 3 4 5 6 7 8 9
ECHO LEVEL	+00 (-20 ~ +20)
BTM-LOCK	NARROW WIDE
ES-STOP	ON OFF
▼▲◀▶:Cursor	
ESC:Esc	

Figure 3-20 SOUNDER SETUP menu

SOUNDER SETUP menu description

EXPansion MARKER: The expansion markers can be turned on or off.

TVG: Raise the TVG (Time Varied Gain) when surface noise masks a shallow target. In addition to suppressing noise, the TVG compensates for propagation loss of sound so that the echoes from the same fish schools appear in the same color. Set the TVG between "3" and "5" for normal use. Too high a setting can erase echoes.

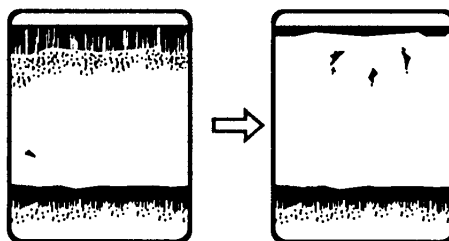


Figure 3-21 Effect of TVG

ECHO LEVEL: This value determines minimum echo sensitivity. Reduce the setting when sensitivity appears to be too high.

BTM-LOCK: The bottom-lock range can be set to wide or narrow. (In meters, this is 5 and 10 meters, respectively.)

ES-STOP: Turn off ES-STOP to disable the video sounder display.

4. ALARMS

4.1 Description of Alarms

There are eight conditions which generate both aural and visual alarms in this unit.

Arrival alarm (waypoint arrival alarm)

The arrival alarm informs you that your boat is approaching a destination waypoint. The area that defines an arrival zone is that of a circle which you approach from the outside of the circle. The alarm will be released if your boat enters the circle.

Anchor watch alarm

The anchor watch alarm sounds to warn you that your boat is moving when it should be at rest.

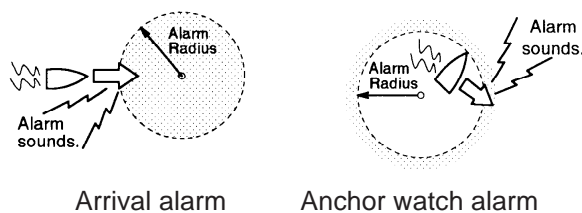


Figure 4-1 How the arrival and anchor watch alarms work

XTE (Cross Track Error) alarm

The XTE alarm warns you when your boat is off its intended course.

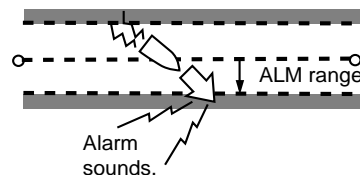


Figure 4-2 How the XTE alarm works

Speed alarm

The speed alarm sounds when your boat's speed is within (or over) the alarm range set.

Water temperature alarm

The water temperature alarm sounds when the water temperature is within (or over) the preset temperature range. This alarm is useful for searching for specific species of fish, since each species of fish has its own habitable water temperature. (This alarm requires connection of a water temperature sensor.)

Trip alarm

The trip alarm sounds when distance travelled exceeds the trip alarm setting.

Fish alarm

The fish alarm sounds when a fish school is detected within the selected range.

Bottom alarm

The bottom alarm sounds when the seabed depth is narrower than the alarm range set.

4.2 Enabling/Disabling the Alarms

Enabling the alarms

- 1) Press the [MENU ESC] key.
- 2) Press the [5] key to select ALARM SETUP.

ALARM SETUP		1/2
ARRIVAL	ARRIVAL ANCHOR	OFF
	Range 00.500nm	
XTE	ON	OFF
	Range 00.250nm	
SPEED	WITHIN OVER	OFF
	Speed 11.0 ~ 15.0kt	
TEMP	WITHIN OVER	OFF
	Temp +11.0 ~ 15.0°C	
TRIP	ON	OFF
	Range 005.00nm	
▲▼ :Cursor Ⓞ: +/-		
CLR:TRIP RESET ESC:Esc		

ALARM SETUP		2/2
FISH	ON	OFF
	Range 011.0 ~ 015.0 ft	
BOTTOM	ON	OFF
	Range 011.0 ~ 015.0 ft	
▲▼ :Cursor		
ESC:Esc		

Figure 4-3 ALARM SETUP menus

- 3) Operate the [Arrow] keys to select alarm desired. (To go to page 2 of the menu, press the [▼] key several times.
- 4) Enter alarm range.

5) Press the [NU/CU ENT] key.

6) Press the [MENU ESC] key.

Note: Avoid exceeding the default arrival alarm range (00.500 nm) to prevent release of the alarm on a distant waypoint.

Disabling the alarms

Select OFF” in step 3 in "4.2 Enabling/Disabling the Alarms" and then press the [NU/CU ENT] and [MENU ESC] keys.

4.3 Deleting Aural and Visual Alarms

When an alarm setting is exceeded, both aural and visual alarms are released. You can silence the aural alarm and erase the visual alarm by pressing the [CLR] key. The aural and visual alarms will be generated at the next violation of the active alarm(s).

5. MENU OPERATIONS

5.1 Chart Position Calibration

In some instances chart position may be off by a few minutes. For example, the position of the ship is shown to be at sea while it is in fact moored at a pier. You can compensate for this error as follows.

- 1) Press the [MENU ESC] key.
- 2) Press the [0] key to select SYSTEM SETUP.
- 3) Press the [9] key to select CHART POSN CALIB.
- 4) Press the [▶] key to select ON.

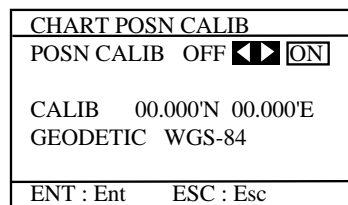


Figure 5-1 CHART POSITION CALIBRATION menu

- 5) Set the cursor on correct position.
- 6) Press the [NU/CU ENT] key. The calibration values appear.
- 7) Press the [MENU ESC] key. The chart offset icon appears on the display.

To remove the correction, select OFF in step 4 of the above procedure and press the [NU/CU ENT] and [MENU ESC] keys.

5.2 GPS Position Correction

You may correct the GPS position to refine position accuracy.

First, moor boat at a pier and plot position shown by GP-1600F on a nautical chart. Then, enter correction value.

- 1) Press the [MENU ESC] key.
- 2) Press the [0] key to select the SYSTEM SETUP menu.
- 3) Press the [7] key. The GPS SETUP menu appears.
- 4) Operate the [Arrow] keys to select POS CALIB.

GPS SETUP	
GPS SMOOTHING	
Posn	000 (000 ~ 999)
Spd	000 (000 ~ 999)
GEODETTIC	WGS-84 OTHER(002)
POS CALIB	00.000'N 00.000'E
UNHEALTH	RSTR DISABLED(03)
TIME DIFF	+00:00
▼▲ :Cursor	↻:N/S,E/W,+/-
ENT:Enter	ESC:Esc

Figure 5-2 GPS SETUP menu

- 5) Enter correction value with numeral keys.
- 6) Press the [NU/CU ENT] key.
- 7) Press the [MENU ESC] key.

L/L appears on the display. To remove the correction, enter zeroes at step 4 in the above the procedure and press the [NU/CU ENT] and [MENU ESC] keys.

5.3 Displaying Loran C or Decca LOPs

Ship's position can be displayed in latitude and longitude, Loran C LOPs or Decca LOPs. To display position in Loran C or Decca LOPs, do the following:

- 1) Press the [MENU ESC] key.
- 2) Press the [0] key to select the SYSTEM menu.
- 3) Press the [2] key to select PLTR SETUP.

PLTR SETUP	
NAVAID	OWN LC DC ALL
SCALE	SCALE RANGE
SMOOTHING	00 (00~15)
SPD AVERAG	00 min
BEARING	TRUE MAG
MAG CALIB	AUTO MAN
	06.9° W 00.0° E
EVNT METHOD	EVENT MARK
POSITION	L/L LOP
DISP	LC DC
Chain:Sec	7970:11-26
LOP CALIB	+000.0µs
	+000.0µs
▼▲ :Cursor	↻:E/W
	ESC:Esc

Figure 5-3 PLTR SETUP menu

- 4) Operating the [Arrow] keys, select LOP at the Position line.
- 5) Operate the [Arrow] keys to select DISP.

- 6) Select LC or DC.
- 7) Press the [▼] key to select Chain:Sec.
- 8) Enter Loran (or Decca) data with the numeral keys.
- 9) To apply an offset to the LOPs, select LOP CALIB and enter offset.
- 10) Press the [NU/CU ENT] key.
- 11) Enter next offset and press the [NU/CU ENT] key.
- 12) Press the [MENU ESC] key.

5.4 DISPLAY SETUP Menu

The DISPLAY SETUP menu lets you set the size and tone of various markers.

Keying sequence: [MENU ESC] [1]

DISPLAY SETUP			
LAND PATTERN	1	2 3	OFF
PLACE NAME	BRT	DIM	OFF
GRID	BRT	DIM	OFF
COURSE BAR	BRT	DIM	OFF
TIME MARK	BRT	DIM	OFF
WPT MARK SIZE	L	S	
CURSOR SIZE	L	S	
SECTOR INFO	ON	OFF	
LIGHTS FLASH	ON	OFF	
▲▼◀▶:Cursor ESC:Esc			

Figure 5-4 DISPLAY SETUP menu

DISPLAY SETUP menu description

LAND PATTERN: Select land display tone.

PLACE NAME: Set place name tone for bright, dim or off.

GRID: Set grid tone for bright, dim or off.

COURSE BAR: Set course bar tone for bright, dim or off.

TIME MARK: Set time mark tone for bright, dim or off.

WPT MARK SIZE: Select size of waypoint mark to large or small. "S" displays all waypoints by an "x." (Waypoint number does not appear.)

CURSOR SIZE: Select size of cursor to large or small.

SECTOR INFO: Turn on/off graphic which shows viewable range for lighthouse.

LIGHTS FLASH: Turn on/off blinking lights on screen, which shows lighthouses or lighted buoys.

5.5 PLOTTER SETUP Menu

The PLOTTER SETUP menu in the SYSTEM SETUP menu contains several items related to plotter operation which you may change according to your operating needs.

Keying sequence: [MENU ESC] [0] [2]

PLTR SETUP	
NAVAID	OWN LC DC ALL
SCALE	SCALE RANGE
SMOOTHING	00 (00~15)
SPD AVERAG	00 min
BEARING	TRUE MAG
MAG CALIB	AUTO MAN
	06.9° W 00.0° E
EVNT METHOD	EVENT MARK
POSITION	L/L LOP
DISP	LC DC
Chain:Sec	7970:11-26
LOP CALIB	+000.0µs
	+000.0µs
▼▲ :Cursor	⊙:E/W ESC:Esc

Figure 5-5 PLOTTER SETUP menu

PLOTTER SETUP menu description

NAVAID: Select navaid which is to feed position data; internal GPS, external GPS, Loran C, Decca, or ALL. Select ALL for multiple navaid connection. In this case position data is read in the order of GPS, Loran C, Decca, etc.

SCALE: Select chart scale display indication on the plotter display to scale or range.

SMOOTHING: Even when the vessel is sailing a straight line the track shown on the display looks crooked. This is due to signal variation of the external navaid. To smooth out this irregularity, change the smoothing factor.

In the figure at the top of the next page, the actual ship's track is shown by a wide hatched arrow and the position being fed from the navaid is shown by black dots. If no smoothing is applied, the track shown on the display will look irregular due to signal variations.

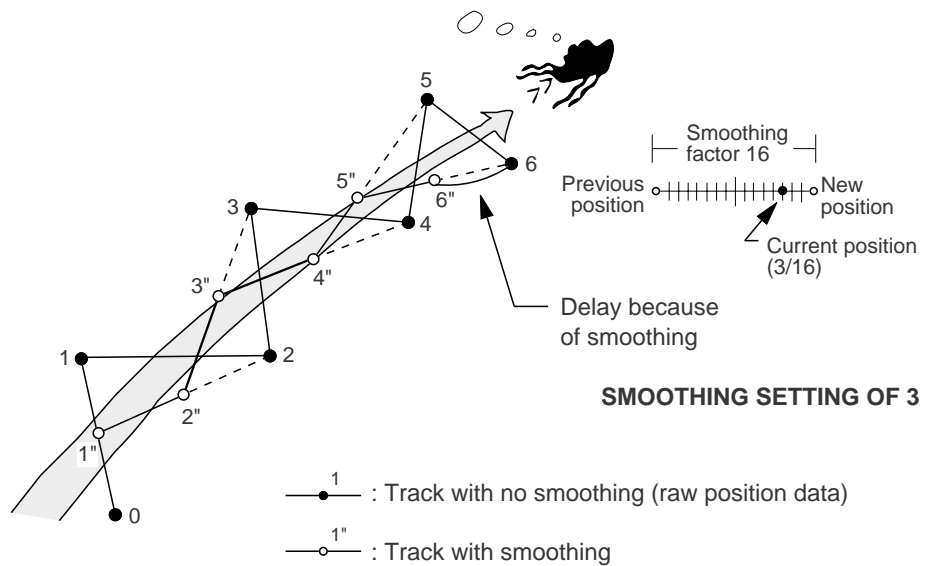


Figure 5-6 Comparing track with smoothing and no smoothing

For instance, number 03 provides a weighting factor of 13/16 for new data and 3/16 for previous data. The higher the smoothing, the slower the position updates becomes. In the following figure, the track shown by the broken line has a time delay more than the one shown by the dot-dash line, because of higher smoothing.

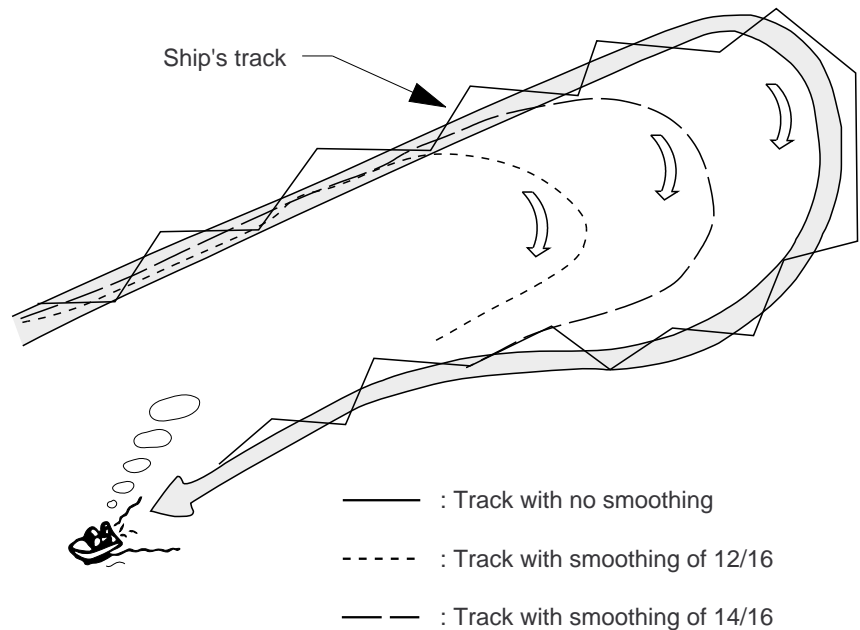


Figure 5-7 Comparing track and different smoothing factors

SPEED AVERAGE: Calculation of ETA and TTG, etc. is based on an average ship's speed over a given period. If the period is too long and the ship's speed is changed suddenly, calculation error will result. The default setting is 001. Increase the setting if time calculations are in error.

BEARING: You may display bearing relative to true North (true bearing) or relative to magnetic North (magnetic bearing).

MAG CALIB: The location of the magnetic pole is different from the geographical North pole. This causes a difference between the true and magnetic North direction. The difference is called magnetic variation, and varies by the observation point on the earth. This unit is programmed with the earth's magnetic variations. However, you may wish to further refine variation for a particular area. If you enter compensation manually, be sure to change it when magnetic variation changes.

EVENT METHOD: Select mark to enter by the [EVENT MOB] key; mark or event mark.

POSITION: Select position display method; latitude and longitude or Loran LOPs.

DISP: If "POSITION" is selected to LOP, enter Loran or Decca chain here.

5.6 UNIT SETUP menu (unit of measurement)

The UNIT SETUP menu lets you select unit of measurement for distance, depth and water temperature.

Keying sequence: [MENU ESC] [0] [4]

UNIT SETUP			
DISTANCE	nm	km	sm
DEPTH	m	ft	fa
TEMP	°C	°F	
▲▼◀▶:Cursor		ESC:Esc	

Figure 5-8 UNIT SETUP menu

UNIT SETUP menu description

DISTANCE: You may set the unit of distance measurement to nautical miles, kilometers, or statute miles.

DEPTH: The unit of depth measurement can be set to meters, feet, fathoms, hiro, or passi/braza.

TEMP: Select Centigrade or Fahrenheit.

5.7 SENSOR SETUP menu

The SENSOR SETUP menu provides for selection and calibration of speed and temperature sensors (optional equipment).

Keying sequence: [MENU ESC] [0] [5]

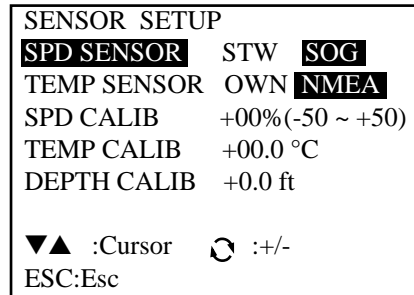


Figure 5-9 SENSOR SETUP menu

SENSOR SETUP menu description

SPD SENSOR: Select speed input source; navaid or internal.

TEMP SENSOR: Select device (option) which feeds temperature data; external or internal.

SPD CALIB: Enter offset to correct speed data.

TEMP CALIB: Enter offset to correct water temperature data.

DEPTH CALIB: Enter offset to correct depth.

5.8 NMEA SETUP menu

This menu selects output data format and type of external device connected to the GP-1600F.

Keying sequence: [MENU ESC] [0] [6]

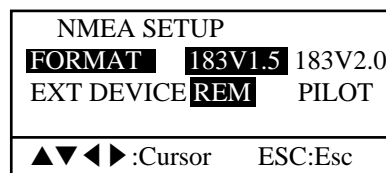


Figure 5-10 NMEA SETUP menu

NMEA SETUP menu description

FORMAT: Select the format of data output to external equipment.

EXT DEVICE: Select external device connected to the GP-1600F.

5.9 GPS SETUP menu

This menu sets up GPS-related items.

Keying sequence: [MENU ESC] [0] [7]

GPS SETUP	
GPS SMOOTHING	
Posn	000 (000 ~ 999)
Spd	000 (000 ~ 999)
GEODETIC	WGS-84 OTHER(002)
POS CALIB	00.000'N 00.000'E
UNHEALTH	RSTR DISABLED(03)
TIME DIFF	+00:00
▼▲:Cursor	⊙:N/S,E/W,+/-
ENT:Enter	ESC:Esc

Figure 5-11 GPS SETUP menu

GPS SETUP menu description

GPS POSITION SMOOTHING: When the DOP or receiving condition is unfavorable, the GPS fix may change greatly, even if the vessel is dead in water. This change can be reduced by smoothing the raw GPS fixes. A setting between 0 and 9 is available. The higher the setting the more smoothed the raw data. Note however that too high a setting slows response time to change in latitude and longitude. This is especially noticeable at high ship's speeds. "000" is the default setting; increase the setting if the GPS fix changes greatly.

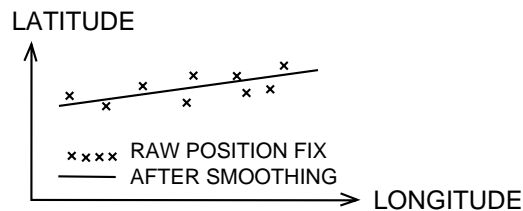


Figure 5-12 GPS position smoothing

GPS SPEED SMOOTHING: During position fixing, ship's velocity (speed and course) is directly measured by receiving GPS satellite signals. The raw velocity data may change randomly depending on receiving conditions and other factors. You can reduce this random variation by increasing the smoothing. Like with latitude and longitude smoothing, the higher the speed and course smoothing the more smoothed the raw data. If the setting is too high, however, the response to speed and course change slows. "000" is the default setting; increase the setting if the GPS speed changes greatly.

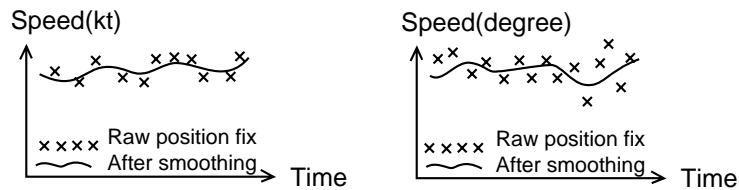


Figure 5-13 GPS speed smoothing

GEODETIC: Select the geodetic chart system you are using. WGS-84 (standard GPS chart system), can be directly selected. For other charts, select OTHER and enter chart number referring to Geodetic Chart List in the Appendix.

POS CALIB:Position calibration: You may apply an offset to position generated by the internal GPS receiver, to further refine position accuracy. The L/L position offset icon ($\frac{L}{L}$) appears on the display.

UNHEALTH: Every GPS satellite is broadcasting abnormal satellite number(s) in the Almanac. Using this information, the GPS receiver eliminates any malfunctioning satellite from the GPS satellite schedule. Once the malfunctioning satellite is returned to on-line status it is automatically restored to the satellite schedule when the Almanac is received. In some instances however the Almanac may not contain information which announces that a satellite is now back on line. If you hear of this through another source, you can manually restore the satellite to the satellite schedule. Conversely, you can manually disable a healthy satellite if you hear it is unhealthy.

To restore or disable a satellite, select RSTR or DISABLED on the UNHEALTH line and then enter satellite number.

TIME DIFF (using local time): GPS uses UTC time. If you want to use local time, enter time difference between local time and UTC time here. The [TONE] key serves to select plus or minus time. See the World Time Standards chart on page A-3 for time differences.

5.10 DGPS SETUP Menu

With connection of an external DGPS beacon receiver (option), GPS position accuracy becomes within 5 to 10 meters.

Keying sequence: [MENU ESC] [0] [8]

DGPS SETUP			
DGPS	ON	OFF	
RTCM VER	1.0	2.0	
BYTE FORM	8-6	8-8	
FIRST BIT	MSB	LSB	
PARITY BIT	EVEN	ODD	NONE
STOP BIT	1	2	
BIT RATES	7	8	
BAUD RATES	300	600	1200
	2400	4800	9600
RS TYPE	422	232C	
▼▲◀▶:Cursor			
ENT : Sel ESC:Esc			

Figure 5-14 DGPS SETUP menu

Turn DGPS on and set other items according to specifications of beacon receiver.

6. MAINTENANCE & TROUBLESHOOTING

WARNING

**Hazardous voltage.
Do not open the
equipment.**

This equipment uses high voltage electricity which can shock. Only qualified personnel should work inside the equipment.

Do not disassemble or modify the equipment.

Electrical shock, fire or serious injury can result.

6.1 Maintenance

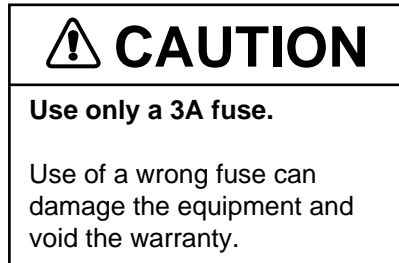
Regular maintenance is essential for good performance. A maintenance program should be established and should at least include the items listed in Table 6-1.

Table 6-1 Recommended maintenance program

Item	Check point	Remedy
Antenna	Check for loosened and corroded bolts.	Tighten loosened bolts. Replace heavily corroded bolts.
Antenna cable	Check connection point for watertightness.	Replace damaged parts.
	Check connector for tightness and corrosion.	
	Check cables for damage.	
Display unit connectors	Check for tight connection.	Tighten loosened connectors.
Ground terminal	Check for tight connection and corrosion.	Clean or replace as necessary.
Display unit	Dust and foreign material on the display unit and screen.	Dust on the display dims the picture. Dust may be removed with a soft cloth. If necessary anti-static cleaner may be used. Never use chemical solvents to clean the display; they can remove paint and markings.
Transducer	Check for marine life on transducer face, each time the boat is docked.	Carefully remove any marine life with a piece of wood or sandpaper.

6.2 Replacement of Fuse

The fuse on the power cable of the display unit protects the system from reverse polarity of the ship's mains and equipment fault. If the fuse blows, find the cause before replacing the fuse. Use only a 3A fuse. Using the wrong fuse will damage the unit and void the warranty.



6.3 Self Tests

Self-test menu

- 1) Press the [MENU ESC] key.
- 2) Press [0] key to select SYSTEM MENU.
- 3) Press [1] key to select SELF TEST. The follows display appears.

SELF-TEST
1. GPS MONITOR DISPLAY
2. MEMORY, I/O PORT TEST
3. PANEL TEST
4. DISPLAY TEST
▲▼:Cursor
ENT:Sel ESC:Esc

Figure 6-2 Self-test menu

Memory, I/O port test

This test conduct a general check of the display unit and the antenna unit. The unit displays the check results for each device or component checked as OK or NG (No Good).

- 1) Press the [MENU ESC] key.
- 2) Press [0] key to select SYSTEM MENU.
- 3) Press [1] key to select SELF TEST.
- 4) Press the [2] key to select MEMORY, I/O PORT TEST.

Test pattern

The test patterns check whether the display circuit is working properly or not.

- 1) Press the [MENU ESC] key to display the main menu.
- 2) Press [0] key to select SYSTEM MENU. The system menu appears.
- 3) Press [1] key to select SELF TEST.
- 4) Press the [4] key to select DISPLAY TEST.

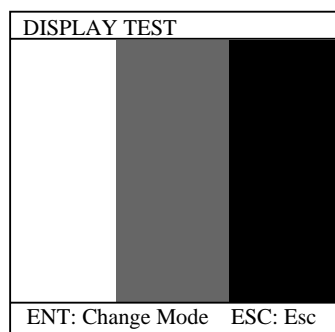


Figure 6-5 Display test pattern

- 5) Press the [NU/CU ENT] key to change test pattern.
- 6) To return to the self-test menu, press the [MENU ESC] key.

6.4 GPS Monitor Display

The GPS monitor display provides information on all GPS satellites.

- 1) Press the [MENU ESC] key.
- 2) Press the [0] to select SYSTEM MENU.
- 3) Press the [1] key twice.

GPS MONITOR DISPLAY			
Fix Mode	3D	Alt---	m
DOP	**		
Date Rx	:OK		
Ref Sta	:OK		
Program No.	48501000**		
Rx Status			
No.	ELV	AZM	SNR
03	48	117	08
--	--	----	--
(8 channel)			
--	--	----	--
ESC:Esc			

Program version

Figure 6-6 Sample GPS monitor display

GPS monitor display description

Fix Mode: This shows current position-fixing mode; 2D or 3D (D2D or D3D appears in DPGS mode).

Alt: Shows present altitude of GPS receiver when position fixing mode is set to 3D.

DOP: This is the index for position-fixing accuracy. The lower the value the higher the accuracy. If the index exceeds 20, position fixing may not be possible.

Data Rx: Shows DGPS beacon receiver is normal or abnormal.

Ref Sta: Shows status of DPGS transmitting station.

Program No.: Shows the program number and version of the unit.

Rx Status: This section shows elevation angle, azimuth and signal levels of GPS satellites.

6.5 GPS Receiver Status Indication

GPS receiver status is shown at the bottom right-hand corner on the display, in three characters. The table below provides GPS receiver status indications and their meanings.

Table 6-2 GPS Receiver status indications

GPS receiver status indication	Meaning
ACQ	Indicates that the GPS receiver is acquiring the GPS satellites referring to the Almanac. If it remains unchanged for a long period of time, the GPS satellite signals may be not received.
ALM	Indicates that the GPS receiver is collecting the Almanac of the GPS satellites being broadcast from each satellite. The Almanac contains estimated arrival time of all GPS satellites. If the unit is not operated for a while and the Almanac becomes too old, the GPS receiver cannot pick up the GPS receiver for a long period of time with "ACQ" indicated. In this state, cold start the GPS receiver to collect the latest Almanac. This can be done on the CLEAR MEMORY menu.
CST	Indicates the GPS receiver is cold starting to collect the latest Almanac. This is performed on the first power application or after clearing memory contents using the CLEAR MEMORY menu.
IMP	Impossible to receive satellite signals. Check that the antenna unit is not blocked by any obstacles within line-of-sight.
INT	Position fixing is interrupted with a loss of necessary satellite signals. Position fixing is resumed when lost satellite signal reappears.

6.6 Troubleshooting Table

The table which follows provides common operating problems and the means with which to restore normal operation.

Table 6-3 Troubleshooting table

If...	Then...
General	
you cannot turn on the power	check for blown fuse.
	check that the power connector is firmly tightened.
	check for corrosion on power cable connector.
	check for damaged power cable.
	check battery for proper voltage output (10.2 to 16.0 V). When battery voltage is less than 10 V, an alarm sounds and the "low battery voltage" icon appears. (Battery voltage appears at the bottom right corner on the plotter and plotter/sounder displays.)
power is on but nothing appears	press the [TONE] key and [Arrow] keys to adjust display brilliance and tone.
there is no response when a key is pressed	turn on the power again.
Plotter	
position is not fixed within 3 minutes	check for loosened antenna connector.
	check for frequency deviation of GPS receiver on GPS monitor display.
	check GPS receiver status indication. See page 5-5.
position is wrong	check that the correct geodetic chart system is selected on the GPS SETUP menu.
	enter GPS position offset on the GPS SETUP menu.
track is not plotted	plotting is stopped. ("H" appears on the plotter display.)
bearing is wrong	check that correct magnetic compensation is entered on the PLOTTER SETUP menu.
Loran or Decca LOPs do not appear	check that proper Loran or Decca chain codes are entered on the PLOTTER SETUP menu.
Loran LOPs are wrong	enter LOP offset on the PLOTTER SETUP menu.
ship's speed display is not zero after ship is stopped	try to decrease GPS speed smoothing setting on the GPS SETUP menu.

If...	Then...
Video Sounder	
no picture but marks and characters appear	<p>check if picture advance speed is set to "0" on the VIDEO SOUNDER SETUP menu.</p> <p>check for loosened transducer connector.</p>
picture appears but no zero line	If using manual video sounder operation, range is shifted; set shifting to zero to correct.
picture sensitivity is too low	<p>check gain setting, if using manual operation.</p> <p>marine life or air bubbles may be clinging to transducer face.</p> <p>water may be dirty.</p> <p>bottom may be too soft to return a suitable echo.</p>
depth is not displayed	adjust gain to display bottom echo in dark tone.
noise or interference obscures the display	<p>check if transducer cable is near ship's engine. If it is, relocate it.</p> <p>check ground.</p> <p>other video sounders may be operating nearby and on same frequency.</p>
water temperature graph appears but no or wrong readout	check for loosened sensor cable.

6.7 Memory Card Operations (for technicians)

Before changing the internal battery, save the contents of the memory (waypoint, event, mark, track, route data and menu setting data) to a memory card (256 K bytes).

Saving data

- 1) Press the [MENU ESC] key.
- 2) Press the [7] key to select MEMORY SAVE/LOAD.
- 3) Press the [▲] key to select SAVE MEMORY.

MEMORY SAVE/LOAD		
SAVE MEMORY	NO	YES
LOAD MEMORY	NO	YES
▼▲ : Cursor ▶ : Go ESC: Esc		

Figure 6-7 MEMORY SAVE/LOAD menu

- 4) Press the [▶] key. The message window appears.
- 5) Press the [NU/CU ENT] key. The card is formatted and data are saved. When saving is completed, the cursor moves to NO at the SAVE MEMORY line.
- 6) Press the [MENU ESC] to escape.

Note: "Memory card err" appears in the following cases:

- No card is set
- Card is write-protected
- Card error

Loading data

Data stored on a memory card can be loaded as follows:

- 1) Press the [MENU ESC] key.
- 2) Press the [7] key to select MEMORY SAVE/LOAD.
- 3) Press the [▼] key to select LOAD MEMORY.
- 4) Press the [▶] key to select YES. The message window appears.
- 5) Press the [NU/CU ENT] key. After the plotter data is loaded, the system is reset and the initial display appears.

6.8 Demonstration Display

The demonstration display provides simulated operation of this unit. Own ship tracks, at the speed selected, a figure eight course, starting from position entered. All controls are operative; you may set destination, enter marks, etc.

- 1) While pressing and holding down the [NU/CU ENT] key, turn on the power. The display shown below appears.

DEMO SETTING	
BASE POSITION	
■	° . . . 'N ° . . . 'W
SPEED:	
00.0kt	
◀▶:Cursor	◀:Column
ENT:Enter	↻:N/S, E/W

Figure 6-8 DEMO SETTING screen

- 2) Key in latitude and longitude for base position. If necessary, press [↻] to switch from North latitude to South latitude or vice versa, or from West longitude to East latitude or vice versa.
- 3) Press the [▼] key.
- 4) Enter ship's speed.
- 5) Press the [NU/CU ENT] key to start the demonstration display.
- 6) To quit the display, turn off the power.

Note: To return to the normal mode, turn off the power and then turn on the power while pressing and holding down [NU/CU ENT] key.

Note: When the memory is cleared while in the demonstration mode, the unit start up in the normal mode.

6.9 Installation of New Program (for technicians)

- 1) Turn off the power.
- 2) Insert new program card supplied by FURUNO.
- 3) Turn on the power. The unit beeps and starts loading the program, which takes several minutes.
- 4) Turn off the power.
- 5) Replace program card with chart card and turn on the unit.

6.10 Clearing the Memory

The memory, which stores all marks and track, can be cleared when marks and track are no longer required.

- 1) Press the [MENU ESC] key.
- 2) Press the [8] key to select CLEAR MEMORY.

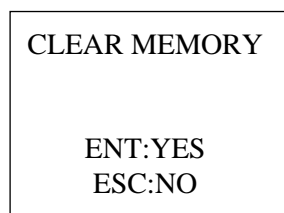


Figure 6-9 CLEAR MEMORY screen

- 3) Press the [NU/CU ENT] key to clear the memory.
- 4) After clearing memory, the initial start-up begins.

Specifications

Display Unit

Type	6-inch monochrome LCD, 240 x 320 dot
Tone	Three levels

Video Sounder

Frequency	50 kHz and 200 kHz
Display range	5, 10, 20, 40, 80, 160, 300 meter (feet, fathoms, and passi/braza also available)
Shift	0 to 300 m

GPS Receiver

Receiver format	8 channels all in view
Tracking system	Parallel
Position accuracy	Approx. 50 m, 95% of the time, Horizontal dilution of position (HDOP) ≤ 4 (Approx. 15 m if SA is not on) DGPS (option): 5 to 10 m, 95% of the time.

Note: All GPS receivers are subject to degradation of position and velocity accuracies under the U.S. Department of Defense. Position may be degraded up to 100 meters.

Plotter Section

Chart projection	Mercator (85° latitude or below)
Display range	0.14 to 6144 nm (above Equator)
Chart display	Land filled in
Memory capacity	Track, 2000 pts; Mark, 100 pts; Event, 100 pts; Waypoint, 200 pts, Route, 20 routes (30 waypoints/route)
Alarms	Arrival, anchor watch, bottom, fish, speed, trip, water temperature, XTE (cross track error)

I/O Data Format

Input format	NMEA 0183, Ver. 1.5 or 2.0
--------------	----------------------------

Output format NMEA 0183, Ver. 1.5 or 2.0

General

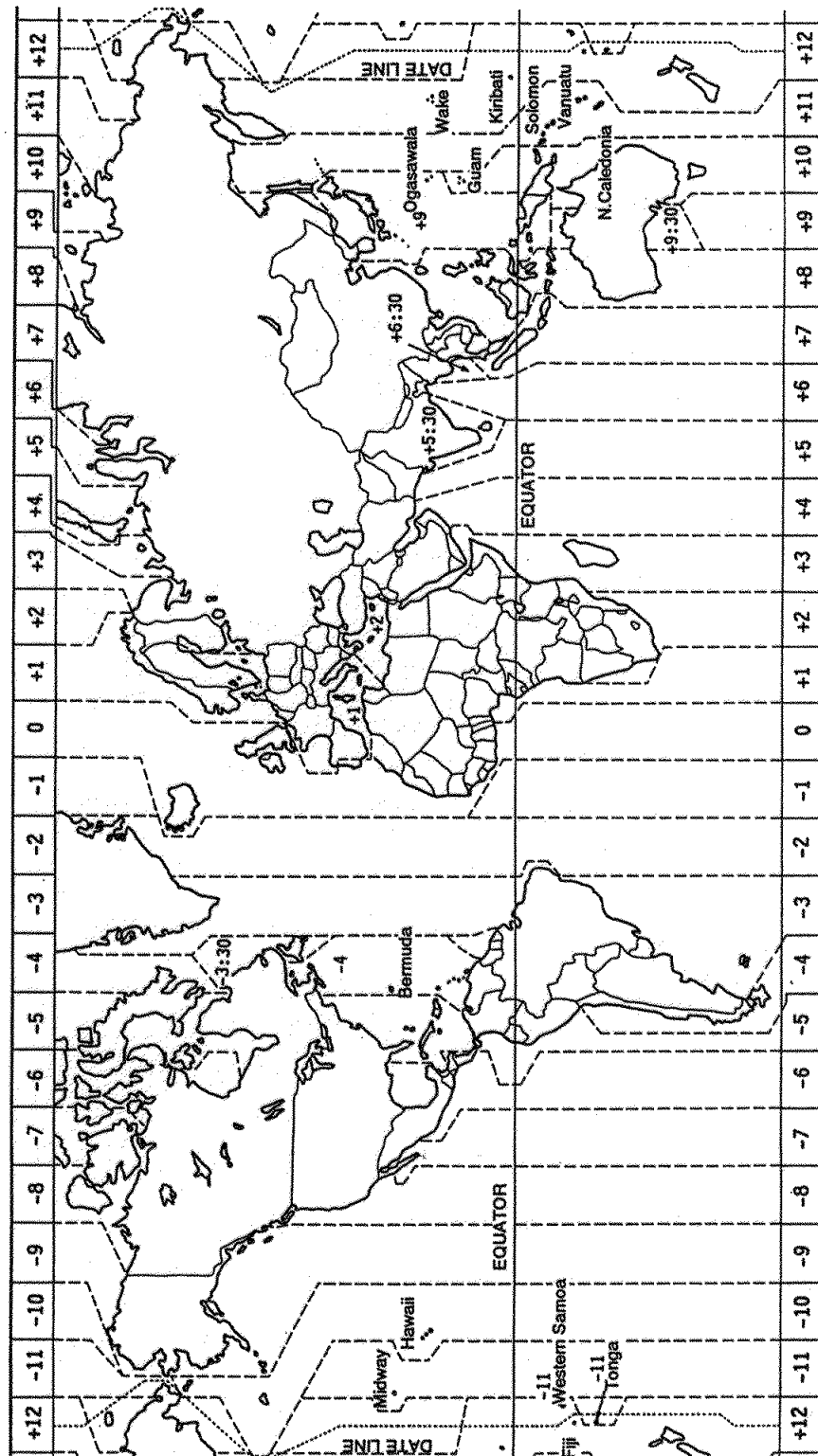
Dimensions and weight Display unit: 182(W) x 188(H) x 104.5(D) mm, 2.0 kg
Antenna unit: \varnothing 62 x 50(H) mm, 80 g

Power 10.2 to 16.0 VDC, 15 W

Useable temperature Display unit: 0°C to 50°C
Antenna unit: -30°C to 70°C

Waterproofing Display unit: IEC529 IPX5
Antenna unit: IEC529 IPX6

World Time Standards



Geodetic Chart List

001:	WGS84		094:		: Alberta and British Columbia
002:	WGS72		095:		: East Canada
003:	TOKYO	: Mean Value (Japan, Korea, and Okinawa)	096:		: Manitoba and Ontario
004:	NORTH AMERICAN 1927	: Mean Value (CONUS)	097:		: Northwest Territories and Saskatchewan
005:	EUROPEAN 1950	: Mean Value	098:		: Yukon
006:	AUSTRALIAN GEODETIC 1984	: Australia and Tasmania Island	099:		: Canal Zone
007:	ADINDAN	: Mean Value (Ethiopia and Sudan)	100:		: Caribbean
008:		: Ethiopia	101:		: Central America
009:		: Mali	102:		: Cuba
010:		: Senegal	103:		: Greenland
011:		: Sudan	104:		: Mexico
012:	AFG	: Somalia	105:	NORTH AMERICAN 1983	: Alaska
013:	AIN EL ABD 1970	: Bahrain Island	106:		: Canada
014:	ANNA 1 ASTRO 1965	: Cocos Island	107:		: CONUS
015:	ARC 1950	: Mean Value	108:		: Mexico, Central America
016:		: Botswana	109:	OBSERVATORIO 1966	: Corvo and Flores Islands (Azores)
017:		: Lesotho	110:	OLD EGYPTIAN 1930	: Egypt
018:		: Malawi	111:	OLD HAWAIIAN	: Mean Value
019:		: Swaziland	112:		: Hawaii
020:		: Zaire	113:		: Kauai
021:		: Zambia	114:		: Maui
022:		: Zimbabwe	115:		: Oahu
023:	ARC 1960	: Mean Value (Kenya, Tanzania)	116:	OMAN	: Oman
024:		: Kenya	117:	ORDNANCE SURVEY OF GREAT BRITAIN 1936 : Mean Value	
025:		: Tanzania	118:		: England
026:	ASCENSION ISLAND 1958	: Ascension Island	119:		: England, Isle of Man, and Wales
027:	ASTRO BEACON "E"	: Iwo Jima Island	120:		: Scotland and Shetland Islands
028:	ASTRO B4 SOR. ATOLL	: Tern Island	121:		: Wales
029:	ASTRO POS 71/4	: St. Helena Island	122:	PICO DE LAS NIVIES	: Canary Islands
030:	ASTRONOMIC STATION 1952	: Marcus Island	123:	PITCAIRN ASTRO 1967	: Pitcairn Island
031:	AUSTRALIAN GEODETIC 1966	: Australia and Tasmania Island	124:	PROVISIONS SOUTH CHILEAN 1963	: South Chile (near 53° S)
032:	BELLEVUE (IGN)	: Efate and Erromango Islands	125:	PROVISIONAL SOUTH AMERICAN 1956	: Mean Value
033:	BERMUDA 1957	: Bermuda Islands	126:		: Bolivia
034:	BOGOTA OBSERVATORY	: Columbia	127:		: Chile—Northern Chile (near 19° S)
035:	GAUPO INCHAUSPE	: Argentina	128:		: Chile—Southern Chile (near 43° S)
036:	CANTON ISLAND 1966	: Phoenix Islands	129:		: Columbia
037:	CAPE	: South Africa	130:		: Ecuador
038:	CAPE CANAVERAL	: Mean Value (Florida and Bahama Islands)	131:		: Guyana
039:	CARTHAGE	: Tunisia	132:		: Peru
040:	CHATHAM 1971	: Chatham Island (New Zealand)	133:		: Venezuela
041:	CHUA ASTRO	: Paraguay	134:	PUERTO RICO	: Puerto Rico and Virgin Islands
042:	CORREGO ALEGRE	: Brazil	135:	QATAR NATIONAL	: Qatar
043:	DJAKARTA (BATAVIA)	: Sumatra Island (Indonesia)	136:	QORNOQ	: South Greenland
044:	DOS 1968	: Gizo Island (New Georgia Islands)	137:	ROME 1940	: Sardinia Islands
045:	EASTER ISLANDS 1967	: Easter Island	138:	SANTA BRAZ	: Sao Maguel, Santa Maria Islands (Azores)
046:	EUROPEAN 1950 (Cont'd)	: Western Europe	139:	SANTO (DOS)	: Espirito Santo Island
047:		: Cyprus	140:	SAPPER HILL 1943	: East Falkland Island
048:		: Egypt	141:	SOUTH AMERICAN 1969	: Mean Value
049:		: England, Scotland, Channel, and Shetland Islands	142:		: Argentina
050:		: England, Ireland, Scotland, and Shetland Islands	143:		: Bolivia
051:		: Greece	144:		: Brazil
052:		: Iran	145:		: Chile
053:		: Italy, Sardinia	146:		: Columbia
054:		: Italy, Sicily	147:		: Ecuador
055:		: Norway and Finland	148:		: Guyana
056:		: Portugal and Spain	149:		: Paraguay
057:	EUROPEAN 1979	: Mean Value	150:		: Peru
058:	GANDAJIKA BASE	: Republic of Maldives	151:		: Trinidad and Tobago
059:	GEODETIC DATUM 1949	: New Zealand	152:		: Venezuela
060:	GUAM 1963	: Guam Island	153:	SOUTH ASIA	: Singapore
061:	GUX 1 ASTRO	: Guadalcanal Island	154:	SOUTHEAST BASE	: Porto Santo and Madeira Islands
062:	HJORSEY 1955	: Iceland	155:	SOUTHWEST BASE	: Faial, Graciosa, Pico, Sao Jorge, and Terceira Islands
063:	HONG KONG 1363	: Hong Kong	156:	TIMBALAI 1948	: Brunei and East Malaysia (Sarawak and Sadah)
064:	INDIAN	: Thailand and Vietnam	157:	TOKYO	: Japan
065:		: Bangladesh, India, and Nepal	158:		: Korea
066:	IRELAND 1965	: Ireland	159:		: Okinawa
067:	ISTS 073 ASTRO 1969	: Diego Garcia	160:	TRISTAN ASTRO 1968	: Tristan da Cunha
068:	JOHNSTON ISLAND 1961	: Johnston Island	161:	VITI LEVU 1916	: Viti Levu Island (Fiji Islands)
069:	KANDAWALA	: Sri Lanka	162:	WAKE-ENIWETOK 1960	: Marshall Islands
070:	KERGUELEN ISLAND	: Kerguelen Island	163:	ZANDERJ	: Surinam
071:	KERTAU 1948	: West Malaysia and Singapore	164:	BUKIT RIMPAH	: Bangka and Belitung Islands (Indonesia)
072:	LA REUNION	: Mascarene Island	165:	CAMP AREA ASTRO	: Camp Mcmurdo Area, Antarctica
073:	L. C. 5 ASTRO	: Cayman Brac Island	166:	G. SEGARA	: Kalimantan Islands (Indonesia)
074:	LIBERIA 1964	: Liberia	167:	HERAT NORTH	: Afghanistan
075:	LUZON	: Philippines (excl. Mindanao Island)	168:	HU-TZU-SHAN	: Taiwan
076:		: Mindanao Island	169:	TANANARIVE OBSERVATORY 1925	: Madagascar
077:	MAHE 1971	: Mahe Island	170:	YACARE	: Uruguay
078:	MARCO ASTRO	: Salvage Islands	171:	RT-90	: Sweden
079:	MASSAWA	: Eritrea (Ethiopia)			
080:	MERCHICH	: Morocco			
081:	MIDWAY ASTRO 1961	: Midway Island			
082:	MINNA	: Nigeria			
083:	NAHRWAN	: Masirah Island (Oman)			
084:		: United Arab Emirates			
085:		: Saudi Arabia			
086:	NAMIBIA	: Namibia			
087:	MAPARIMA, BWI	: Trinidad and Tobago			
088:	NORTH AMERICAN 1927	: Western United States			
089:		: Eastern United States			
090:		: Alaska			
091:		: Bahamas (excl. San Salvador Island)			
092:		: Bahamas, San Salvador Island			
093:		: Canada (incl. Newfoundland Island)			

Loran C Chains

Chain	GRI	S1	S2	S3	S4	S5
Central Pacific	08: 4990	11	29	—	—	—
Canadian East Coast	11: 5930	11	25	38	—	—
Command Lion (Korea)	12: 5970	11	31	42	—	—
Canadian West Coast	05: 5990	11	27	41	—	—
South Saudi Arabia	16: 7170	11	26	36	52	—
Labrador Sea	13: 7930	11	26	—	—	—
Eastern Russia	15: 7950	11	30	46	61	—
Gulf of Alaska	06: 7960	11	26	—	—	—
Norwegian Sea	00: 7970	11	26	46	60	—
Southeast USA	02: 7980	11	23	43	59	—
Mediterranean Sea	10: 7990	11	29	47	—	—
Western Russia	18: 8000	11	25	50	65	—
North Central USA	20: 8290	11	27	42	—	—
North Saudi Arabia	17: 8990	11	25	40	56	69
Great Lakes	03: 8970	11	28	44	—	—
South Central USA	19: 9610	11	25	40	52	65
West Coast USA	04: 9940	11	27	40	—	—
Northeast USA	01: 9960	11	25	39	54	—
Northeast Pacific	09: 9970	11	30	55	81	—
Icelandic	14: 9980	11	30	—	—	—
North Pacific	07: 9990	11	29	43	—	—

Decca Chains

Chain No.	Chain	Chain code	Location
01	South Baltic	0A	Europe
02	Vestlandet	0E	"
03	Southwest British	1B	"
04	Northumbrian	2A	"
05	Holland	2E	"
06	North British	3B	"
07	Lofoten	3E	"
08		3F	"
09	North Baltic	4B	"
10	North West	4C	"
11	Trondelag	4E	"
12	English	5B	"
13	North Bothnian	5F	"
14	Southern Spanish	6A	"
15	North Scottish	6C	"
16	Gulf of Finland	6E	"
17	Danish	7B	"
18	Irish	7D	"
19	Finmark	7E	"
20	French	8B	"
21	South Bothnian	8C	"
22	Hebridean	8E	"
23	Frisian Islands	9B	"
24	Helgeland	9E	"
25	Skagerrak	10B	"
26	North Persian Gulf	5C	Persian Gulf & India
27	South Persian Gulf	1C	"
28	Bombay	7B	"
29	Calcutta	8B	"
30	Bangladesh	6C	"
31	Saliyah	2F	"
32	Hokkaido	9C	Japan
33	Tohoku	6C	"

Chain no.	Chain	Chain code	Location
34	Kanto	8C	Japan
35	Shikoku	4C	"
36	Hokuriku	2C	"
37	Kita Kyushu	7C	"
38	Namaqualand	4A	Southern Africa
39	Cape	6A	"
40	Eastern Province	8A	"
41	South West Africa	9C	"
42	Natal	10C	"
43	Dampier	8E	Australia
44	Port Headland	4A	"
45	Anticosti	9C	Northern Africa
46	East Newfoundland	2C	"
47	Cabot Strait	6B	"
48	Nova Scotia	7C	"

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