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CE

KODEN

OPERATION MANUAL

DGPS NAVIGATOR

KGP-931D

TÜV PRODUCT SERVICE Quality System certified to ISO 9001

93121562-10

Important Notice

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

The Global Positioning System (GPS) consists of a total of 28 GPS satellites that orbit on the earth, enabling you to calculate your position anywhere in the world, 24 hours a day if you can receive satellite signals. However, these satellites are controlled by the U.S. DoD and the satellite position and speed may be changed slightly without notice due to U.S. military strategy. Also, radio emission may be stopped due to equipment testing or adjustment or changes in their orbit, causing your positioning to fail. During actual navigation, carefully compare the calculated data with all available navigation sources such as Loran C, Decca, other navigators, charts, visual navigation, depth, water temperature and others. It is your responsibility to make navigation judgments.

About the positioning accuracy:

The GPS positioning accuracy is reduced due to U.S. military strategy (SA). When the PDOP is 3 or less and when the GPS satellites are well positioned in orbit, you can get 95% of positioning data in the accuracy within 100 m. The remaining 5% of data can have errors to 200 m or more. If the antenna unit is shaded, or if the satellites are not positioned well, the PDOP may drop and even the 95% of positioning data may have errors exceeding 100 m.

DGPS operation note:

Your position can be inproved by DGPS correction. However, when you are communicating with other ships, you may use the DGPS correction but they do not. Take care not to make this mistake during communication.

Pictorials

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

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

WARNING <For System Operators>

Always follow this instruction to prevent personal injury or death.

	Turn power OFF during abnormality.	If smoke or a smell of burning occurs, a fire or an electrical short circuit may result. Turn the power switch OFF and shut down the power supply immediately. Never try to repair the system yourself. Call for service.
	Do not open the cabinet.	High voltage exists in the instrument. Contact with it may cause personal injury or death.
	Do not use in poor ventilation.	If you cover it or use in a closed place, it may malfunction or become damaged due to an overheating. Use only where there is enough ventilation.

Installation Cautions <For Service Personnel>

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

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

Maintenance Cautions <For Maintenance Personnel>

Use the following safety precautions during internal inspection.

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

Operation Notes <For Operators>

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

Backup important data.	Save or log important data in a backup memory or log sheets. The initial setup data and your storage data may be lost when the internal battery expires or when you service the electrical circuits.
Avoid excessive force.	Take care not to apply excessive force to the display unit (LCD). Since the display panel has high-density electronics components, excessive force can crack or damage it.

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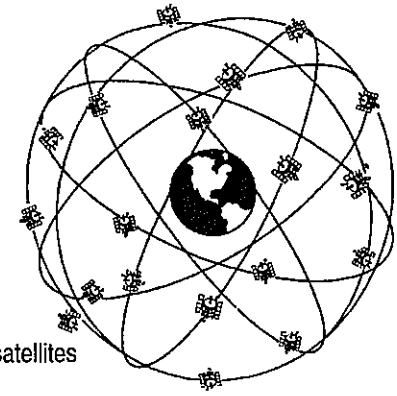
Understanding GPS (Global Positioning System)

Arrangement of GPS satellites

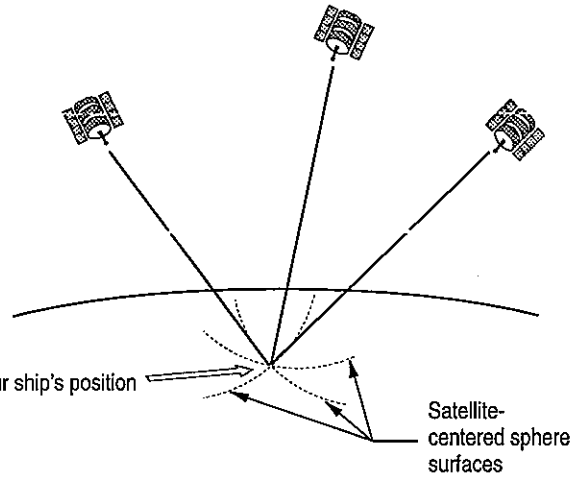
GPS is a navigation system using 24 satellites (21 plus 3 in reserve) orbiting 20,183 km high from the earth every 11 hours 58 minutes.



Arrangement of GPS satellites

How your position is obtained?

Your position is determined by calculating the distance from two satellites (in 2-dimensional positioning) or three satellites (in 3-dimensional positioning) to your position. The distance is determined by the time taken for a message to be sent from the satellites to the receiver. However, an additional satellite is used to eliminate measuring errors resulting from the time factor since it is not practical to have a clock synchronized precisely with the clocks on the satellites.
In 2-dimensional positioning, your position (latitude and longitude; height is preset) is determined at the intersection point of three spheres formed by three satellites. In 3-dimensional positioning, your position (latitude, longitude and height) is determined at the intersection point of four spheres formed by four satellites.

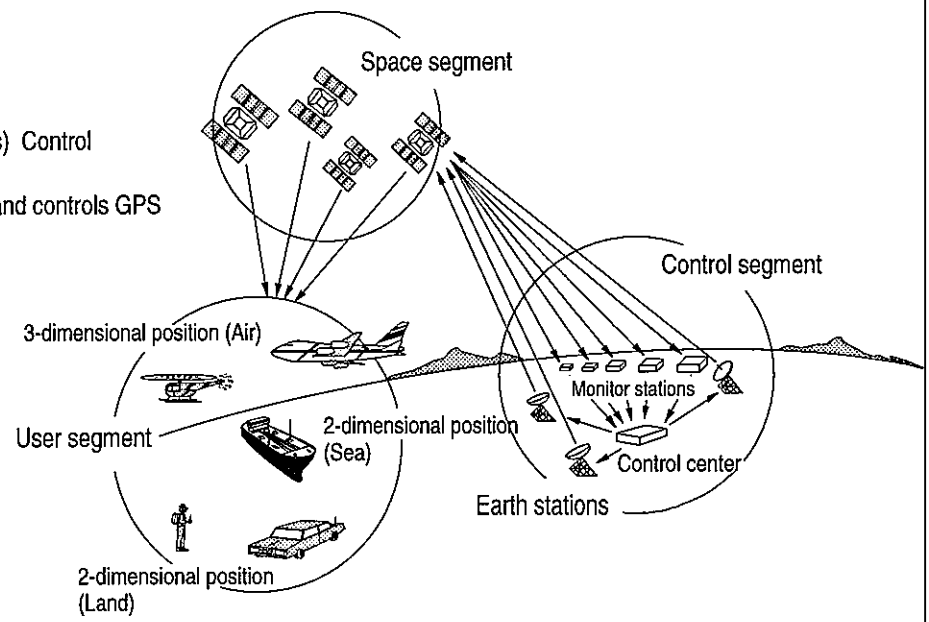


Notes:

1. The accuracy of measurement by GPS may be subject to change by the policy of the U.S. Department of Defense (DoD).
2. The GPS system is based on a geodetic system called WGS-84. In conventional world map system, one coordinate system differs from others with region, and this causes the position fix made on the map and GPS measurement to differ to a certain extent. For further information, see "Selecting a geodetic datum" on Page 29 and "Correction your position" on Page 31 to 33.

Structure of GPS

- Space segment
  24 satellites (6 orbits × 4 satellites) Control segment
- The control station that monitors and controls GPS satellites from the earth.
- User segment
  GPS receiver owned by users.

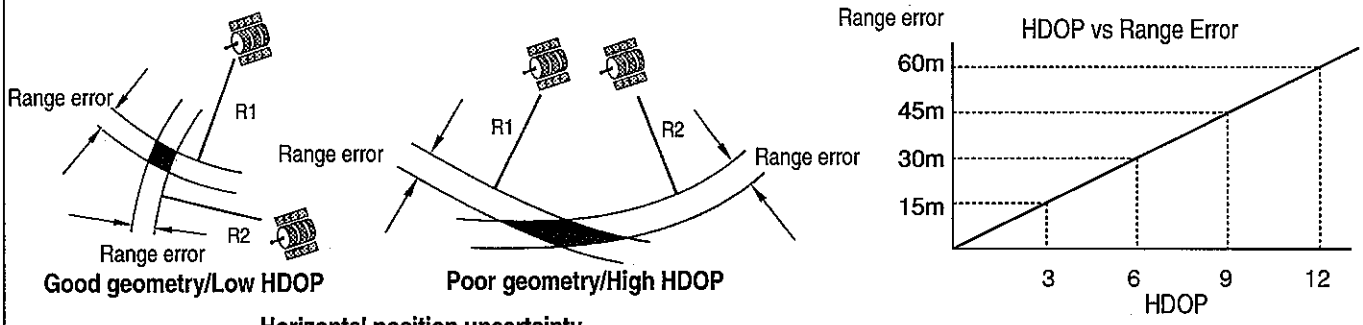


For Proper Operation

GPS signal reception (HDOP or PDOP)

The accuracy of position determination with GPS is affected by the geometrical position of satellites and the accuracy of the ranging to the satellite.

- The satellite geometrical position in comparison to the user is expressed in the Geometrical Dilution of Precision, GDOP (or DOP). Roughly speaking, the more "spread out" the satellites are, the better accuracy of the position. When the satellites are bunched together, the position may not be as accurate as normal.
- GPS navigator usually employs an algorithm which selects satellites based on the lowest DOP in accordance with satellites moving.
- Horizontal DOP (HDOP) is for the horizontal (LAT/LONG) aspect of the error: two-dimensional navigation.
- Position DOP (PDOP) is for both horizontal (LAT/LONG) and vertical (altitude) aspect of error: three-dimensional navigation.



Notes:

- The two-dimensional measurement may have a dropped accuracy in horizontal direction (about an error multiplied by HDOP) if your altitude differs from the antenna height you have entered.
- The value of DOP changes with time because all satellites move in orbit. As a result. even if the GPS receiver is fixed to a certain point. the value measured by the geometrical position is not fixed at all times.
- When satellites are positioned near the horizon (lower elevation), you cannot receive GPS signals due to interruption by mountains, buildings, etc.
- GPS signals cannot be received in a room. Place the antenna in an open site, away from obstacles.
- The bearing data obtained from the GPS navigation system is a reference from the true north.

It takes more time to fix position when:

- **You use your GPS navigator for the first time.**
- **The stored orbital data is not suitable for the available satellite, or purged due to lengthy storage.**
- **You use it after moving a long distance.**

NAVIGATOR shortens position calculating time by storing the orbital data sent from the available satellites. When you first switch on the navigator, it may take about 15 minutes before the first fix is made.
From the second operation, the receiver can fix your position within a minute because of stored satellite data from the previous operation.

Mounting GPS receiver and notes on LCD

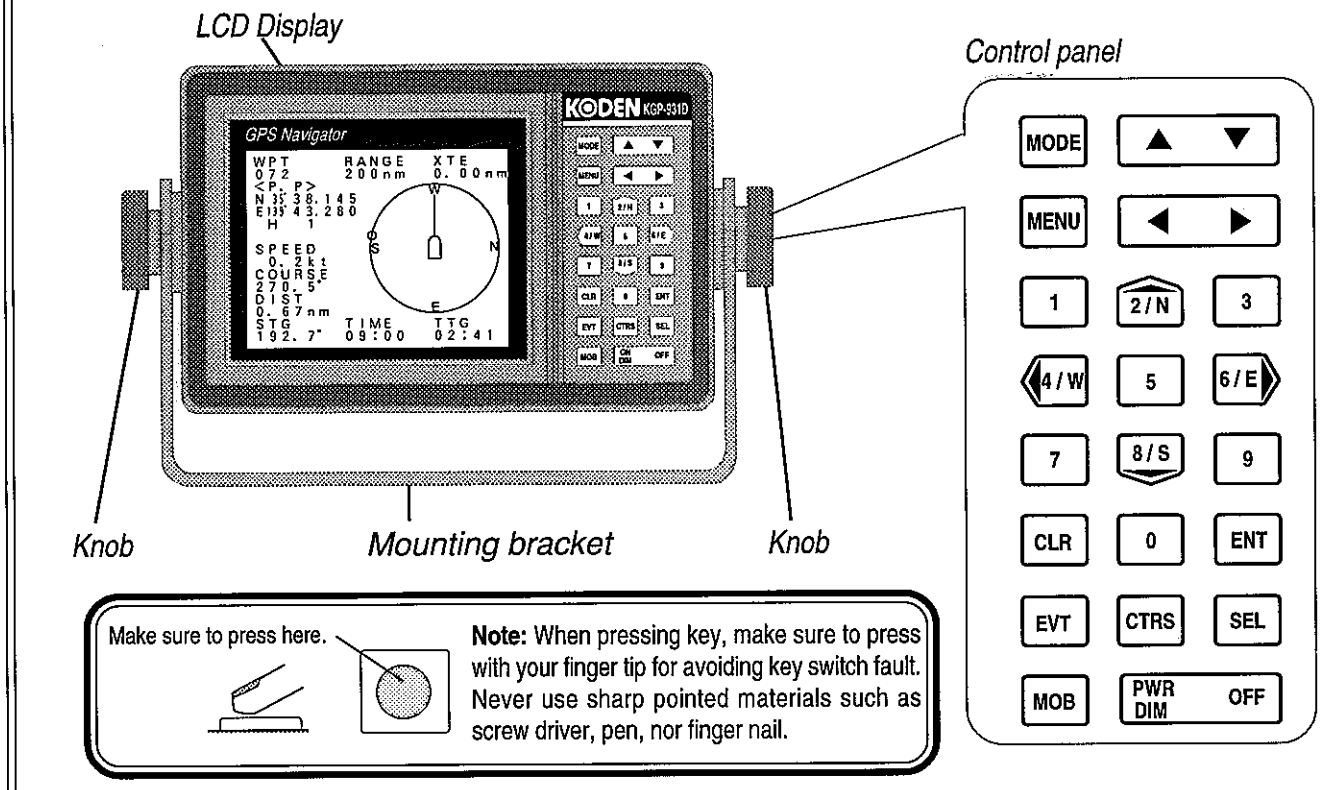
Read and follow the Important Notice given at the beginning of this manual for operations.

When NAVIGATOR is damaged or out of order, please contact your local agent or authorized dealer for service.

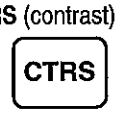
Special notes for LCD (Liquid Crystal Display) panel

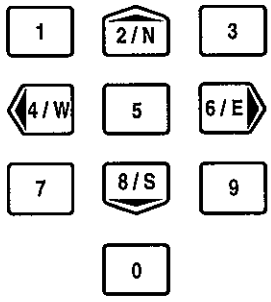
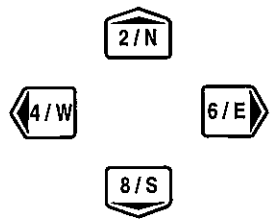
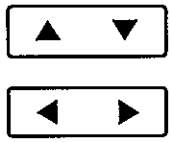
- Avoid following conditions to insure good LCD visibility:
- Long-time exposure to direct sun rays or UV.
  Extremely hot (surrounding temperature above 50°C or 120°F) or cold (below 0°C or 32°F) environment. The character switching speed can drop in low temperature (however, this is not an error as it becomes normal in warm temperature).
- Extremely high humidity. The LCD can have a dropped performance or can be damaged.

Display Unit



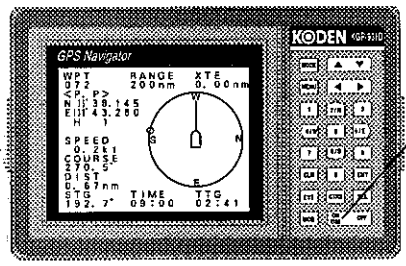
Note: When pressing key, make sure to press with your finger tip for avoiding key switch fault. Never use sharp pointed materials such as screw driver, pen, nor finger nail.

MODE key	Selects a visual presentation of either NAV 1, NAV 2, NAV 3, or PLOT mode.
MENU key	Selects a display of active mode above.
CLR (Clear) key	Clears incorrect data entered. Turns the alarm off temporarily.
ENT (enter) key	Enters the data to be stored.
EVT (event) key	Stores present position.
CTRS (contrast) key 	Changes the contrast of the display.
SEL (selection) key	Selects each setting item.
MOB (Man over-board) key	Stores the present position for emergency use.

PWR/DIM (power/dimmer) key	Turns the power on. Changes the brightness of the display.
POWER OFF key	Turns the power off.
Numerical key 	Enters numbers such as group number and point number.
N, S, E, W key 	Specifies either N, S, E, or W. Moves the present position on PLOT mode display. Selects mark and comment letter on MENU mode display.
Arrow key 	Selects and moves setting item Moves cursor for setting letters or numbers. Pressing each arrow moves cursor in the same direction as mark.

Getting Started

GPS NAVIGATOR shortens position calculating time by continuously updating bit data sent from the available satellites. (The condition where no orbit data is stored is called initialized condition.) When you first switch on the receiver, it may take about 15 minutes until the first fix is made because no orbit data is stored.
Therefore, to fix the position for the first time, follow the steps below to store orbit data in your area:



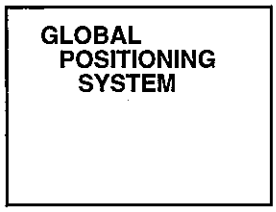
Power switch

Power HOLD ON

When the power is accidentally interrupted and is resumed, the position is automatically displayed because of POWER ON function. Therefore, you do not have to press ON key again to turn the power on.

PWR DIM Power on by pressing the key.

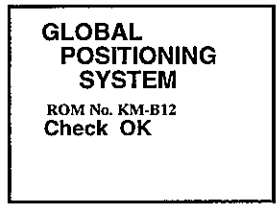
Before the latitude and longitude of the present position are displayed, the screen changes as shown below:



The display when the power switch has been pressed.

Adjusting back light brightness

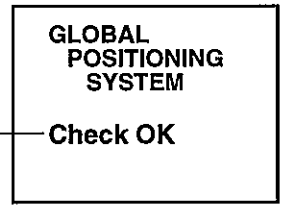
PWR DIM Every press of ON key changes backlit brightness in 3 states.



The display when checking the function of the reception display operation has finished.

Changing the screen contrast

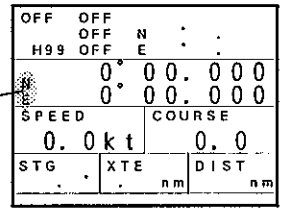
CTRS Changes the contrast (intensity) of the back light each time this key is pressed.



The display when checking the function of the antenna.

When the power switch is pressed.

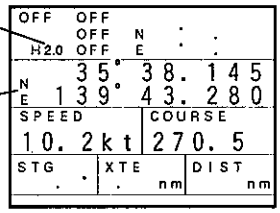
Impossible positioning
The number of satellites being received is two or less, or DOP value exceeds the preset value, position fix is not available.



The display when the GPS satellites are searched.

Letters blink

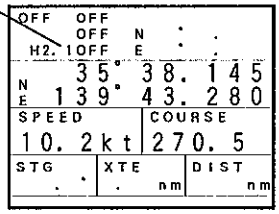
DOP value



The display when receiving of signals from the GPS satellite is stable.
If the receiving state becomes unstable, N (or S) and E (or W) begin to blink on the NAV1 or NAV2 screen.

If satellite reception becomes unstable, letters will blink.

The value of DOP goes down.



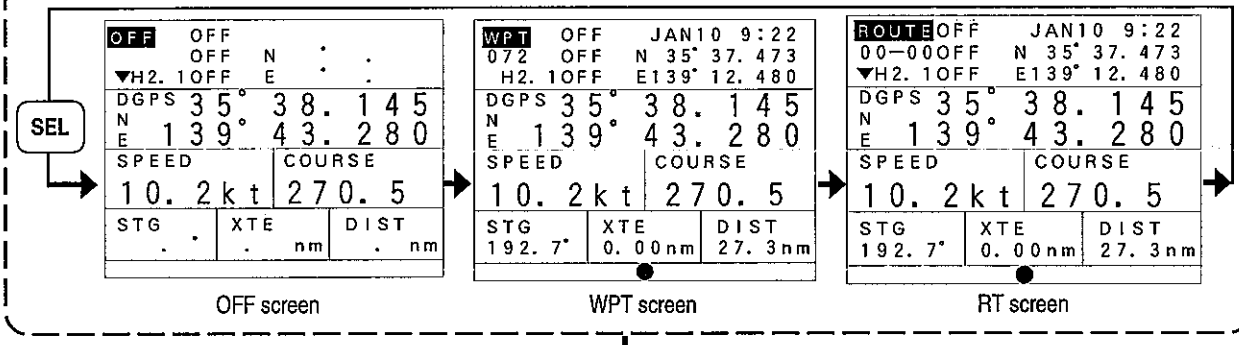
The display when more than three satellites are received, the latitude and longitude of the present position will be shown.

Turning the power off

OFF Pressing and holding down **PWR/DIM** key for more than 2 seconds turns the power off. The setting condition before turning off the power will be maintained.

Changing display modes

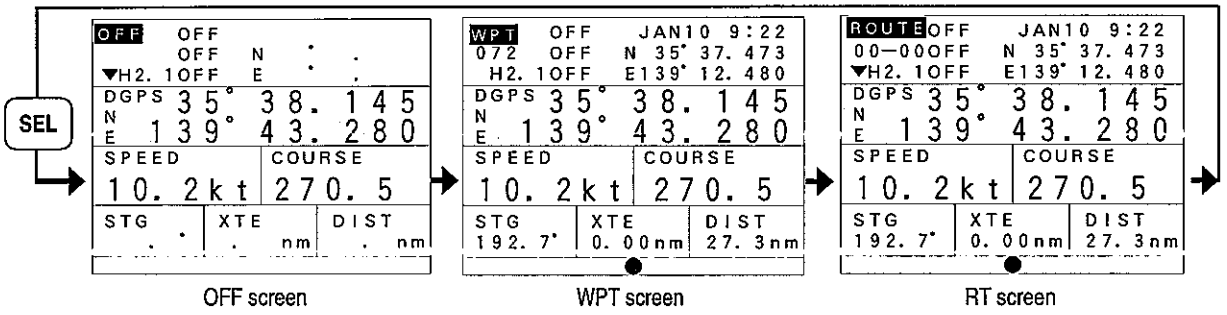
NAV 1 mode
The same screen configuration is displayed in the NAV 1 and NAV 2 modes, and you can select either one of two upon your requirement.



OFF screen WPT screen RT screen

MODE

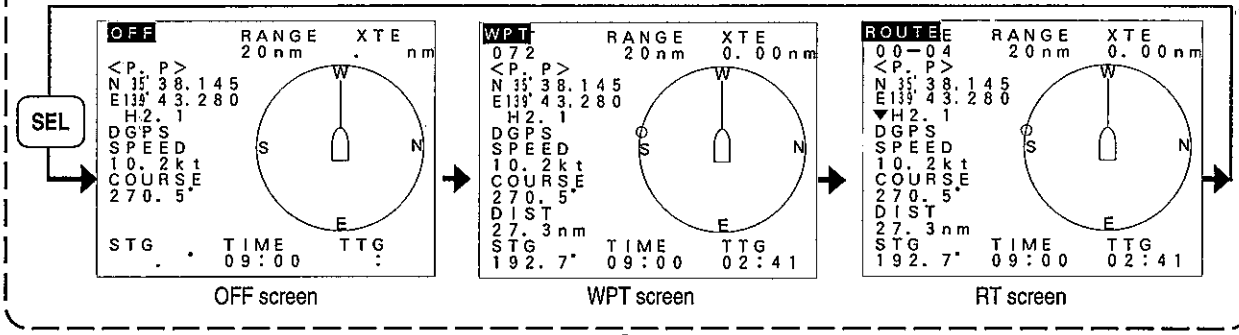
NAV 2 mode
The same screen configuration is displayed in the NAV 1 and NAV 2 modes, and you can display two types of screens simultaneously.



OFF screen WPT screen RT screen

MODE

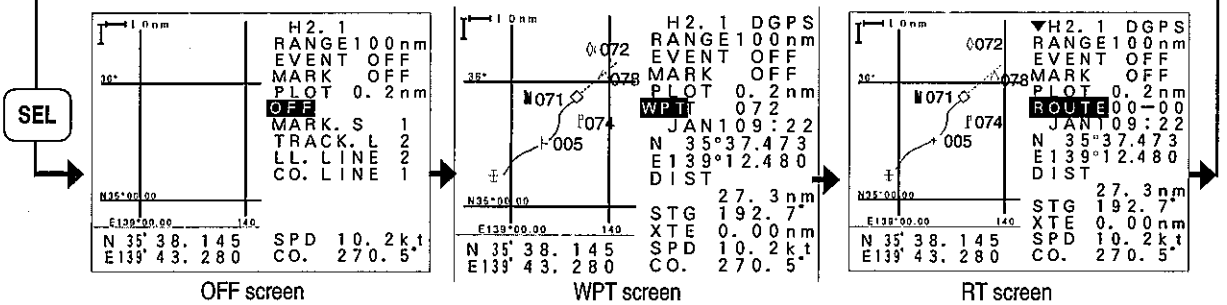
NAV 3 mode



OFF screen WPT screen RT screen

MODE

PLOT mode : Press **ENT** key to display presetting menu. See "**Plotting Own Vessel Tracks**" (page 36).



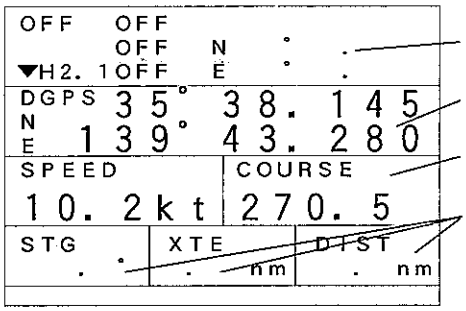
OFF screen WPT screen RT screen

MODE

Every press of the key changes the screen in the direction of the arrow.

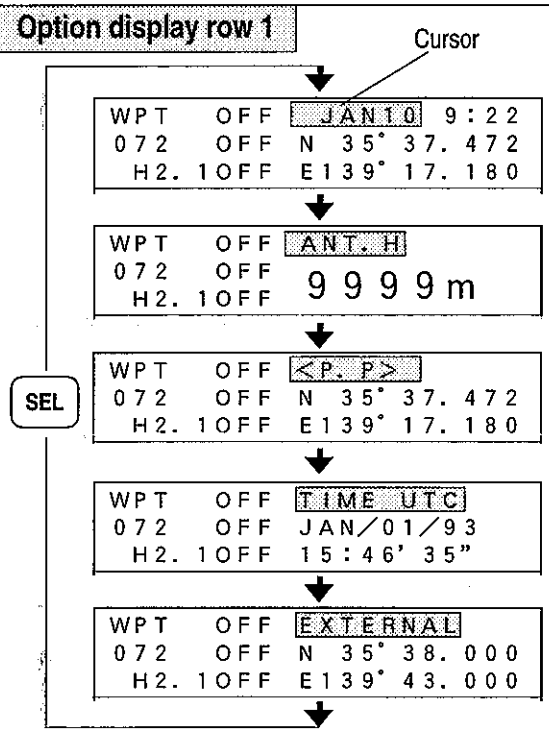
Changing display between NAV 1 and NAV 2

The same screen configuration is displayed in the NAV 1 and NAV 2 modes, and you can have two types of screens simultaneously.



SEL — Move the cursor on the item to be changed by pressing arrow keys. Cursor position is displayed by reverse characters.Every press of the key changes the screen in the direction of the arrow.

Option display row 1



Waypoint display
The stored point of the present waypoint and a comment are displayed.

Antenna height
2D mode: The entered antenna height is display.
3D mode: The measured antenna height is display.
You can select the unit of antenna height on the menu screen.

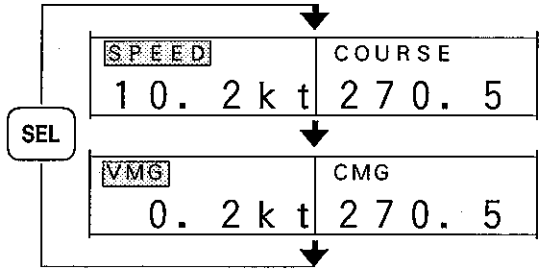
Present position display
LOPs (Loran C or Decca) is displayed when the second row shows L/L position is displayed with the second row in LOP position L/L position.

Current time display
The universal time coordinated (UTC) or local time coordinated (LTC) is displayed. For display of the local time coordinated, refer to "Display local time" (page 54).

External input data display
The externally entered navigation data is display. They are:
- Gyro log data from the GRA-20A
- Depth data from color echo sounder.
- Position data from Loran C LOP (or Decca LOP) navigator
- L/L position data from navigator

You can select the display data on the menu screen.

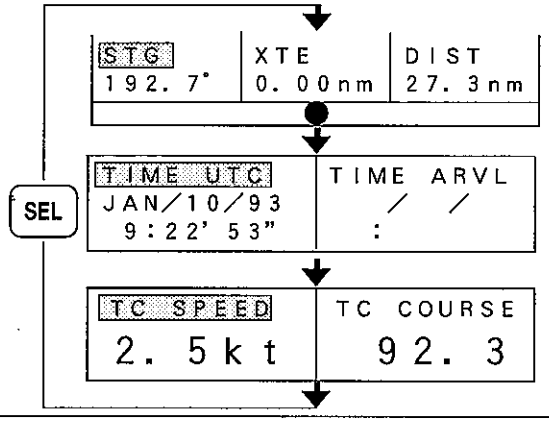
Option display row 2



Speed and course display
Your vessel speed and route are calculated based on the present position data and displayed.

VMG and CMG display
The velocity made good and course made good are displayed after power-on to the present position.

Option display row 3



STG, XTE, DIST display
The bearing to the waypoint, cross track error, and distance to the waypoint are displayed.

Current, TTG, total needed, elapsed and final arrival time display
The current time is shown at left. Shift the cursor to the right and press the SEL key, and the time to go to waypoint (page 27), the proximate arrival time (page 28), and the elapsed time (page 12) based on the average speed and course will be shown.

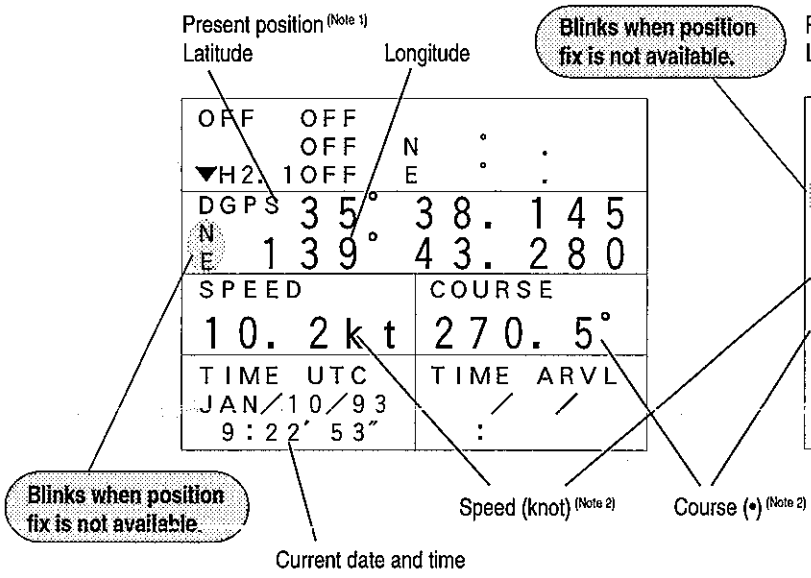
TC (tide current) speed and course display
The speed and direction of drift are displayed. To display the TC speed or course, enter Gyro and log signals from the GRA-20A (optional).

Present Position Information

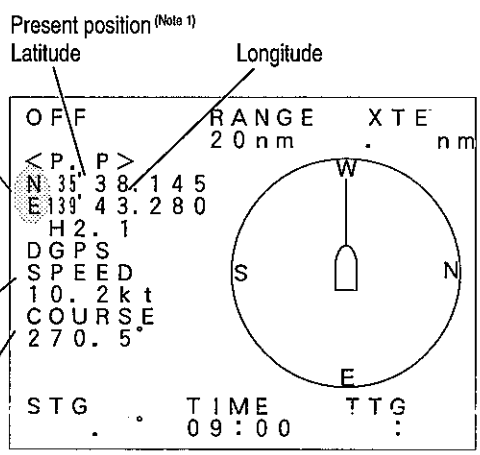
Your present position is displayed in latitude and longitude.

MODE When you press **MODE** key, the display will change.

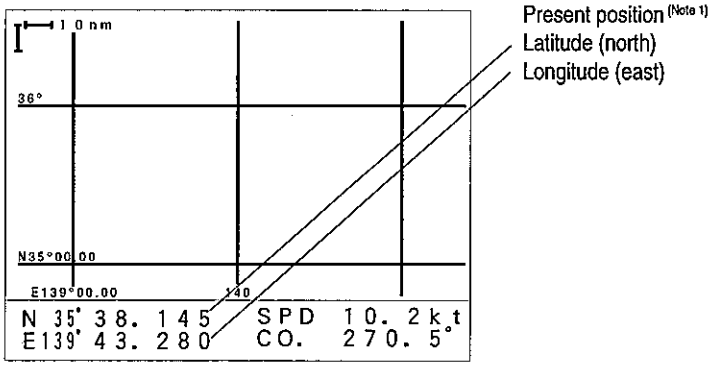
NAV 1 or NAV 2 mode



NAV 3 mode



PLOT mode



Note 1: When the satellite signals are interrupted..
When positioning by GPS is interrupted, the unit will maintain position for 1 minute by dead reckoning. Then the unit will maintain the final position and universal or local time at final positioning. While positioning is maintained, a small letter '**h**' is indicated s DOP indication.
When the gyro log interface GRA-20A (option) is connected, the present position is calculated by using the speed data from log and bearing from gyro through GRA-20A.

Note 2: Display of speed and bearing when GRA-20A is connected.
When it is possible to fix position: Speed and direction of drift (NAV1 and NAV 2 mode). See page 11.
When it is impossible to fix position: Data of speed and direction from GRA-20A is shown. See page 11.

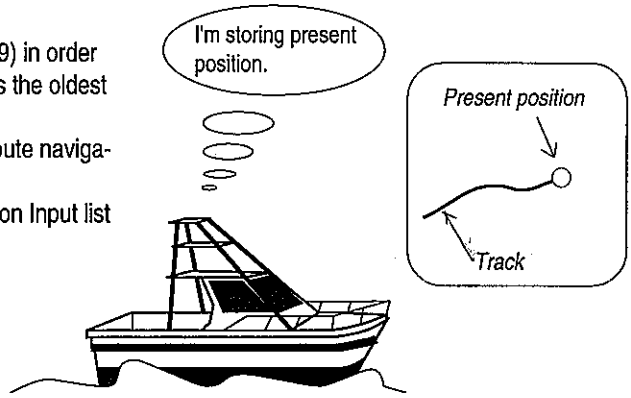
- *The present position can be displayed in Loran C LOP or Decca LOP coordinates.*
  *For more information, see **Changing the coordinates for present position display** on Page 42 and **Alternating Loran C LOP and Decca LOP** on Page 63.*
- *The unit of speed can be changed.*
  *For more information, see **Changing the unit of measure for velocity and distance** on Page 41.*
- *When you connect GRA-20A, select NMEA-0183 for input format.*
  *For more information, see **Selecting data input format and connector** on Page 57.*

Storing present position (EVENT)

A total of 99 present positions can be stored with numbers (001 to 099) in order by pressing EVT key. After the 100th position, the latest one replaces the oldest one : therefore, the position numbers rotate.

- It is convenient to store the present position for later use such as route navigation.

The present position is stored in group numbers 00 to 09 of the Position Input list of the menu.

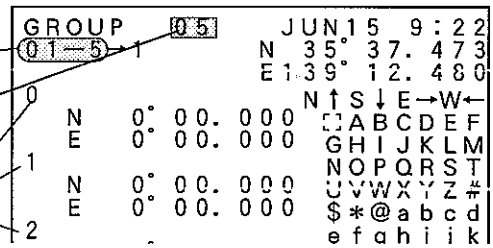


EVT

Pressing **EVT** key stores present position. Every press of **EVT** key, up to 100 present positions can be stored in order: from Group 00 (point 1 to 9) and Group 09 (point 0 to 9).

EVT key cannot activate in MENU modes.
Even when **MOB** key is pressed, present position can be stored.

Recalling a stored present position



Event position number currently used.

Group number

Point number

The present positions stored as event positions are grouped with group numbers 00 to 09 and point numbers 0 to 9 in order.

MENU ➡ ▲ or ▼ ➡ **ENT** ➡ ➡ **ENT** ➡ ▲ or ▼

Select MENU mode.

Move cursor to **10. MARK.**

Display the Enter/Edit Position screen.

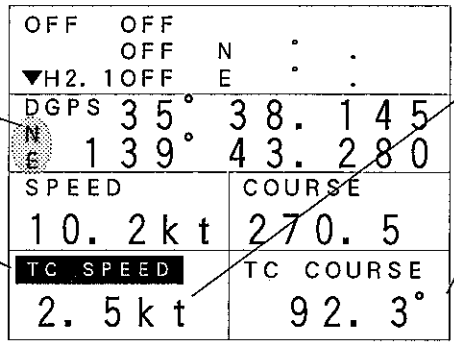
Select the entered group (00 to 09).

Move cursor onto the point number you check.

Displaying the speed and direction of drift

It is necessary to enter the data of speed and direction through GRA-20A.

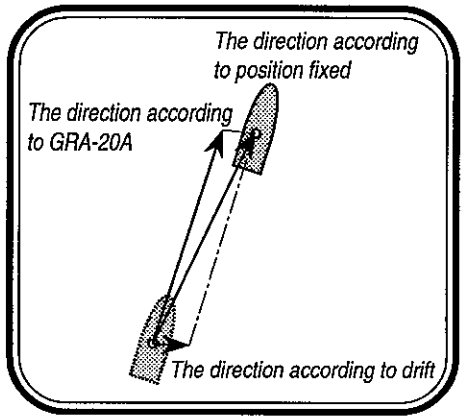
Select NMEA-0183 as input data format.
For more information, see **Selecting the input signal format and connector** on Page 57.



Blinks when position fix is not available.

Cursor

When position is fixed:
The speed according to position fixed
When position is not fixed:
The speed according to GRA-20A
When position is fixed:
The direction according to position fixed
When position is not fixed:
The direction according to GRA-20A



MODE ➡ ▲ or ▼ ➡ **SEL** or **ENT**

Select **TC SPEED**, and the velocity and direction of drift will appear.

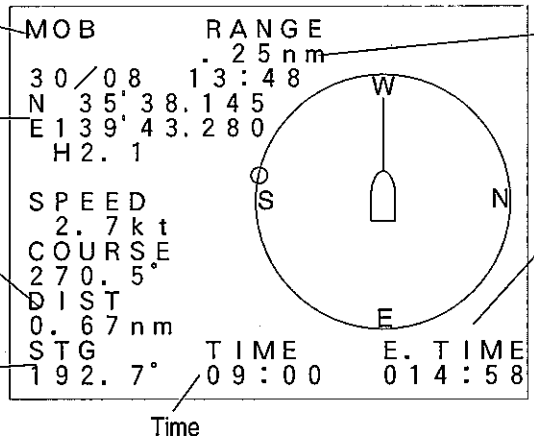
Move cursor to the position shown above.

Select NAV 1 or NAV 2 mode.

Using MOB (Man over-board) key

Note: **MOB** key does not function, when positioning is interrupted.

MOB Press **MOB** key, and present position is immediately stored with **MOB** screen displayed.



The positioning where MOB key is pressed will be registered with data and time, in point 0 or group 00 of "**10. MARK**" in the position registration list on the menu.

The keys except five keys shown below are not operable during MOB display.

CLR CTRS PWR DIM OFF

CLR Press **CLR** key, and **MOB** screen display returns to the screen previously displayed.

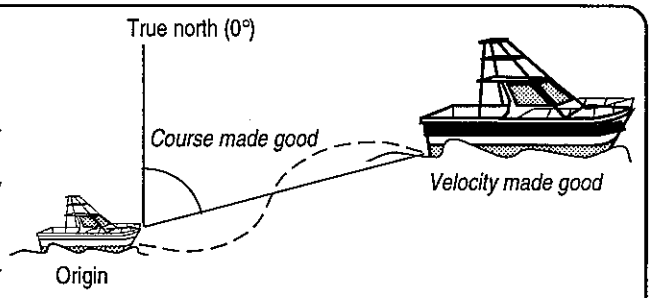
Displaying velocity made good (VMG) and course made good (CMG)

What are velocity made good, course made good, and elapsed time?

Velocity made good: A value which is calculated by dividing the distance between the origin (the point where you set the elapsed time) and the present position by the elapsed time.

Course made good: A true bearing from origin to present position.

Elapsed time: The time elapsed after your power-on or after you have pressed the **CLR** (Reset) key.



MODE ➡ ▼ ➡ SEL ➡ CLR

CMG and VMG can be displayed also during waypoint navigation or route navigation.

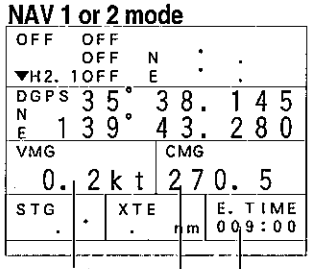
Press **CLR** key to reset the elapsed time.

The letters **SPEED** turn to **VMG**.

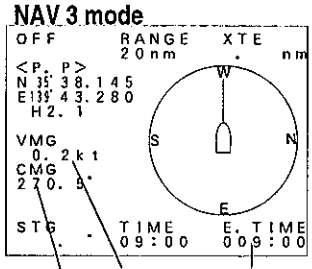
Move cursor to **SPEED**.

Select the NAV 1, NAV 2 or NAV 3 mode.

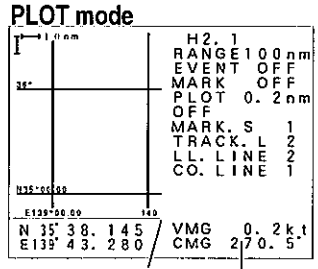
NAV 1 or 2 mode



NAV 3 mode



PLOT mode



The elapsed time can be checked in the NAV 1, NAV 2, or NAV 3 mode.

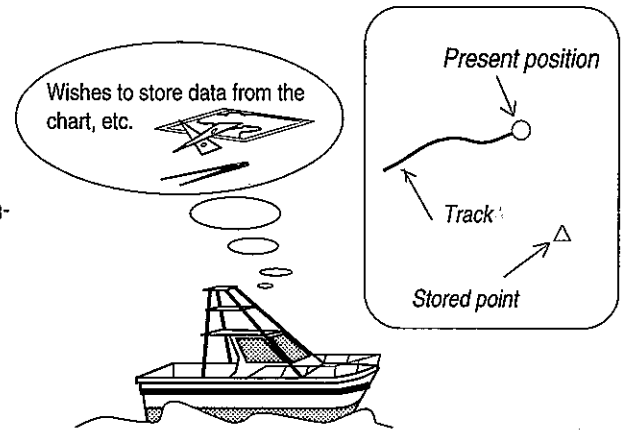
Distance and Bearing to Stored Position

The information required to navigate to waypoint such as:

- *The distance and the bearing from the present position to the waypoint, and*
- *The speed, time to go, and the arrival time,*

can be displayed.
It is convenient when you navigate to the waypoint.
You can enter up to 400 points and can choose the group to enter from:

■ *40 groups (No. 10 to 49) with 10 points (No. 0 to 9) each. Group number and point number must be specified.*

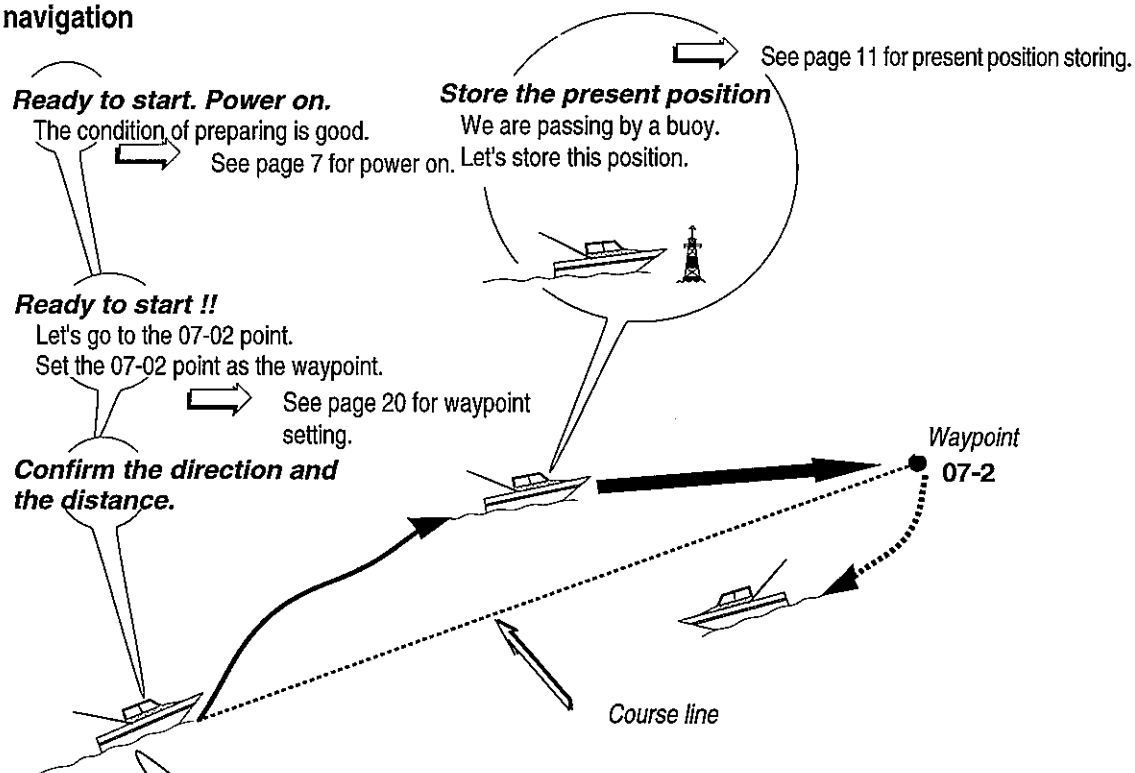


Navigating to a stored point

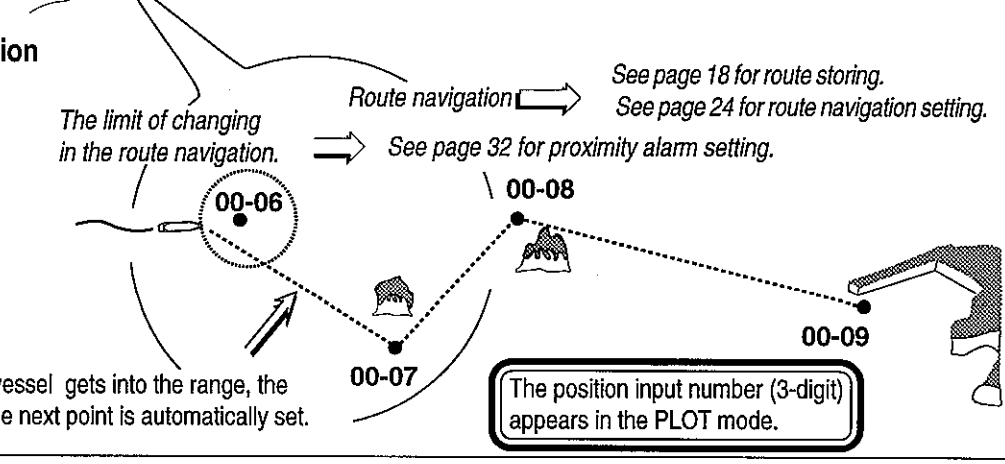
Operate according to the procedures 1 to 5 , for example, to navigate to the waypoint.
Each operation will be explained from page 14.

1. Make up the waypoint or the point you want to pass according to a chart , etc.
2. Enter latitude and longitude of the point you want to pass.
3. Make the route by combining the data of entered position and that of the present position.
4. Confirm the passing point on the Mark Mode display and correct it if necessary.
5. Start navigation to the waypoint.

For waypoint navigation



Route navigation

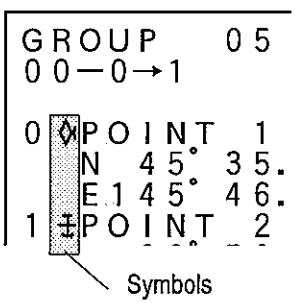


Storing Destination or Waypoint on a Route in Lat/Lon or Loran C LOPs

Storing position (MARK memory)

The number of positions which can be stored is 400: 40 groups (10 to 49) with 10 points (0 to 9) each. When storing, make sure to specify the group and point number for the position.

1 *How to enter comment*



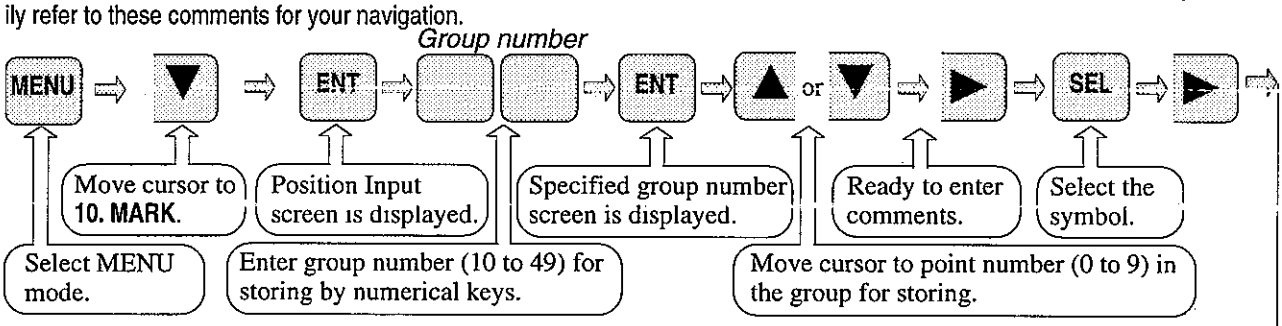
In the comment column, six types of symbols can be entered. After specifying these symbols, comment with maximum 10 letters can be attached. When PLOT mode screen is selected, the specified symbol and its memory number are displayed. If no symbol is specified before entering comment, only memory number is displayed without symbol.

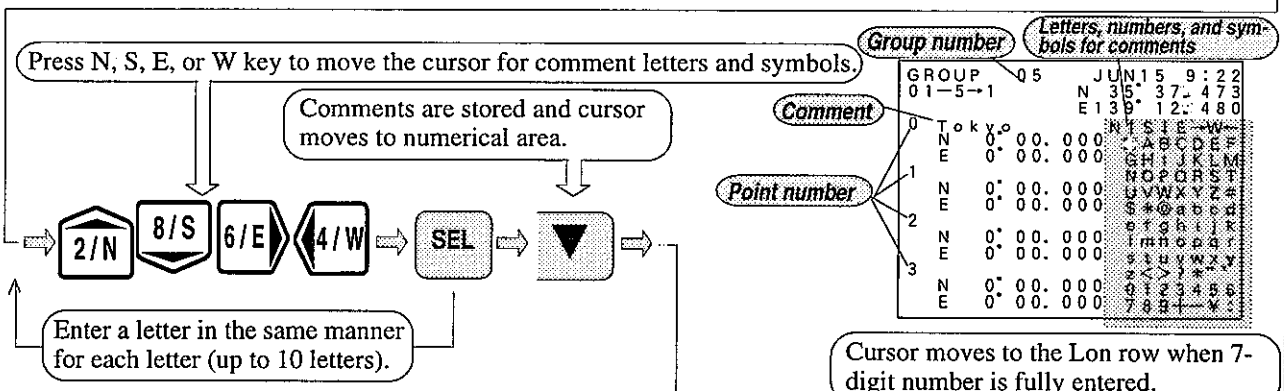
Example of using symbols:

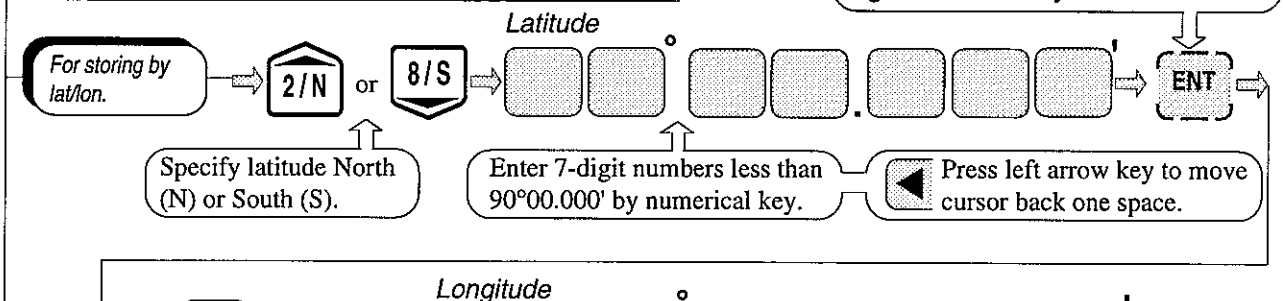
- : For reference point for fishing spot
- : For reference point for shallow
- : For reference point for prohibited area
- : For reference point for buoy
- : For other points
- : For anchoring point or other ships

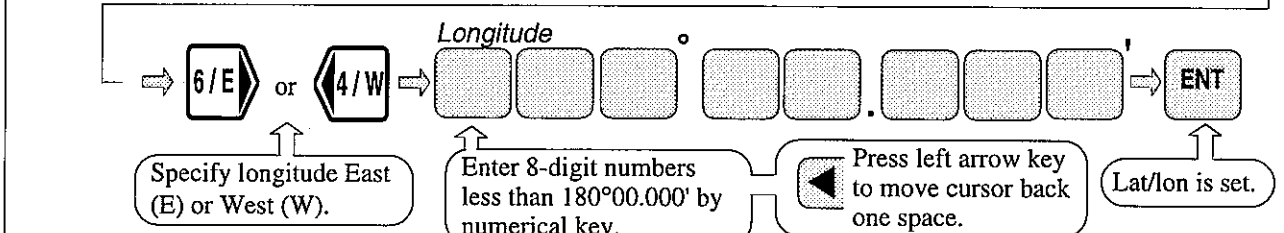
2 *Entering comment*

We recommend you give any comment such as geographical name when storing destination or waypoint so that you may easily refer to these comments for your navigation.









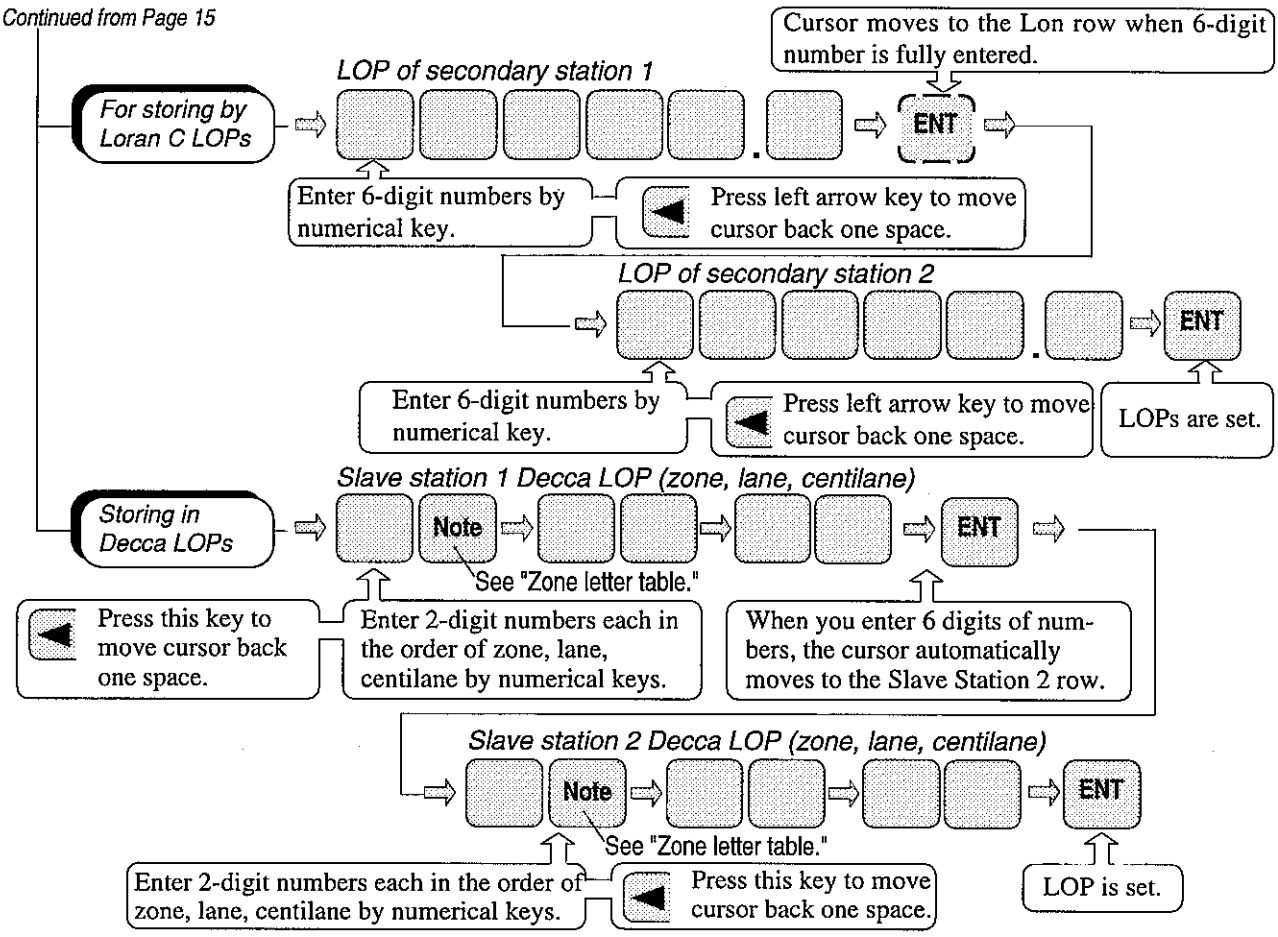
Storing in Loran C LOPs

Storing in Decca LOPs

Continued on Page 15

When a waypoint is stored in Loran C LOPs or Decca LOPs, operations of **"Changing Decca chain"** on page 43 and **"Alternating Loran C LOP and Decca LOP"** on page 63 should be performed in advance.

Continued from Page 15

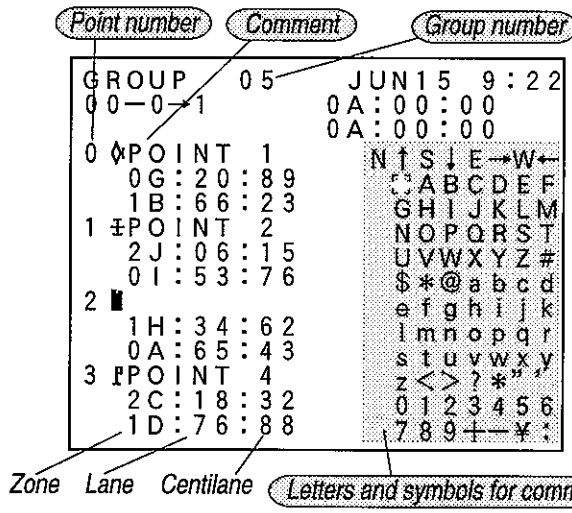


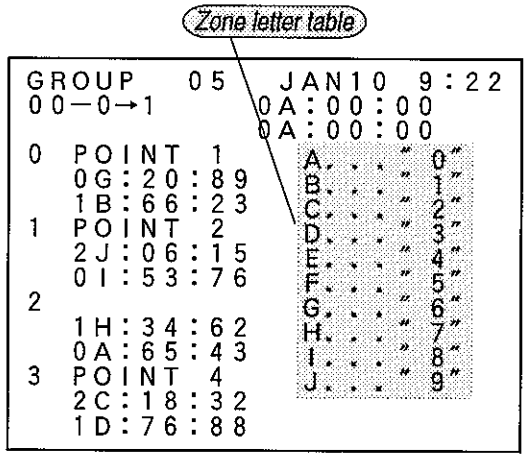
	No.	Code
EUROPE		
South Baltic	00	0A
Vestlandet	01	0E
Southwest British	02	1B
Northumbrian	03	2A
Holland	04	2E
North British	05	3B
Lofoten	06	3E
German	07	3F
North Baltic	08	4B
Northwest Spanish	09	4C
Trondelag	10	4E
English	11	5B
North Bothnian	12	5F
South Spanish	13	6A
North Scottish	14	6C
Gulf of Finland	15	6E
Danish	16	7B

	No.	Code
Irish	17	7D
Finnmark	18	7E
French	19	8B
South Bothnian	20	8C
Hebridean	21	8E
Frisian Islands	22	9B
Helgeland	23	9E
Skagerrak	24	10B
PERSIAN GULF		
North Persian	25	5C
South Persian	26	1C
INDIAN OCEAN		
Bombay	27	7B
Calcutta	28	8B
Bangladesh	29	6C
JAPAN		
Hokkaido	30	9C
North Kyushu	32	7C

	No.	Code
SOUTH AFRICA		
Namaqua	33	4A
Cape	34	6A
Eastern province	35	8A
NORTH WEST AUSTRALIA		
Dampier	36	8E
Port Hedland	37	4A
CANADA		
Anticosti	38	9C
Newfoundland	39	2C
Cabot Straits	40	6B
Nova Scotia	41	7C
INDIAN OCEAN		
Salaya	42	2F
SOUTH AFRICA		
Southwest Africa	44	9C
Natal	45	10C

Setup notes on stave station Decca LOP

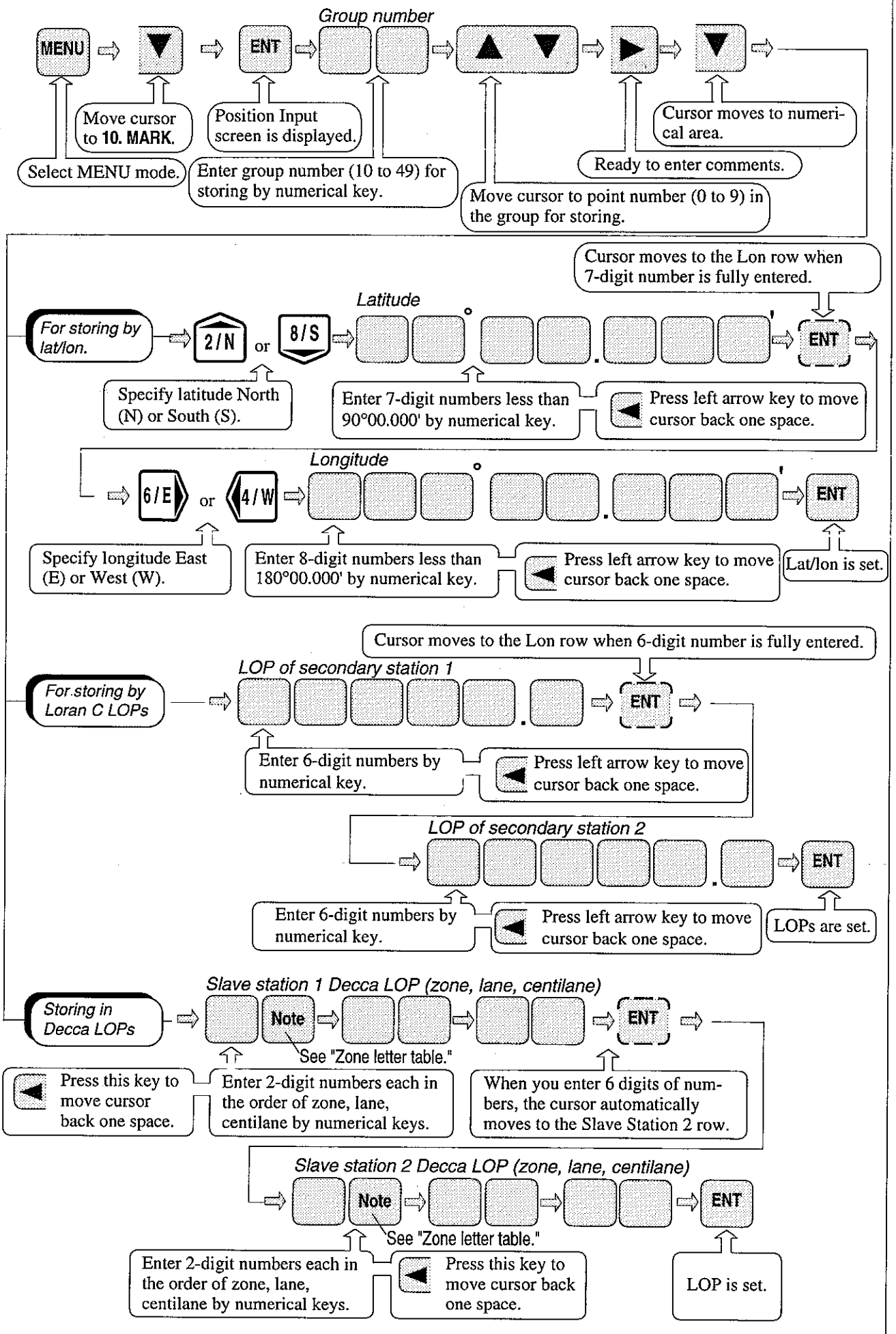




The lane values may vary according to the slave station.

Red station	Green station	Purple station
00 to 23	30 to 47	50 to 79

2 Entering no comment



Transferring event memory into waypoint with other number

Up to 100 present positions can be stored. The 101th position data replaces the oldest one in order. For storing present position data (group numbers 00 to 09) permanently without erasing, use the following procedure.
In addition, the stored position data can be stored with other number.

Original point number Renamed point number

(00) (01) (02) (03) (04) (05) (06) . . . (19) — Group

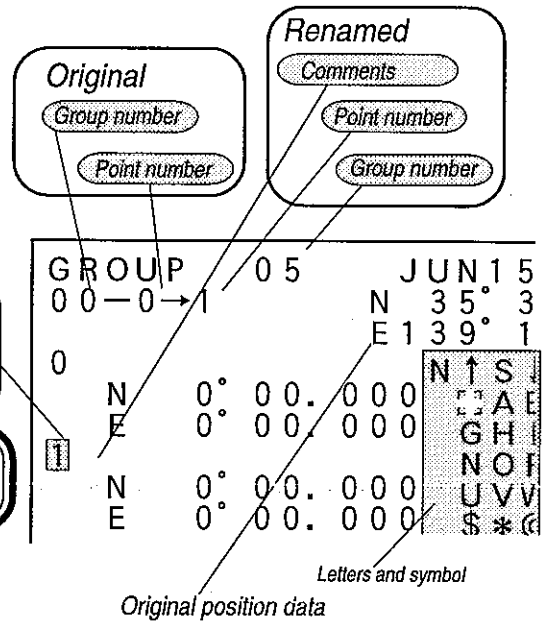
(0) copy → (1) — Point

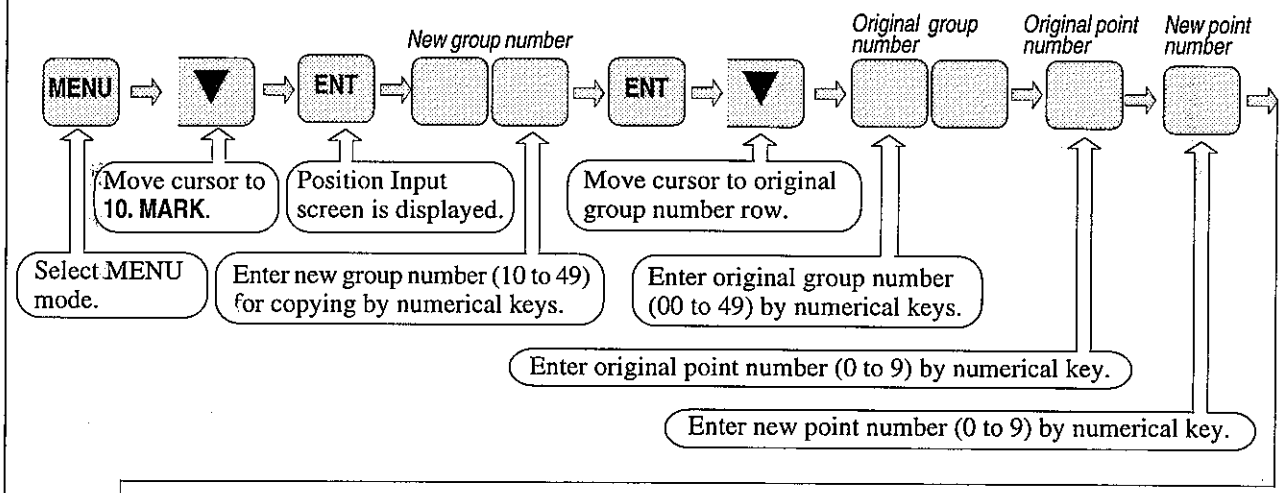
0 1 2 3 4 5 6 7 8 9 | 0 1 2 3 4 5 6 7 8 9

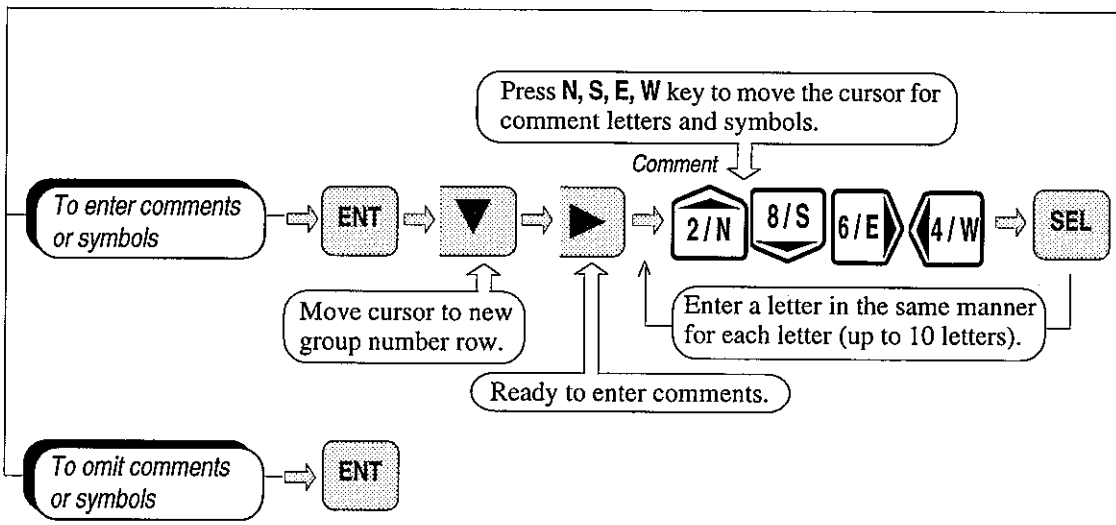
Figure right shows the example to copy the present position data in group number 01, point number 0 to the group number 05, point number 1.

When you want to store the comment for the point number 1, move the cursor to this position.

Group number 00 and Point number 0 is effective only for **MOB** (Man Over board) operation. That data is stored until **MOB** key is pressed again.

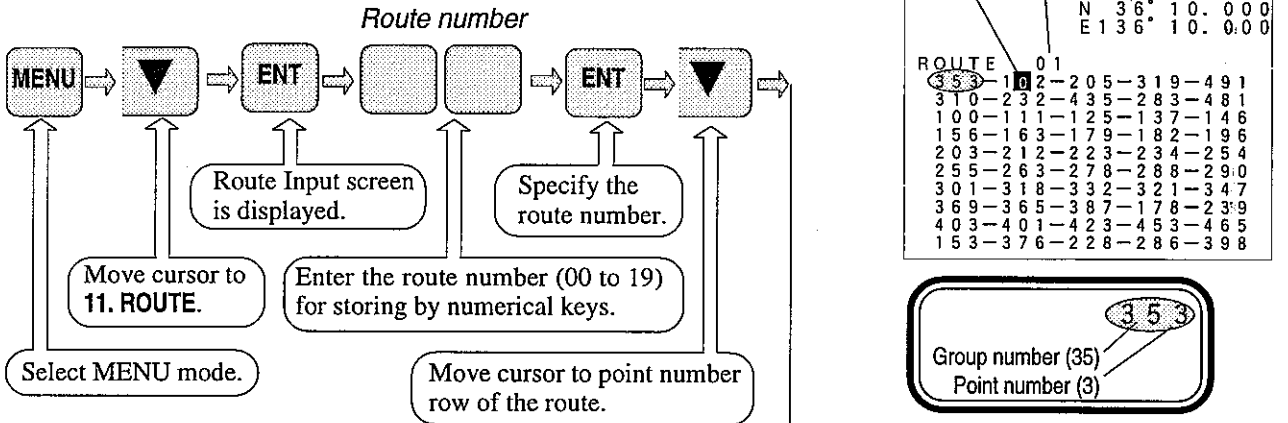


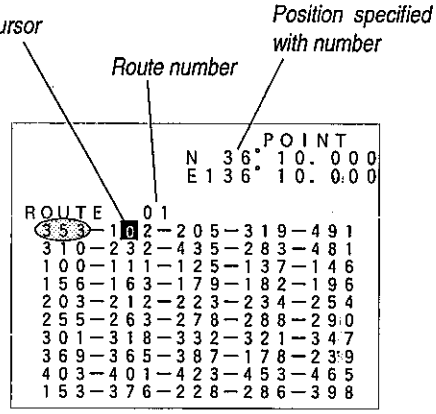


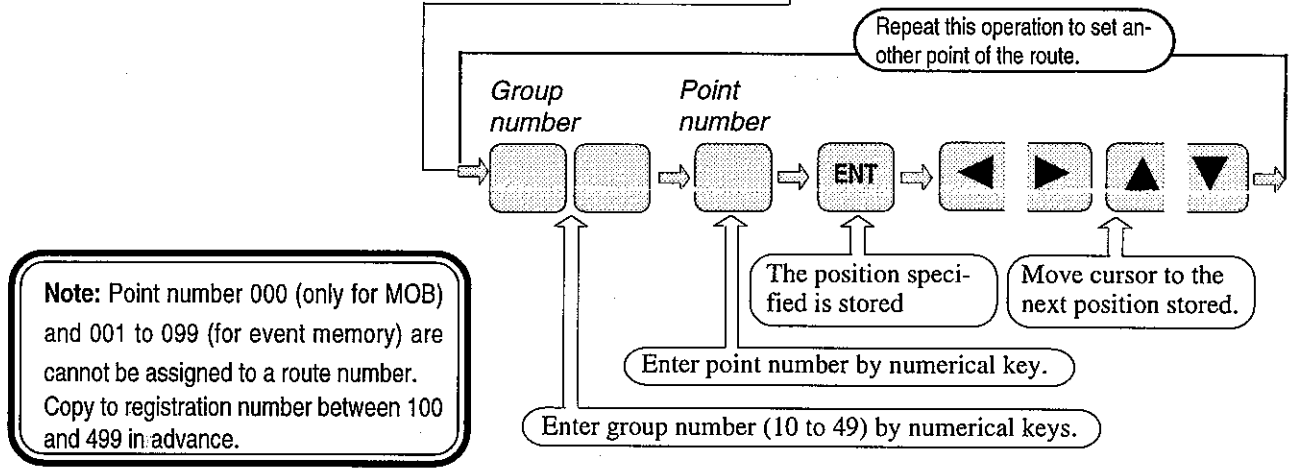


Storing route

The number of routes which can be registered is maximum 20: A number from 00 to 19 is assigned to each route. Up to 50 waypoints can be included in a route. When creating route, waypoints stored on MARK mode are used.

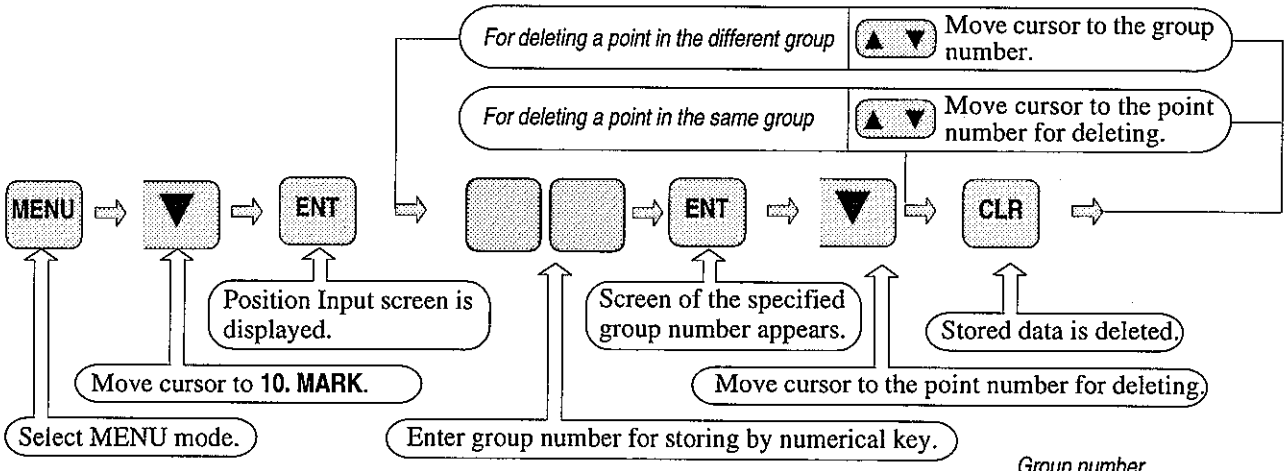




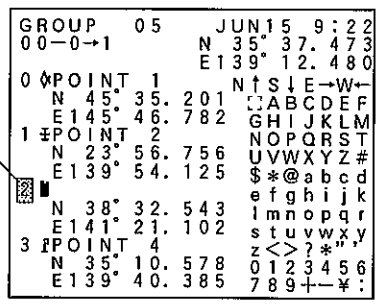


Note: Point number 000 (only for MOB) and 001 to 099 (for event memory) are cannot be assigned to a route number. Copy to registration number between 100 and 499 in advance.

Deleting stored position data

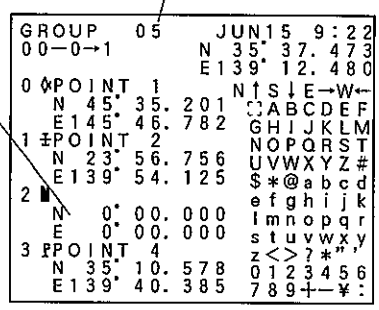


Cursor is moved to point number 2.

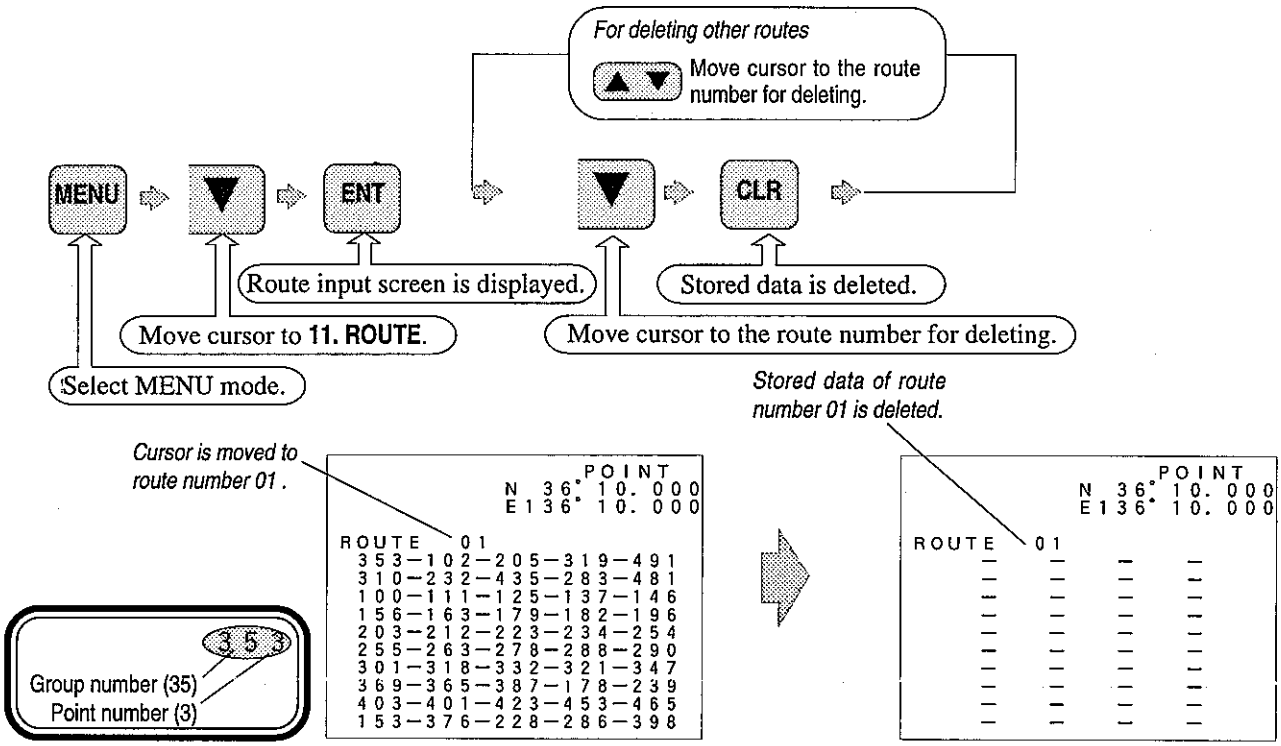


Stored data of point number 2 is deleted.

Group number

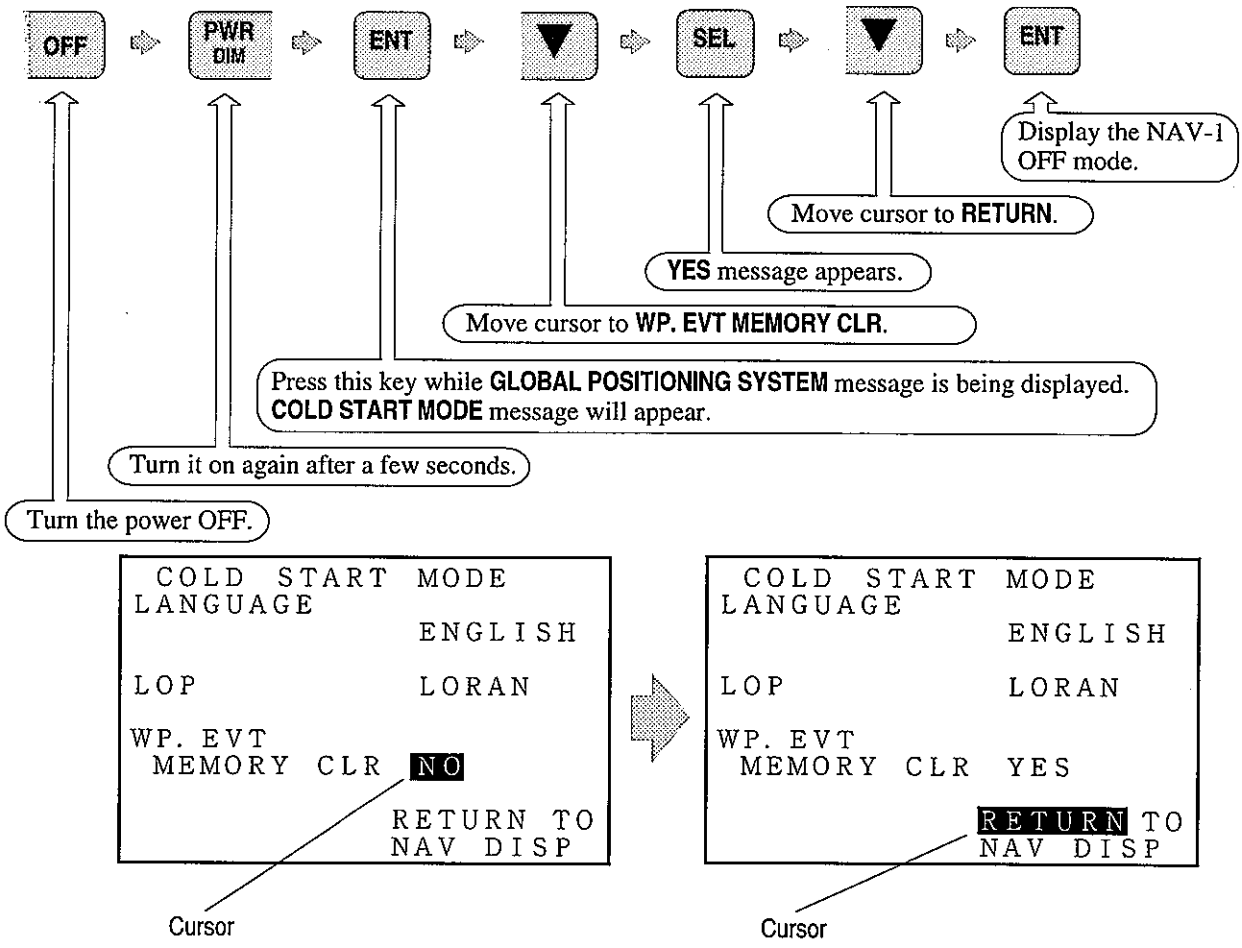


Deleting stored route data



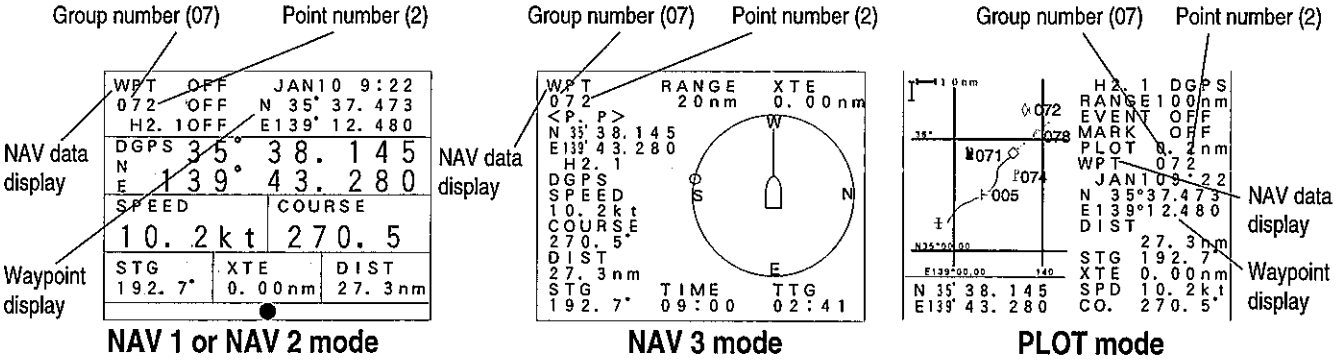
Deleting all the stored data

All the stored position data and route data can be deleted by the following procedure. It takes 2 to 30 minutes to display the present position.



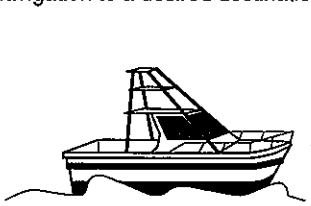
Setting Waypoint

When setting waypoint (WPT) navigation, positions stored on MARK mode are used.
Waypoint can be set by designating group number and point number in **NAV1**, **NAV2**, **NAV3** or **PLOT** mode.

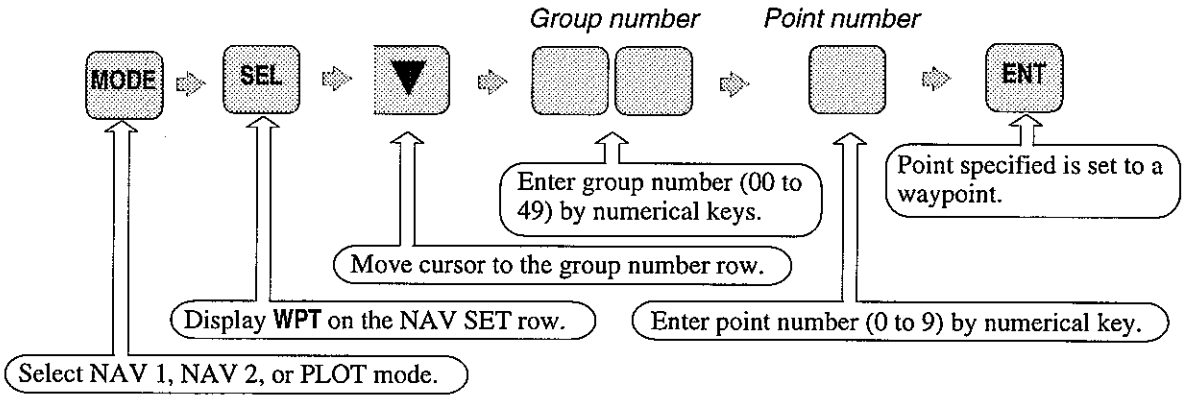


Setting waypoint navigation

Navigation to a desired destination is called a waypoint navigation.

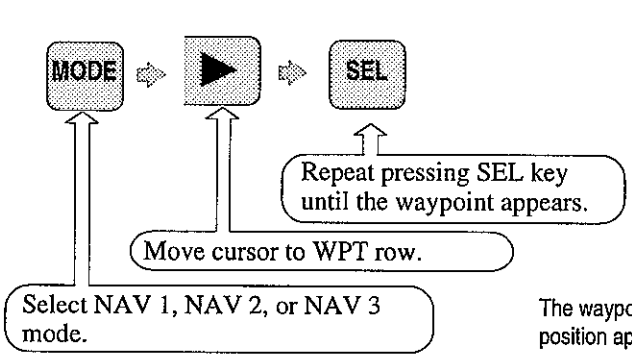


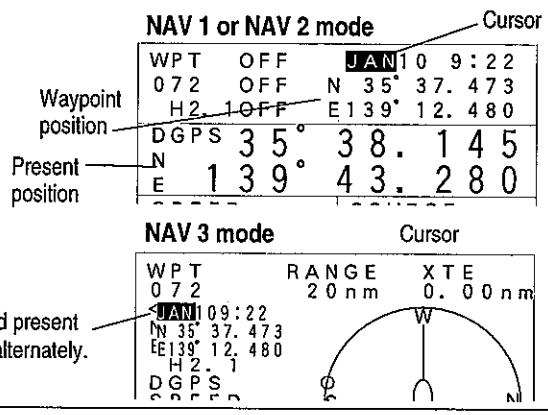
Note: when the position being used for the waypoint is changed for editing during waypoint navigation, waypoint must be re-entered.



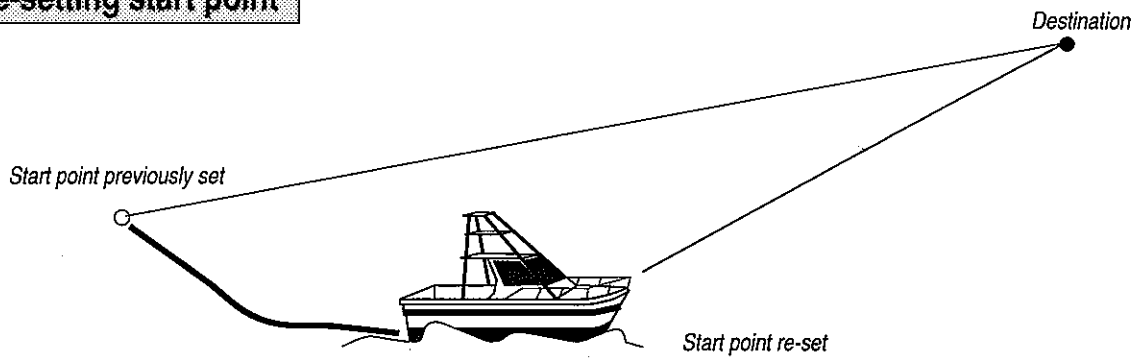
Alternating display between present position and waypoint position

Both the present position and waypoint position can be displayed on the PLOT screen. However, they can be displayed alternately on NAV 1, NAV 2, and NAV 3 mode screens by the following procedure:



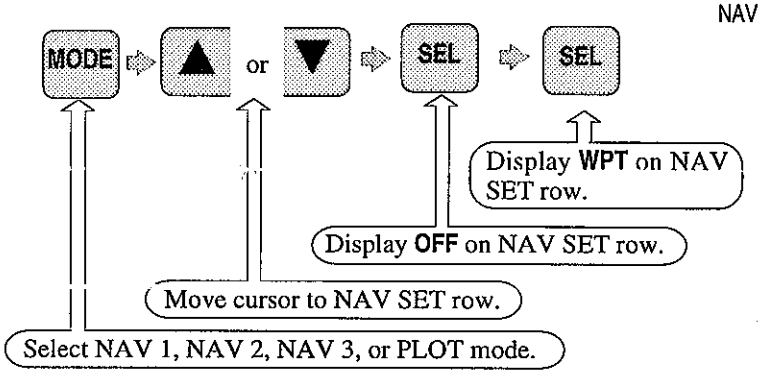


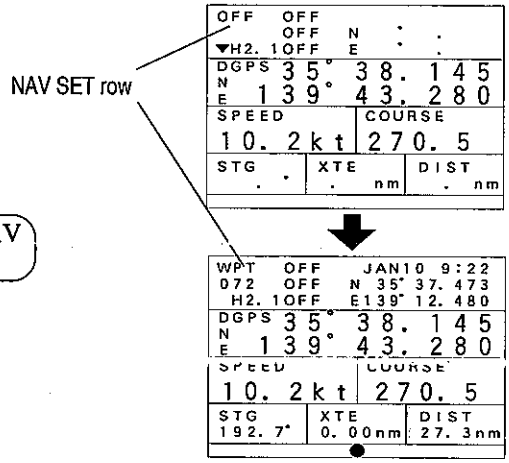
Re-setting start point



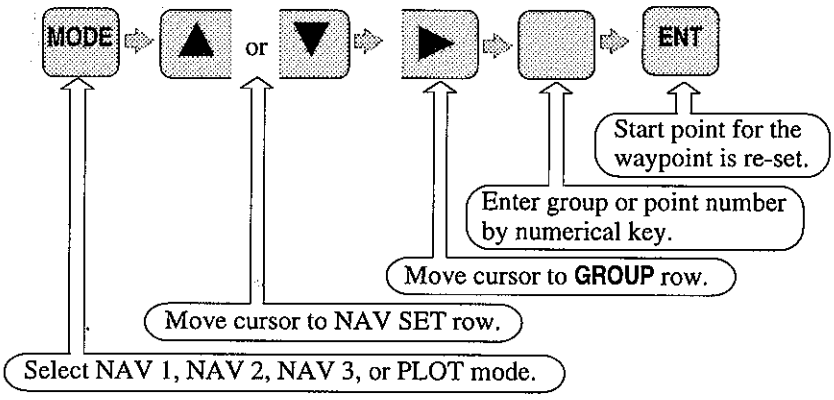
There are two ways to reset start point as follows. After the reset, navigation calculation is performed based on the new start point.

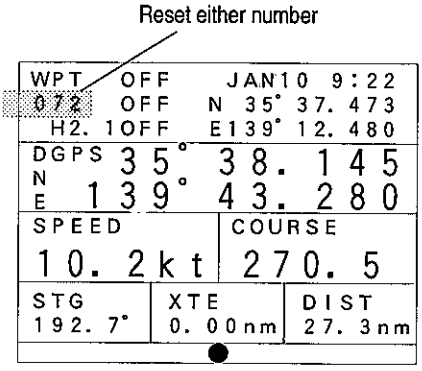
1 Displaying OFF on NAV SET row





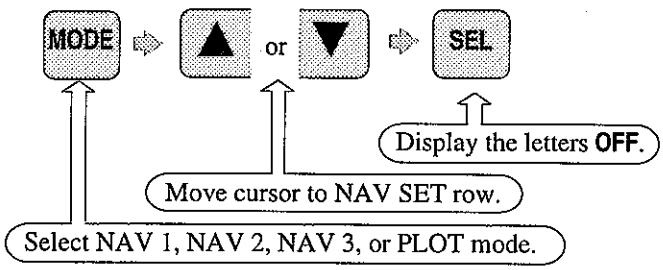
2 Re-setting group or point number of waypoint

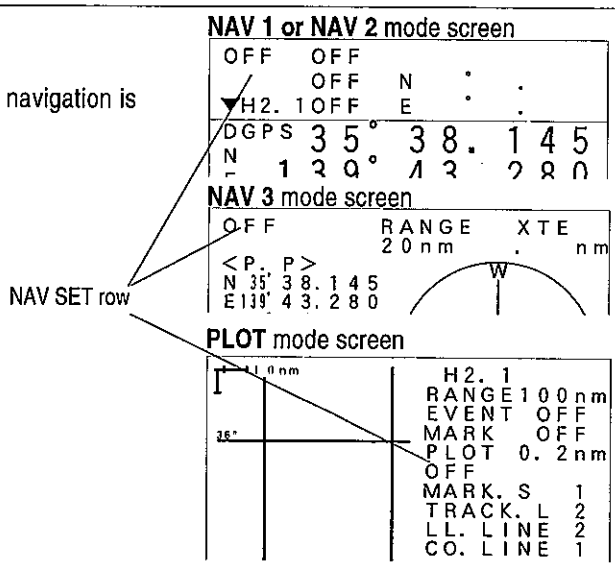




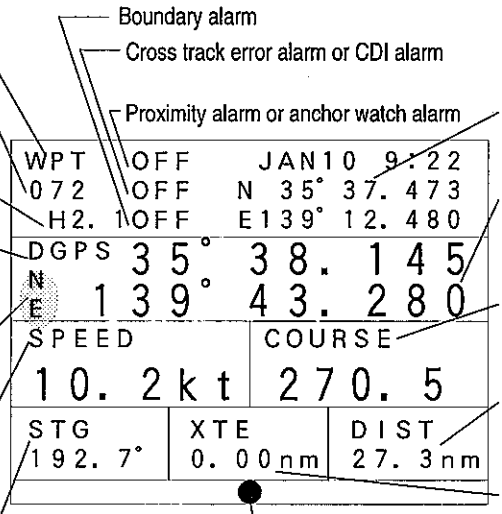
Cancelling waypoint navigation

When the letters OFF are displayed on NAV SET row, waypoint navigation is cancelled.



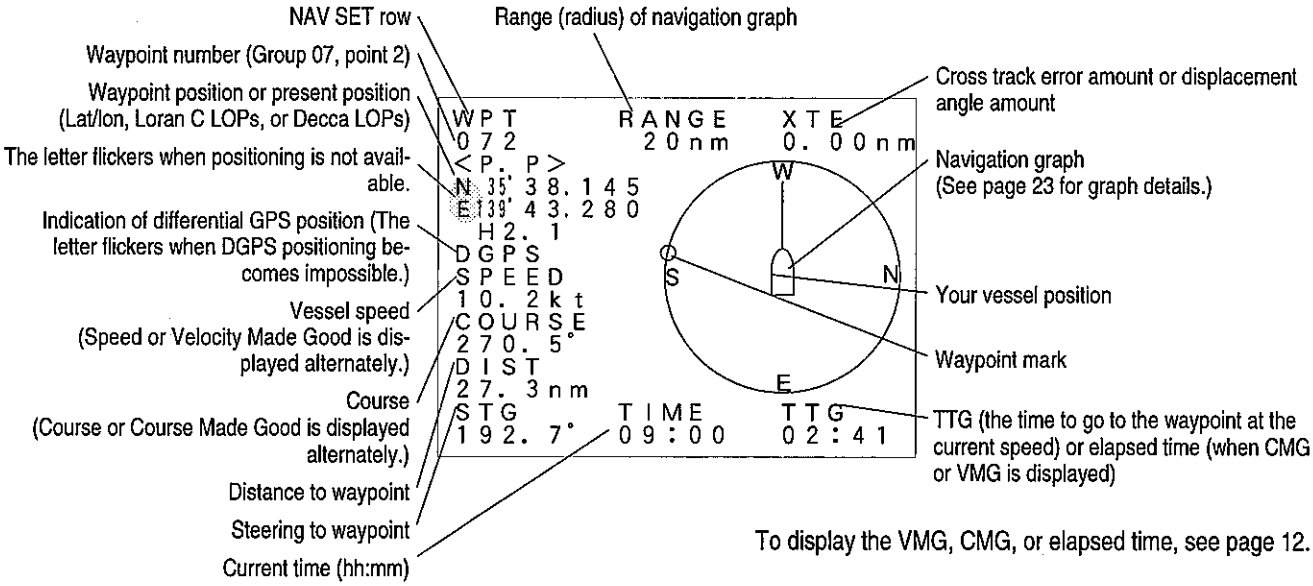


Reading NAV 1 and NAV 2 mode screens during waypoint navigation



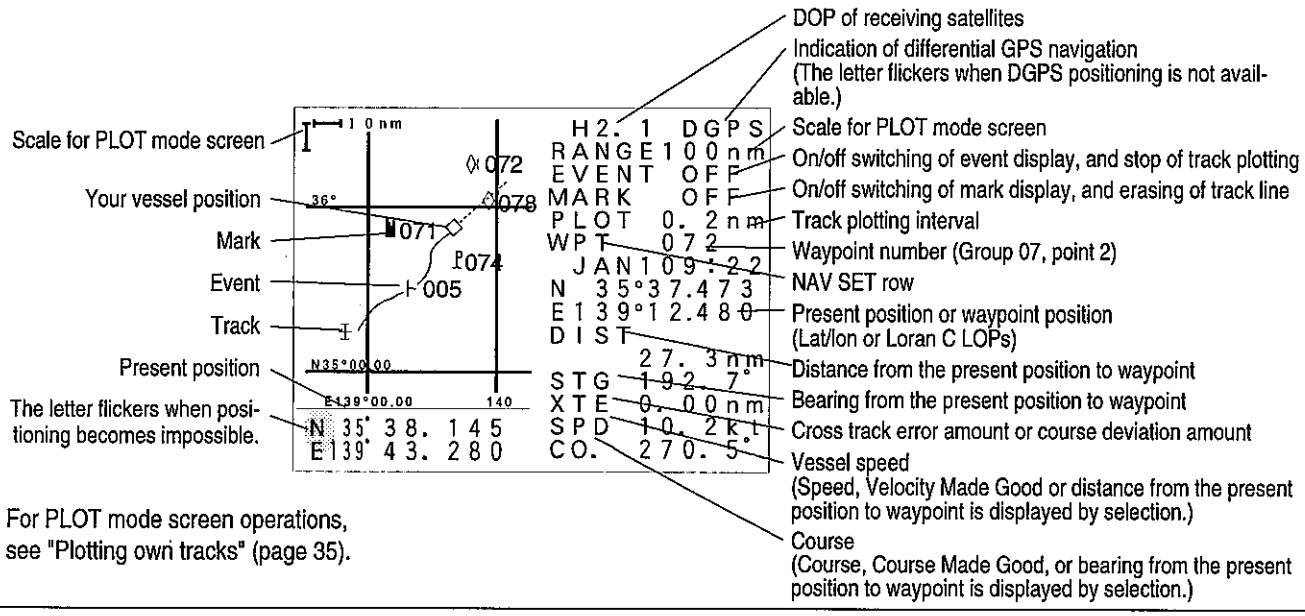
To display the VMG, CMG, or elapsed time, see page 12.

Reading NAV 3 mode screen during waypoint navigation



To display the VMG, CMG, or elapsed time, see page 12.

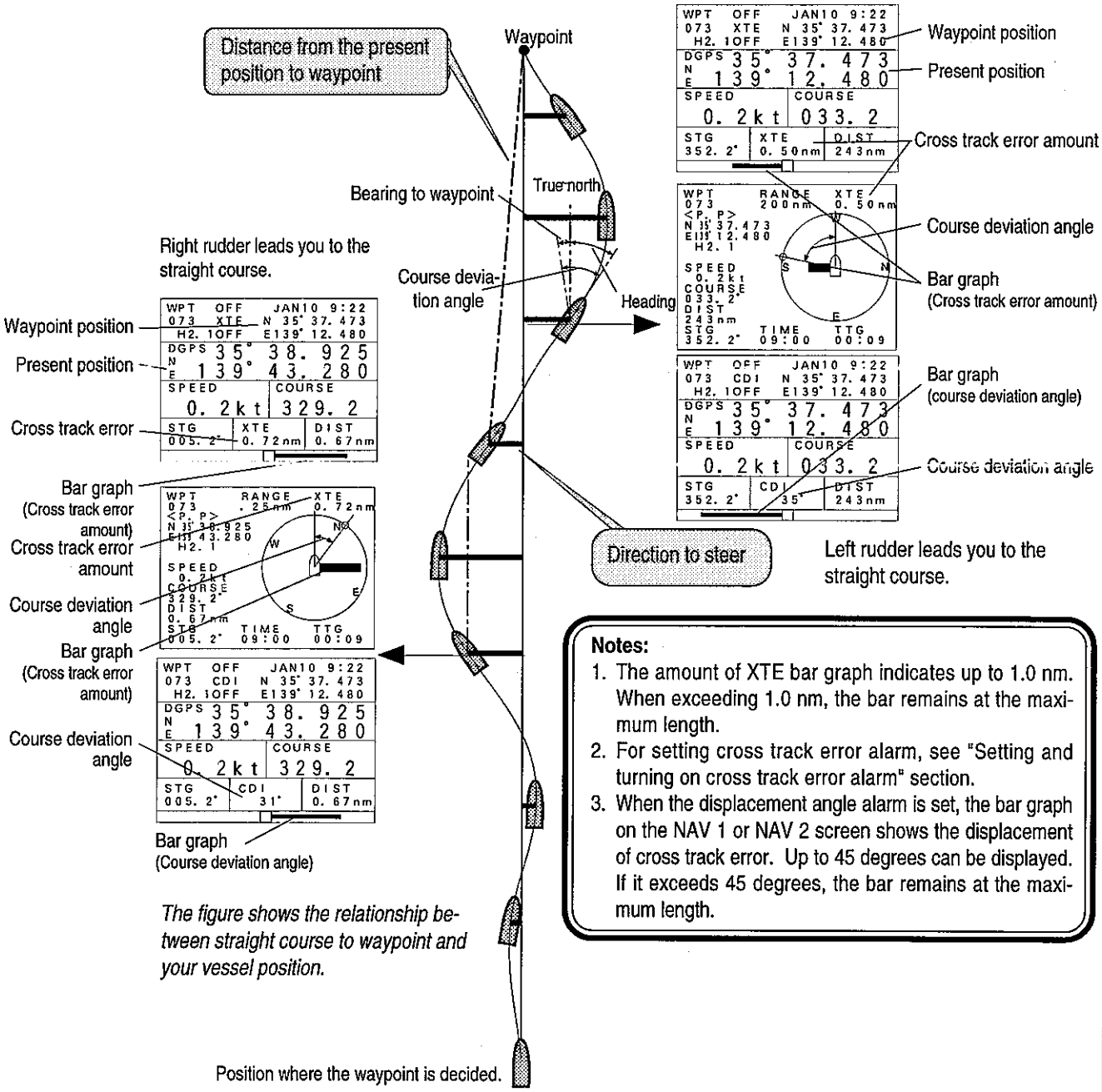
Reading PLOT mode screen during waypoint navigation



For PLOT mode screen operations, see "Plotting own tracks" (page 35).

Reading navigation graph

The navigation graph is very useful to check the distance and bearing from your vessel position to the waypoint. If the distance to the waypoint is larger than the range (radius) of the previously specified navigation graph, the waypoint mark appears on the circle of navigation graph. If it is smaller than the specified range (radius), the waypoint mark appears inside of the navigation graph. A bar graph indicating the cross track error appears only when the waypoint is outside of the circle of navigation graph. When the waypoint mark enters inside of the graph circle, the bar graph disappears. To use the bar graph, reduce the range (numerical value) of the navigation graph. The bar graph function is not active until the waypoint navigation or route navigation is set.

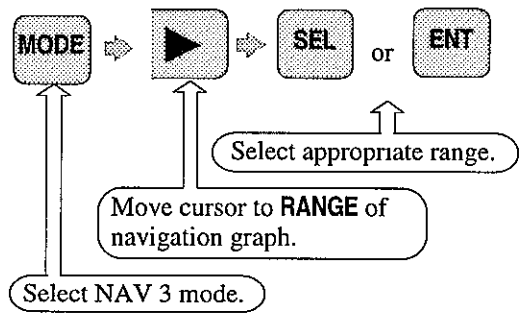


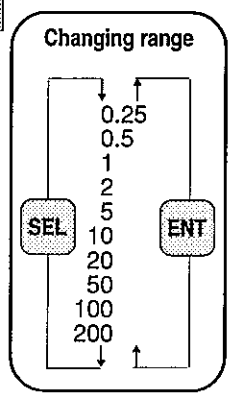
The figure shows the relationship between straight course to waypoint and your vessel position.

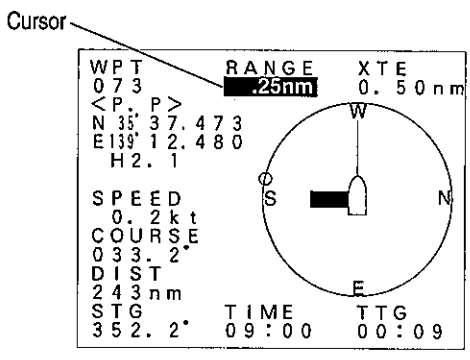
Notes:

1. The amount of XTE bar graph indicates up to 1.0 nm. When exceeding 1.0 nm, the bar remains at the maximum length.
2. For setting cross track error alarm, see "Setting and turning on cross track error alarm" section.
3. When the displacement angle alarm is set, the bar graph on the NAV 1 or NAV 2 screen shows the displacement of cross track error. Up to 45 degrees can be displayed. If it exceeds 45 degrees, the bar remains at the maximum length.

Changing range for navigational graph

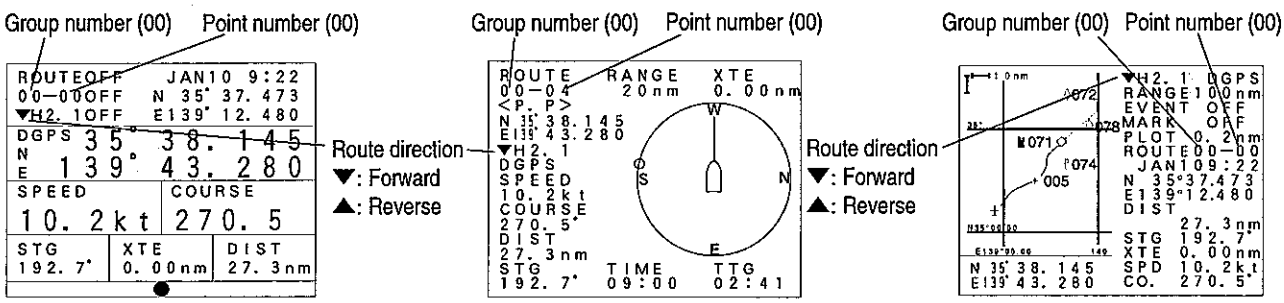






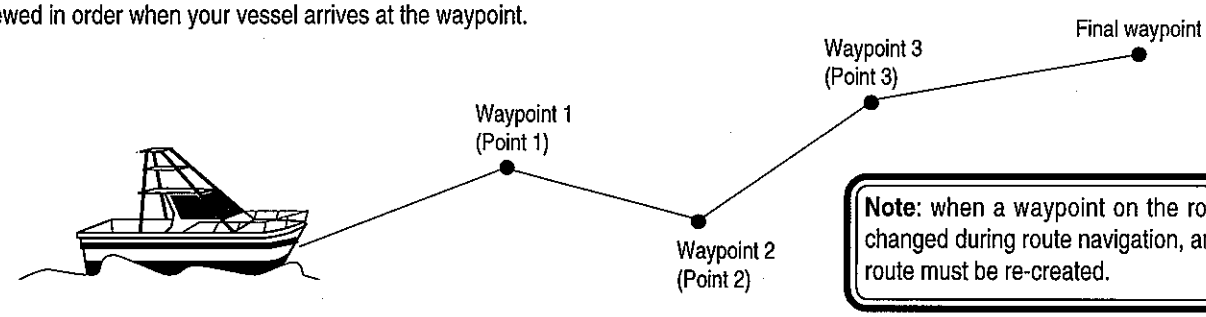
Setting Route

By connecting the stored points (max. 50 points) , a route to the final waypoint can be created.
You can sail to the final waypoint on the route not only in the forward direction but also in the reversed direction all the way to the start point from the present position for your particular application.
When setting route navigation, a route which is set in ROUTE SET mode is applied and each point in a route should be registerned before hand. A route is created by specifying a route number and a point number (the first waypoint on the route) on NAV 1, NAV 2, NAV 3, or PLOT mode screen.

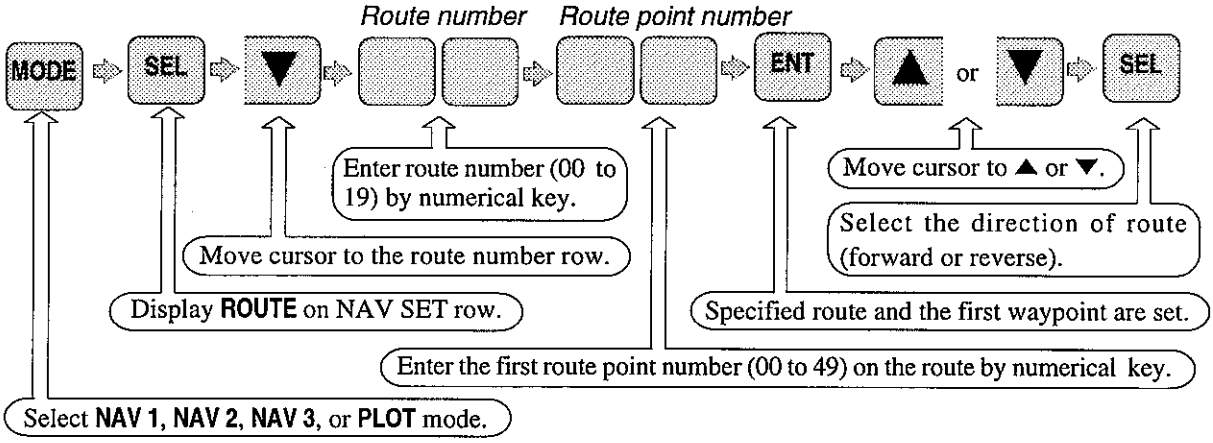


Creating route

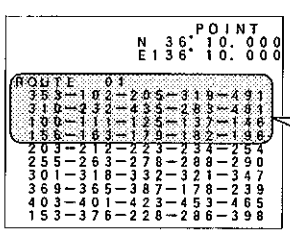
Once the route is created, the waypoint on the route is automatically re-newed in order when your vessel arrives at the waypoint.



Note: when a waypoint on the route is changed during route navigation, another route must be re-created.



What is the route point number?



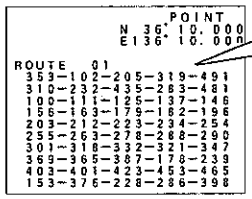
Example: Waypoint **435** (group number 43 and point number 5) is the 07th waypoint in this route.

ROUTE 01
353−102−205−319−491
310−232−435−283−481
100−111−125−137−146
156−163−179−182−196

Point number (memory number)
Group number (memory number)

Order on the route:
00→01→02→03→04→
05→06→**07**→08→09→
10→11→12→13→14→

Route point numbers during forward and reverse navigation



Waypoint numbers during route setup
353→102→205→319→491→
310→232→435→283→481→
100→111→125→137→146→
156→163→179→182→196→

If you activate a route at waypoint 435 (route point number 07th) forward (▼) and reverse (▲) navigation are as follows:

Forward (▼) navigation

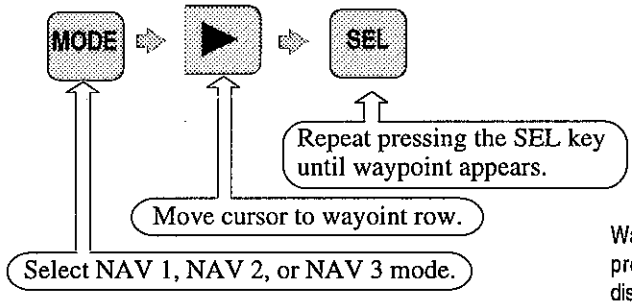
435→283→481→100→111→
125→137→146→156→163→
179→182→196→203→212→

Reverse (▲) navigation

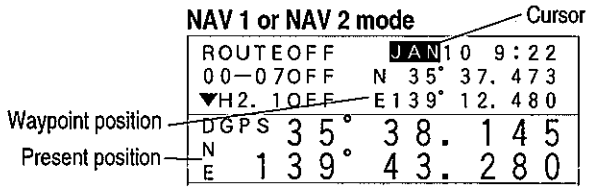
435→232→310→491→319→
205→102→353

Alternating display between present position and waypoint position

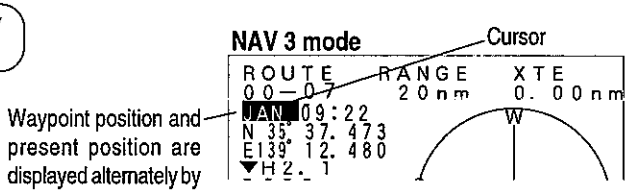
Present position and waypoint position are displayed on PLOT mode screen; however, the waypoint in use can be displayed on NAV 1, NAV 2, and NAV 3 mode screens by the following procedure:



NAV 1 or NAV 2 mode

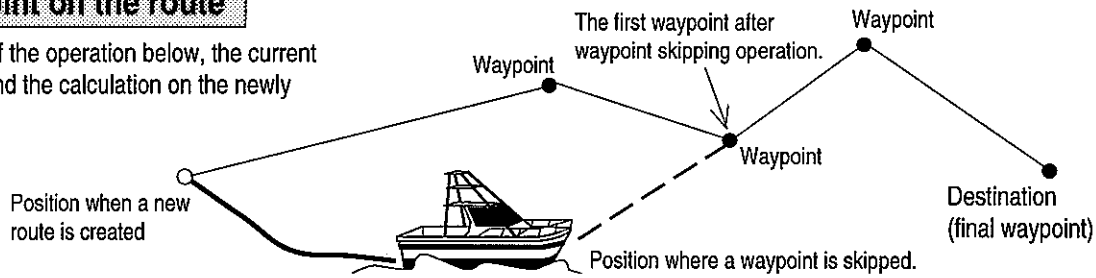


NAV 3 mode

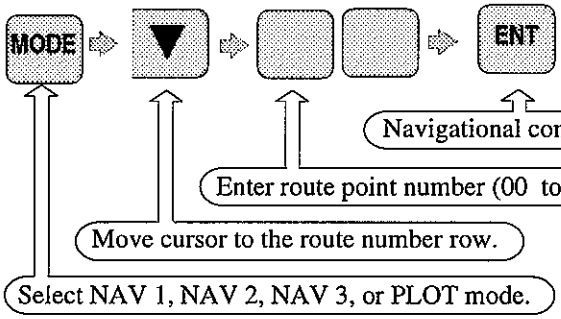


Skipping waypoint on the route

After the completion of the operation below, the current waypoint is skipped and the calculation on the newly set waypoint begins.

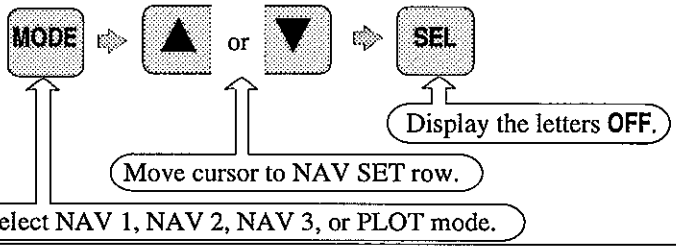


Route point number

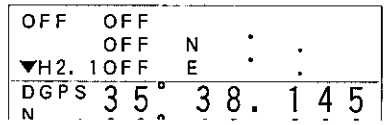


Cancelling route navigation

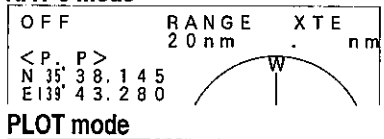
When the letters OFF are displayed on NAV SET row, route navigation is cancelled.



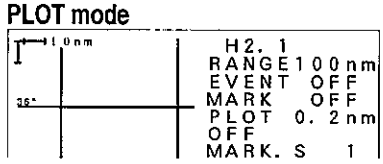
NAV 1 or NAV 2 mode



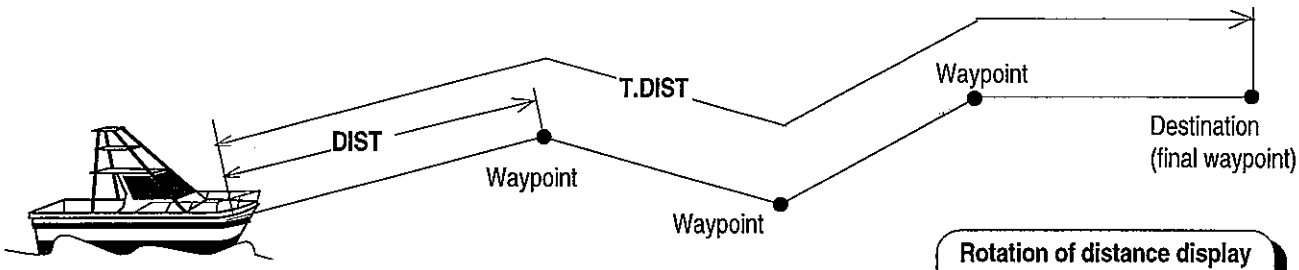
NAV 3 mode



PLOT mode



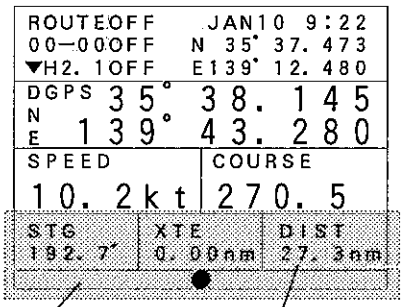
Changing distance (DIST/T.DIST)



Rotation of distance display
DIST ⟷ T.DIST

During route navigation, the following display contents can be changed:
- Distance to waypoint (DIST) or total distance to the final waypoint (T.DIST)

NAV 1 or NAV 2 mode



Option display 3

DIST/T.DIST display

MODE ⇨ ▲ ▼ ◀ ▶ ⇨ SEL

- MODE: Select NAV 1 or NAV 2 mode.
- ▲ ▼ ◀ ▶: Move cursor to DIST/T.DIST display.
- SEL: **DIST** (distance to waypoint) or **T.DIST** (total distance to the final waypoint) is displayed alternately.

When **DIST** is displayed: Distance to the next waypoint is displayed.
When **T.DIST** is displayed: Total distance required to arrive the final destination and arrival time are displayed (9999 nm, km, sm maximum).

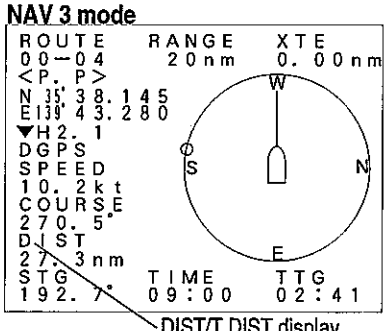
9999	The positioning has failed or the required distance has exceeded 9999 nm, km, sm.

When **DIST** or **T.DIST** is not displayed on NAV 1 or NAV 2 mode screen:

MODE ⇨ ▲ or ▼ ⇨ SEL ⇨ ▶ ⇨ SEL

- MODE: Select **NAV 1** or **NAV 2** mode.
- ▲ or ▼: Move cursor to option display 3.
- SEL: Press the SEL key to display **STG**.
- ▶: Move cursor to **DIST/T.DIST** display.
- SEL: **DIST** (distance to waypoint) or **T.DIST** (total distance to the final waypoint) is displayed alternately.

NAV 3 mode

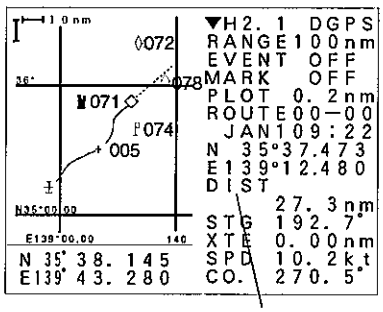


DIST/T.DIST display

MODE ⇨ ▼ ⇨ SEL

- MODE: Select NAV 3 mode.
- ▼: Move cursor to **DIST/T.DIST** display.
- SEL: **DIST** (distance to waypoint) or **T.DIST** (total distance to the final waypoint) is displayed alternately.

PLOT mode

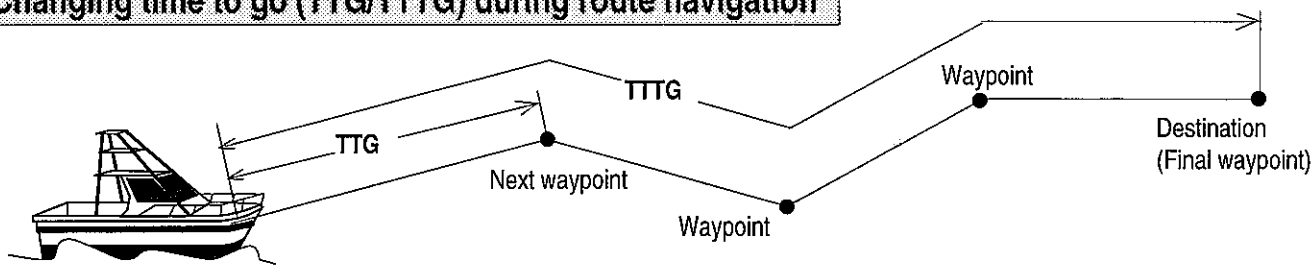


DIST/T.DIST display

MODE ⇨ ▼ ⇨ SEL

- MODE: Select PLOT mode.
- ▼: Move cursor to **DIST/T.DIST** display.
- SEL: **DIST** (distance to waypoint) or **T.DIST** (total distance to the final waypoint) is displayed alternately.

Changing time to go (TTG/TTTG) during route navigation



To switch the display between the time to go (**TTG**) to the next waypoint and the total time (**TTTG**) required to the final waypoint.

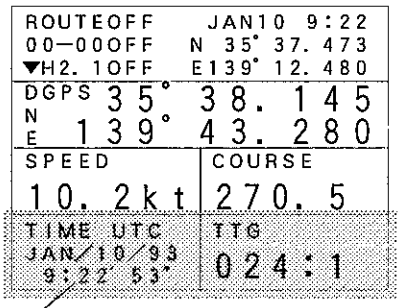
Rotation of time display

TTG → TTTG → ••• →

When **TTG** (Time to Go) is shown:
Time to go to the next waypoint is shown.
When **TTTG** (Total Time to Go) is shown:
The total time required to arrive the final waypoint is shown (999 hours 50 minutes maximum).

99:99	Positioning has failed or not available or the TTTG has exceeded 999 hours.

NAV 1 or NAV 2 mode



Option display 3

TTG/TTTG display

MODE ▲ ▼ ◀ ▶ SEL

Select NAV 1 or NAV 2 mode.

Move cursor to **TTG/TTTG** display.

Press to display time in the specified mode.

When **TTG** or **TTTG** is not displayed on NAV 1 or NAV 2 mode screen:

MODE ▲ or ▼ SEL ▶ SEL

Select NAV 1 or NAV 2 mode.

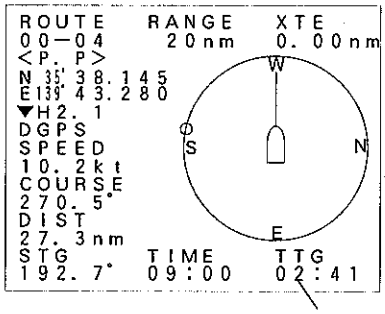
Move cursor to option display 3.

Press the SEL key to display **TIME UTC** or **LTC**.

Move cursor to **TTG/TTTG** display.

Press to display time in the specified mode.

NAV 3 mode



TTG/TTTG display

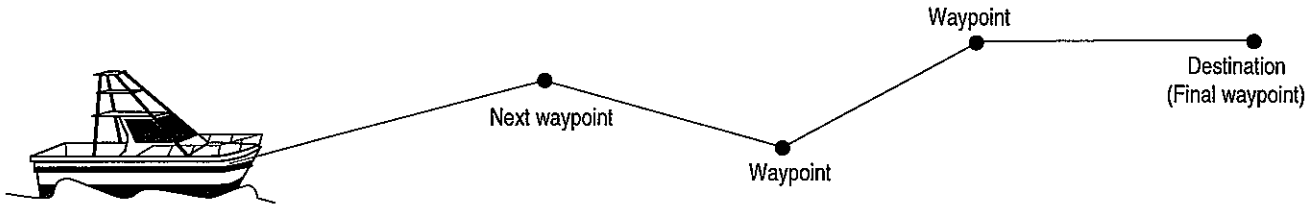
MODE ▼ SEL

Select NAV 3 mode.

Move cursor to **TTG/TTTG** display.

Press to display time in the specified mode.

Changing arrival time (TIME ARVL/T.T ARVL) during route navigation



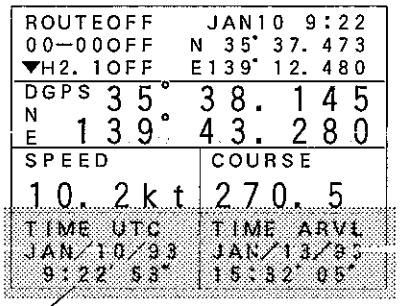
Toswitch the display between the arrival time (**TIME ARVL**) to the next waypoint and the arrival time (**T.T ARVL**) to the final waypoint.

When **TIME ARVL** is shown:
The arrival time to the next waypoint is shown.
When **T.T ARVL** is shown:
The arrival time to the final waypoint is shown.

Rotation of time display

TIME ARVL → **T.T ARVL** → ••• →

NAV 1 or NAV 2 mode



Option display 3

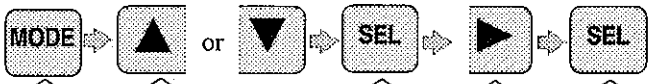
TIME ARVL/T.T ARVL display

Select NAV 1 or NAV 2 mode.

Press to display time in the specified mode.

Move cursor to **TIME ARVL/T.T ARVL** display.

When **TIME ARVL** or **T.T ARVL** is not displayed on NAV 1 or NAV 2 mode screen:



Press to display time in the specified mode.

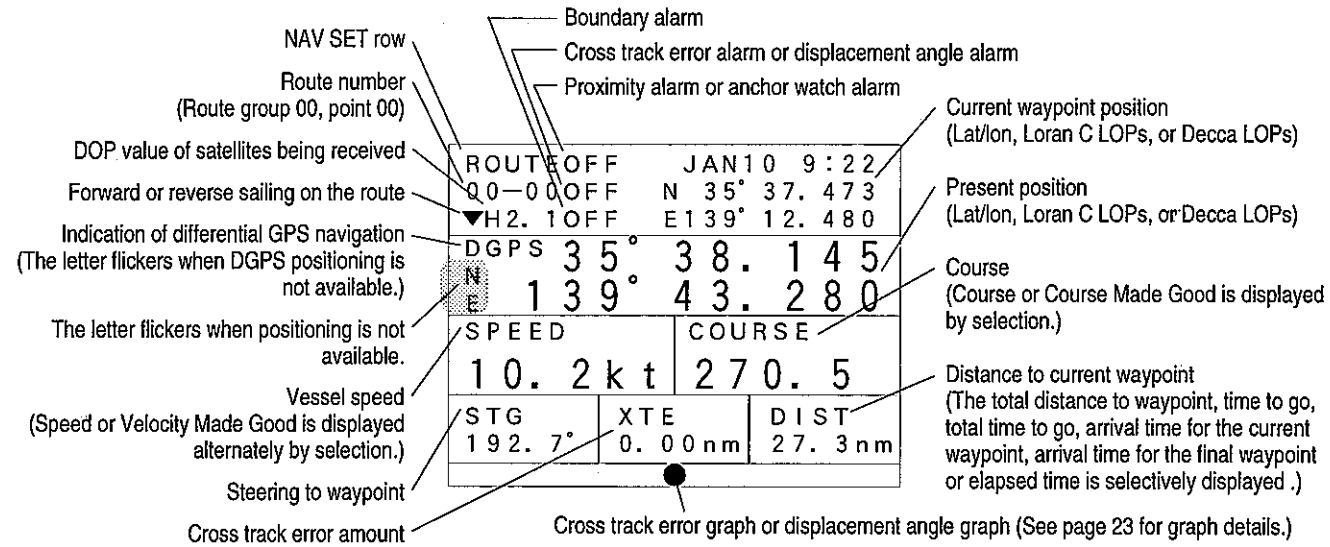
Move cursor to **TIME ARVL/T.T ARVL** display.

Press the SEL key to display **TIME UTC** or **LTC**.

Move cursor to option display 3.

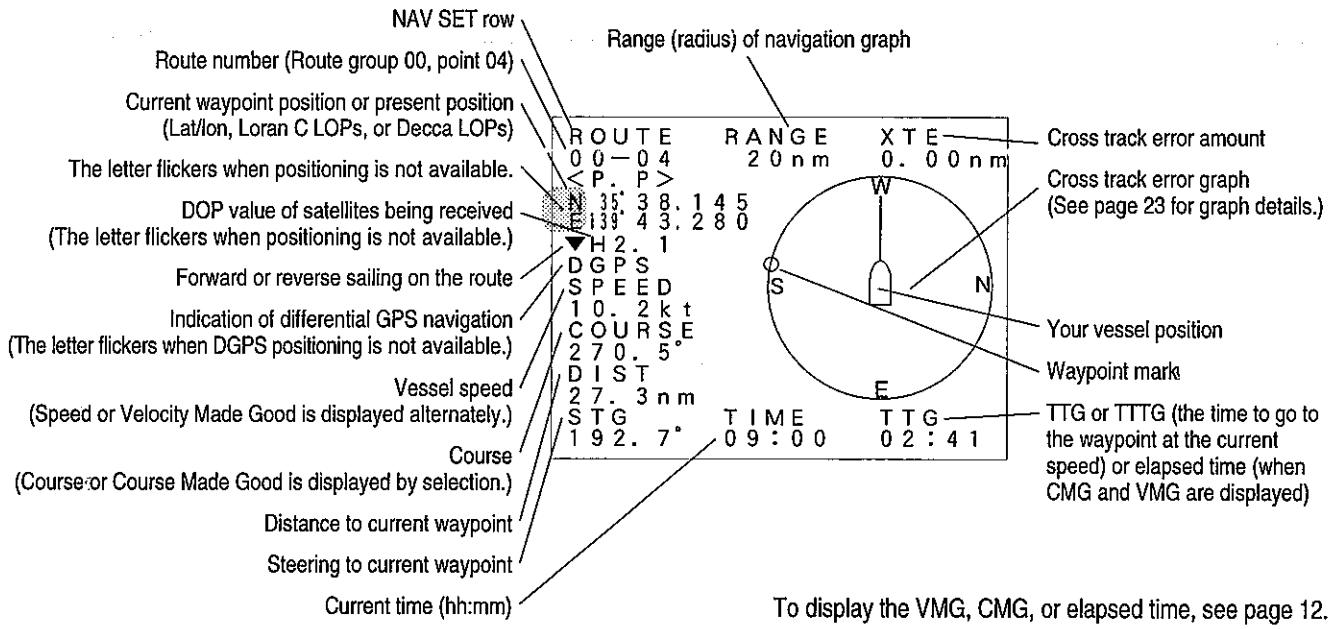
Select NAV 1 or NAV 2 mode.

Reading NAV 1 and NAV 2 mode screens during route navigation



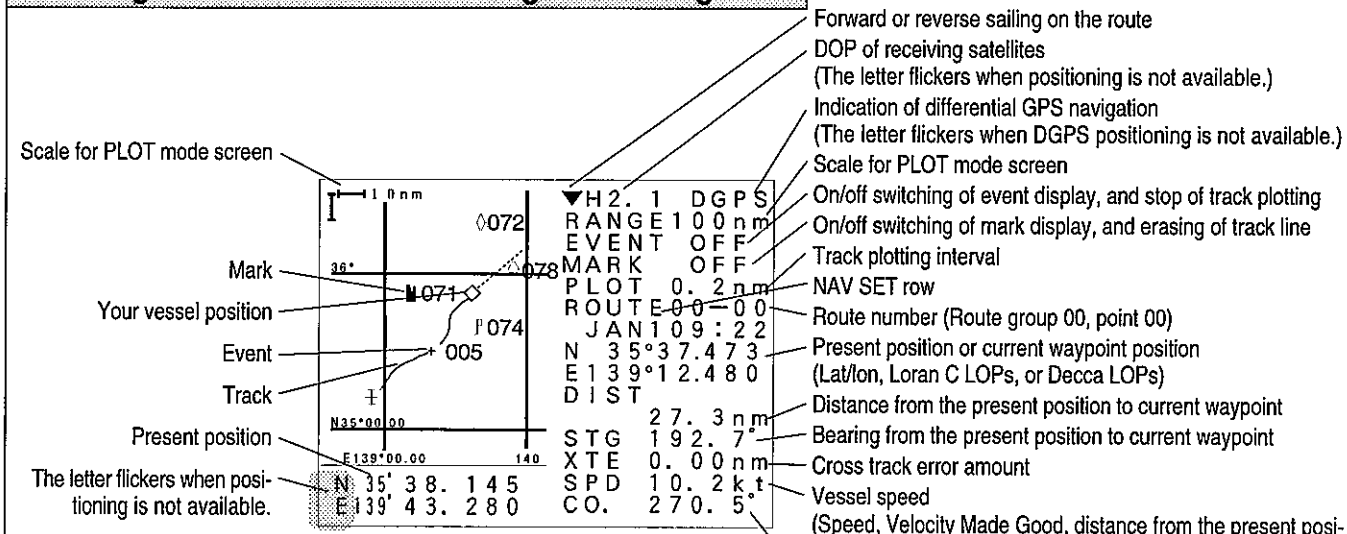
To display the VMG, CMG, or elapsed time, see page 12.

Reading NAV 3 mode screen during route navigation



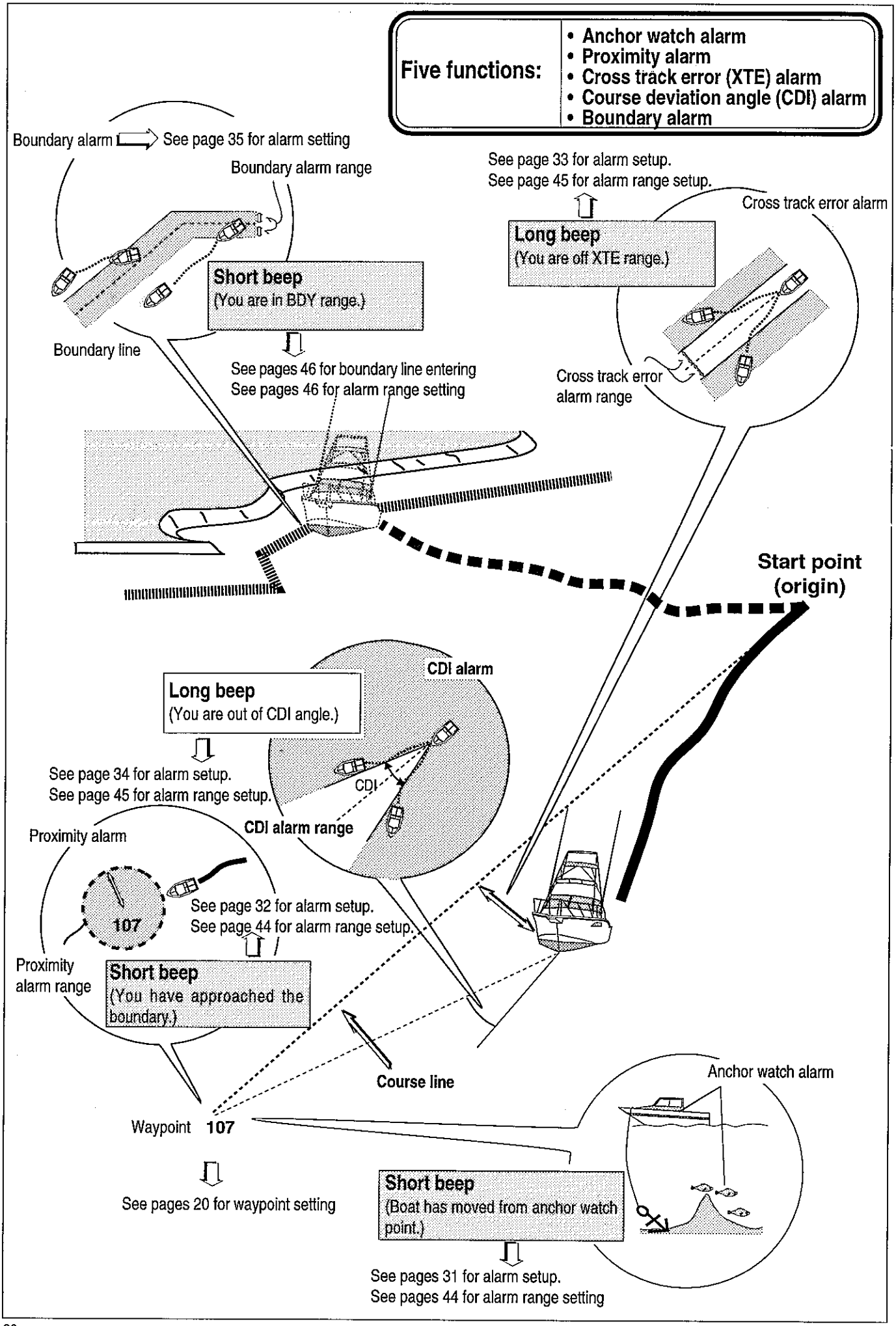
To display the VMG, CMG, or elapsed time, see page 12.

Reading PLOT mode screen during route navigation



For PLOT mode screen operations, see Page 36.

Alarms

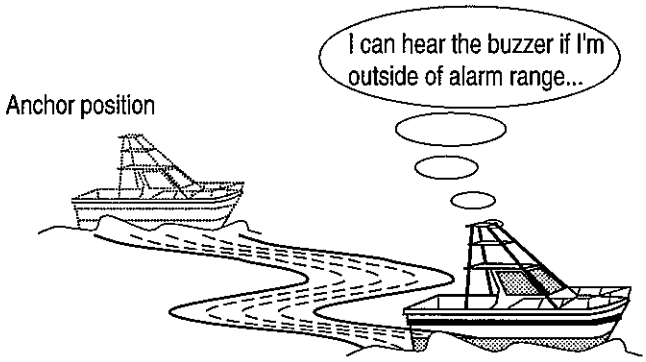

Five functions:
• Anchor watch alarm
• Proximity alarm
• Cross track error (XTE) alarm
• Course deviation angle (CDI) alarm
• Boundary alarm
Boundary alarm
See page 35 for alarm setting
Boundary alarm range
Short beep
(You are in BDY range.)
Boundary line
See pages 46 for boundary line entering
See pages 46 for alarm range setting
See page 33 for alarm setup.
See page 45 for alarm range setup.
Long beep
(You are off XTE range.)
Cross track error alarm
Cross track error
alarm range
Start point
(origin)
CDI alarm
Long beep
(You are out of CDI angle.)
See page 34 for alarm setup.
See page 45 for alarm range setup.
CDI
CDI alarm range
Proximity alarm
107
See page 32 for alarm setup.
See page 44 for alarm range setup.
Proximity
alarm range
Short beep
(You have approached the boundary.)
Course line
Anchor watch alarm
Waypoint 107
See pages 20 for waypoint setting
Short beep
(Boat has moved from anchor watch point.)
See pages 31 for alarm setup.
See pages 44 for alarm range setting

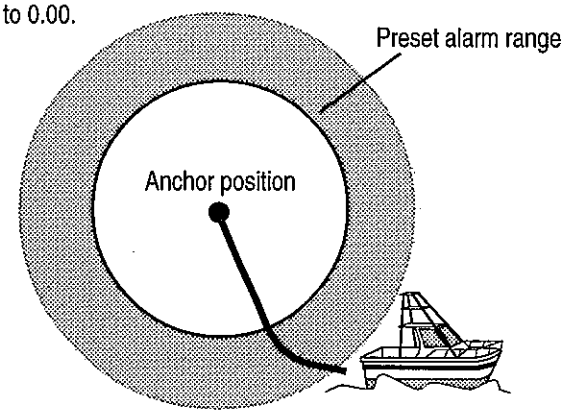
Setting and Cancelling an Anchor Watch Alarm

What is an anchor watch alarm?

Initial setup: 0.00

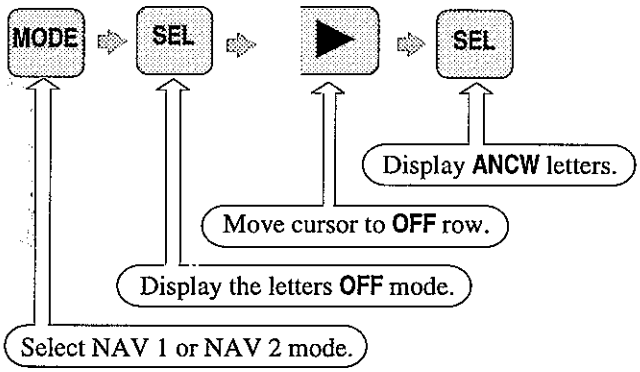
The buzzer sounds and letters **ANCW** brink when your ship has moved outside of anchor watch alarm range. The alarm function does not work if the alarm range is set to 0.00.

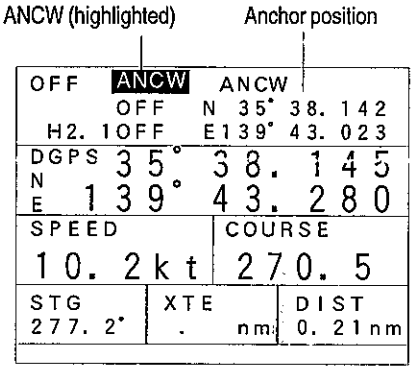




Setting an anchor watch alarm

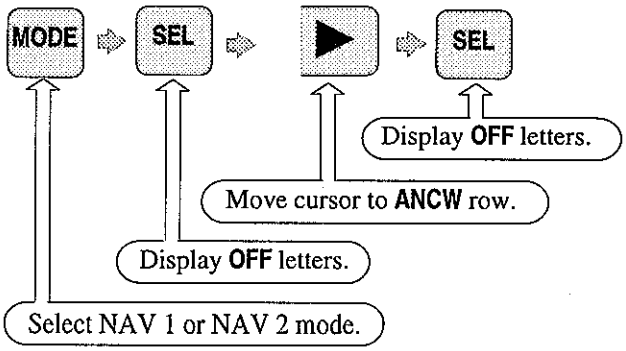
When the following operation is executed, the current position will become the anchor position, and anchor watch alarm wilt. At the same time, the anchor position will be registred in point 9 of group 49 and displayed with comments (ANCW) on the waypoint position indication of seiection indication coiumn 1. Also, the direction and distance of the anchor position from the current position will be indicated as the waypoint direction and distance in selection indication column 3.

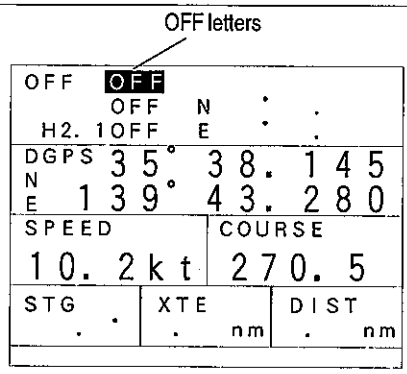




Alarm range is set on **ALARM (ANCW** row) of **MENU** mode display.

Cancelling the anchor watch alarm





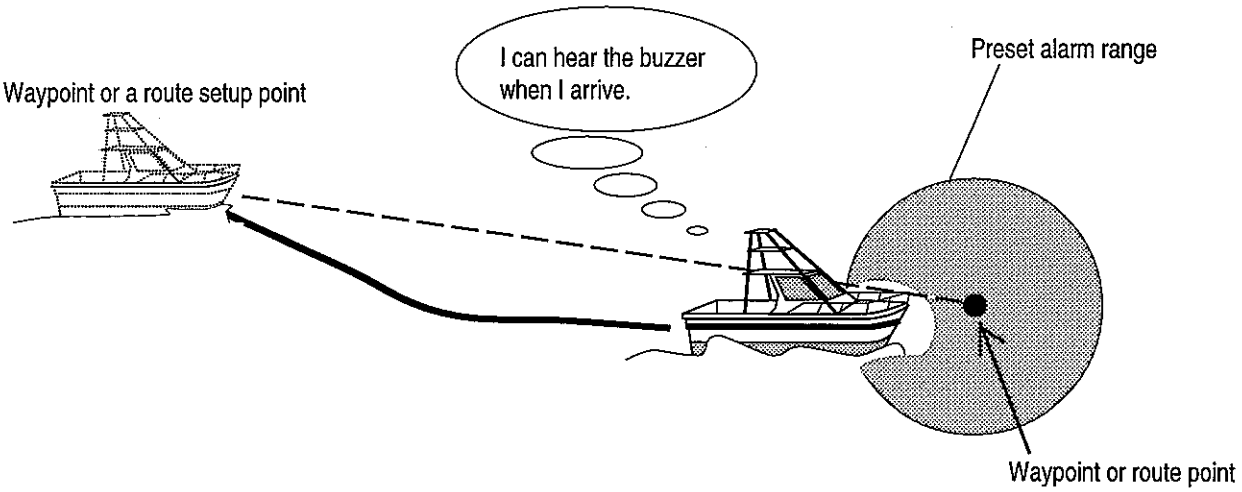
CLR Press CLR key to temporarily turn the alarm sound off.

Setting and Cancelling a Proximity Alarm

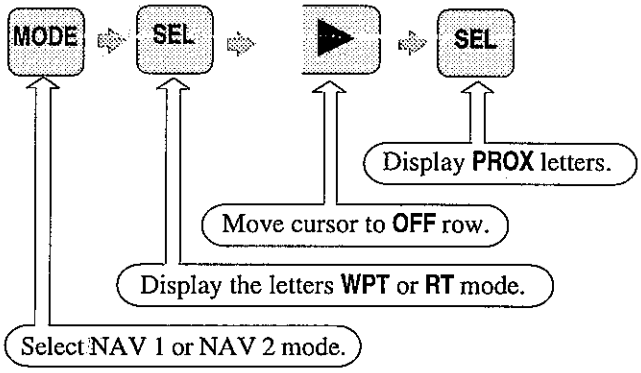
What is a proximity alarm?

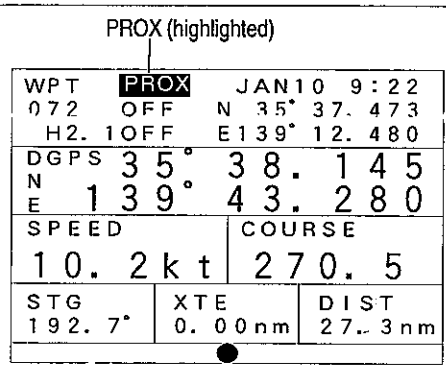
Initial setup: 0.00

The buzzer sounds letters **PROX** blink when you have arrived at the waypioint during waypoint or route navigation. This alarm is set automatically when you have selected the waypoint or route navigation. The alarm function does not work if the alarm range is set to 0.00.



Setting a proximity alarm

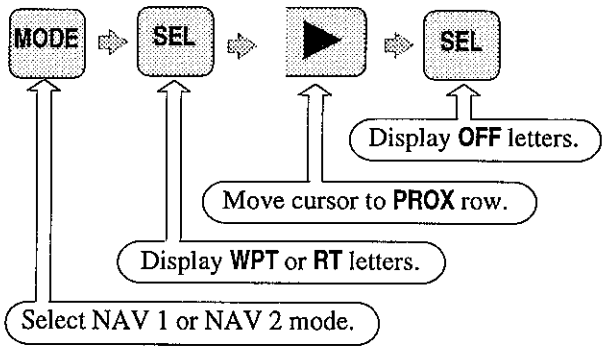


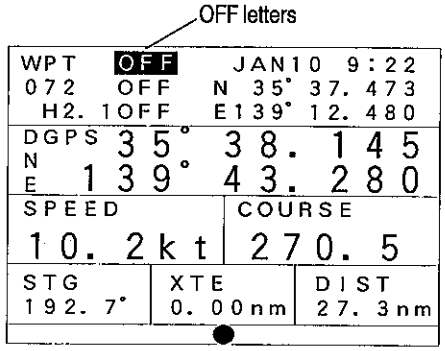


Proximity alarm is available during waypoint navigation and route navigation.

Alarm range is set on **ALARM** (**PROX** row) of **MENU** mode display.

Cancelling the proximity alarm





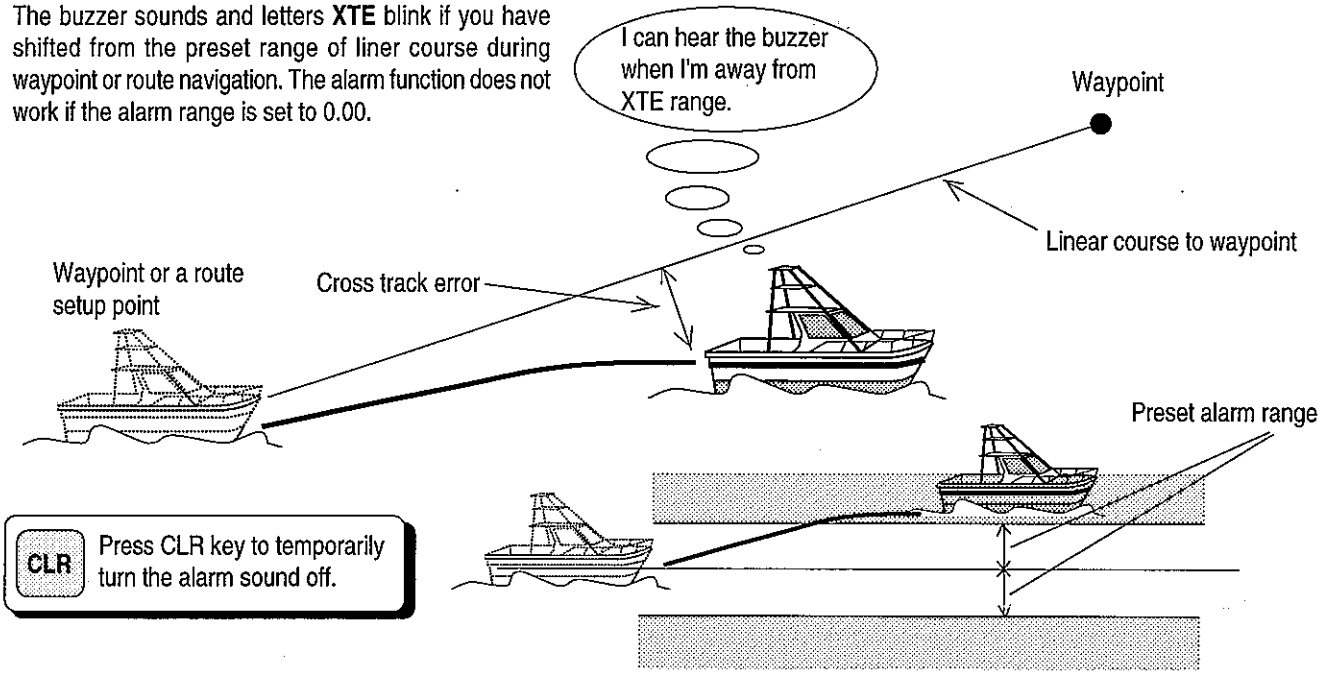
CLR Press CLR key to temporarily turn the alarm sound off.

Setting and Cancelling a XTE Alarm

What is a cross track error alarm (course deviation)?

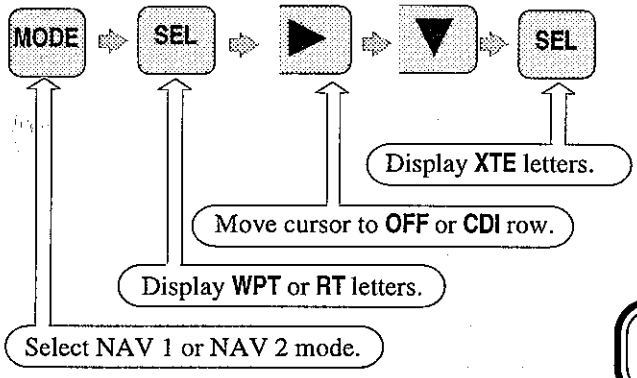
Initial setup: 0.00

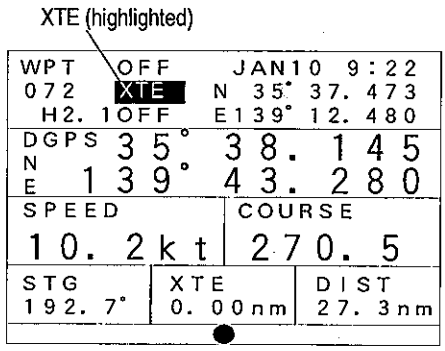
The buzzer sounds and letters **XTE** blink if you have shifted from the preset range of liner course during waypoint or route navigation. The alarm function does not work if the alarm range is set to 0.00.



CLR Press CLR key to temporarily turn the alarm sound off.

Setting a XTE alarm





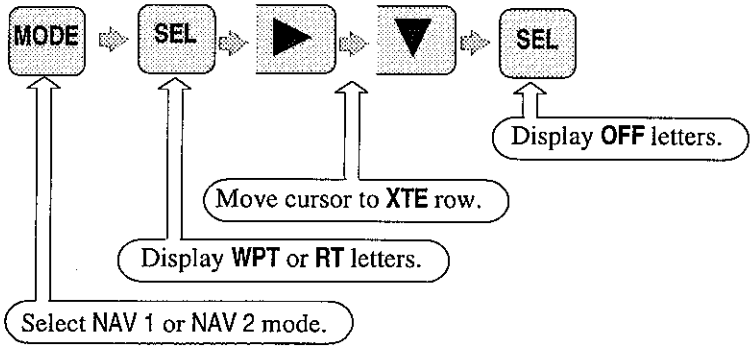
When XTE alarm is set, the XTE amount is shown by bar graph up to 1.00 nm. (see page 23 for details).

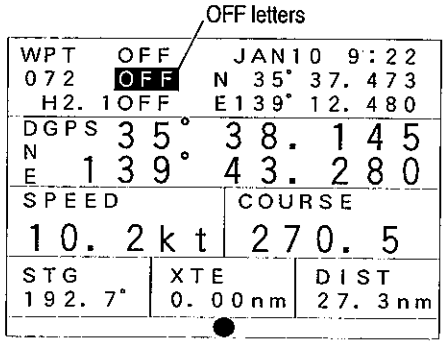
Alarm range is set on **ALARM** (**XTE** row) of **MENU** mode display.

Cross track error alarm cannot be used with CDI alarm.

Cross track error alarm is available during waypoint navigation and route navigation.

Cancelling the XTE alarm



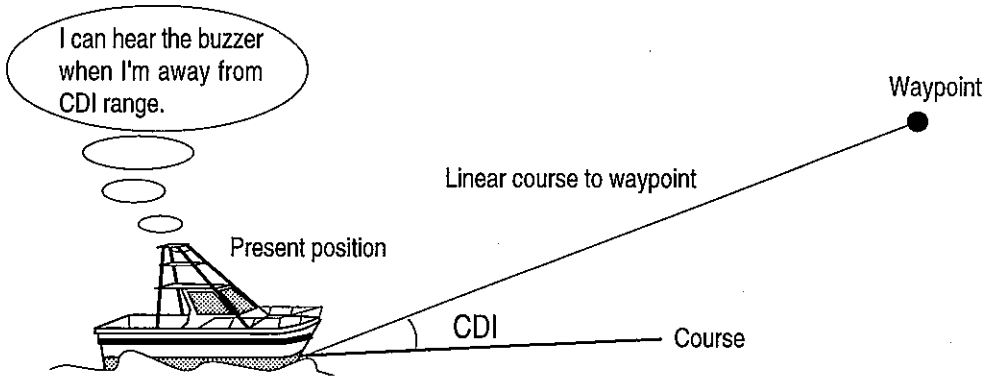


CLR Press CLR key to temporarily turn the alarm sound off.

Setting and Canceling CDI Alarm

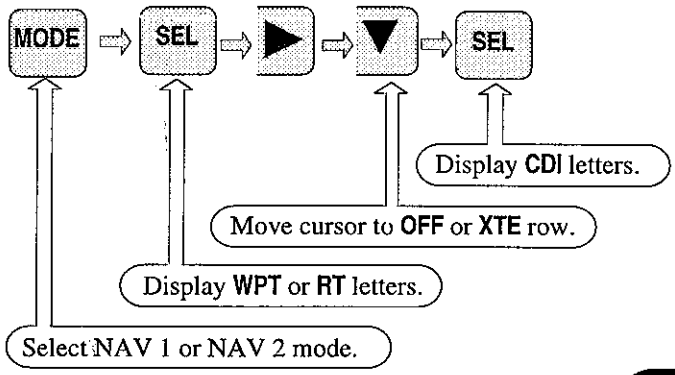
What is a CDI alarm (Course Deviation angle)?

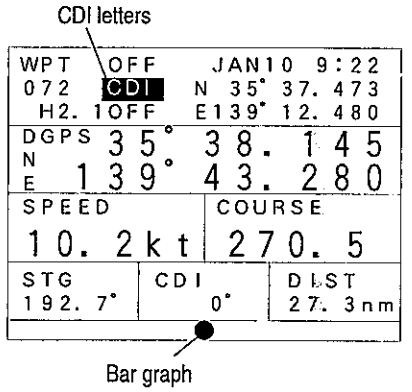
The buzzer sounds if you have deviated from the course beyond the preset angle. However, the CDI alarm does not operated if its alarm range is set to 0.00 or if a XTE alarm has been set. At the same time, letters CDI blink.



The CDI alarm is activated when you have set the waypoint or route navigation.

Setting a CDI alarm



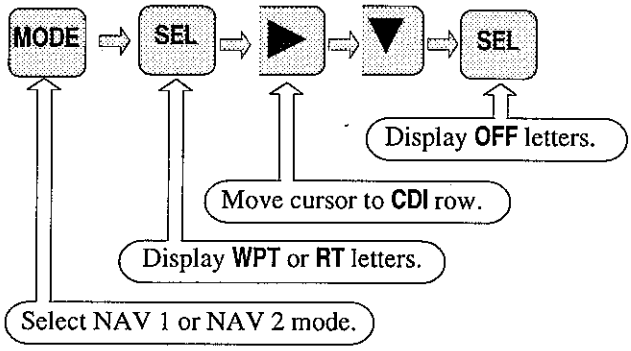


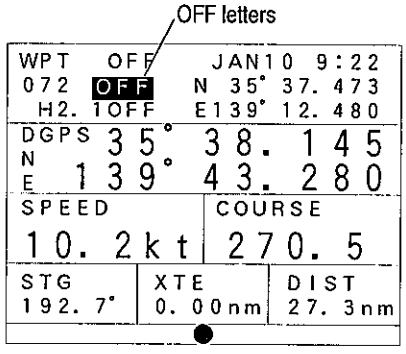
When CDI alarm is set, the CDI amount is shown by bar graph up to 45 degrees. (see page 23 for details).

CDI alarm can not be used with XTE alarm.

Alarm range is set on ALARM (CDI row) of MENU mode display.

Cancelling the CDI alarm



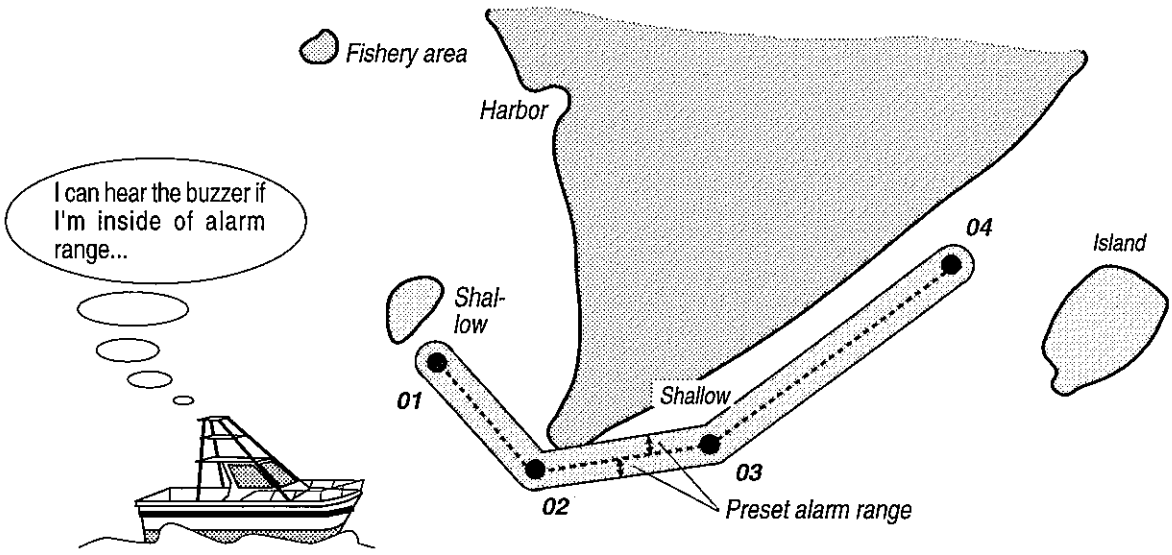


CLR Press CLR key to temporarily turn the alarm sound off.

Setting and Canceling Boundary Alarm

What is a boundary alarm?

The buzzer sounds and letters BDY blinks when you have entered the preset range of a dangerous area such as shallow, wreck, coastal line. The alarms functions does not work if the alarm range is set to 0.00.

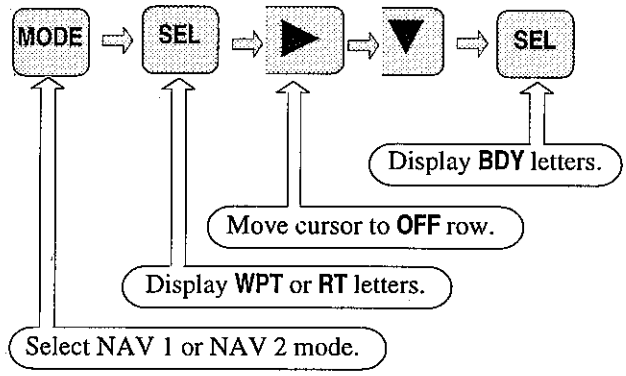


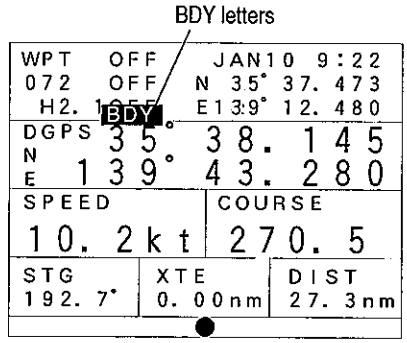
Boundary group number ; 09

The boundary alarm is activated when you have set the waypoint or route navigation.

Setting a boundary alarm

Store points to be used for boundary line before this operation. This is the same as "Storing route" of page 18.

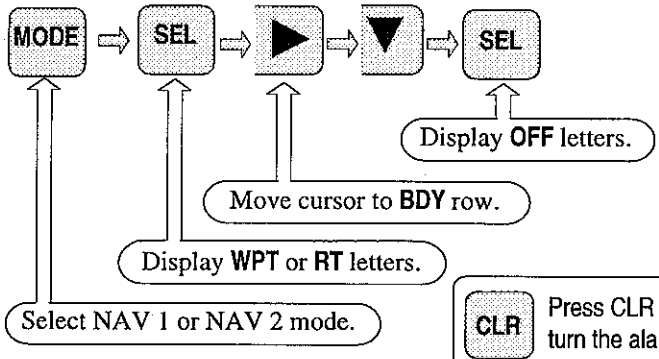




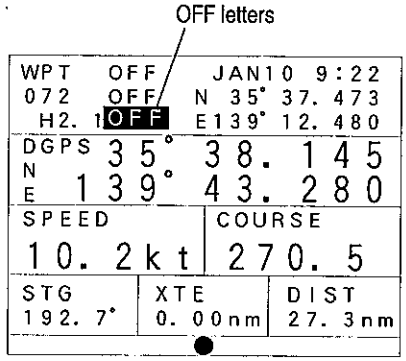
Boundary is set on ALARM (BDY SET row) of MENU mode display.

Alarm range is set on ALARM (BDY row) of MENU mode display.

Cancelling the boundary alarm



CLR Press CLR key to temporarily turn the alarm sound off.

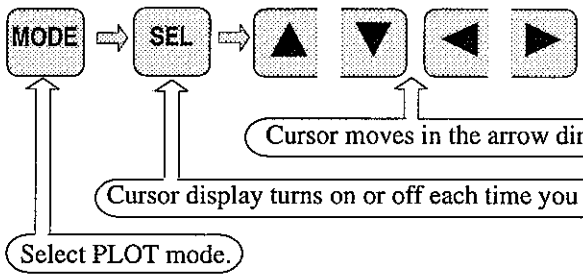


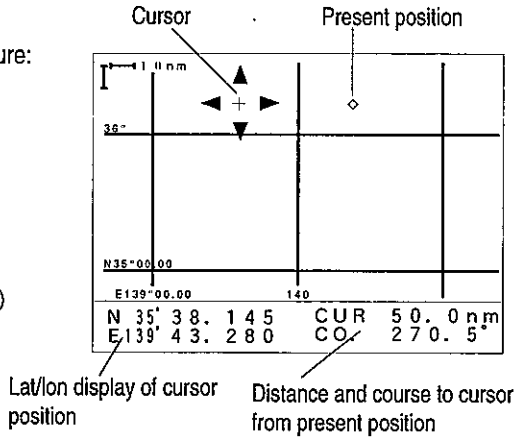
Plotting Own Vessel Tracks

On PLOT mode display, you can display your vessel tracks, waypoint, course, latitude and longitude, and cursor on the screen.

Displaying cursor on PLOT mode screen

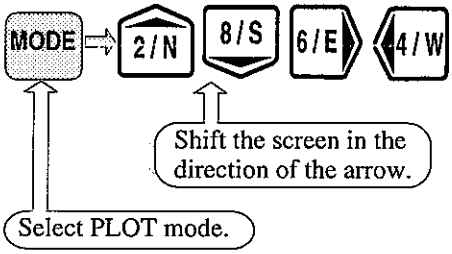
The cursor can be displayed and moved within the screen by the following procedure:

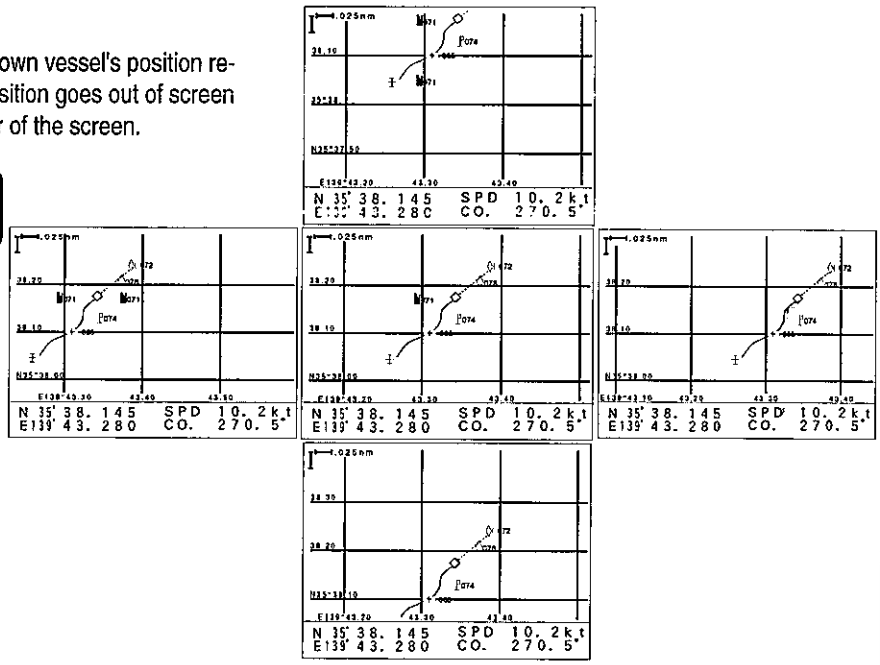




Shifting plotter screen

The plotter screen can be changed with your own vessel's position remaining on the screen. When your vessel position goes out of screen edge, the vessel position returns to the center of the screen.

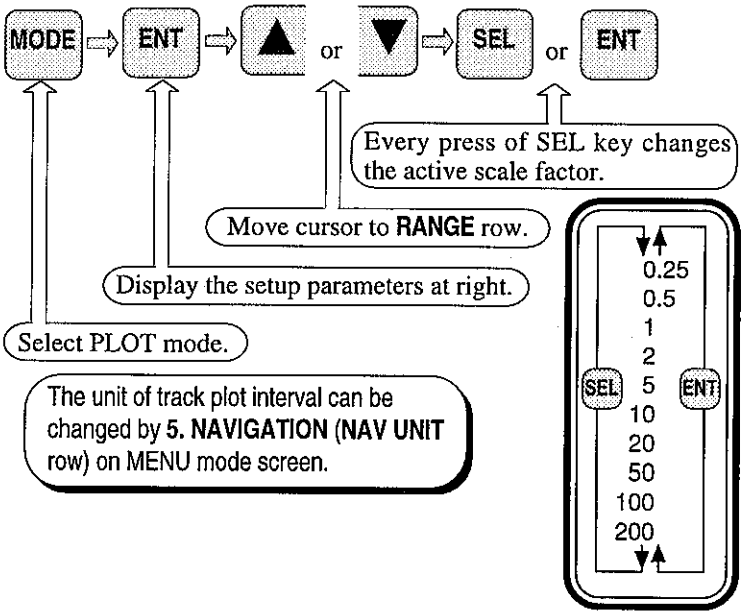




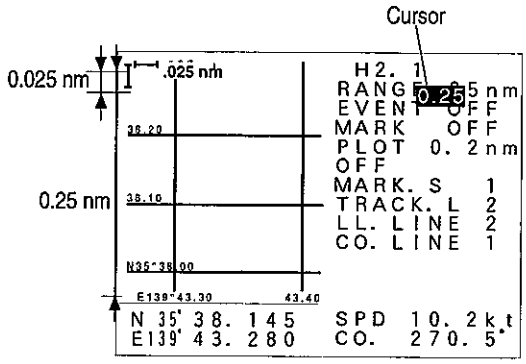
Changing screen scale factor

Initial setting: 0.025

The scale factor of plotter screen can be changed by the following procedure:



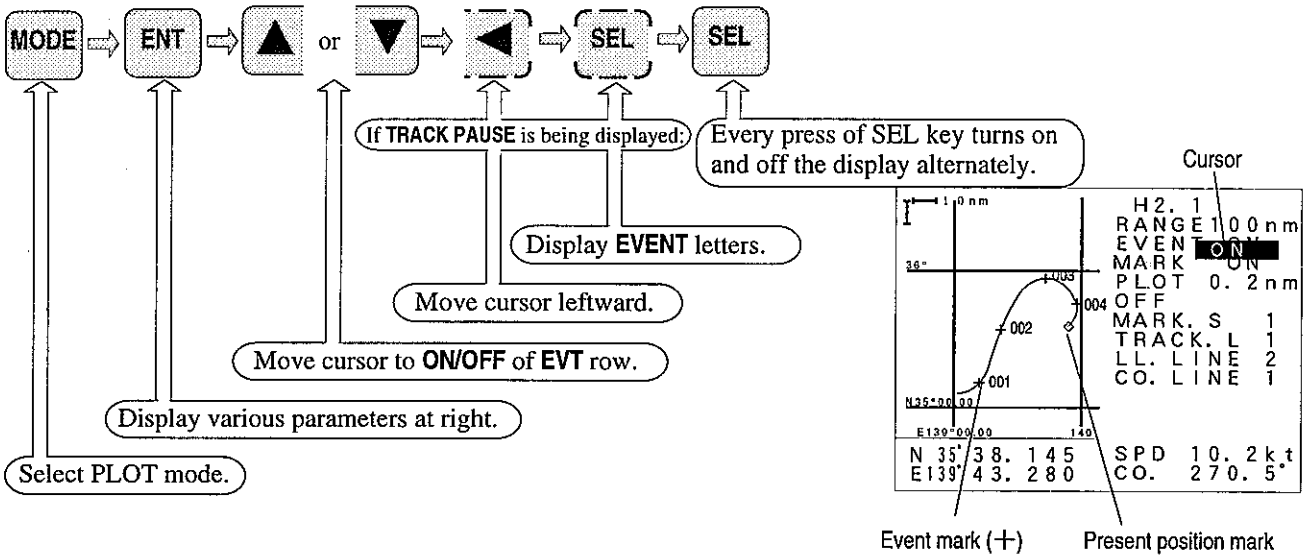
The unit of track plot interval can be changed by **5. NAVIGATION (NAV UNIT** row) on MENU mode screen.



The scale in use for PLOT mode screen is equal to 1/10 of width of screen.

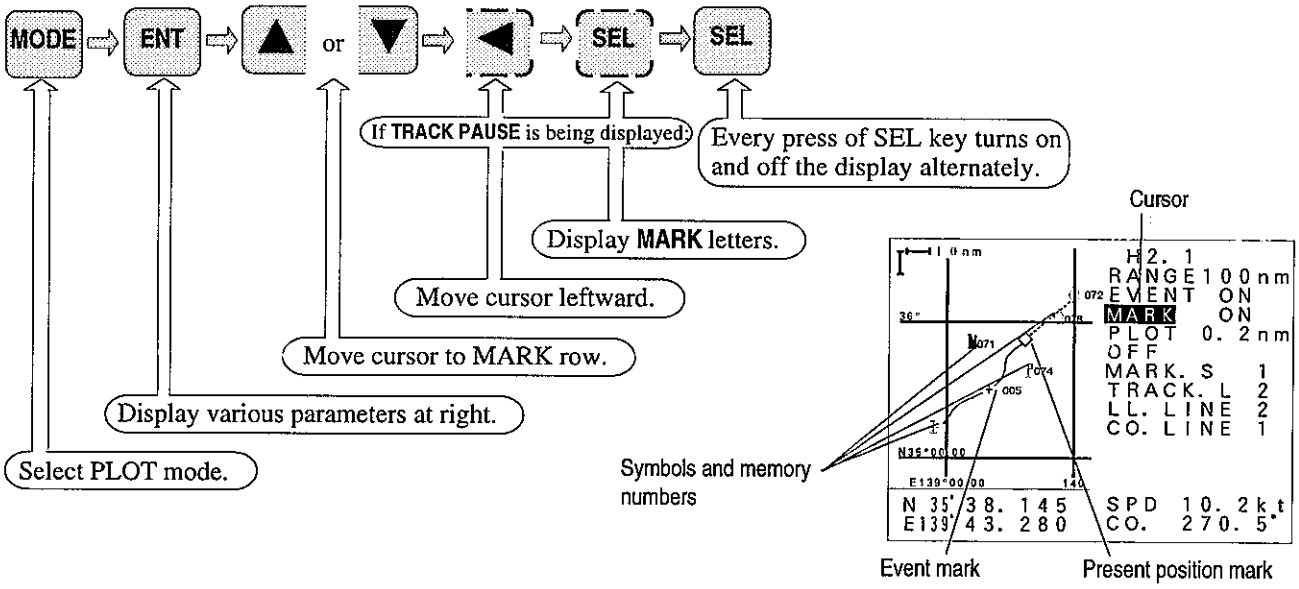
Turning on or off the display of present position (event mark): EVT ON/OFF

By turning the event mark (EVT ON), up to 100 positions of the present position stored are displayed on the plotter screen with event mark (+), group number (00 to 09), and point number (0 to 9) by the following procedure:



Turning on or off the display of waypoint memory position (with mark): MARK ON/OFF

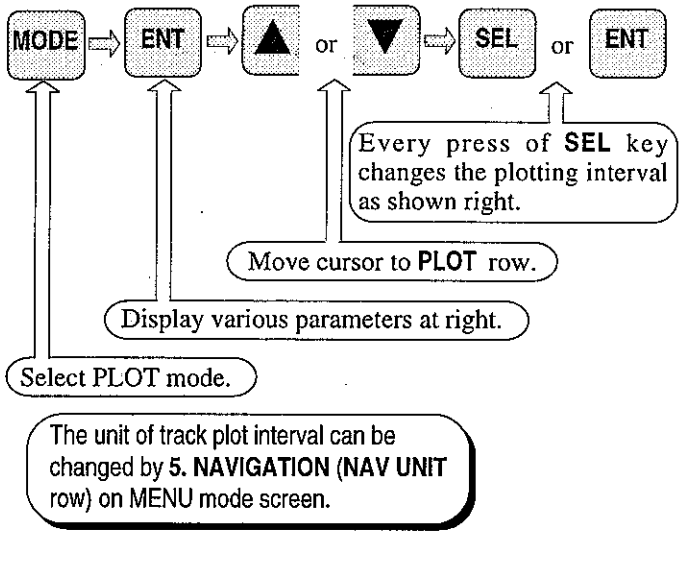
By turning the mark on (MARK ON), waypoint memory position stored on the plotter screen is displayed with symbol, group number (10 to 49), and point number (0 to 9) by the following procedure:



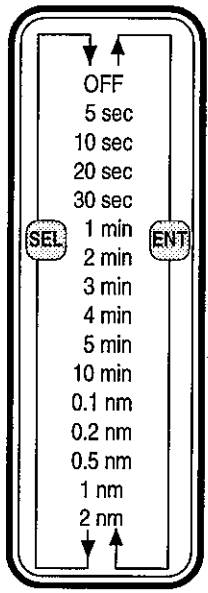
Changing track plotting interval: PLOT

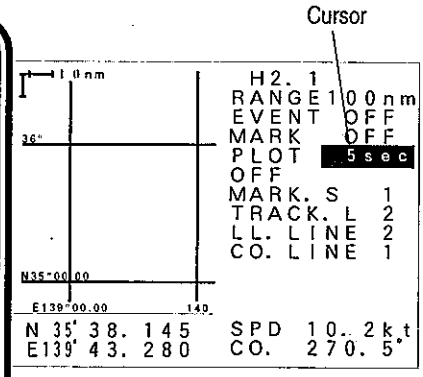
Initial setting: 5 sec

The track plotting interval (time and distance) can be changed by the following procedures:



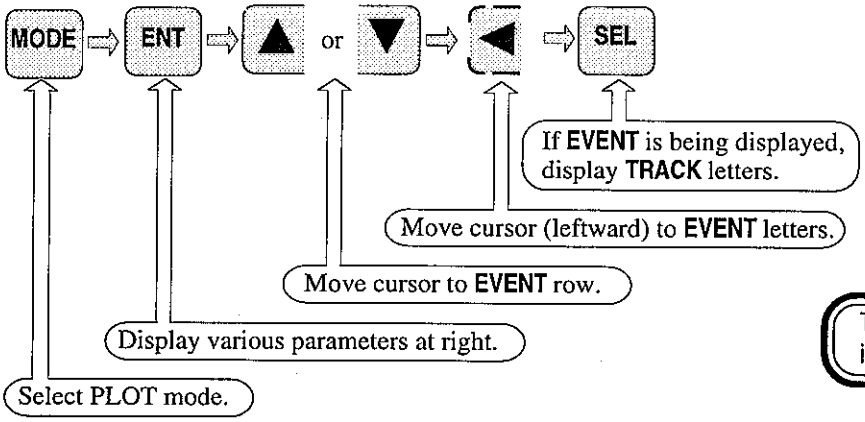
The unit of track plot interval can be changed by **5. NAVIGATION (NAV UNIT** row) on MENU mode screen.

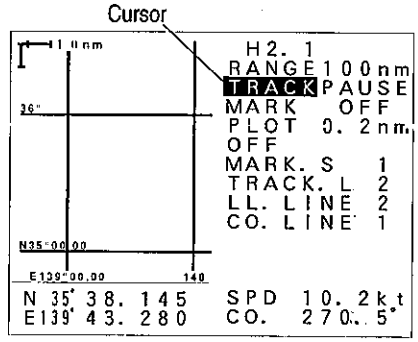




Stopping track plotting: TRACK PAUSE

By stopping the track plotting the letters **PAUSE** appear and the track line freezes.
The present position mark (◇), however, continues to move on the screen.

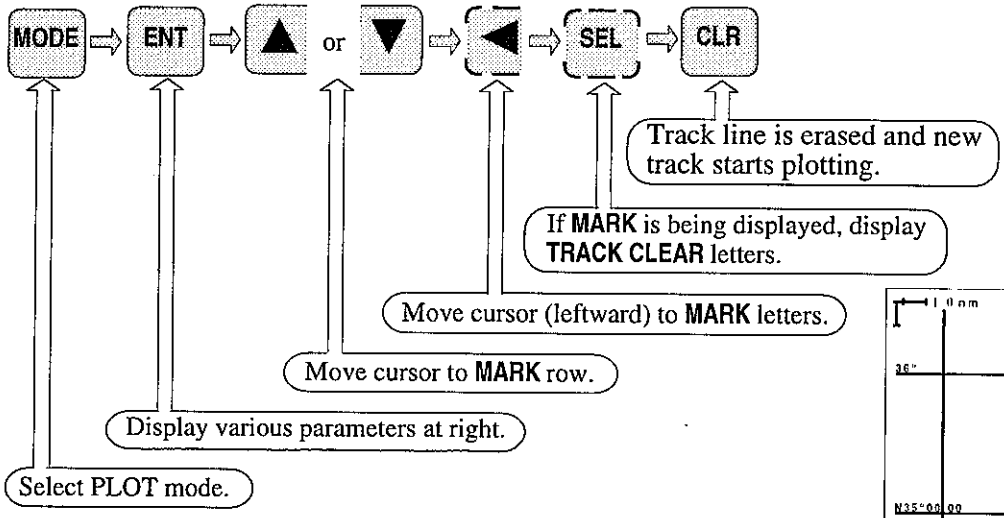


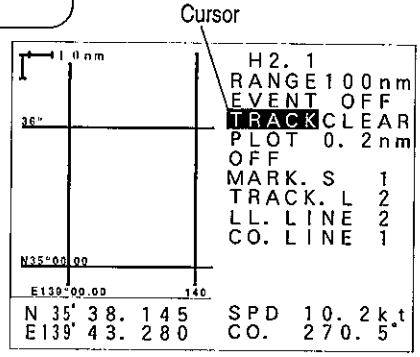


To re-display the track, display **EVENT** instead of **TRACK**.

Erasing track: TRACK CLR

Once a previous track line is erased, a new track line starts plotting by the following procedures:





Changing mark display size: MARK.S

Initial setting: 1 (small size)

The display size (large or small size) of event marks can be changed on the PLOT mode screen by the following procedure:

MODE ⇨ ENT ⇨ ▲ or ▼ ⇨ SEL

This operation is valid only when navigation is off.

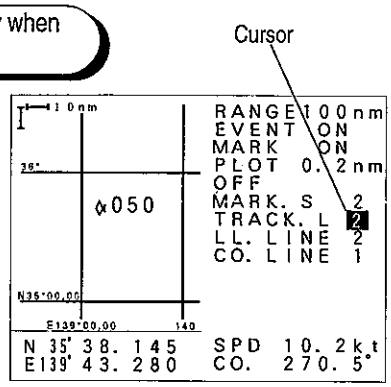
Every press of SEL key switches the mark size.

Move cursor to **MARK.S** row.

Display various parameters at right.

Select PLOT mode.

0: No display
1: Small
2: Large



Turning on or off of track line display and changing its type: TRACK.L

Initial setting: 2 (Continuous line)

The track line display can be turned on or off and its line type (continuous line or dotted lines) can be changed by the following procedure:

MODE ⇨ ENT ⇨ ▲ or ▼ ⇨ SEL

This operation is valid only when navigation is off.

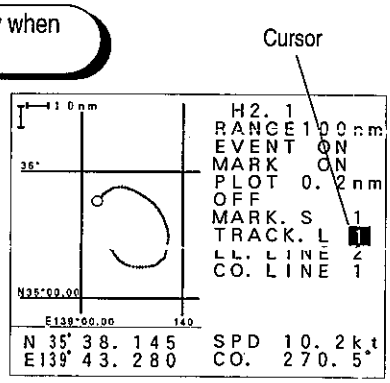
Press SEL key to turn the display on or off and to set the line type.

Move cursor to **TRACK.L** row.

Display various parameters at right.

Select PLOT mode.

0: No display
1: Dotted line (x)
2: Continuous line



Turning on or off of lat/lon display and their line display: LL.LINE

Initial setting: 2

The display of latitude and longitude and their lines (grids) can be turned on or off by the following procedure:

MODE ⇨ ENT ⇨ ▲ or ▼ ⇨ SEL

This operation is valid only when navigation is off.

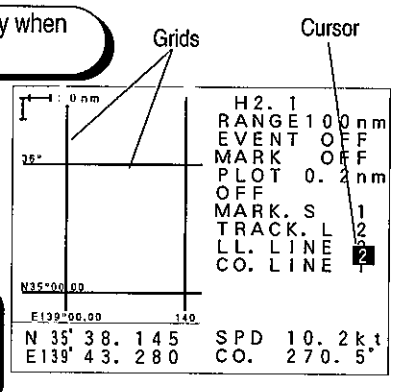
Press SEL key to turn the display on or off.

Move cursor to **LL.LINE** row.

Display various parameters at right.

Select PLOT mode.

0: No display
1: Lat/lon lines are displayed.
2: Lat/lon and their lines are displayed.



Turning on or off of course line display: CO.LINE

Initial setting: 1

During waypoint navigation or route navigation, the display of course line to the current waypoint can be turned on or off by the following procedure:

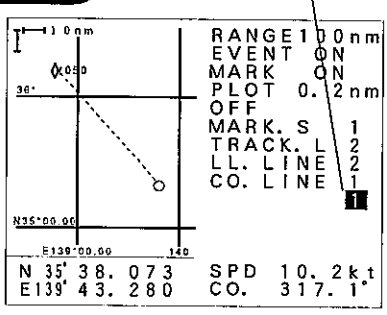
MODE ⇨ ENT ⇨ ▲ or ▼ ⇨ SEL

This operation is valid only when navigation is off.

Press SEL key to turn the display on or off.

Move cursor to **CO.LINE** row.

Display various parameters at right.

Select PLOT mode.

0: No display
1: Course line is displayed.