Chapter 4: ARPA Operation

This Automatic Radar Plotting Aid (ARPA) tracks the movement of up to 30 radar targets. Targets can be acquired manually or automatically. All 30 targets can be acquired manually when the ARPA acquisition area is inactive. With the acquisition area that total is equally divided between manual and auto acquisition.

ARPA requires speed and heading data. The symbols used in this radar comply with IEC 60872-1.

⚠ WARNING

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

- This auto plotter automatically tracks an automatically or manually acquired radar target and calculates its course and speed, indicating them by a vector. Since the data generated by the auto plotter are based on what radar targets are selected, the radar must always be optimally tuned for use with the auto plotter, to ensure required targets will not be lost or unwanted targets such as sea returns and noise will not be acquired and tracked.

- A target does not always mean a landmass, reef, ships or other surface vessels but can imply returns from sea surface and clutter. As the level of clutter changes with environment, the operator should properly adjust the A/C SEA, A/C RAIN and GAIN controls to be sure target echoes are not eliminated from the radar screen.

⚠ CAUTION

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

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

Display accuracy is affected by the following:

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

4.1 Enabling, Disabling ARPA

1. On the Chart Plotter or Radar display, long-push the Rotary Knob.
2. Select the Targets ROTOkey and push the Rotary Knob.
3. Select the ARPA ROTOkey.
4. Push the Rotary Knob to alternately enable and disable the ARPA display.

4.2 Manually Acquiring a Target

1. Use the Cursorpad to put the cursor on the target you want to acquire.
2. Press the **right-button** key to show the Radar pop-up menu.
3. Select Acquire Target and push the Rotary Knob.

A target just acquired is marked with a broken square and a vector appears within 20 scans of the antenna to indicate the target's motion trend. Within 60 scans, the initial tracking stage is finished and the target becomes ready for stable tracking. At this point, the broken square mark changes to a solid circle. (Targets automatically acquired are distinguished from those acquired manually. The targets which are acquired manually are displayed by bold symbol.)

ARPA Symbol	Meaning
	Immediately after acquisition.
	Within 20 scans of the antenna after acquisition, a vector appears to show a trend of movement.
	Within 60 scans of the antenna after acquisition, the plotting symbol changes to a small circle, indicating steady-state tracking condition.
 (flashing)	**Lost target** is indicated by flashing diamond symbol. The diamond is formed from two equal triangles.

Note 1: For successful acquisition, the target to be acquired should be within 0.2 to 32 nm from own ship and not obscured by sea or rain clutter.

Note 2: When the capacity for manual acquisition is reached, an appropriate message appears in the text message area. Cancel tracking of non-threatening targets if you wish to acquire additional targets manually.

Note 3: Acquisition is also possible with the ROTOkeys. Select the target to acquire, long-push the Rotary Knob, choose the Target ROTOkey followed by the Acquire ROTOkey.

4.3 Clearing a Lost Target

On the radar or chart plotter display, place the cursor on the lost target and select the ROTOkeys Target and Clear Lost.

4.4 Cancelling Tracking of Targets

ARPA targets can be cancelled individually or collectively as shown below. All targets can also be cancelled from the Radar pop-up menu.

1. **For cancelling individual target,** use the Cursorpad to put the cursor on the target you want to cancel tracking.
2. Long-push the Rotary Knob.
3. Select the Targets ROTOkey and push the Rotary Knob.
4. Select the Cancel or Cancel All ROTOkey as applicable and push the Rotary Knob.

Tracking is cancelled and targets are erased from the screen.

4.5 CPA/TCPA Alarm

The CPA/TCPA alarm is useful for alerting to possible collision situations. With the alarm active, the ARPA continuously monitors the predicted range at the Closest Point of Approach (CPA) and predicted time to CPA (TCPA) of each tracked target to own ship. When the predicted CPA of any target becomes smaller than a preset CPA alarm range and its predicted TCPA less than a preset TCPA alarm limit, the buzzer sounds and an appropriate text message appears. In addition, the ARPA symbol changes to a triangle and flashes together with its vector.

Provided that this feature is used correctly, it will help prevent the risk of collision by alerting you to threatening targets. However, it is important that gain, sea and rain controls are properly adjusted.

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

Setting the CPA/TCPA Alarm

1. Press the **MENU** key to open the menu.
2. Select the Radar sub menu.
3. Select CPA/TCPA Alarm.
4. Push the Rotary Knob to show the status box in green to activate the CPA/TCPA alarm.
5. Set CPA and TPCA values at CPA Alarm Value and TCPA Alarm Value.
6. Press the **MENU** key to close the menu.

Acknowledging the CPA/TCPA Alarm

The CPA/TCPA alarm sounds when the CPA and/or TCPA of an ARPA target is within the CPA/TCPA alarm range. To acknowledge and silence the CPA/TCPA alarm, press the **CANCEL** key. The audio alarm is silenced and the symbol stops flashing.

Disabling the CPA/TCPA Alarm

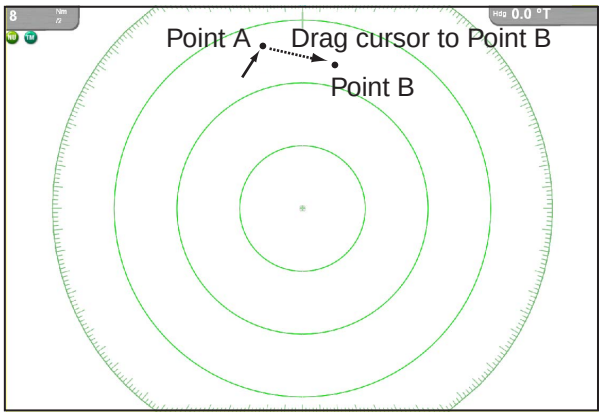
Show the status box of CPA/TCPA Alarm in gray to disable the alarm. (See "Setting the CPA/TCPA Alarm" above for the procedure.)

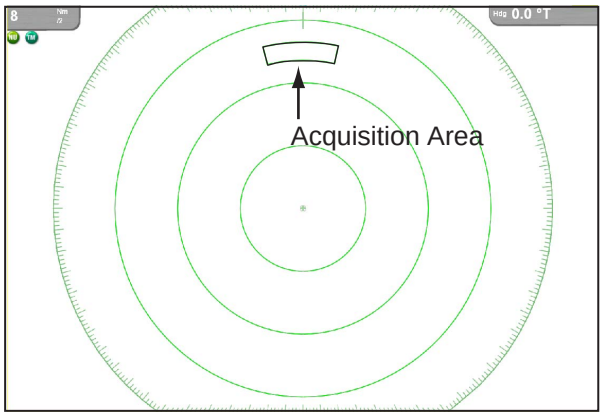
4.6 Setting ARPA Acquisition Area

Any target entering the ARPA acquisition area will be automatically acquired and tracked. When a target transits the area, the buzzer sounds and the target causing the warning is clearly indicated with an inverted flashing triangle. You can silence the buzzer with the **CANCEL** key.

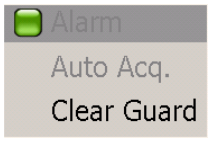
1. On the radar display, push the **right-button** key to show the Radar pop-up menu.

2. Rotate the Rotary Knob to choose Set Guard 1 or Set Guard 2, whichever you want to set, and push the Rotary Knob. The point placement cursor appears at cursor location.
3. Use the Cursorpad to put the point placement cursor at the top left corner for the guard zone (Point A below).
4. Press the **left-button** key in the center of the Cursorpad.
5. Use the Cursorpad to drag the point placement cursor to the bottom right corner (Point B below) for the guard zone and push the **left-button** key.





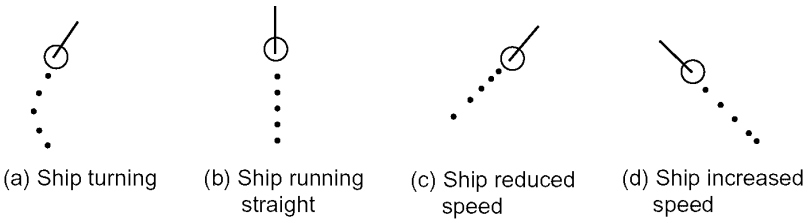
To erase the guard zone (and return to full manual acquisition), put the cursor on a line of the guard zone and push the **right-button** key to show the Guard Zone pop-up. (The line becomes thicker if correctly selected.) Rotate the Rotary Knob to choose Clear Guard and push the Rotary Knob.



4.7 Track History Display

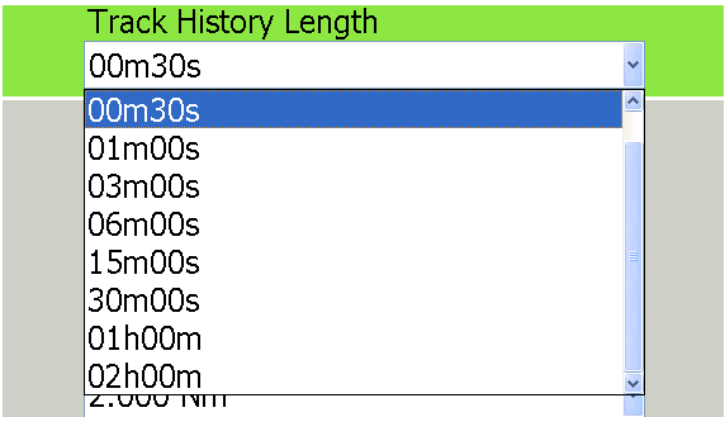
This ARPA can mark the past positions of any targets being tracked, with equally time-spaced dots.

A new dot is added every minute (or at other preset time intervals) until the preset number is reached. If a target changes its speed, the spacing between dots will be uneven. If a target changes its course, its plotted course will not be a straight line.



Selecting Track History Plotting Interval

1. Press the **MENU** key to open the menu.
2. Open the Targets menu.
3. Select Track History Length and push the Rotary Knob.



4. Rotate the Rotary Knob to select plot interval desired.
5. Press the **MENU** key to close the menu.

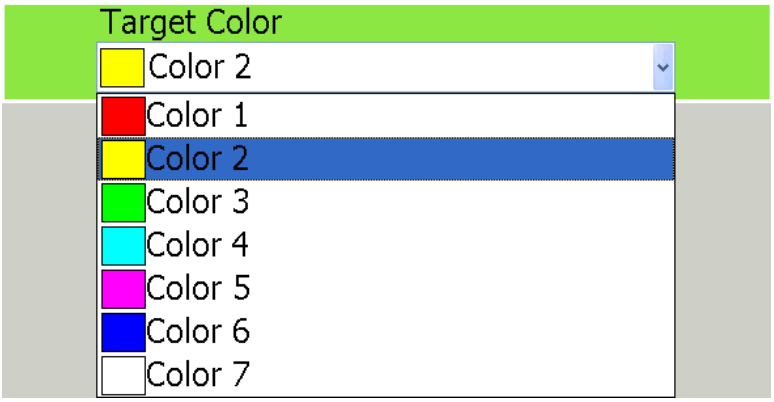
Showing, Hiding the Track History Display

On the radar display or the chart plotter display, long-push the Rotary Knob to show the ROTOkeys. Choose the Targets ROTOkey followed by the Track ROTOkey. Push the Rotary Knob to alternately show and hide the track history display.

4.8 ARPA Symbol Color

The color of the ARPA symbol is available in yellow, red, green, light-blue, purple, blue, and white.

1. Press the MENU key to open the menu.
2. Open the Targets menu.
3. Select Target Color and push the Rotary Knob.



4. Select color desired and push the Rotary Knob.
5. Press the **MENU** key to close the menu.

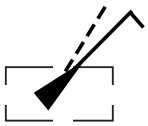
Chapter 5: AIS Operation

An AIS transponder uses VHF frequencies, and broadcasts your own vessel's position, name, callsign, along with detailed parameters like length, beam, draft, and tonnage. It also broadcasts details of the current navigation system: speed, course, rate of turn, destination, and ETA. The transponder receives this same information from other ships, and displays it on radar and chart plotter displays. The positions and intentions of nearby vessels are available to you unambiguously and in real time.

5.1 Enabling, Disabling AIS

1. Long-push the Rotary Knob to show the ROTOkeys.
2. Select the Targets ROTOkey and push the RotaryKnob.
3. Select AIS and push the Rotary Knob to alternately turn the AIS function on and off.

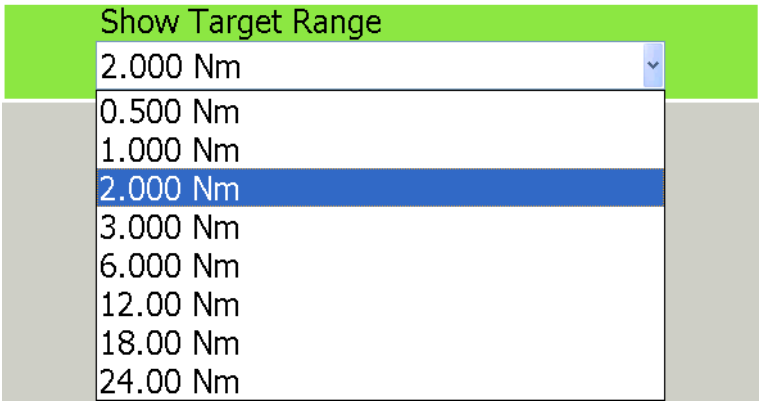
5.2 AIS Target Symbols

Symbol	Target type	Color	Description
	Activated target w/ROT line	Blue	Heading is shown with a solid line extending from the tip of the triangle. COG is shown with a broken line extending from the center of the triangle. The ROT line appears when a target's ROT is more than 10 degrees/min.
	Target selected	Blue	A target selected to display its data is marked with a broken rectangle.
	Dangerous target	Red	An AIS target whose CPA and TCPA are less than those values set on the CPA Settings dialog box or the proximity alarm range is considered a dangerous target, on collision course with own ship. A dangerous target is colored pink when selected to find its data.
	Lost target	Black or white	If no signal is received from an AIS target for 10 minutes it is declared a lost target. If no signal is received for another 10 minutes the lost target symbol is automatically erased.

5.3 Setting Acquisition Range

In the default setting, all AIS targets within VHF range from your boat are shown on the display. If the screen becomes too cluttered with AIS targets, you may wish to set an acquisition range in order lessen the number of AIS targets on the screen. Only those targets within the range selected will be monitored.

1. Press the **MENU** key to open the menu.
2. Open the Targets menu.
3. Select Show Target Range and push the RotaryKnob.

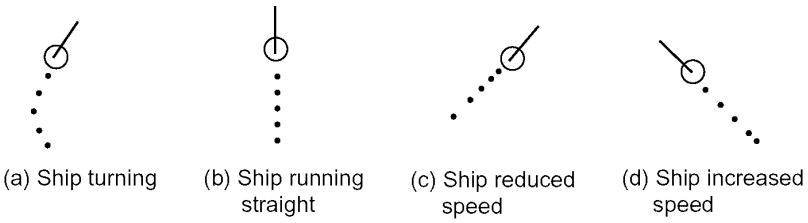


4. Select a range and push the Rotary Knob.
5. Press the **MENU** key to close the menu.

5.4 Track History Display

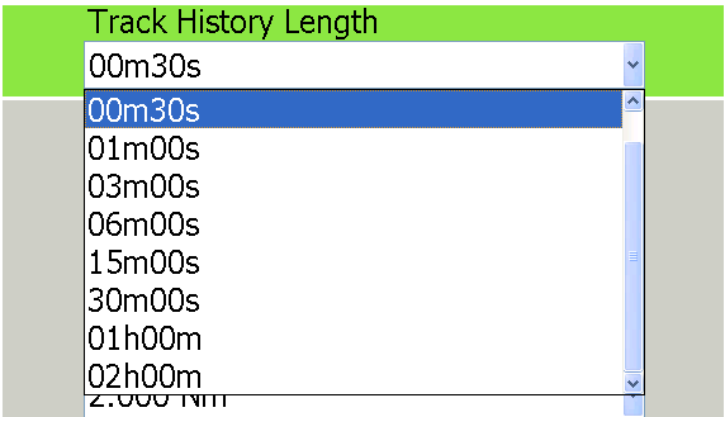
This AIS can mark the past positions of any targets being tracked, with equally time-spaced dots.

A new dot is added every minute (or at other preset time intervals) until the preset number is reached. If a target changes its speed, the spacing between dots will be uneven. If a target changes its course, its plotted course will not be a straight line.



Selecting Track History Plotting Interval

1. Press the **MENU** key to open the menu.
2. Open the Targets menu.
3. Select Track History Length and push the RotaryKnob.



4. Rotate the Rotary Knob to select plot interval desired.
5. Press the **MENU** key to close the menu.

Showing, Hiding the Track History Display

On the radar display or the chart plotter display, long-push the Rotary Knob to show the ROTOkeys. Choose the Targets ROTOkey followed by the Track ROTOkey. Push the Rotary Knob to alternately show and hide the track history display.

5.5 Showing, Hiding Target ID

The MMSI no. of an AIS target can be shown or hidden on the display.

1. Press the **MENU** key to open the menu.
2. Open the Targets menu.
3. Select DIsplay Target IDs.
4. Push the Rotary Knob to alternately show and hide the target IDs.
5. Press the **MENU** key to close the menu.

Chapter 6: Card Operations

This chapter covers how to use SD cards to save and load data, and how to manage your chart cards. Topics include

- Save tracks, routes and points
- Load tracks, routes and points
- Save user setup
- Load user setup
- Manage chart catalog
- Delete files
- Move files, and
- Request and load update files

6.1 Compatible SD Cards

The manufacturer and model of compatible SD cards are listed in the table below

Compatible SD cards

Make	Model	Capacity
SANDISK	SDSDB-xxx-J60	256 MB, 512 MB, 1 GB, 2GB
	DSDH-xxx-903	512 MB, 1 GB, 2GB
Panasonic	RP-SDRxxxJ1A/ RP-SDKxxxJ1A	512 MB, 1 GB, 2 GB
	RP-SDxxxBL1A	256 MB
Lexar:	SDxxx-231	256 MB, 512 MB, 1 GB
PQI	QSDS-xxx	256 MB, 512 MB, 1 GB, 2 GB
Kingston	SD/xxxFE	256 MB, 512 MB, 1 GB, 2 GB
I/O DATA	SD-xxx	128 MB, 256 MB, 512 MB, 1 GB, 2 GB
	SDP-xxx	256 MB, 512 MB, 1 GB, 2 GB
HAGIWARA SYS-COM	PC-SDxxxM	256 MB
	PC-SDxxxTP	256 MB, 512 MB, 1 GB
	HPC-SDxxxM2	128 MB, 1 GB, 2GB
	HPC-SDxxxT	128 MB, 256 MB, 512 MB, 1 GB, 2 GB
BUFFALO	RSDC-Sxxx	32 MB, 64 MB, 128 MB, 256 MB, 512 MB, 1 GB, 2 GB
	RSDC-Gxxx	512 MB, 1 GB, 2 GB

xxx: Capacity of card

6.2 Saving and Loading Data

The Save & Load menu is where all phases of saving and loading are done. To display the Save & Load menu, do the following:

1. Press the **MENU** key to open the menu.
2. Rotate the Rotary Knob to choose Save & Load and push the Rotary Knob.

Saving Data

Save Points & Routes

This unit holds 2,000 points and 200 routes in its hard disk. When the capacity for points or routes is reached, a new point or route cannot be entered unless an unnecessary one is erased. For those reasons, you may wish to save points and routes to an SD card. Select Save Points & Routes from the Save and Load menu to save points and routes. Follow the on-screen instructions.

Save Tracks

The hard disk of this unit holds 12,000 points of tracks. When that total is reached, the oldest track is deleted to make room for the latest. If you require the track save it to an SD card. Select Save Tracks and follow the on-screen instructions.

Save User Setup

The user setup feature stores all user-set menu options. It may be useful to have several different sets of user setups to set up the system according to expected usage. For example, you may want to have a user setup with settings suited to fishing and one for cruising. Select Save User Setup and follow the on-screen instructions.

Loading Data

Load Points and Routes

Use the Load Points and Routes function to load points and routes saved to an SD card. Points and routes loaded from an SD card are displayed together with current points and routes. In case of identical names, the point or route data is written over with the matching data on the SD card. Select Load Points & Routes and follow the on-screen instructions.

Load Tracks

You can load past tracks on the display. This is useful when you want to created a route using past tracks. Select Load Tracks and follow the on-screen instructions.

Load User Setup

Select Load User Setup to load user settings into the HD. The current user settings are written over. Select Load User Setup and follow the on-screen instructions.

Deleting Files

Select Delete File and follow on-screen instructions to delete files.

Moving Files

Select Move File to copy MP3 files, etc.

Manage Chart Catalog

Use this feature to delete and transfer (to SD card) the charts stored on the hard disk.

Request Update File

This feature requests the application version nos. of all NavNet equipment in the NavNet network.

Load Update File

Select this item to update all NavNet applications in the NavNet network.

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Chapter 7: Customizing Your Unit

After you have become familiar with your equipment's basic operating procedures, you will need to

- set it up according to equipment connected to it, and
- tailor how it operates and displays information

All tailoring is done from the menu, which is opened and closed with the **MENU** key. Once you have set the values, they are retained in the processor, even when the system is powered off. If you decide to return to default settings, a convenient, "Set Default" button is provided on each sub menu to quickly restore all default settings for the the selected sub menu.

A few of the items which you can customize are

- ROTOkeys
- NavData boxes
- units of measurement
- general settings
- system settings, and
- chart display

7.1 ROTOkeys

The user can select how many ROTOkeys to make available with the Rotary Knob. Three pre-set amounts are available: basic, standard and full. A custom setting is also available, and it allows you to select the ROTOkeys to make available.

The ROTOkeys available with the basic, standard and full sets in the chart plotter and radar modes are shown in the tables on the next several pages.

Chart plotter ROTOkey description and ROTOkey availability

Basic	Standard	Full	Title	Level 1	Function
Yes	Yes	Yes	**North-Up**	North-up/Course-up/Head-up	Presentation mode selection
Yes	Yes	Yes	Course Up		
Yes	Yes	Yes	Head Up		
No	No	Yes	**Auto Shift**	Autoshift on/off	
No	Yes	Yes	**3D**	3D	3D/2D display selection
No	Yes	Yes	2D		2D view
No	Yes	Yes	3D Mariner		Mariner 3D view
No	No	Yes	3D Custom		last user "oriented" view
No	No	Yes	Orientation		3D display orientation tool
Yes	Yes	Yes	Track	Show/hide track	
No	Yes	Yes	**Radar**	Radar Overlay on/off	
No	Yes	Yes	**Rings**	Show/hide range rings	
No	No	Yes	**Targets**	ARPA/AIS	
No	No	Yes	ARPA		Show/hide ARPA display.
No	No	Yes	AIS		Show/hide AIS display.
No	No	Yes	Track		Show/hide track history display.
No	No	Yes	Acquire		Acquire target for ARPA.
No	No	Yes	Cancel		Cancel tracking on selected ARPA target.
No	No	Yes	Cancel All		Cancel tracking on all ARPA targets.
No	No	Yes	Clear Lost		Clear lost ARPA target.
No	Yes	Yes	**Points**	Point processing	
No	Yes	Yes	List		Show Points list.
No	Yes	Yes	Create		Enter a point.
No	No	Yes	Points		Show/hide points.
No	Yes	Yes	**Routes**	Route processing	
No	Yes	Yes	New		Create new route.
No	Yes	Yes	List		Show Routes list.
No	Yes	Yes	XTE Init		Restart XTE.
No	Yes	Yes	Stop		Stop following a route.
No	Yes	Yes	Reverse		Reverse route following direction.
No	No	Yes	Routes		Show/hide routes.
Yes	Yes	Yes	**Chart**	Chart selection	
Yes	Yes	Yes	Raster		Raster chart
Yes	Yes	Yes	Vector		Vector chart
Yes	Yes	Yes	Photo		Show/hide satellite photo.
Yes	Yes	Yes	**Display**	Show/hide display	
No	Yes	Yes	Shading		Show/hide depth contours.
No	Yes	Yes	Tide		Show/hide tide display.
No	Yes	Yes	Current		Show/hide tidal currents.
No	No	Yes	Weather		Show/hide weather display.
No	No	Yes	**Animate**	Animate	Animate weather/tidal current.
Yes	Yes	Yes	**Tide**	Tide	Show/hide tide display.
No	No	Yes	**Entertain**	Entertain	Enable/disable entertainment.
No	Yes	Yes	**Ruler**	Ruler tool	Measure range/bearing to a location.

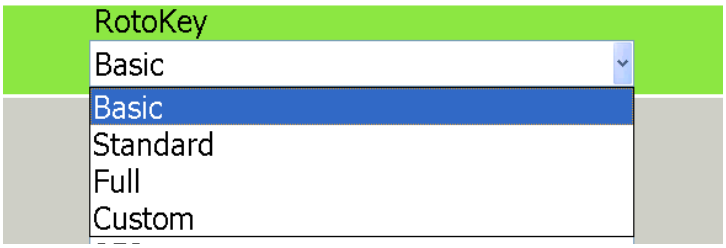
Radar ROTOkey description and ROTOkey availability

Basic	Standard	Full	Title	Level1
No	Yes	Yes	**North-Up**	North-up/Course-up/Head-up
No	Yes	Yes	North Up	
No	Yes	Yes	Course Up	
No	Yes	Yes	Head Up	
No	No	Yes	**True motion**	True motion on/off
No	No	Yes	**Auto Shift**	Autoshift on/off
Yes	Yes	Yes	**Tx**	Tx on/off
No	No	Yes	**Process.**	Radar image processing
No	No	Yes	Int.Rej.	Interference rejector on/off
No	No	Yes	Stretch	Echo stretch on/off
No	No	Yes	Average	Echo average on/off
Yes	Yes	Yes	**Rings**	Range rings on/off
No	Yes	Yes	**Heading**	Heading line on/off
No	No	Yes	**Trail**	Echo trail on/off
No	No	Yes	**Clear Trail**	Clear echo trails.
No	Yes	Yes	**EBL**	EBL processing
No	Yes	Yes	EBL1	Activate EBL1.
No	No	Yes	EBL2	Activate EBL2.
No	Yes	Yes	Clear1	Deactivate EBL1.
No	No	Yes	Clear2	Deactivate EBL2.
No	Yes	Yes	**VRM**	VRM processing
No	Yes	Yes	VRM1	Activate VRM1.
No	No	Yes	VRM2	Activate VRM2.
No	Yes	Yes	Clear1	Deactivate VRM1.
No	No	Yes	Clear2	Deactivate VRM2.
No	No	Yes	**Guard**	Guard Zone processing
No	No	Yes	Zone1	Enable guard zone 1.
No	No	Yes	Zone2	Enable guard zone 2.
No	No	Yes	Clear1	Disable guard zone 1.
No	No	Yes	Clear2	Disable guard zone 2.
No	No	Yes	**Watchman**	Enable, disable watchman.
No	No	Yes	**Targets**	ARPA/AIS target processing
No	No	Yes	ARPA	Show/hide ARPA display.
No	No	Yes	AIS	Show/hide AIS display.
No	No	Yes	Track	Show/hide track history display.
No	No	Yes	Acquire	Acquire target for ARPA.
No	No	Yes	Cancel	Cancel tracking on selected ARPA target.
No	No	Yes	Cancel All	Cancel tracking on all ARPA targets.
No	No	Yes	Clear Lost	Clear lost ARPA target.
No	No	Yes	**Routes**	Show/hide routes.
Yes	Yes	Yes	**Tide**	Show/hide tide display.
No	No	Yes	**Entertain**	Enable, disable entertainment.

Selecting the ROTOkey Set to Use

Select the ROTOkey set to use as follows:

1. Press the **MENU** key to open the menu.
2. Open the Settings sub menu in the My NavNet menu.
3. Select Rotary Knob and push the Rotary Knob to display the Rotary Knob options window.

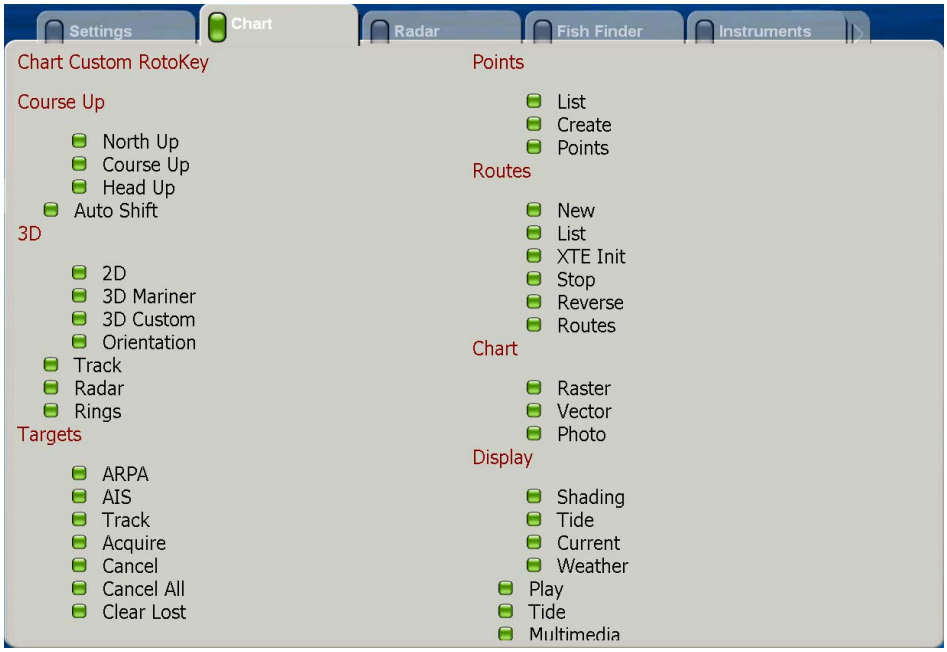


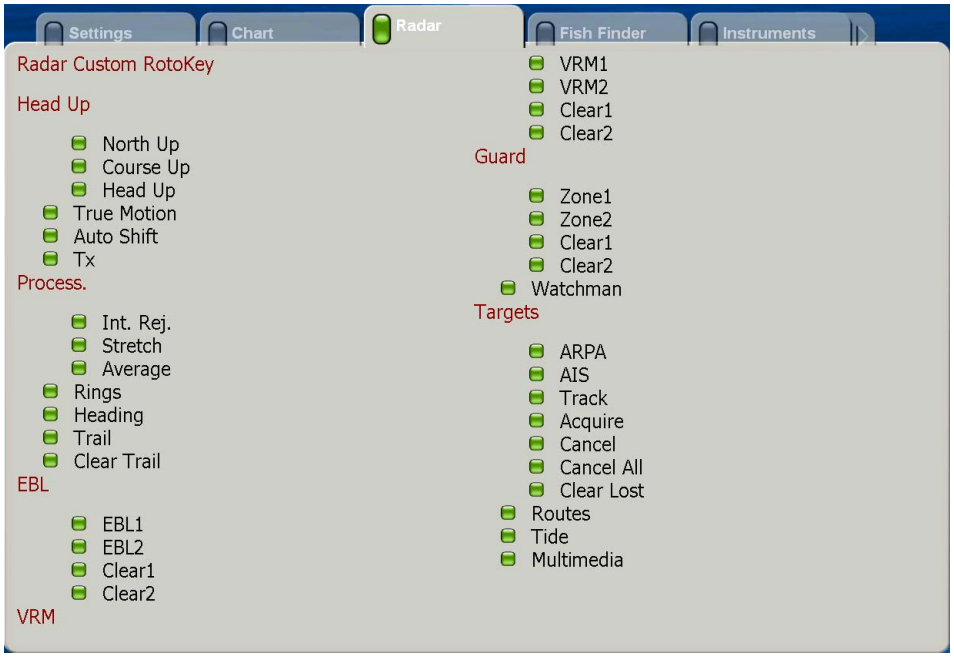
4. Select Basic, Standard, Full or Custom as applicable and push the Rotary Knob. (For Custom, see the next section for how to customize the ROTOkeys.)
5. Press the **MENU** key to close the menu.

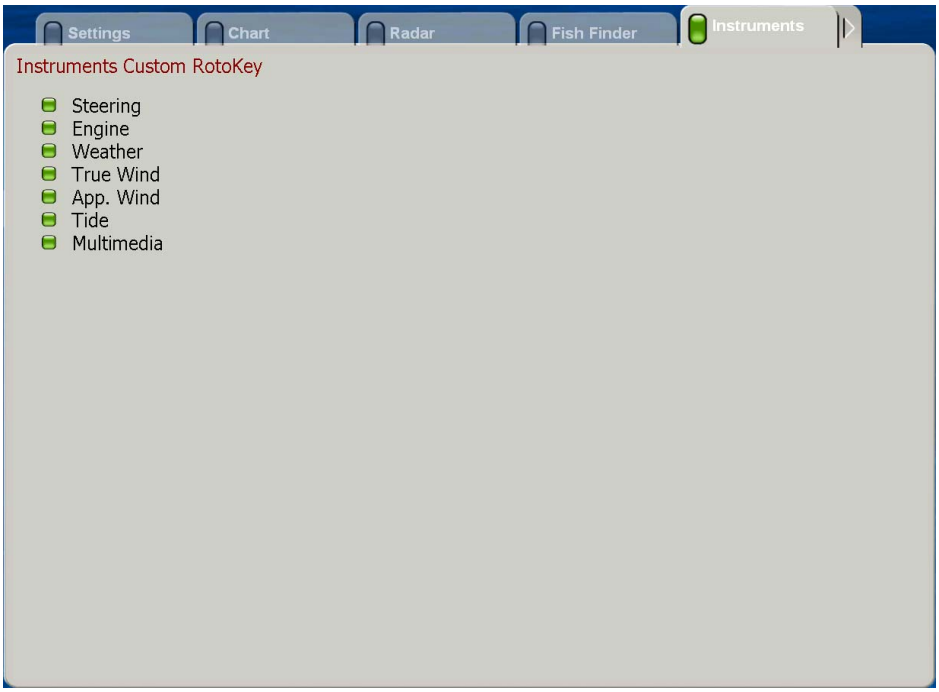
Customizing the ROTOkeys

If the basic, standard or full set of ROTOkeys is not to your liking, you can specify what ROTOkeys to use, on the My NavNet menu.

1. Press the **MENU** key to open the menu.
2. Open the Settings sub menu of the My NavNet menu.
3. Open the Chart, Radar, Instruments or Video sub menu, whichever you want to set. (Note that Fish Finder is currently under development.)







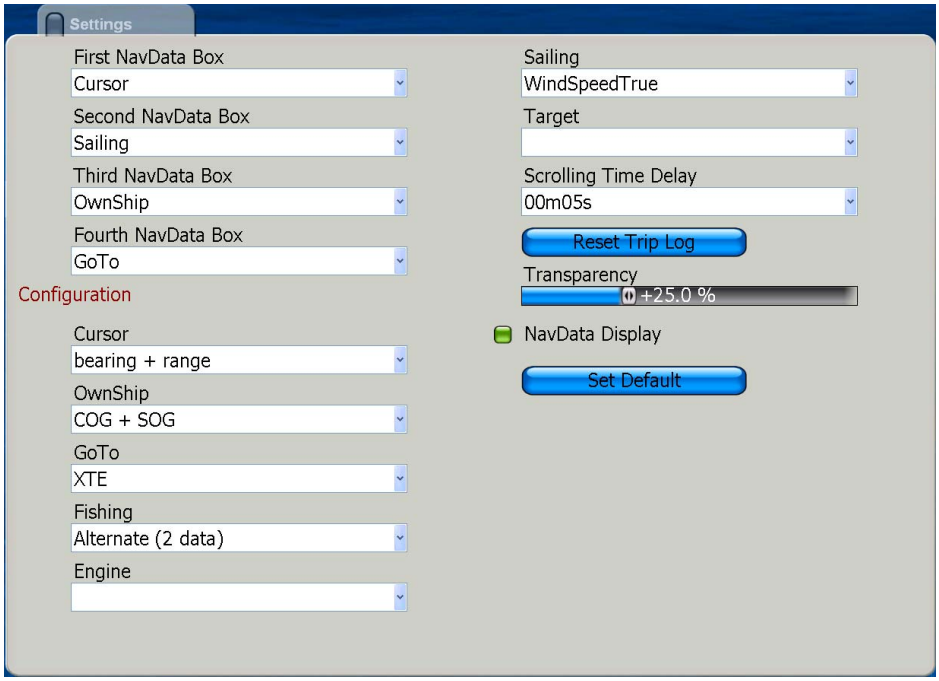
4. Rotate the Rotary Knob to choose item.
5. Push the Rotary Knob to alternately turn item on or off. Show the item's status box in green to turn it on, or gray to turn it off.
6. Press the **MENU** key to close the menu.

To enable the custom ROTOkeys, set Rotary Knob in the Settings sub menu of the My NavNet to Custom.

7.2 NavData Boxes

Earlier you learned how to select what data to show in the data boxes directly on-screen. This section shows you how to further customize the boxes, from the NavData menu.

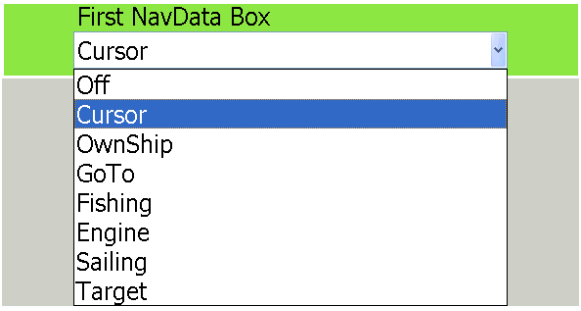
1. Press the **MENU** key to open the menu.
2. Open the NavData menu.



Selecting NavData category to use for each NavData box

Select the navdata category to assign to each NavData box. The choices are cursor, own ship, GoTo, Fishing, Engine, Sailing and Target

3. Use the Rotary Knob to choose FIrst NavData Box and push the Rotary Knob.

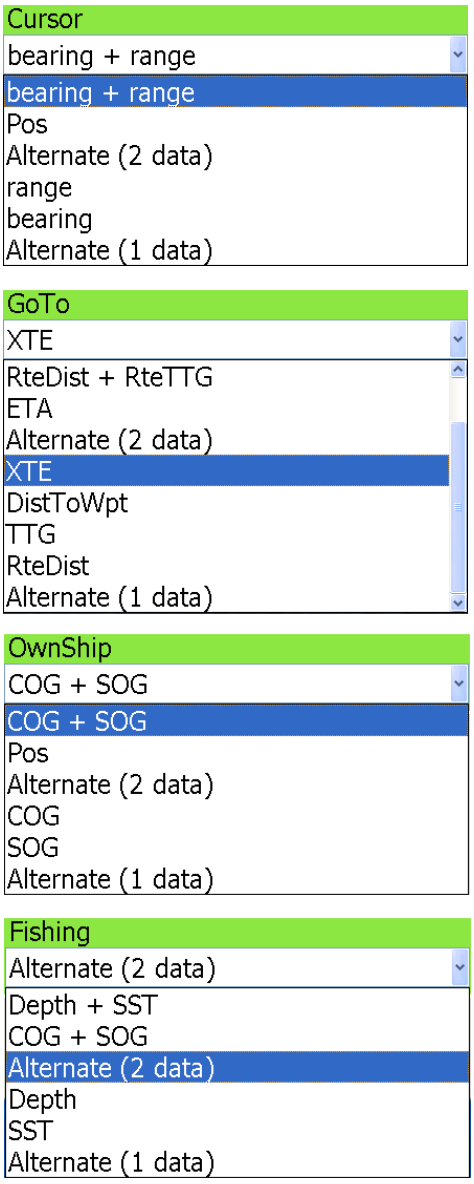


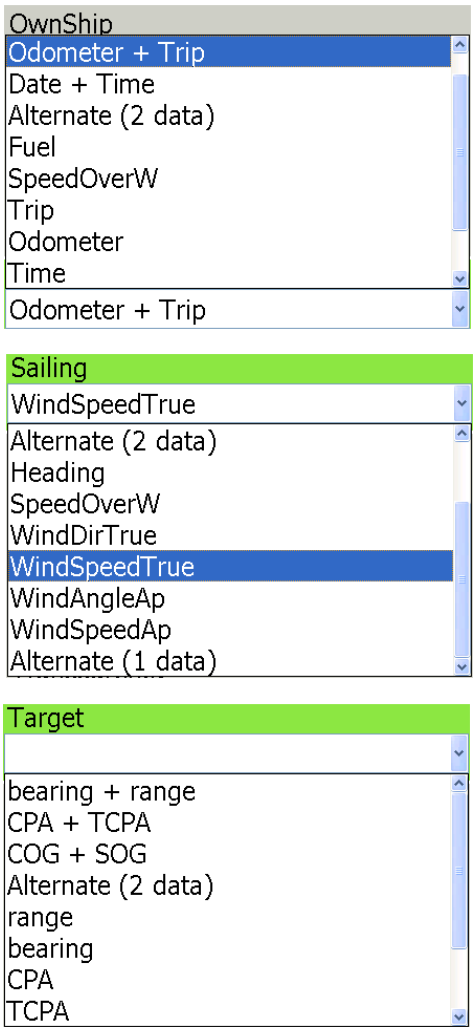
4. Select the category of NavData to use and push the Rotary Knob.
5. Set the 2nd, 3rd and 4th NavData boxes similarly.

Selecting NavData for each NavData category

Select the data to go with each NavData category.

6. In the Configuration section, select Cursor, Own Ship, GoTo, Fishing, Engine, Sailing and Target one by one and choose data to assign to each category.





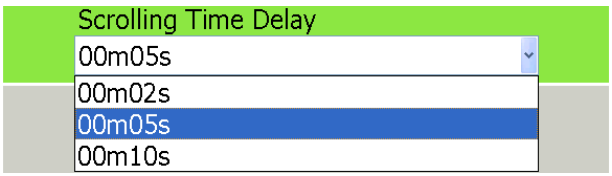
Abbrevations key

Pos: Position
COG: Course Over Ground
CPA: Closest Point of Approach
SOG: Speed Over Ground
SST: Sea Surface Temperature
TCPA: Time to Closest Point of Approach
TTG: Time To Go (to a point)

Selecting scrolling time delay

Select the amount of time to display each NavData in case of alternating data displays.

7. Select Scrolling Time Delay and push the Rotary Knob.

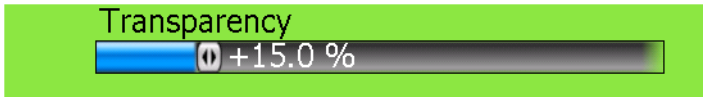


8. Select the amount of time to display each display in alternating displays and push the Rotary Knob.

Selecting percentage of transparency

You can select how transparent to make the data boxes. The higher the percentage the greater the transparency.

9. Select Transparency and push the Rotary Knob.



10. Rotate the Rotary Knob to set the percentage desired and push the Rotary Knob.

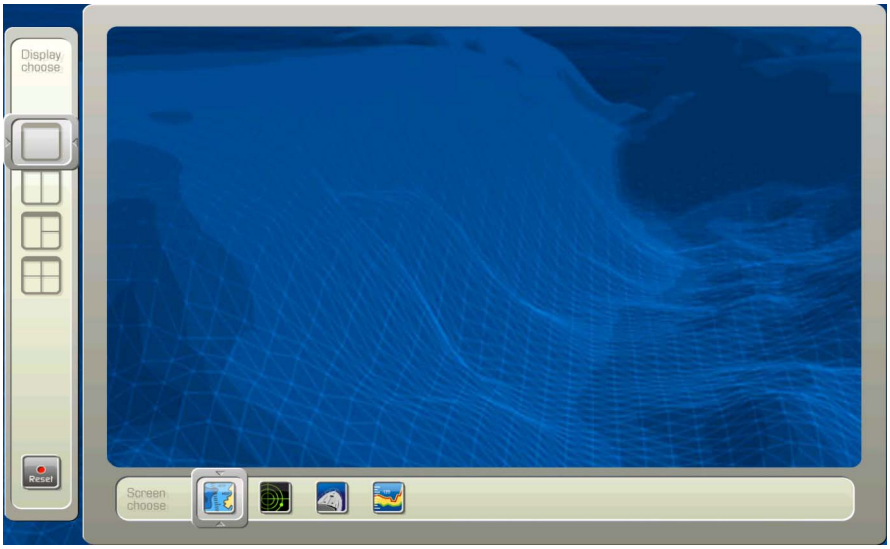
Globally turning data boxes on/off

Data boxes can be globally turned on and off from the NavData menu, as well as with the **DATA/VOL** key. Select NavData Display and push the Rotary Knob to turn the NavData boxes on and off alternately.

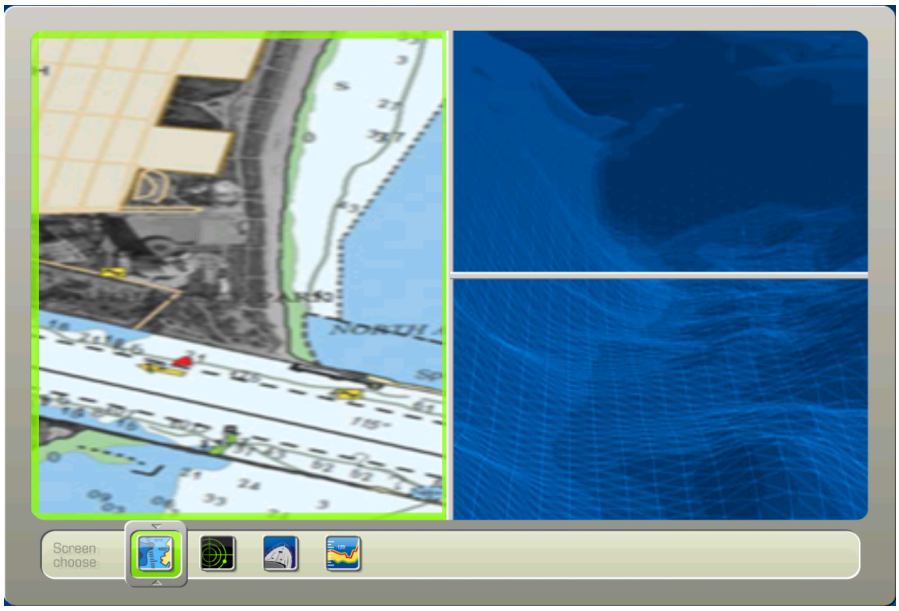
7.3 Changing Display Arrangements

The default display selection provides 10 display arrangements in various single and combination displays. If the default arrangement is not to your liking you can change it as follows:

1. Press the **DISP** key to show the display selection screen.
2. Use the Rotary Knob to select the display you want to rearrange and then long-push the Rotary Knob.



3. Rotate the Rotary Knob to select the display split you want to use with the display split selector at the left side of the screen and push the Rotary Knob. For example, choose the three-split screen. Your screen should now look something like the one below.



4. A green rectangle is circumscribing the active selection. By default the chart plotter screen is selected. If you prefer a different display, rotate the Rotary Knob to choose desired display from the choices at the bottom of the screen and push the Rotary Knob.

5. The green rectangle jumps to the top right 1/4 of the screen. Rotate the Rotary Knob to select a display and then push the Rotary Knob.

   Note: To switch the active screen, use the **CANCEL** key.

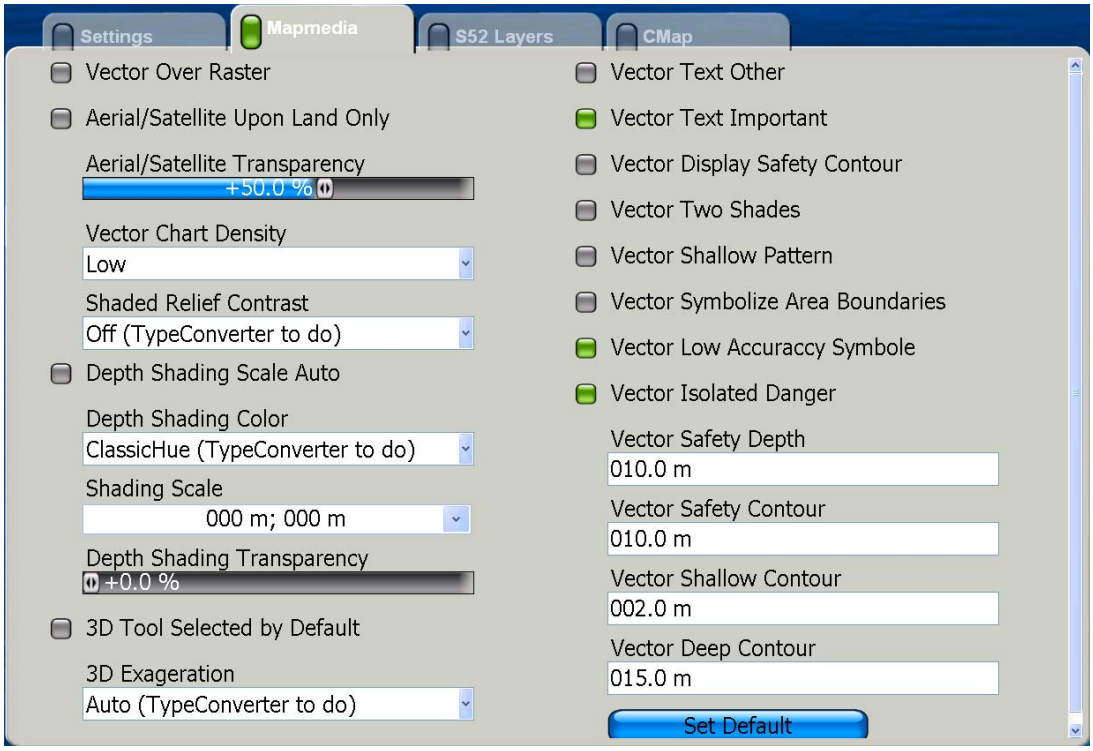
6. The green rectangle jumps to the bottom right 1/4 screen. Rotate the Rotary Knob to choose a display and then push the Rotary Knob.

The newly arranged display appears on the screen.

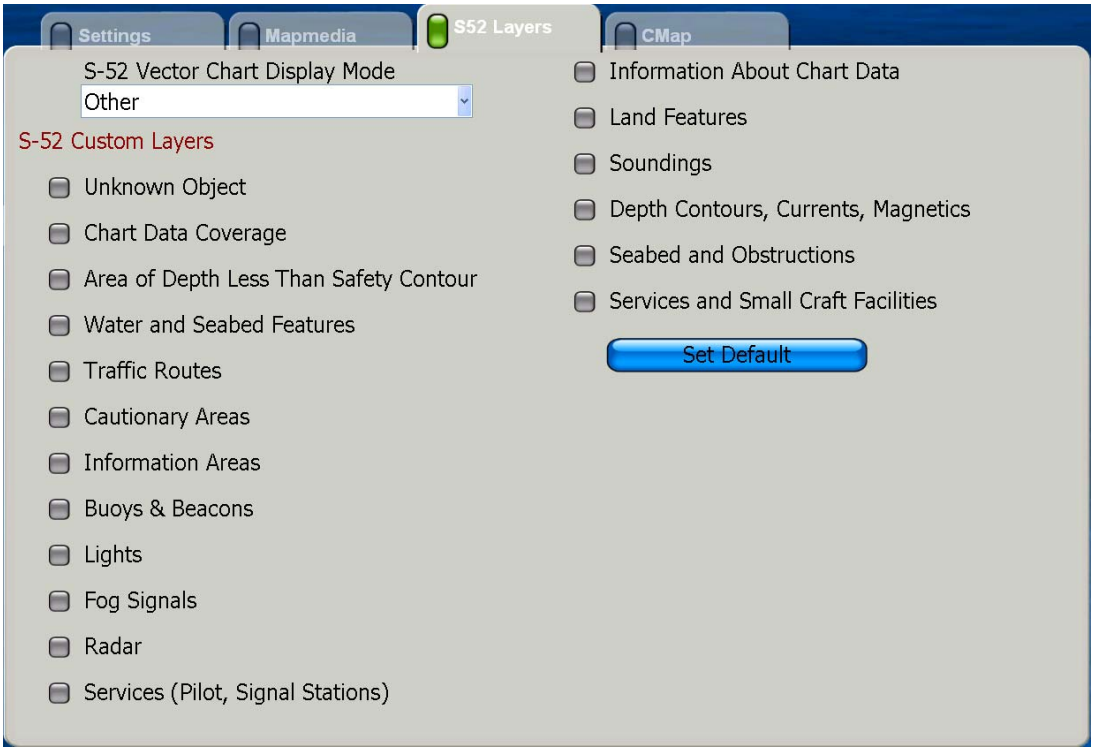
7.4 Chart Setup

Mapmedia, S52 and C-Map charts can be set up from the Chart menu. Choose applicable sub menu and turn features on or off as appropriate.

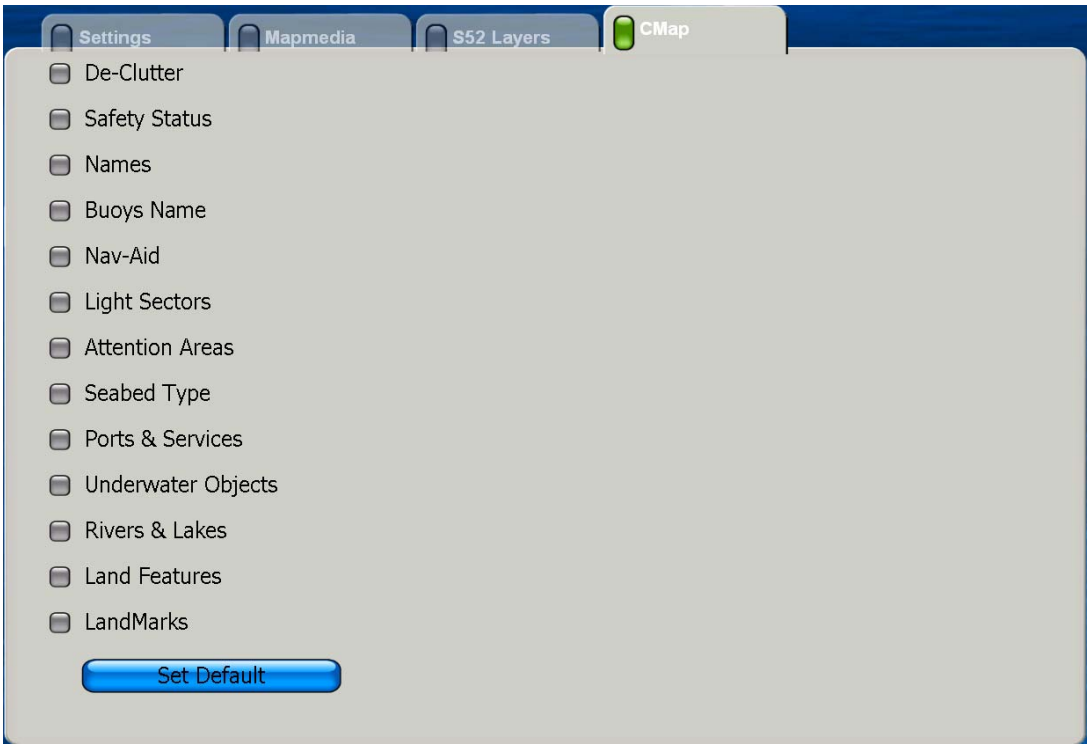
Mapmedia Sub Menu



S52 Sub Menu



C-Map Sub Menu

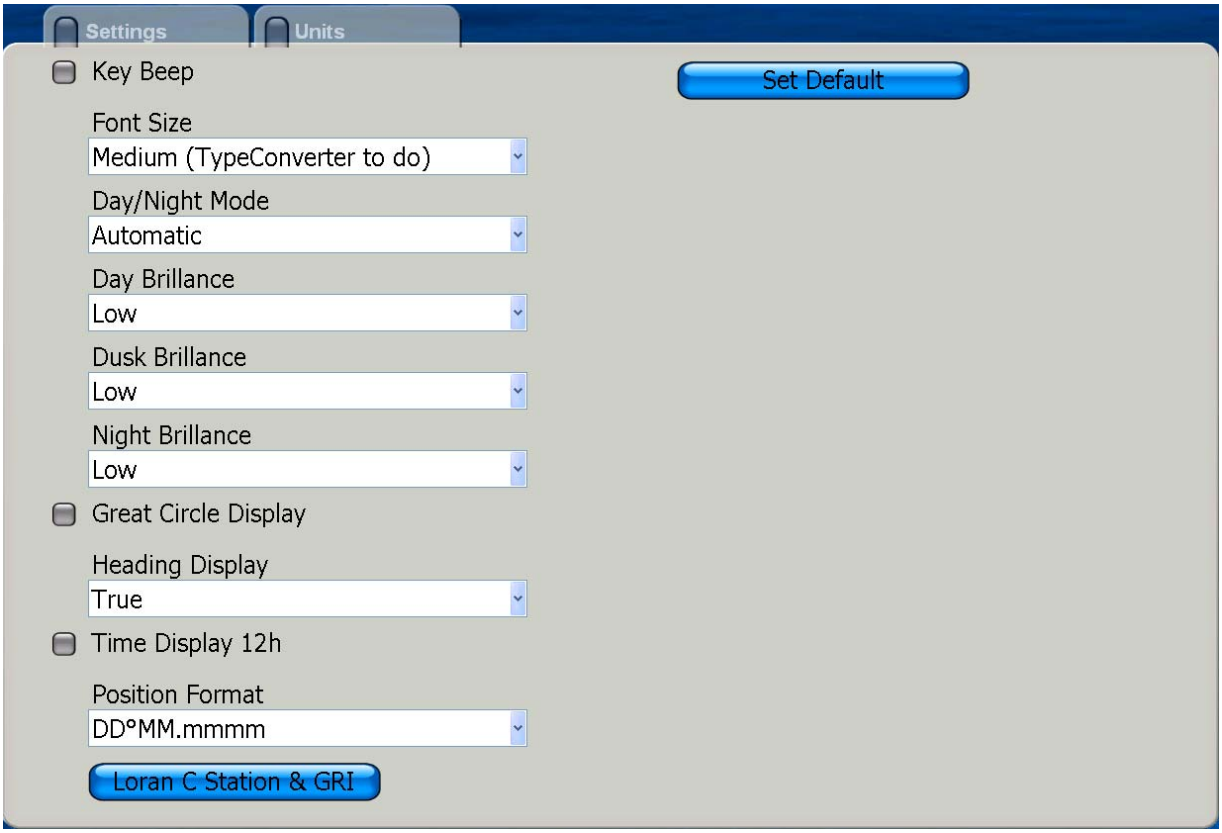


7.5 General Menu

The General menu has two sub menus for general set up of the equipment. The Settings sub menu contains such items as key beep on/off, brilliance presets, time display format, position format, etc. The Units sub menu is for selecting units of measurement for range, depth, height, speed, etc.

Settings Sub Menu

Open the General menu and select the Settings sub menu. Set each item as desired, referring to the description on the next page.



General menu, settings sub menu parameters

Menu item	Options	Default setting
Key Beep	ON, OFF	Off
Font Size	Small, Medium, Large	Medium
Day/Night Mode	Automatic, Day, Dusk, Night, Low	Automatic
Day Brilliance	Low, Medium, High	Low
Dusk Brilliance	Low, Medium, High	Low
Night Brilliance	Low, Medium, High	Low
Great Circle Display	ON, OFF	OFF
Heading Display	True, Magnetic	True
Time Display 12h	ON, OFF	OFF
Position Format	DD°MM.mmmm DDD.dddddd Loran-C MGRS	DD°MM.mmmm
Loran C Station & GRI		

Key Beep: Select to sound or not sound a beep when a key is pressed.

Font Size: Select font size for all indications, menus, etc.

Day/Night Mode: Sets the brilliance of Display Unit MCU-002 for optimum viewing in day, night and dusk times. **Automatic** offers complete automatic control of brilliance. at any time of day. **Day, Dusk, Night** provide control of brilliance at respective times.

Day Brilliance, Dusk Brilliance, Night Brilliance: Set the level of brilliance to use at day, dusk and night. Effective when respective time is chosen at Day/Night Mode.

Great Circle Display: The are two methods for measuring course distances: great circle and rhumb line. Great circle is the shortest line joining two points on the earth's surface. Rhumb line is a straight line compass course between two points. The great circle path is short but requires you to constantly change heading.

Heading Display: The mode (magnetic or true) of all heading and bearing data.

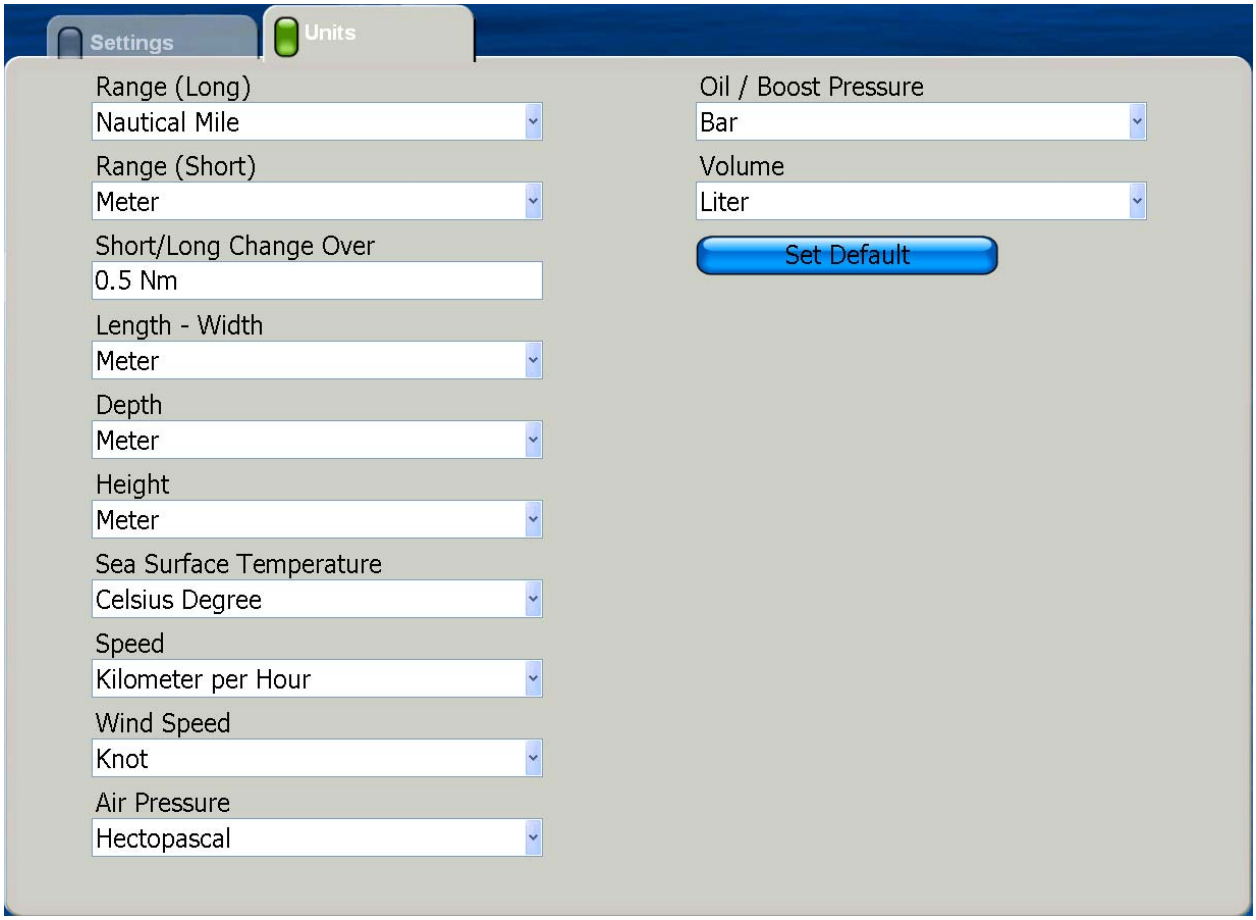
Time Display: Turn on this item to display time in 12 hour format; turn it off to use 24 hour format.

Position Format: Choose two show position in one of two latitude and longitude formats, Loran C time differences or MGRS (Military Grid Reference System).

Loran C Station and GRI: Choose the Loran C stations and GRIs from which to obtain Loran C position.

Units Sub Menu

The Units sub menu lets you choose the desired units of measurement for range, length, depth, height, sea surface temperature, speed, wind speed, air pressure, oil / boost pressure, and volume



Units sub menu parameters

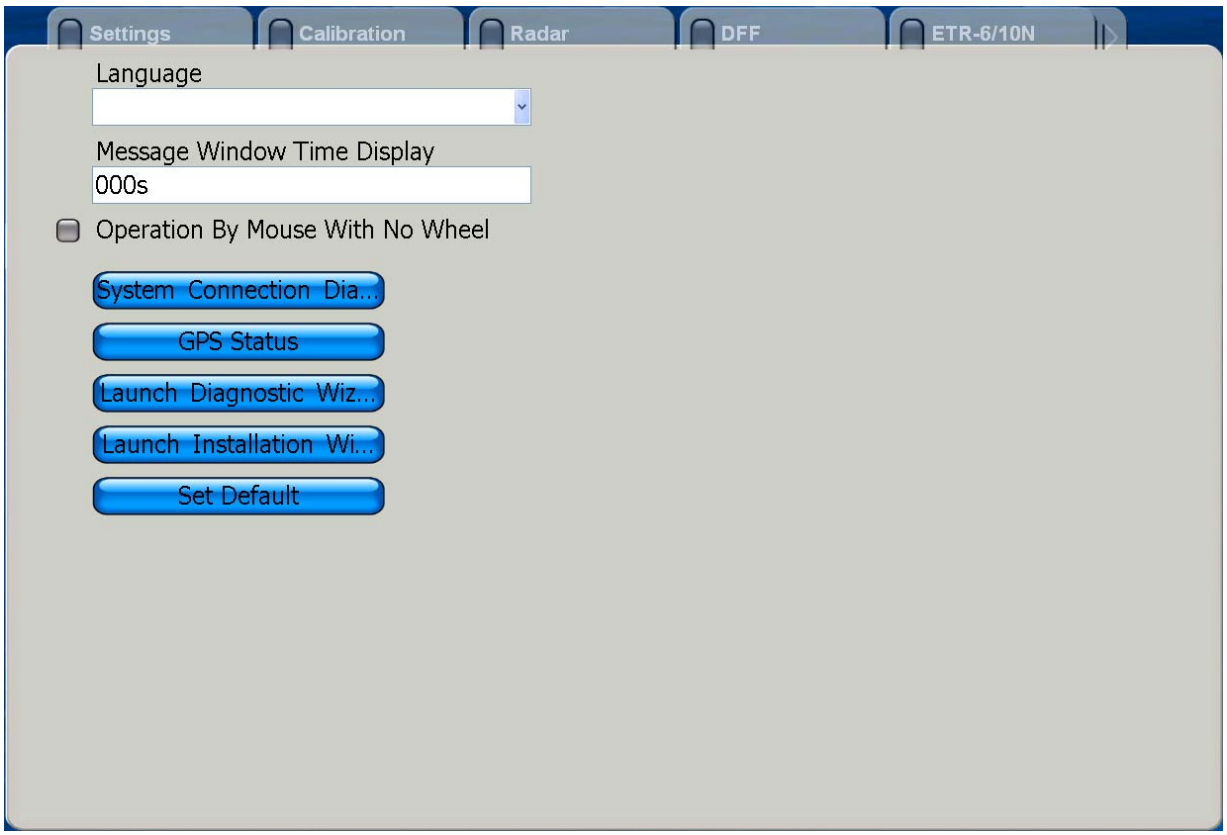
Menu item	Options	Default setting
Range (long)	nautical mile, kilometer, mile	nautical mile
Range (short)	foot, meter, yard	yard
Short/Long Change OVer		feet
Length - Width	foot, meter	feet
Depth	foot meter, fathom, passi braza	meter
Height	foot, meter	feet
Sea Surface Temperature	Celsius degree, Fahrenheit degree	Celsius degree
Speed	knot, kilometer per hour, mile per hour, meter per second	knot
Wind Speed	knot, kilometer per hour, mile per hour, meter per second	knot
Air Pressure	hectopascal, millibar, milli-meter of mercury, inch of mercury	hectopascal
Oil / Boost Pressure	kilopascal, bar, pound per square inch	kilopascal
Volume	U.S. gallon, liter	gallon

7.6 System Menu

The System menu has several sub menus for general system settings, sensor calibration, radar, fish finder (under development).

Settings Sub Menu

The Settings sub menu of the System menu provides for selection of language, message window display time and mouse type.



Language: See section 1.2 for details.

Message Window Time Display: Set the number of seconds to leave a message window open before it is automatically closed.

Operation By Mouse WIth No Wheel: Turns this item on if you are using a mouse that does not have a scrollwheel.

System Connection Diagram: Display the system connection diagram.

GPS Status: Display the GPS Status screen. See chapter 8 for details.

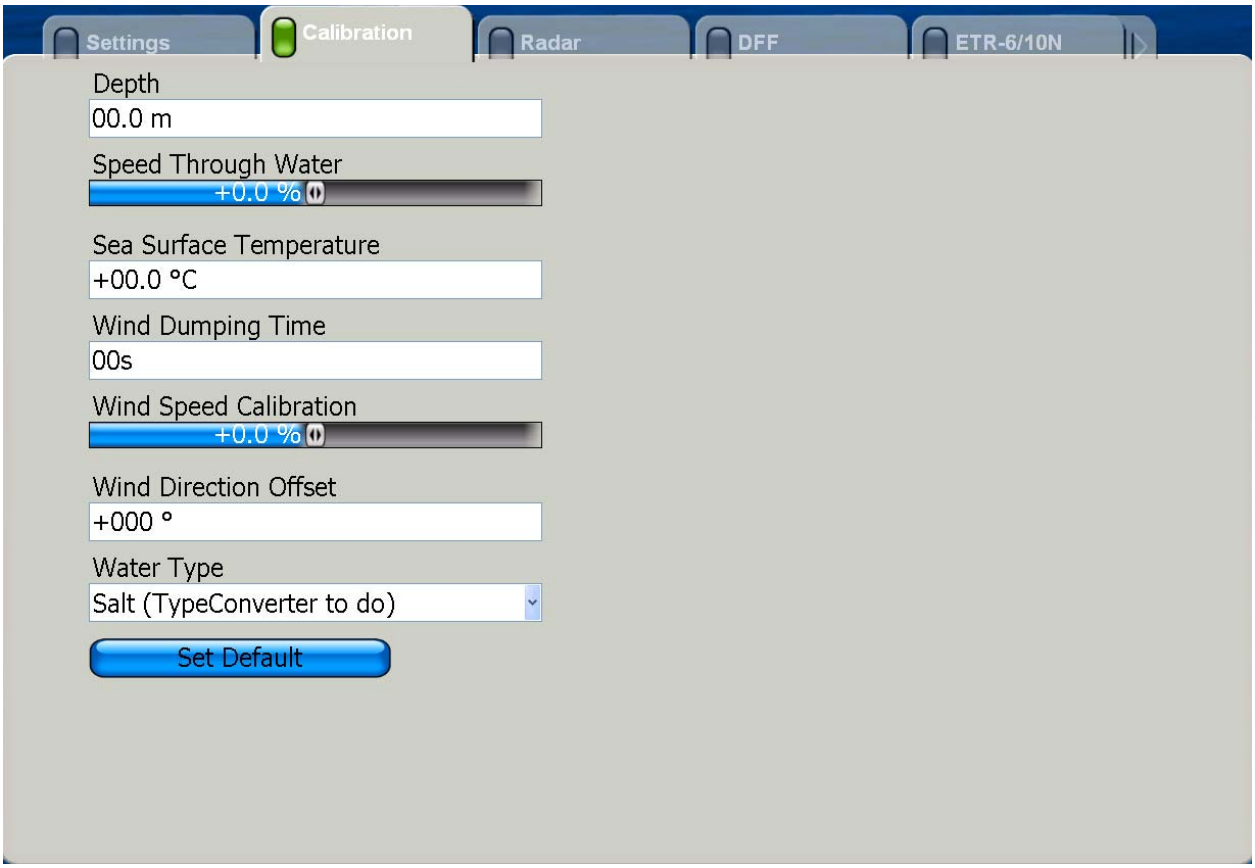
Launch Diagnostic Wizard: Do system diagnostics. See chapter 8 for details.

Launch Installation Wizard: Launch the installation wizard to install the system.

Set Default: Restore all default settings for this sub menu.

Calibration Sub Menu

The Calibration menu mainly lets you enter offsets for external sensors (speed, wind, temperature) to show true values on the display.



Depth: Add an offset to measured depth to get actual depth. The setting range is 0-99.9 (m).

Speed Through Water: Add an offset to measured speed to display actual speed. The range is -50 to +50 (%).

Sea Surface Temperature: Add an offset to measured sea surface temperature to display actual speed. The setting range is -99.9 to +99.9 (°C).

Wind Damping Time: Set wind damping time. The setting range is 0-99 (seconds).

Wind Speed Calibration: Apply an offset to measured speed to display actual wind speed. The range of offset is -50 to +50.]

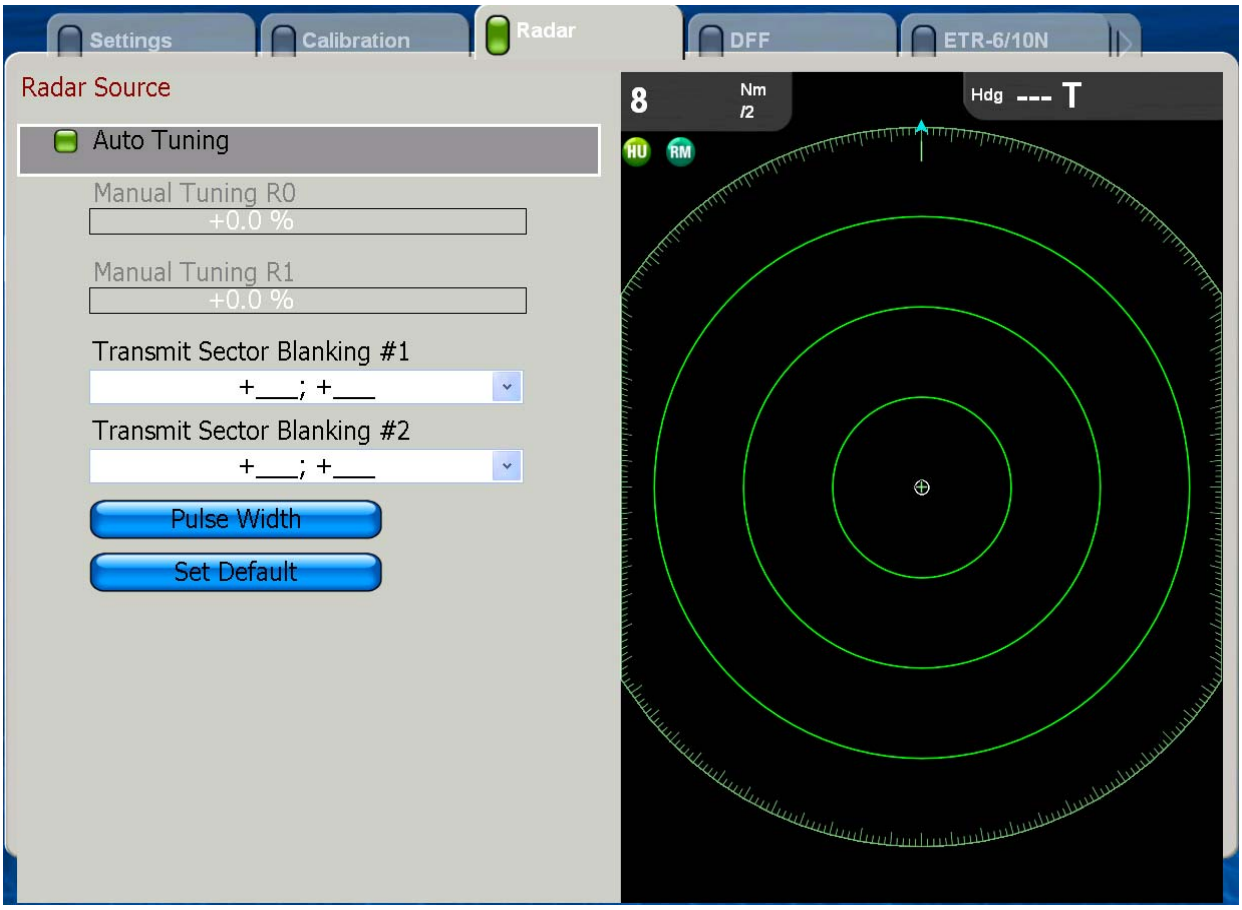
Wind Direction Offset: Add a wind direction offset to measured wind direction to correct displayed wind direction.

Water Type: Choose the type of water the vessel is used in, saltwater or freshwater.

Set Default: Restore all default settings for this sub menu.

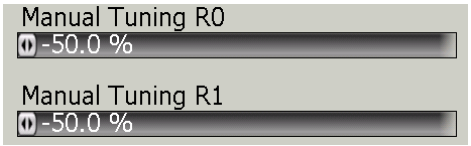
Radar Sub Menu

The radar sub menu has facilities for manual tuning, blind sector (area of no transmission) creation and pulse length selection.



Manual Tuning: If you require manual tuning, do the following:

1. Use the **RANGE** key to select the 48-mile range.
2. Press the **MENU** key to open the menu.
3. Open the System menu.
4. Open the Radar sub menu.
5. Choose Auto Tuning and push the Rotary Knob to color Auto Tuning's status box gray to disable automatic tuning. Then, the two manual tuning items are made active.



6. Choose Manual Tuning R0 (range in dual range mode) or Manual Tuning R1 (range in dual range mode) as applicable and push the Rotary Knob.
7. Rotate the Rotary Knob to adjust the tuning. The range is -50 to +50(%).
8. Push the Rotary Knob to confirm the setting.
9. Press the MENU key to close the menu.

Transmit Sector Blanking: It may be necessary to prevent the radar from transmitting within a certain sector. For example, you would want to blind sector (area where no echoes appear). To enter a blank sector, enter start bearing relative to the heading and dead sector angle. This is usually done by the installer of the equipment. Two sectors may be set. One sector should be less than 180 degrees in width and the total width of two sectors should not exceed 270 degrees

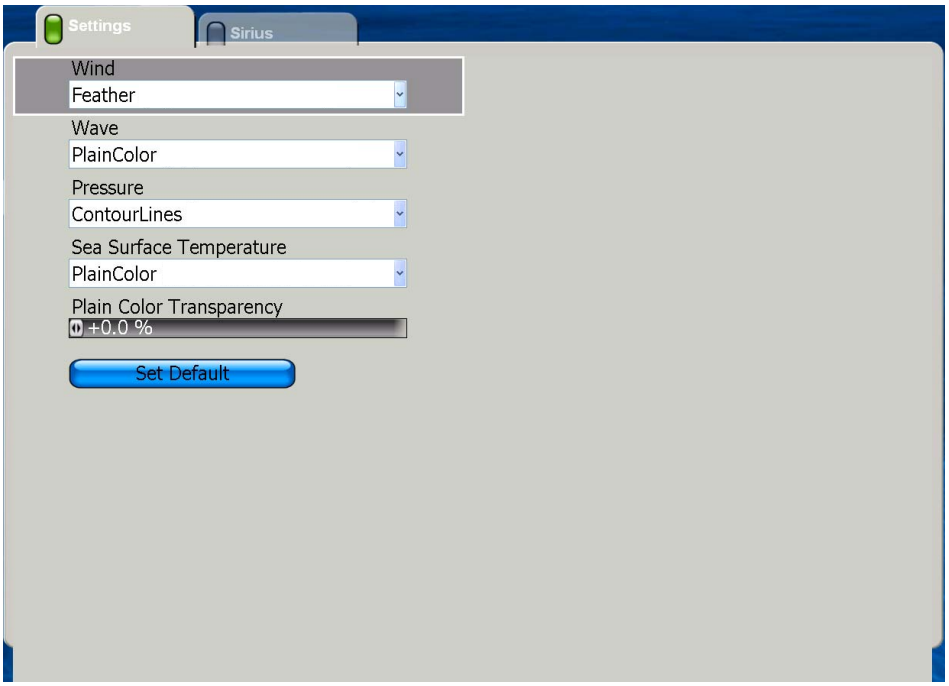
Pulse Width: Select pulse width.

Set Default: Restore all default settings for this sub menu.

7.7 Weather Display Setup

This section shows you how to set up the weather information display, which is available only in the United States of America. Open the Weather menu and then open appropriate sub menu.

Settings Sub Menu



Wind: Display wind direction and magnitude in Plain Color or Feather. "Feather" shows more detailed speed of winds.

Wave: Display wave height in Plain Color or Arrows. Plain Colors shows wave icons in reds, greens and blues, in order of descending height. Arrows show height with the arrow icon.

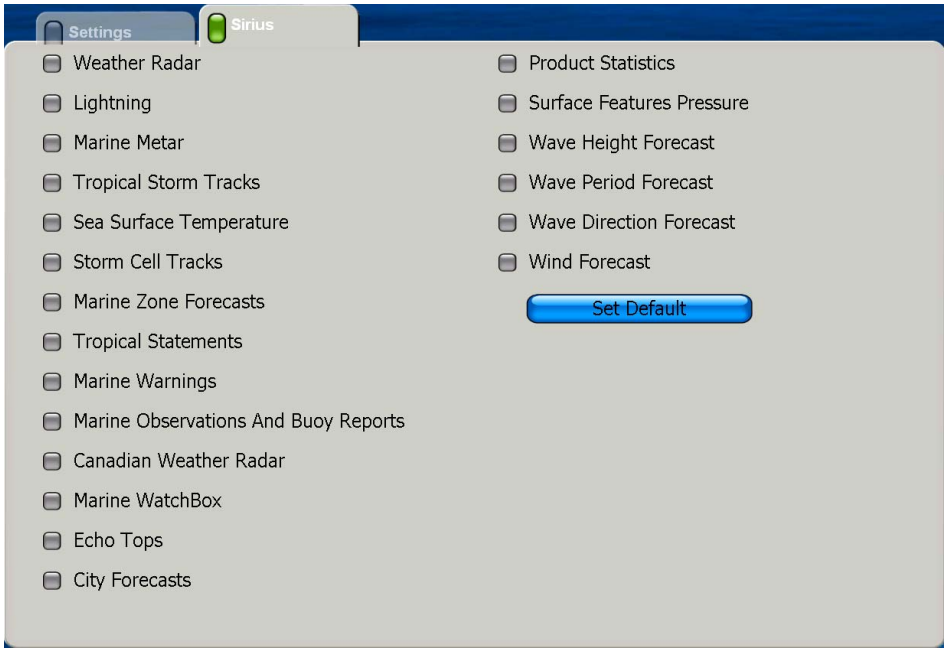
Pressure: Show atmospheric pressure in Plain Color or Contour Line.

Sea Surface: Show sea surface temperature in Plain Color or Contour Line.

Plain Color Transparency: Select the level of transparency for items set for Plain Color.

Sirius Sub Menu

The Sirius sub menu contains Sirius weather related items that can be turned on or off.



Weather Radar: Type and level of precipitation from NOWRAD (North American Weather Radar).

Color	Precipitation type	Level
Light green	Rain	15-19 dBZ
Medium green	Rain	20-29 dBZ
Dark green	Rain	30-39 dBZ
Yellow	Rain	40-44 dBZ
Orange	Rain	45-49 dBZ
Light red	Rain	50-54 dBZ
Dark red	Rain	over 55 dBZ
Light blue	Snow	5-19 dBZ
Dark blue	Snow	over 20 dBZ
Light pink	Mixed	5-19 dBZ
Dark pink	Mixed	over 20 dBZ

Lightning: Lighting icons show when lighting occurred, by shades of yellow. Dark yellow, last 0-5 min., medium yellow, last 5-10 min., weak yellow, last 10-15 min.

Icon	Color
	Dark yellow (recorded in last 0-5 min.), Medium yellow (recorded in last 5-10 min.), Light yellow (recorded in last 10-15 min.)

Marine Metar: Marine Meteorological Aviation Report.

Storm Cell Tracks: Monitor remarkable storms, depressions, tropical disturbances, hurricanes, cyclones and typhoons in your area.

Icon	Meaning
	Hurricane (Category 1-5)
	Tropical storm
	Tropical disturbance, Tropical depression

Sea Surface Temperature: Sea surface temperature in shading contrasts of green, yellow, orange and red, in order of ascending temperature.

Storm Cell Tracks: Graphical depictions of the storm attributes produced by analysis of the radar data.

Marine Zone Forecasts: Coastal waters forecasts are subdivided by zone, each identified by text description and a code. You can show these on the screen with lines.

Tropical Statements: Tropical storm warnings.

Marine Warnings: Marine warnings.

Marine Observations and Buoy Reports: Turn these types of reports on or off.

Canadian Weather Radar: Enable or disable Canadian weather radar service.

Color	Level (mm per hour)
Transparent (low precipitation)	0.00 to 0.20 mm/hr
Light green	0.21 to 1.00 mm/hr
Medium green	1.01 to 4.00 mm/hr
Dark green	4.01 to 12.00 mm/hr
Yellow	12.01 to 24.00 mm/hr
Orange	24.01 to 50.00 mm/hr
Light red	50.01 to 100 mm/hr
Dark red	over 100.01 mm/hr

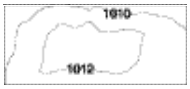
Marine WatchBox: Alert you when severe weather advisories are issued for you area.

Echo Tops: An echo top is the radar indicated top of an area of precipitation. Echo tops can be used to assess the intensity of a storm. The rule of thumb is that the higher the echo tops are in a storm then the stronger the updraft is that produced that storm.

City Forecasts: City weather forecasts.

Product Statistics: No use

Surface Features Pressure: Show surface pressure with meteorological symbols.

Icon	Color	Meaning
	Blue	High pressure
	Red	Low pressure
	Red	Warm front
	Blue	Cold front
	Purple	Occluded front
	Red-Blue	Stationary front
	Brown	Trough
	Red	Squall line
	Brown	Dry line
	Grey	Isobars

Wave Height Forecast: Wave height shown in reds, greens and blues, in order of descending height.

Wave Period Forecast: The time between successive waves.

Wave Direction Forecast: Wave direction over time.

WInd Forecast: Wind speed and direction over time.

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Chapter 8:Maintenance, Troubleshooting

This chapter provides information on maintenance and possible causes of problems that you may experience.

⚠ WARNING

ELECTRICAL SHOCK HAZARD
Do not open the equipment.

Only qualified personnel should work inside the equipment.

8.1 Maintenance

Regular maintenance is necessary to maintain performance. Check the items listed in the table below monthly to keep your unit in good working order.

Routine maintenance

Check item	Check point	Remedy
Cabling	Check that all cabling is securely fastened and is free or rust and corrosion.	Reconnect if necessary. Replace if damaged.
Cabinet	Dust on cabinets	Remove dust with a dry clean cloth. Do not use commercial cleaners for cleaning - they can remove paint and markings and deform the equipment.
LCD (For DCU12)	The LCD will, in time, accumulate a coating of dust which tends to dim the picture.	Carefully wipe the LCD to prevent scratching, using tissue paper and an LCD cleaner. To remove dirt or salt deposits, use an LCD cleaner, wiping slowly with tissue paper so as to dissolve the dirt or salt. Change paper frequently so the salt or dirt will not scratch the LCD. Do not use commercial cleaners for cleaning - they can remove paint and markings and deform the equipment.
Radar antenna	Foreign material on the radar antenna can reduce sensitivity.	Foreign material on the radar antenna can reduce sensitivity. Clean the antenna with a freshwater-moistened cloth. Do not use commercial cleaners to clean the antenna - they can remove paint and markings and deform the equipment.

8.2 Replacing Fuses

The processor unit has two fuses (10A, 24V, 20A, 12V) which protect the system from overcurrent and equipment fault. If the power cannot be turned on a fuse may have blown. Find out the reason for the blown fuse before replacing it. If the fuse blows again after replacement, contact your dealer for advice.

⚠ WARNING

Use the proper fuse.

Use of a wrong fuse can result in damage to the equipment and cause fire.

8.3 Replacing Battery

The lithium battery on the Mother board in the processor unit backs up data when the power is turned off. The life of the battery is about three years. When its voltage is low the battery icon appears at the top of the display. When the icon appears, contact your dealer to request replacement of the battery, at your earliest convenience.

Battery ordering information

Name	Type	Code No.
Lithium battery	CR2032	000-159-662-10

8.4 Replacing the Magnetron

When the magnetron has expired, distant targets cannot be seen on the display. When you feel that long range performance has decreased, contact a FURUNO agent or dealer about replacement of the magnetron.

Magnetron ordering information

Radar sensor	Magnetron	Code No.
DRS2D	E3590	000-164-574-10
DRS4D	E3571	000-146-867-00
DRS4A	MAF1421B	000-158-786-10
DRS6A	MAF1422B	000-158-788-10
DRS12A	MAF1425B	000-146-872
DRS25A	MG5436(E2V)	000-140-762

8.5 Troubleshooting

This section provides simple troubleshooting procedures that you can follow to restore normal operation. If you cannot restore normal operation do not attempt to check inside the unit. Any trouble should be referred to a qualified technician.

General Troubleshooting

If…	Then…
you cannot turn on the power	• check for blown fuse. • check that the power connector is firmly fastened. • check for corrosion on the power cable connector. • check for damaged power cable. • check battery for proper voltage output (10.8 to 31.2 V).
there is no response when a key is pressed	turn off and on the power. If there still is no response the key may be faulty. Request service.

Radar Troubleshooting

If…	But…	Then…
you pressed the **POWER** switch followed by the **TX/ GAIN** key to transmit	nothing appears on the display	• check that the antenna cable is firmly fastened. • check if radar source is correct.
marks, legends appear	no echo appears	• check that the antenna cable is firmly fastened.
the picture is not updated or it freezes	—	• check antenna cable. • for freeze up, turn the display unit on and off again.
tuning is adjusted	sensitivity is poor	• magnetron may need to be replaced. Contact your dealer.
the range is changed	radar picture does not change	• try to hit the **RANGE** keys again. • turn the display unit off and on again.
there is poor discrimination in range	—	• try to suppress sea clutter with "Sea".
the true motion presentation is not working properly	—	• reselect true motion mode. • check if heading and speed are input.
the range rings are not displayed	—	• open the Radar pop-up menu and turn on "Rings".

Chart Plotter Troubleshooting

If…	Then…
position is not fixed within three minutes	check that antenna connector is firmly fastened.
the track is not plotted	check that track is turned on. (Put cursor on boat icon to open pop-up and check that "In Track" is on.)
Loran C TDs do not appear	check that Loran C station & GRI are properly set, on the Settings sub menu in the General menu.

8.6 Diagnostic Wizard

The diagnostic wizard facility has six diagnostic tests: Memory test, Keyboard test, I/O test, BBGPS test, and Radar/ARPA test.

Memory Test

The memory test displays the boot and app programs and checks devices and ports for proper operation.

```
MPU-001(Mother)
  Boot Program No.--
  APP Program No.--
  ROM : OK
  RAM : OK
  Port
    NMEA1 : --
    NMEA2 : --
    NMEA3 : --
    NMEA2000 : --
    NETWORK : --
    HDD : MHV2040AC  40GB
    PCI : --
    BATTRY : 4.0V
  LAN MAC address :
  CAN Unique Number :

MPU-001(USB-NMEA)
  Boot Program No.--
  APP Program No.--
  ROM : OK
  RAM : OK
  Port
    USB1 : --
    USB2 : --

MCU-001(or DCU12)
  Boot Program No.--
  APP Program No.--
  CPLD : 12345678
  ROM : OK
  RAM : OK
  (EEPROM : OK)*
  Port
    NETWORK : --
    SD card1 : --
    SD card2 : --
  LAN MAC address :
```

* DCU12 only

Keyboard Test

The layout of the keyboard is replicated on-screen. Press each key one by one to check them for proper operation. The corresponding location on the screen "lights" when the key is pressed and goes off when the key is released. For the Rotary Knob, rotate it to show X-Y position and push it to confirm function.

I/O Test

The I/O test checks for proper input and output of data. The result is shown as OK or NG.

BBGPS Test

This test requires the FURUNO GPS Receiver GPS-320B. The GPS receiver program version number is displayed, and the GPS receiver is checked for proper operation, displaying OK or NG (No Good) as the result. For NG, request service.

Radar/ARPA Test

The ROM and RAM for the radar/ARPA are checked for proper operation. The results are shown as OK or NG (No Good). For any NG, request service.

```
"Self test of ***"
DRS(SPU)
  Boot Program No.
  APP Program No.
  FPGA :
  ROM : OK (SPU)
  RAM : OK (SPU)
  Port
    NMEA2000 : --
  TX TIME : 000000.0h
  ON TIME : 000000.0h

  LAN MAC address :
  CAN Unique Number :

DRS(NMEA)
  Boot Program No.
  APP Program No.
  ROM : OK
  RAM : OK
```

8.7 GPS Status Display

The GPS status display provides data about the GPS satellites. It is available with connection of the GPS Receiver GP-310B/320B or a GPS navigator outputting the data sentence GSA or GSV.

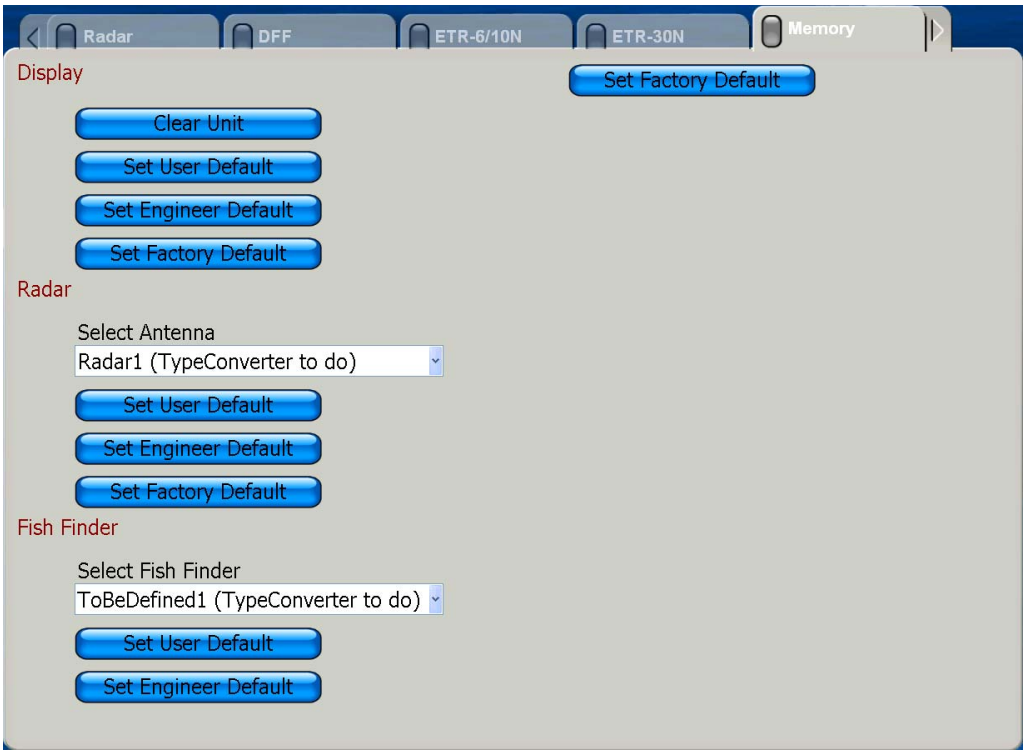
8.8 Restoring Default Settings

There are several types of default setting restorations:

- **Clear unit:** Clear all data - points, routes and tracks. Settings are not cleared.
- **Engineer default:** Restore all installer-entered settings for selected category.
- **Factory default:** Restore all default settings for selected category.

To restore default settings, do the following:

1. Press the **MENU** key to open the menu.
2. Open the System menu.
3. Open the Memory sub menu.



4. Use the Rotary Knob to select applicable item and then push the Rotary Knob.
5. Follow on-screen instructions to restore selected default type.

SPECIFICATIONS OF MFDBB (MULTI-FUNCTION DISPLAY BLACKBOX TYPE) WITH RADAR SENSOR (DRS2D, DRS4D, DRS4A, DRS6A, DRS12A, DRS25A)

1 PLOTTER SECTION

1.1	Projection	Mercator
1.2	Usable Area	85 latitude or below
1.3	Effective Area	211.2 x 158.4 mm
1.4	Position Indication	Latitude/longitude, Loran C LOP or DECCA LOP
1.5	Effective Projection Area	0.125 nm to 1,024 nm (at equatorial area)
1.6	Track Colors	Red, yellow, green, purple, light-blue, blue, white
1.7	Storage Capacity	Track: 12,000 points, Points: 2,000 points Routes: 200 routes with 50 waypoints each
1.8	MOB	1 point
1.9	Electronic Chart	Mapmedia, S52 layers, C-Map
1.10	Alarms	Arrival, Anchor watch, XTE, Proximity, Depth, Temperature, Speed, Trip log, Countdown timer, Alarm clock

2 PROCESSOR UNIT MCU-001

2.1	I/O Ports	NMEA 0183: 3 I/O ports, 38400 bps/4800 bps NMEA 2000: 1 port LAN: 4 ports (2 POE/100BASE-TX, 2 non-POE/100BASE-TX USB: 2 ports (USB 2.0): PIP: 2 ports (DVI)
2.2	Output Resolution	1280×1024 (SXGA) 1024×768 (XGA) 800×600 (SVGA)

3 DISPLAY CONTROL UNIT DCU012

3.1	Input	800×600 (SVGA)
3.2	Display Colors	Plotter: 262,144 colors Radar: 16 colors
3.3	Chart Card	Two slots

4 CONTROL UNIT MCU-001

4.1	Chart Card	Two Slots

5 RADAR SENSOR

5.1 General

Range, Pulse length & Pulse Repetition Rate

nm	0.0625	0.125	0.25	0.5	0.75	1.0	1.5	2	3	4	6	8	12	16	24	36	48	64	72	96
S1	■	■	■	■																
S2					■	■	■													
M1								■	■											
M2										■										
M3											■									
L												■	■	■	■	■	■	■	■	■

Pulse length: S1: 0.08µs, S2: 0.15µs, M1: 0.30µs, M2: 0.50µs, M3: 0.70µs, L: 0.80µs
Frequency: S1, S2: 3000 Hz, M1: 1500 Hz, M2: 1000 Hz, M3, L: 600 Hz
Max. range: See table below.

Range Resolution	20 m
Bearing Resolution	DR2SD: 5.2°, DRS4D: 3.9°, DRS4A: 2.3°, DRS6A, DRS12A, DRS25A: 1.9° (radiator XN12A), 1.4° (radiator XN13A)
Minimum Range	25 m
Bearing Accuracy	±1°
Range Ring Accuracy	1.0% of range or 8 m, whichever is the greater

Range (nm), Range Ring Interval (RI), Number of Rings (NOR)

nm	0.0625	0.125	0.25	0.5	0.75	1.0	1.5	2	3	4	6	8	12	16	24	36	48	64	72	96
RI	0.03125	0.0625	0.125	0.25	0.25	0.25	0.5	0.5	1	1	2	2	3	4	6	12	12	16	16	24
NOR	2	2	2	2	3	4	3	4	3	4	3	4	4	4	4	3	4	4	4	4

Max. range: DRS2D: 24 nm, DRS4D: 36 nm, DRS4A: 48 nm, DRS6A, DRS12A: 64 nm, DRS25A: 96 nm

5.2 Antenna Unit

Model DRS2D

Radiator	Center fed travel virtual antenna
Polarization	Horizontal
Antenna Rotation	Less than 2.0 nm: 48 rpm Less than 12 nm: 36 rpm 12 nm or higher: 24 rpm
Radiator Length	46 cm
Horizontal Beamwidth	5.2°
Vertical Beamwidth	22°
Sidelobe Attenuation	-25 dB or less (within ±20º of main-lobe) -27 dB or less (±20º of main-lobe or more)

Model DRS4D

Radiator	Center fed travel virtual antenna
Polarization	Horizontal
Antenna Rotation	Less than 2.0 nm: 48 rpm Less than 12 nm: 36 rpm 12 nm or higher: 24 rpm
Radiator Length	60 cm

Horizontal Beamwidth	3.9°
Vertical Beamwidth	22°
Sidelobe Attenuation	-25 dB or less (within ±20° of main-lobe)
	-27 dB or less (±20° of main-lobe or more)

Model DRS4A

Radiator	End fed travel slotted array antenna
Polarization	Horizontal
Antenna Rotation	Less than 1.5 nm: 48 rpm
	Less than 12 nm: 36 rpm
	12 nm or higher: 24 rpm
Radiator Length	100 cm (XN10A)
Horizontal Beamwidth	2.3°
Vertical Beamwidth	22°
Sidelobe Attenuation	-20 dB or less (within ±10° of main-lobe)
	-28 dB or less (±10° of main-lobe or more)

Model DRS6A, DRS12A, DRS25A

Radiator	End fed travel slotted array antenna
Polarization	Horizontal
Antenna Rotation	Less than 1.5 nm: 48 rpm, Less than 12 nm: 36 rpm
	12 nm or higher: 24 rpm
Radiator, Radiator Length	XN12A: 120 cm, XN13A[1]: 130 cm
Horizontal Beamwidth	XN12A: 1.9°, XN13A: 1.4°
Vertical Beamwidth	22°
Sidelobe Attenuation	XN12A: -27 dB or less (within ±10° of main-lobe)
	XN12A: -34 dB or less (±10° of main-lobe or more)
	XN13A: -29 dB or less (within ±10° of main-lobe)
	XN13A: -37 dB or less (±10° of main-lobe or more)

[1] XN13A for DRS12A, DRS25A

5.3 Transceiver Module

Frequency and Modulation	9410 MHz ±30MHz (X band), P0N
Peak Output Power	DRS2D: 2.2 kW nominal
	DRS4D: 4 kW nominal
	DRS4A: 4 kW nominal
	DRS6A: 6 kW nominal
	DRS12A: 12 kW nominal
	DRS25A: 25 kW nominal
Modulator	FET Switching Method
Intermediate Frequency	60 MHz
Tuning	Automatic or manual
Receiver Front End	MIC (Microwave IC)
Bandwidth	M1 or shorter: 20 MHz
	M2 or higher: 1.6 MHz

	Duplexer	Circulator with diode limiter
	Warming up	90 s approx

6 INTERFACE

6.1	Input Data	IEC 61162-1 (NMEA 0183 Ver1.5/2.0) Own ship's position: GGA>RMC>RMA>GLL Ship's speed: RMC>RMA>VTG>VHW Bearing (True): HDT>HDG*1>HDM*1>VHW Bearing (Magnetic): HDM>HDG*1>HDT*1>VHW Course: RMC>RMA>VTG Water depth: DPT>DBT>DBS>DBK Wind: MWV>VWT>VWR Water Temperature: MTW Time: ZDA *1: calculated by magnetic deviation
6.2	Output Data	
	Alarm Signal	12 VDC, 100 mA or less
	NMEA 0183 Ver1.5	GGA, GLL, RMA, RMC, GTD, VTG, ZDA (GPS data required) RMB, WPL, BWC or BWR, APB, AAM, BOD, XTE, VHW, MTW, DPT or DBT, DBS (ETR required), TLL (L/L, Heading data required), TTM (ARPA required)

7 POWER SUPPLY

7.1	Supply Voltage	10.8-31.2 V DC, 100-115/220-230 VAC, ø1, 50/60 Hz with optional rectifier
7.2	Rated Voltage/Current	MFDBB(MPU-001+MCU-001): 8.7A-4.4A, 12-24 VDC DCU12: 2.5A-1.3A, 12-24 VDC MFDBB+DRS2D: 13.6A-6.8A, 12-24 VDC MFDBB+DRS4D: 14.3A-7.2A, 12-24 VDC MFDBB+DRS4A: 18.3A-9.2A, 12-24 VDC MFDBB+DRS6A: 19.7A-9.8A, 12-24 VDC MFDBB+DRS12A: TBA MFDBB+DRS25A(PSU-013): TBA

8 ENVIRONMENTAL CONDITIONS

8.1	Ambient Temperature	Antenna Unit: -30°C to +55°C Processor Unit: 0°C to +40°C Display Control Unit: -15°C to +55°C
8.2	Relative Humidity	93% or less at +40°C
8.3	Waterproofing	Antenna Unit: IP56 Control Unit: IP56 (Front panel), IP20 (Rear panel) Display Control Unit: IP56 (Front panel), IP22 (Rear panel) Processor Unit: IPX20

8.4	Vibration IEC 60945-4th	- 2 Hz-5Hz and up to 13.2 Hz with an excursion of ±1 mm ±10% (7 m/s^2 maximum acceleration at 13.2 Hz); - above 13.2 Hz and up to 100 Hz with a constant maximum acceleration of 7 m/s^2.

9 COATING COLOR

9.1	Control Unit, Processor Unit	N2.5
9.2	Antenna Unit	DRS2D, DRS4D: N9.5 (upper), 2.5PB3.5/10 (lower) DRS4A, DRS6A, DRS12A: N9.5

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