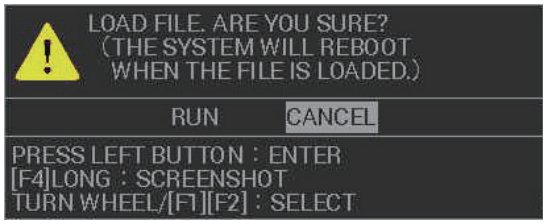
6. Repeat steps 4 and 5 to add other items you want to load.
7. Select the data to load from the [DATA SELECTION] list. A confirmation message appears.

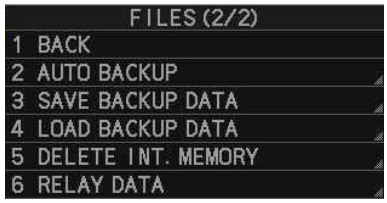


8. Select [YES] to load the selected data, or select [CANCEL] to cancel the load. If you selected [YES], a progress bar appears to indicate the loading status, followed by a confirmation message when the loading is complete.
9. Select [CONFIRM].
10. Close the window.

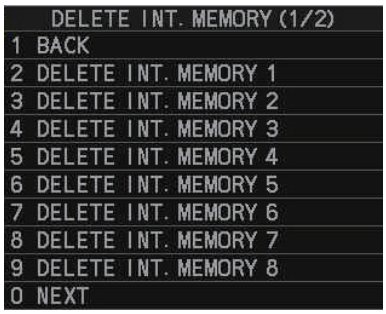
1.59.4 How to delete the contents of the internal memory

You can delete the contents of each internal memory area.

1. Open the menu.
2. Select [6 FILES]. The [FILES] menu appears.
3. Select [0 NEXT] to show the second page of the [FILES] menu.



4. Select [5 DELETE INT. MEMORY]. The internal memory areas appear in a two-page menu.



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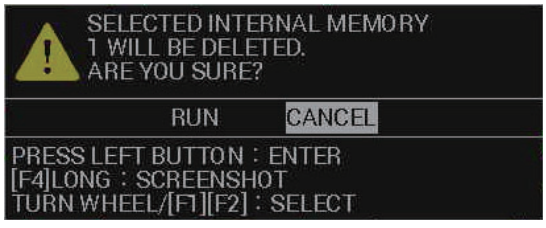
5. Select the internal memory area you want to delete. A confirmation message appears.



6. Select [RUN] to delete the area, or [CANCEL] to cancel the deletion.
   If you selected [RUN], the message "PROCESSING. PLEASE WAIT" appears in a window while the memory is deleted. The message disappears when the delete process ids complete.
7. Close the menu.

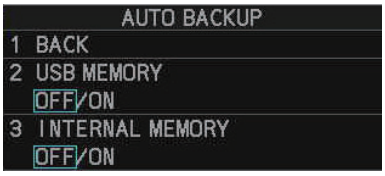
1.59.5 How to backup data in the internal memory

Data can be automatically backed up when the system starts up, or you can manually back up your data at any time.

Note: For automatic backups, the system start-up will take a short while longer than normal, to allow for the data backup.

How to automatically backup your data

1. Open the menu.
2. Select [6 FILES]. The [FILES] menu appears.
3. Select [0 NEXT] to show the second page of the [FILES] menu.
4. Select [2 AUTO BACKUP].



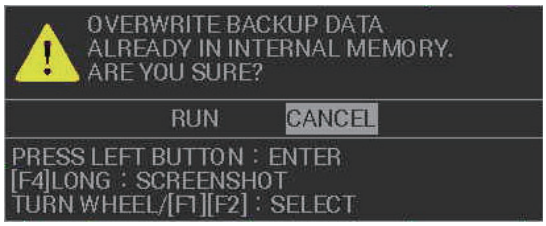
5. Select [3 INTERNAL MEMORY].
6. Select [ON] to activate, or [OFF] to deactivate, the automatic backup.
   If you selected [ON], the internal memory is backed up each time you turn the system on.
7. Close the menu.

Note: When auto backup is activated, the system starts the backup process after the start-up warning screen is closed. A message appears while the backup is in progress and the message disappears when the backup is complete.

How to manually backup your data

1. Open the menu.
2. Select [6 FILES]. The [FILES] menu appears.
3. Select [0 NEXT] to show the second page of the [FILES] menu.
4. Select [3 SAVE BACKUP DATA].

5. Select [3 SAVE TO INT. MEMORY]. A confirmation message appears.

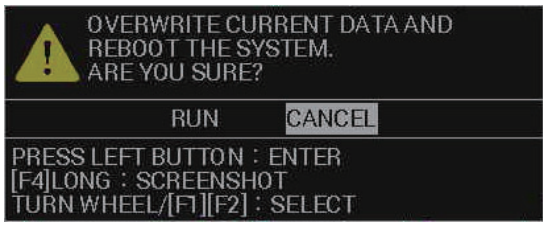


6. Select [RUN] to backup the area, or [CANCEL] to cancel the backup.
   If you selected [RUN], the message "TRANSFERRING. PLEASE WAIT" appears in a window while the data is backed up and a progress bar indicates the backup progress. The message changes to "TRANSFER COMPLETED" when the back-up is completed.
7. Select [CONFIRM] to close the window.

1.59.6 How to load backup data from the internal memory

1. Open the menu.
2. Select [6 FILES]. The [FILES] menu appears.
3. Select [0 NEXT] to show the second page of the [FILES] menu.
4. Select [4 LOAD BACKUP DATA].

5. Select [3 LOAD FROM INT. MEMORY]. A confirmation message appears.



6. Select [RUN] to backup the area, or [CANCEL] to cancel the backup.
   If you selected [RUN], a progress window appears. When the data load is complete, the system restarts automatically.

1.60 USB Flash Memory (C-types only)

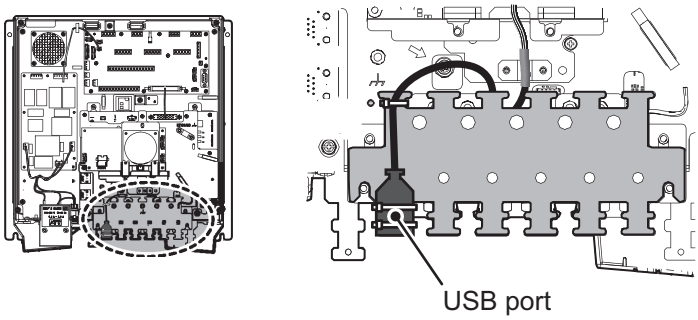
Note 1: This equipment is compatible with USB2.0.

Note 2: The procedures in this section must be done with the radar in STBY. If the radar is set to transmit, the [FILES] menu is not available.

1.60.1 USB Flash memory connection

Connect your flash memory to the USB port on the processor unit.

Note: The following figure is for explanatory purposes, with the cover of the processor unit removed. There is no need to remove the cover when connecting a flash memory.



1.60.2 How to remove the USB flash memory safely

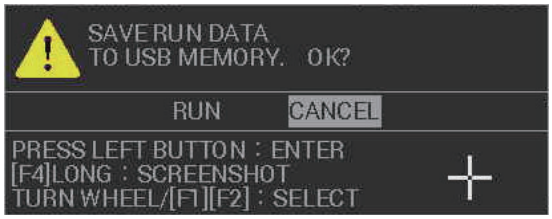
⚠ CAUTION

When removing the USB flash memory, only use the method described in this section.

Use of any other method may result in malfunction or incorrect operation of the USB and/or this equipment.

Note: If this equipment is turned off, steps 1 through 4 (menu operations) are not required.

1. Open the menu.
2. Select [6 FILES]. The [FILES] menu appears.
3. Select [8 REMOVE USB MEMORY]. A confirmation message appears.

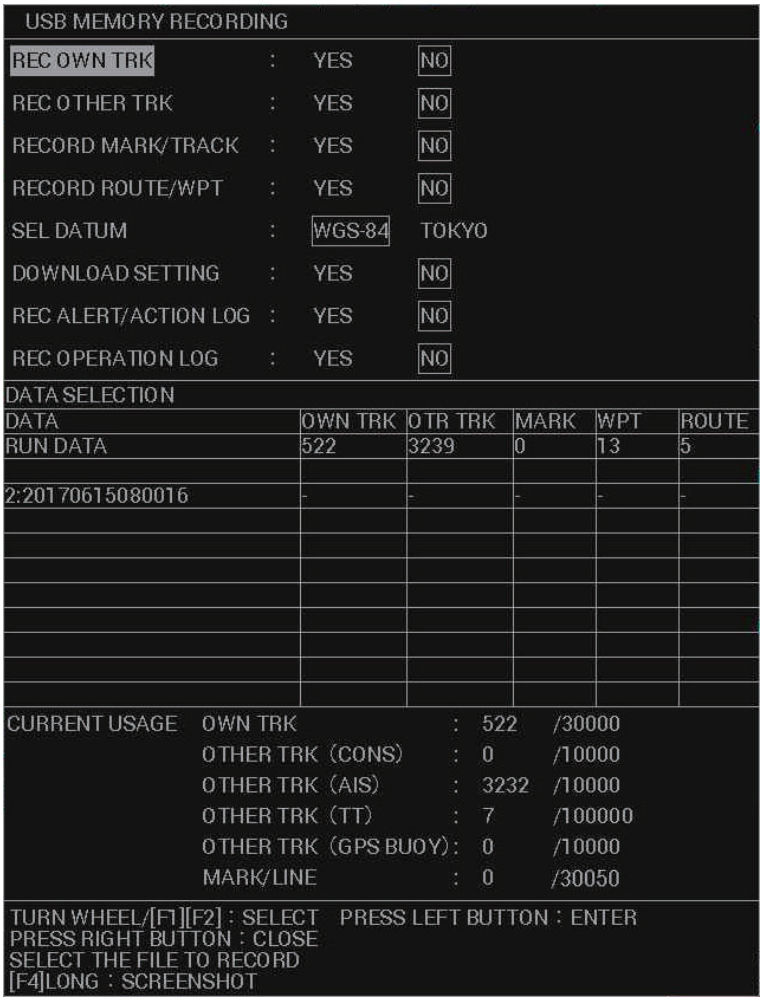


4. Select [CONFIRM].
5. Remove the USB flash memory from the processor unit.

1.60.3 How to save data to the USB flash memory

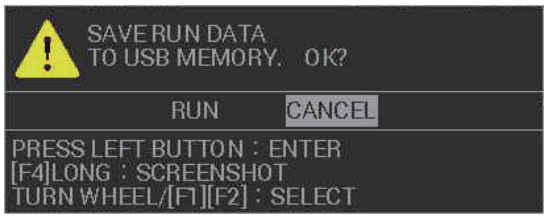
You can save your temporary data and the internal memory data (tracks, marks/lines, routes/waypoints, settings information, alert/action log and operation log) to a USB flash memory.

1. Open the menu.
2. Select [6 FILES]. The [FILES] menu appears.
3. Select [2 SAVE TO USB MEMORY]. The [USB MEMORY RECORDING] window appears.



4. Select an item, then select [YES] to save the item to the USB flash memory.
5. To save other items, repeat step 4 as required.
6. Select [SEL. DATUM].
7. Select [WGS-48] or [TOKYO] as required.
8. Select the data you want to save from the [DATA SELECTION] section.
   - [RUN]: Saves the data stored in the temporary memory.
   - [1:XXXXXXXXXX] though [10:XXXXXXXXXX]: Saves the data stored in the selected internal memory area. (“XXXXXXXXXX” indicates the file name.)
9. A pop up window appears showing the file name for the saved data. The default name is the date and time at which the data was saved.
10. **To change the filename**, go to the next step.
    To keep the default filename, close the menu.

11. Referring to section 1.5.3, enter the desired filename. A confirmation message, similar to the one below, appears.

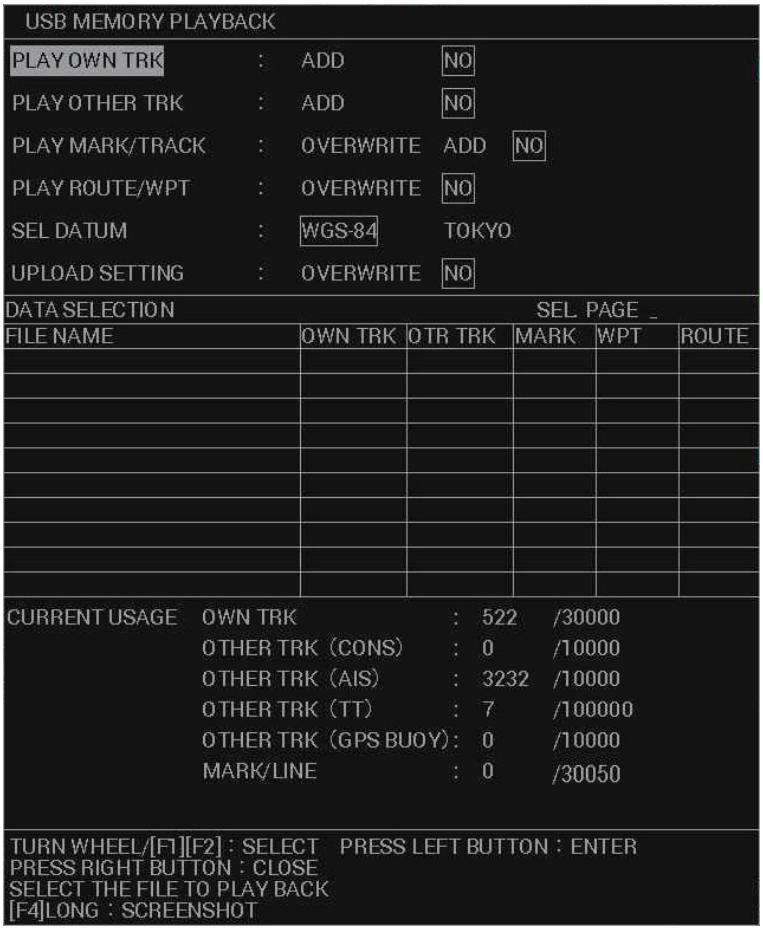


12. Select [ENTER] to save the data, or select [CANCEL] to cancel the procedure. If you selected [ENTER], a progress window appears to show the save progress. When the save is completed, a message appears.
13. Select [CONFIRM].
14. Close the menu.

1.60.4 How to load data from the USB memory

You can load the data from the USB flash memory, however, this procedure replaces the temporary memory contents with the contents of the USB flash memory. If you want to keep the contents of the internal memory, save the contents before continuing with this procedure.

1. Open the menu.
2. Select [6 FILES]. The [FILES] menu appears.
3. Select [5 LOAD FROM INT. MEMORY]. The [INTERNAL MEMORY PLAYBACK] window appears.



4. Select the item you want to load from the [DATA SELECTION] section of the window.
   Note: If you are loading multiple items, load the settings information before any other data. If settings information is loaded together with other data, some, or all, of the non-settings data may not load correctly.
5. Depending on the item selected at step 4, select [ADD], [OVERWRITE] or [NO] as appropriate.
   - [ADD]: selected data is added to the temporary data. Temporary data is not overwritten.
   - [OVERWRITE]: replace (overwrite) the temporary data with the selected data.
   - [NO]: selected data is not used.

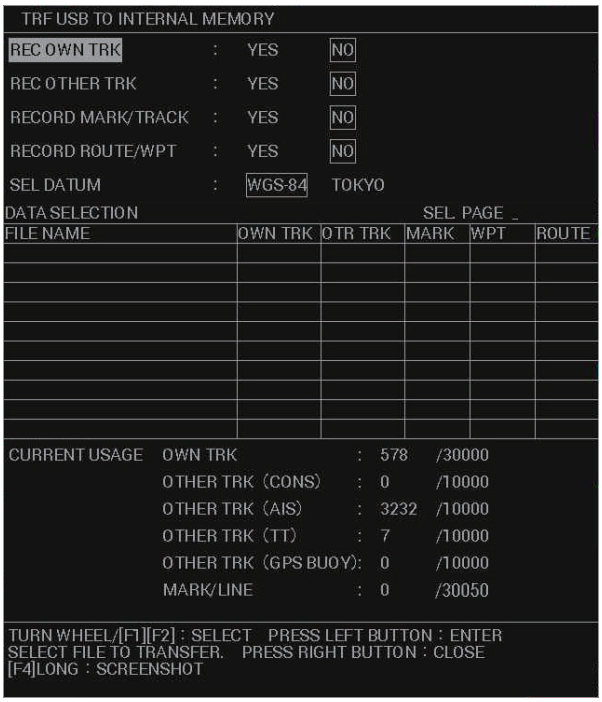
   Note 1: When [ADD] is selected for [PLAY MARK/TRACK], a limit of 30,000 items applies. When this limit is reached, no more items can be added.

   Note 2: When [ADD] is selected for [PLAY OWN TRK] or [PLAY OTHER TRK] and the limit is reached, the oldest items are deleted to make way for new items. For example, if you have 10,000 tracks already saved and add 25,000, the oldest 5,000 tracks from those already saved are deleted.
6. Repeat steps 4 and 5 to add other items you want to load.
7. Select [SEL DATUM].
8. Select [WGS-48] or [TOKYO] as required.
9. Select the data to load from the [DATA SELECTION] list. A confirmation message appears.
10. Select [YES] to load the selected data, or select [CANCEL] to cancel the load. If you selected [YES], a progress bar appears to indicate the loading status, followed by a confirmation message when the loading is complete.
11. Select [CONFIRM].
12. Close the window.

1.60.5 How to transfer USB data to the internal memory

You can save your transfer your USB data to the internal memory.

1. Open the menu.
2. Select [6 FILES]. The [FILES] menu appears.
3. Select [6 TRF USB TO INT. MEMORY]. The [TRANSFER USB TO INTERNAL MEMORY] window appears.



4. Select an item, then select [YES] to transfer the item from the USB flash memory.
5. To transfer other items, repeat step 4 as required.
   Note: Internal memory has the capacity to store the following:
   - Own Track: 30,000
   - Marks/Lines: 30,050
   - Waypoints: 3,500
   - Routes: 200
   - Other tracks: 40,000, comprised of:
     Consort tracks: 10,000
     AIS tracks: 10,000
     TT tracks: 10,000
     GPS buoy tracks: 10,000
6. Select [SEL. DATUM].
7. Select [WGS-48] or [TOKYO] as required.
8. Select the data you want to transfer from the [DATA SELECT] section.
9. A pop up window appears showing the file name for the saved data. The default name is the date and time at which the data was saved.
10. **To change the filename**, go to the next step.
    To keep the default filename, select go to step 12.
11. Referring to section 1.5.3, enter the desired filename (max. 15 characters).
    A confirmation message appears.
12. Select [ENTER] to save the data, or select [CANCEL] to cancel the procedure.
    If you selected [ENTER], a progress window appears to show the save progress.
    When the save is completed, a message appears.
13. Select [CONFIRM].
14. Close the menu.

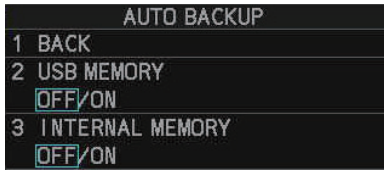
1.60.6 How to save the backup data to the USB flash memory

Data can be automatically backed up when the system starts up, or you can manually back up your data at any time.

Note: For automatic backups, the system start-up will take a short while longer than normal, to allow for the data backup.

How to automatically backup your data to the USB flash memory

1. Open the menu.
2. Select [6 FILES]. The [FILES] menu appears.
3. Select [0 NEXT] to show the second page of the [FILES] menu.
4. Select [2 AUTO BACKUP].



5. Select [2 USB MEMORY].
6. Select [ON] to activate, or [OFF] to deactivate, the automatic backup.
   If you selected [ON], the internal memory is backed up each time you turn the system on.
7. Close the menu.

Note: When auto backup is activated, the system starts the backup process after the start-up warning screen is closed. A message appears while the backup is in progress and the message disappears when the backup is complete.

How to manually backup your data to the USB flash memory

1. Open the menu.
2. Select [6 FILES]. The [FILES] menu appears.
3. Select [0 NEXT] to show the second page of the [FILES] menu.
4. Select [3 SAVE BACKUP DATA].
5. Select [2 SAVE TO USB MEMORY]. A confirmation message appears.
6. Select [RUN] to backup the area, or [CANCEL] to cancel the backup.
   If you selected [RUN], the message "TRANSFERRING. PLEASE WAIT" appears in a window while the data is backed up and a progress bar indicates the backup progress. The message changes to "TRANSFER COMPLETED" when the back-up is completed.
7. Select [CONFIRM] to close the window.

1.60.7 How to load backup data from the USB flash memory

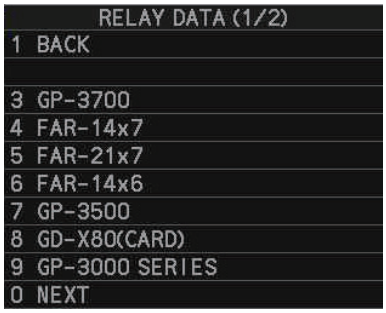
1. Open the menu.
2. Select [6 FILES]. The [FILES] menu appears.
3. Select [0 NEXT] to show the second page of the [FILES] menu.
4. Select [4 LOAD BACKUP DATA].
5. Select [2 LOAD FROM USB MEMORY]. A confirmation message appears.
6. Select [RUN] to backup the area, or [CANCEL] to cancel the backup.
   If you selected [RUN], a progress window appears. When the data load is complete, the system restarts automatically.

1.60.8 How to import data from other equipment

You can import data from other compatible equipment into the internal memory.

Note: Before importing data, consult your local dealer.

1. Connect the USB with the data you want to import to the USB port on the processor unit.
2. Open the menu.
3. Select [6 FILES]. The [FILES] menu appears.
4. Select [0 NEXT] to show the second page of the [FILES] menu.
5. Select [6 RELAY DATA]. The [RELAY DATA] menu appears.



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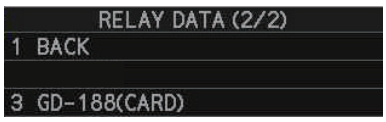
Menu item [8 GD-X80] covers GD-280, GD-380, GD-680 and GD-280BB.



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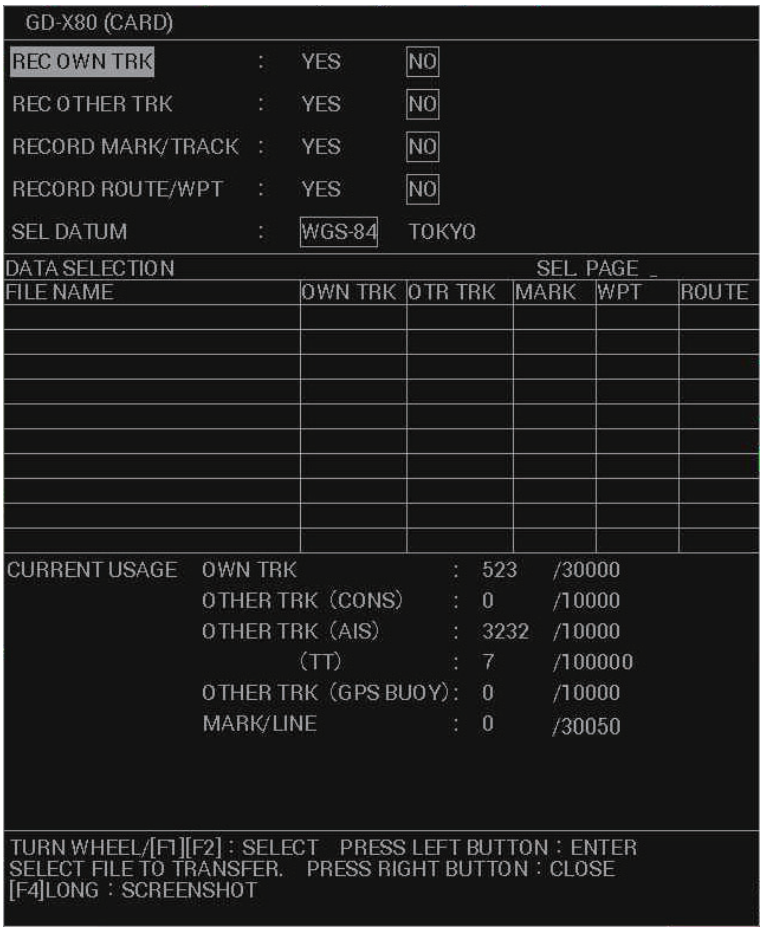
6. Select the equipment from which you want to import data. the following figure shows an example of the GD-X80 (CARD) import window.



7. Select the data you want to import from the [DATA SELECTION] section of the window. A confirmation message appears.
   Note: Internal memory has the capacity to store the following:
   - Own Track: 30,000
   - Marks/Lines: 30,050
   - Waypoints: 3,500
   - Routes: 200
   - Other tracks: 40,000, comprised of:
     Consort tracks: 10,000
     AIS tracks: 10,000
     TT tracks: 10,000
     GPS buoy tracks: 10,000

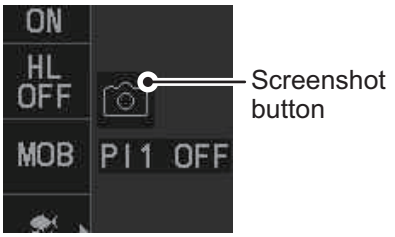
8. Select [RUN] to import the selected data, or select [CANCEL] to cancel the import. If you selected [RUN], the message "TRANSFERRING. PLEASE WAIT" appears while the data is imported up and a progress bar indicates the import progress. The message changes to "TRANSFER COMPLETED" when the import is complete.
9. Select [CONFIRM] to close the window.

1.61 How to Take a Screenshot

The system has an in-built screenshot feature. To use the feature, a SD Card must be inserted in the Processor Unit. If there is no card inserted, the screenshot button on the screen is not active.

To take a screenshot of the currently displayed screen, click the screenshot button.

Note: The screenshot function can also be assigned to a function key. For how to set up the function keys, see section 1.8



2. RADAR OBSERVATION

2.1 General

2.1.1 Minimum range

The minimum range is defined by the shortest distance at which, using a scale of 1.5 or 0.75 nm, a target having an echoing area of 10 m^2 is still shown separate from the point representing the antenna position.

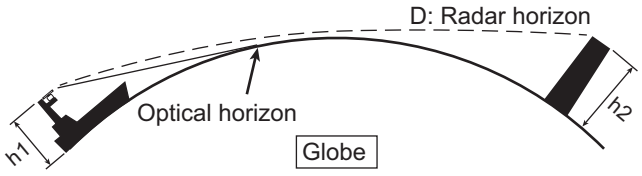
It is mainly dependent on the pulselength, antenna height, and signal processing such as main bang reduction and digital quantization. It is a good practice to use a shorter range scale as far as it gives favorable definition or clarity of picture.

The IMO Resolution MSC.192(79) requires the minimum range to be less than 40 m, respectively. This series of radars satisfy this requirement.

2.1.2 Maximum range

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

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



$D = 2.2 \times (\sqrt{h1} + \sqrt{h2})$
where D: radar horizon (nautical miles)
h1: antenna height (m)
h2: target height (m)

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

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

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

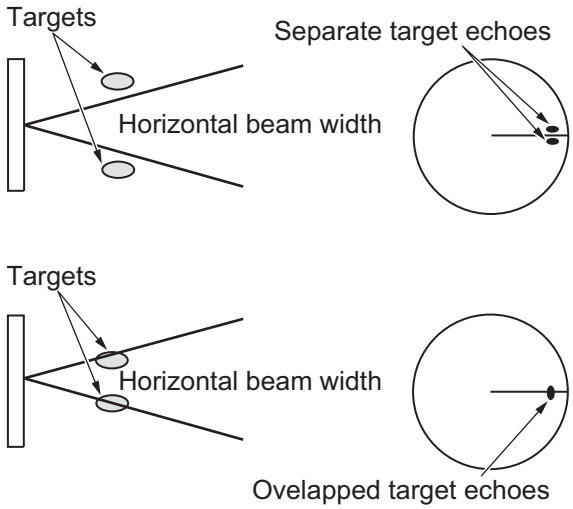
2.1.3 X-band and S-band

In fair weather, the equation on the previous page does not give a significant difference between X- and S-band radars. However, in heavy precipitation condition, an S-band radar would have better detection than an X-band radar.

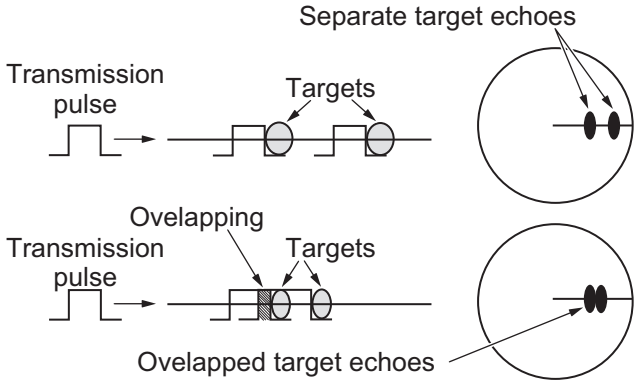
2.1.4 Radar resolution

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

- Bearing resolution is the ability of the radar to display as separate pips the echoes received from two targets that are at the same range and close together. It is proportional to the antenna length and reciprocally proportional to the wavelength. The length of the antenna radiator should be selected for a bearing resolution better than 2.5° (IMO Resolution). This condition is normally satisfied with a radiator of 1.2 m (4 ft) or longer in the X-band. The S-band radar requires a radiator of about 12 feet (3.6 m) or longer.



- Range resolution is the ability to display as separate pips the echoes received from two targets that are on the same bearing and close to each other. This is determined by pulselength only. Practically, a 0.08 microsecond pulse offers the discrimination better than 40 m as do so with all FURUNO radars.
  Test targets for determining the range and bearing resolution are radar reflectors having an echoing area of 10 m^2.



2.1.5 Bearing accuracy

One of the most important features of the radar is how accurately the bearing of a target can be measured. The accuracy of bearing measurement basically depends on the narrowness of the radar beam. However, the bearing is usually taken relative to the ship's heading, and thus, proper adjustment of the heading line at installation is an important factor in ensuring bearing accuracy. To minimize error when measuring the bearing of a target, put the target echo at the extreme position on the screen by selecting a suitable range.

2.1.6 Range measurement

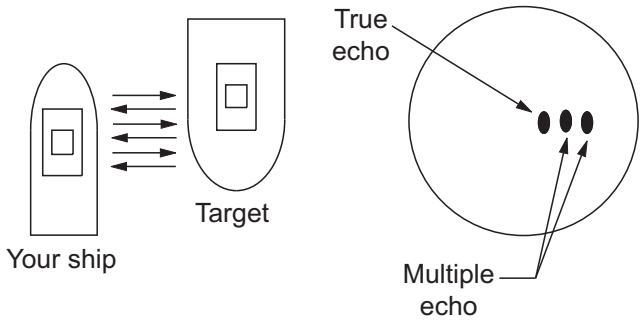
Measurement of the range to a target is also a very important function of the radar. Generally, there are two means of measuring range: the fixed range rings and the variable range marker (VRM). The fixed range rings appear on the screen with a predetermined interval and provide a rough estimate of the range to a target. The variable range marker's diameter is increased or decreased so that the marker touches the inner edge of the target, allowing the operator to obtain more accurate range measurements.

2.2 False Echoes

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

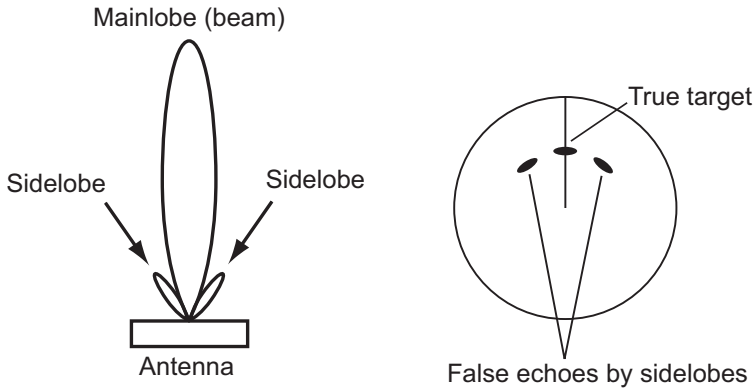
Multiple echoes

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



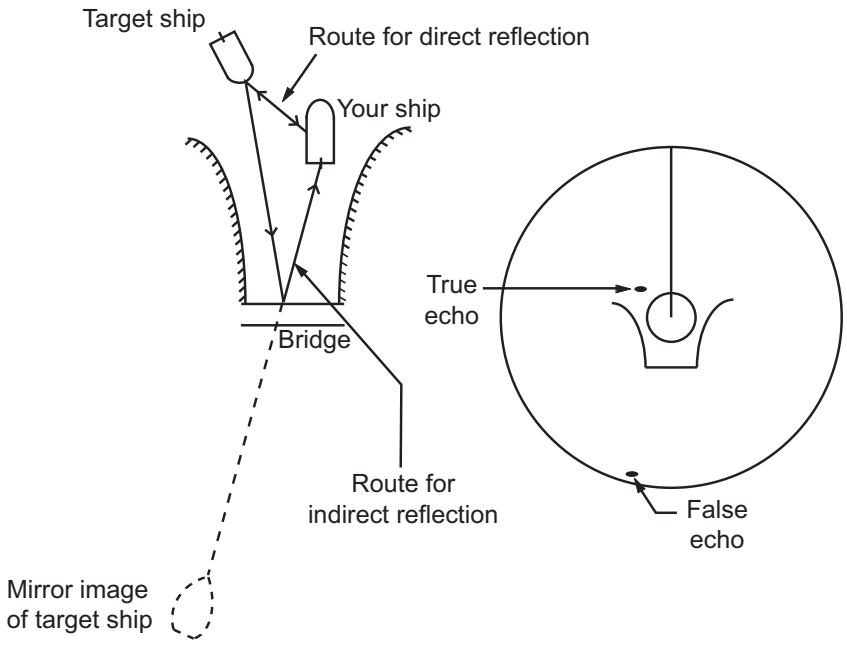
Sidelobe echoes

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



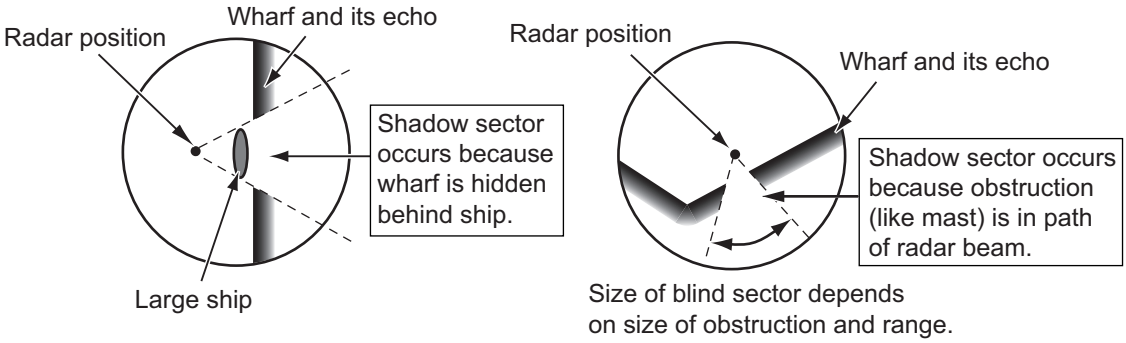
Virtual image

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



Shadow sectors

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



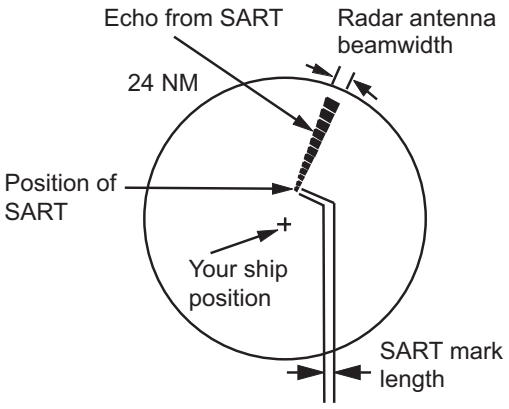
2.3 SART (Search and Rescue Transponder)

2.3.1 SART description

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

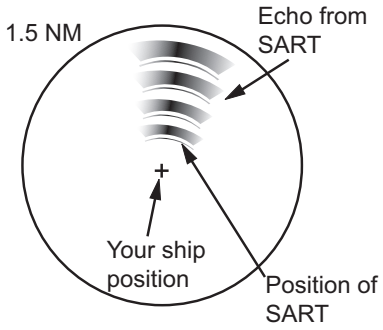
When the radar to the SART is reduced to about 1 nm, the radar display my show also the 12 responses generated during the fast sweeps. These additional dot responses, which also are equally spaced by 0.64 nautical miles, will be interspersed with the original line of 12 dots. They will appear slightly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

Screen A: When SART is distant



Screen B: When SART is close

Lines of 12 dots are displayed in concentric arcs.



2.3.2 How to show SART marks on the radar display

This radar is equipped with a feature that optimally sets up the radar for SART detection. This feature automatically detunes the radar receiver out of its best tuning condition. This erases or weakens all normal radar echoes, but the SART marks are not erased because the SART response signal scans over all frequencies in the 9 GHz band. When the radar approaches the SART in operation, the SART marks will enlarge to large arcs, blurring a large part of the screen.

Note: The following procedure is not available from FAR-2x58 and FAR-2268DS monitors which are assigned as [SUB] at installation.

1. Open the menu.
2. Select [1 ECHO], then press the **ENTER MARK** key.
3. Select [7 SART], then press the **ENTER MARK** key.
4. Select [ON] to show SART marks on the radar display, then press the **ENTER MARK** key. Select [OFF] to hide SART marks.
   When the SART function is active, the settings listed in the table on the following page are automatically made to radar functions:

Setting	Changed to
Range	12 NM
Pulselength	Long
Echo Stretch	Off
Noise Rejector	Off
Echo Averaging	Off
Interference Rejector	Off
Performance Monitor	Off
A/C RAIN	Off

5. Close the menu.

The indication "SART" appears at the top of the screen, in yellow text, when this feature is active. Be sure to turn this feature off when SART detection is no longer your objective.

2.3.3 General remarks on receiving SARTs

SART range errors

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

Radar bandwidth

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

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

Radar sidelobes

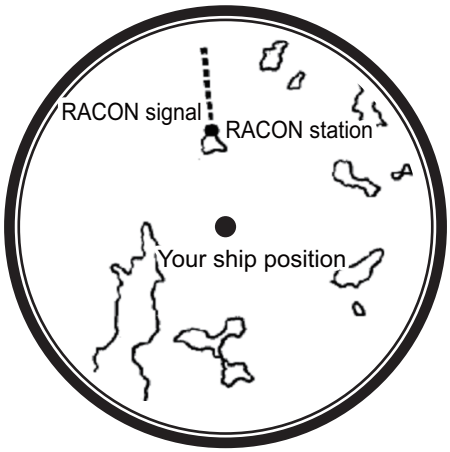
As the SART is approached, sidelobes from the radar antenna can show the SART responses as a series of arcs or concentric rings. These can be removed by the use of the anti-clutter sea control although it can be operationally useful to observe the side lobes as they may be easier to detect in clutter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

Note: SART information excerpted from IMO SN/Circ 197 OPERATION OF MARINE RADAR FOR SART DETECTION.

2.4 RACON

A RACON is a radar beacon that emits radar receivable signals in the radar frequency spectrum (X- or S-band). There are several signal formats; in general, the RACON signal appears on the radar screen as a rectangular echo originating at a point just beyond the position of the radar beacon. It has a Morse coded pattern. Note that the position on the radar display is not accurate.

Echoes on the radar screen



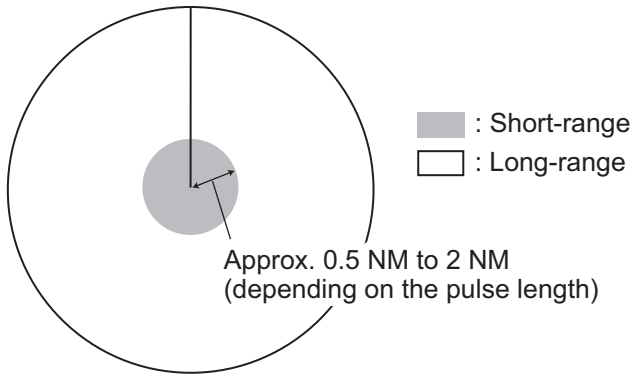
Echo description

2.5 Radar Target Enhancer (RTE)

An RTE is a radar transponder mounted on navigation buoys and masts of small crafts to significantly improve their detection by radar. Unlike a SART or RACON, which are passive, the RTE receives a radar signal, amplifies it and re-transmits it, with the intention of making the target's signal look larger on a radar display. The RTE is available in X-band and S-band types.

2.6 Solid state radar

In Solid State radars, long-range and short-range pictures are mixed before they are displayed on the screen. Due to this mixing process, echoes may be displayed differently when compared with magnetron radars.



Range and signal intensity

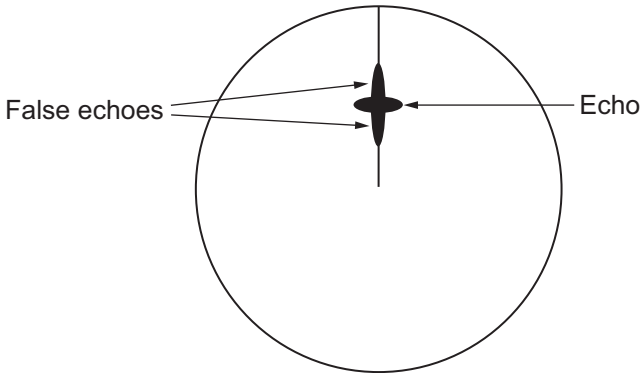
At long-range, even though the Solid State radar has lower transmission power than magnetron radars, the signal intensity is equivalent.

At short-range on the other hand, due to the lower transmission power the signal intensity of closer targets (including sea clutter and rain clutter) is reduced.

For this reason, when a long-range target enters short-range the signal intensity appears weaker.

False echoes fore and aft of the target

At long-range, echoes with a strong reflection may appear with a false echo to their fore and aft. When the target changes direction, the reflection may weaken, causing the false echoes to disappear. You can also reduce the false echoes in these cases by reducing the gain.



3. TARGET TRACKING (TT)

3.1 Precautions when Using Target Tracking

⚠ 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 TT automatically tracks automatically or manually acquired radar targets and calculates their courses and speeds, indicating them by vectors. Since the data generated by the auto plotter are based on what radar targets are selected, the radar must always be optimally tuned for use with the auto plotter, to ensure required targets will not be lost or unwanted targets such as sea returns and noise will not be acquired and tracked.

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

⚠ CAUTION

The plotting accuracy and response of this TT 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.

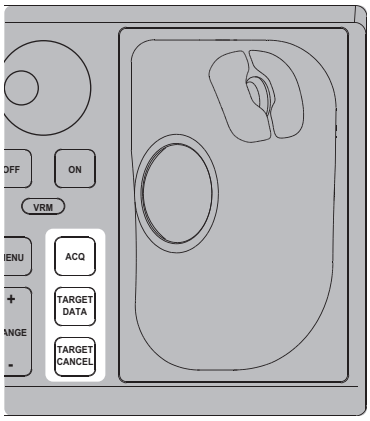
- The target tracking and pertinent vector calculation accuracy is influenced by the following:
  - Echo intensity
  - The range measurement accuracy; characterized by both random and biased measurement errors.
  - The angular measurement accuracy; characterized by beam shape, target glint and bias errors.
  - Radar transmission pulsewidth
  - Gyrocompass heading error
  - Speed log error
  - Curent and wind (set & drift)
  - Course change (own ship and target)

The data generated by TT, AIS and video plotter are intended for reference only.

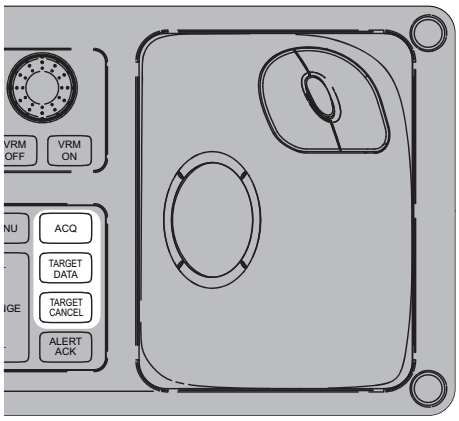
Refer to official nautical charts for detailed and up-to-date information.

3.2 TT Controls

The control unit has three keys that are used in the target tracking mode. The keys are indicated in the figure below.



RCU-014



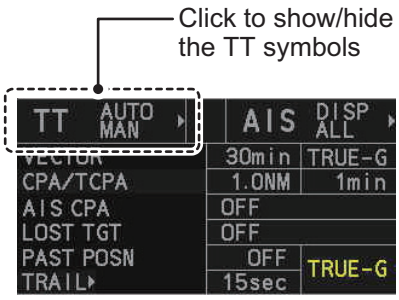
RCU-031

- **ACQ**: Acquires the selected echo as a target.
- **TARGET DATA**: Shows the selected target's data in the information box.
- **TARGET CANCEL**: Deactivates tracking for the cursor-selected target.

These functions, along with other TT functions, can also be accessed from the [CURSOR] menu (See section 1.7.3).

3.3 How to Show/Hide the TT Symbols

You can show/hide the TT symbols to suit your requirements. To hide the symbols, left-click the TT indication in the TT•AIS box to show [OFF]. To show the symbols, left-click the indication to show [AUTO]*, [AUTO/MAN]*, [MAN]*.
*: These TT modes and their settings are described in section 3.4.



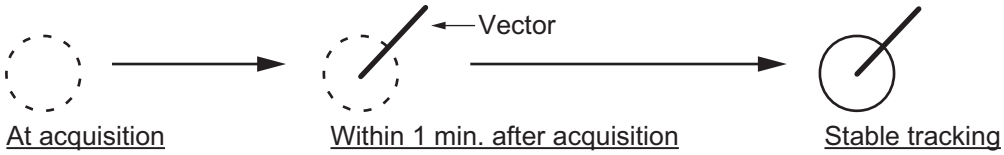
Note: The TT mode indication is hidden when [SIMPLE] display mode is used. To change TT settings in [SIMPLE] mode, first restore [NORMAL] display mode, adjust the settings, then return to [SIMPLE] mode. See section 1.9 for how to change the display mode.

3.4 How to Select the TT mode

This radar can automatically acquire and track a maximum of 100 targets.

The number of automatically and manually acquired targets is determined by the setting for [TT SELECT] in the [TT] menu.

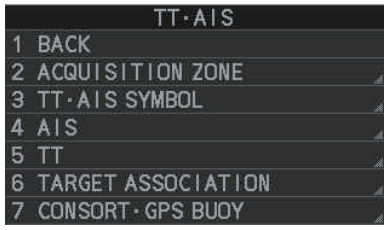
A target just acquired automatically is marked with a dashed circle and a vector appears within one minute to indicate the target's motion trend. If the target is consistently detected for three minutes, the plotting symbol changes to a solid circle. If acquisition fails, the target symbol blinks.



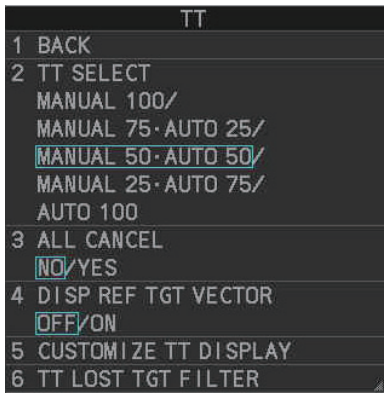
3.4.1 How to setup the acquisition method

You can set the system to acquire targets automatically, manually, or a combination of automatic and manual.

1. Open the menu.
2. Select [5 TT•AIS].



3. **For IMO-types**, select [6 TT].
   For C-types, select [5 TT].



   Note: You can also right-click the TT indication in the [TT•AIS] box to open the [TT] menu.

4. Select [2 TT SELECT], then select the acquisition condition.

Menu setting	Acquisition condition
[MANUAL 100]	100 targets manually, auto acquisition not available
[MANUAL 75 • AUTO 25]	25 targets automatically, 75 targets manually
[MANUAL 50 • AUTO 50]	50 targets automatically, 50 targets manually
[MANUAL 25 • AUTO 75]	75 targets automatically, 25 targets manually
[AUTO 100]	100 targets automatically, manual acquisition not available

5. Close the menu.
   The selected settings change how the TT indication is displayed in the TT•AIS box as follows:

TT mode selected	Indication change
[MANUAL 100]	"TT OFF" → "TT MAN" → "TT OFF"...
[MANUAL 75 • AUTO 25]	"TT OFF" → "TT MAN/AUTO" → "TT OFF"...
[MANUAL 50 • AUTO 50]	"TT OFF" → "TT MAN/AUTO" → "TT OFF"...
[MANUAL 25 • AUTO 75]	"TT OFF" → "TT MAN/AUTO" → "TT OFF"...
[AUTO 100]	"TT OFF" → "TT AUTO" → "TT OFF"...

Note: When the menu-set number of automatically acquired targets have been acquired, the Alert "TT TARGET FULL(AUTO)" appears in the [Alert] box.

3.4.2 How to manually acquire targets

Note: The following procedure requires [2 TGT DATA/ACQ SETTING] on the second page of the [CURSOR] menu to be set as [ANY] or [TT ONLY].

Acquire a target from the Control Unit (RCU-014/RCU-031)

Use the trackball to place the cursor on the target you want to acquire, then press the **ACQ** key.

Acquire a target by the trackball module

1. When the target to acquire and the AIS symbol overlap one another, right-click the operational display area to show the [CURSOR MENU].
2. Select [TT TARGET DATA/ACQ].
3. Place the cursor on the target to acquire then left-click.

Note 1: For successful acquisition, the target should be within 24 NM (or 32 NM, depending on initial setting) from own ship and not obscured by sea or rain clutter.

Note 2: You are alerted when the capacity of manual acquisition is 95% and 100%. These alerts are "TT TARGET95%(MAN)" and "TT TARGET FULL(MAN)". If the capacity is 100% you cannot acquire more targets. Cancel tracking of non-threatening targets if you wish to acquire additional targets manually.

Note 3: When a target being tracked nears another target being tracked, the targets may be "swapped". When two targets acquired either automatically or manually come close to each other, one of the two may become a lost target. If this occurs, manual re-acquisition of the lost target may be necessary after the two have separated.

Note 4: You can reuse a target number. This is useful when you acquire the “wrong” target. Drag and drop the symbol onto the correct target.

3.4.3 How to automatically acquire targets

Targets are automatically acquired when the TT mode is set to other than [MANUAL 100] and a target enters the acquisition zone (see section 3.14). The maximum tracking distance (24 NM, 32 NM or 48 NM*) is set at installation.

*: The maximum track distance of 48 NM is only available for the FAR-2x58 and FAR-2268DS.

3.5 How to Enter Own Ship Speed

The TT requires own ship's speed and heading data. The speed can be STW, SOG or echo-referenced speed (based on 3 max. stationary objects). Manual input is also possible. For automatic or manual input, see section 1.11. For echo-referenced speed input follow the procedure below.

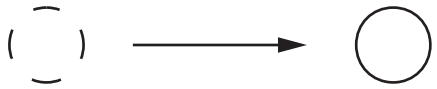
3.5.1 Echo-referenced speed input

The use of echo-referenced speed is recommended when:

- The speed log is not operating properly or not connected to the radar.
- The vessel has no device (doppler sonar, speed log, etc.) that can measure ship's bow-stern, port-starboard movement.

If you select echo-referenced speed, the TT calculates own ship's speed relative to a fixed reference target. The number of targets may be R1, R2 or R3. When a plural of objects are selected, the mean value is used, for stabilization and speed.

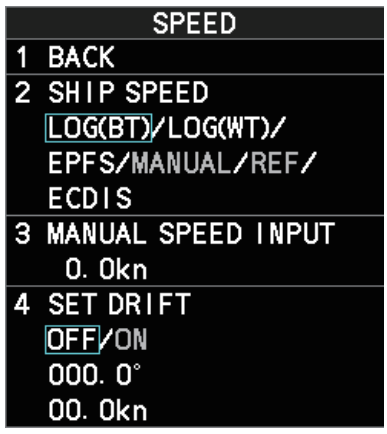
1. Right-click the operational display area to show the [CURSOR MENU].
2. Select [REF MARK]. The cursor is highlighted to indicate that the reference mark function is active.
3. Place the cursor on a fixed echo (such as an island, etc.) at a range of 0.1 to 24 NM from own ship, to be used as a reference, then left-click. The cursor changes from the highlighted cross to a circle with dashed lines, indicating that the reference location is now set. See section 3.8 for more information on TT symbols and their attributes.



At acquisition Stable tracking

The dashed lines of the reference point change to a solid line over time, as shown in the figure above.

4. Repeat step 3 until to place up to three reference points.
5. Right-click to deactivate the reference mark function.
6. Open the menu.
7. Select [7 INFORMATION BOX].
8. Select [2 OWN SHIP INFO].
9. Select [2 SHIP SPEED].
10. Select [REF].
11. Close the menu.
    It takes approximately one minute for the speed to appear in the own ship information box. When the speed appears, the indication "REF BT" also appears to the right of the speed value.



Notes on speed input by reference target

- Reference targets are only used for the calculation of true speed.
- Do not use reference target generated true speed to calculate relative speed. Relative speed data is not accurate because response to speed change is slow, hampering the TT's ability to accurately judge the possibility of collision.
- Select a stationary target as a reference target to calculate own ship speed as ground tracking speed. Do not choose a moving target as a reference target. A moving target produces error in the vector for TT and AIS, which results in wrong collision avoidance information. Further, an unstable stationary target produces inaccurate speed data and the target itself may become lost.
- On IMO-type radars with AIS in use, echo-referenced speed is shown in gray to indicate they are not available for selection.
- When a reference target is lost or goes out of the acquisition range, that reference target mark blinks and the indication "REF TARGET LOST" appears in the alert box. If all reference targets are lost, the speed indication reads "*.*" Select a different reference target if currently selected one is lost.
- When all targets are deleted, the reference target mark is also deleted and the target-based speed becomes invalid. The speed is indicated as "BTREF" where BT means Bottom Track (speed over ground).
- For IMO-types only, reference targets can be marked with a vector.
  This can be done with [REF TARGET VECTOR] on the [TT TARGET] menu.
- Loss of reference target will affect the calculation of true speed and true course of targets. Further, own ship speed will be inaccurate.

How to cancel echo-referenced speed input

1. Open the menu.
2. Select [7 INFORMATION BOX].
3. Select [2 OWN SHIP INFO].
4. Select [3 SPEED]. The [SPEED] menu appears.
5. Select any option, other than [REF].
6. Close the menu.

3.6 How to Cancel Target Tracking

When the number of tracked targets reaches maximum capacity, the alert box shows [TT TARGET FULL (MAN)] or [TT TARGET FULL (AUTO)], based on the selected TT mode. No new targets can be acquired until a tracked target is lost or tracking is canceled. When this occurs, cancel tracking for non-dangerous targets as required.

3.6.1 How to cancel tracking for individual TT targets

Note: The following procedure requires [3 TGT CANCEL SETTING] on the second page of the [CURSOR] menu to be set as [ANY] or [TT ONLY].

Using the control unit (RCU-014/RCU-031)

1. Place the cursor on the tracked target, or tracked target's data, to cancel.
2. Press the **TARGET CANCEL** key.

Using the CURSOR menu

1. Right-click the operational display area to show the [CURSOR MENU].
2. Select [TARGET CANCEL], then left-click.
3. Select the tracked target to cancel, then left-click.
4. Right-click to complete the procedure.

3.6.2 How to cancel tracking for all TT targets

Using the control unit (RCU-014/RCU-031)

Press and hold the **TARGET CANCEL** key.

Using the menu

1. Open the menu.
2. Select [5 TT•AIS].
3. **For IMO-types**, select [6 TT].
   For C-types, select [5 TT].
4. Select [3 ALL CANCEL].
5. Select [YES] to cancel tracking for all TT targets.
6. Close the menu.

3.7 Lost Target

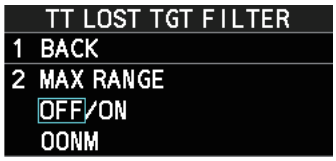
Targets not detected in nine consecutive scans become “lost targets”. A lost target is shown in the display with a flashing red "×". Flashing stops after lost target alert is acknowledged. Further, the alert box shows the indication "TT TARGET LOST" in orange characters and the audible alert sounds. The symbol disappears when the alert is acknowledged.

If you are in an area where tracked targets are lost frequently, you may want to disable the lost target alert against tracked targets by maximum range.

3.7.1 How to set the lost target filter

You can set the lost target alert to sound against lost targets that are within a specific range. To set the criteria, use the procedure below.

1. Open the menu.
2. Select [5 TT•AIS].
3. **For IMO-types**, select [6 TT].
   For C-types, select [5 TT].
4. Select [7 TT LOST TGT FILTER].
5. Select [MAX RANGE].
6. Select [ON]. The settings can now be adjusted.
7. Spin the scrollwheel to adjust the setting as required, then left-click to apply the setting.
8. Close the menu.

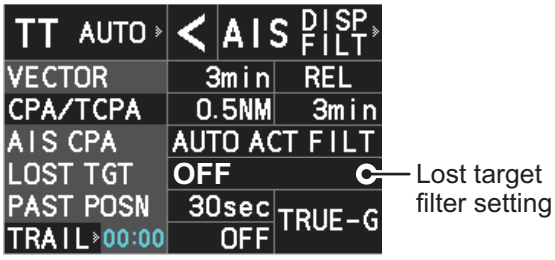


Note: Reference targets are not affected by this filter.

3.7.2 How to enable/disable the lost target alert

The [LOST TARGET] box, located at the bottom-right corner of the screen, enables and disables the lost target alert. This setting is shared for TT and AIS functions.

Select the box with the cursor, then left-click to cycle through the settings in the following order: [OFF] → [FILT] → [ALL] → [OFF]...



- [OFF]: Disable the alert.
- [FILT]: Enable the alert for all lost targets, excluding filtered targets.
- [ALL]: Enable the alert for all lost targets, including filtered targets.

Note: The lost target filter setting is hidden when [SIMPLE] display mode is used. To change TT settings in [SIMPLE] mode, first restore [NORMAL] display mode, adjust the settings, then return to [SIMPLE] mode. See section 1.9 for how to change the display mode.

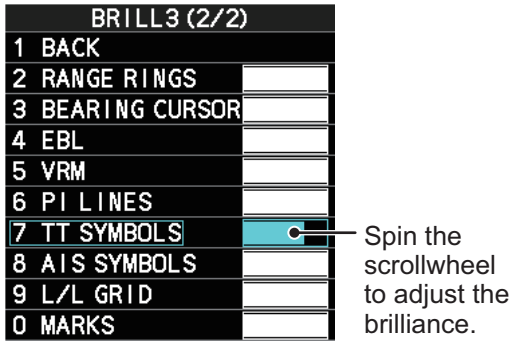
3.8 TT Symbols and Attributes

The TT symbols used in this equipment are compliant with IEC62288. For details regarding the symbols and their meanings, see "TT/AIS symbols" on page AP-34.

3.8.1 How to adjust symbol brilliance

Note: Each color scheme (palettes PLT1 to PL4) can be adjusted individually. For how to select a color scheme, see section 1.46.3.

1. Open the menu.
2. Select [9 INITIAL SETTINGS].
3. Select [2 BRILL]. The [BRILL] menu appears.
4. Select [0 NEXT] to show the next menu page.
5. Select [7 TT SYMBOLS]. The settings are highlighted and can now be adjusted.
6. Spin the scrollwheel to select the desired brilliance, then left-click to apply the setting.
7. Close the menu.



3.8.2 How to set the symbol color

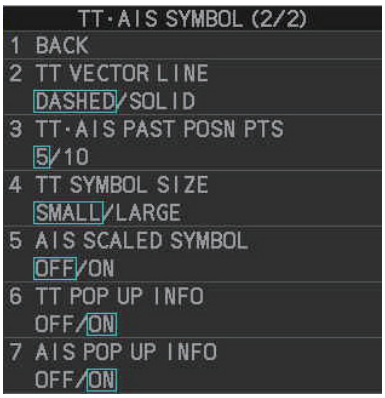
1. Open the menu.
2. Select [5 TT•AIS].
3. **For IMO-types**, select [4 TT•AIS SYMBOL].
   For C-types, select [3 TT•AIS SYMBOL].

4. **For IMO-types**, select [2 TT•AIS SYMBOL COLOR].
   For C-types, select [2 TT SYMBOL].
   Note: For IMO-types, symbol color is shared between TT and AIS.
5. Select the appropriate color, then left-click.
6. Close the menu.

3.8.3 How to set the symbol size (C-types only)

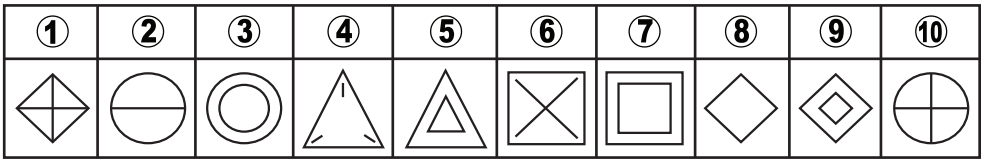
C-types radar can show TT symbols in small or large size. You can change the size with the following procedure.

1. Open the menu.
2. Select [5 TT•AIS].
3. Select [3 TT•AIS SYMBOL].
4. Select [0 NEXT] to show the second page of the menu.
5. Select [4 TT SYMBOL SIZE].
6. Select [SMALL] or [LARGE] as required.
7. Close the menu



3.8.4 How to select a TT symbol (C-type only)

With a C-type radar, you can assign a symbol (other than the standard circle) to TT targets. You can also change the color and naming for the TT symbols. There are 10 preset symbols available.The following figure shows the default presets, in numerical order.

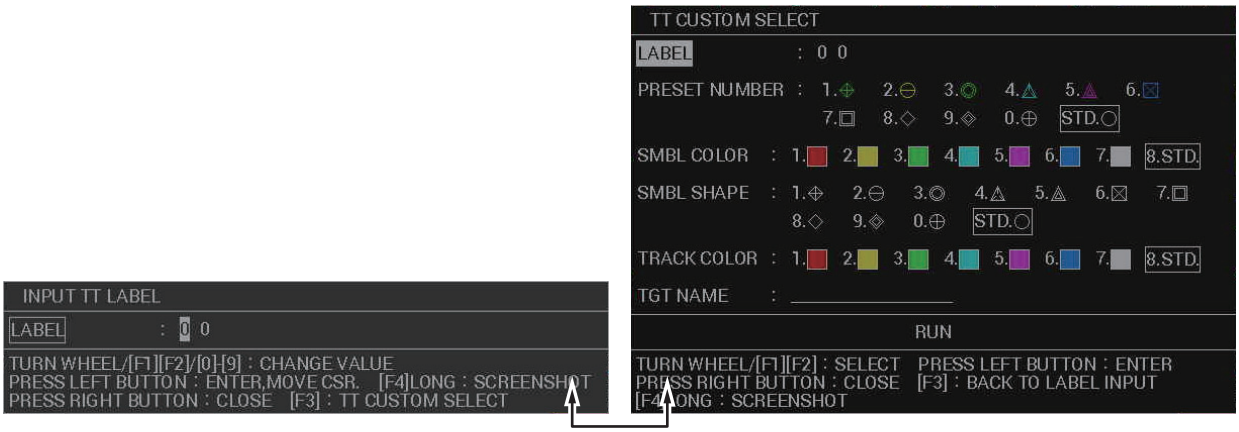


How to select a symbol from the presets

Place the cursor on the TT symbol you want to change, then spin the scrollwheel. The selected target's symbol changes in numerical order. To change the attributes of each preset, see section 3.8.5.

How to change the attributes assigned to a symbol

1. Place the cursor on the symbol whose attributes you want to change, then right-click.
   The editing window appears (either [TT CUSTOM SELECT], or [INPUT TT LABEL]). Press **F3** to toggle between the windows.



Press **F3** to toggle between the two windows.

   Note: You can also left-click the TT target's data in the information box (see section 3.9.2) to show the editing window.

2. If the [INPUT TT LABEL] window is shown, press **F3** to show the [TT CUSTOM SELECT] window.
3. Referring to the following table, select the item you want to edit.

Menu item	Description
[LABEL]	Assigns a number to the target, other than the pre-assigned TT number. **Note 1:** The value set here appears in front of the name (assigned at [TGT NAME]). If no name is set, only the label appears with the target. **Note 2:** If "00" is set as the value, the label does not appear on-screen.
[PRESET NUMBER]	Assign preset attributes to the symbol. **Note:** You can change the symbol color, symbol shape and track color assigned to the preset.
[SMBL COLOR]	Assign a color to the TT symbol.
[SMBL SHAPE]	Assign a shape to the TT symbol.
[TRACK COLOR]	Assign a color to the track for the selected target.
[TGT NAME]	Assign a name to the target. **Note:** The software keyboard appears inside the editing window. See section 1.5.3 for how to use the keyboard.

4. Select [RUN] to apply the changes and close the editing window.

3.8.5 How to change the attributes for a TT symbol preset

The attributes for each preset can be customized to suit your preferences.

1. Open the menu.
2. Select [5 TT•AIS].
3. Select [5 TT].

4. Select [5 CUSTOMIZE TT DISPLAY]. The [TT CUSTOM SETTINGS] window appears.

5. Select [PRESET NO.].
6. Select the preset number whose attribute you want to change. The settings indicated at [SMBL COLOR], [SMBL SHAPE], [TRK COLOR] and [TGT NAME] change according to the preset selected.
7. Referring to the following table, select the item you want to edit.

Menu item	Description
[SMBL COLOR]	Change the symbol color for the selected preset.
[SMBL SHAPE]	Change the symbol shape for the selected preset.
[TRACK COLOR]	Change the track color for the selected preset.
[TGT NAME]	Assign/change the target name. **Note:** The software keyboard appears inside the editing window. See section 1.5.3 for how to use the keyboard.

8. Right-click to close the window.

3.9 How to Display/Remove Target Data

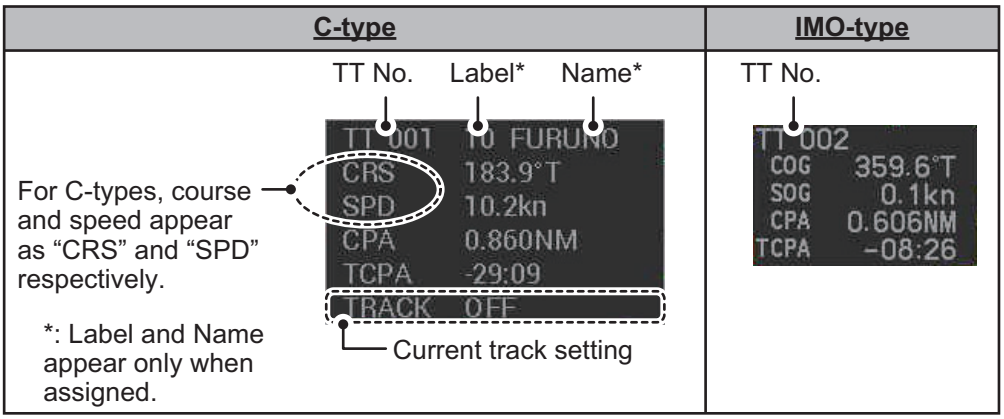
The TT mode provides the full functionality of TT as required by the IMO Resolution A.823(19) and IEC 62288, including display of range, bearing, course, speed, CPA and TCPA of all tracked targets.

The target bearing is shown in relative bearing in the HEAD UP mode and true bearing in the COURSE UP, NORTH UP and True Motion modes, with the suffix "R" (Relative) or "T" (True).

The target speed and course are shown as speed over the ground or speed through the water depending on speed source.

3.9.1 TT pop up information

The TT pop-up shows abbreviated TT data for the selected TT. Simply put the cursor on the TT symbol to show the pop-up. The following figure shows pop-up examples.



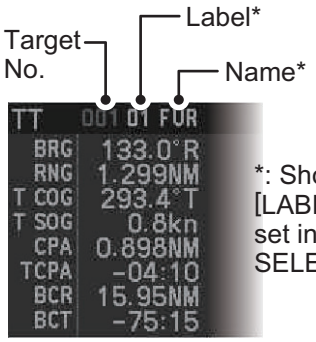
The popup can be enabled or disabled with the following procedure.

1. Open the menu.
2. Select [5 TT•AIS].
3. **For IMO-types**, select [4 TT•AIS SYMBOL], then select [0 NEXT].
   For C-types, select [3 TT•AIS SYMBOL], then select [0 NEXT].
4. Select [6 TT POP-UP INFO].
5. Select [ON] or [OFF] as required.
6. Close the menu

3.9.2 How to show target data in the data display area

Place the cursor on a desired tracked target and left-click, or press the **ACQ** key. The target's symbol is surround with a broken square and the selected TT target's data is shown in the data display area.

Note: This feature requires [2 TGT DATA/ACQ SETTING] on the second page of the [CURSOR] menu to be set as [ANY] or [TT ONLY].



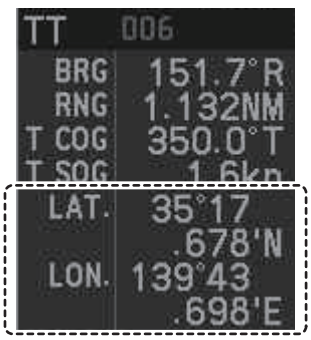
*: Shown for C-types only when [LABEL] and [TGT NAME] are set in the [TT CUSTOM SELECT] settings window.

Indication	Description
Target No.	Number assigned by the system to this target. Target numbers which have become vacant are not re-used until the system is restarted, or the system tracks more than 100 targets.
Label	Label number assigned to this target (C-types only).
Name	Name assigned to this target (C-types only).
BRG	Bearing from own ship to target in relative (R) or True (T) reference.
RNG	Range from own ship to target.
T COG	Relative (R) or True (T) Course Over Ground of target. Displayed as "T CTW" where speed input is set to [LOG(WT)]. Displayed as "R CRS" where speed data is not available.
T SOG	Relative (R) or True (T) Speed Over Ground of target. Displayed as T STW where speed input is set to [LOG(WT)]. Displayed as R SPD where speed data is not available.
CPA*	Closest Point of Approach of target to own ship.
TCPA*	Time to CPA of target to own ship.
BCR*	Bow crossing range of target.
BCT*	Bow crossing time of target.

*: Not shown for C-types when the following menu settings (see section 1.48) are applied:

- Main menu → [7 INFORMATION BOX] → [7 TARGET DATA] is set to [5 BOX].
- Main menu → [7 INFORMATION BOX] → [8 DISPLAY TT COORDS] is set to [ON]. When [8 DISPLAY TT COORDS] is set to [ON], these items are replace with the latitude/longitude of the target, as shown in the following example.

CPA, TCPA, BCR and BCT are replaced with the lat/lon coordinates for the target.



The number of TT data that can be displayed at one time in the information box depends on your settings for [7 INFORMATION BOX] (see section 1.48).

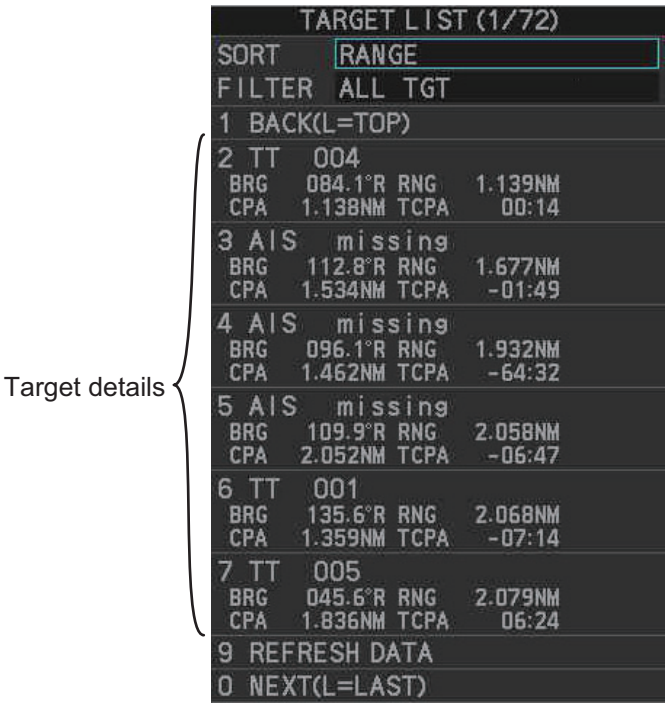
To remove the target data, place the cursor on a desired tracked target and press the **TARGET CANCEL** key, left-click. The select target's data is removed from the data display area.

3.9.3 How to display, hide and sort the target list

The target list provides a comprehensive data display of all TT (and AIS) targets being tracked (up to 1303 targets on total).

How to display/hide the target list

Select the [TGT LIST] menu item at the bottom-right of the screen, then left-click. The target list appears inside the information box.



The following operations are available when the list is open:

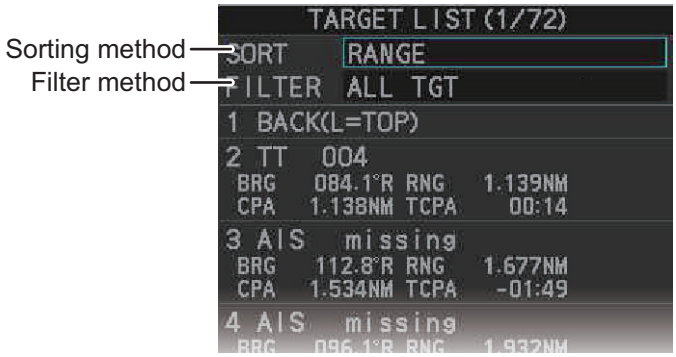
- Go to next page: Click [0 NEXT].
- Go back one page: Click [1 BACK].
- Go to the top (first) page of the list: Select [1 BACK], then press and hold the **left-button**.
- Go to the last (bottom) page of the list: Select [0 NEXT], then press and hold the **left-button**.
- Refresh the list: Click [9 REFRESH DATA].

To hide the list, do one of the following:

- Place the cursor inside the list, then right-click.
- Press the **MENU** key.
- Left-click the [MENU] box.

How to sort the target list

1. With the target list displayed, place the cursor on the sorting method indication to the right of [SORT] ("CPA" in the example below). The indication is highlighted.
2. Spin the scrollwheel to select the sort method, referring to the table below, then left-click.



Sorting method	Description
[CPA]	Targets are sorted in order from closest to farthest CPA.
[TCPA]	Targets are sorted in order from shortest to longest TCPA.
[BCR]	Targets are sorted in order from closest to farthest BCR.
[BCT]	Targets are sorted in order from shortest to longest BCT.
[RANGE]	Targets are sorted in order from closest to farthest range.
[SPEED]	Targets are sorted in order from fastest to slowest.
[NAME]	Targets are sorted in Alphabetical order.

Note: Targets with no data are sorted to the back of the list, regardless of the selected sorting method.

3. Set the filter method in the same manner.

Filter method	Description
[TT ONLY]	Show only TT targets.
[AIS ONLY]	Show only AIS targets.
[DISP FILTER]	Show only filtered targets.
[ALL TGT]	Show all targets (ignore filter settings).

4. Close the menu.

3.10 Vector Modes

Target vectors can be displayed relative to own ship’s heading (Relative) or North (True).

Note: IMO recommends the use of true vector mode in sea stabilization or relative vector mode for collision avoidance.

3.10.1 Description of vectors

Stabilization modes

It is important to select the optimum stabilization mode for the radar display. To assess risk of collision the relative motion of a target gives the clearest indication of CPA and may be monitored by observing either the direction of the target's relative trail, or the CPA predicted by the relative vector. By default, relative motion displays relative target trails and true motion displays true target trails. Where true target trails is selected, a sea stabilized display will indicate all targets' motion through the water. A ground stabilized display will indicate all targets' motion over the ground.

In coastal, estuarine and river waters where a significant set and drift may be experienced, a sea stabilized display will produce significant target trails from all fixed (stationary) objects possibly producing an unacceptably high level of clutter and masking. In such circumstances a ground stabilized display may reduce its effect and enable the observer to detect clearly the trails of moving targets, thus enhancing the observer's situational awareness.

However, the display should be considered only as an approximation of the course and speed made good over the ground. Among other factors, the accuracy of the ground-stabilization is affected by inaccuracies in speed and heading inputs as well as radar measurement imprecision and will require the display to be readjusted periodically. The information displayed should be interpreted with due regard to these factors.

Note: It should be noted that in determining a target's aspect by radar; the calculation of its true track is dependent on the choice and accuracy of the own ship's course and speed input. A ground-stabilized target plot may accurately calculate the ground track of the target, but the target's heading may be significantly different from its track when experiencing set, drift or leeway. Similarly, a sea stabilized target plot may be inaccurate when own ship and the target, are experiencing different rates of set, drift or leeway.

Ground stabilization and sea stabilization

Target vectors can be ground stabilized or sea stabilized in the True Motion mode. To select speed over the ground or speed through the water data, open the page from the menu. Select for ground stabilization or for sea stabilization. The vector mode indication shows the stabilization mode in the true motion as [TRUE-G] or [TRUE-S].

Sea stabilization is a mode where own ship and all targets are referenced to the sea using a compass heading and single-axis log water speed inputs in the true motion mode. Ground stabilization is a mode where own ship and all targets are referenced to the ground using the ground track or set and drift inputs. If the accuracy seems unsatisfactory, enter set and drift corrections. Note that set and drift should not be used when the radar is displaying AIS targets.

True vector

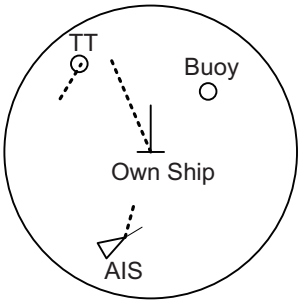
In the true motion mode, all fixed targets such as land, navigational marks and ships at anchor remain stationary on the radar screen with vector length zero. But in the presence of wind and/or current, the vectors appear on fixed targets representing the reciprocal of set and drift affecting own ship unless set and drift values are properly entered.

In the true vector mode, there are two types of stabilization: ground stabilization (TRUE-G) and sea stabilization (TRUE-S). The stabilization mode is automatically selected according to speed selection, as shown in the table below. Manual selection is available from the [SPD] menu at the top-right of the screen.

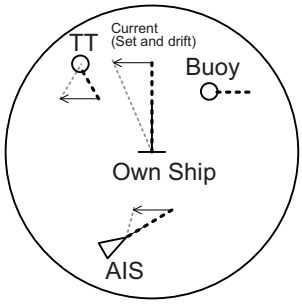
Speed selection	True vector mode
LOG(WT)	TRUE-S
LOG(WTC)	TRUE-G
LOG(BT)	TRUE-G
EPFS(BT)	TRUE-G
REF(BT)	TRUE-G
MAN(WT)	TRUE-S
MAN(WTC)	TRUE-G

Relative vector

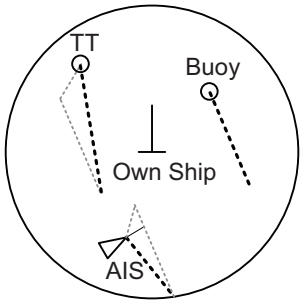
Relative vectors on targets that are not moving over the ground such as land, navigational marks and ships at anchor will represent the reciprocal of own ship's ground track. A target whose vector passes through own ship is on a collision course. (Dotted lines in the figure are for explanation only.)



True vectors in ground stabilization



True vectors in sea stabilization



Relative vectors

3.10.2 Vector mode and vector length

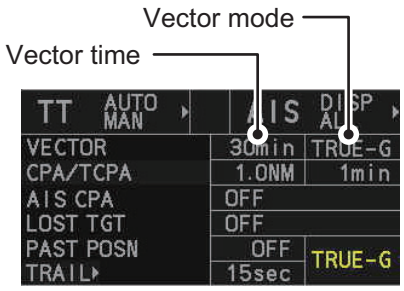
Vectors can be displayed in true or relative modes. Vector lengths can be set between 30 seconds and 60 minutes.

The vector tip shows an estimated position of the target after the selected vector time elapses. It can be valuable to extend the vector length to evaluate the risk of collision with any target.

How to change the vector mode

Place the cursor on the vector reference indication in the [Vector] box, then left-click to cycle through the following settings.

[REL] → [TRUE-G/TRUE-S] → [REL]...



How to change the vector time

Place the cursor on the vector time indication in the [Vector] box, then left-click to cycle through the following settings.

[6min] → [10min] → [20min] → [30min] → [45min] → [60min] → [30sec] → [1min] → [3min] → [5min] → [6min]...

You can also spin the scrollwheel to change the vector time in one-minute increments.

Note: When [7 VECTOR TIME LINK] is set to [LINK RANGE], the trail time is also automatically adjusted as the range changes, to provide a “normalized” vector. While linked, the vector time indication appears in yellow color.

3.10.3 How to change the vector appearance (C-types only)

By default, vectors appear as a dashed line. For C-types, you can show vectors as a solid line with the following procedure.

1. Open the menu.
2. Select [5 TT•AIS].
3. Select [3 TT•AIS SYMBOL], then select [0 NEXT].
4. Select [2 TT VECTOR LINE].
5. Select [DASHED] or [SOLID] as required.
6. Close the menu

3.11 Past Position Display

The past position display shows equally time-spaced dots marking the past positions of any targets being tracked.

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 will be uneven. If it changes the course, its plotted course will not be a straight line.

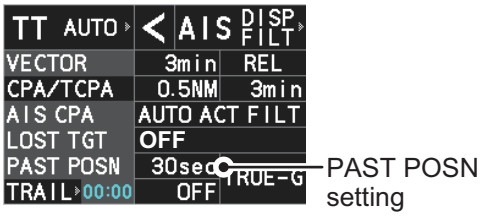
Past position orientation, true or relative, is controlled with [TRAIL MODE] in the [TRAIL] context menu. To adjust the trail orientation, see section 1.37.1.

3.11.1 How to display past position points and select the plotting interval

Select the [PAST POSN] setting, then left-click to cycle through the following settings.

[OFF] → [30sec] → [1min] → [2min] → [3min] → [6min] → [OFF]...

When [OFF] is selected, all past position tracks are deleted.



Note: The [PAST POSN] setting is hidden when [SIMPLE] display mode is used. To change the setting in [SIMPLE] mode, first restore [NORMAL] display mode, adjust the setting, then return to [SIMPLE] mode. See section 1.9 for how to change the display mode.

3.11.2 How to select the number of past position points to be displayed

1. Open the menu.
2. Select [5 TT•AIS].
3. **For IMO-types**, select [4 TT•AIS SYMBOL].
   For C-types, select [3 TT•AIS SYMBOL], then select [0 NEXT].
4. **For IMO-types**, select [5 TT•AIS PAST POSN POINTS].
   For C-types, select [3 TT•AIS PAST POSN POINTS].
5. Select [5] or [10] as appropriate.
6. Close the menu.

3.11.3 How to change the color of TT tracks (C-types only)

You can change the color of the TT tracks with the following procedure.

1. Open the menu.
2. Select [5 TT•AIS].
3. Select [3 TT•AIS SYMBOL].
4. Select [3 TT SYMBOL COLOR].
5. Select the desired color you want to show the TT tracks in.
6. Close the menu.

3.12 Set and Drift

Set, the direction in which a water current flows, can be manually entered in 0.1-degree steps. Drift, also known as “Rate”, or the speed of the current, can also be entered manually in 0.1-knot steps.

When course through water and speed through water are available, activate set and drift to get course over ground and speed over ground.

Set and drift corrections are beneficial for increasing the accuracy of vectors and target data. Refer to the tide table on board the ship for setting information. These values are applied to all targets. If stationary targets have vectors, set and drift values should be adjusted until they lose vectors.

To enter set and drift do the following:

1. Open the menu.
2. Select [7 INFORMATION BOX].
3. Select [2 OWN SHIP INFO].
4. Select [3 SPEED]. The [SPEED] menu appears.
   Note: You can also access the [SPEED] menu from the on-screen box. Place the cursor on the [SPD ▶] indication in the speed box at the top-right of the screen, then right-click.
5. Select [4 SET DRIFT].
6. Select [ON], then press the **ENTER MARK** key. The setting can now be adjusted and [SET] is selected.
7. Spin the scrollwheel to select the appropriate setting (Setting range: 000.0° to 359.9°), then left-click. The [DRIFT] setting is now selected.
8. Spin the scrollwheel to select the appropriate setting (Setting range: 00.0kn to 19.9kn), then left-click.
9. Close the menu.

Note 1: Set and drift are available when using manually input speed, speed through the water. The speed source is shown as "WTC" (Water Tracking Count).

Note 2: Set and drift should be checked periodically for correctness.

Note 3: When speed data input from the position sensor is valid, set and drift are not adjustable.

3.13 Collision Alarm (CPA, TCPA)

This radar calculates CPA and TCPA by using own ship and relative target positions.

The TT continuously monitors the predicted range at the Closest Point of Approach (CPA) and predicted time to CPA (TCPA) of each TT. When the predicted CPA of any TT becomes smaller than a preset CPA range and its predicted TCPA less than a preset TCPA limit, the audio alarm sounds and "TT DANGER OF COLLISION" appears (in red, flashing) in the Alert Box. In addition, the symbol of the offending TT is red and flashes together with its vector.

⚠ CAUTION

CPA/TCPA Alarm

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

This feature, when used correctly, helps prevent the risk of collision by alerting you to threatening targets. It is important that GAIN, A/C SEA, A/C RAIN and other radar controls are properly adjusted.

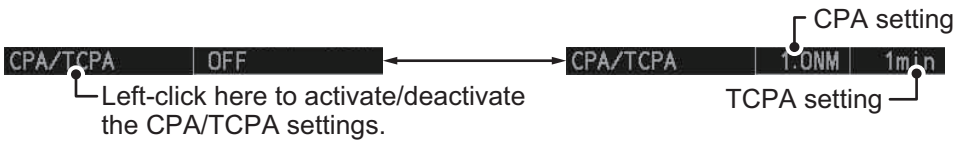
CPA and TCPA ranges must be set up properly taking into consideration the size, tonnage, speed, turning performance and other characteristics of own ship.

The reference point for CPA and TCPA calculation can be selected from antenna position or conning position. For further details, see section 1.51.

3.13.1 How to set the CPA and TCPA ranges

CPA and TCPA ranges can be adjusted from the appropriate indication in the [TT] box.

1. Left-click the [CPA/TCPA] indication to activate the feature.



Note: The [CPA/TCPA] indication is hidden when [SIMPLE] display mode is used. To change the setting in [SIMPLE] mode, first restore [NORMAL] display mode, adjust the setting, then return to [SIMPLE] mode. See section 1.9 for how to change the display mode.

2. Place the cursor on the indication you wish to adjust.
3. Left-click, or spin the scrollwheel, to adjust the settings as required. The settings options are outlined in the table below.

Indication	Method	Settings options
CPA	Left-click	0.5, 1, 1.5, 2, 3, 4, 5, 6 (NM)
	Scrollwheel	0.1 to 20; 0 to 10 in 0.1 NM increments, 1 NM increments thereafter
TCPA	Left-click	1, 2, 3, 4, 5, 6, 12, 15 (minutes)
	Scrollwheel	1 to 60 minutes in 1-minute increments

3.13.2 How to acknowledge the TT collision alarm

Press the **ALARM ACK** (RCU-014) or **ALERT ACK** (RCU-031) key on the control unit, or select the [ALERT] box with the trackball then left-click to acknowledge the alarm and silence the buzzer. The alert "TT DANGER OF COLLISION" remains in the Alert Box until the dangerous situation is gone or you intentionally terminate target tracking. The symbol and vector stop flashing and are displayed in a solid red color.

Note that when the "TT DANGER OF COLLISION" alarm is generated the AIS display is automatically turned on.

3.14 Acquisition Zone

The acquisition zone functions both to alert you targets in a specific area and acts as an automatic acquisition area when automatic target acquisition is active. Any targets entering the zone will be automatically acquired.

When a target enters an acquisition zone, the buzzer sounds and the indication "TT NEW TARGET" (or "AIS NEW TARGET") appears (in yellow-orange) in the Alert Box. The symbol of the offending target is red and flashing. Further, the AIS display is automatically turned on if it is off.

There are two types of acquisition zones available, arc and polygon, however, AZ1 can only be set as an arc.

3.14.1 How to enable the acquisition zones

1. Open the menu.
2. Select [5 TT•AIS].
3. Select [2 ACQUISITION ZONE].

4. Select [2 AZ/ALR SELECT].
5. Select [ACQUISITION ZONE].
   The [ACQUISITION ZONE] box title changes to read "AZ".

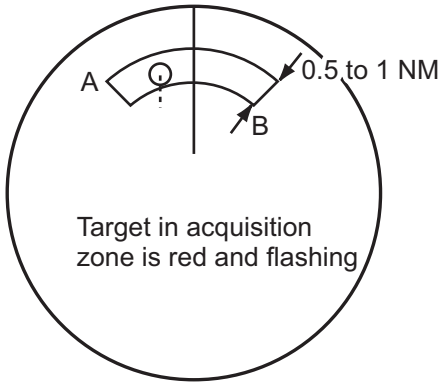
6. Close the menu.

3.14.2 How to activate the first acquisition zone (AZ1)

The No. 1 acquisition zone is available between 3 NM and 6 NM and can have a width between 0.5 NM and 1 NM. The TT/AIS acquisition zone's lines are white and dashed so as to distinguish them from the radar target alarm.

The procedure below shows how to set AZ1, using the example at the bottom of the page.

1. Place the cursor on the [1:] indication at the bottom-right of the screen, then left-click. The AZ zone setting reads "1: SET" and the cursor moves inside the operational display area.
2. Place the cursor on the acquisition zone starting point ("A" in the figure to the right), then left-click.
3. Place the cursor on the acquisition zone end point ("B" in the figure to the right), then left-click.
   The AZ zone setting now reads "1: WORK".



3.14.3 How to set a polygon acquisition zone (AZ2)

Note: This procedure is not available if [5 AZ POLYGON] in the [ACQUISITION ZONE] menu is set to [OFF].

The No. 2 acquisition zone can be set anywhere when the No. 1 zone is already in use.

Polygon zones must have at least three points, and may have a total of 10 points.

To set a polygon shaped acquisition zone:

1. Place the cursor on the [2:] indication at the bottom-right of the screen, then left-click. The AZ zone setting reads "2: SET" and the cursor moves inside the operational display area.
2. Place the cursor on the acquisition zone starting point, then left-click.
3. Place the cursor on the second point, then left-click.
4. Repeat step 3 as required to set the remaining points of the polygon zone.
5. Right-click to complete the acquisition zone set up.
   Note: If 10 points are entered, the zone is automatically completed.

Notes on acquisition zones

- If you wish to create an acquisition zone having a 360-degree coverage around own ship, set point B in almost the same direction (approx. ±3°) as point A.
- The default acquisition zone is fan shaped. It can also be a polygon having 3-10 points.
- If both acquisition zones are displayed, a maximum of four polygon points are shown.
- TT and AIS are automatically set to TT=AUTO MAN and AIS=DISP, respectively, when an AZ is activated in the following conditions:
  TT: TT=OFF or TT=MANUAL 100
  AIS:AIS FUNC=OFF or AIS DISP=OFF

3.14.4 How to sleep/deactivate an acquisition zone

1. Select the appropriate [AZ] box.
2. Sleep, or deactivate, the acquisition zone, as explained below:

   Sleeping the acquisition zone

   Left-click the box several times until the indication shows "SLEEP".

   Deactivating the acquisition zone

   Highlight the box with the cursor, the press and hold the **left-button** until the AZ box becomes blank.

   Note: When both zones ([1:] and [2:]) are active, [2:] must be deactivated before [1:] can be deactivated.
   If [1:] and [2:] are active when you try to deactivate [2:], the system releases an audible alert and shows the message "DELETE AZ2 FIRST".

3.14.5 How to acknowledge the acquisition zone alert

You can acknowledge the alert, and silence the buzzer, with one of the following methods:

- Press the **ALARM ACK** (RCU-014) or **ALERT ACK** (RCU-031) key;
- Highlight the [ALERT] box with the cursor, then left-click;
- Highlight the alert in the [ALERT LIST], then left-click.

3.14.6 How to select the target type to acquire (C-types only)

You can set the radar to acquire on TT targets, or both AIS and TT targets. To select the target type to acquire, do the following:

1. Open the menu.
2. Select [5 TT•AIS].
3. Select [2 ACQUISITION ZONE].
4. Select [3 TARGET TYPE TO ACQUIRE].
5. Select [TT AND AIS] or [TT ONLY] as appropriate.
6. Close the menu.

3.14.7 How to change the acquisition zone reference

The acquisition zone can be referenced to heading or North using the following procedure:

1. Open the menu.
2. Select [5 TT•AIS].
3. Select [2 ACQUISITION ZONE].
4. Select [4 AZ STABILIZATION].
5. Select [STAB HDG] to reference heading, or [STAB NORTH] to reference North, then press the **ENTER MARK** key.
6. Close the menu.

3.14.8 How to set acquisition zone shape and stabilization

The shape of the No. 2 acquisition zone can be a sector or a polygon having up to 10 points. (The shape of the No.1 acquisition zone is always a sector.)

1. Open the menu.
2. Select [5 TT•AIS].
3. Select [2 ACQUISITION ZONE].
4. Select [5 AZ POLYGON].
5. Select the appropriate setting.

Setting	Description
[OFF]	Acquisition zone is a sector; number of points is limited to four. Stabilized against land.
[STAB GND]	Polygon having 3-10 points. Stabilized against ground.
[STAB HDG]	Polygon having 3-10 points. Stabilized against heading.
[STAB NORTH]	Polygon having 3-10 points. Stabilized against North.
[AROUND CHECK AREA]*	Sets a check area around own ship. See the topic on the following page for details and settings.

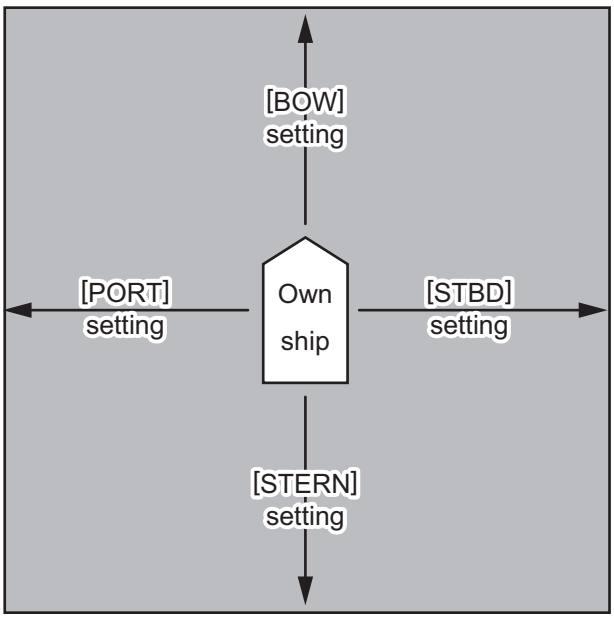
*: Shown only for C-types.

6. Close the menu.

How to set the check area around own ship (C-type only)

When [5 AZ POLYGON] is set to [AROUND CHECK AREA], the area details must be set. To setup the check area, do the following procedure. This procedure is abbreviated, and takes into consideration that [AROUND CHECK AREA] is selected.

1. Select [6 CHECK AREA SETTING].
2. Referring to the figure below, use the number keys to enter a distance for [PORT], [STBD], [BOW] and [STERN]. You can also spin the scrollwheel, then left-click to enter these values.



The area shown in gray is the “check area”.
The available setting range for all four values is [0.0NM] to [16.0NM]. The default setting for all four values is [1.0NM].

3.15 Trial Maneuvers (IMO-types only)

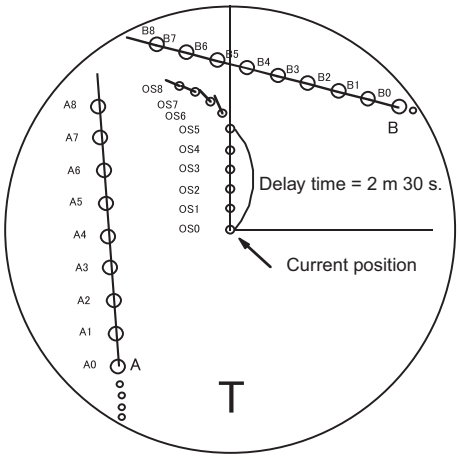
The trial maneuver feature simulates the effect of own ship's movement against all tracked targets, without interrupting the updating of target information. It is available for use with the TT and AIS functions. For more accurate results, use sea stabilization (water tracking).

3.15.1 Types of trial maneuvers

There are two types of trial maneuvers: dynamic and static.

Dynamic trial maneuver

A dynamic trial maneuver displays predicted positions of the tracked targets and own ship. You enter own ship's intended speed and course with a certain "delay time." Assuming that all tracked targets maintain their present speeds and courses, the targets' and own ship's future movements are simulated in 0.5-second increments indicating their predicted positions in 30-second intervals as illustrated in the right figure.



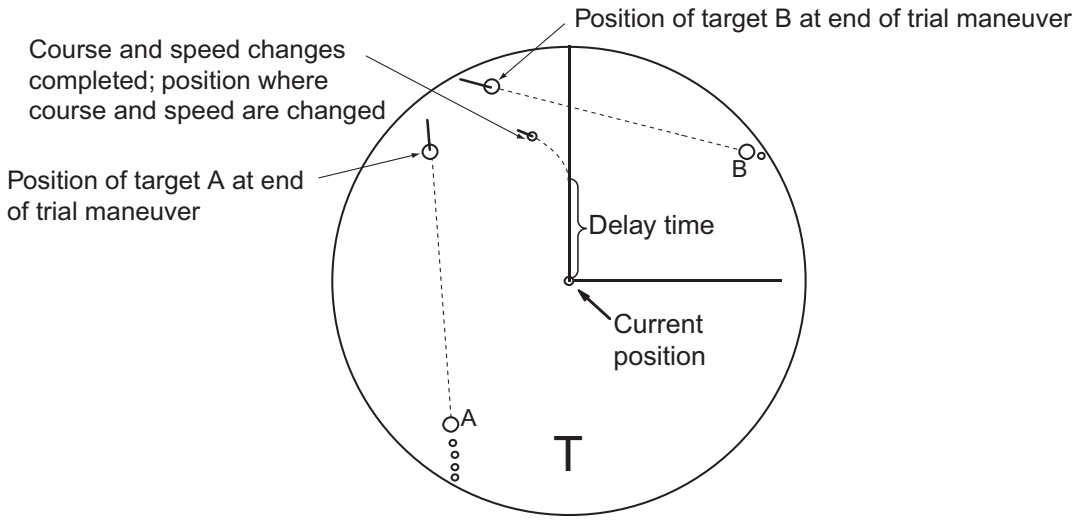
The delay time represents the time lag from the present time to the time when own ship will actually start to change her speed and/or course. You should therefore take into consideration own ship's maneuvering characteristics such as rudder delay, turning delay and acceleration delay. This is particularly important on large vessels. Regardless of how much the delay is set the situation starts immediately and ends in a minute.

In the example shown below, own ship will advance straight ahead (even after a maneuver) for a delay time of 2:30 and alters speed and course until operator-specified intended speed and course are achieved (position OS7 in this example).

Static trial maneuver

The static trial maneuver shows the relationship between your ship and tracked targets at the completion of the trial maneuver. The expected position of TTs at the end of the trial maneuver are shown on the display.

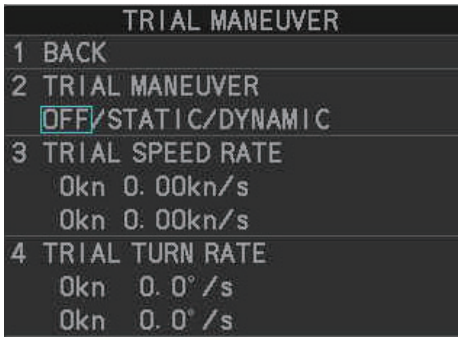
By shortening and extending the trial time you can find the safe time to make a maneuver. Thus, the static trial maneuver will be convenient when you wish to know the maneuver result immediately.



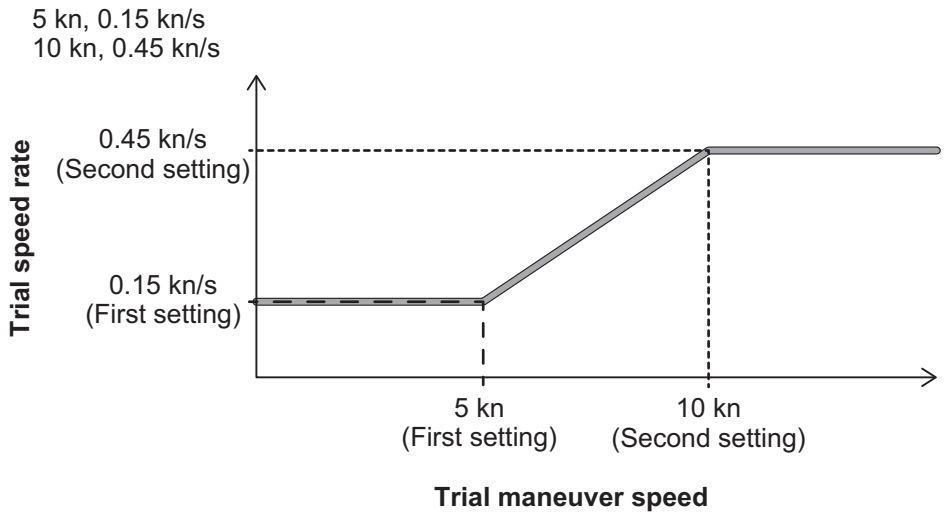
3.15.2 How to perform a trial maneuver

To set up and perform a trial maneuver, do the following:

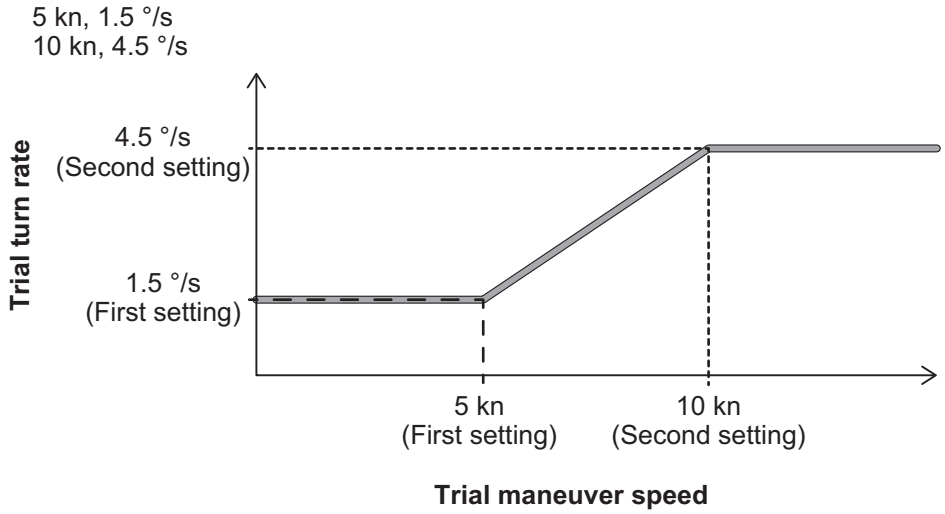
1. Open the menu.
2. Select [5 TT•AIS].
3. Select [3 TRIAL MANEUVER].
4. Select [2 TRIAL MANEUVER].
5. Select [OFF], [STATIC] or [DYNAMIC] as appropriate.
6. Select [3 SPEED RATE].
7. Set the upper and lower speed rate as required.
8. Select [4 TRIAL TURN RATE].
9. Set the upper and lower turn rate for the trial as required.
   Note: Two sets of trial speed and trial turn rate combinations are provided. This is done to provide accurate trial maneuver results for various ship's speeds and turn rates.



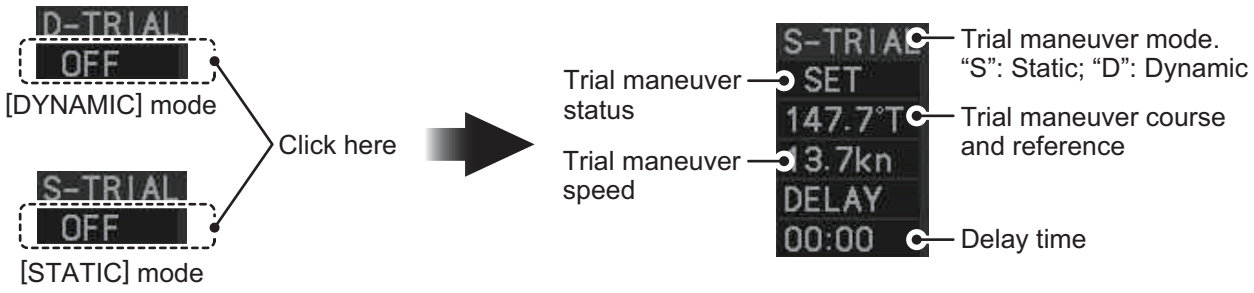
Setting example for [3 TRIAL SPEED RATE]



Setting example for [4 TRIAL TURN RATE]



10. Close the menu
11. Highlight the [TRIAL] status indication in the [TRIAL] box, then left-click. The indication changes from "OFF" to "SET" and the trial maneuver settings appear.



Note: The initial indications for course and speed are derived from own ship's current course and speed at the time when the trial maneuver set up starts.

12. Select the trial maneuver course and reference indication, then left-click.
13. Spin the scrollwheel to set the course, then left-click.
    The reference is not changeable here.
14. Set the speed in the same manner as the course.

15. Select the delay time indication, then left-click.
16. Spin the scrollwheel to set the amount of delay. This is the time after which own ship takes a new situation, not the time the simulation begins. Change the delay time according to own ship loading condition, etc.
    The time indication depends on trial type:
    [DYNAMIC]: The position of your ship and TTs is displayed every 30 seconds and updating occurs every 0.5 seconds.
    [STATIC]: The position of your ship and TTs when set course and speed are reached are displayed. Put the cursor in the Trial time indication and roll the scrollwheel. Increase or decrease the time to get a safe maneuver. If a maneuver is unsafe, change speed, course and delay until it is safe.
17. Highlight the [TRIAL] status indication, then left-click. The indication changes from "SET" to show a timer for the trial maneuver and the maneuver begins.

The trial maneuver takes place with the letter "T" displayed at the bottom of the screen. The time appears at the top-right position on the display. If any TT is predicted to be on a collision course with own ship (that is, the target ship comes within preset CPA/TCPA limits), the target plotting symbol flashes. If this happens, change own ship's trial speed, course or delay time to obtain a safe maneuver.

3.15.3 How to stop the trial maneuver

You can stop the maneuver at any time by placing the cursor on the [TRIAL] status indication, then press and hold the left mouse button until "OFF" is shown.

When [DYNAMIC] is selected as the maneuver type, the maneuver automatically stops when the trial timer reaches 60 minutes.

When [STATIC] is selected as the maneuver type, the maneuver automatically stops when there is no operation of the [TRIAL] box for more than one minute.

3.16 TT System Messages

There are four main reasons the TT may trigger the audio and visual alerts:

- Collision alarm
- Acquisition zone alert
- Lost target alert
- Target capacity

You can acknowledge visual alerts and silence the audio alerts with one of the following methods:

- Press the **ALARM ACK** (RCU-014) or **ALERT ACK** (RCU-031) key
- Click the [ALERT] box, at the bottom-right of the screen.
- Click the alert in the [ALERT LIST].

Alert message	Priority	Meaning	Action required
TT DANGER OF COLLISION	Alarm	A tracked target is on collision course with your vessel.	Take evasive action or terminate tracking of TT.
TT NEW TARGET	Warning	Tracked target has entered an acquisition zone. The tracked target's symbol is red and flashing.	Confirm the tracked target, then press the **ALARM ACK** (RCU-014) or **ALERT ACK** (RCU-031) key.
TT TARGET LOST	Warning	When the system detects a loss of a tracked target, the lost tracked target symbol appears in red and flashes. At the same time, an audio alert is produced for one second. The lost target mark disappears from the screen after the lost target alert is acknowledged.	Confirm the lost target, reacquire if necessary.
REF TARGET LOST	Warning	When the system detects a loss of a reference target, the target symbol turns red and flashes. At the same time, an audio alert is produced for one second. The reference target mark disappears from the screen after the reference target alarm is acknowledged.	To continue using a referenced target for speed input, select another tracked target.
TT TARGET FULL (AUTO) or (MAN)	Warning	Appears when capacity for automatically (manually) acquired targets is full.	To continue acquiring targets, cancel tracking for unnecessary targets.
TT TARGET 95% (AUTO) or (MAN)	Caution	Appears when capacity for automatically (manually) tracked targets is 95% full.	

3.17 TT Simulation Mode

You can simulate the risk of a collision by using the TT simulation mode. This function can be used for familiarization training for your crew. The simulation can be terminated at any time by pressing the **STBY TX** key.

1. Open the menu.
2. Select [9 INITIAL SETTINGS].
3. Select [7 TESTS].
4. Select [4 TT SIMULATION MODE].

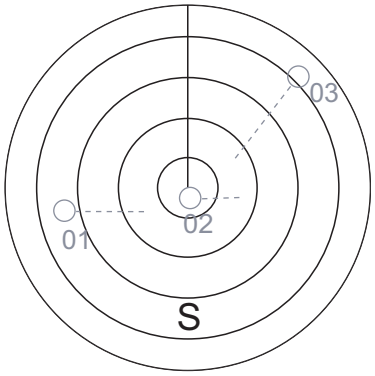
The normal operation is suspended then three simulated targets appear on the display.

The indication "S" appears at the bottom of the effective display area during the simulation mode. The simulation may be terminated any time by going to the STBY mode.

Three simulated targets move as the following table. The simulated target is automatically generated with the relative movement in the following table based on own ship's movement at the start of simulation mode.

Note: If own ship moves after the start of simulation mode, the movement of the simulated target is not matched with the values in the following table.

	Range (R)	Bearing (R)	Speed (R)	Course (R)	CPA	TCPA
Target 01	9.5 NM	270.0°	20.0 kn	90.0°	0.0 NM	28.5 min
Target 02	1.1 NM	333.0°	10.2 kn	90.2°	1.0 NM	2.9 min
Target 03	9.3 NM	45.0°	19.9 kn	225.1°	0.0 NM	28.0 min



Place the cursor on a target, then press the **ACQ** key to display the target data.

Acquire the simulated targets after the TT simulation mode is performed. The tracking state changes from unstable to stable and the vector appears. You can simulate the movement of each function with changing true/relative vector, stabilization through the water/over the ground, range or length of vector.

Repeat the check for all targets.