2.4 ARPA FUNCTION

This chapter describes the operation of the automatic radar plotting aid (ARPA).

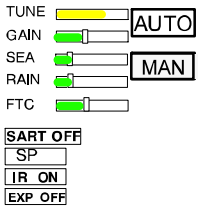
NOTE

The NSC ARPA information is considered to assist decision making in the current situation.
The resulting assessment with regard to avoiding collisions must be made independently in accordance with the valid regulations!

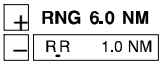
2.4.1 General Information

- **Requirements for optimum ARPA support**

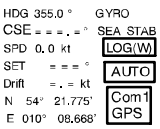
The following requirements must be met on the NSC Radar to achieve optimum ARPA functionality.



– The sensitivity controls are optimally adjusted for the current weather conditions



– ***Before you start to use this function you need to select a RANGE higher than 6 NM for the ZONE settings.***
The zone might not be visible at lower ranges.



– **Heading** e.g. gyro and **Speed** (log, course over water (W) or course over ground (B))

- **Target acquisition**

can be used to manually or automatically acquire up to 70 targets.
The tracking data for selected targets is displayed in the ARPA information window.

- **ARPA alarms**

ARPA displays alarm messages (see also chapter 2.3.6.4) and artificial symbols (see ARPA SYMBOLS) visually and acoustically.

– “Dangerous Targets Alarm”
  This alarm is triggered as soon as a tracked target exceeds the set limits for CPA or TCPA (see chapter 2.4.2).

– “Guard Zone Alarm”
  This alarm is triggered as soon as an untracked target enters an acquisition / guard zone.

– “Target Lost”
  This alarm indicates that the tracked target has been lost.

– “Target Overflow”
  This alarm is triggered if more than 70 targets have been acquired. This situation can be resolved by deleting acquired targets that are of no interest.

- **ARPA symbols**

When using the ARPA function, the radar video displays various artificial symbols that describe the following situations.

SHOW	Indicates that target data is displayed in the ARPA INFO window.
TEMP	After acquisition, the target is observed for a set period of time.
SHOW	This state is indicated if the current CPA/TCPA collision conditions are met. The target vector flashes.
CONTACT	This state describes a target which has entered the warning/acquisition zone. The symbol flashes.
LOST	This state is indicated if a target has been lost for a short time. The target has passed the warning and acquisition zones.
T TRIAL	This state is indicated if the trial maneuver is activated. The symbol flashes.
TRAIL SITUATION	This state is indicated if the current CPA/TCPA collision conditions are met in the trial maneuver. The symbol flashes.
XX TEST	This state is indicated if the test function has been called up. The symbol flashes.
GROUND	Ground referencing.

Figure: 2–34 ARPA display symbols

- **ARPA colors**

The NSC Radar ARPA function includes the following color assignments.

– Ship heading marker, SHM	– WHITE
Vector (TRUE)	– PURPLE
– Tracked target	– RED –
Vector	– RED –
Past Pos	– RED –
Trails	–GRAY–
– CPA/TCPA zone	– RED –
– Acquisition zone	– YELLOW –
– Guard zone	– RED –
– Exclusion zone	– GREEN –
– Artificial ARPA symbols (PCP/CPA)	– RED –

2.4.2 MANUAL PLOTTING – ACQ TGT –

Targets can be manually acquired using the trackball and the cursor.

The target information (ARPA INFO softkey) can include slight tolerances caused by possible influencing parameters such as weather conditions, heading sensor tolerance or log sensor tolerance.

- Click the softkey
  Position the cursor on the object identified as the target; press the **Left** button.
  The target is acquired by the computer and given its synthetic symbol, corresponding to the tracking status (TRACKED, MISSED, LOST,..).

2.4.3 AUTOMATIC PLOTTING – ARPA MENU –

Automatic plotting means that the radar can acquire and track targets automatically.

The operator can define acquisition zones.
As soon as a target enters such a zone, it is plotted and tracked by the radar.

ARPA acquisition zones

- CPA/TCPA limits
- Acquisition zone
- Guard zone
- Exclusion zone

NOTE

Despite all the advantages of automatic target acquisition, it may be the case that:
Certain targets cannot be acquired due to the current weather conditions.
Targets cannot be acquired due to the set acquisition zone.
Targets cannot be acquired due to their size and material.

The target information (ARPA INFO softkey) can include slight tolerances caused by possible influencing parameters such as weather conditions, heading sensor tolerance or log sensor tolerance.

2.4.4 CPA/TCPA

ARPA constantly evaluates the closest point of approach (CPA) and the time to closest point of approach (TCPA) status of each tracked target.

This CPA/TCPA zone is available with predefined values.
The CPA/TCPA values are generally ship–specific and must be adapted to the profile of the ship.
The ship's profile includes features such as stopping distance, sea area and visibility.

Acquired targets that move inside the radius (CPA) or the time threshold (TCPA) generate a "CPA/TCPA Alarm" in the message display and the relevant target is simultaneously assigned a flashing symbol.

The CPA/TCPA zone can be shown or hidden in the radar video as required.

2.4.4.1 Determining the CPA/TCPA radius

The CPA/TCPA radius can quickly be adjusted to the desired situation as shown in Figure: 2–35.

Procedure:

Step 1 Open the ARPA menu

Step 2 Show or hide the radius in the radar video

Step 3 Edit and apply individual values for CPA and TCPA

Step 4 Complete the input

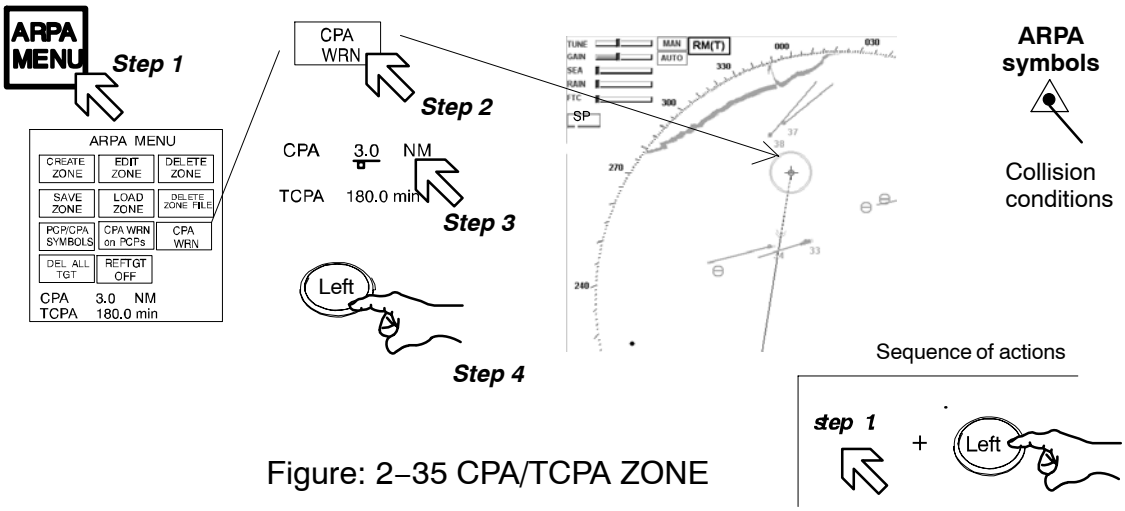


Figure: 2–35 CPA/TCPA ZONE

Result:

If a tracked target moves inside the set limits, a “Dangerous Target Alarm” is triggered.

2.4.5 CREATE ZONE form

Create zone provides 3 different ARPA zones.
Within these zones, various zone forms are available (sector, polygon or circle).
You can choose to edit each of these zone forms using the **cursor** (drag and drop) or a **text slider**.
The desired zone form is initially shown in the radar video with preset values.
The zone form can be modified in editing mode.
Editing mode can be identified by the editing marks (see Figure: 2–38).
Once acknowledged, the zone becomes effective, the editing marks are hidden and the lines are continuous.

Procedure:

Step 1 Open the ARPA menu
Step 2 Open the CREATE ZONE menu
Step 3 Select the zone form

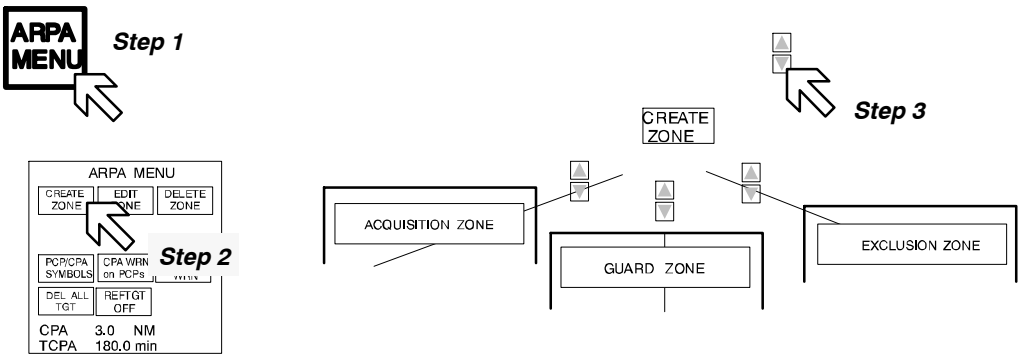


Figure: 2–36 CREATE ZONE

Acquisition zone

- The ACQUISITION ZONE is used for automatic target acquisition and subsequent target tracking.
  If a ship enters the ACQUISITION ZONE the radar outputs a “Guard Zone Alarm”. The target is automatically acquired and tracked.

NOTE

The ACQUISITION ZONE is considered to be an essential aid and information source for assessing the situation.
The decision as to whether a short–range situation will develop from this information must be made by the navigator himself!

Guard zone

- If an acquired target enters this GUARD ZONE, the radar outputs a “Guard Zone Alarm” but the target is **not** acquired and tracked.

NOTE

The GUARD ZONE and related target acquisition are only intended to draw the radar observer’s attention to a target.
The decision as to whether a short–range situation will develop from this information must be made by the navigator himself!

Exclusion zone

- If the user wants to exclude certain areas from automatic acquisition, he can create an EXCLUSION ZONE. In this zone, all possible targets will be ignored.

NOTE

Within the exclusion zone, no targets are acquired and displayed in the radar video.
The master and navigator are responsible for assessing and considering any possible collision situations that could result from this.

2.4.5.1 Select ACQUISITION zone form

The sequence of operations below can be used to select the acquisition zone form SECTOR (see Figure: 2–37).
The NSC menu provides 3 possible acquisition forms.

- **ACQUISITION ZONE SECTOR**

Procedure:

Step 1 Open the ARPA menu
Step 2 Open the CREATE ZONE menu
Step 3 Open the ACQUISITION ZONE menu
with the options SECTOR, POLYGON, RING
Step 4 Open the ACQUISITION ZONE SECTOR menu

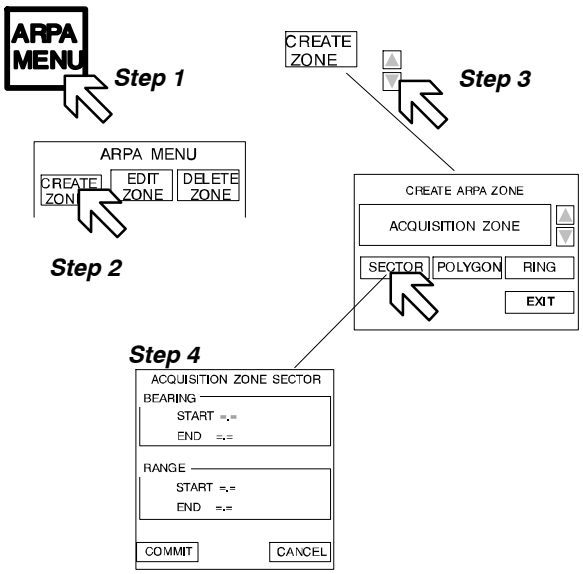


Figure: 2–37 ACQUISITION ZONE FORM

Result:

A sector with preset values appears in the direction of travel in the radar video (see Figure: 2–38).
The sector can be changed immediately using the sector editing marks (1...4).
These changes can be made directly using the cursor (drag and drop (see chapter 2.2.4.5)) or using the text lines with slider functions for BEARING and RANGE located in the ACQUISITION ZONE SECTOR display field.

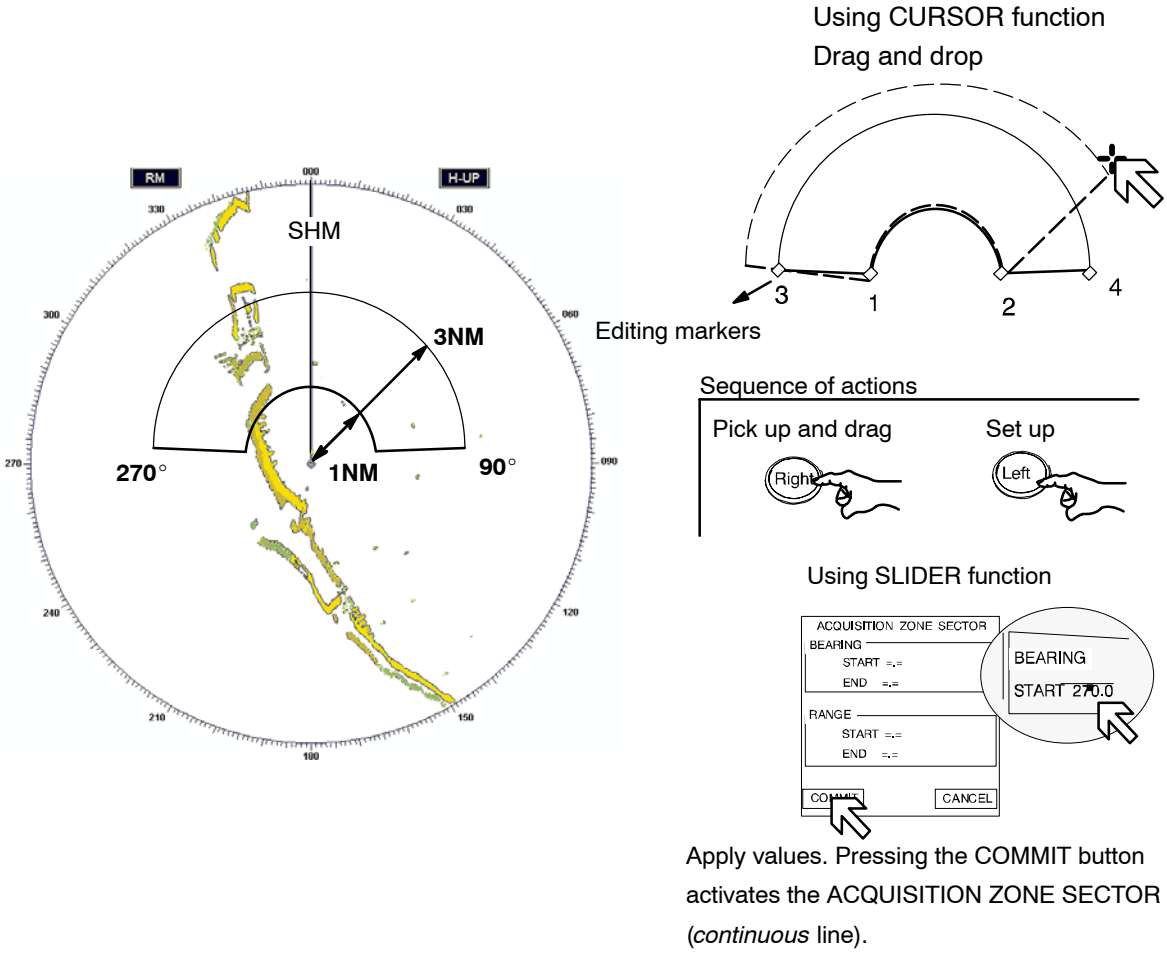


Figure: 2–38 ACQUISITION FORM SECTOR

Subsequent changes can be introduced at any time.
Several SECTORS can be displayed in the radar video.

- **ACQUISITION ZONE POLYGON**

This function allows the user to create a zone with any shape.

Procedure:

Step 1 Open the ARPA menu

Step 2 Open the CREATE ZONE menu

Step 3 Open the ACQUISITION ZONE menu containing the options SECTOR, POLYGON, RING

Step 4 Open the ACQUISITION ZONE POLYGON menu

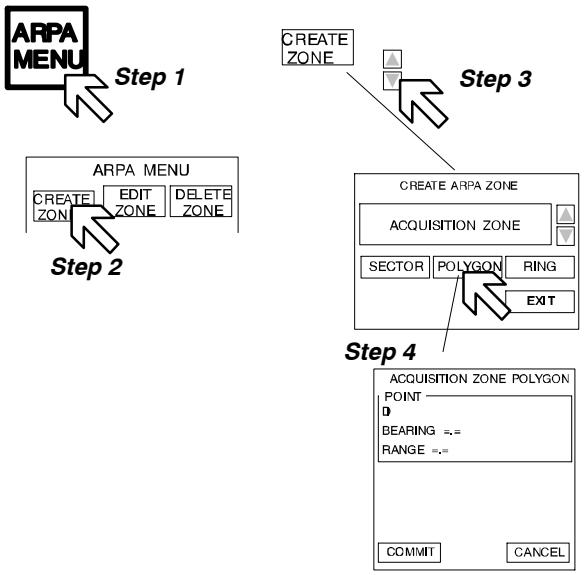


Figure: 2–39 ACQUISITION FORM POLYGON

Result:

A polygon with preset BEARING and RANGE values appears in the radar video (see Figure: 2–40).
The polygon can be individually adapted using the editing marks (1....10).
The polygon method can be edited to any shape. The default shape is shown in Figure: 2–40. It must be ensured that the ACQUISITION ZONE AREA includes the ship for the special polygon shape ACQUISITION ZONE.
These changes can be made directly using the cursor (drag and drop (see chapter 2.2.4.5)) or using the text lines with slider functions for BEARING and RANGE located in the ACQUISITION ZONE POLYGON display field.

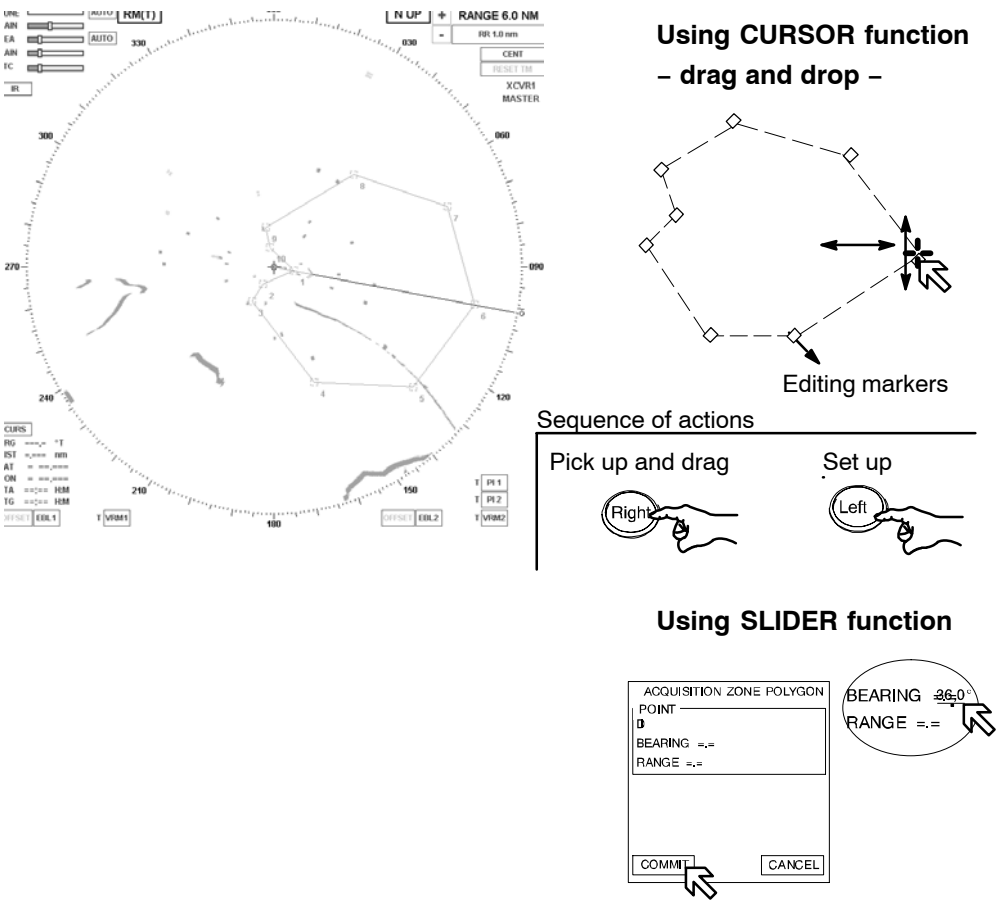


Figure: 2–40 ACQUISITION ZONE POLYGON

- **ACQUISITION ZONE RING**

Procedure:

Step 1 Open the ARPA menu
Step 2 Open the CREATE ZONE menu
Step 3 Open the ACQUISITION ZONE menu containing the options SECTOR, POLYGON, RING
Step 4 Open the ACQUISITION ZONE RING menu

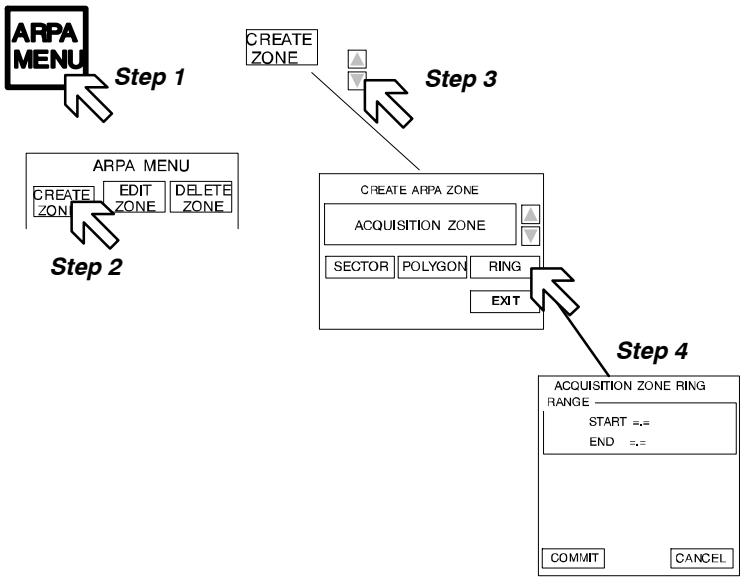
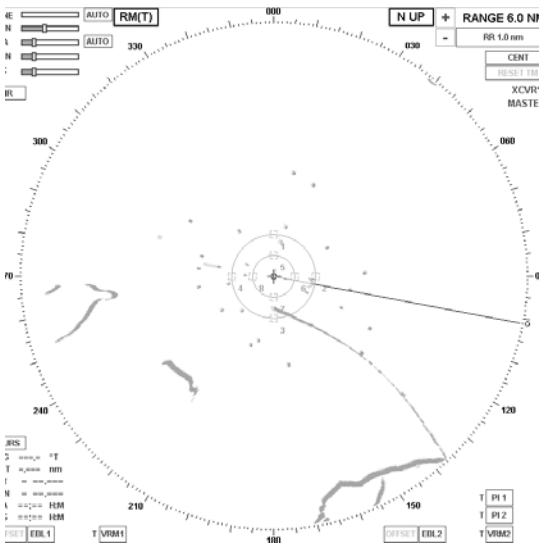


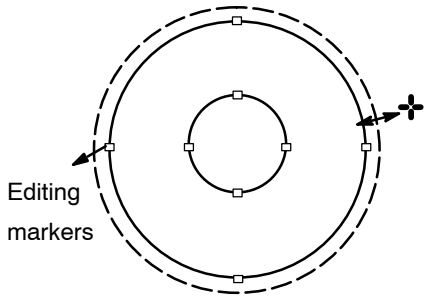
Figure: 2–41 ACQUISITION FORM RING

Result:

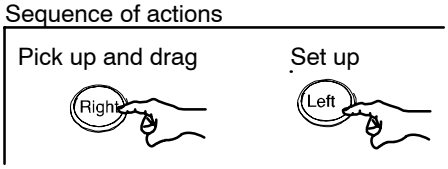
A range area with preset values for range START, range END and own position appears in the radar video (see Figure: 2–42).
The range area is made up of two rings that can be individually adjusted using editing marks.
There is an inner ring, which can be edited using drag and drop or the text line (*START*) and an outer ring, which can likewise be edited using drag and drop or the text line (*END*).
The default ring is small, as a suggestion for the anchor watch.



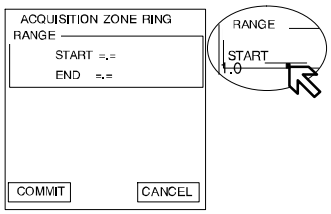
Using CURSOR function
– drag and drop –



Sequence of actions



Using SLIDER function or
NUMERICAL softkeys



Apply values. Pressing the COMMIT button activates the ACQUISITION ZONE RING (*continuous* line).

Figure: 2–42 ACQUISITION FORM RING

2.4.5.2 Select GUARD zone form

The sequence of operations below can be used to select the GUARD FORM (step 4). The NSC menu provides 2 possible GUARD zone forms.
The GUARD zone detects tracked ARPA targets that penetrate the pre−selected area. This situation is indicated by an alarm (visual and acoustic).

- **GUARD ZONE SECTOR**

Procedure:

Step 1 Open the ARPA menu
Step 2 Open the CREATE ZONE menu
Step 3 Open the GUARD ZONE menu containing the options SECTOR and RING
Step 4 Open the GUARD ZONE SECTOR menu

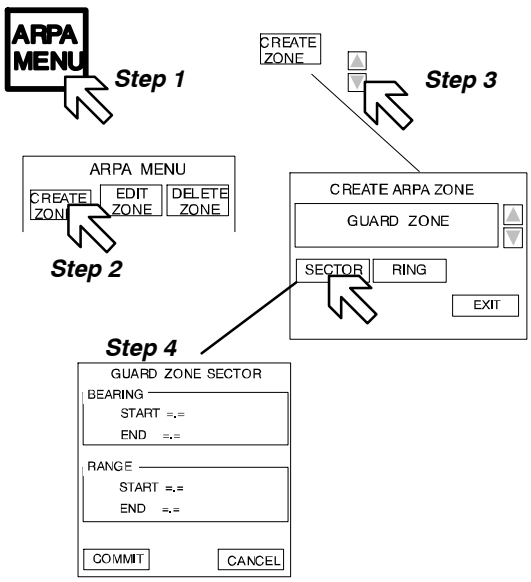


Figure: 2−43 GUARD ZONE SECTOR

Result:

A sector with preset values appears in the direction of travel in the radar video (see Figure: 2–44).
The sector can be changed using the sector editing marks (1...4).
These changes can be made directly using the cursor (drag and drop (see chapter 2.2.4.5)) or using the text lines with slider functions for BEARING and RANGE located in the GUARD ZONE SECTOR display field.

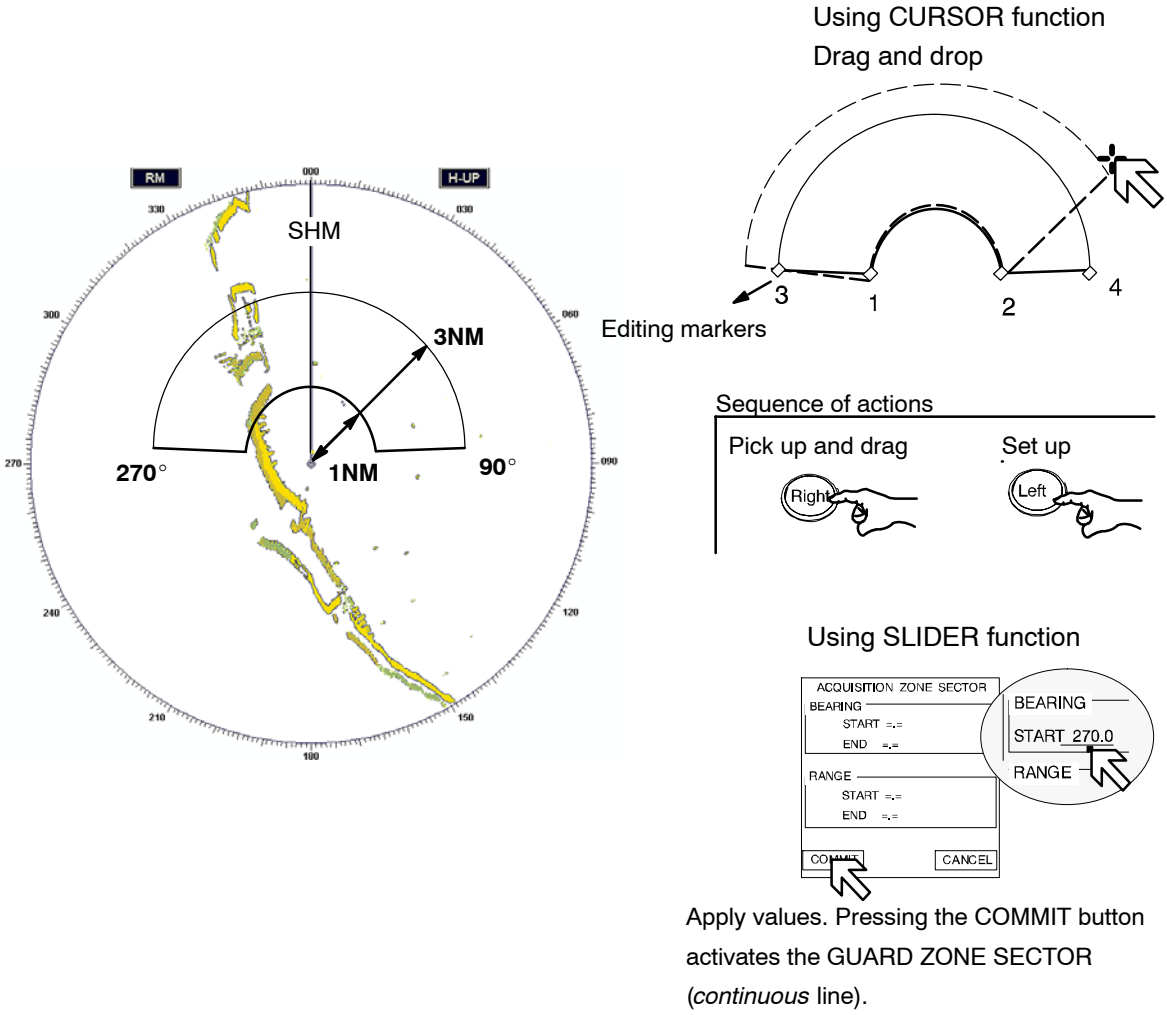


Figure: 2–44 GUARD FORM SECTOR

Subsequent changes can be introduced at any time.
Several SECTORS can be displayed in the radar video.

- **GUARD ZONE RANGE**

Procedure:

Step 1 Open the ARPA menu
Step 2 Open the CREATE ZONE menu
Step 3 Open the GUARD ZONE menu containing the options SECTOR and RING
Step 4 Open the GUARD ZONE RING menu

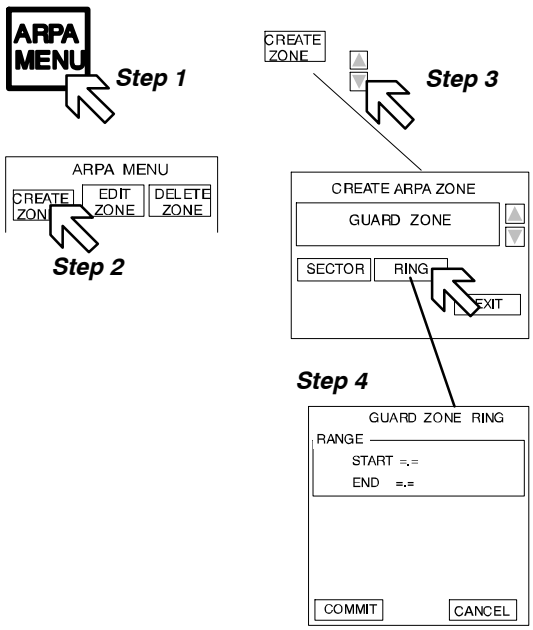
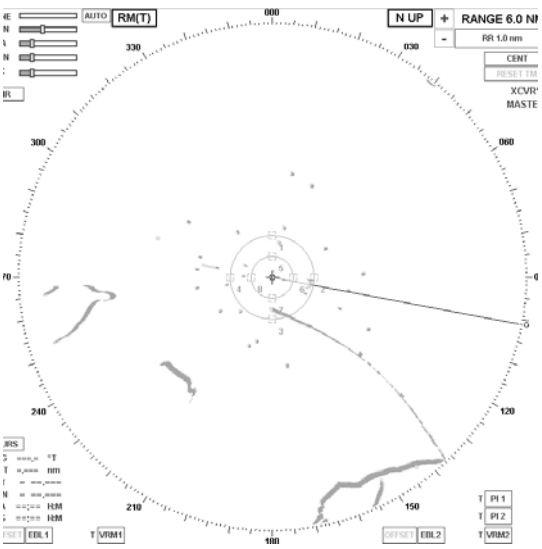


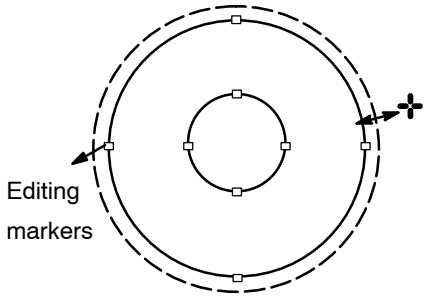
Figure: 2–45 GUARD ZONE RING

Result:

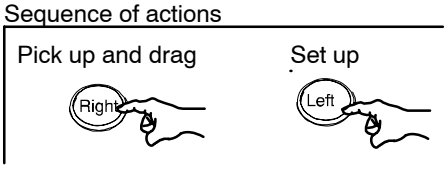
A range area with preset values for range START, range END and own position appears in the radar video (see Figure: 2–46).
The range area is made up of two rings that can be individually adjusted using editing marks.
There is an inner ring, which can be edited using drag and drop or the text line (*START*) and an outer ring, which can likewise be edited using drag and drop or the text line (*END*).



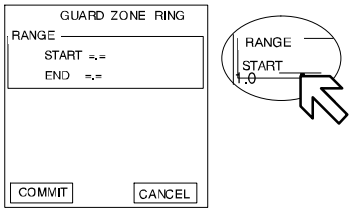
Using CURSOR function
– drag and drop –



Sequence of actions



Using SLIDER function or NUMERICAL softkeys



Apply values. Pressing the COMMIT button activates the GUARD ZONE RING (*continuous* line).

Figure: 2–46 GUARD ZONE RING

2.4.5.3 Select EXCLUSION zone form

The sequence of operations below can be used to select the EXCLUSION ZONE. Exclusion zones can be relative (moving with the ship) or true (fixed to a position)

- **EXCLUSION ZONE RELATIVE**

Procedure:

Step 1 Open the ARPA menu
Step 2 Open the CREATE ZONE menu
Step 3 Open the EXCLUSION ZONE menu RELATIVE
Step 4 Open the EXCLUSION ZONE RELATIVE menu

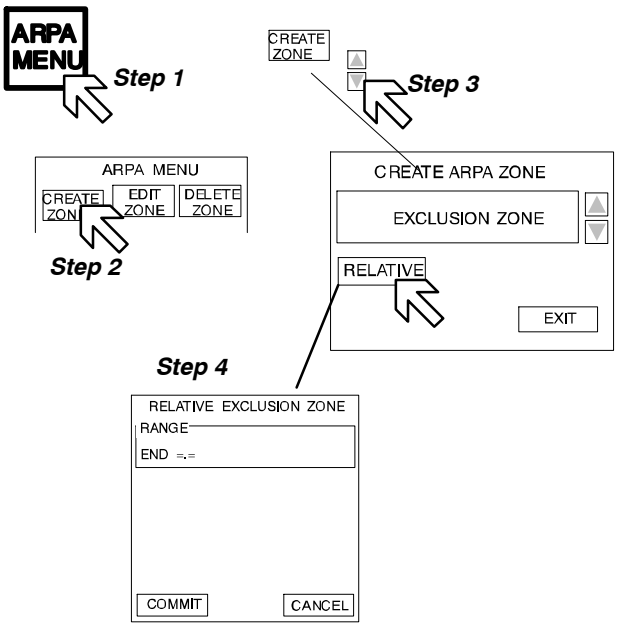
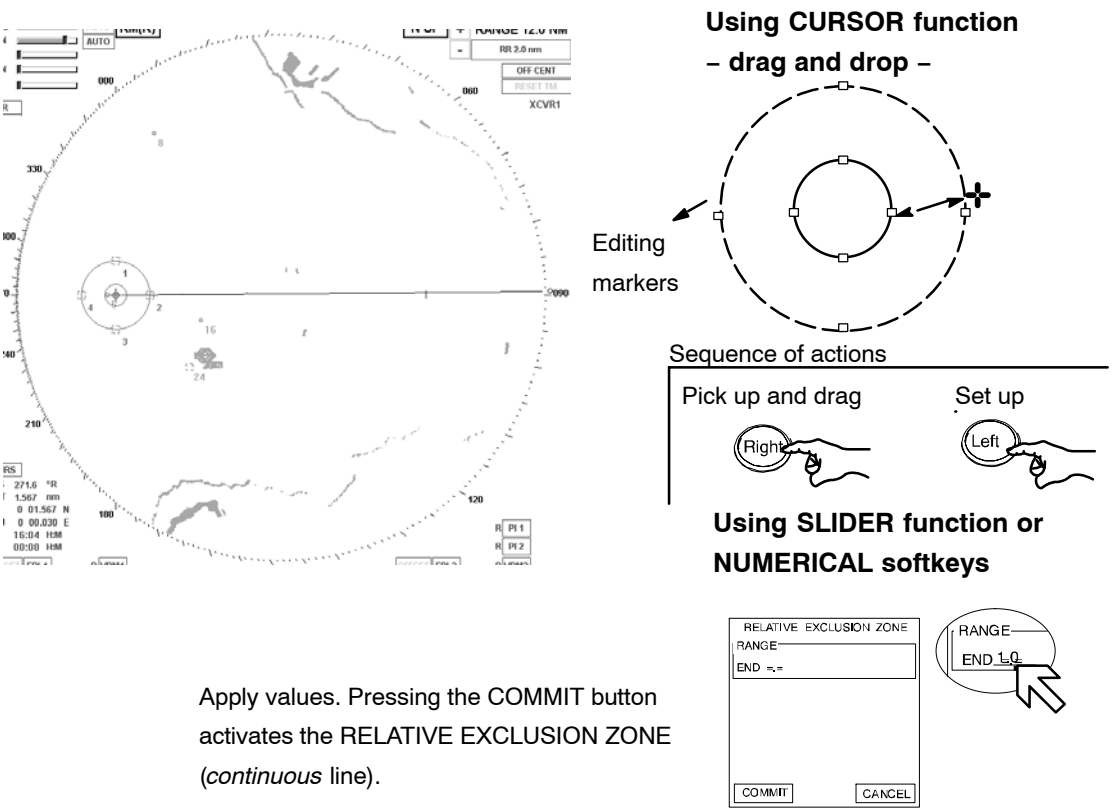


Figure: 2–47 EXCLUSION FORM

Result:

> NOTE
> The relative exclusion zone is predominantly shown for sea clutter at close range (approx. 3 nm).
> However, as well as the sea clutter some targets will also be ignored. The master must be aware of this situation.

This example (see Figure: 2–48) shows a ring centered on your own ship, which may be useful when the sea conditions or observation of buoys near own ship produces numerous false alarm echoes from waves. The exclusion zone will inhibit the auto acquisition function. This function can be used temporarily or left on to eliminate acquisition of false echo effects from the ship structure. The alternative for preventing false echoes is sector blanking, which must be commissioned by a service engineer with shipyard approval.
The range area can be individually adjusted using the editing marks.



Apply values. Pressing the COMMIT button activates the RELATIVE EXCLUSION ZONE (*continuous* line).

Figure: 2–48 EXCLUSION ZONE RELATIVE

2.4.6 EDIT ZONE

EDIT ZONE allows later editing of an active zone.
In the example below, the ACQUISITION ZONE POLYGON is to be changed.

Procedure:

Step 1 Open the ARPA menu
Step 2 Open the EDIT ZONE menu
Step 3 Select polygon using **Right** button (polygon points visible)
Step 4 Pick up desired point using **Right** button, change polygon (dotted lines).
Step 5 Drop polygon using **Left** button, pick up next point. Or complete the editing procedure with *step 6*.
Step 6 Select COMMIT softkey in menu using cursor and **Left** button.
The changed ACQUISITION ZONE POLYGON is activated.

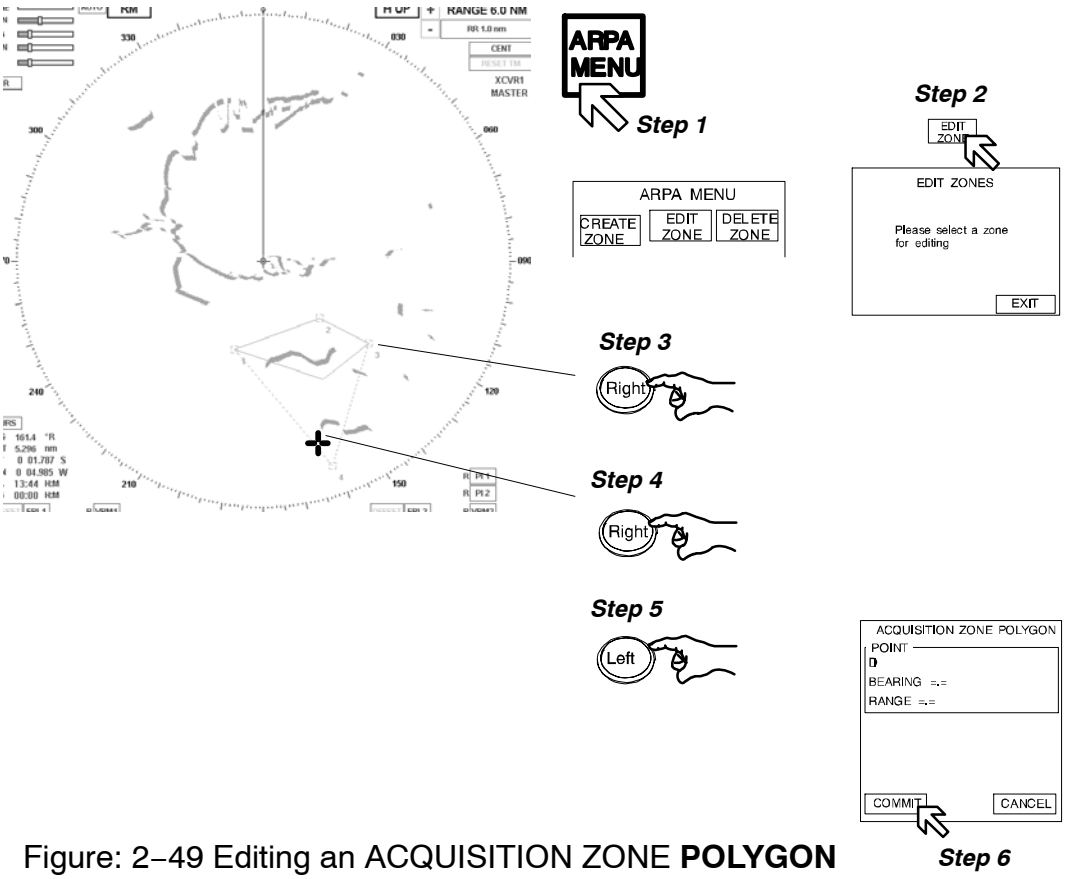


Figure: 2–49 Editing an ACQUISITION ZONE **POLYGON**

2.4.7 DELETE ZONE

DELETE ZONE allows you to delete a selected zone or all zones located in the radar video.
In the example below, the ACQUISITION ZONE POLYGON is to be deleted.

Procedure:

Step 1 Open the ARPA menu
Step 2 Open the DELETE ZONE menu
Step 3 Select polygon using **Right** button (editing points visible)
Step 4 Select softkey **OK** in menu using cursor and **Left** button.
The ACQUISITION ZONE is deleted.

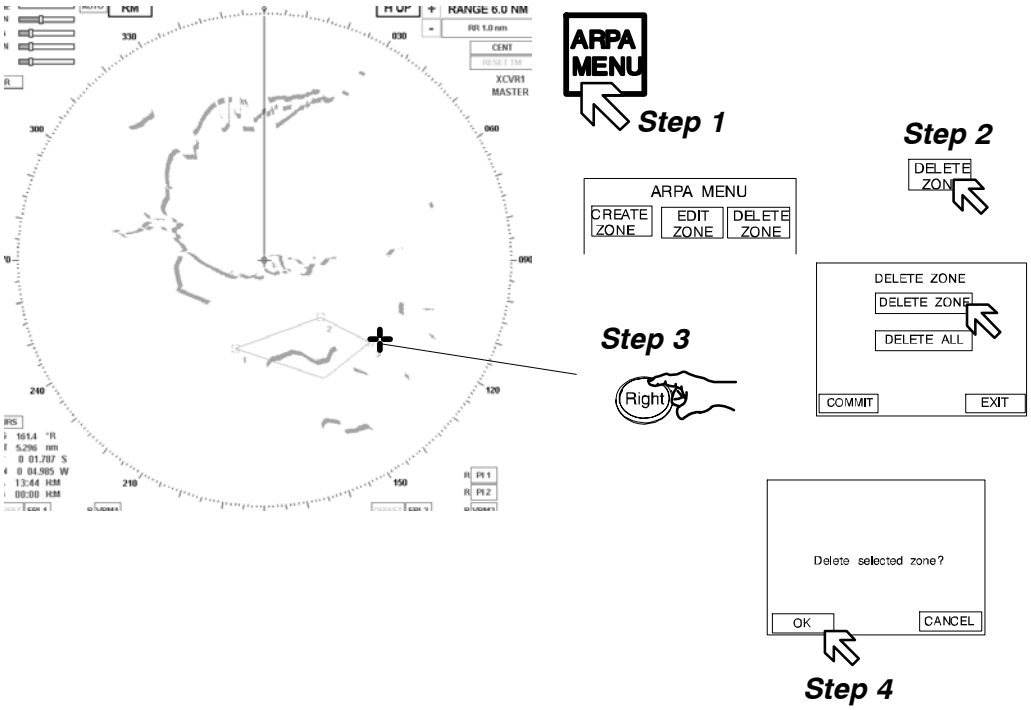
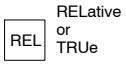


Figure: 2–50 Delete all zones or a selected zone

2.4.8 Potential collision points (PCP) and closest point of approach (CPA) symbols

PCP and CPA symbols are a useful tool that assists the user in identifying possible collision danger.

The function allows the potential collision point (PCP) or the closest point of approach (CPA) for acquired targets to be indicated by a circular symbol in the radar video.



The relevant function, PCP (potential collision points) or CPA (closest points of approach), is determined by the setting of TRUE or RELATIVE.

TRUE allows the PCPs for all acquired targets to be displayed in the radar video.
RELATIVE allows the CPAs for all acquired targets to be displayed in the radar video.
Both types of display support prompt assessment of close range situations.

TRUE – Potential Collision Points (PCP) –
Potential collision points (PCP) provide a rapid overview of current and potential collision danger (see Figure: 2–51).

Assessment:

- There is a current collision danger if a PCP lies on your own ship's head up line.
- There is a potential collision danger if your own ship changes its current course such that a PCP that did not previously lie on the ship's head up line will now lie on that line.

Potential collision points are calculated by target acquisition.
Every target is normally marked with a PCP, which appears as a small circle.
Under certain circumstances, it is possible that a target is marked by 2 PCPs.
In such a situation, both PCPs are applicable and must be taken into account when viewing the radar image.

Procedure:

Target acquisition must first be carried out.

Step 1 Select TRUE
Step 2 Open the ARPA menu
Step 3 Select PCP/CPA SYMBOLS mode

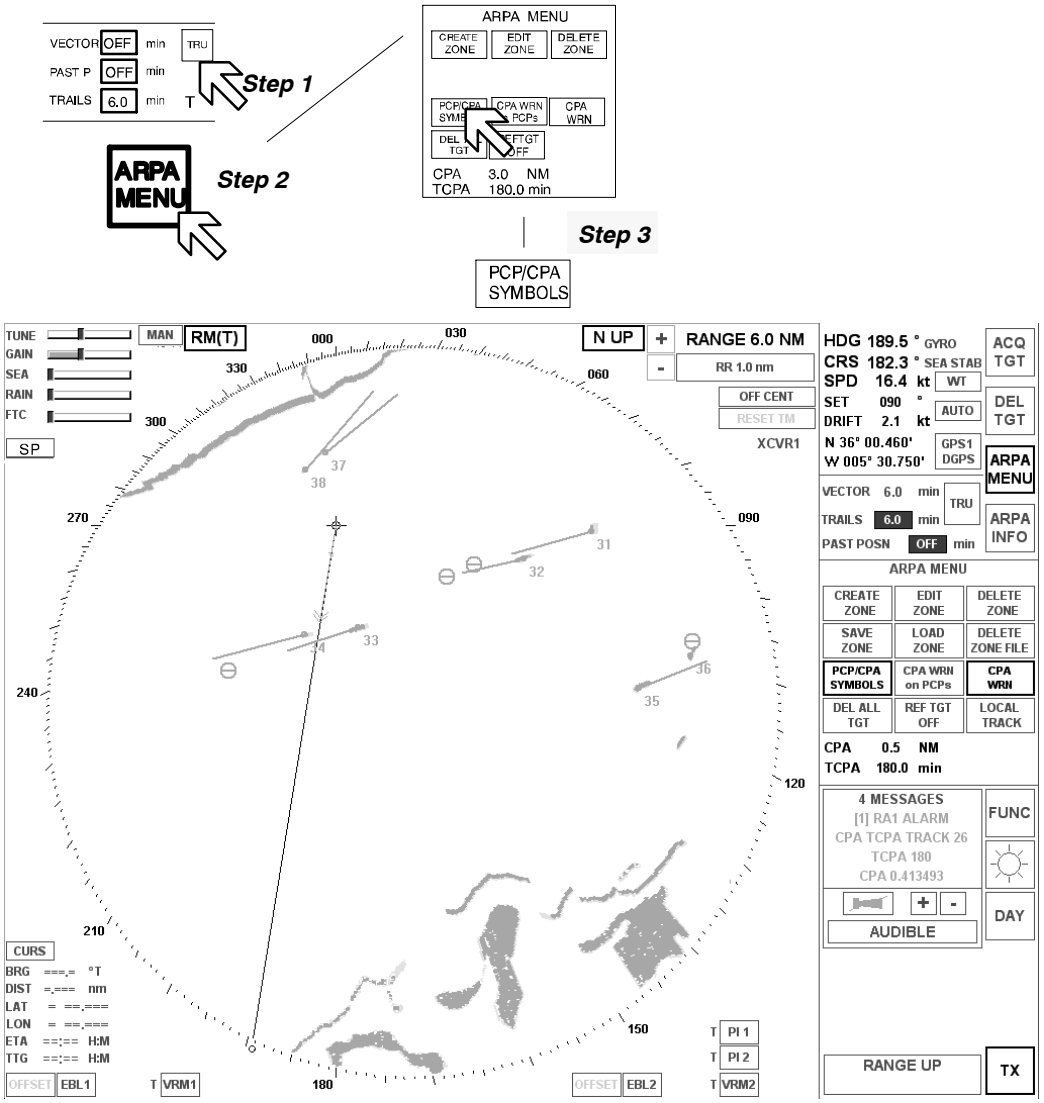


Figure: 2–51 Potential Collision Points –VECTOR mode TRUE–

Result:

Switching to TRUE VECTORS shows potential collision points (PCP). These are places on the chart where your own vessel could collide or choose to rendezvous with any target. It is similar to half a trial maneuver, in that it shows where your own vessel could meet the other track, at the present speed PCPs move. This is because a choice has no longer been made to meet the vessel. After some time, meeting the vessel becomes more difficult, and can finally be impossible, for example, when following another ship that is faster.

VECTOR mode REL – Closest Point of Approach (CPA) –

In this function, the closest point of approach (CPA) for acquired targets with relative vectors is indicated by a small circle (see Figure: 2–52)

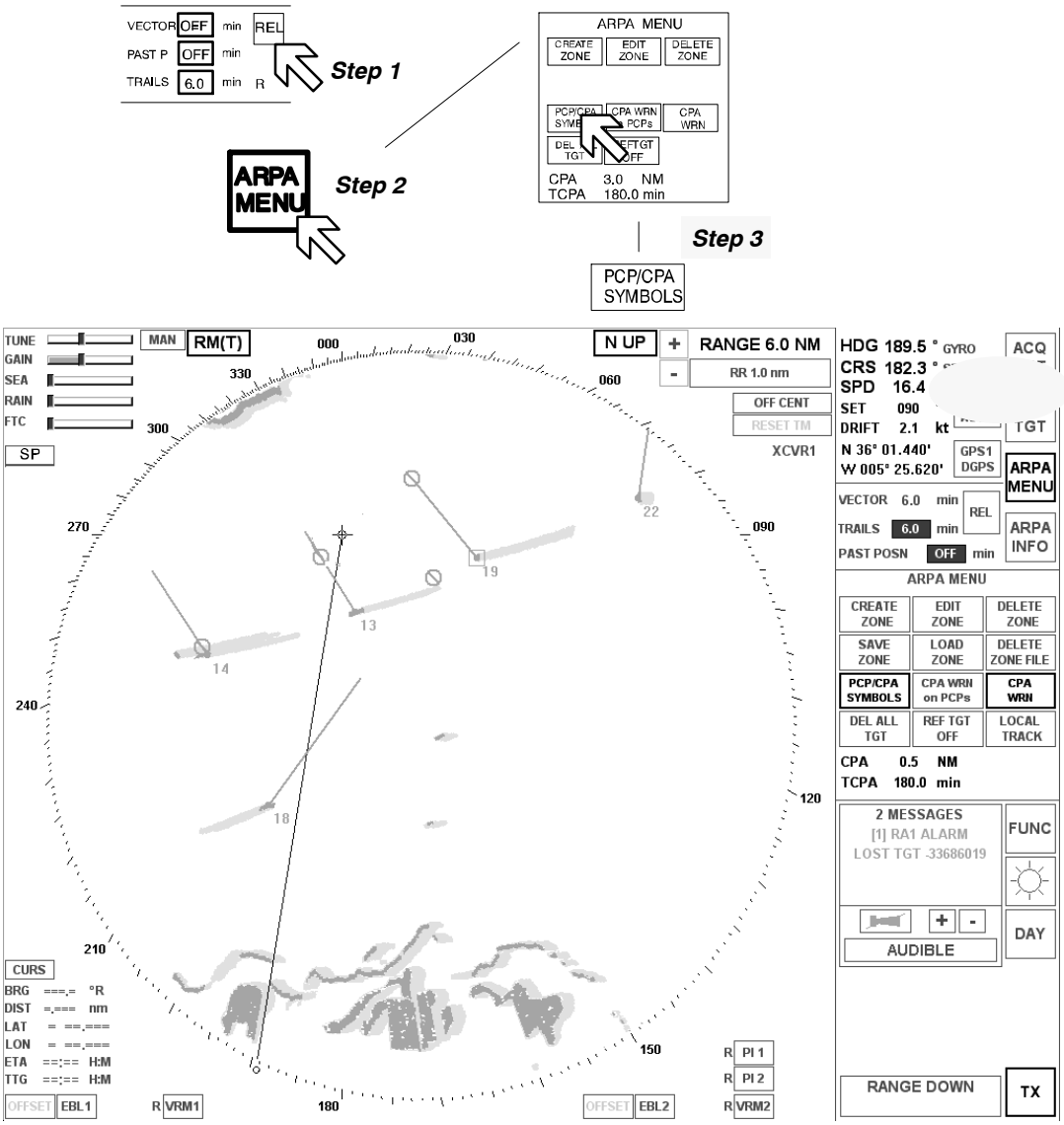


Figure: 2–52 Closest Point of Approach –VECTOR mode REL–

Result:

Adding CPA symbols shows where the approach will be closest, on which quarter of your own vessel. The CPA readout shows when this will occur.

Adding CPA warning circles shows the criteria for dangerous TRACK Alarms. This display is optional, but the alarm system is still operational.

2.4.9 Closest point of approach (CPA) warning on PCPs

This function softkey displays the CPA warning ring (see chapter 2.4.4.1) centrally over the potential collision point (PCP) and displays it simultaneously. This type of display supports prompt assessment of close range situations. It is preparation for TRIAL MANEUVER. If does NOT substitute for TRAIL MANEUVER.

Procedure:

Step 1 Select the VECTOR mode TRUE
Step 2 Open the ARPA menu
Step 3 Select CPA WRN on PCPs

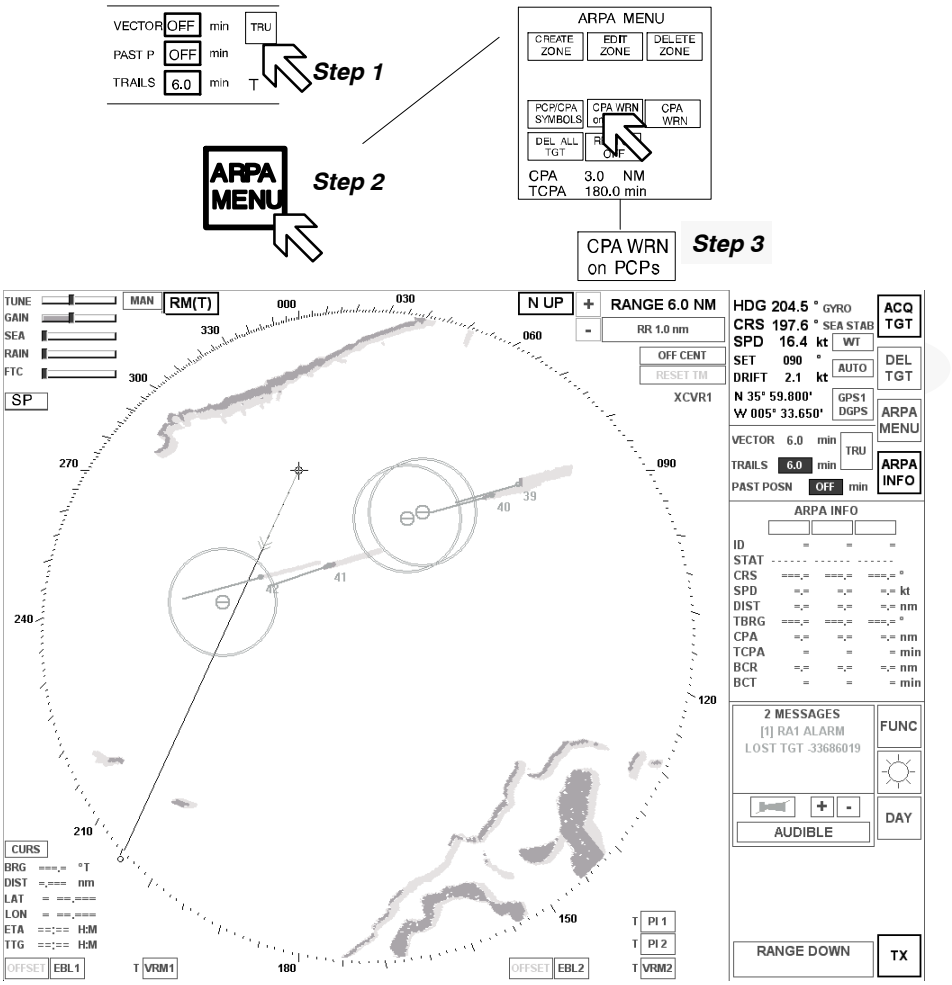


Figure: 2–53 CPA warning on PCPs

Result:

The CPA warning limit and the circle defined by the ship's master can be added to the potential collision points, and thus to the "no go areas". It is an aid to navigation that indicates how your own ship could avoid CPA alarms.
It does NOT indicate the safe maneuver because it does NOT indicate the actual closest point of approach (use Relative Vectors or TRIAL MANEUVER).
It is a local range marker only – for planing assistance.

2.4.10 Closest point of approach CPA warning

This softkey function allows the CPA warning ring to be shown or hidden in the radar video (see chapter 2.4.4.1).

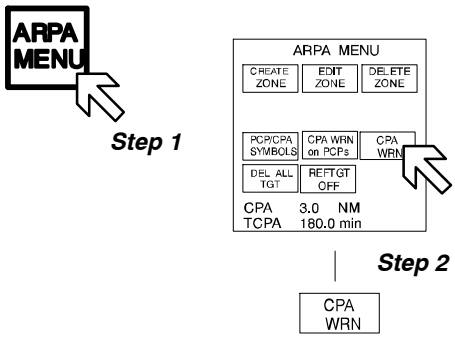


Figure: 2–54 CPA warning ring ON/OFF

2.4.11 Delete all targets

Pressing this softkey deletes all acquired targets in the radar video.

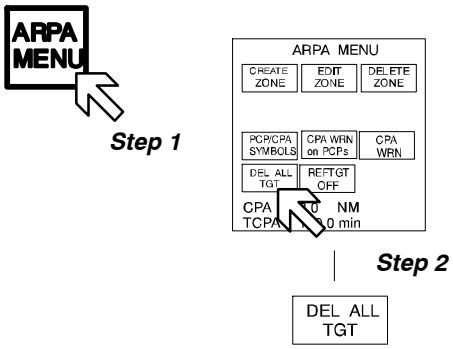


Figure: 2–55 Delete all targets

2.4.12 Reference target ON/OFF

The reference target feature tracks a fixed target (zero speed) to correct your own ship's course and speed errors caused by set, drift, speed log, gyro errors, or other factors.

The NSC Radar can support this by accepting one echo that the user knows is geostationary. Radar, after 2 minutes, accurately calculates own ship ground velocity until the track is lost or a new echo chosen. ARPA is best with water velocity, so this feature was mostly used to stabilize maps and work up the best Dead Reckoning (DR) position possible.

Use of Reference Target is not necessary when GPS is available.

If Reference Target work is preferred, GPS must be deselected.

The sequence:
The desired target must be acquired at first.

step 1 opens the ARPA INFO
step 2 selects the desired target (must be a fixed target),
the SHOW symbol indicates the target
step 3 opens the ARPA MENU
step 4 select REF TGT OFF/ON
the SHOW symbol changes to the REFERENCE TARGET symbol.

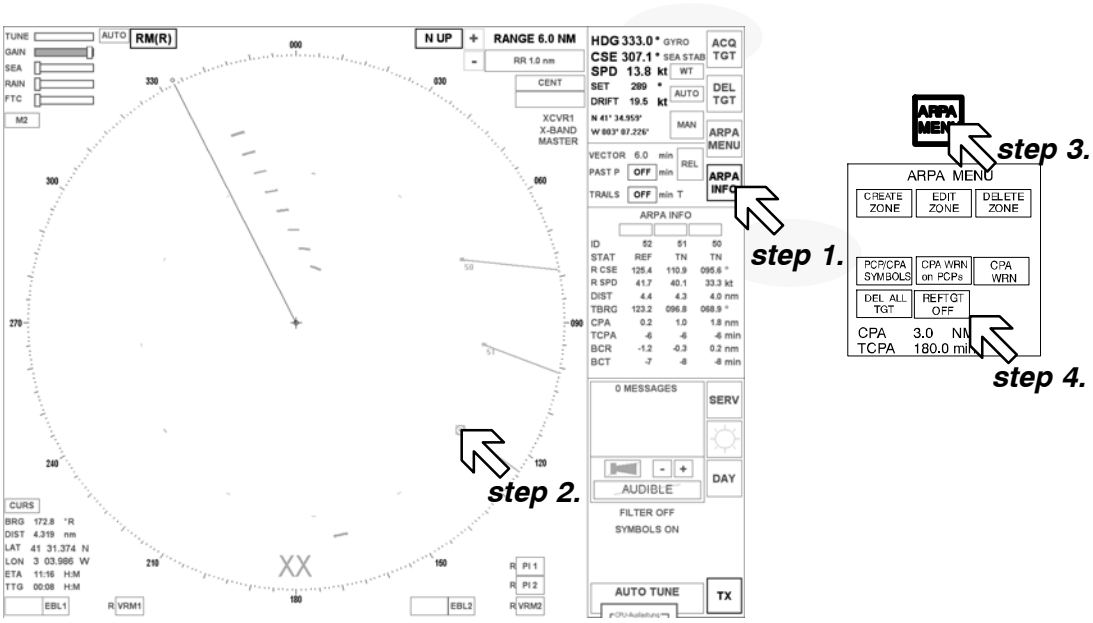
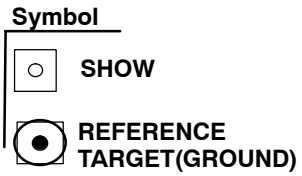
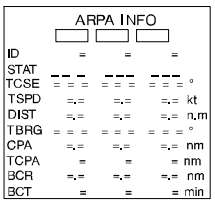


Figure: 2–56 Reference target ON/OFF

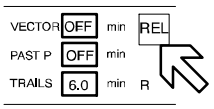


2.4.13 ARPA INFO

The ARPA INFO display can simultaneously show up to 3 items of target information.



ID Identifier no. (1...70)
STAT Status **)***
TCSE True course / can be changed to relative course **RCSE**
TSPD True speed / can be changed to relative speed **RSPD**
DIST Distance
TBRG True bearing
CPA Closest point of approach
TCPA Time of closest point of approach
BCR Bow crossing range
BCT Bow crossing time



)*	TCPA	Dangerous situation
	TI	Target initial, after approx. 10 scans
	TN	Target normal
	GUARD	Target acquired using a GUARD zone
	REF	Info about a reference target

Figure: 2–57 ARPA INFO

Procedure:
Initial target selection is carried out using the cursor. The target information is then shown in order from left to right in the ARPA INFO display.

Step 1 Open the ARPA INFO display
Step 2 Select the relevant targets

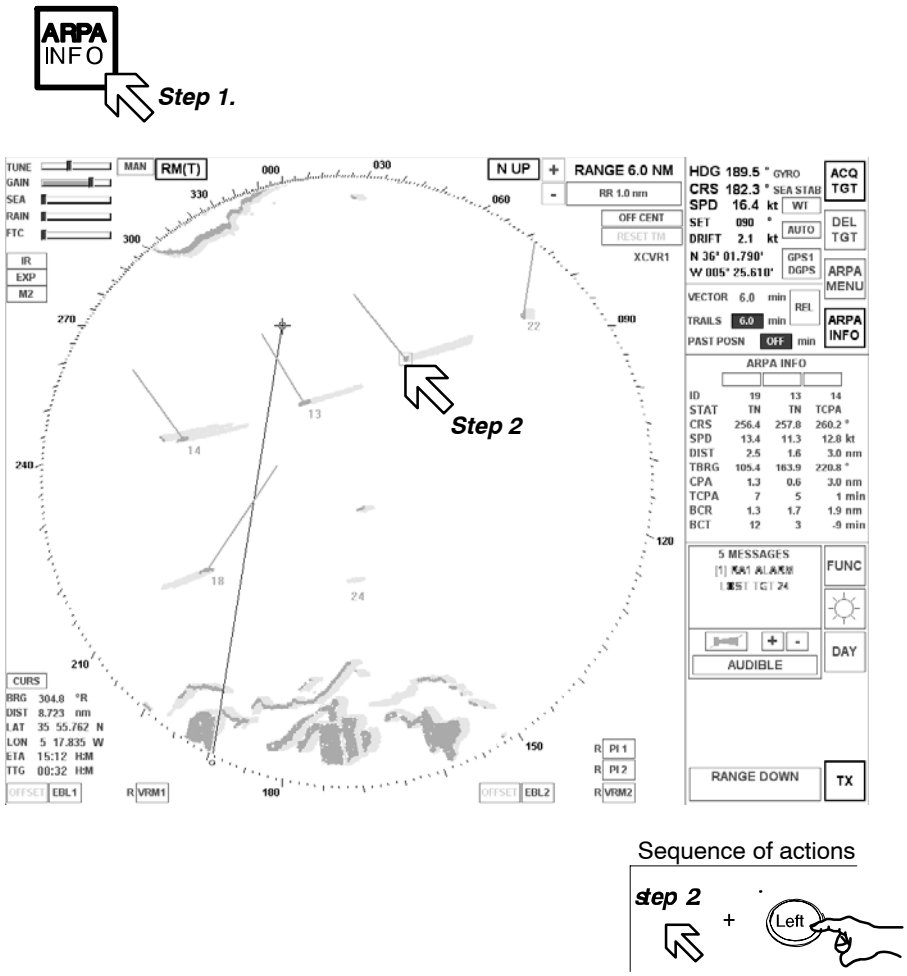


Figure: 2–58 Select ARPA targets for ARPA INFO

INFO

Targets that the ARPA function classifies as dangerous trigger an alarm (visual and acoustic). At the same time the target information for that target is shown in the 1st position in the ARPA INFO display.

The previous target information entries are moved to the right.

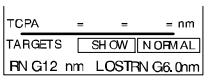
Acknowledging the alarm removes the relevant target information. The other target information entries move back to the left.

2.4.14 AIS INFO (option)

The Automatic Identification System (AIS) is designed for automatic and autonomous data communication between ships. The communication data consist of information such as identification, position, speed, course over ground (detailed information see AIS Manual).

AIS targets can be displayed on the Radar Video, detailed information on AIS Targets can be shown on request and alarms for LOST and DANGEROUS AIS Targets will be generated automatically.

The Radar AIS INFO allows to change the following settings:



TARGETS:

SHOW	enables the AIS symbols on the Radar Video
HIDE	disables the AIS symbols on the Radar Video
SLEEPING	the target symbols indicates the presence and orientation of the vessels equipped with AIS in a certain location. No additional information is present until activated thus avoiding information overload.
NORMAL	the target symbols indicate the presence and orientation of the vessels equipped with AIS in a certain location. All additional information are present in the AIS information. The AIS symbols display the total information (see chapter 2.4.14.2)
RN G ...	a range at which the AIS Targets shall be displayed can be set from 10 to 55 nm.
LOST ...	a range can be defined, above which no LOST Target Alarms will be generated. All Targets which go lost outside this range will disappear immediately without an indication.

NOTE

Setting AIS LOSTRN = 0 nm will present multiple AIS Alarms and make important standard Radar alarms more visible.

The Radar AIS INFO gives the following presentation information:

AIS1 AIS2 AIS3

Indication field for 3 items of AIS target informations.
The current AIS information is shown in order from left to right.

ID AIS Identifier no. from the ship of interest
STAT Status **)***
CSE Course
SPD Speed
DIST Distance
TBRG True bearing
CPA Closest point of approach
TCPA Time of closest point of approach

)* Danger Dangerous situation

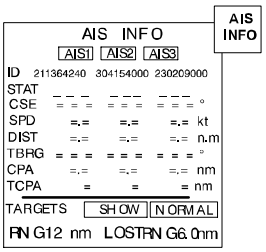


Figure: 2–59 AIS INFO

2.4.14.1 AIS Symbols in the Radar Video

Figure: 2–60 shows a possible Radar Video with AIS Targets and information.

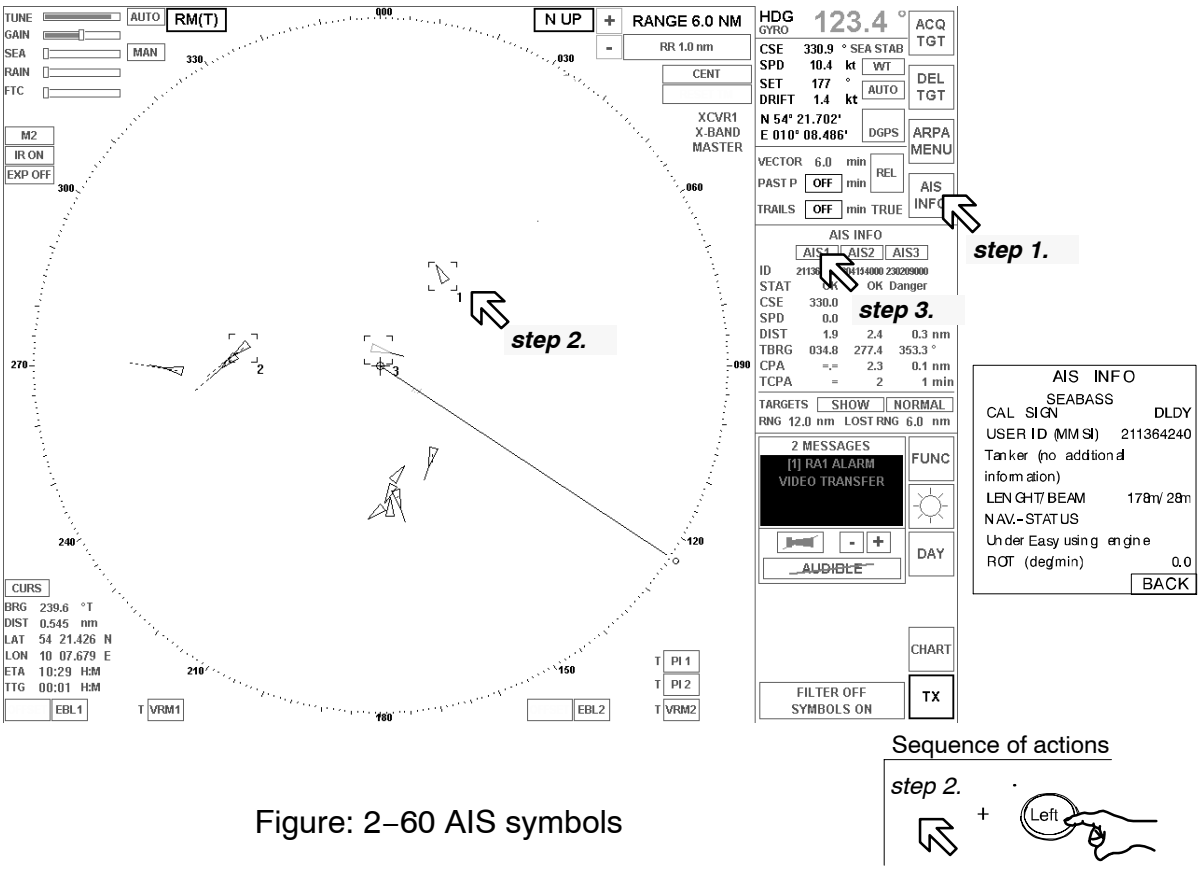


Figure: 2–60 AIS symbols

Sequence of actions

Procedure:

After pressing the ARPA INFO softkey, the AIS INFO function is activated. The AIS symbols appear in the Radar Video. The area for receiving the AIS information depends on the used range area RNG .....

In addition to the position information, the ship specific information can be shown in a second AIS INFO display.

Step 1 Open the AIS INFO display

Step 2 Select the AIS symbol of interest, three symbols are marked with a square and accordingly no. 1....3

Step 3 Open the second AIS display (showing the ship specifics information)

2.4.14.2 AIS symbols

The AIS symbols are assigned 5 different pieces of target information. Depending on the situation, each symbol has a different meaning (see following table).

AIS Target	Symbol	Description of symbol
AIS targets Targets SLEEPING		An isosceles, acute–angled triangle should be used with its centriod representing the target's reference position. The most acuteapex of the triangle is aligned with the heading of the target, or with its COG, if heading information is not available. The symbol of the sleeping target is smaller than that of the activated target.
Activated AIS targets Targets NORMAL		An isosceles, acute–angled triangle should be used with its centriod representing the target's reference position. The most acute apex of the triangle should be aligned with the heading of the target, or with its COG, if heading information is not available. The COG/SOG vector is displayed as dashed line starting at the centriod of the triangle. The heading is be displayed as solid line of fixed length starting at the apex of the triangle. A flag on the heading indicates a turn and its direction in order to detect a target manoeuvre without delay.
Selected target		A square indicated by its corner is drawn around the target symbol.
Dangerous target		A bold line clearly distinguishable from the standard lines is used to draw the symbol may be increased. The target displayed with: vector, heading, and rate of turn indication. The symbol flashes until the Dangerous Target Alarm is acknowledged.
Lost target		A prominent solid line across the symbol, perpendicular to the last orientation of the symbol is used. The line flashes until the Lost Target Alarm is acknowledged. The target is displayed without vector, heading and rate of turn indication.

2.5 FUNCTION MENU

This menu provides additional functions.

2.5.1 Select MAP MENU

The MAPS function allows the operator to create and permanently store maps.

MAPS are normally produced for the current radar video. For example, they can be saved under the name of a sea area corresponding to the radar video. If the ship enters this sea area again, the associated map can be loaded.

A map is formed by adding true mark symbols, nav lines and index lines to the radar video at points selected by the operator or at areas of interest. The symbols can be used to mark navigation channels, exclusion or safety zones, buoys or other pertinent points.

NOTE

Valid position information is required to create maps. Position information is transferred from a position receiver (e.g. GPS) to the NSC in the form of data telegrams.
The MAP MENU cannot be called up without valid position information.

A map can be made up of any combination of 100 TRUE MARKS, 50 NAV LINES and 50 INDEX LINES.

As a map is created, it is placed in temporary storage. It is then saved (if desired) and placed in permanent storage. The maps may be placed in permanent storage. Each map may be assigned a label made up of alpha numeric characters.

Procedure: (see Figure: 2–61)

Step 1 Open the FUNC menu
Step 2 Open the MAP menu
Step 3 Open the MAP menu function EDIT

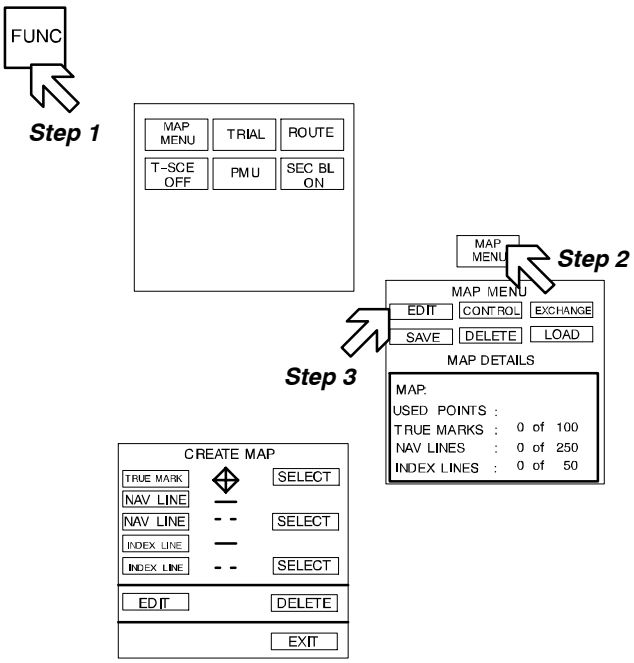


Figure: 2–61 Calling up the MAP menu function CREATE MAP

2.5.1.1 MAP MENU – EDIT

(1) CREATE MAP *TRUE MARK*

TRUE MARK

True marks may be used to identify targets or points of interest. This function is available in the RM (..), TM, N UP or C UP modes.

Once entered into the system, a true mark is treated as stationary object by being true motion stabilized and fixed to the radar map. The true mark position is changed to reflect any changes in range scale, and display offsets.

Procedure: (see Figure: 2–62)

Step 1 Open the TRUE MARK function

Step 2 Position the cursor and press the **Left** button

Step 3 Shows the co–ordinates of the 1st TRUE MARK

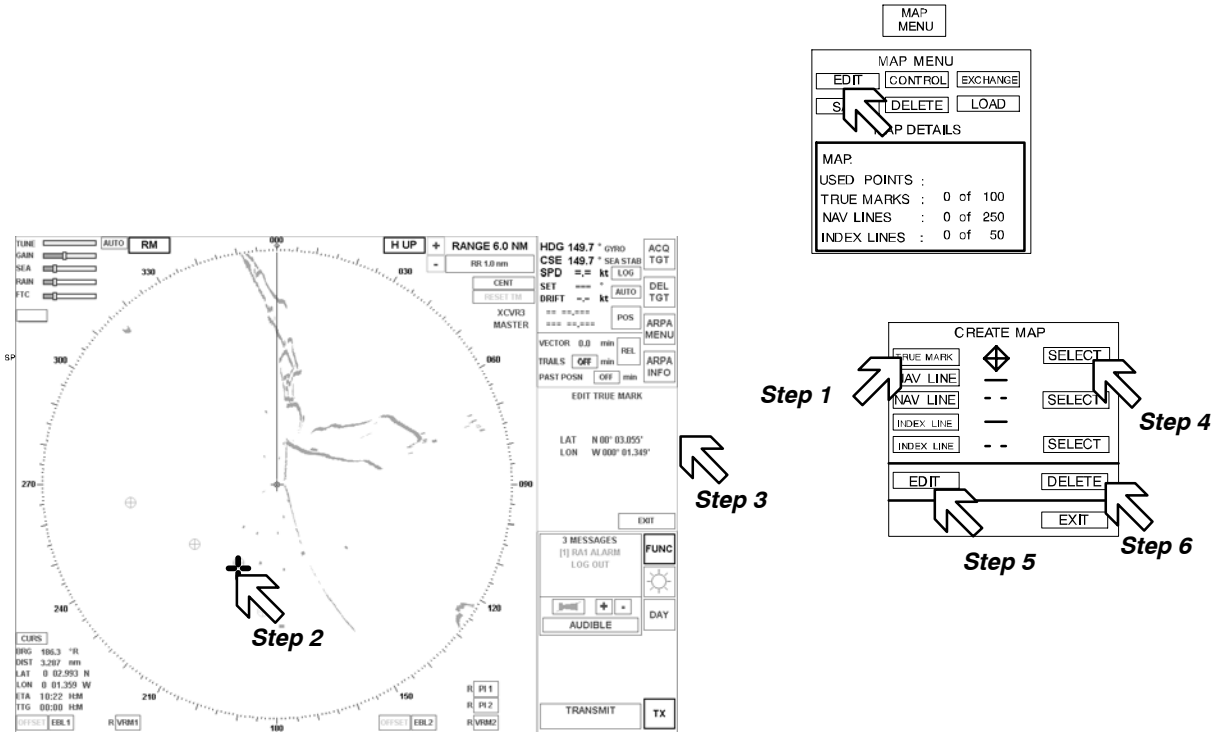


Figure: 2–62 Setting up a TRUE MARK

Editing a TRUE MARK

Procedure: (see Figure: 2–62)

Step 4 Open SELECT mode for TRUE MARK

Step 5 Open EDIT mode for TRUE MARK

Step 2 Select TRUE MARK using trackball and press **Right** button.
The color of the symbol changes to RED.
The MARK can now be repositioned using the trackball.
Pressing the **Left** button drops the MARK.

Deleting a **TRUE MARK**

Procedure: (see Figure: 2–62)

Step 4 Open SELECT mode for TRUE MARK
Step 6 Open DELETE mode for TRUE MARK
Step 2 Select TRUE MARK using trackball and press **Right** button.
The MARK is deleted immediately.

(2) **CREATE MAP *NAV LINE***

NAV LINE
Navigation lines are shown as absolute lines in the radar video.

The navigation lines can be plotted in the radar video using polygons. This means that the navigation lines can be either continuous or dotted.
The co–ordinates (LAT/LON) of the polygon points can be shown in the display (EDIT NAV LINE) using the cursor.

NOTE
Navigation Lines are stored by latitude and longitude. Ensure that correct positioning information is available before creating a new map.

Procedure: (see Figure: 2–63)

Step 1 Open the NAV LINE function (e.g. continuous lines)
Step 2 Position the cursor and press the **Left** button for the start of the 1st line. Position the cursor at the next point and press the **Left** button again. Repeat this action until the desired NAV LINE is shown in the radar video.
Pressing the **Right** button completes the NAV LINE

- Cursor returns to park position

This situation occurs after a pause in input. The cursor is returned to park position. The NAV LINE operation is canceled. The previous NAV LINE remains in the radar video but switches to fixed status (points are hidden). If the NAV LINE is to be extended or changed, this can be done immediately by selecting it again (see *Step 1*) or later using the EDIT function.

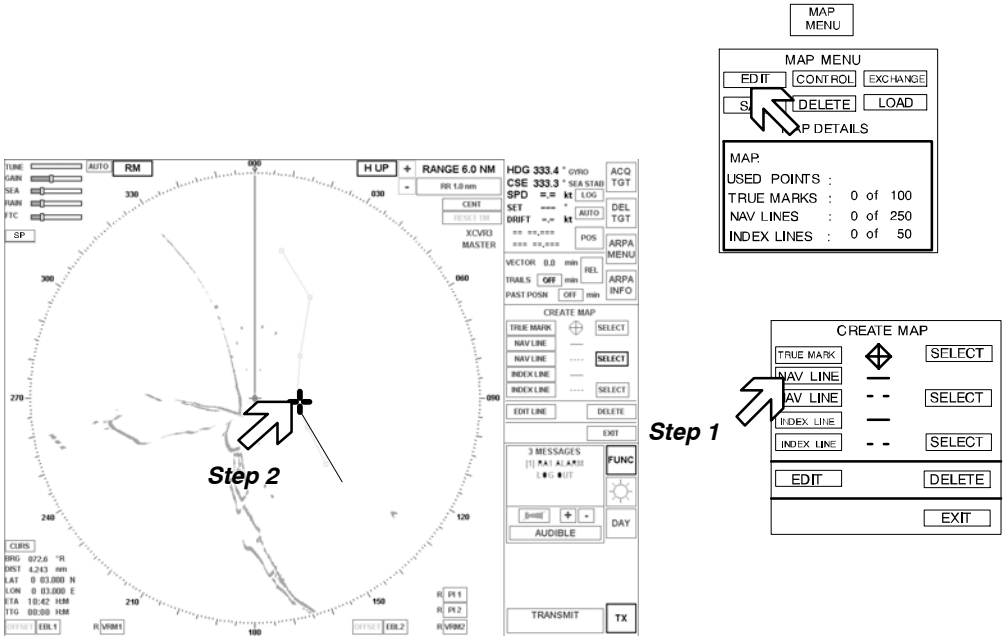


Figure: 2–63 Setting up a NAV LINE

Editing a NAV LINE

Editing a NAV LINE allows you to change existing navigation lines. Either individual polygon points or the entire MAP can be repositioned.
Procedure: (see Figure: 2–64)

Step 1 Open SELECT mode for NAV LINE
Step 2 Select NAV LINE using trackball and press **Right** button.
The NAV LINE display changes and all points are shown.
The EDIT function is activated.

Step 3 Open EDIT mode for the NAV LINE

Step 4 In this status, there are two editing options:

1 – Change the course of the NAV LINE by moving one of the points.
Select the desired point using the trackball and press the **Right** button.
The current position is shown in the EDIT NAV LINE display.
Determine marker position and drop by pressing the **Left** button.

2 – Move NAV LINE or entire MAP in radar video.
Position the cursor on a line in the MAP and press the **Right** button. This position is shown in the EDIT NAV LINE display.
The entire MAP can now be moved as required.
Pressing the **Left** button drops the MAP in the radar video.

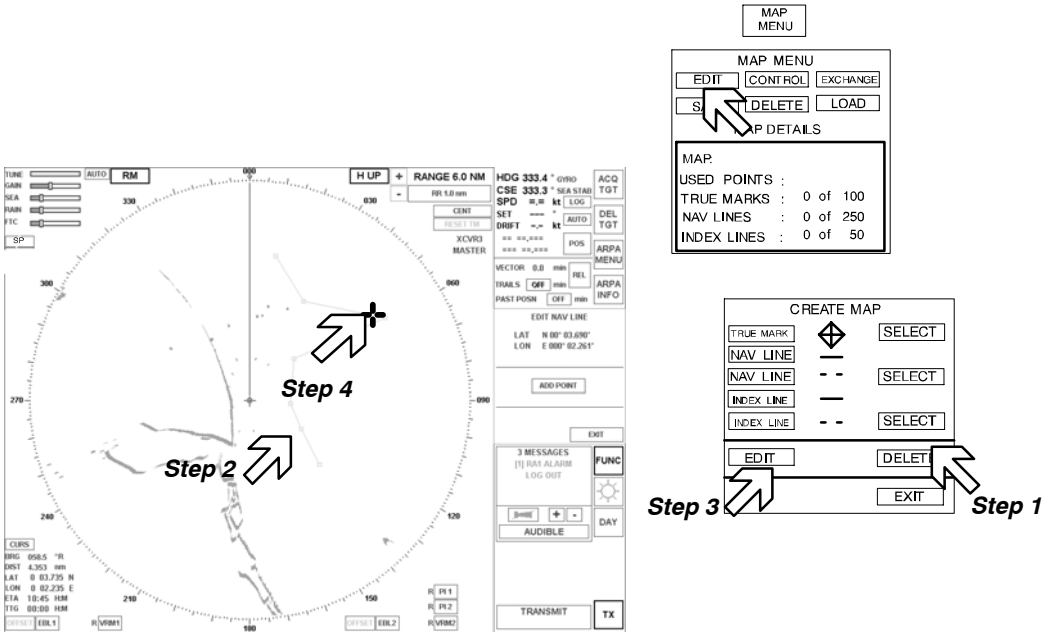


Figure: 2–64 Editing a NAV LINE

Deleting a **NAV LINE**

Procedure: (see Figure: 2–65)

Step 1 Open SELECT mode for NAV LINE

Step 2 Select NAV LINE using trackball and press **Right** button.
The NAV LINE display changes and all points are shown.
The DELETE function is activated.

Step 3 Pressing the DELETE softkey deletes the NAV LINE from the radar video.

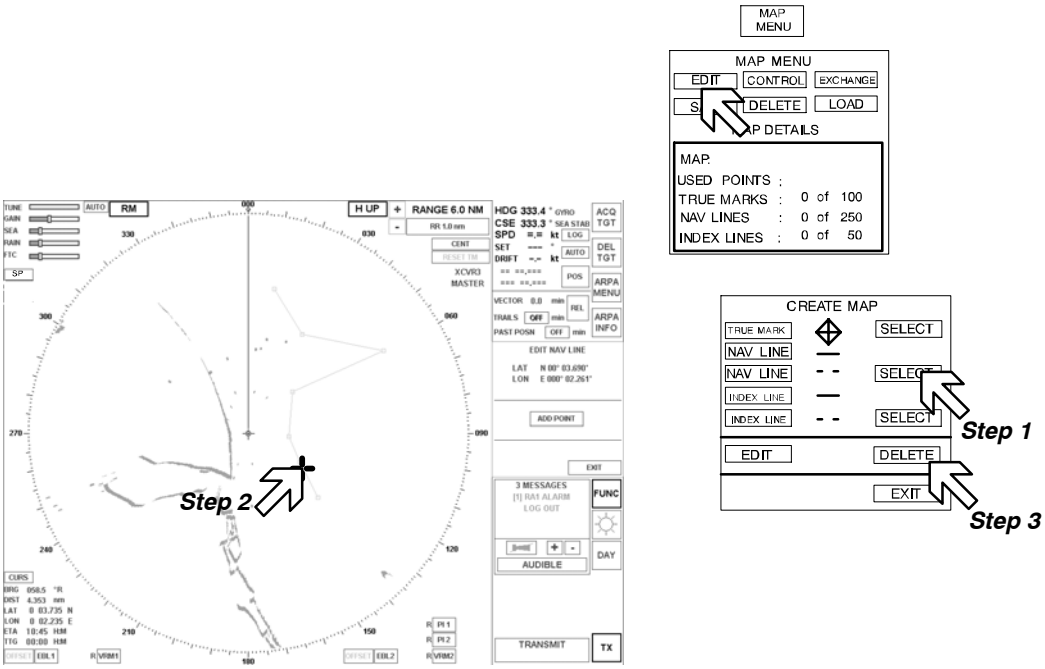


Figure: 2–65 Deleting a NAV LINE

(3) CREATE MAP *INDEX LINE*

INDEX LINE

Map Index lines are shown as relative lines in the radar video. Using a paper chart they are planned before passing obstacles to maintain stand–off range.

They are also used to prepare wheel–over points.

The index lines can be plotted in the radar video using two points.
Index lines can either be shown as continuous or dotted.
The co–ordinates of the index lines are ship–specific (relative) and are shown in (°) for the bearing and in (NM) for the distance in the EDIT INDEX LINE display.
Procedure: (see Figure: 2–66)

Step 1 Open the INDEX LINE function (e.g. continuous line)
Step 2 Position the cursor and press the **Left** button for 1st point on the index line. Position the 2nd point on the index line.

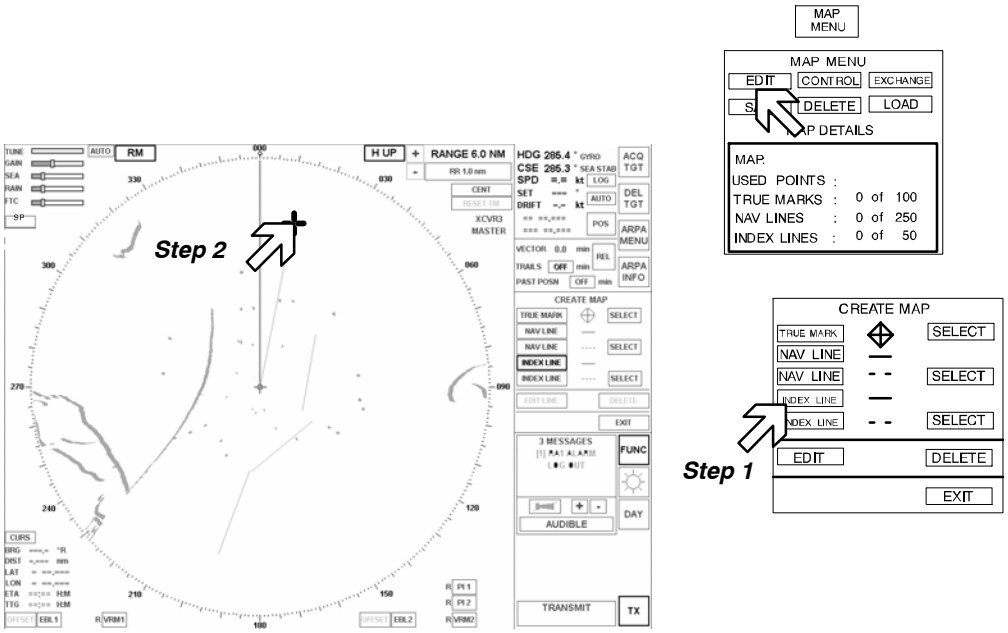


Figure: 2–66 Creating an INDEX LINE

Editing an **INDEX LINE**

The index lines can be edited by way of their index points.

Procedure: (see Figure: 2–67)

Step 1 Open SELECT mode for INDEX LINE

Step 2 Select INDEX LINE using trackball and press **Right** button.
The INDEX LINE display changes and both points are shown.
The EDIT function is activated.

Step 3 Open the EDIT INDEX LINE display
Select the desired point using the trackball and press the **Right** button.
The current position is shown in the EDIT NAV LINE (bearing and distance) display.

Step 4 Determine the new position and drop by pressing the **Left** button.

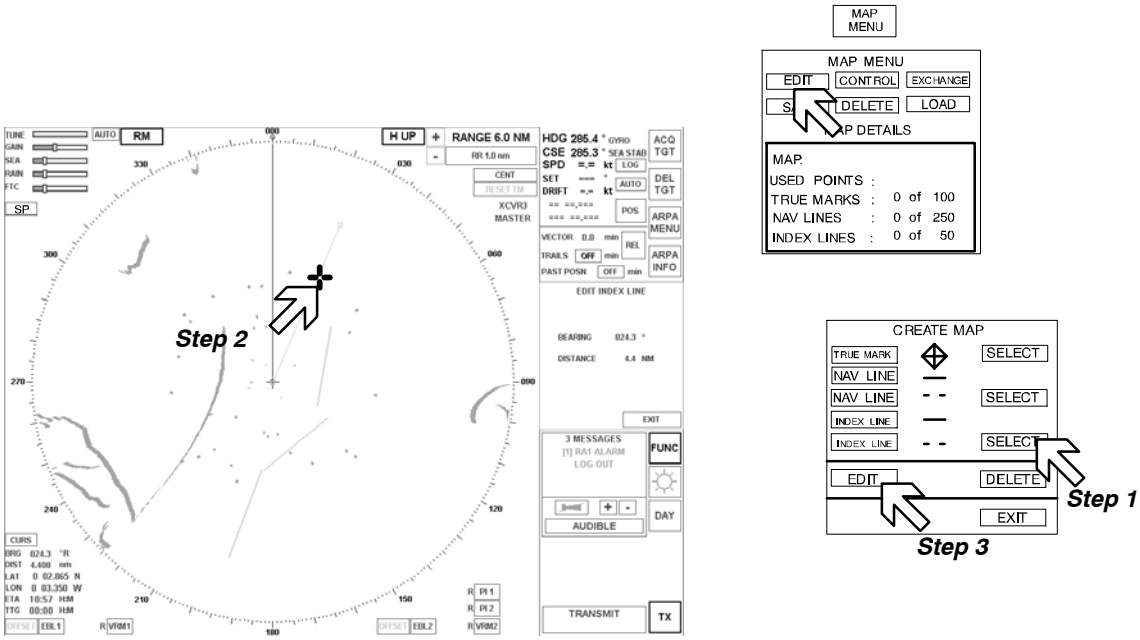


Figure: 2–68 Editing an INDEX LINE

Deleting a **NAV LINE**

Procedure: (see Figure: 2–68)

Step 1 Open SELECT mode for INDEX LINE

Step 2 Select INDEX LINE using trackball and press **Right** button.
The INDEX LINE display changes and both points are shown.
The DELETE function is activated.

Step 3 Pressing the DELETE softkey deletes the INDEX LINE from the radar video.

2.5.1.2 MAP MENU – CONTROL –

CONTROL

The control menu allows the operator to correct the placement of a MAP.

This function can be used to realign NAV LINES, TRUE MARKERS and INDEX LINES in the current radar video.

> **NOTE**
>
> A position offset between a MAP and the current radar video can have various causes (position, gyro, map date).
>
> The MAP MENU function CONTROL is only activated when a MAP is loaded (see chapter 2.5.1.6).

Procedure:

Step 1 Open the MAP menu.

Step 2 Open the MAP menu function CONTROL.

Step 3 Pressing the ADJUST softkey displays the ADJUST MAP menu (*step 3.1*). Depending on the composition of the MAPs (TRUE points or INDEX points or both) the individual operations are activated.

MOVE ALL TRUE Points allows a new positioning of TRUE MARKERS and TRUE LINES. On pressing the soft button, the Cursor is positioned into the PPI–center. On the Radar Video, the MAP is faded in according to its geographical position. If the MAP is not visible, the range has to be adjusted accordingly.
The MAP can now freely be moved on the Radar Video by means of the cursor and adjusted via reference points or lines (buoys or coastlines). On pressing the **Left** button, the MAP is placed on the Radar Video.

The new position is indicated as RADAR FIX coordinate ΔLATITUDE and ΔLONGITUDE on the CONTROL MAP display.

Simultaneously, the alarm message FIX ACTIVE: MAP LAT/LON is indicated on the display for ALARM MESSAGES
Pressing the CANCEL FIX softkey shows the original position of the MAP in the radar video.

MOVE ALL INDEX Points (Relative) allows realignment of INDEX LINES, if the passage plan spontaneously changes.
On pressing the soft buttons, the cursor is positioned into the PPI–center. In parallel, the MAP is faded in on the Radar Video.

Now the MAP can freely be moved on the Radar Video. The current distance is indicated on the ADJUST MAP display. On pressing the **Left** button, the MAP is fixed on the desired position on the Radar Video.

ROTATE INDEX Points (Relative) allows realignment of the INDEX LINES, if a gyro error is detected.
As Index Lines are stabilized in true azimuth but are fixed to own ship in range, own ship changes course, the index lines on a map do not change in True Bearing, but will change in Relative Bearing.

On pressing the soft buttons, the MAP can be rotated/turned in any direction.
On pressing the **Left** button, the MAP is fixed on the desired position in the Radar Video.

Step 4 TRUE MARKERS, NAV LINES or INDEX LINES can be shown or hidden as required.

Step 5 The current MAP is hidden in the radar video.

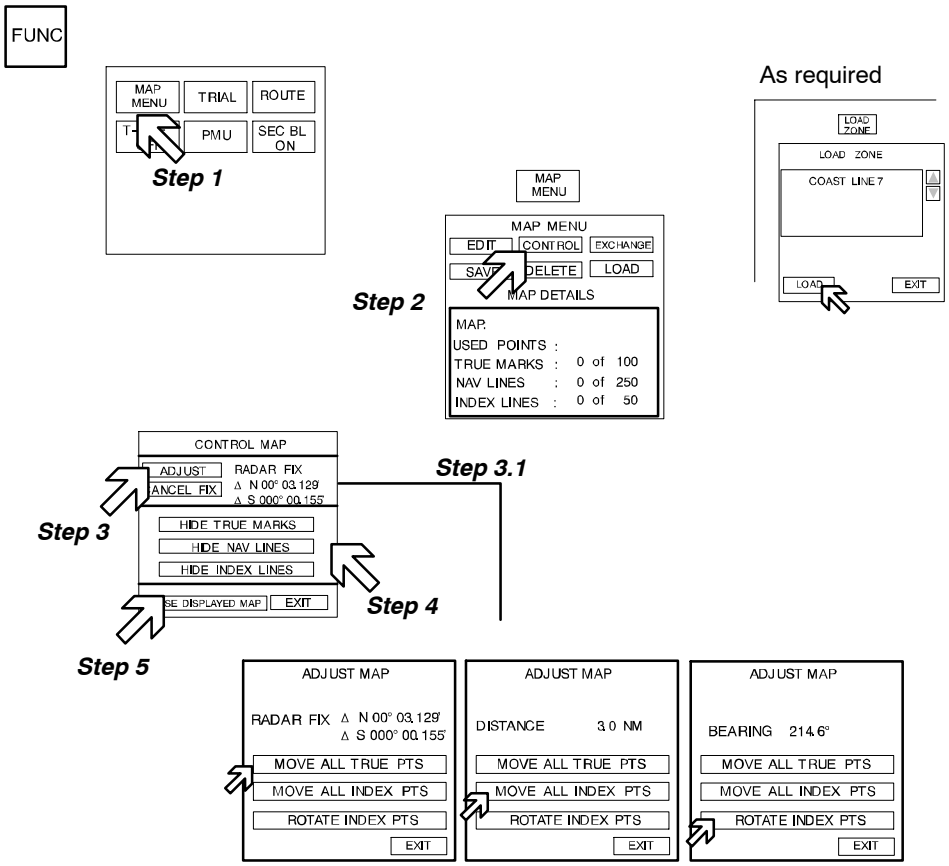


Figure: 2–69 Calling up the MAP menu function CONTROL MAP

The RADAR FIX effect:
If a MAP has been created and does not **fit** the current radar video when subsequently loaded, a RADAR FIX can be used. This is done by using TRUE POINTS or TRUE LINES.

If a saved MAP does not **fit** the real radar video one or more of the following can be true:

a) The TRUE MAP was created using points or lat/long information from a paper chart not in WGS 84 datum.

b) The TRUE or INDEX MAP was created “live” from a radar image on a previous voyage while the gyro was inaccurate (North speed errors not compensated, for example).

c) The TRUE or INDEX MAP was created “live” from a radar image using different gyros (for ships equipped with two gyros).

d) The gyro currently in use has a new error and requires service.
Latitude North speed correction!

e) The position sensor has an “error of the day”. For example Loran C errors.

f) The position sensor currently in use is set to different data than the TRUE MAP data used, has incorrect data for where the ship is now or is set to data that is suitable for paper chart work but is not compatible with radar work.

INFO
Before using RADAR FIX, consider how the MAP was created and check the position sensor DATA/GYRO. It is better to organize these consistently than to apply the RADAR FIX option. Radar fix can provide temporary assistance (particularly in case e and f).

2.5.1.3 MAP MENU – EXCHANGE –

EXCHANGE

This function allows MAPs created on the NSC Radar to be read in and out.
A USB stick can be used as an external storage medium.
The USB port is located on the front of the unit.

Procedure: (see Figure: 2–70)

Step 1 Open the FUNC menu
Step 2 Open the MAP menu
Step 3 Open the MAP menu function EXCHANGE
Step 4 Insert the USB stick into USB port
Step 5 Press the REFRESH softkey; the NSC processor automatically detects the USB stick.
Step 6/7 Select the desired operation.
EXPORT – All MAPs located in the NSC MAP memory are transferred onto the USB stick.
IMPORT – All MAPs located on the USB stick are transferred to the NSC memory.
Step 8 Press the EJECT DEVICE softkey; the NSC processor automatically completes the operation.

NOTE

To counteract possible data loss, before removing the USB stick ensure that the EJECT DEVICE softkey is pressed!

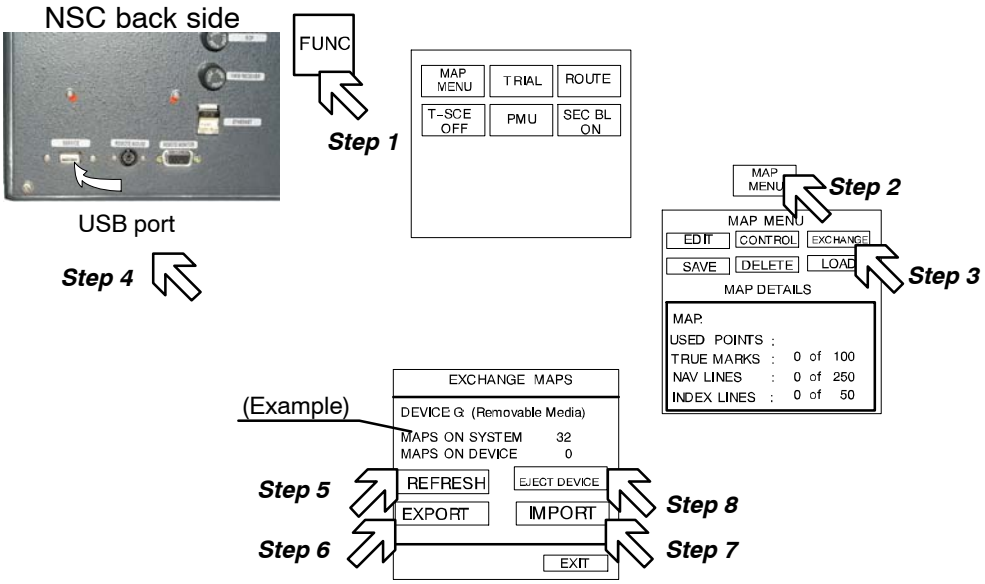


Figure: 2–70 Calling up the MAP menu function EXCHANGE MAPS

2.5.1.4 MAP MENU – SAVE –

SAVE

MAPS are created in the current radar video and can then be saved, for example under the name of the sea area.
MAPS are saved based on the fixed LATITUDE and LONGITUDE co–ordinates.

Procedure: (see Figure: 2–71)

Step 1 Open the FUNC menu
Step 2 Open the MAP menu
Step 3 Open the MAP menu function SAVE
Step 4 Enter the desired MAP name using the cursor and the softkey keyboard.
Pressing the SAVE softkey completes the operation.
To check this, call up the MAP MENU LOAD (see chapter 2.5.1.6).
The name of the saved MAP appears when you call up LOCAL MAP.

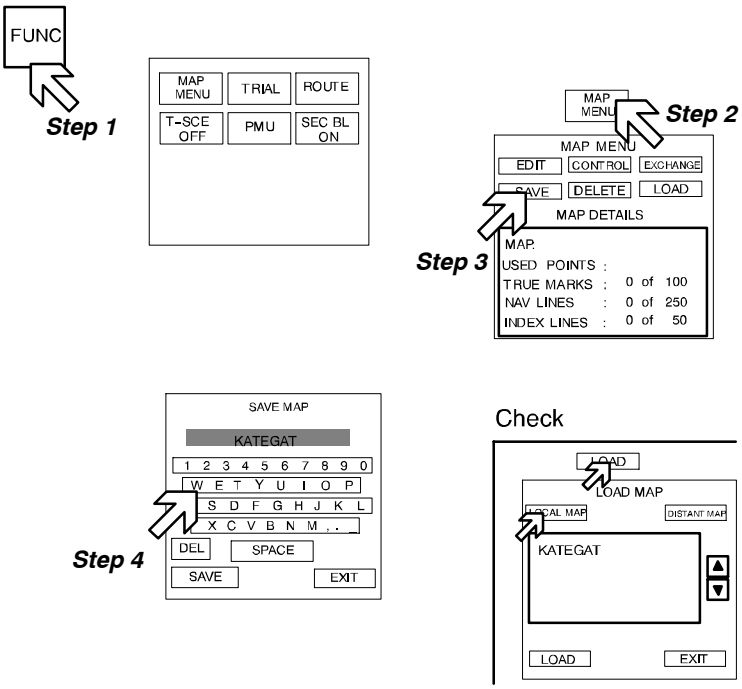


Figure: 2–71 Calling up the MAP menu function SAVE

2.5.1.5 MAP MENU – DELETE –

DELETE

Delete allows you to delete MAPS, which can be LOCAL or DISTANT MAPS.

Procedure: (see Figure: 2–72)

Step 1 Open the FUNC menu

Step 2 Open the MAP menu

Step 3 Open the MAP menu function DELETE.

Step 4 Select LOCAL or DISTANT.
Select the desired MAP.
Pressing the DELETE softkey deletes the MAP.

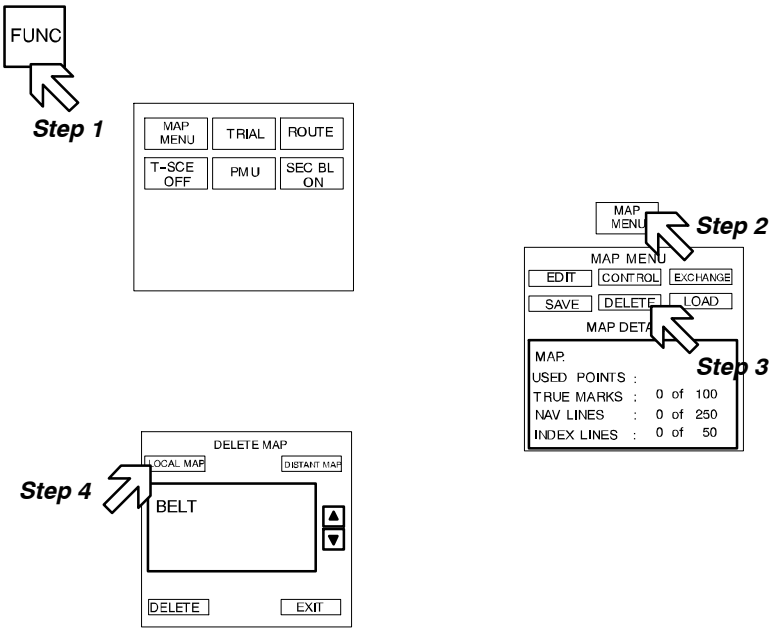


Figure: 2–72 Calling up the MAP menu function DELETE

2.5.1.6 MAP MENU – LOAD –

LOAD

Load allows you to load a saved MAP. This function provides various MAP categories. The NSC system uses the saved LATITUDE / LONGITUDE co–ordinates to identify the correlation between the MAP and the sea area currently displayed in the radar video.
The subsequent MAP lists are then automatically adapted to the changing radar video view.

LOCAL MAP
Local MAPS are MAPS whose saved co–ordinates match the current sea area.

DISTANT MAP
Distant MAPS are MAPS created for a different sea area.

The MAP names are shown in a list. Toggle fields allow you to scroll through this list.

Procedure: (see Figure: 2–73)

Step 1 Open the FUNC menu
Step 2 Open the MAP menu
Step 3 Open the MAP menu function LOAD.
Step 4 Select LOCAL or DISTANT.
Select the desired MAP.
Pressing the LOAD softkey shows the MAP in the radar video. If necessary, select another range scale to find the LOCAL MAP in the Radar Video. Possible corrections can be made using the MAP MENU function CONTROL (see chapter 2.5.1.2).

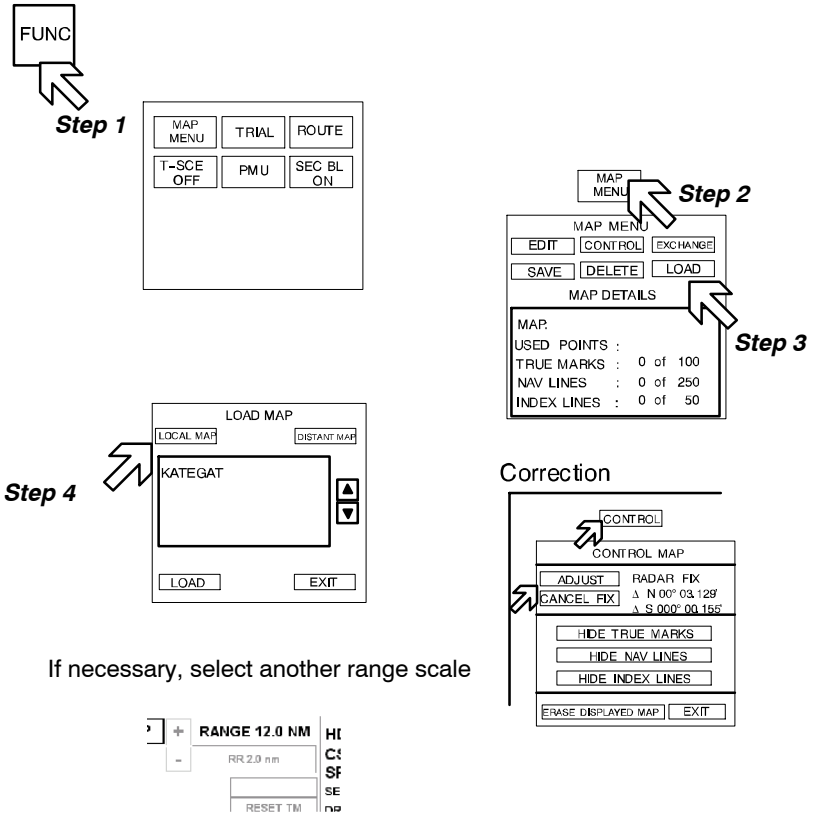


Figure: 2–73 Calling up the MAP menu function LOAD MAPS

2.5.2 Select TRIAL MANEUVER

The trial maneuver feature allows the operator to see the results of possible changes in their own speed and/or course, without actually committing their own ship to those changes.
When the trial maneuver function is on, a large letter T flashes at the bottom of video display. This is to remind the operator that the current radar video and plotting data is not the true navigational situation. The user can return to normal radar operation by clicking on Trial again.
When changing course or testing a proposed course, the trial heading is indicated in white and by a dashed line originating from own ship.

NOTE

If True vectors are selected, your own ship's vector will reflect any set and drift inputs (course made good).
Target data (SPD, CSE, ID, CPA, TCPA) that is being plotted is still shown in the actual TRIAL MANEUVER readout.

During a trial maneuver, there are no restrictions on operation within the NSC user interface.

Alarms and warnings during the trial maneuver;

Real alarms
The ARPA tracking system continues running in the background.
If there is a real close range situation (target enters the CPA/TCPA zone limits), an automatic alarm is generated. The target symbol flashes and a corresponding text message appears in the alarm display.

Temporary alarms
If a close range situation occurs during the trial maneuver, the target symbols flash.

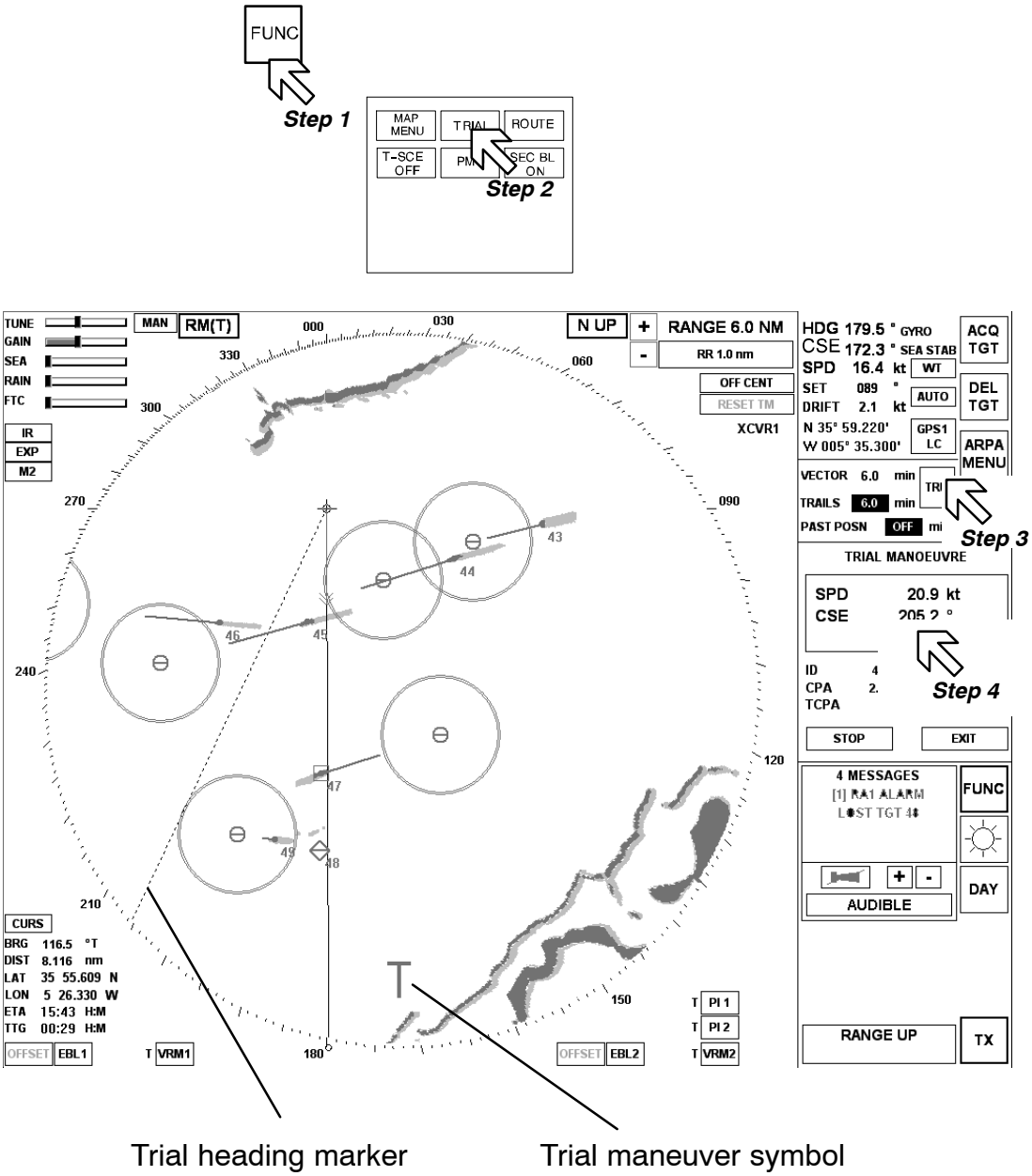
Procedure: (see Figure: 2–74)

Step 1 Open the FUNCTION menu

Step 2 Open the TRIAL function

Step 3 Switch the vector display into TRUE mode (possible example)

Step 4 Execute the TRIAL maneuver.
The trial heading marker and the SHM are shown congruently in the radar video.
Move the Course slider, CSE, to start the TRIAL
maneuver. The trial heading marker is moved using the CSE slider. As well as the course, the speed SPD can also be adapted to the maneuvered. The readouts show relevant targets (ID no.) with their CPA/TCPA values, which could result in a possible close range situation during the TRIAL maneuvered.



Settings for this example:
(ARPA MENU)
- PCP/CPA SYMBOLS ON
- CPA WRN on PCP ON

Figure: 2–74 Trial maneuver (example)

Result:

When a trial maneuver is added, the trial course (CSE) identifies the new heading but cannot affect potential collision points because these depend on the speed of approach towards other vessels (where your own ship could potentially meet another).

Trial speed (SPD) changes the potential collision points and the higher the selected speed the more PCPs there will be in the vicinity of the tracked ships.

A trial maneuver and PCPs are a way to view the advantages of a change in speed.

2.5.3 Select ROUTE (option)

This function allows the transfer of routes, e.g. between an electronic sea chart NSC ECDIS and the NSC radar.
The route planning is effected via NSC ECDIS (see NSC ECDIS manual).
If the route position (NSC ECDIS) matches with the radar position, the route can be displayed in the current radar video.

Parallel to the route display, the active cursor of the NSC ECDIS appears in the radar video, and the active cursor from NSC radar on the display of the NSC ECDIS.

Precondition:
- route planning via NSC ECDIS
- position alignment of NSC ECDIS and NSC radar

Procedure: (see Figure: 2–75)

Step 1 Open the FUNCTION menu
Step 2 Open the ROUTE function
Step 3 Select the ROUTE view of interest
- HIDE ROUTE, for fading out the complete Route
- HIDE XTD LIMITS, for fading out the XTD LIMITS only
- HIDE WPT LABELS for fading out the WPT LABELS only

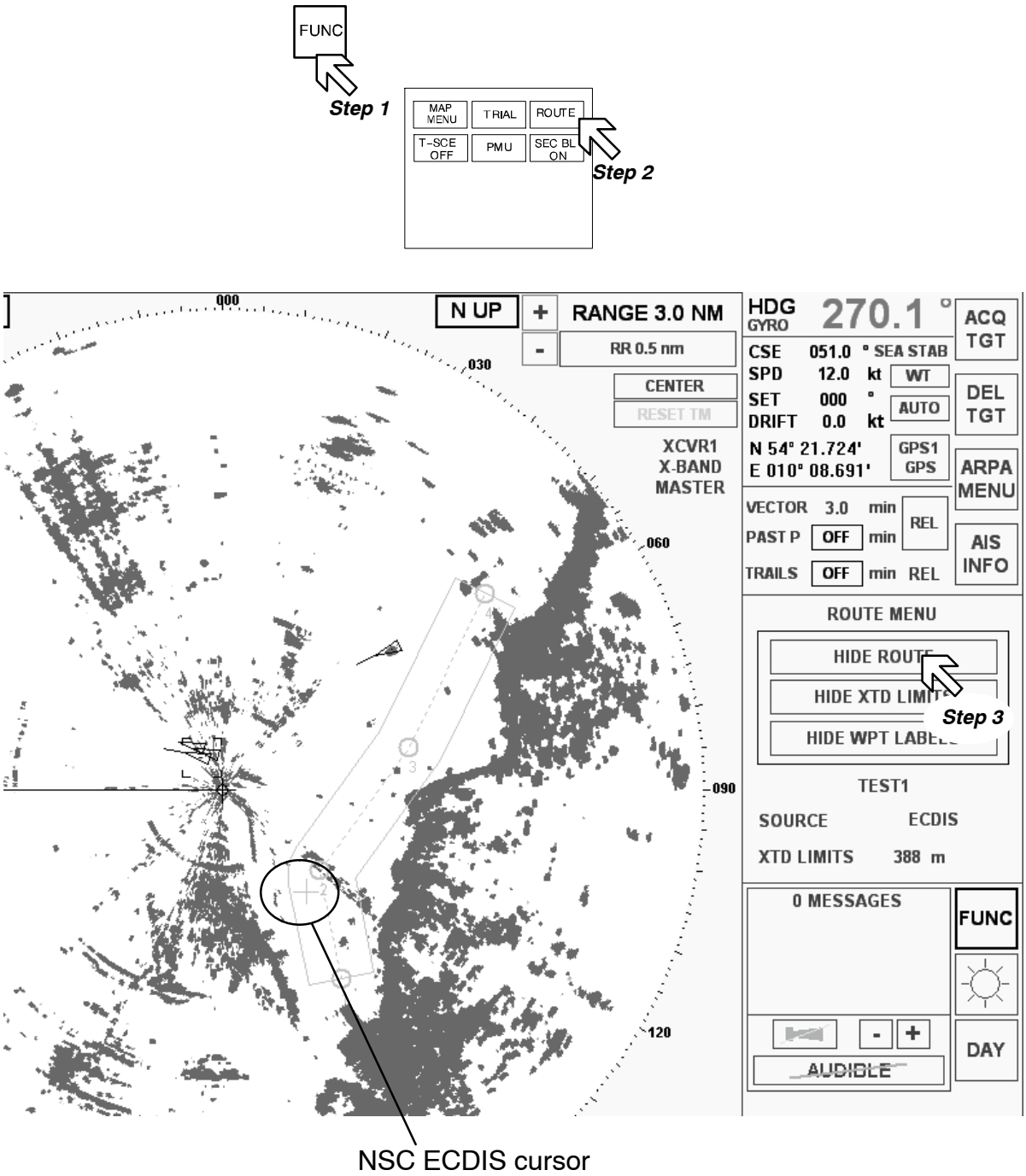


Figure: 2–75 ROUTE (example)

2.5.4 Select T–SCE (ON/OFF)

This function allows you to call up a TEST SCENARIO.
The test scenario is described by an independent radar video, in which the test targets are displayed.
The radar video is identified by two flashing **XX** characters and is shown in the PPI.

Procedure: (see Figure: 2–76)

Step 1 Open the FUNCTION menu

Step 2 Set T–SCE ON
After several cycles, the test scenario appears in the PPI.
These targets can be acquired manually or using the ARPA zones. The corresponding target information can be read out using the ARPA INFO.

T–SCE OFF hides the test scenario.

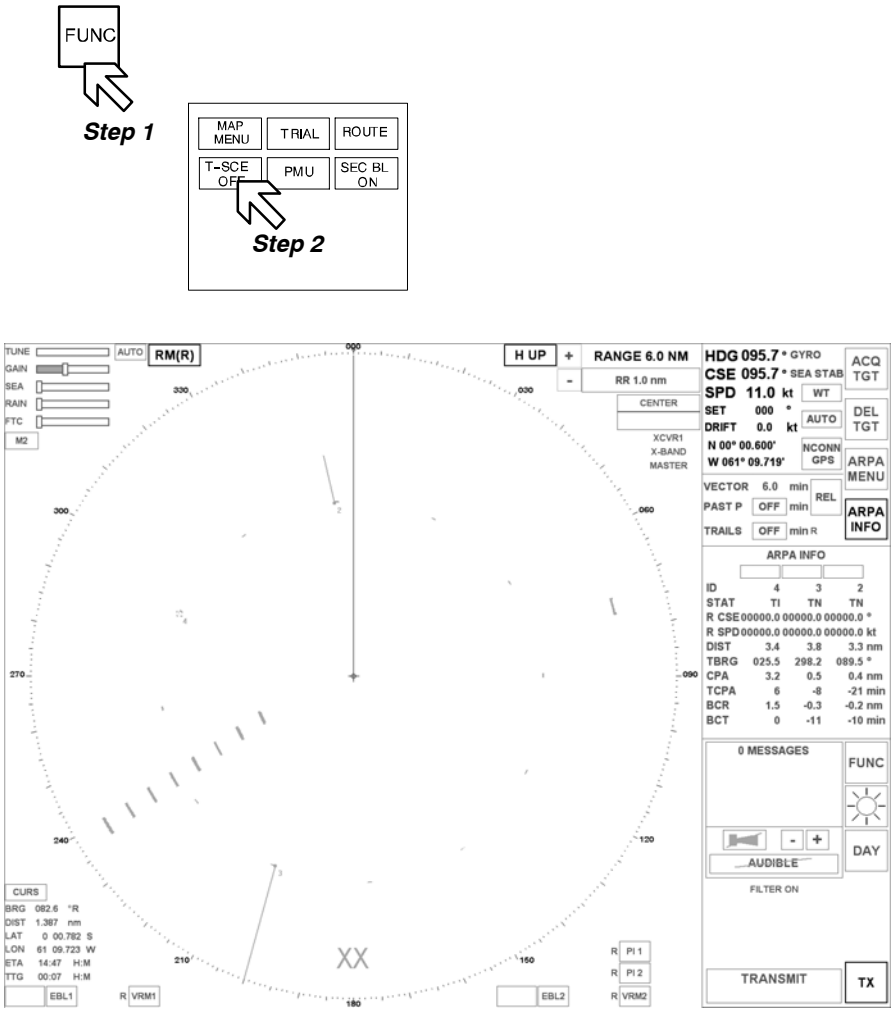


Figure: 2–76 Test scenario

Result:

This test allows the ARPA tracker to be tested.
The test is normally carried out in open waters.
Activating **T–SCE** displays an artificial radar video containing several targets.
These targets can be acquired manually or using acquisition zones.
Each target acquired can be identified by the ARPA INFORMATION.
The VECTORS, TRAILS and PAST POSITIONS for the targets can also be shown.

2.5.5 Select PERFORMANCE MONITOR

The performance monitor PMU provides a transmitter power check and a receiver sensitivity check. When targets are not available, the PMU can also be used for manual tuning of the radar to ensure maximum radar performance at all times.

2.5.5.1 Performance monitor

Brief description
This is a passive performance monitor system.

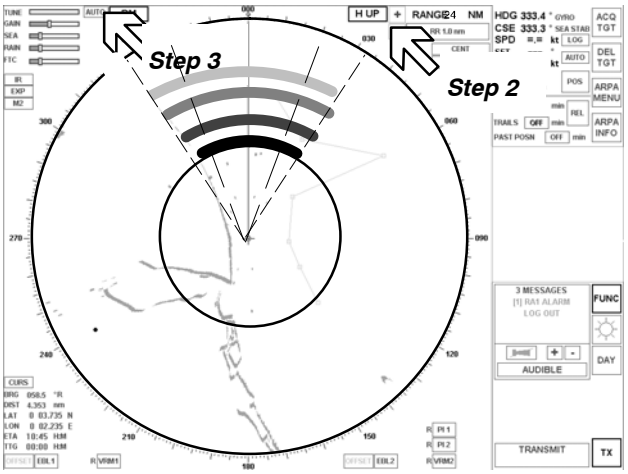
This means:
The performance monitor is a device capable of signaling any degradation in the performance of the radar in the display. In particular, indicates the efficiency of the transmitter and the receiver.

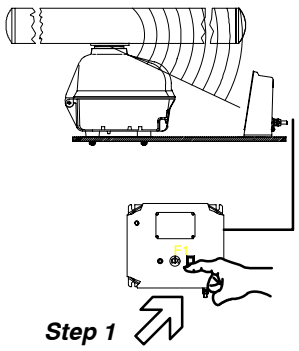
Procedure: (see Figure: 2–77)

Step 1 Switch on the performance monitor by turning switch S1 on the external performance monitor switch to **ON**.

Step 2 Select the 24 NM range.
Wait at least 30 minutes in order to allow the temperature of the two systems to stabilize.

Step 3 Change the TUNE mode from Auto to Manual by selecting the upper AUTO toggle field.
Slowly adjust (TUNE slider) the tuning command for Radar Up to the 4 markers produced by the performance monitor and visualized in the NSC display (inability to synthesize the marker on the display unit may be due to a degradation above 10 dB on the transmitter and receiver or to a failure of the performance monitor).





PMU
transmission check

Info
The dotted lines are only used to explain the PMU check.

— — Normal operation of transmitter power

— — Degradation of 4 dB in transmitter power

Figure: 2–77 PMU display for 6 feet X–band

Result:

By visualizing 4 markers on the radar video in the shape of an arc of a circle, the performance monitor simultaneously performs the following checks:

- Monitoring efficiency of radar transmission system
- Monitoring efficiency of radar reception system

Monitoring efficiency of radar transmission system

During normal operation of the transmission system, the 4 markers, set to 14, 16, 18 and 20 NM (see Figure: 2–77) must be visible in the radar video.

Degradation of the transmitter power is indicated by a shift of the 4 markers towards the center of the radar video;

in particular a shift of 4 markers of 2 NM towards the center of Radar Video is obtained by each degradation of the transmitted power corresponding to 2 dB.

Monitoring efficiency of radar reception system

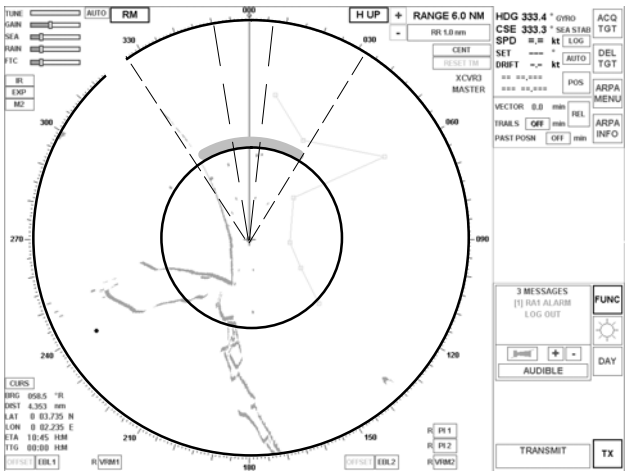
Adjust the radar GAIN to obtain a floor noise that is just visible. If the radar is working correctly, the 4 arcs must be recognizable; in particular the furthest must be hardly recognizable by floor noise.

The 4 markers are visualized with decreasing intensity starting from the nearest marker to the one furthest from the center of the radar video.

Each jump in intensity indicates a decrement of 3 dB in reception.

If the sensitivity of the receiver decreases by 10 dB, the marker nearest to the center of the radar video will only just be recognizable above the noise.

In the extreme condition corresponding to a degradation in power equal to or greater than 10 dB for the transmitter and receiver, only one marker will appear on the radar video at a distance of 4 NM.



Info
The dotted lines are only used to explain the PMU check.

PMU
receiver/transmitter check

— — Degradation of 10 dB for receiver

— — Degradation of 10 dB in transmitter and receiver power

Figure: 2–78 PMU receiver and transmitter check

2.5.6 Select SECTOR BLANKING (ON/OFF)

SECTOR BLANKING is one of the ship–specific settings to be made at commissioning.

The setting normally depends on the ship's superstructure (e.g. cranes, chimneys etc.), from which strong reflection effects can be expected. These effects have a negative impact on the quality of the radar video. To counteract this, the relevant sectors can be blanked out in the radar video.

Procedure: (see Figure: 2–79)

Step 1 Open the FUNC menu

Step 2 The default setting for SECTOR BLANKING is **ON**.
Pressing the softkey restores the blanked sector to the radar video.
Pressing the softkey again blanks the sector again.

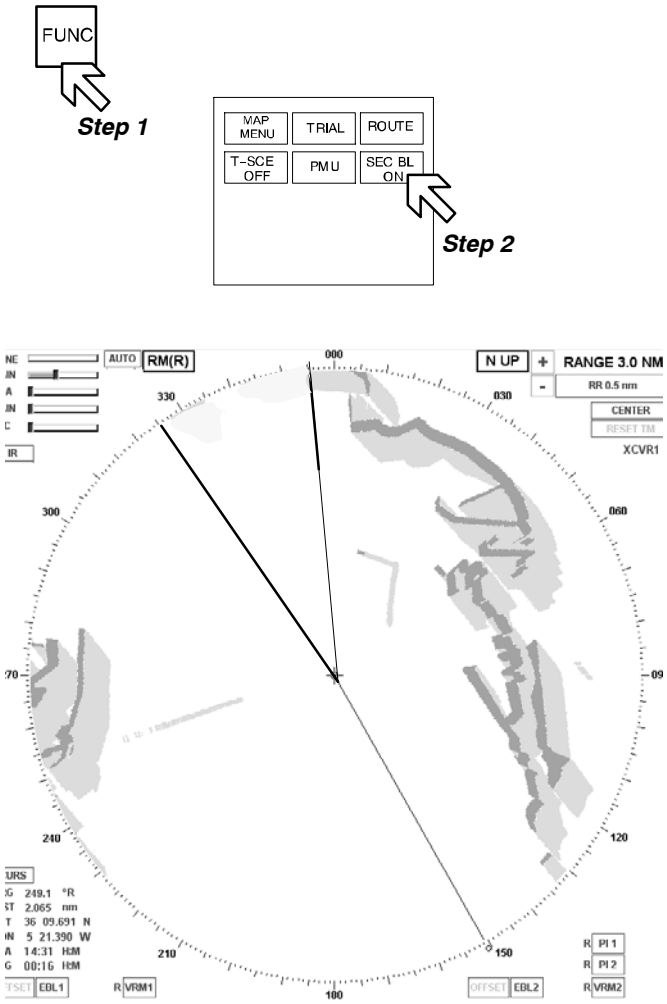


Figure: 2–79 Sector blanking

Result:

The radar video quality within the sector depends on the reflection influences.

3 Theory of Operation

This chapter gives additional information about radar operation and functions. It explains terminology and and describes a number of effects which have influence on radar performance and have to be considered by the operator.

A radar uses a very high frequency radio wave (microwave) which has similar properties to those of light regarding straightness and uniform velocity. The radar antenna radiates the fan shape fine microwave (fan beam) to the target just as a search light throws the light beam to the target, and the reflected microwave from the target returns to the antenna.
The radar does not use a continuous wave but radiates the wave for a very short period (approx. 10^{-6} to 10^{-8} second .... called pulse) to measure the time from when the wave is radiated till the reflected wave returns to the antenna. In addition, with rotation of the antenna at a constant speed, the fan shape radio wave radiated from the antenna scans around 360° – with the antenna at its center – in order to detect the object.

3.1 Radar Plotting Terminology

- **Bearing (AZIMUTH)**
  The horizontal direction of one point from another point, expressed as the angle in the horizontal plane between a reference line and the horizontal projection of the line joining the two points.

  – TRUE Bearing > Reference is true north

  – RELATIVE Bearing > Reference is own ship's heading

- **Target Speed**

  – TRUE > Actual Speed made good by target.

  – RELATIVE > In relation to own ship's movement

- **Target Course**

  – TRUE > Direction of target movement referenced to true north.

  – RELATIVE > Direction of target movement referenced to own ship bow.

- **Closest Point of Approach (CPA)**

  The point at which a target will be closest to own ship

- **Time to Closest Point of Approach (TCPA)**

  The time remaining to CPA, based on current own ship speed.

- **Potential Collision Point (PCP)**

  The point at which a collision would take place if the target vessel maintains present course and speed, and own ship maintains present speed and if own ship were to choose to steer a collision course now.

- **Radar Video presentation**

  Relative Motion (RM)
  In this mode, the radar shows the motion of a target relative to the motion of own ship, own ship is fixed on the screen. Targets move on the screen. Relative Motion can be with True Trails RM (T) with Relative Trails RM (R)

  True Motion (TM)
  In this mode, the actual or true motion of a target and own ship, i.e. land masses or non–moving targets are fixed on the screen while targets with actual motion and own ship move on the screen (similar to plotting chart).

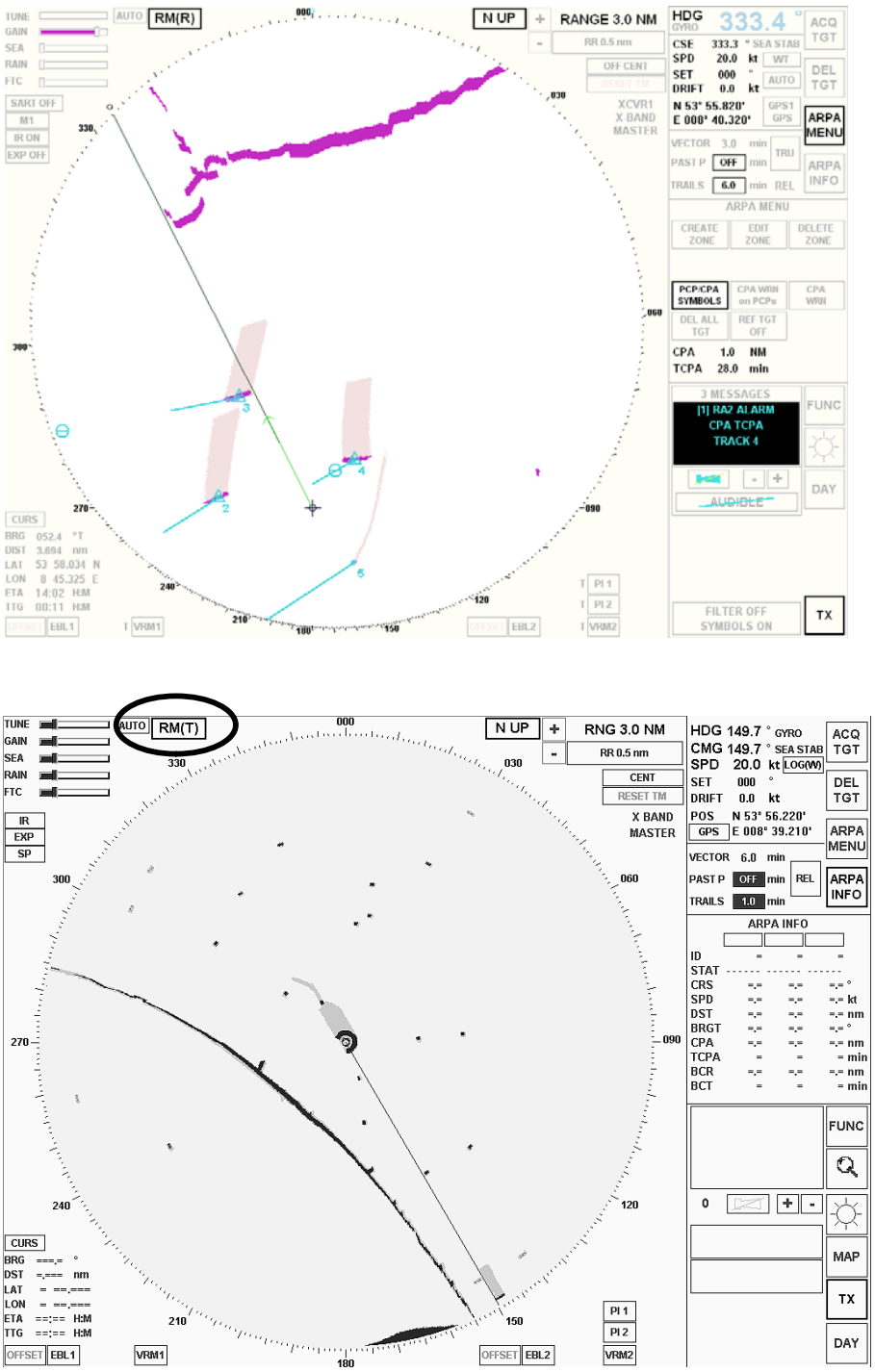


Figure: 3–1 Relative Motion (R) / Relative Motion (T)

- **Vectors**

  Relative Vector

  Line drawn on screen to indicate calculated relative course and speed of targets.

  True Vector

  Line drawn on screen to indicate calculated true course and speed of targets.

3.2 Radar Pattern Interpretation

The radar displays a chart–like picture (PPI) on TFT under normal conditions. Under certain conditions, however, various false echoes are generated, and small targets are hidden by rain, snow or sea waves. To correctly interpret targets and patterns which appears on the TFT requires considerable experience. Compare patterns that appear on the radar image to the actual topography to acquire experience as far as possible.

3.2.1 Range

The detectable range depends on the antenna height and height of targets. Sometimes, however, the radar detectable range is longer due to refraction of the wave beam according to weather conditions.

The radio wave is obstructed by mountains and hills, forming a shadow behind these objects.

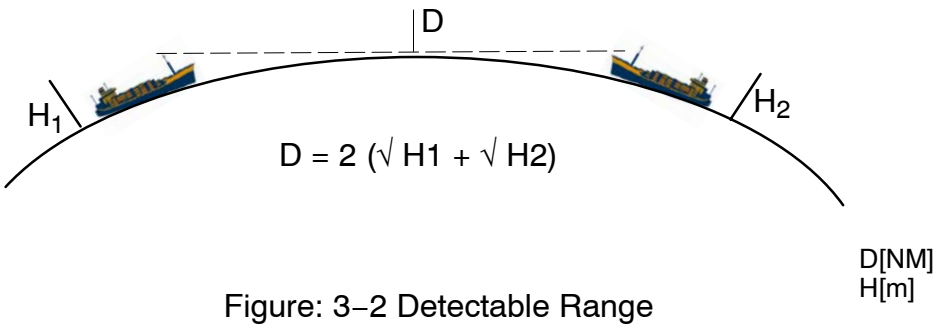


Figure: 3–2 Detectable Range

Examples:

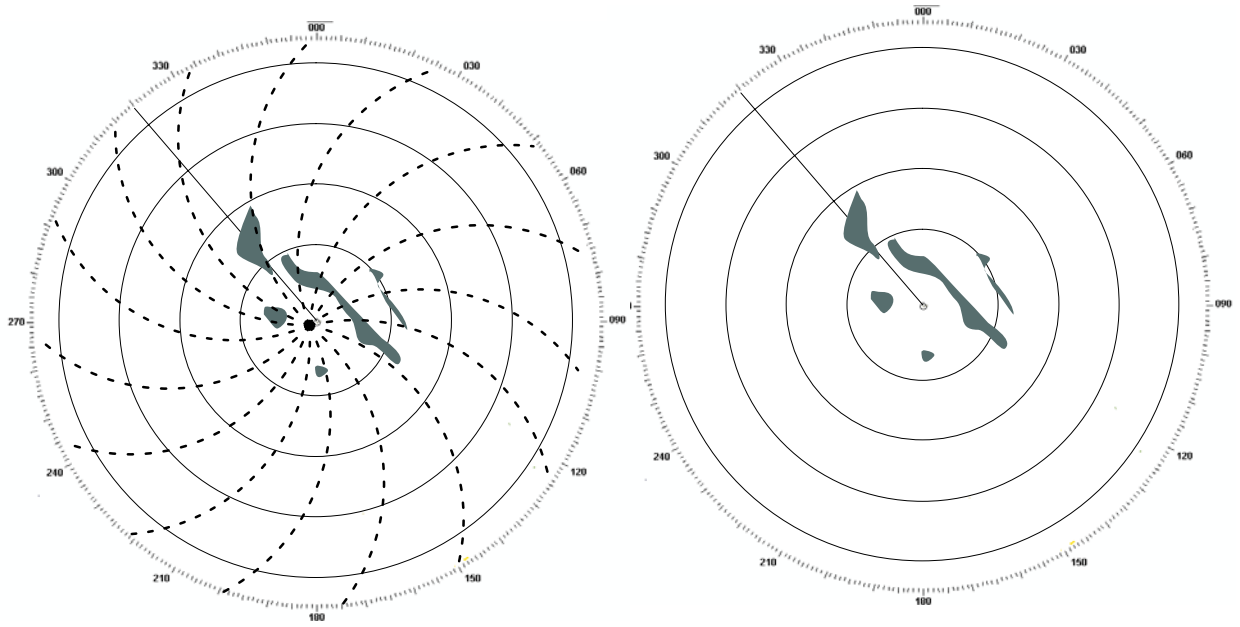
A big ship with 25 m antenna high can detect a 4 m high small ship in up to 14 NM distance.

A big ship with 25 m antenna high can detect a 25 m high ship in up to 20 NM.

A big ship with 25 m antenna height can detect a 100 m high coast in up to 30 NM.

3.2.1.1 Radar Interference

When a radar is used on another ship nearby, a radial pattern of dots may appear on the display. There are various patterns caused by the radar interference which can be eliminated by reducing the range scale.
This radar provides a radar interference rejection device, and the radar interference from the radars of other ships can be cancelled (see Figure: 3–3).



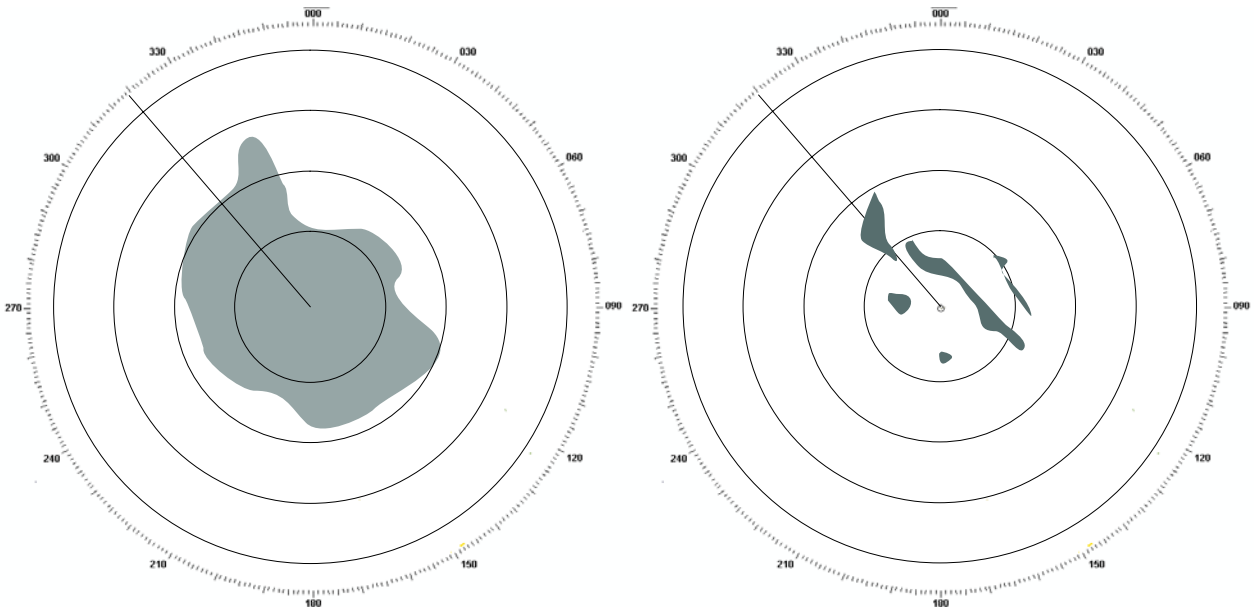
Without Interference rejection **With** Interference rejection

Figure: 3–3 Interference rejection

3.2.1.2 Sea Clutter, Rain Clutter

The radar wave is reflected by waves, clouds, rain and snow. This is then displayed as a bright noise which clutters the Radar Video and may hide targets When this happens, adjust GAIN, SEA (sea clutter), RAIN (rain and snow clutter) controls to assist in the detection of targets easily.

Then adjust FTC.
Take note that ordinary visible targets cannot be seen in heavy rain and snow (see Figure: 3–4).



Without Rain, Snow Clutter Control

With Rain, Snow Clutter Control

Figure: 3–4 Pattern interpretation

3.2.1.3 Side Lobe Effect

In short ranges, not only the main lobe of the radar is reflected by ships nearby but in some cases also the side lobes are reflected.
This leads to false echoes, which are all at same distance, but different bearings.

Multiple reception effect
If a strong echo reflected from a large object at short range is reflected several times between the object and own ship, false echoes are displayed at positions of 1, 2, 3 or more times the distance of the actual position. ***A*** is the actual echo, ***B*** and ***C*** are false echoes, and ***D*** and ***E*** are side lobe echoes (see Figure: 3–5). These echoes can easily be identified because these echoes can be reduced by adjustment of GAIN, SEA controls.

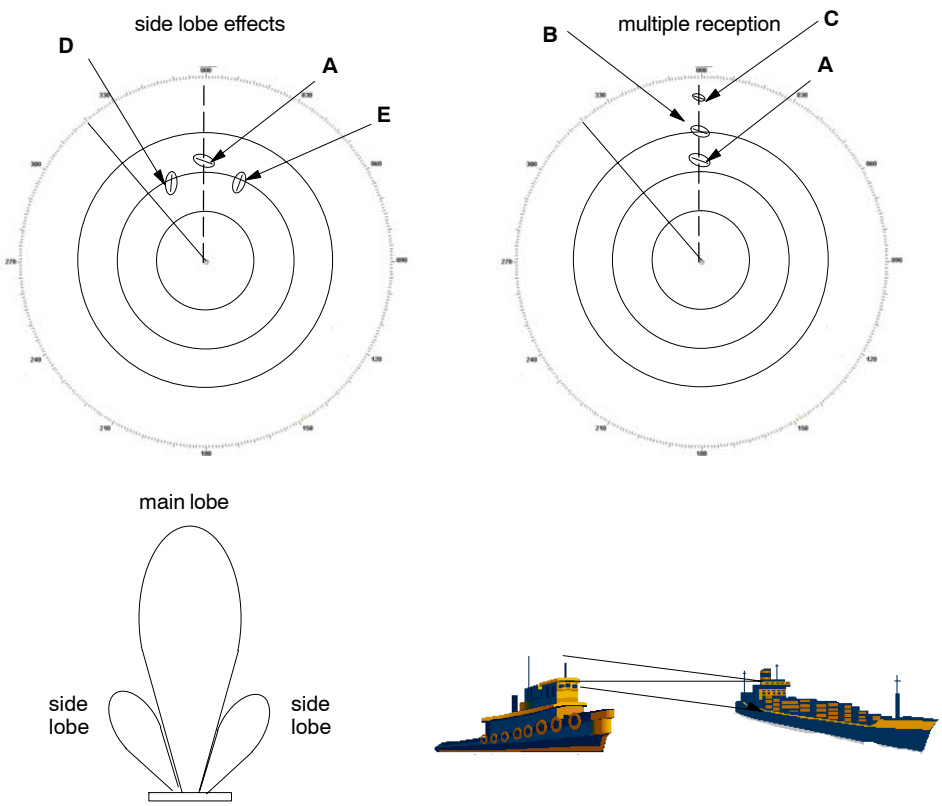


Figure: 3–5 Side Lobe and Multiple Reception False Echo

3.2.1.4 Second trace false echo

The second trace false echo appears when the signal is received at the next pulse repetition period after it was reflected by a high mountain or similar object in long distance. Therefore, the position in which it appears is identified by subtracting distance corresponding to the pulse repetition interval from the actual distance. Assuming the pulse period is 1000 µs and the range scale is adjusted tor 12 NM, the pulse reflected from a target 80 NM away returns after 1000 µs. Targets lying at a distance of beyond (80 NM + 12 NM=) 92 NM, therefore, can generate second trace false echoes.
A target in 83 NM distance may generates an echo on the radar display at 3NM (see Figure: 3–6).

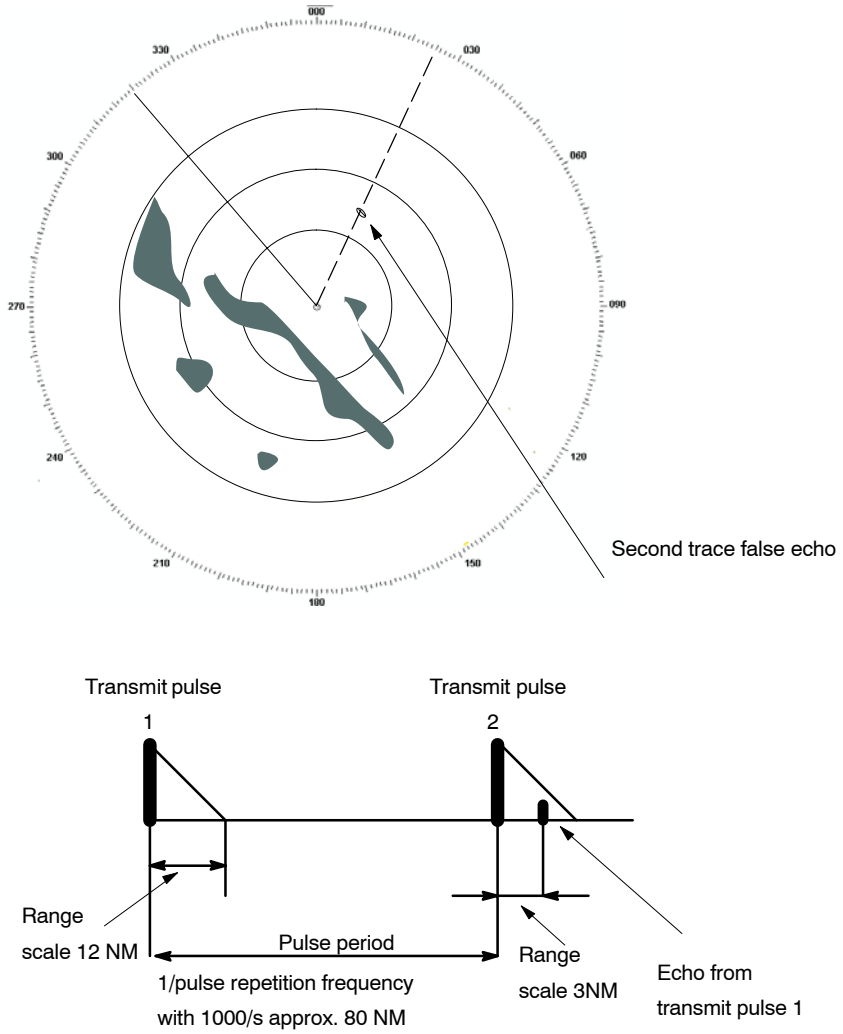


Figure: 3–6 Second Trace False Echo Effect

It often appears that the radio wave propagation is abnormal (duct effect), when the object is a very large mountain. If the signal reception level, however, is small and the transmitted pulse intervals are slightly changed, then a long cloudy form echo appears as shown in the figure, and can easily be identified. If it is difficult to identify, reduce the receiver gain (GAIN) slightly. In rare cases, the guard ring alarm goes off. In this case, check and observe the video echoes, and reduce the receiver gain, and in case of medium range scale (3, 6, 12 NM) switch to LONG PULSE or to 24 NM range scale (see Figure: 3–7).

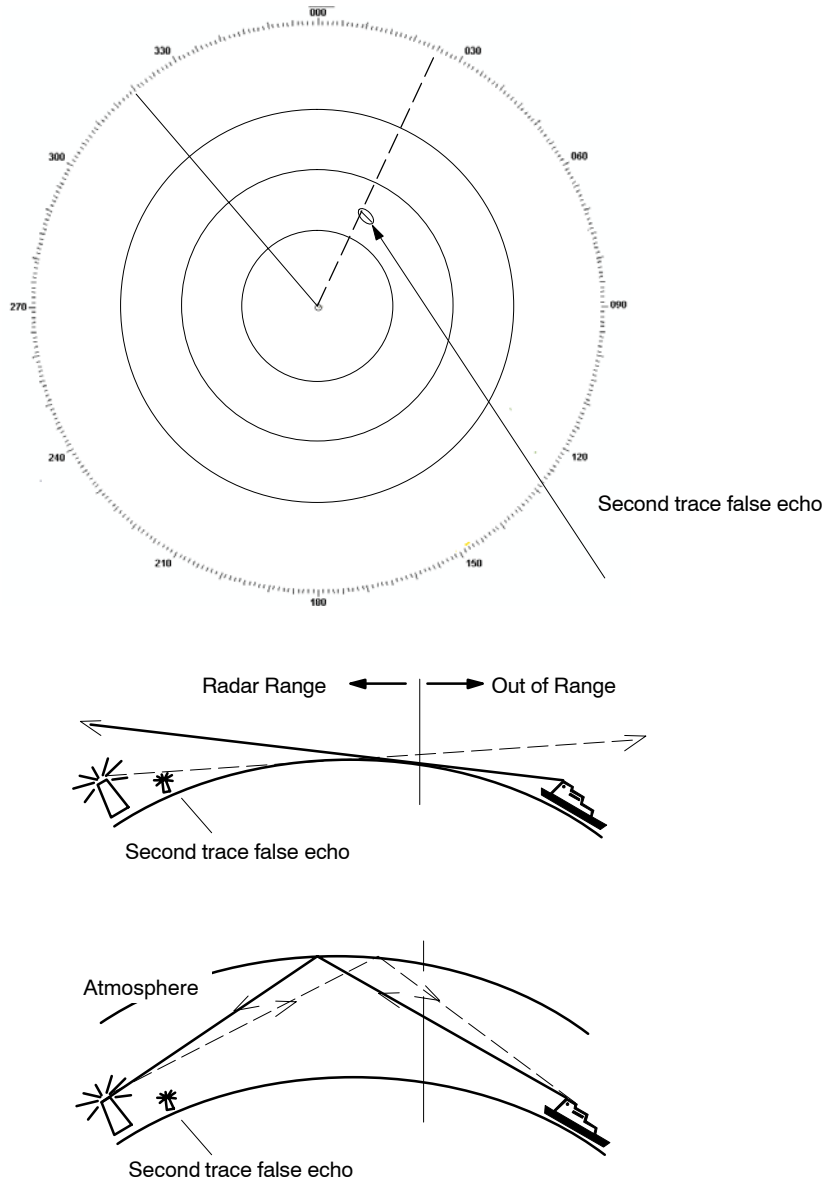


Figure: 3–7 Second Trace False Echo, Duct Effect

3.2.1.5 Abnormal Atmospheric Conditions

Under certain abnormal atmospheric conditions, the radar wave can be reflected at higher layers in the atmosphere. This leads to wrong measurements in long distances.

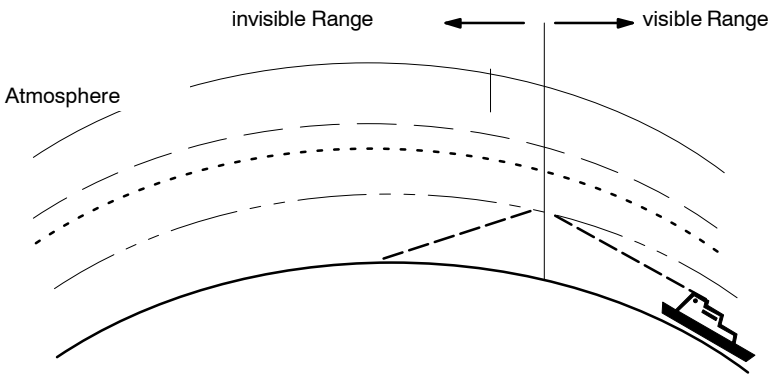


Figure: 3–8 Atmospheric Condition

3.3 Vector Presentation

3.3.1 True Vector Mode

(see Figure: 3–9)
True vector mode displays the true movement of all targets with true course and true speed.

The actual speed and course of own ship and and two targets are such that **target 1** will eventually collide with own ship, and the **target** 2 will pass well behind own ship. In TRUE vector mode, tracked targets which are standing still (such as **target 3**) do not display a vector.

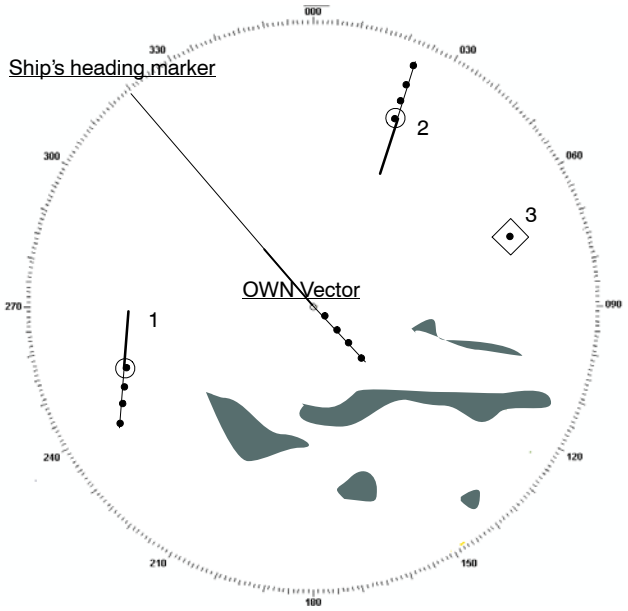


Figure: 3–9 True Vector Mode

3.3.2 Relative Vector Mode

(see Figure: Figure: 3–10)
Relative vector mode shows how targets move in relation to own.

All ships that have relative vectors pointing to my own ship are dangerous targets.

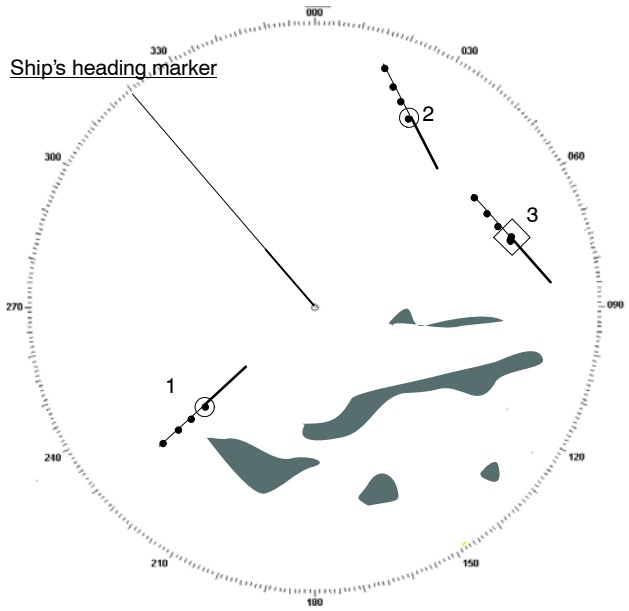


Figure: 3–10 Relative Vector Mode

When the same situation is displayed in RELATIVE vector mode, target 1 gradually closing with own ship and it is apparent that target 2 indicates no threat as long as neither own ship nor target changed their headings.
The stationary target 3 does not move at all. Its relative vector is exactly opposite to own ship's vector.

3.4 Automatic Radar Plotting Aid (ARPA)

The purpose of an Automatic Radar Plotting Aid (ARPA) is to interpret radar information continuously and to display the results so that watch officers may quickly assess and react to potential danger. The performance specfication of the International Maritim Organization (IMO) requires the ARPA plotting reliability to be as good as manual plotting techniques. The NSC meets and exceeds these minimum requirements to provide a greater margin of safetey.

The first requirement of safetey is to maintan surveillance of traffic and navigation harzards. The ARPA will plot up to 70 manually acquired (Plot) targets.

For any targets being plotted, the ARPA continuously displays vectors indicating speed and course. Based on preset conditions the ARPA determines if the possibility for collision exists.

When a potentially dangerous target is detected, warnings are given and information detailed on the target is displayed.

If the watch officer determines that an avoidance maneuver is required, the ARPA trial maneuver mode can assist in the planning. When a maneuver is actually made, the ARPA continuously displays the effect on all plotted targets during and after the course change.

3.4.1 Sensor Errors

The performance of ARPA depends on the quality of the sensor information which is processed. The radar is the sensor which measures target range and bearing relative to own ship. The gyro compass measures the heading of the own ship ship relative to north. The speed log measures the motion of ship own relative to the water or bottom.

3.4.1.1 Gyro Compass

A precise Gyro Compass heading is an important condition for accurate target tracking and ARPA information. The radar user should be aware that Gyro Compasses may have errors (speed error and acceleration error). These errors can degrade the accuracy of target results (ARPA INFO).

Raytheon Gyro Compasses have automatic error correction and supply true heading to radars.
This may not be the case for other Gyro Compass models.

If Gyro Compass heading input is interrupted, the radar will give alarm.

3.4.1.2 Speed Log

A precise speed input from the log is an important condition for accurate target tracking and ARPA INFO. The radar user should be aware that speed outputs of logs may be temporarily unstable for various reasons. This may degrade the accuray tracking results (ARPA INFO).

If speed input is interrupted, the radar will release alarm.

3.4.1.3 Plotting

Plotting is started by positioning the trackball cursor over the desired target echo. When the softbutton is pressed the radar aquires the target.

When a target becomes too weak or too large and is identified by the ARPA as a LOST TARGET, two options are available:

(1) CANCEL Option: As a warning, a flashing symbol marks the last position of the target. The ARPA attempts the target by increasing the window size. It coasts for five scans (antenna rotations) and if the target is not located in the enlarged window, the plot is cancelled.

(2) COAST Option: The lost target data is not automatically cancelled but rather is “coasted “ and the flashing LOST TARGET symbol marks the last position of the target. To delete the LOST TARGET symbol, track, and target data, a manual cancel operation must be done.

CAUTION

IF A TARGET GETS CLOSE TO ANOTHER TARGET, THE TWO TARGETS CANNOT BE DISCRIMINAT AND TRACKING MAY RESUME ON THESE SIGNALS.
THE OPERATOR SHOULD INVESTIGATE ALL ARPA ALARMS.

Occasionally, when a vessel changes course while coasting or other targets are in the vicinity, a plot may be lost or transferred to another target. The flashing alerts the operator to verify the condition after coasting.

NOTE

If a plot acquisition is attempted on a target close to another plot, the new plot will be refused.

To determine accurate ARPA results, a number of past positions have to be recorded. After acquiring a close target, the processor takes about a minute to record enough position data to get a good, accurate speed.
More time could be required for targets more than eight miles away.

NOTE

For accurate target data, accurate own ship's course and speed are required, particularly during course changes. Sensor errors in own ships course and speed will cause equal errors in target data. Manual speed entries can be used, but for best performance an accurate speed log is recommended.
A Ground Reference mode is provided to improve speed measurements. A small, fixed, stable target is plotted to give a zero speed reference. Target positions and own ship's position may be referred to the Reference Target. The use of a suitable reference target will improve motion stabilization and target data.

3.4.2 Collision Assessment (Surveillance)

Once the true velocities of own ship and targets are established (within one minute of acquisition), it is valid to interpret displayed information for collision assessment. TRUE and RELATIVE VECTORS are available to present target velocities.
The NSC provides two additional surveillance features to aid in rapid assessment of collisions potential in congested situations. When displaying TRUE VECTORS, the operator may choose to display Potential Collision Point (PCPs). The appearance of one or more of these symbols, on or near own ship's heading line, immediately signals collision potential. When displaying RELATIVE VECTORS, the operator may choose to display all CPAs within the set CPA limit, plus one mile of own ship whose TCPA is less than 30 minutes. The appearance of one or more of these symbols near own ship's current position immediately signals collisions potential.

3.4.2.1 Accuracy of Collision Assessment

The position of PCP and CPA are the key parameters in collision assessment and of vital importance. Both are calculated from knowledge of present position and velocities of targets and own ship.

3.4.2.2 Displaying of CPAs

CPA is the Closest Point of Approach for any target vessel if both the target vessel and own ship maintain course and speed. The calculated CPA will match the actual CPA only if the present course and speed of the target vessel has been maintained long enough for the target velocity filters to settle. The ARPA specification allows up to three minutes for this purpose. The NSC accomplishes this in one minute .

Furthermore, if own ship's speed–log has no smoothing or delay in its readings, the NSC will produce an accurate CPA even as own ship comes to a new course and/or speed (target not maneuvering). CPA and TCPA are calculated for all targets; once for each revolution of the radar antenna (approximately two seconds for Raytheon radars).

CPA symbols will be displayed if:

(1) the operator selects the CPA/PCP display button on the collisions assessment menu page and

(2) RELATIVE vector mode is selected and

(3) the CPA symbols are located within the bearing scale and

(4) display is stabilized and

(5) symbol display state is ON and

(6) “ARPA DATA” display state is ON

3.5 Keep the following points in mind when operating the NSC:

- **Radar Video**
  The radar video display area is updated from a memory. The memory is updated as the antenna scans. The radar picture is signal processed from previous scan of the antenna. This process is called scan–to–scan integration. Three scans are required to integrete a target to full brightness. It should be noted that while in head up, the scan integration process is removed and all targets including clutter are displayed at full brightness.

- **Sensitiveity Controls**
  When the sensitivity controls are used, the operator must wait for three scans to see final result. The radar picture will “build” until targets are displayed at a bright level. Receiver noise and in most cases, clutter, will not be integrated and will appear dim when the controls are properly set. Adjust the controls in small increments.

- **Radar Detectability**
  The processing of three scans of radar data results in greater radar detectability. Targets which otherwise would be in noise now stand out clearly. Greater radar detectability could occasionally cause reflections and other undesired echos to appear as strong returns. Use the sensitivity controls to achieve a suitable presentation.

- **Best Clutter/Interference Rejection**
  The best clutter/interference rejection will occur when accurate speed (log) and gyro information is used to stabilize the radar display. Use the Sea, FTC and Rain controls to suppress clutter and leave targets at a bright level.

Radar video displays, see chapter 2.3.2

Radar video settings, see chapter 2.3.3

INFORMATION PANEL, see chapter 2.3.6

MENU bar, see chapter 2.3.6.6

SHM see chapter 2.3.2.1

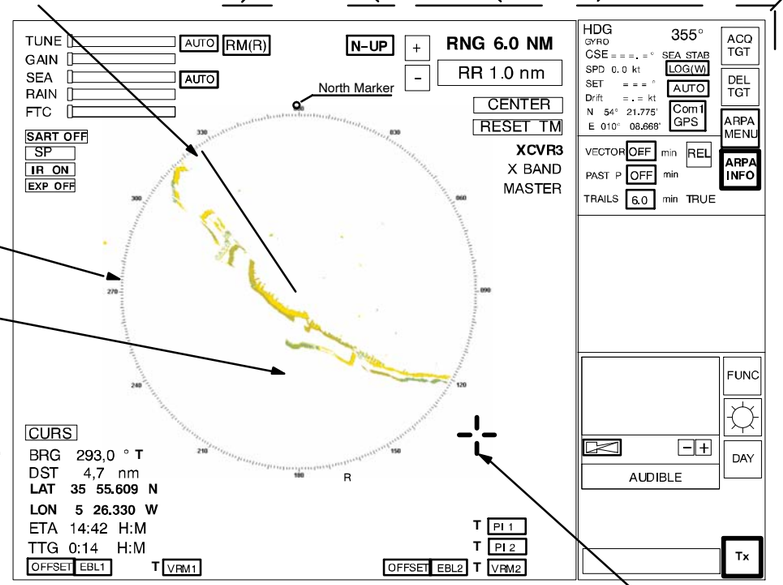
Antenna sensitivity controls, see chapter 2.3.1.

PPI

Radar compass rose

Radar video

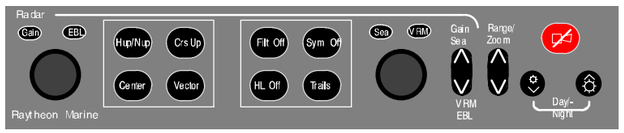
Cursor information in radar video range, see chapter 2.3.5



Navigation
Electronic bearing lines (EBL) and variable range markers (VRM), see chapter 2.3.4

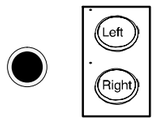
Park position automatic cursor position

Radar operator panel, see chapter 2.2.3



Power ON/OFF button see chapter 2.2.1

Reset Dip switch see chapter 2.2.5



Trackball see chapter 2.2.2

Raytheon Marine

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Raytheon Marine GmbH
High Seas Products
D-24100 Kiel, Germany
Tel +49(0)4 31-30 19-0
Fax +49(0)4 31-30 19-291
Email Service@raykiel.com
www.raytheon-marine.de