FURUNO

OPERATOR'S MANUAL

Electronic Chart Display and Information System (ECDIS)

FEA-2107
FEA-2107-BB
FEA-2107-D
FEA-2807
MODEL FEA-2807-D

Instructions for use with Autopilots:
FAP-2000
PT-500A(CAT B, CAT C)
PR-6000

FURUNO ELECTRIC CO., LTD.

www.furuno.co.jp

(Elemental Chlorine Free)

The paper used in this manual
is elemental chlorine free.

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(DAMI) FEA-2x07 AUTOPILOT

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Foreword

The purpose of this manual is to provide the instructions for how to use the Autopilots FAP-2000, PT-500A(CAT B and CAT C)[1] and PR-6000[2] with the FURUNO FEA-2107-D, FEA-2107-BB-D, FEA-2807-D Electronic Chart Display and Information System (ECDIS). For ECDIS operating information, see its Operator's Manual.

[1] PT-500A(CAT B and CAT C) are products of YOKOGAWA ELECTRIC CORPORATION.
[2] PR-6000 is a product of TOKYO KEIKI INC

Important Notices

- The operator of this equipment must read and follow the descriptions in this manual. Wrong operation can cancel the warranty or cause injury.
- Do not copy any part of this manual without written permission from FURUNO.
- If this manual is lost or worn, contact your dealer about replacement.
- The contents of this manual and equipment specifications can change without notice.
- The example screens (or illustrations) shown in this manual can be different from the screens you see on your display. The screens you see depend on your system configuration and equipment settings.
- Save this manual for future reference.
- Any modification of the equipment (including software) by persons not authorized by FURUNO will cancel the warranty.
- All brand and product names are trademarks, registered trademarks or service marks of their respective holders.

Safety Instructions

WARNING	Indicates a condition that can cause death or serious injury if not avoided.
CAUTION	Indicates a condition that can cause minor or moderate injury if not avoided.

Warning, Caution Prohibitive Action Mandatory Action

WARNING

Do not open the equipment.

This equipment uses high voltage that can cause electrical shock.
Only qualified persons can work inside the equipment.

Turn off power at switchboard if the something is dropped inside the equipment.

Fire or electrical shock can result if the power remains on.

Turn off power at switchboard if the equipment is emitting smoke or fire.

Fire or electrical shock can result if the power remains on.

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

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

CAUTION

Do not dissassemble or modify the equipment.

Fire, electrical shock or bodily injury can result.

Do not operate the equipment with wet hands.

Fire or electrical shock can result.

Keep the equipment away from rain, water and water splash.

Fire or electrical shock can result if water gets into the equipment.

Use the correct fuse.

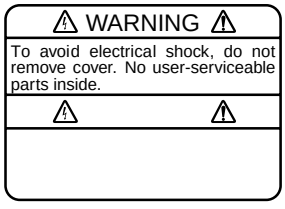
Use of a wrong fuse can cause bodily injury or fire.

The CPU board (PCG820 or 24P0100) in the processor unit has a lithium battery. The battery should only be replaced by a qualified technician.

The battery may burst if it is the wrong type.

WARNING LABEL

A warning label is attached to the processor unit. Do not remove the label. If the label is missing or damaged, contact a FURUNO agent or dealer about replacement.



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

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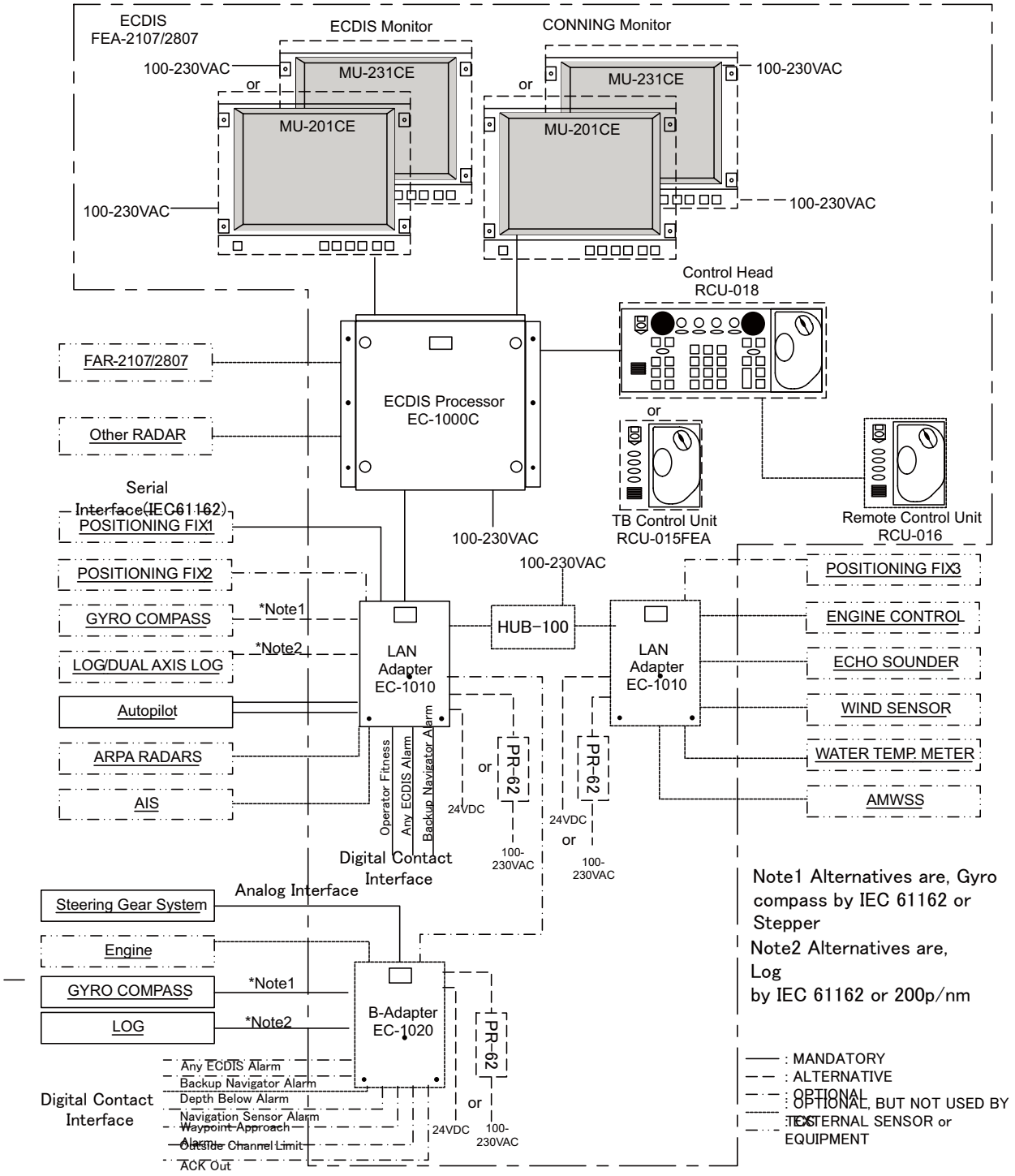
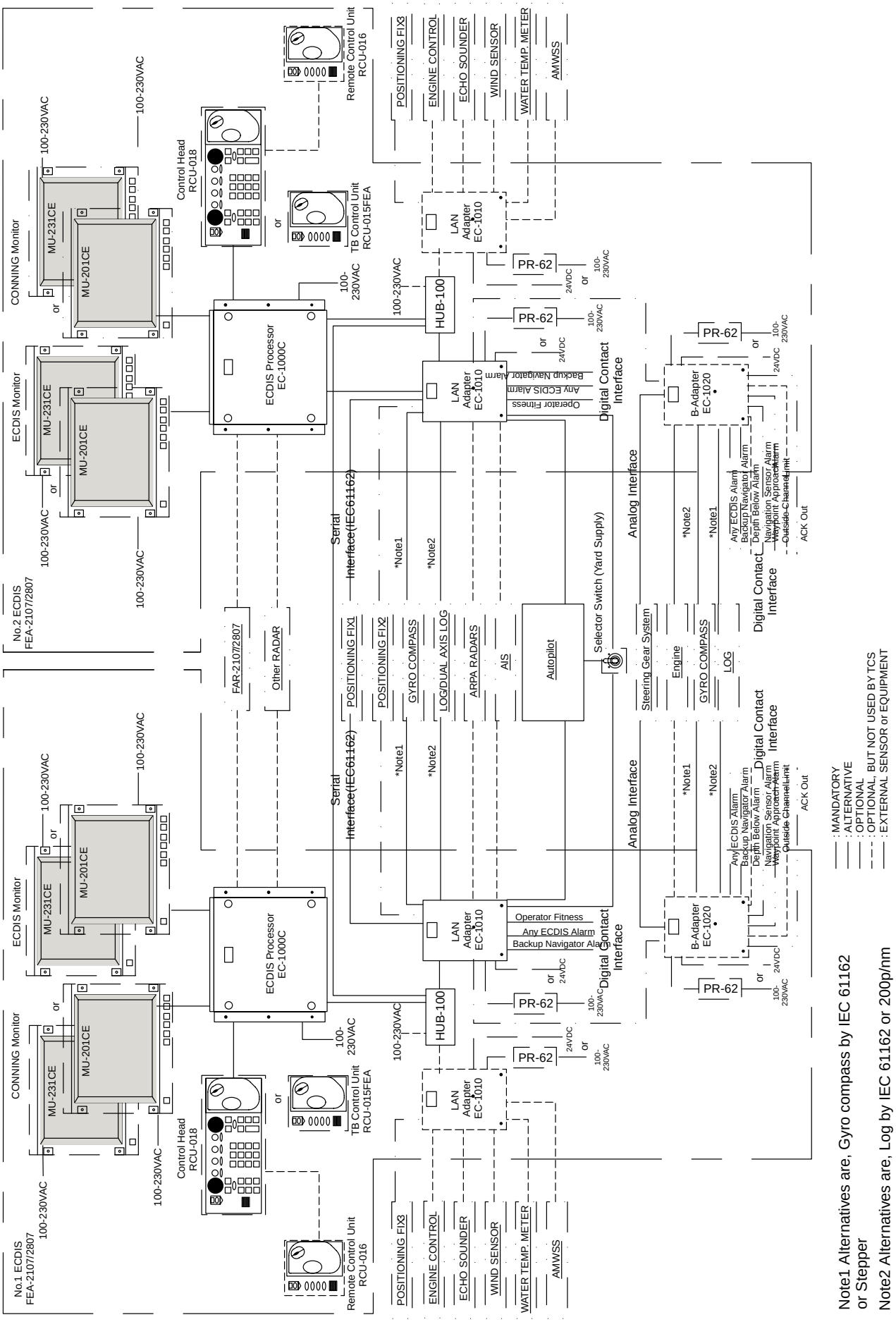
SYSTEM CONFIGURATION

Single workstation



Multi workstation



Note1 Alternatives are, Gyro compass by IEC 61162 or Stepper

Note2 Alternatives are, Log by IEC 61162 or 200p/nm

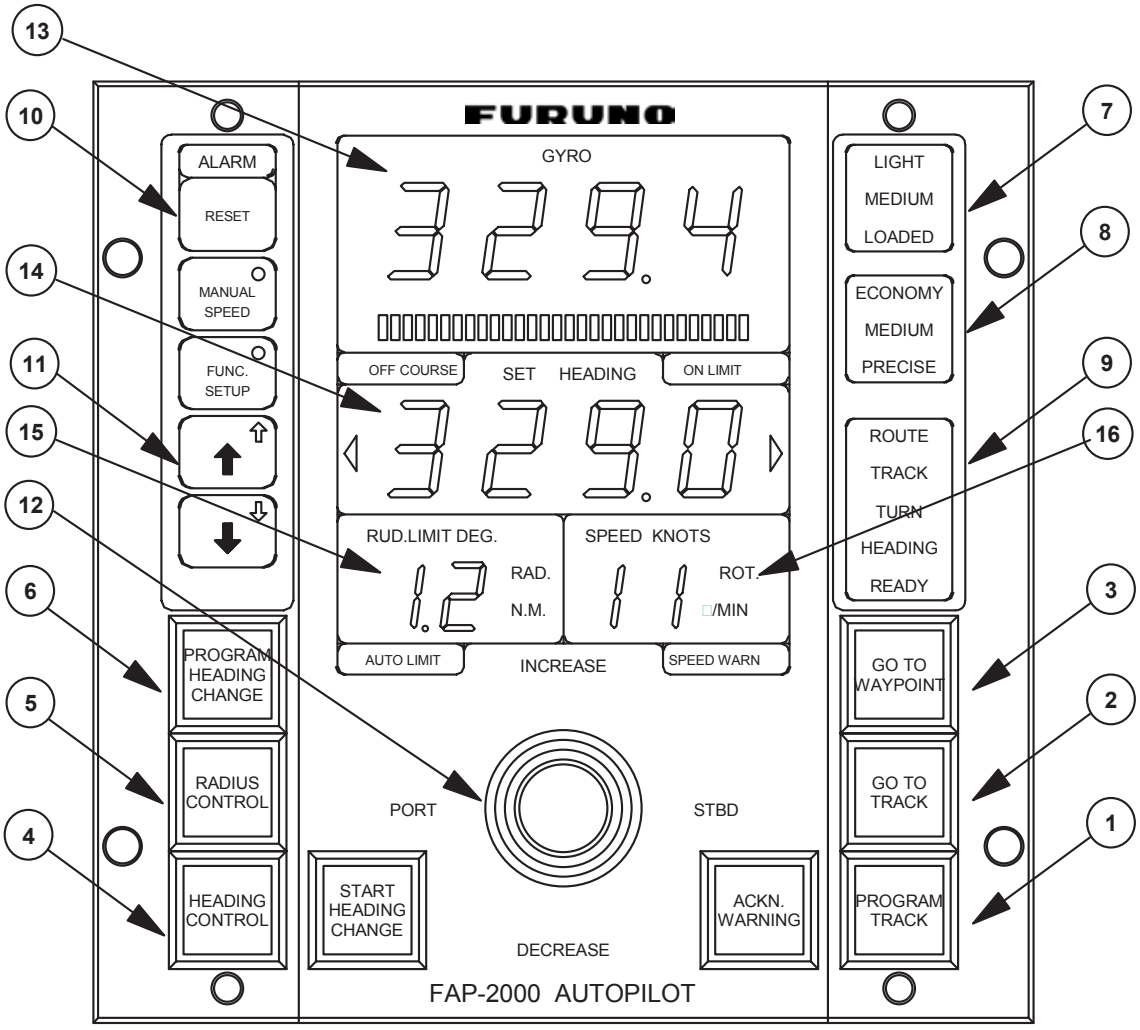
1. FURUNO Autopilot FAP-2000

1.1 Introduction

This chapter describes the steering functions available with the FURUNO Autopilot FAP-2000.

1.2 Control Panel

This section describes the FAP-2000's control panel.



1-6: **Steering mode selection**

- **PROGRAM TRACK**: Program Track-controlled heading change using set radius. Also for steering with selected TT models.
- **GOTO TRACK**: Track-controlled route steering
- **GOTO WPT**: Course-controlled route steering
- **HEADING CONTROL**: Immediate heading-controlled course change using set rudder angle limit
- **RADIUS CONTROL**: Immediate radius-controlled course change using set radius
- **PROGRAM HEADING CHANGE**: Program heading-controlled course change using set radius

7: **Loading condition indicator**: Loading conditions, Light, Medium or Loaded

8: **Performance indicator**: Performance status, Economy, Medium or Precise

9: **Status indicator**: Shows selected mode and state of readiness:

- FAP-2000 in operation: READY
- FAP-2000 control mode: HEADING/TRACK
- FAP-2000 route steering: ROUTE
- FAP-2000 track-controlled turn: TURN

10: **Alert indicator and buzzer cancel**

- **ALERT** lamp for other FAP-2000-related alerts and errors.
- **RESET** button for acknowledging other FAP-2000-related alerts and errors.

11: **Special function keypads**

- Manually input speed.
- Adjust panel dimmer.
- Set manual speed value, auto speed, rudder limit function, performance and conditions.

12: **Tiller**

- Set course and radius.
- PORT and STBD lamps show when the tiller can be used to set course.
- INCREASE. and DECREASE. lamps show when the tiller can be used to set a radius or a rudder angle limit.

13: **Gyro reading and a bar graph showing rate of turn**

14: **Set Heading display includes**:

- Off course alert
- Turn side
- Rudder-on limit indication

15: **Rudder displays**:

- Radius set-point in the Radius Control mode
- Rudder limit in the Heading Control mode
- AUTO LIMIT lamp lights to indicate selection of automatic rudder limit function.

16: **Speed displays**:

- ROT in the Radius Control mode
- Speed in the Heading Control mode
- Speed warning indicator (LOG FAILURE or LOW)

1.3 Steering Modes

The FAP-2000 receives position, heading and speed data, compares them with the track section to be steered, and applies that information to calculate and command the necessary rudder angle.

1.3.1 Hand steering modes

The following hand steering modes are available without the autopilot:

- Steering wheel
- Wing steering control
- Override tiller

While in a hand steering mode, the ECDIS indicates the rudder angle and the hand steering mode.

1.3.2 Autopilot steering modes

The autopilot steering modes are selected from the autopilot control panel.

Heading Control mode

The Heading Control steering mode can be used always because it does not require position data.

- Mode selection: HEADING CONTROL
- The HEADING CONTROL and HEADING lamps are lit.
- Immediate course change when the tiller is used to set the heading.
- Course change is defined as heading controlled by the set rudder angle limit.

Radius Control mode

The Radius Control steering mode can be used always because it does not require position data.

- Mode selection: RADIUS CONTROL
- RADIUS CONTROL and HEADING lamps are lit.
- Course change is radius controlled with the set radius.
- If wind, current, etc. affect the ship, the ship will drift (inside or outside) from the planned turn. This is displayed on the radar screen.

Program Heading Change mode

The Program Heading Change steering mode can be used always because it does not require position data.

- Mode selection: PROGRAM HEADING CHANGE
- PROGRAM HEADING CHANGE and HEADING lamps are lit.
- The tiller is first used to set a new heading and radius, which are also displayed on the radar screen.
- "START HEADING CHANGE" flashes if the newly set heading is different from the currently used heading.
- Start course change by pushing the **START HEADING CHANGE** button.
- After activation, control is returned to RADIUS CONTROL.
- If wind, current, etc. affect the ship, the ship will drift away (inside or outside) from planned turn. This is displayed on the radar screen.

Program Track mode

The Program Track steering mode requires the Kalman filter and a high-precision sensor such as DGPS:

- Mode selection: PROGRAM TRACK
- PROGRAM TRACK, TRACK and TURN lamps are lit.
- The tiller is first used to set a new heading and radius, which are also displayed on the radar screen.
- "START HEADING CHANGE" flashes if newly set heading is different from currently used set heading.
- Start course change by pushing the **START HEADING CHANGE** button.
- After activation, the mode becomes PROGRAM TRACK.
- Course change is track controlled with the set radius.
- If wind, current, etc. affect the ship, the system tries to prevent the ship from drifting away (inside or outside) from the planned designed turn. This is displayed on the radar screen.

Alerts in the Program Track steering mode

The following alerts may appear in the Program Track steering mode.

Alert "**488 Track Control Stopped**": Internal failure - program track mode is cancelled.

Alert "**493 PrgTrack**: **Needs Filter ON**": The Kalman filter is not used with the program track mode. This alert is repeated every four minutes for the next 10 minutes. If the condition continues, the alert "**496 ProgTrack**: **Stop - Sensor Fail**" is generated and the steering mode is automatically changed to "Radius Control".

Alert "**494 PrgTrack**: **Needs Log sens.**": The Kalman filter is used with the program track mode but without including an independent speed source (separate log sensor or two position sensors). This alert is repeated every four minutes for the next 10 minutes. If the condition continues, the alert "**496 ProgTrack**: **Stop - Sensor Fail**" is generated and the steering mode is automatically changed to "Radius Control".

Alert "**495 PrgTrack**: **Needs diff Pos.**": The Kalman filter is used with the program track mode but without a high-precision sensor (for example, DGPS). This alert is repeated every four minutes for the next 10 minutes. If the condition continues, the alert "**496 ProgTrack**: **Stop - Sensor Fail**" is generated and the steering mode is automatically changed to "Radius Control".

Alert "**496 PrgTrack**: **Stop - Sensor Fail**": No gyro data or if conditions of alert 493, 494, 495 or 503 have been valid for the last 10 minutes.

Alert "**498 Use manual rudder control**": Generated every two minutes to alert the operator to control the rudder manually, when the FAP-2000 has lost the gyro data and thus cannot control the rudder.

Alert "**503 PrgTrack**: **Need higher Spd**": The Kalman filter is used with the program track mode but the speed is below the limit set for the track steering in the installation parameters. The alert is repeated every four minutes for the next 10 minutes. If the condition continues, the alert "**496 ProgTrack**: **Stop - Sensor Fail**" is generated and the steering mode is automatically changed to "Radius Control".

Alert "**504 PrgTrack**: **Use Radius ctrl.**": Informs the operator to change the steering mode to "Radius Control". This alert is generated if there are not sufficient conditions to continue the program track (i.e. alert 493, 494, 495 or 503 has been valid two minutes). This alert is repeated every four minutes.

Alert "**509 PrgTrack**: **Need SOG/COG ref**": Appears when there is no Speed Over Ground (SOG) and Course Over Ground (COG) available from the position sensor(s) or bottom track from a dual-axis log. This alert is repeated every four minutes for the next 10 minutes. If the condition continues, the alert "**496 ProgTrack**: **Stop - Sensor Fail**" is generated and the steering mode is automatically changed to "Radius Control".

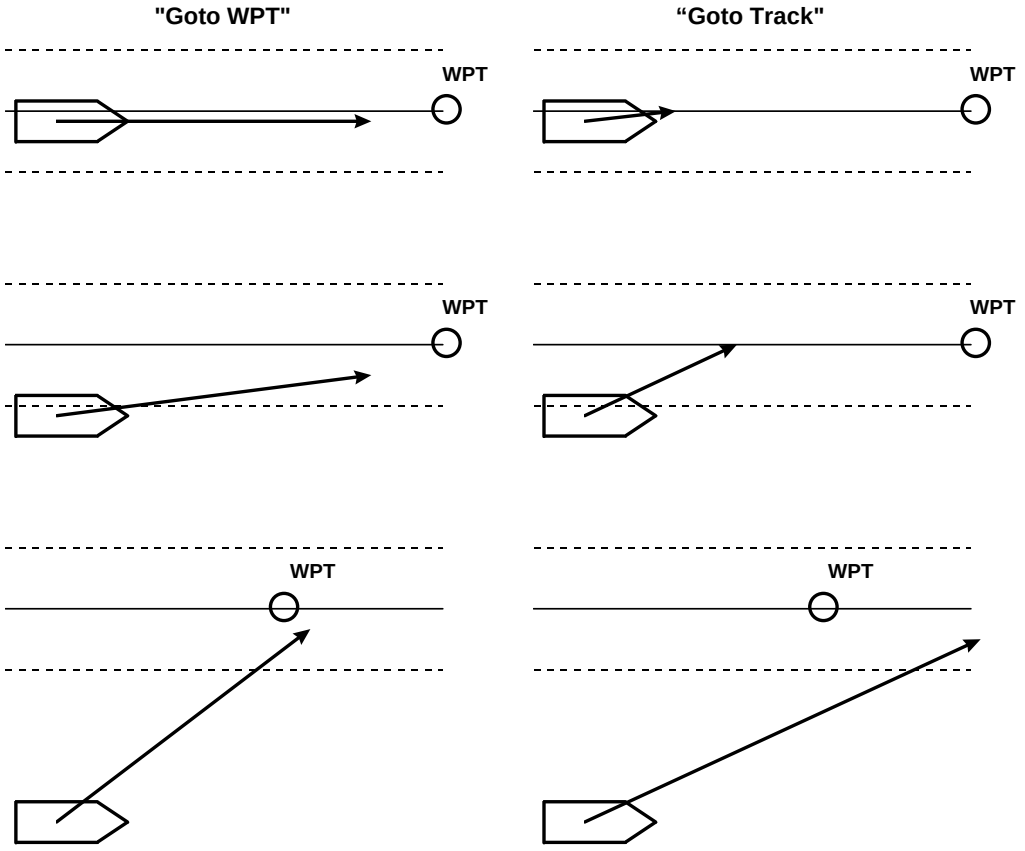
Summary of autopilot steering modes

	HEADING CONTROL	RADIUS CONTROL	PROGRAM HEADING CHANGE	PROGRAM TRACK
Set heading	Yes	Yes	Yes	Yes
Set radius	No	Yes	Yes	Yes
Radius control	No	Yes	Yes	Yes
Design before execution	No	No	Yes	Yes
Full curved EBL on radar screen	No	Yes	Yes	Yes
Wind, current, etc. compensation	No	No	No	Yes
Needs gyro	Yes	Yes	Yes	Yes
Needs log	No	Yes	Yes	Yes
Needs high-precision position	No	No	No	Yes
Needs direct SOG/COG sensor	No	No	No	Yes

1.3.3 Route steering modes

In route steering, you can use either the Goto WPT mode or the Goto Track mode. Route steering is available with a predefined monitored route and when your ship is located inside a channel of a monitored route.

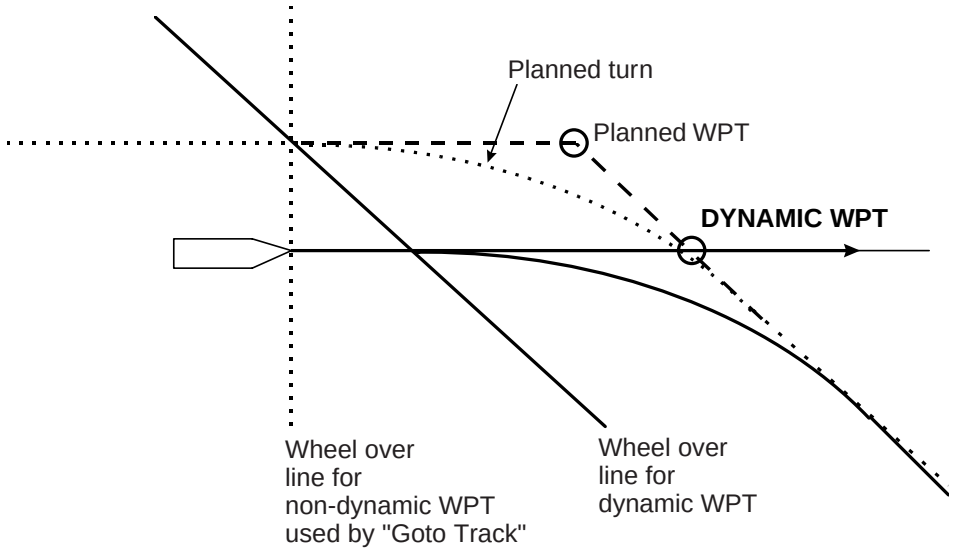
See the figure below for the differences between Goto WPT and Goto Track. As shown, the ship will always make way toward the waypoint in Goto WPT, and return to set course in Goto Track.



Note: If the off track error is more than 100 meters in the Goto Track mode, the system cannot increase the approach angle towards the center line of the route.

Goto WPT mode

- Mode selection: Goto WPT
- Goto WPT and ROUTE lamps are lit.
- The tiller can be used to set radius, but not course, which is set automatically.
- Steering is course controlled with set radius.
- If wind, current, etc. affect the ship between waypoints, the system tries to prevent the ship from drifting from the planned route. The system has three means to prevent drifting from the planned route, and they are most effective when used together. If cross-track error is used alone, your ship stabilizes typically in a constant off-track position. The means are:
  - Measured cross-track error from the centerline, which is always active.
  - Drift compensation available from route parameters
  - Gyro error compensation available from route parameters
- If wind, current, etc. affect the ship during turns, the ship will drift (inside or outside) from the planned turn, which is displayed on the radar screen. This kind of turn is called an "assisted turn".
- Can be used when the ship has an accurate position source available.
- Normally, the Goto WPT mode uses the dynamic location of a waypoint. However, if alert 413 is active, a non-dynamic waypoint is used. The figure below shows how the location of a dynamic WPT is defined in the Goto WPT mode.



Goto Track mode

- Mode selection Goto TRACK
- Available when the ship has a high-precision position source available.
- The **GOTO TRACK** button and ROUTE and TRACK lamps are lit.
- The tiller can be used to set radius, but not heading, which is set automatically.
- Steering is track-controlled with set radius.
- If wind, current, etc. affect the ship between waypoints, the system tries to prevent the ship from drifting from the planned route. The system has three means to prevent drifting from the planned route, and they are most effective when used together. If cross-track error is used alone, your ship stabilizes typically in a constant off-track position. The means are:
  - Measured cross-track error from the centerline, which is always active.
  - Drift compensation is available from the route parameters.
  - Gyro error compensation is available from the route parameters.
- The Goto Track mode uses non-dynamic waypoint.

Summary of route steering modes

	Goto WPT	Goto Track
Set course	Automatic	Automatic
Set radius	Automatic / Manual	Automatic / Manual
Radius control	Yes	Yes
Dynamic waypoint location	Yes	No
Design before execution	Yes	Yes
Full curved EBL on radar screen	Yes	Yes
Wind, current, etc. compensation running straights between WPT	Low gain	High gain
Wind, current, etc. compensation in turns	No	Yes
Needs gyro	Yes	Yes
Needs log	Yes	Yes
Precision of position equipment	Good[1]	High[2]
Needs direct SOG/COG sensor	No	Yes

[1] Precision of position is good with LORAN and GPS.

[2] Precision of position is high with DGPS and SYLEDIS.

Preconditions for route steering

General preconditions

The Goto WPT and Goto Track modes can be activated when your ship is located inside a channel of a monitored route.

The difference between actual heading and planned course to approach the "To WPT" must be less than the limit set in the route steering parameters in order to initiate route steering.

Route steering requires activation of the Kalman filter. If you try to activate a route steering mode without the filter, you get the alert "**470 Disabled**: **Needs filter on**".

If you try to activate any of the route steering modes without an independent speed source, you get the alert "**490 Disabled**: **Needs log sens.**". Route steering requires that you have at least either one log and a position receiver or two position receivers available and in use.

Alert "**499 Disabled**: **Needs good Pos**" appears when the Kalman filter did not have high-precision position sensor for route steering, and position discrepancy limit between primary and secondary sensors is exceeded.

Alert "**502 Disabled**: **Need higher Spd**" appears when the speed used by the Kalman filter calculation is below the limit set for track steering in the installation parameters.

It is recommended to activate the position discrepancy detector (i.e., set position discrepancy limit > 0). This lets the Kalman filter exclude from position calculation a sensor that has a large position discrepancy. This also influences the Goto WPT, Goto Track and Program Track steering modes.

If the position discrepancy limit is set very small (0.01 nm), the system will quickly alert you to the discrepancy, but you may also experience frequent release of the alert.

Goto Track mode preconditions

Route steering with the Goto Track mode requires that you have at least one high-precision position receiver and direct SOG/COG reference available and in use.

At least one high-precision position is available and in use when the permanent indication **FILTER HIGH** appears at the top right corner of the ECDIS display. DGPS, etc. are considered high-precision position receivers. Note that a standard GPS or a DGPS without differential position available are not acceptable as high-precision position receivers.

It is also required that the Speed Over Ground (SOG) reference is available either from position sensor(s) or bottom track from a dual-axis log.

If any of the conditions described above are lost during the Goto Track mode, the system automatically activates the Goto WPT mode within 10 minutes and you get the alert "**489 Route**: **CHG to Goto WPT**".

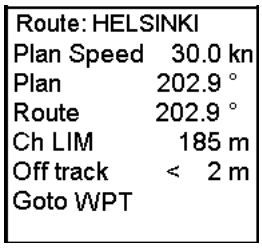
How to activate route steering

To activate route steering, push the **GOTO WPT** or **GOTO TRACK** button on the FAP-2000's control panel. The lamp of the pushed button flashes and if the ECDIS accepts the requested route steering mode, the lamp will then light to indicate the route steering mode in use.

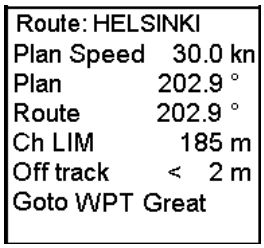
Route steering indications on ECDIS

Goto WPT

The indication "Goto WPT" appears in the route monitor window on the ECDIS display.

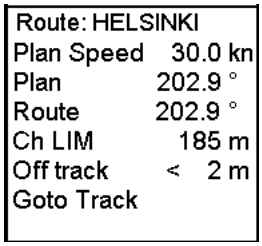


If the planned course to approach a "To WPT" is defined using Great Circle, the indication "Goto WPT Great" appears in the route monitor window on the ECDIS display.

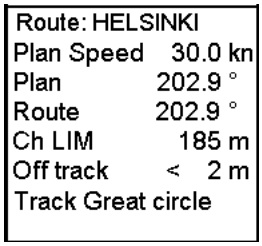


Goto Track

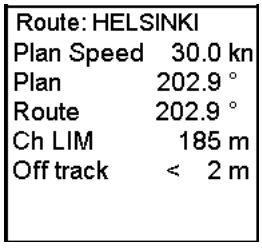
The indication "Goto Track" appears in the route monitor window on the ECDIS display.



If the planned course to approach a "To WPT" is defined using Great Circle, the indication "Track Great circle" appears in the route monitor window on the ECDIS display.



When route steering is not used or if the ECDIS did not accept the requested route steering mode, there is no indication of route steering in the route monitor window, as shown right.



Alerts shown when route steering cannot be accepted

There are several reasons why the requested route steering mode could not be accepted:

Alert "**464 Route**: **No selected route**" informs you that there is no route selected for route monitoring.

Alert "**465 Route**: **Illegal WPT**" informs you that there is a route selected for route monitoring, but the selection of the next or final waypoint is missing or illegal.

Alert "**467 Disabled**: **Steering off**" informs you that the ECDIS didn't have steering controlling permission at the time of the request. Check that you have properly enabled the FAP-2000 for steering.

Alert "**468 Disabled**: **Out of course**" informs you that the difference between the current heading of your ship and the required set heading to start the route steering are greater than set by the operator in the "Route start limit angle" of Route Parameters.

Alert "**470 Disabled**: **Needs filter on**" informs you that you didn't have the Kalman filter ON at the time of the request. Route steering requires that you use the Kalman filter, because the filter eliminates sudden jumps of the position and thus prevents unpredictable maneuvers of your ship. Check your sensor selection.

Alert "**477 Disabled**: **Out of channel**" informs you that the current location of your ship is not inside the channel of the monitored route.

Alert "**490 Disabled**: **Needs log sens.**" informs you that the Kalman filter did not have an independent speed source. You need either a log, a dual-axis log or two position receivers. Check your sensor selection.

Alert "**491 Disabled**: **Needs diff Pos**" informs you that the Kalman filter did not have high-precision position sensor for the Goto Track steering mode. Selected sensors must include at least one high-precision sensor.

Alert "**499 Disabled**: **Needs good Pos**" appears when the Kalman filter did not have a high-precision position sensor for route steering, and position discrepancy limit between primary and secondary sensors is exceeded.

Alert "**502 Disabled**: **Need higher Spd**" appears when the speed used by the Kalman filter calculation is below the limit set for track steering in the installation parameters.

Alert "**508 Disabled**: **Need SOG/COG ref**" appears when neither Speed Over Ground (SOG) nor Course Over Ground (COG) is available from position senor(s) or bottom track of a dual-axis log.

Alert "**510 Disabled**: **Out of turn**" appears when **GOTO WPT** or **GOTO TRACK** button was pressed when the route monitoring of the system detects that your ship is turning, but your ship's location is out of the turn. Check and reset correct "To WPT" for route monitoring.

When you arrive at a waypoint

Route steering navigation tries to keep the ship always inside the channel limits and go to the next waypoint. At the "pre-warning point", the visual alert "**485 Route**: **WPT prewarning**" appears on the ECDIS display and the **ACKN. WARNING** button on the FAP-2000 lights.

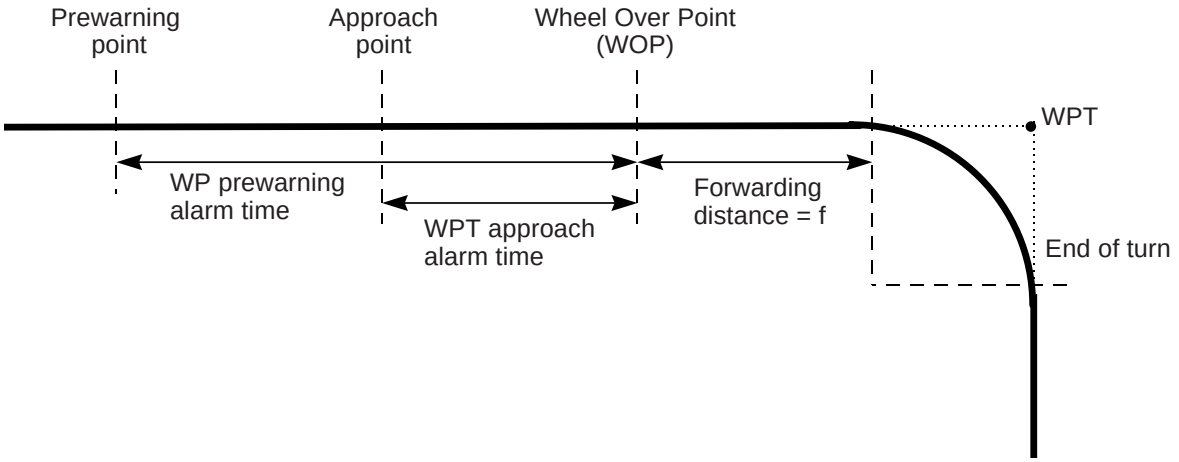
At the "approach point", the operation that occurs depends on if you acknowledged the preceding acknowledgeable visual alert "**485 Route**: **WPT prewarning**".

When you acknowledged the alert 485 at the approach point, the acknowledgeable visual alert "**451 Route**: **WPT approach alarm**" appears on the ECDIS display and the **ACKN. WARNING** button on the FAP-2000's control panel lights. If you do not acknowledge alert 451 before the wheel over point, the alert 451 will be changed from an acknowledgeable visual indication to an audio alarm.

If you did not acknowledge the alert 485 at the approach point, the alert "**451 Route**: **WPT approach alarm**" appears on the ECDIS display, the **ACKN. WARNING** button on the FAP-2000's control lights, and the buzzer sounds.

TURN IS ALWAYS ENABLED. THE ONLY WAY TO DISABLE THE AUTOMATIC TURN IS TO SELECT ANOTHER STEERING MODE.

Note that these alerts are programmable (the time before you reach a turn) and it is relative to the starting point of the maneuver). See the figure below for description.



As soon as the ship arrives at the wheel over point, the ECDIS sends a new course command to the autopilot FAP-2000 and the corresponding maneuver is initiated. During a maneuver, both the radar display and the ECDIS display show the curved EBL, indicating the planned radius for the maneuver.

Waypoint-related indications on ECDIS

Goto WPT

When the "pre-warning point" is passed in the Goto WPT mode and the acknowledgeable visual alert "485 Route: WPT prewarning" is acknowledged at the FAP-2000's control panel, the text "Ass. Appr. Enabled" appears in the route monitor window on the ECDIS display.

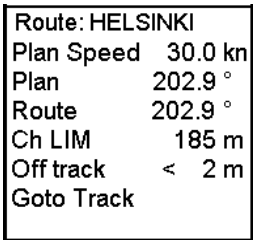
Route: HELSINKI	
Plan Speed	30.0 kn
Plan	202.9 °
Route	202.9 °
Ch LIM	185 m
Off track	< 2 m
Ass. Appr. Enabled	

Goto Track

When the "pre-warning point" is passed in the Goto Track mode and the acknowledgeable visual indication "**485 Route**: **WPT prewarning**" is acknowledged at the FAP-2000's control panel, the text "Track Appr. Enabled" appears in the route monitor window on the ECDIS display.

Route: HELSINKI	
Plan Speed	30.0 kn
Plan	202.9 °
Route	202.9 °
Ch LIM	185 m
Off track	< 2 m
Track Appr. Enabled	

If the acknowledgeable visual indication 485 is not acknowledged, the text in the route monitor window (Goto Track or Goto WPT) will remain the same as it was before the prewarning point.

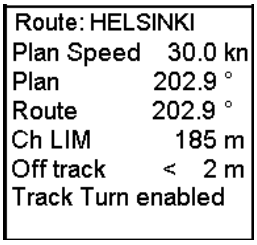


Goto WPT

When the "approach point" is passed and the acknowledgeable visual indication or alert "**451 Route**: **WPT approach alarm**" is acknowledged, the text "Ass. Turn enabled" appears in the route monitor window on the ECDIS display.

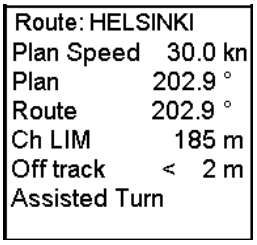
Goto Track

When the "approach point" is passed and the acknowledgeable visual indication or alert "**451 Route: WPT approach alarm**" is acknowledged, the text "Track Turn enabled" appears in the route monitor window on the ECDIS display.



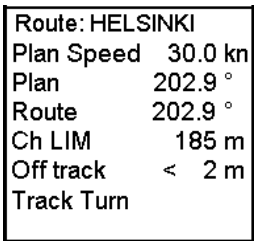
Goto WPT

During the turn the text "Assisted Turn" appears in the route monitor window on the ECDIS display.



Goto Track

During the turn the text "Track Turn" appears in the route monitor window on the ECDIS display.



Note: When you approach the last waypoint, the acknowledgeable visual indication or alert "**458 Route**: **Last WPT approach**" appears. After you acknowledge the alert 458, the route steering is automatically terminated and the FAP-2000 goes into the Radius Control mode.

Route steering alerts

There are two types of alerts relevant to route steering, permanent and intermittent.

Permanent route steering alerts

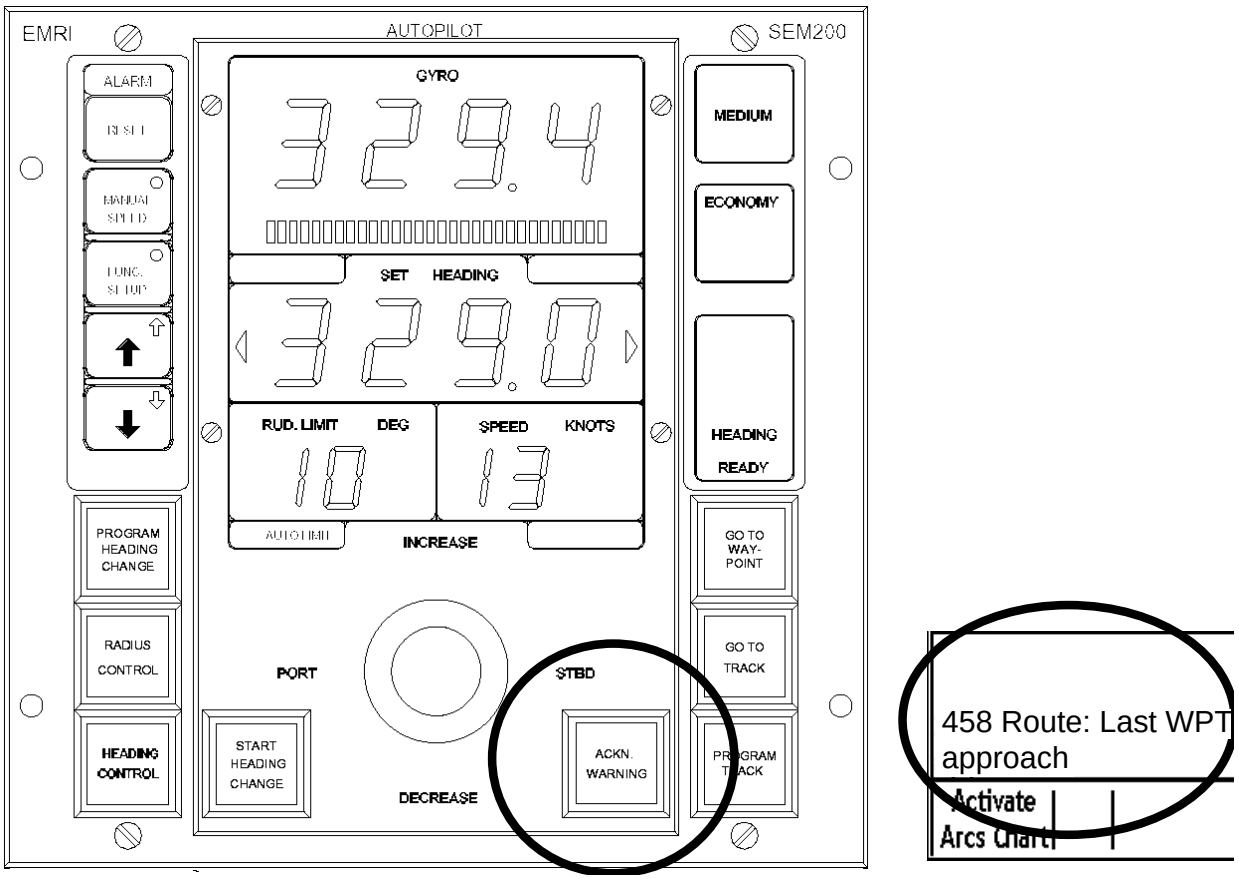
Permanent alerts are available regardless of the steering mode used:

- Outside channel is indicated by displaying the text "Off track" in orange and its value in red.
- The text "Out of Gate" is orange. "Out of Gate" indicates that, if the ship continues using the current course, the ship will be outside of the channel at the wheel over point.

Route: HELSINKI	
Plan Speed	30.0 kn
Plan	202.9 °
Route	202.9 °
Ch LIM	185 m
Off track	< 2 m
Goto WP	
Out of Gate	

Intermittent route steering alerts

- Alert number and text are visible at the bottom right corner of the ECDIS display (see example below).
- The **ACKN. WARNING** button on the FAP-2000's control panel lights to provide a visual alert (see example below).
- The buzzer sounds from the FAP-2000's control panel.
- Acknowledge an intermittent alert by pushing the **ACKN. WARNING** button on the FAP-2000's control panel.



Alert "**410 Filter**: **POSN source CHG**" appears when differential GPS used in filter positioning has changed its operation mode, either from differential mode to normal mode or normal mode to differential mode. If the steering mode is Goto Track, alert "492 Route: Needs diff Pos" also appears, if DGPS has changed its mode to normal mode.

Alert "**413 SOG&COG unreliable**" appears when the system finds that the SOG and COG from sensors are inaccurate. Speed/Course sensors and position sensors can be the source of SOG and COG.

Alert "**455 Route**: **off course**" appears when the system needs more than a set limit (the limit is available in Installation parameters) to keep the track. This alert is repeated every five minutes, if the condition continues.

Alert "**456 Route**: **WPT approach error**" appears, for example, when a decrease in ship speed is more than the waypoint approach alert time + 100 seconds away from the wheel over point after the user have already acknowledged alert "451 Route: WPT approach alarm" to enable the next automatic turn. After the alert 456 appears, the next turn is not enabled and the system will generate the alert "451 Route: WPT approach alarm" when appropriate.

Alert "**457 Route**: **Outside chl limits**" appears when your ship goes outside the planned channel.

Alert "**460 Pilot**: **ROT will be exceed**" informs you that the set radius value together with the current speed of the ship-requested rate of turn is over the limit set with " Max. rate of turn" in the route parameters.

Alert "**461 Route**: **ROT will be exceed**" informs you that the planned radius for the next waypoint together with the current speed of the ship-requested rate of turn is over the limit set with " Max. rate of turn" in the route parameters. This alert is activated if the own ship is within the value set for "WPT approach alert time" (in route parameters) from the wheel over point.

Alert "**469 Autopilot FAP-2000**: **off course**" appears when the FAP-2000 needs more than the set limit. (The limit is set in the installation parameters for the Goto WPT mode.) The Goto Track mode uses the fixed value of 30 degrees) to keep the track. This alert is repeated every five minutes, if the condition continues.

Alert "**475 Route**: **Needs filter on**" appears when the position from the Kalman filter is not available. Alert 475 will be repeated every four minutes for the next 10 minutes. If the condition still exists, alert "**497 Route**: **Stop - Sensor Fail**" is generated and the steering mode is automatically changed to "Radius Control".

Alert "**476 Route**: **Needs log sensor**" appears when the position from the Kalman filter cannot be compared against an independently operating log. Alert 476 will be repeated every four minutes for the next 10 minutes. If the condition still exists, alert "**497 Route**: **Stop - Sensor Fail**" is generated and the steering mode is automatically changed to "Radius Control".

Alert "**478 Route**: **Needs good Pos**" appears when the Kalman filter did not have high precision position sensor for route steering and the position discrepancy limit between primary and secondary position or between your ship and any position is exceeded. The alert is repeated every two minutes for 10 minutes after which alert "**497 Route**: **Stop - Sensor Fail**" appears.

Alert "**488 Track Control Stopped**" appears when system internal failure has occurred, which prevents continuation of Goto WPT or Goto Track mode.

Alert "**492 Route**: **Needs diff Pos**" appears for any use of Goto Track with Kalman filter but without a high precision sensor (an example is DGPS). Alert 492 will be repeated every four minutes for the next 10 minutes. If the condition still exists, alert "**489 Route**: **CHG to Goto WPT**" is generated and steering mode is automatically changed to Goto WPT.

Alert "**497 Route**: **Stop - Sensor Fail**" appears when no gyro data is received or if conditions of alert 475, 476, 478, 492 or 501 has been valid for last 10 minutes.

Alert "**498 Use manual rudder control**" appears every two minutes to advise the operator to manually control the rudder, when the FAP-2000 has lost gyro and thus cannot control rudder.

Alert "**501 Route**: **Needs higher Speed**" appears for any use of Goto Track with the Kalman filter but speed below limit set for track steering in the installation parameters. This alert is repeated every four minutes for the next 10 minutes. If the condition still exists, alert "**497 Route**: **Stop - Sensor Fail**" is generated and the steering mode is automatically changed to "Radius Control".

Alert "**505 Route**: **Use Goto WPT**" is instruction for the operator to change the steering mode to Goto WPT. This alert is generated if there are not sufficient conditions to continue Goto Track (i.e. alert 492 or 507 has been valid two minutes). This alert is repeated every four minutes.

Alert "**506 Route**: **Use Radius ctrl**" is instruction for the operator to change the steering mode to "Radius Control". This alert is generated if there are not sufficient conditions to continue Goto Track (i.e. alert 475, 476 or 501 has been valid 2 minutes). This alert is repeated every four minutes.

Alert "**507 Route**: **Need SOG/COG ref.**" appears when any use of Goto Track with the Kalman filter but without direct Speed Over Ground (SOG) and Course Over Ground (COG) available from position sensor(s) or from bottom track of a dual-axis log. If the condition still exists after 10 minutes, alert "**489 Route**: **CHG to Goto WPT**" is generated and the steering mode is automatically changed to Goto WPT.

Alert "**516 Trackpilot**: **Drift limit**" appears if the trackpilot needs more than a set limit to compensate drift (the limit is available in Installation parameters for Track mode (max drift compensation)). This alert is repeated every 5 minutes, if the condition continues.

Alert "**788 System Frozen**" appears as an early warning indication that the system may enter state of freeze. You need to restart the ECDIS's processor unit.

Collision avoidance maneuver during route steering

Often route steering is interrupted by a collision avoidance maneuver, but there are also several other reasons to interrupt route steering. You have several options with which to set the collision avoidance or any other maneuver:

- Use override tiller, direct rudder pump operation button or non-follow-up rudder control.
- Use follow-up rudder control.
- Use FAP-2000's HEADING CONTROL.
- Use FAP-2000's RADIUS CONTROL.
- Use FAP-2000's Program Track mode.

To use any of the above autopilot modes, push the desired mode button and follow normal instructions.

Now the route steering is disabled until the **GOTO WPT** or **GOTO TRACK** button is pushed again. Note that in order to return to route steering the ship heading must point to the next waypoint, otherwise the alert "**468 Disabled**: **Out of course**" is generated.

How to stop or modify an pre-enabled turn in route steering

There are two cases where the automatic route turn must be stopped or modified:

- The turn cannot be performed up to the final value.
- The turn that your ship will perform is outside of the planned turn. (Too fast or too slow.)

You can also during turns use all methods described in the "Collision avoidance maneuver during route steering". However, you may interrupt a route steering turn and continue it in the manual steering mode.

How to stop a turn

- If the turn has already started, the set course display on the FAP-2000 shows the new course value.
- Push the **RADIUS CONTROL** button on the FAP-2000's control panel.
- Now the manual steering is enabled and your turn continues with previously set values of course and radius.
- Use the tiller to set the new intended course.

Example:
Actual course = 45°, new course = 120°, route turn was enabled. At the moment the ship's heading is 60°, the helmsman wishes to change the course to 90°. The set course already shows 120°. Push the **RADIUS CONTROL** button on the FAP-2000's control panel then use the tiller to set the new course to 90°. The turn will be done to that value.

How to modify a turn

This is used in case the ship is not performing the planned radius and the radius must be modified.

1. If the actual turning is too fast, use the tiller on the FAP-2000's control panel to increase the radius.
2. With some selected radar models you can also use the **RADIUS INCR** button. Push the button once.

The new situation is shown on the radar screen. The same logic applies for too slow turning.

Accuracy of route steering

Accurate route steering is defined as a small cross-track error when automatically following a route. Two of the route parameters - drift compensation and gyro error compensation - have a significant effect on the accuracy of route steering. If you need the most accurate route steering, then both of these parameters should be enabled. . Before activating the gyro error compensation, see section 19.10 "Gyro Error Correction" in the ECDIS Operator's Manual to find the possible methods for gyro error compensation.

1.4 Additional Information About Steering Modes

Use of multiple FAP-2000 control panels

The FAP-2000 system may incorporate several control panels. In this case:

- The active panel is indicated by a light in one of the steering mode buttons (RADIUS CONTROL, COURSE CONTROL, Goto WPT, Goto TRACK and PROGRAM TRACK).
- Both active and non-active panels indicate the steering mode in use by lamps and displays. See the table below.
- You can transfer control from the active panel to the non-active panel by pushing one of the steering mode buttons (RADIUS CONTROL, COURSE CONTROL, Goto WPT, Goto TRACK and PROGRAM TRACK). This action lets you change the steering mode or continue with the previous one. To continue with the previous steering mode, push the steering mode button corresponding to the previous steering mode. Note that you can observe the lamp indications to know the current steering mode.

Steering mode	**Lamp indication**	**Radius/Rudder limit display**
Heading Control	Heading	Rudder limit
Radius Control	Heading	Radius
Program Track	Track	Radius
Goto WPT	Route	Radius
Goto Track	Route and Track	Radius

Details of program turns

The FAP-2000 allows the operator to design a turn beforehand and to begin execution of the turn when the **START COURSE CHANGE** button is pushed. The table below summarizes the properties of each applicable steering mode.

Steering mode	**Rule applicable**	**Turn control**	**Change of Set course**	**Change of Radius**	**Change of rudder limit**	**Curved EBL "Start course change" does not flash**	**Curved EBL "Start course change" flashes**
Heading control	Turn or linear	Rudder angle limit	Immediate action	Not applicable	Immediate	Not applicable	Not applicable
PHC + Heading control	Turn or linear	Rudder angle limit	No action until click of Start [1]	Not applicable	Immediate	Not applicable	Not applicable
Radius control	Turn or linear	Radius control	Immediate action	Immediate	Not applicable	If displayed indicates ongoing turn	Not applicable
PHC + Radius control	Linear [2, 3]	Radius control	No action until click of Start [1]	Immediate	Not applicable	If displayed indicates ongoing turn	Display planned turn
PHC + Radius control (executing a turn)	Turn [2, 3]	Radius control	No action until click of Start [1]	**Not available**	Not applicable	Displays ongoing turn	Display planned turn
PTT	Linear [2]	Not applicable	No action until click of Start[1]	Immediate	Not applicable	If displayed indicates ongoing turn	Display planned turn
PTT (executing a turn)	Turn [2]	Position controlled radius	No action until click of Start[1]	**Not available**	Not applicable	Displays ongoing turn	Display planned turn

[1] "Start course change" flashes to indicate immediate execution of the changed set course.

[2] "Increase" and "Decrease" lamps indicate "Linear" and "Turn". If those lamps are on, then it is Linear. If the lamps are off, then it is Turn.

[3] If the difference between the heading and set course is less than 10 degrees, then the situation is interpreted as Linear.

PHC = Program Heading Change

PTT = Program Track

1.5 Important Information About Steering Mode Changes

When the FAP-2000 is not used for steering

In addition to the FAP-2000, a ship may have a steering selection unit of some kind that minimally incorporates HAND and "FAP-2000" functions. HAND can function to override the tiller, direct rudder pump operation buttons, non-follow-up rudder control or follow-up rudder control. While in the HAND mode, the FAP-2000 always sets a course equal to the gyro course.

User can change to the HAND mode from any of the FAP-2000 steering modes.

Steady as she goes

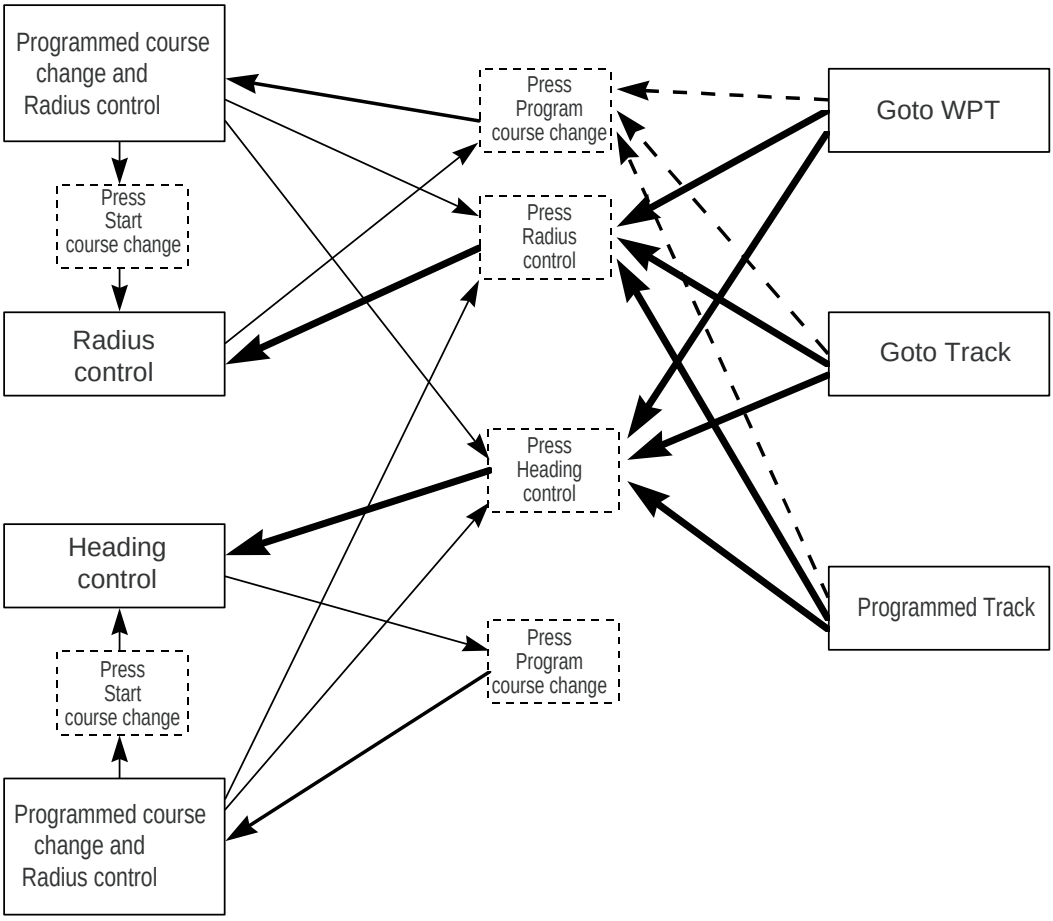
If you want the ship to go "steady as she goes" while in the middle of any FAP-2000 operation, switch from any FAP-2000 steering mode to the HAND mode (and back again to switch back to FAP-2000 control).

About mode changes when using FAP-2000 for steering

The operator can change from any steering mode to any other steering mode. For example, it is possible to leave route steering and return to route steering during both linear parts and turns.

The new steering mode continues from the previously displayed course, shown on the set course display. The only exceptions are pending program modes (PROGRAM HEADING CHANGE and PROGRAM TRACK), when the new mode continues from currently used set course. These pending modes are indicated by flashing the lamp in the **START HEADING CHANGE** button.

The diagram below shows all the other possible steering mode changes, but not activation of Goto WPT, Goto Track or Program Track.

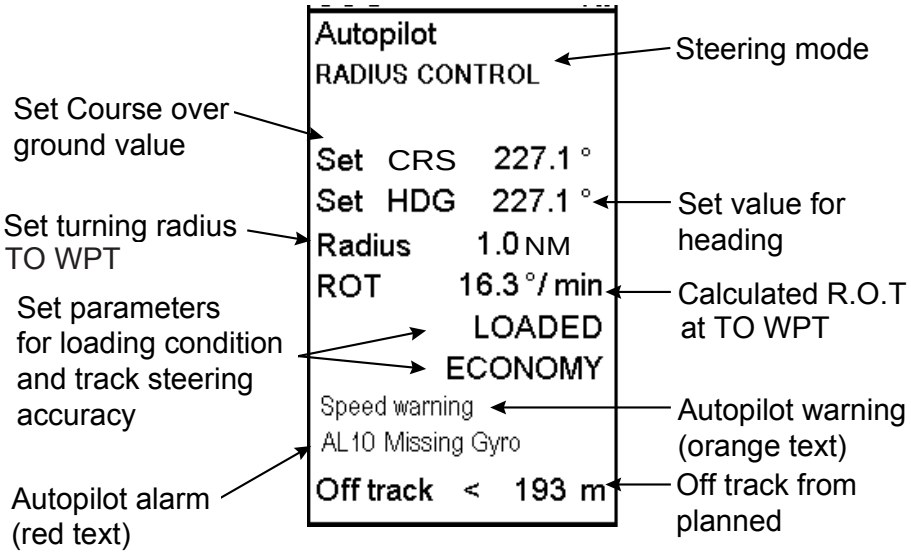


1.6 Autopilot Display in Sidebar

You can show the autopilot display in the sidebar on the ECDIS display. This display provides information about autopilot status.

To show the autopilot display:

1. Put the cursor on the right hand side of the route monitor window to show "Menu/ /Select Sidebar" in the mouse guidance box.
2. Press the right mouse button to open the Sidebar menu.
3. Select Autopilot from the menu.



Autopilot dialog box

1.7 Expected Steering Performance Under Various Conditions

The system has many kinds of steering modes. Below is a summary of how various environmental conditions affect steering performance. The system uses a combination of drift compensation and off track compensation to keep the ship inside the channel limit.

1.7.1 Expected steering performance for going ahead

Environmental conditions	**Heading control** **Radius control** **Program heading change**	**Program Track**	**Goto WPT**	**Goto Track**
Calm sea, no wind, no current	COG is about the same as set course in autopilot.	**Drift compensation ON or OFF**: COG is equal to course set on autopilot. Ship accurately follows imaginary line over ground.	**Drift compensation ON or OFF**: Ship follows monitored route.	**Drift compensation ON or OFF**: Ship follows monitored route.
Moderate wind and/or current	Ship has a tendency to drift.	**Drift compensation ON or OFF**: COG is equal to course set on autopilot. Ship accurately follows imaginary line over ground.	**Drift compensation ON**: Ship follows monitored route. **Drift compensation set as OFF**: Ship follows monitored route in an off-track position inside the channel limit.	**Drift compensation ON or OFF**: Ship follows monitored route.
High wind and/or current	Ship is drifting.	**Drift compensation ON**: COG is equal to course set on autopilot. Ship follows nicely imaginary line over ground. **Drift compensation OFF**: COG is equal to course set on autopilot.. Ship has trouble in following imaginary line over ground.	**Drift compensation ON**: Ship follows monitored route. **Drift compensation OFF**: Ship may have trouble in following monitored route inside the channel limit.	**Drift compensation ON**: Ship follows monitored route. **Drift compensation OFF**: Ship may have trouble in following monitored route inside the channel limit.

Environmental conditions	**Heading control** **Radius control** **Program heading change**	**Program Track**	**Goto WPT**	**Goto Track**
Slow change of wind and/or current	There is no compensation for change.	**Drift compensation ON**: COG is equal to course set on autopilot. Ship follows imaginary line over ground. **Drift compensation OFF**: COG is equal to course set on autopilot. Ship has trouble in following imaginary line over ground.	**Drift compensation ON**: Ship follows monitored route, but may need full channel limit area. **Drift compensation OFF**: Ship may have trouble in following monitored route inside the channel limit.	**Drift compensation ON**: Ship follows monitored route. **Drift compensation OFF**: Ship may have trouble in following monitored route inside the channel limit.
Sudden change of wind and/or current (For example sudden change from no current to 5 kn current perpendicular to track)	There is no compensation for change.	**Drift compensation ON**: COG is equal to course set on autopilot. Ship follows imaginary line over ground, but may drift away from imaginary line then return to it. **Drift compensation OFF**: COG is equal to course set on autopilot. Ship has trouble in following imaginary line over ground.	**Drift compensation ON**: Ship may go outside channel limit and return back inside channel limit. **Drift compensation OFF**: Ship may have trouble in following monitored route inside the channel limit.	**Drift compensation ON**: Ship may go outside channel limit and return back inside channel limit. **Drift compensation OFF**: Ship may have trouble in following monitored route inside the channel limit.

Environmental conditions	**Heading control** **Radius control** **Program heading change**	**Program Track**	**Goto WPT**	**Goto Track**
Slow change of speed	There is no compensation for change.	**Drift compensation ON or OFF**: COG is equal to course set on autopilot. Ship follows imaginary line over ground.	**Drift compensation ON**: Ship follows monitored route. **Drift compensation set as OFF**: Ship may have troubles to follow monitored route inside the channel limit	**Drift compensation ON or OFF**: Ship follows monitored route.
Fast change of speed (For example speed decreased from 20 to 7 kn)	There is no compensation for change.	**Drift compensation ON**: COG is equal to course set on autopilot. Ship follows imaginary line over ground, but may drift away from imaginary line then return to it. **Drift compensation OFF**: COG is equal to course set on autopilot. Ship may have trouble in following imaginary line over ground.	**Drift compensation ON**: Ship may go outside channel limit and return back inside channel limit. **Drift compensation OFF**: Ship may have trouble in following monitored route inside the channel limit.	**Drift compensation ON**: Ship follows monitored route, but may need full channel limit area. **Drift compensation OFF**: Ship may have trouble in following monitored route inside the channel limit.

1.7.2 Expected steering performance for turns

Environmental conditions	**Heading control** **Radius control** **Program heading change**	**Program Track**	**Goto WPT (assisted turn)**	**Goto Track**
Calm sea, no wind, no current	Ship follows curved EBL.	**Drift compensation ON or OFF**: Ship follows curved EBL.	**Drift compensation ON or OFF**: Ship follows monitored route.	**Drift compensation ON or OFF**: Ship follows monitored route.
Moderate wind and/or current	Ship goes inside or outside of turn.	**Drift compensation ON or OFF**: Ship follows curved EBL.	**Drift compensation ON**: Ship follows monitored route, but may need full channel limit area. **Drift compensation set as OFF**: Ship goes inside or outside of turn.	**Drift compensation ON or OFF**: Ship follows monitored route.
High wind and/or current	Ship goes fast inside or outside of turn.	**Drift compensation ON**: Ship follows curved EBL. **Drift compensation OFF**: Ship goes inside or outside of turn.	**Drift compensation ON**: Ship follows monitored route, but may go outside channel limit area. **Drift compensation OFF**: Ship goes fast inside or outside of turn.	**Drift compensation ON**: Ship follows monitored route. **Drift compensation OFF**: Ship goes inside or outside of turn.
Slow change of wind and/or current	Ship goes inside or outside of turn.	**Drift compensation OFF**: Ship has trouble in following imaginary line over ground.	**Drift compensation ON or OFF**: Ship goes inside or outside of turn.	**Drift compensation ON**: Ship follows monitored route. **Drift compensation OFF**: Ship may have troubles in following monitored route inside the channel limit.

(Continued from previous page)

Environmental conditions	**Heading control** **Radius control** **Program heading change**	**Program Track**	**Goto WPT (assisted turn)**	**Goto Track**
Sudden change of wind and/or current (For example sudden change from no current to 5 kn current perpendicular to track)	Ship goes fast inside or outside of turn.	**Drift compensation ON**: Ship follows curved EBL, but may drift from curved EBL then return back to curved EBL. **Drift compensation OFF**: Ship goes inside or outside of turn.	**Drift compensation ON or OFF**: Ship goes fast inside or outside of turn.	**Drift compensation ON**: Ship may go outside channel limit and return back inside channel limit. **Drift compensation OFF**: Ship goes inside or outside of turn.
Slow change of speed	Ship follows curved EBL.	**Drift compensation ON or OFF**: Ship follows curved EBL.	**Drift compensation ON or OFF**: Ship follows monitored route, but may need full channel limit area.	**Drift compensation ON or OFF**: Ship follows monitored route.
Fast change of speed (For example speed decreased from 20 to 7 kn)	Ship goes inside or outside of turn.	**Drift compensation ON**: Ship follows curved EBL, but may drift from curved EBL then return back to curved EBL. **Drift compensation OFF**: Ship drifting away from curved EBL and may not return back to curved EBL.	**Drift compensation ON or OFF**: Ship goes inside or outside of turn.	**Drift compensation ON or OFF**: Ship follows monitored route, but may need full channel limit area.

Note: Drift compensation is turned on or off in the Ship and Route parameters in the Navigation Parameters dialog box. See section 27.1.4 "Navigation parameters setting" in the ECDIS Operator's Manual.

1.8 Expected Steering Performance Under Critical Failure

This section summarizes how various failures affect steering performance.

Note: The backup navigator alert is activated if an alert is not acknowledged within 30 seconds. For more information about this alert, see section "30.11 Backup Navigator Alert" in the ECDIS Operator's Manual.

1.8.1 Lost heading from autopilot (ECDIS may also have lost heading)

	Associated alerts	Expected system performance	What operator should do
Immediately	• Sensor alert "755: Gyro error (Autopilot FAP-2000)" is generated at ECDIS. • Alert 10 is generated at the autopilot.	• If ship is running straight, rudder order is frozen for last value in order to approximately continue ahead. • If ship is turning, rudder order is frozen for last value in order to approximately continue rate of turn.	• Change immediately to manual control of rudder. • Acknowledge alerts. • Monitor situation.
Within a few seconds	• Alert "496 ProgTrack Stop-Sensor fail" or "497 Route Stop-Sensor fail."		• Change immediately to manual control of rudder. • Acknowledge alerts. • Monitor situation.
Repeat every 2 minutes	• Alert "498 Use manual rudder control" is generated at ECDIS.	• Reminder	• Change immediately to manual control of rudder.

1.8.2 Lost heading from ECDIS (autopilot still has heading)

	Associated alerts (generated at ECDIS)	Expected system performance	What operator should do
	• Sensor alert, for example Alert "705: Gyro error" or "706: Gyro error."		• Acknowledge alerts. • Monitor situation.
Within few seconds	• Alert "402 No heading available." • Alert "496 ProgTrack Stop-Sensor fail" or "497 Route Stop-Sensor fail".	• Steering mode automatically changed to Radius Control. • If ship is running straight, actual heading is used as set heading. If ship is turning, last-set heading and radius remain.	• Acknowledge alerts. • Monitor situation.

1.8.3 Lost speed

	Associated alerts (generated at ECDIS)	Expected system performance	What operator should do
	• Sensor alert, for example Alert "708: Log error", "712…716: Position equipment error", etc.		• Acknowledge alerts. • Monitor situation.
Within 30 seconds	• Alert "476 Route Needs log sensor" or "494 Progtrack: Needs log sens."		• Acknowledge alerts. • Monitor situation.
After 2 minutes then every 4 minutes	• Alert "506 Route: Use Radius control" or "504 PrgTrack: Use Radius Ctrl."	• Guidance for navigator	• Change to local autopilot control immediately. • Acknowledge alerts.
After 4 minutes then every 4 minutes	• Alert "476 Route Needs log sensor" or "494 Progtrack: Needs log sens."	• Reminder	• Acknowledge alerts. • Monitor situation.
Within 10 minutes	• Alert "496 ProgTrack Stop-Sensor fail" or "497 Route Stop-Sensor fail."	• Steering mode automatically changed to Radius Control. • If ship is running straight, actual heading is used as set heading. If ship is turning, last-set heading and radius remain.	• Acknowledge alerts. • Monitor situation.

1.8.4 Low speed

	Associated alerts (generated at ECDIS)	Expected system performance	What operator should do
	• Alert "408 Filter: SPD below xx KN."		• Acknowledge alerts. • Monitor situation.
Within 90 seconds	• Alert "410 Filter: POSN source CHG".		• Acknowledge alerts. • Monitor situation.
Within 30 seconds	• Alert "503 ProgTrack: Needs higher Speed" or "501 Route: Needs higher Speed."		• Acknowledge alerts. • Monitor situation.
After 2 minutes then every 4 minutes	• Alert "506 Route: Use Radius control" or "504 PrgTrack: Use Radius Ctrl."	• Guidance for navigator	• Change to local autopilot control immediately. • Acknowledge alerts.
After 4 minutes then every 2 minutes	• Alert "503 ProgTrack: Needs higher Speed" or "501 Route: Needs higher Speed."	• Reminder	• Acknowledge alerts. • Monitor situation.
Within 10 minutes	• Alert "496 ProgTrack Stop-Sensor fail" or Alert "497 Route Stop-Sensor fail."	• Steering mode automatically changed to Radius Control. • If ship is running straight, actual heading is used as set heading. If ship is turning, last-set heading and radius remain.	• Acknowledge alerts. • Monitor situation.

1.8.5 Lost SOG/COG reference

Goto Track steering mode

	Associated alerts (generated at ECDIS)	Expected system performance	What operator should do
	• Alert "507 Route: Need SOG/COG ref."		• Acknowledge alerts. • Monitor situation.
After 2 minutes then every 4 minutes	• Alert "505 Route: Use Goto WPT."	• Instruction for navigator	• Change to Goto WPT steering mode. • Acknowledge alerts.
After 4 minutes then every 4 minutes	• Alert "507 Route: Need SOG/COG ref."	• Reminder	• Acknowledge alerts. • Monitor situation.
Within 10 minutes	• Alert "489 Route: CHG to Goto WPT."	• Steering mode automatically changed to Goto WPT.	• Acknowledge alerts. • Monitor situation.

Program Track steering mode

	Associated alerts (generated at ECDIS)	Expected system performance	What operator should do
	• Alert "509 Progtrack: Needs SOG/COG ref."	• Program Track mode requires differential position.	• Acknowledge alerts. • Monitor situation.
After 2 minutes then every 4 minutes	• Alert "504 PrgTrack: Use Radius Ctrl."	• Guidance for navigator	• Change to local autopilot control immediately. • Acknowledge alerts.
After 4 minutes then every 2 minutes	• Alert "509 Progtrack: Needs SOG/COG ref."	• Reminder	• Acknowledge alerts. • Monitor situation.
Within 10 minutes	• Alert "496 ProgTrack Stop-Sensor fail."	• Steering mode automatically changed to Radius Control. • If ship is running straight, actual heading is used as set heading. If ship is turning, last-set heading and radius remain.	• Acknowledge alerts. • Monitor situation.

1.8.6 Total lost position

	Associated alerts (generated at ECDIS)	Expected system performance	What operator should do
	• Alert "712…716: Position equipment error." OR • Kalman filter detects jump, etc.		• Acknowledge alerts. • Monitor situation.
Within 30 seconds	• Alerts "400 Filter: POSN unreliable" and "406 Route: CRS jump possible."	• Kalman Filter is turned OFF and system uses dead reckoning for positioning. • If you have log or dual-axis log, then dead reckoning is based on them and gyro. • If you have log or dual-axis log, then dead reckoning is based on last plausible speed from position sensors. This is indicated by showing own ship position, SOG and COG in red. The source indication for SOG and COG is "(LAST)".	• Acknowledge alerts. • Monitor situation.
After 2 minutes then every 4 minutes	• Alert "506 Route: Use Radius control" or "504 PrgTrack: Use Radius Ctrl."	• Guidance for navigator	• Change to local autopilot control immediately. • Acknowledge alerts.
After 4 minutes then every 4 minutes	• Alert "475 Route Needs filter ON", or "493 Progtrack: Needs filter ON."	• Reminder	• Acknowledge alerts. • Monitor situation.
Within 10 minutes	• Alert "496 ProgTrack Stop-Sensor fail" or Alert "497 Route Stop-Sensor fail."	• Steering mode automatically changed to Radius Control. • If ship is running straight, actual heading is used as set heading. If ship is turning, last-set heading and radius remain.	• Acknowledge alerts. • Monitor situation.

1.8.7 Lost differential position

Goto Track steering mode

	Associated alerts (generated at ECDIS)	Expected system performance	What operator should do
	• Alert "727…731: Lost DGPS" or "712…716: Position equipment error."		• Acknowledge alerts. • Monitor situation.
Within 90 seconds	• Alert "410 Filter: POSN source CHG".		• Acknowledge alerts. • Monitor situation.
Within 30 seconds	• Alert "492 Route: Needs diff pos."	• Goto Track requires differential position.	• Acknowledge alerts. • Monitor situation.
After 2 minutes then every 4 minutes	• Alert "505 Route: Use Goto WPT."	• Guidance for navigator	• Change to Goto WPT steering mode. • Acknowledge alert.
After 4 minutes then every 4 minutes	• Alert "492 Route: Needs diff pos."	• Reminder	• Acknowledge alerts. • Monitor situation.
Within 10 minutes	• Alert "489 Route: CHG to Goto WPT."	• Steering mode automatically changed to Goto WPT.	• Acknowledge alerts. • Monitor situation.

Program Track steering mode

	Associated alerts (generated at ECDIS)	Expected system performance	What operator should do
	• Alert "727…731: Lost DGPS" or "712…716: Position equipment error."		• Acknowledge alerts. • Monitor situation.
Within 90 seconds	• Alert "410 Filter: POSN source CHG".		• Acknowledge alerts. • Monitor situation.
Within 30 seconds	• Alert "495 Progtrack: Needs diff pos."	• Program Track mode requires differential position.	• Acknowledge alerts. • Monitor situation.
After 2 minutes then every 4 minutes	• Alert "504 PrgTrack: Use Radius Ctrl."	• Guidance for navigator	• Change to local autopilot control immediately. • Acknowledge alert.
After 4 minutes then every 2 minutes	• Alert "503 ProgTrack: Needs diff pos."	• Reminder	• Acknowledge alerts. • Monitor situation.
Within 10 minutes	• Alert "496 ProgTrack Stop-Sensor fail."	• Steering mode automatically changed to Radius Control. • If ship is running straight, actual heading is used as set heading. If ship is turning, last-set heading and radius remain.	• Acknowledge alerts. • Monitor situation.

1.8.8 Lost differential position and position discrepancy

	Associated alerts (generated at ECDIS)	Expected system performance	What operator should do
Precon-dition	If sensors in Filter calculation are NOT inside user-selected position discrepancy limit. • Alert "407 Position discrepancy"		• Acknowledge alerts. • Monitor situation.
	• Alert "727…731: Lost DGPS" or "712…716: Position equipment error"		• Acknowledge alerts. • Monitor situation.
Within 90 seconds	• Alert "410 Filter: POSN source CHG".		• Acknowledge alerts. • Monitor situation.
Within 30 seconds	• Alert "478 Route: Needs good Pos"		• Acknowledge alerts. • Monitor situation.
After 2 minutes then every 4 minutes	• Alert "506 Route: Use Radius control"	• Guidance for navigator	• Change to local autopilot control. • Acknowledge alerts.
After 4 minutes then every 2 minutes	• Alert "478 Route: Needs good Pos"	• Reminder	• Acknowledge alerts. • Monitor situation.
Within 10 minutes	• Alert "497 Route Stop-Sensor fail"	• Steering mode automatically changed to Radius Control. • If ship is running straight, actual heading is used as set heading. If ship is turning, last-set heading and radius remain.	• Acknowledge alerts. • Monitor situation.

1.8.9 Lost communication between ECDIS and autopilot

	Associated alerts	Expected system performance	What operator should do
Within 15 seconds	• Alert "488 Track Control Stopped" generated at ECDIS. • Alert 12 is generated at the autopilot.	• Steering mode automatically changed to Radius Control. • If ship is running straight, actual heading is used as set heading. If ship is turning, last-set heading and radius remain.	• Acknowledge alerts. • Monitor situation.

1.8.10 Lost communication between autopilot and ECDIS

	Associated alerts	Expected system performance	What operator should do
Within 15 seconds	• Alert "488 Track Control Stopped" and "480 Trackpilot Receive error" is generated at the ECDIS. • Alert 05 is generated at the autopilot.	• Steering mode automatically changed to Radius Control. • If ship is running straight, actual heading is used as set heading. If ship is turning, last-set heading and radius remain.	• Acknowledge alerts. • Monitor situation.

1.9 Other Operations

Speed used by

- The FAP-2000 uses the speed from its own log input interface or from the serial line coming from an integrated computer, and one is selected during the installation. This speed is called the "internal speed reference".
- The operator may select the internal speed reference or manual speed with the **MANUAL SPEED** button.

Control strategy

- The operator may select among ECONOMY, MEDIUM and PRECISE by using the **FUNC. SETUP** button and the **ARROW** buttons.
- Control strategy (economy, medium, precise) selects course-keeping accuracy.

Load conditions

- The operator may select among LIGHT, MEDIUM and LOADED by using the **FUNC. SETUP** button and the **ARROW** buttons.
- Rudder gain is selected according to load condition (light, medium, loaded).

1.10 Alerts

1.10.1 Alerts generated by autopilot

- The ALARM lamp on the FAP-2000's control panel goes on.
- An alert is displayed on the FAP-2000's control panel as OFF COURSE/SPEED WARNING or as an alert number "AL: NN", where NN is the number of an alert.
- Acknowledge an alert by pushing the **RESET** button on the FAP-2000's control panel.

OFF COURSE	The ship is not following set course.
SPEED WARNING	The speed is below 20% or above 120% of MCR speed (max. cruising speed). For further details, see the Autopilot's operator's manual.
	Another reason is that the FAP-2000 has lost speed data from the ECDIS. In this case, the FAP-2000 uses its backup speed source or last plausible speed.
ON LIMIT	FAP-2000 uses rudder up to its set limit value. Normally this is only an indication, but if it continues for a long period and the heading of the ship doesn't turn, it is an indication of failure of the steering system. For further details, see the Autopilot's operator's manual.
AL 04	Rudder servo: Leak detected or no movement when valve is on.
AL 05	Navigation computer has cancelled a remote mode.
AL 06	24 VDC alert system supply failure.
AL 07	Navigation computer didn't accept a request to go for a remote mode.
AL 10	Missing working gyro.
AL 11	Compass comparison alert or reference gyro missing.
AL 12	Messages from the navigation computer were missing while FAP-2000 was in remote mode.

A central alert system outputs these and other alerts: low voltage alert, stop alert (track control), position differential alert, heading differential alert, course error alert, cross-track error alert, sensor alert, low speed alert, destination arrival alert, track control loss alert, etc. For more information about the alerts the central alert system displays see its Operator's Manual.

1.10.2 Alerts generated by ECDIS

- The ACKN. WARNING lamp of the FAP-2000's control panel flashes.
- The type of alert is displayed on the ECDIS display as number and text.
- An alert is acknowledged by pushing the **ACKN. WARNING** button on the FAP-2000's control panel.

```
Alert number 451:   ROUTE: WPT APPROACH ALARM    /1 or /7
             ------------------------------------
             WAYPOINT IS NOW BEING APPROACHED.
             CLICK 'ACKN. WARNING' TO ACCEPT THE
             TURN.

Alert number 452:   ROUTE: TURNING DISABLED      /1
             ------------------------------------
             WHEELOVER POINT HAS BEEN PASSED
             WITHOUT 'ACKN. WARNING* 'RADIUS
             CONTROL' MODE HAS THEN AUTOMATICALLY
             BEEN INITIATED

Alert number 454:   ROUTE: END REACHED         /3
             ------------------------------------
             CLICK 'ACKN. WARNING' TO ACCEPT THE
             END OF ROUTE STEERING.

Alert number 455:   ROUTE: OFF COURSE       /6/13
             ------------------------------------
             REQUIRED 'SET COURSE' FOR NEXT
             WAYPOINT EXCEEDS THE 'LOWER
             OFFCOURSE' OR 'HIGHER OFF COURSE'
             LIMIT OF PLANNED COURSE. ACCEPT THE
             SITUATION BY CLICKING 'ACKN. WARNING'

Alert number 456:   ROUTE: WPT APPROACH ERROR    /5
             ------------------------------------
             'TIME TO WOP' HAS CHANGED SINCE 'WPT
             APPROACH' ALERT WAS ACKNOWLEDGED,
             POSSIBLY DUE TO A POSITION JUMP.
             VERIFY POSITION AND SPEED SEN SORS
             IN 'SENSORS' PAGE

Alert number 458:   ROUTE: LAST WPT APPROACH    /1 or /7
             ------------------------------------
             FINAL WAYPOINT OF THE ROUTE IS
             REACHED. AUTOMATICALLY INITIATE
             'RADIUS CONTROL' MODE, AND CANCEL
             THE ROUTE.

Alert number 460:   PILOT: ROT WILL BE EXCEED  /6/13
             ------------------------------------
             THE RADIUS SENT TO AUTOPILOT IS
             EXCEEDING THE MAXIMUM LIMIT FOR
             TURNRATE. INCREASE THE RADIUS, OR
             REDUCE SPEED.
```

```
Alert number 461:   ROUTE:ROT WILL BE EXCEED   /6/13
             ------------------------------------
             WAYPOINT IS BEING APPROACHED WITH
             TOO HIGH SPEED FOR THE PLANNED
             RADIUS, CAUSING MAX. TURNRATE TO BE
             EXCEEDED. REDUCE THE SPEED OR
             INCREASE RADIUS BY OVERDRIVING WITH
             'MAN. SET COURSE'.

Alert number 464:   ROUTE: NO SELECTED ROUTE     /4
             ------------------------------------
             NO ROUTE HAS BEEN SELECTED, AND
             ROUTE STEERING CANNOT BE INITIATED.
             SELECT A ROUTE AND NEXT WAYPOINT
             THROUGH 'ROUTE MONITOR' PUSHBUTTON.

Alert number 465:   ROUTE: ILLEGAL WPT      /4
             ------------------------------------
             ROUTE STEERING CANNOT START FROM
             WAYPOINT 1. USE 'ROUTE MONITOR'
             PUSHBUTTON TO SELECT "TO WPT" TO BE 2
             OR HIGHER.

Alert number 467:   DISABLED: STEERING OFF      /3
             ------------------------------------
             TRACKPILOT IS IN 'STEERING OFF'
             MODE, AND STEERING COMMANDS CANNOT
             BE EXECUTED. STEERING MUST BE ENA-
             BLED AT THE MAIN STEERING SELECTOR

Alert number 468:   DISABLED: OUT OF COURSE      /3
             ------------------------------------
             ROUTE STEERING CAN ONLY BE INITIATED
             WHEN SHIPS COURSE IS WITHIN THE
             'Goto WPT LIMIT' FOR 'Goto WPT' OR
             WITHIN THE 'Goto TRACK LIMIT' FOR
             'Goto TRACK'. USE 'RADIUS CONTROL'
             MODE TO STEER WITHIN THE LIMITS.

Alert number 469:   TRACKPILOT: OFF COURSE     /6/13
             ------------------------------------
             TRACKPILOT DOES NOT STEER WITHIN
             LIMITS OF 'COURSE TO STEER' COMMAND'.
             VERIFY TRACKPILOT FUNCTIONS.

Alert number 470:   DISABLED: NEEDS FILTER ON     /3
             ------------------------------------
             'ROUTE STEERING' MODE CAN BE USED
             ONLY WHEN 'FILTER' IS ON AND THERE
             ARE ENOUGH SPEED, HEADING AND
             POSITION SENSORS. VERIFY AND SELECT
             POSITION SENSORS IN 'SENSORS' PAGE

Alert number 475:   ROUTE: NEEDS FILTER ON     /3/10
             ------------------------------------
             THIS IS A WARNING THAT YOU ARE USING
             ROUTE STEERING WITHOUT FILTERED
             POSITION AVAILABLE. VERIFY AND
             SELECT POSITION SENSORS IN 'SENSORS'
```

```
Alert number 476:   ROUTE: NEEDS LOG SENSOR     /3/10
             ------------------------------------
             THIS IS A WARNING THAT YOU ARE USING
             ROUTE STEERING WITH ONE POSITION
             DEVICE AND WITHOUT ANY LOG DEVICE.
             VERIFY AND SELECT SENSORS IN'SENSORS'

Alert number 477:   DISABLED: OUT OF CHANNEL     /3
             ------------------------------------
             'Goto WPT' OR 'Goto TRACK' CAN ONLY
             BE INITIATED WHEN SHIP IS WITHIN
             CHANNEL LIMIT OF MONITORED ROUTE.

Alert number 478:   ROUTE: NEEDS GOOD POSIT.    /3/10
             ------------------------------------
             THIS IS WARNING THAT YOU ARE USING
             Goto WPT STEERING MODE WITHOUT
             DIFF. POSITION AND POSITION
             DISCREPANCY LIMIT BETWEEN PRIMARY
             AND SECONDARY SENSORS IS EXCEEDED.
             THIS IS REPEATED EVERY 2 MINUTES
             UNTIL AFTER 10 MINUTES "ALERT 497"
             APPEARS.

Alert number 485:   ROUTE: WPT PREWARNING   /5/7
             ------------------------------------
             WAYPOINT IS SOON BEING APPROACHED.

Alert number 489:   ROUTE: CHG TO GOTO WPT     /5
             ------------------------------------
             SYSTEM CANNOT CONTINUE Goto TRACK
             MODE BECAUSE KALMAN FILTER POSITION
             IS LOST OR NO LOG SENSOR IS
             AVAILABLE KALMAN FILTER

Alert number 490:   DISABLED: NEEDS LOG SENS.    /3
             ------------------------------------
             'ROUTE STEERING' MODE CAN BE USED
             ONLY WHEN THERE IS AN INDEPENDENT
             SPEED SOURCE. ALTERNATIVES ARE A
             LOG OR TWO POSITION RECEIVERS

Alert number 491:   DISABLED: NEEDS DIFF POS.     /3
             ------------------------------------
             'Goto TRACK' MODE CAN BE USED ONLY
             IF A HIGH-PRECISION POSITION SENSOR
             IS IN USE WITH KALMAN FILTER.

Alert number 492:   ROUTE: NEEDS DIFF POS.    /5/12
             ------------------------------------
             'Goto TRACK' MODE CANNOT CONTINUE
             WITHOUT A HIGH-PRECISION POSITION
             SENSOR. STEERING MODE IS
             AUTOMATICALLY CHANGED "Goto WPT" WITH
             ALERT 489:ROUTE: CHG TO GOTO WPT

Alert number 493:   PROGTRACK: NEEDS FILTER ON   /3/10
             ------------------------------------
             A WARNING THAT YOU ARE USING PROGRAM
             TRACK WITHOUT FILTERED POSITION
             AVAILABLE.
```

Alert number 494: PROGTRACK: NEEDS LOG SENS. /3/10

A WARNING THAT YOU ARE USING PROGRAM TRACK WITHOUT A LOG SENSOR OR WITHOUT TWO POSITION SENSORS

Alert number 495: PROGTRACK: NEEDS DIFF POS. /5/12

A WARNING THAT YOU ARE USING PROGRAM TRACK WITHOUT A HIGH-PRECISION POSITION SENSOR

Alert number 496: PROGTRACK: STOP-SENSOR FAIL /3

GYRO, SPEED AND/OR POSITION DATA IS NOT RECEIVED CORRECTLY.

Alert number 497: ROUTE: STOP-SENSOR FAIL /3

GYRO, SPEED AND/OR POSITION DATA IS NOT RECEIVED CORRECTLY.

Alert number 498: USE MANUAL RUDDER CONTROL /5/12

CHANGE IMMEDIATELY TO DIRECT CONTROL OF RUDDER. THIS ALERT IS REMINDER THAT TRACKPILOT HAS LOST GYRO HEADING. IT IS REPEATED EVERY TWO MINUTES.

Alert number 499: DISABLED: NEEDS GOOD POS /5

'ROUTE STEERING' MODE CANNOT BE ACTIVATED WITHOUT DIFF. POSITION AND IF POSITION DISCREPANCY LIMIT IS EXCEEDED.

Alert number 501: ROUTE: NEED HIGHER SPEED /3/10

THIS IS WARNING THAT SPEED IS BELOW LIMIT SET FOR KALMAN FILETER. IT IS AVAILABLE TOGETHER "ALERT 408". "ALERT 501" IS REPEATED EVERY 2 MINUTES UNTIL AFTER 10 MINUTES "ALERT 497" APPEARS.

Alert number 502: DISABLED: NEED HIGHER SPD /3

THIS IS WARNING THAT SPEED IS BELOW LIMIT SET FOR KALMAN FILTER. IT IS AVAILABLE TOGETHER "ALERT 2008" TO ACTIVATE ROUTE STEERING USE HIGHER SPEED .

```
Alert number 503:   PROGTRACK: NEED HIGHER SPD   /3/10
             ------------------------------------
             THIS IS WARNING THAT SPEED IS BELOW
             LIMIT SET FOR KALMAN FILETER. IT IS
             AVAILABLE TOGETHER "ALERT 408".
             "ALERT 503" IS REPEATED EVERY 2
             MINUTES UNTIL AFTER 10 MINUTES
             "ALERT 496" APPEARS.

Alert number 504:   PRGTRACK: USE RADIUS CTRL.   /5/12
             ------------------------------------
             THIS IS INSTRUCTION TO CHANGE
             STEERING MODE. THIS ALERT IS
             GENERATED IF THERE ARE NOT
             SUFFICIENT SENSORS AVAILABLE TO
             CONTINUE PROGRAM TRACK

Alert number 505:   ROUTE: USE GOTO WPT       /5/12
             ------------------------------------
             THIS IS INSTRUCTION TO CHANGE
             STEERING MODE. THIS ALERT IS
             GENERATED IF THERE ARE NOT
             SUFFICIENT SENSORS AVAILABLE TO
             CONTINUE Goto TRACK

Alert number 506:   ROUTE: USE RADIUS CTRL.     /5/12
             ------------------------------------
             THIS IS INSTRUCTION TO CHANGE
             STEERING MODE. THIS ALERT IS
             GENERATED IF THERE ARE NOT
             SUFFICIENT SENSORS AVAILABLE TO
             CONTINUE Goto WPT OR Goto TRACK

Alert number 507:   ROUTE: NEED SOG/COG REF.    /5/12
             ------------------------------------
             'Goto TRACK' MODE CANNOT CONTINUE
             WITHOUT SOG/COG REFERENCE AVAILABLE
             FROM POSITION SENSOR OR BOTTOM TRACK
             OF DUAL AXIS LOG.

Alert number 508:   DISABLED: NEED SOG/COG REF.    /3
             ------------------------------------
             Goto TRACK STEERING MODE CANNOT BE
             ACTIVATED WITHOUT SOG/COG REFERENCE
             AVAILABLE FROM POSITION SENSOR OR
             BOTTOM TRACK OF DUAL AXIS LOG

Alert number 509:   PROG TRACK: NEED SOG/COG REF.  /5/12
             ------------------------------------
             'PROGRAM TRACK' MODE CANNOT CONTINUE
             WITHOUT SOG/COG REFERENCE AVAILABLE
             FROM POSITION SENSOR OR BOTTOM TRACK
             OF DUAL AXIS LOG.
```

```
Alert number 510:   DISABLED: OUT OF TURN         /3
              ------------------------------------
              Goto TRACK OR Goto WPT STEERING MODE
              CANNOT BE ACTIVATED IF THE ROUTE
              MONITORING OF THE SYSTEM DETECTS
              THAT ROUTE MONITOR IS in TURN, BUT
              OWN SHIP LOCATION IS OUT OF TURN.
              CHECK AND SET CORRECT "TO WPT" AGAIN
              FOR ROUTE MONITORING.

Alert number 516:   TRACKPILOT: DRIFT LIMIT         /5/12
            ----------------------------------
            IF THE TRACKPILOT NEEDS MORE THAN A
            SET LIMIT TO COMPENSATE DRIFT(THE
            LIMIT IS AVAILABLE IN INSTALLATION
            PARAMETERS FOR TRACK MODE (MAX DRIFT
            COMPENSATION).  THIS ALERT IS
            REPEATED EVERY 5 MINUTES, IF THE
            CONDITION CONTINUES.
```

1.10.3 Error alerts generated by autopilot

Errors that occur during normal operation are related to internal problems. An internal problem is announced as follows:

- The ALERT lamp on the FAP-2000's control panel lights.
- An error is displayed on the FAP-2000's control panel as error number type ERR NN, where NN is the number of an error.
- An error is acknowledged by pushing the **RESET** button on the FAP-2000's control panel.
- Typical error alerts:

ERR 01	Restart (cold start)
ERR 06	Parameter checksum error
ERR 07	Code checksum error
ERR 08	RAM error
ERR 12	Autopilot FAP-2000 processor failure
480	Autopilot FAP-2000 receive error

1.11 How to Use the Curved EBL

1.11.1 What is the curved EBL?

The curved EBL is a design and control tool that functions to start a turn at the correct position and to monitor behavior of your ship during a turn. The curved EBL is available on the ECDIS display and on some radar displays.

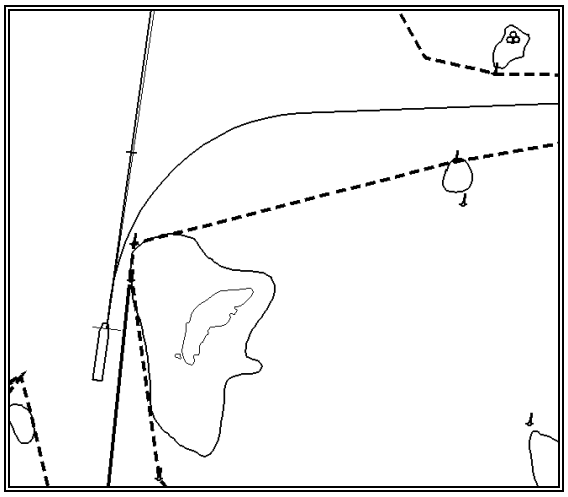
Before you make a turn, you can use the curved EBL to select the best position to initiate the intended turn. In this so-called design phase, your ship "pushes" the curved EBL in front of the ship. This design phase is available in the following conditions:

- Program Track of the FAP-2000
- Program Course Change of the FAP-2000

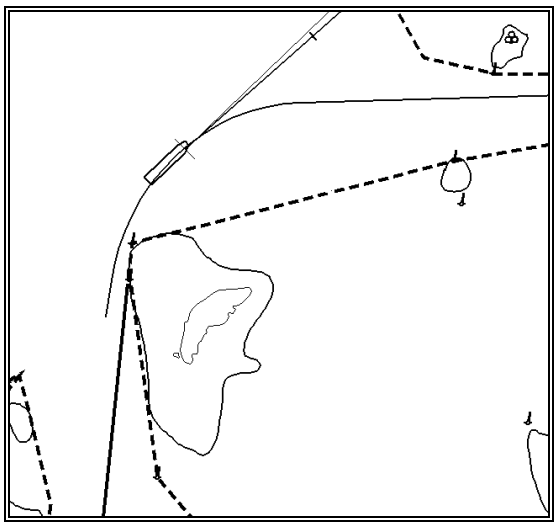
The curved EBL is locked to its position when your ship initiates a turn by

- Route steering: Goto WPT or Goto Track
- Program Track of the FAP-2000
- Program Course Change of the FAP-2000

During the turn you can monitor how your ship performs the intended maneuver against the plan by comparing the curved EBL position and your current your ship's position.



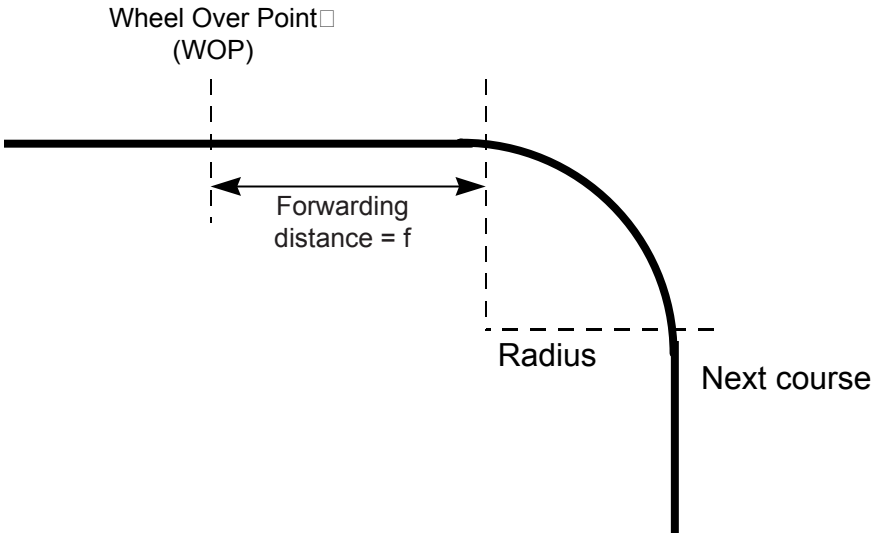
Curved EBL, at wheel over point



Curved EBL, locked during turn

1.11.2 Structure of the curved EBL

The curved EBL consists of a straight part at its beginning called "forwarding distance". Then an arc with selected radius and finally an EBL in the direction of the newly requested set course. See the figure below.



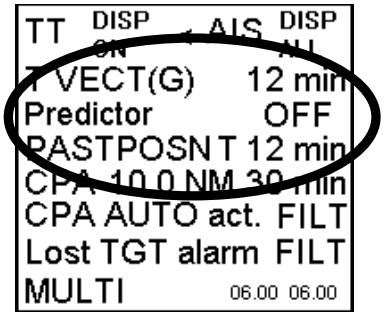
You may adjust forwarding distances to suit your ship’s characteristics. See Chapter 27 in the ECDIS Operator's Manual.

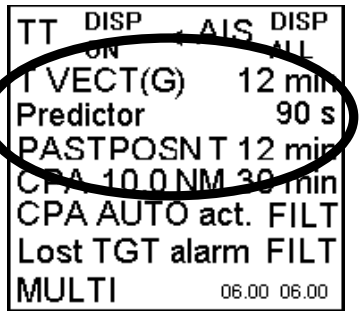
1.11.3 How to design a new turn while the ship is turning

The Program Course Change and Program Track steering modes allow you to design turns before you execute them. The system displays only one curved EBL. A newly designed turn takes priority over the currently displayed turn. If turn design is available from the Program Heading Change or Program Track steering mode, the curved EBL shows it. If no turn design is available, the curved EBL shows current turn.

1.12 How to Use the Predictor

The Predictor is a tool for estimating your ship's future positions and behavior, and it is located in the information area. Put the cursor on the text "Predictor" then use left mouse button to toggle the predictor ON/OFF. The current setting is shown in the mouse functions area. To set the time for the predictor, put the cursor on the time indication next to Predictor, spin the scrollwheel to select a time then push the scrollwheel. The time from current position to the last of the predicted position may be selected between 30 and 180 seconds, in 30-second intervals. The on-screen Predictor graphic consists of five pieces of your ship, drawn in true scale to successive future positions.



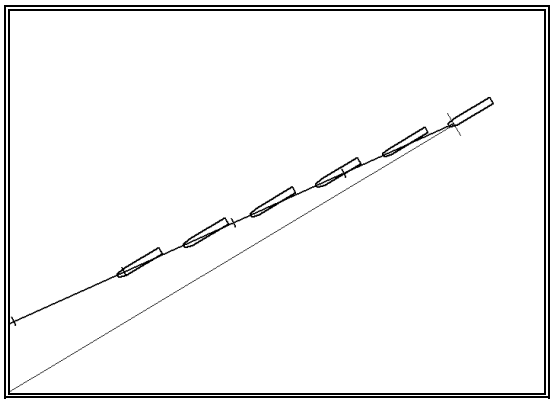


The predictor is calculated using current speed and rate of turn:

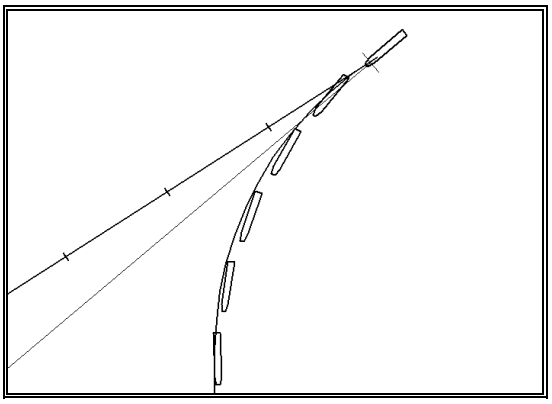
- Docking speed components:
  - Transversal bow speed
  - Transversal stern speed
  - Longitudinal center speed
- Rate of turn

These components are assumed to be stable during the prediction period.

The predictor can be used in every steering-state, even when steering without the autopilot.



Predictor shows drift



Predictor in a turn

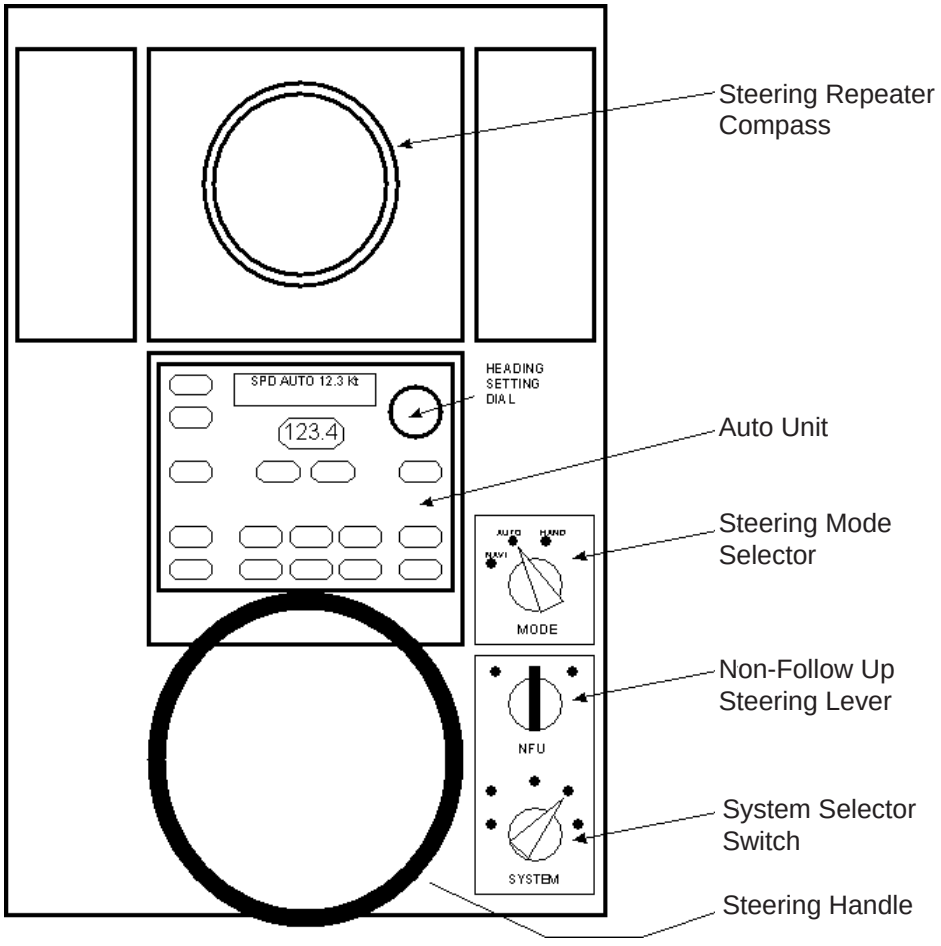
2. YOKOGAWA Autopilot PT-500A (category B)

2.1 Introduction

This chapter describes the steering functions available with the YOKOGAWA Autopilot PT-500A (category B).

2.2 Steering Control Unit

Below is the layout of the Steering Control Unit.



2.3 Steering Modes

All steering related functions are available only if the ECDIS system is also connected to the PT-500A (category B) autopilot processor. To use any steering mode, the **System Selector** switch must be in the **FU** (Follow Up) position.

2.3.1 Hand steering mode (Mode selector: HAND)

Set the **Steering Mode Selector** switch to HAND. The ECDIS displays the rudder angle and indicates the steering mode.

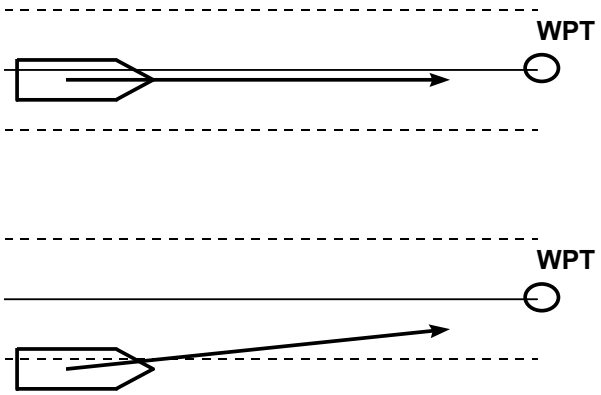
2.3.2 Autopilot steering mode (Mode selector: AUTO)

- The operator sets the required heading of the ship using the "Heading Setting Dial".
- The rudder limit controls all turns.
- The operator initiates all turns.

In the autopilot steering mode, the ECDIS system displays the rudder angle and the steering mode. The curved EBL is not available because the use of it requires radius-controlled turns.

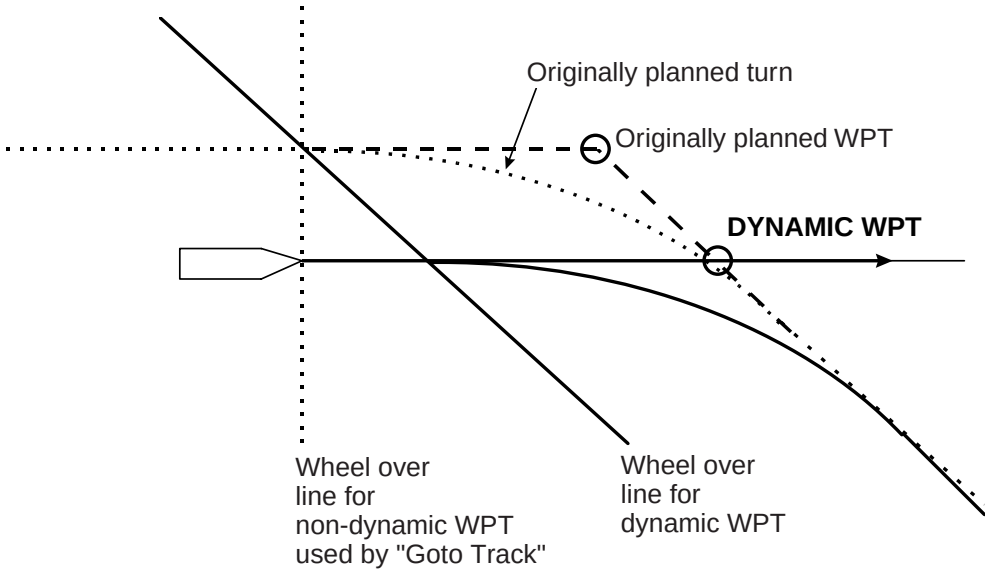
2.3.3 Route steering mode (Mode selector: NAVI)

Route steering can be used with a predefined monitored route, and activated when the ship is located inside the channel of the monitored route.



Performance of route steering

- The ECDIS system will follow the planned track to the next waypoint but with moderate accuracy, in order to have more economic sailing (sailing in ocean areas).
- When approaching the next waypoint, the system pre-alerts the operator well before the turn and just before the turn a second acknowledge is given. (See section 2.4.5 in the ECDIS Operator's Manual.)
- The ECDIS system performs turns using planned radius.



How the location of a Dynamic WPT is defined when the NAVI steering mode is in use

Characteristics of route steering

Steering is course-controlled with set radius between waypoints. If wind, current etc. affects the ship, the system tries to prevent the ship from drifting away from the planned route. The system has three means to prevent drifting away from the planned route. They are most effective when used together. If cross-track error is used alone, then your ship stabilises typically in a constant off-track position. The means are:

- Measured cross-track error from the center line, which is always active.
- Drift compensation available from Route Parameters
- Gyro error compensation available from Route Parameters

If wind, current etc. affects the ship during turns, the ship will drift away (inside or outside) from the planned designed turn that is displayed on the radar screen.

Summary of route steering

Item	Goto WPT
Set heading	Automatic
Set radius	Automatic
Radius control	Yes
Dynamic waypoint position	Yes
Design before execution	Yes
Full curved EBL on radar screen	Yes
Wind, current etc. compensation running straight between WPT	Low gain
Wind, current etc. compensation in turns	No
Needs gyro	Yes
Needs log	Yes
Precision of position equipment	Good[1]

[1] Precision of position is good with LORAN and GPS.

Preconditions for route steering

Route steering requires activation of the position filter. For details, see Kalman Filter in section 19.8 "Filter Operation" in the ECDIS Operator's Manual.

If you try to activate any of the route steering modes without the filter, you get alert "**470 Disabled**: **Needs filter on**" and "**471 AP mode Conflict - Use AUTO**". First change the **Steering Mode Selector** switch back to AUTO or HAND at the Steering Control Unit, then turn ON the Kalman filter. Select NAVI mode again.

Ship's heading must point to the next waypoint and ship must be located inside the channel limits of the route, otherwise the alert "**468 Disabled - out of course**" or "**477 Disabled**: **Out of channel**" appears.

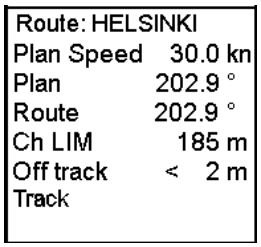
If you loose the filter position in route steering, you first get the alert "**475 Route**: **Needs filter on**" then alert "**506 Use Heading Control**".

How to activate route steering

To activate route steering, set the **Steering Mode Selector** switch on the Steering Control Unit to the NAVI position.

Route steering indications on ECDIS

When NAVI is selected, the indication "Track" appears in the route monitor window on the ECDIS display.

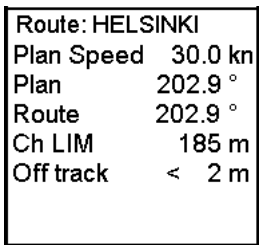


If the ECDIS did not accept the requested route steering mode, the indication "Autopilot Conflict" appears in the route monitor window on the ECDIS display.

Also alerts "**470 Disabled**: **Needs filter on**" and "**471 AP mode Conflict - Use AUTO**" appear.

At the Steering Control Unit, the text "Caution-01 CHANGE TO AUTO" appears and the buzzer sounds.

When route steering is not used, there is no indication in the route monitor window in the ECDIS.



Alerts shown when route steering cannot be accepted

There are several reasons why the requested route steering mode cannot be accepted.

Alert "**464 Route**: **No selected route**" informs you that there is no route selected for route monitoring.

Alert "**465 Route**: **Illegal WPT**" informs you that there is a route selected for route monitoring, but the selection of the next or final waypoint is missing or illegal.

Alert "**468 Disabled**: **Out of course**" informs you that the difference between the current heading of your ship and the required set heading to start the route steering are greater than set by the operator in the "Route start limit angle" of Route Parameters.

Alert "**470 Disabled**: **Needs filter on**" informs you that you didn't have the Kalman filter activated and selected to ON at the time of the request. Route steering requires that you use the Kalman filter, because the filter eliminates sudden jumps of the position and thus prevents unwanted movement of your ship. Check your selection of the sensors.

Alert "**471 AP mode Conflict - Use AUTO**" informs you that ECDIS and the PT-500A cannot perform route steering mode. First change the mode from NAVI to AUTO then check that the preconditions for route steering are fulfilled.

Alert "**477 Disabled**: **Out of channel**" informs you that the current location of the ship is not inside the channel of the monitored route.

Alert "**490 Disabled**: **Needs log sens.**" informs you that the Kalman filter did not have an independent speed source. You need either a log, a dual-axis log or two position receivers. Check your selection of the sensors.

When you arrive at a waypoint

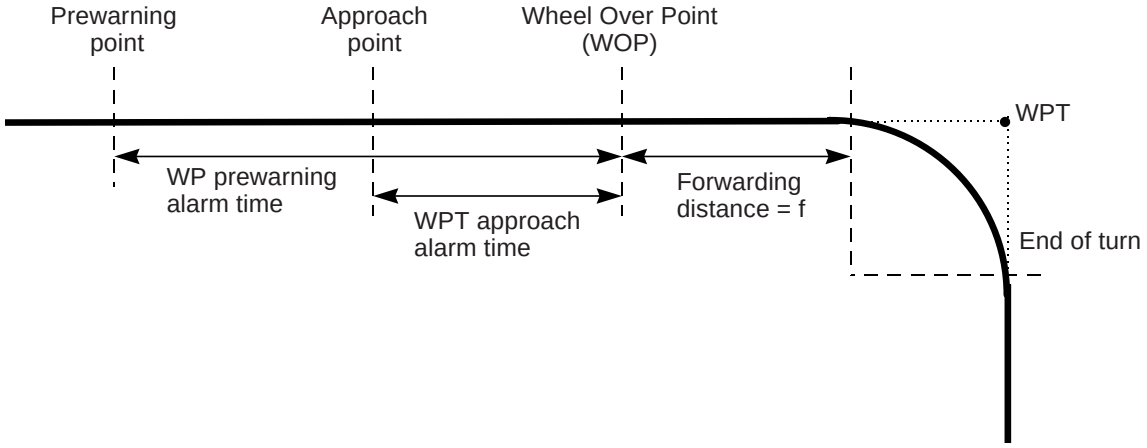
Route steering navigation tries to keep the ship always inside the channel limits and going to the next waypoint. Well before the next waypoint, the alert "**485 Route WPT prewarning**" appears. As soon as the alert appears, verify that the maneuver is safe and there are no dangerous targets. If the maneuver is safe, press the **ALARM ACK** key on the ECDIS control unit. If the maneuver is not safe, quit the route steering by setting the mode to AUTO or HAND from the Steering Control Unit.

TURN IS ALWAYS ENABLED. THE ONLY WAY TO DISABLE THE AUTOMATIC TURN IS TO SELECT ANOTHER STEERING MODE EXCEPT NAVI FROM THE AUTOPILOT.

Note that alert 485 is programmable (the time before the turn) and it is relative to the starting point of the maneuver. See the figure below.

At the moment your near the next waypoint, the alert "**451 Route: WPT approach alarm**" appears.

Note also that alert 451 is programmable (the time before turn) and it is relative to the starting point of the maneuver. See the figure below.



As soon as the ship arrives at the wheel over point, the ECDIS sends a new course command to the autopilot and the maneuver is started. During a maneuver, the radar display and the ECDIS display show the curved EBL that shows the planned radius for a maneuver.

Waypoint-related indications on ECDIS

After acknowledging the alert "**485 Route**: **WPT prewarning**" the text "Ass. Appr. enabled" appears in the route monitor window on the ECDIS display.

After acknowledging the waypoint approach alert, the text "Ass. Turn enabled" appears in the route monitor window on the ECDIS display.

During the turn, the text "Assisted Turn" appears in the route monitor window on the ECDIS display.

Note: When you approach the last waypoint, the alert "**458 Route**: **Last WPT approach**" appears. Leave the NAVI mode before performing acknowledge of the alert 458. This will terminate the route correctly. If you acknowledge alert 458 when the autopilot is still in the NAVI mode, the route steering is automatically terminated and the system generates alert "**471 AP mode Conflict - Use AUTO**".

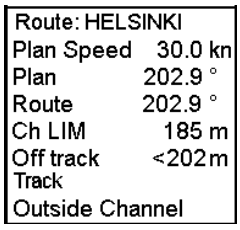
Route steering alerts

There are two types of alerts relevant to automatic steering, permanent and intermittent.

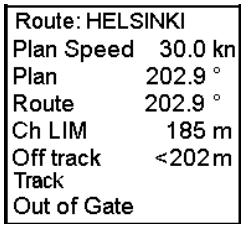
Permanent route steering alerts

Permanent alerts below are available regardless of the used steering mode.

- "Off track" value in red
- "Outside Channel" in orange

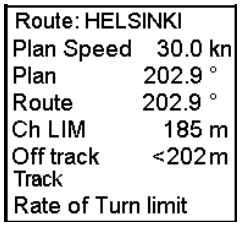


- **Out of Gate** is orange. Out of gate indicates that, if the ship continues using the current course, the ship will be outside of the channel at wheel over point.



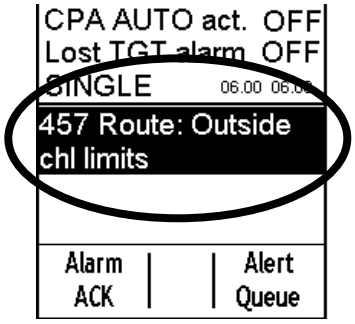
The permanent alert shown right is available only during route steering mode:

- "Rate of Turn Limit" is orange.



Intermittent route steering alerts

- Visual alert and buzzer are generate from the ECDIS.
- Alert number and text are visible at the bottom right corner of the ECDIS screen (see example below).



Alert "**455 Route**: **off course**" informs you that the system needs more than the set limit (the limit is available in Installation parameters) to keep the track. This alert is repeated every 5 minutes, if the condition continues.

Alert "**456 Route**: **WPT approach error**" appears, for example, when a decrease in ship speed is more than the waypoint approach alert time + 100 seconds away from the wheel over point after the user have already acknowledged alert "451 Route: WPT approach alarm" to enable the next automatic turn. After the alert 456 appears, the next turn is not enabled and the system will generate the alert "451 Route: WPT approach alarm" when appropriate.

Alert "**457 Route**: **Outside chl limits**" appears if the ship is outside the planned channel.

Alert "**460 Pilot**: **ROT will be exceed**" informs you that the set radius value together with the current speed of the ship-requested rate of turn is over the limit set with " Max. rate of turn" in the route parameters.

Alert "**461 Route**: **ROT will be exceed**" informs you that the planned radius for the next waypoint together with the current speed of the ship-requested rate of turn is over the limit set with " Max. rate of turn" in the route parameters. This alert is activated if the own ship is within the value set for "WPT approach alert time" (in route parameters) from the wheel over point.

Alert "**469 Autopilot**: **off course**" informs you that the autopilot needs more than the set limit. (The limit is set in the installation parameters for the Track mode.) This alert is repeated every 5 minutes, if the condition continues.

Alert "**471 AP mode Conflict - Use AUTO**" informs you that that ECDIS and autopilot cannot activate the Track steering mode. First change mode from NAVI to AUTO then check that the preconditions for route steering are fulfilled.

Alert "**475 Route**: **Needs filter on**" informs you that the position from the Kalman filter is not available. This alert is repeated every 15 seconds, if the condition continues.

Alert "**476 Route**: **Needs log sensor**" informs you that the position from the Kalman filter cannot be compared against an independently operating log. This alert is repeated every 15 seconds, if the condition continues.

Alert "**488 Integrated Steering lost**" informs you that the connection to the autopilot is lost during route steering and the used integrated steering mode cannot be continued. (Normally, you get the alert "**480 Autopilot Receive error**" first.)

Alert "**497 Route**: **Stop - Sensor Fail**" informs you that no gyro data is received or the conditions of alert 475 or 476 have been valid for the last minute.

Alert "**506 Route**: **Use AUTO control**" is instruction for the user to change the steering mode to AUTO. This alert is generated if there are not sufficient conditions to continue the Track mode (i.e. alert 475 or 476 has been valid 10-15 seconds).

Alert "**511 Route**: **Auto resume disable**" appears if alert 471 has been generated and later the condition for alert 471 is resolved without changing the steering mode from NAVI to AUTO or HAND. First change the steering mode to AUTO or HAND then check that the preconditions for route steering are fulfilled.

Alert "**512 Use NFU rudder control**" appears if the rudder servo unit cannot be controlled by the Steering Control Unit. This alert is generated to request a change to Non-Follow-Up control of rudder(s). First use the **System Selector Switch** from "**FU**" to NFU then use **Non-Follow Up steering lever** to control the rudder(s).

Alert "**514 Route**: **Complete turn**" is generated if there are not sufficient conditions to continue the Track mode during a turn (i.e. alert 475 or 476 has been valid 10-15 seconds). Ship will complete the turn with planned conditions.

Alert "**515 Conflict - NAVI compl. turn**" informs you that ECDIS and the autopilot cannot activate the Track steering mode after a turn. The autopilot uses the planned radius to complete the turn. After the turn is completed, change the steering mode from NAVI to AUTO then check that the preconditions for route steering are fulfilled to start the Track steering mode again.

Alert "**516 Trackpilot**: **Drift limit**" informs you that the trackpilot needs more than a set limit to compensate drift. (The limit is available in the installation parameters for the Track mode (max drift compensation)). This alert is repeated every 5 minutes, if the condition continues.

Alert "**788 System Frozen**" appears as an early warning indication that the system may enter state of freeze. You need to restart the ECDIS EC1000C processor.

Collision avoidance maneuver during route steering

Route steering is often interrupted by a collision avoidance maneuver, but there are also several other reasons to interrupt route steering.

There are several possibilities to set the collision avoidance or any other maneuver:

- Use the Non-Follow Up steering lever to control directly rudder pumps.
- Use the Follow Up rudder control (Change mode from NAVI to HAND).
- Use the local Autopilot Heading control (Change mode from NAVI to AUTO).

Now route steering is disabled until the NAVI mode is reselected at the autopilot. To return to route steering, the ship heading must point to the next waypoint and the ship must be located inside the channel limits, otherwise an alert is given.

How to stop or modify a pre-enabled turn in route steering

There are two cases that the automatic route turn must be stopped or modified.

- Because the turn cannot be performed up to the final value.
- Because the turn that the ship performs goes outside of the planned turn. (Too fast or too slow).

How to stop a turn

To stop a turn, change the steering mode from NAVI to AUTO at the Steering Control Unit.

How to modify a turn

What to do	How to do it
Use different final value of set course	The problem is that Radius Control is only available in the NAVI steering mode. As soon as you change the steering mode to something other than NAVI, the ship stops following the radius. Below is what you can do: • Change the steering mode from NAVI to AUTO. This stops the turn completely and the current gyro heading is selected as the new set course for the autopilot. Then set a new final value for the set course and select a suitable max. rudder angle to prevent too fast turning. • Turn the steering wheel to a suitable angle to continue with a new radius (i.e. to equal previous rudder angle). Then change the steering mode from NAVI to HAND. Continue manual steering. • Change the steering mode from NAVI to NFU, then use the NFU steering lever. Manually steer the ship.
Compensate too fast turning	As soon as you change the steering mode to something other than NAVI, the ship stops following the radius. Below is what you can do: • Change the steering mode from NAVI to AUTO. This stops the turn completely and the current gyro heading is selected as the new set course for the autopilot. Then set a final value for the set course and select a suitable max. rudder angle to prevent too fast turning. • Set the steering wheel to a suitable angle to continue with a larger radius (i.e. smaller than previous rudder angle). Then change the steering mode from NAVI to HAND. Manually steer the ship. • Change the steering mode from NAVI to NFU. Manually steer the ship.
Compensate too slow turning	As soon as you change the steering mode to something other than NAVI, the ship stops following the radius. Below is what you can do: • Set the steering wheel to a suitable angle to continue with a smaller radius (i.e. higher rudder angle than before). Then change the steering mode from NAVI to HAND. Manually steer the ship. • Change the steering mode from NAVI to NFU. Manually steer the ship.

Accuracy of route steering

Accurate route steering is defined as small cross-track error when automatically following the route. Two of the Route Parameters - Drift compensation and Gyro error compensation - have a significant effect on the accuracy of route steering. If you need very accurate route steering, then both of these parameters should be enabled. Before activating the gyro error compensation, see section 19.10 "Gyro Error Correction" in the ECDIS Operator's Manual to find the possible methods for gyro error compensation.

2.4 Other Operations

Speed used by autopilot

- NAVI Mode: Speed Data(serial) from ECDIS only.
- AUTO Mode: Direct input(LOG Speed) to Autopilot or Manual Speed set in Autopilot.
- HAND Mode: N/A

Control strategy

- The operator may select among ECONOMY, PRECISION 1 and PRECISION 2 by using the **OPERATION MODE** button.
- Control strategy (ECONOMY, PRECISION 1 and PRECISION 2) selects course-keeping accuracy.

Load conditions

- The operator may select among BALLAST, MIDDLE and FULL with the **DRAFT MODE** button.
- Load condition (BALLAST, MIDDLE and FULL) selects rudder gain.

2.5 Alerts Generated by ECDIS

2.5.1 Operational alerts

- The lamp in the **ALARM ACK** key on the ECDIS control unit goes on.
- The type of alert is displayed on the ECDIS display as number and text.
- An alert is acknowledged by pushing the **ALARM ACK** key on the ECDIS control unit.

```
Alert number 451:   ROUTE: WPT APPROACH ALARM    /1 or /7
             -----------------------------------
             WAYPOINT IS NOW BEING APPROACHED.
             CLICK 'ACKN. WARNING' TO ACCEPT THE
             TURN.

Alert number 452:   ROUTE: TURNING DISABLED      /1
             -----------------------------------
             WHEELOVER POINT HAS BEEN PASSED
             WITHOUT 'ACKN. WARNING* 'RADIUS
             CONTROL' MODE HAS THEN AUTOMATICALLY
             BEEN INITIATED

Alert number 455:   ROUTE: OFF COURSE       /6/13
             -----------------------------------
             SYSTEM NEEDS MORE THAN A SET LIMIT TO
             KEEP THE TRACK. THIS ALERT IS REPEATED
             EVERY 5 MINUTES.

Alert number 456:   ROUTE: WPT APPROACH ERROR     /5
             -----------------------------------
             'TIME TO WOP' HAS CHANGED SINCE 'WPT
             APPROACH' ALERT WAS ACKNOWLEDGED,
             POSSIBLY DUE TO A POSITION JUMP.
             VERIFY POSITION AND SPEED SEN SORS
             IN 'SENSORS' PAGE
```

```
Alert number 458:   ROUTE: LAST WPT APPROACH     /1 or /7
             ------------------------------------
             FINAL WAYPOINT OF THE ROUTE IS
             REACHED. LEAVE NAVI MODE BEFORE
             ACKNOWLEDGED ALERT.

Alert number 460:  PILOT: ROT WILL BE EXCEED  /6/13
             ------------------------------------
             THE RADIUS SENT TO AUTOPILOT IS
             EXCEEDING THE MAXIMUM LIMIT FOR
             TURNRATE. INCREASE THE RADIUS, OR
             REDUCE SPEED.

Alert number 461:   ROUTE: ROT WILL BE EXCEED   /6/13
             ------------------------------------
             WAYPOINT IS BEING APPROACHED WITH
             TOO HIGH SPEED FOR THE PLANNED
             RADIUS, CAUSING MAX. TURNRATE TO BE
             EXCEEDED. REDUCE THE SPEED OR
             INCREASE RADIUS BY OVERDRIVING WITH
             'MAN. SET COURSE'.

Alert number 468:   DISABLED: OUT OF COURSE      /3
             ------------------------------------
             ROUTE STEERING CAN ONLY BE INITIATED
             WHEN SHIPS COURSE IS WITHIN THE
             'TRACK LIMIT' FOR 'TRACK. USE 'AUTO'
             OR 'HAND' MODE TO STEER WITHIN
             THE LIMITS.

Alert number 469:  AUTOPILOT: OFF COURSE     /6/13
             ------------------------------------
             AUTOPILOT DOES NOT STEER WITHIN
             LIMITS OF 'COURSE TO STEER' COMMAND'.
             VERIFY TRACKPILOT FUNCTIONS.

Alert number 470:   DISABLED: NEEDS FILTER ON     /3
             ------------------------------------
             'ROUTE STEERING' MODE CAN BE USED
             ONLY WHEN 'FILTER' IS ON AND THERE
             ARE ENOUGH SPEED, HEADING AND
             POSITION SENSORS. VERIFY AND SELECT
             POSITION SENSORS IN 'SENSORS' PAGE

Alert number  471:   AP MODE CONFLICT - USE AUTO/4/11
              ------------------------------------
              YOU HAVE TRIED TO ACTIVATE TRACK
              STEERING OR YOU HAVE REACHED THE END
              OF THE ROUTE, BUT YOU HAVE NOT LEFT
              'TRACK' MODE CHANGE IMMEDIATELY TO
              AUTO' MODE

Alert number 475:   ROUTE: NEEDS FILTER ON     /3/10
             ------------------------------------
             THIS IS A WARNING THAT YOU ARE USING
             ROUTE STEERING WITHOUT FILTERED
             POSITION AVAILABLE. VERIFY AND
             SELECT POSITION SENSORS IN 'SENSORS'
```

```
Alert number 476:   ROUTE: NEEDS LOG SENSOR     /3/10
             ------------------------------------
             THIS IS A WARNING THAT YOU ARE USING
             ROUTE STEERING WITH ONE POSITION
             DEVICE AND WITHOUT ANY LOG DEVICE.
             VERIFY AND SELECT SENSORS IN'SENSORS'

Alert number 485:   ROUTE: WPT PREWARNING   /5 or /7
             ------------------------------------
             WAYPOINT IS SOON BEING APPROACHED.

Alert number 497:   ROUTE: STOP-SENSOR FAIL      /3
             ------------------------------------
             GYRO, SPEED AND/OR POSITION DATA IS
             NOT RECEIVED CORRECTLY.

Alert number 506:   ROUTE:USE AUTO CONTROL      /5/12
              ------------------------------------
              THIS IS INSTRUCTION TO CHANGE
              STEERING MODE.  THIS ALERT IS
              GENERATED IF THERE ARE NOT
              SUFFICIENT SENSORS AVAILABLE TO
              CONTINUE TRACK MODE

Alert number 511:   ROUTE:AUTO RESUME DISABLE    /3
              ------------------------------------
              IF ALERT 471 HAS BEEN GENERATED
              AND LATER CONDITION FOR ALERT 471
              DISAPPEARS WITHOUT CHANGING STEERING
              MODE FROM NAVI TO AUTO OR HAND.
              FIRST CHANGE STEERING MODE TO AUTO
              OR HAND AND CHECK THAT PRECONDITIONS
              FOR ROUTE STEERING ARE FULFILLED.

Alert number 512:   USE NFU RUDDER CONTROL      /3/10
              ------------------------------------
             RUDDER SERVO UNIT CANNOT BE
             CONTROLLED BY YOKOGAWA STEERING
             CONTROL UNIT, THIS ALERT IS GENERATED
             TO CHANGE NON FOLLOW UP CONTROL OF
             RUDDER(S). FIRST CHANGE USING SYSTEM
             SELECTOR SWITCH FROM "FU" TO NFU AND
             THEN USE NON-FOLLOW UP STEERING LEVER
             TO CONTROL RUDDER(S).

Alert number 514:   ROUTE: NAVI COMPLETE TURN   /5/12
              ------------------------------------
             THIS IS INSTRUCTION TO CHANGE
             STEERING MODE.  THIS ALERT IS
             GENERATED IF THERE ARE NOT
             SUFFICIENT SENSORS AVAILABLE TO
             CONTINUE TRACK MODE AFTER TURN.
```

```
Alert number 515:   CONFLICT-NAVI COMPL. TURN       /5/12
             ------------------------------------
            THIS IS INSTRUCTION TO CHANGE
            STEERING MODE FROM NAVI TO AUTO.
            THIS ALERT IS GENERATED IF AUTOPILOT
            CANNOT CONTINUE TRACK MODE.  TURN IS
            COMPLETED WITH PLANNED RADIUS.
            CONTINUE AUTO MODE AFTER TURN.

Alert number 516:  TRACKPILOT: DRIFT LIMIT         /5/12
             ------------------------------------
            IF THE TRACKPILOT NEEDS MORE THAN A
            SET LIMIT TO COMPENSATE DRIFT(THE
            LIMIT IS AVAILABLE IN INSTALLATION
            PARAMETERS FOR TRACK MODE (MAX DRIFT
            COMPENSATION)).  THIS ALERT IS
            REPEATED EVERY 5 MINUTES, IF THE
            CONDITION CONTINUES.
```

2.5.2 Error alerts

Errors that occur during normal operation are related to internal problems. An internal problem is announced as follows:

- The lamp in the **ALARM ACK** key on the ECDIS control unit goes on.
- The type of alert is displayed on the ECDIS screen with a number and text.
- Acknowledge an alert by pushing the **ALARM ACK** key on the ECDIS control unit.
- Typical error alerts:

  480 Autopilot receive error

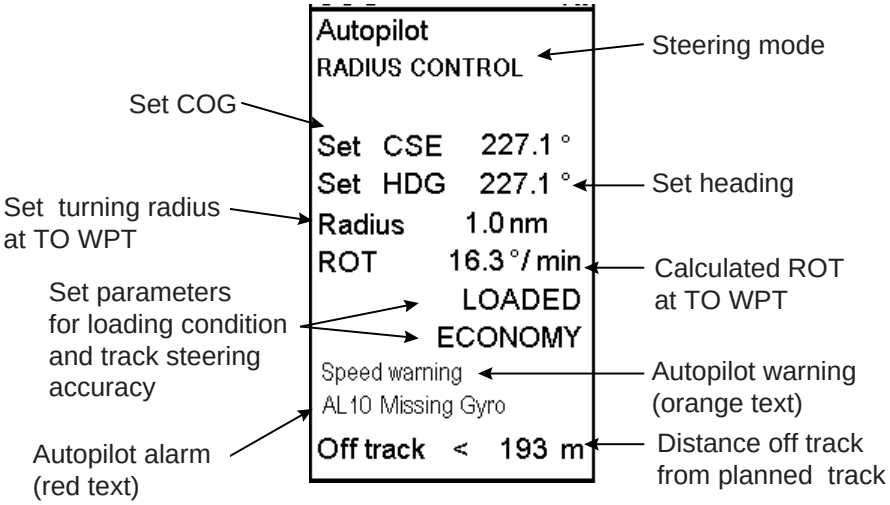
  488 Integrated steering lost

2.6 Autopilot Display in Sidebar

You can show the autopilot display in the sidebar on the ECDIS display. This display provides information about autopilot status.

To show the autopilot display:

1. Put the cursor on the right hand side of the route monitor window to show "Menu/ /Select Sidebar" in the mouse guidance box.
2. Press the right mouse button to open the Sidebar menu.
3. Select Autopilot from the menu.



2.7 Expected Steering Performance Under Various Conditions

The system has many kinds of steering modes. Below is a summary of how various environmental conditions affect steering performance. The system uses a combination of drift compensation and off track compensation to keep the ship inside the channel limit.

2.7.1 Expected steering performance for going ahead

Environmental conditions	Heading control = AUTO	Track = NAVI
Calm sea, no wind, no current	COG is about the same as Set Course in autopilot	**Drift compensation ON or OFF**: Ship follows monitored route.
Moderate wind and/or current	Ship has a tendency to drift.	**Drift compensation ON**: Ship follows monitored route. Drift compensation OFF: Ship follows monitored route in an off-track position inside the channel limit.
High wind and/or current	Ship is drifting.	**Drift compensation ON**: Ship follows monitored route. **Drift compensation OFF**: Ship may have troubles to follow monitored route inside the channel limit.
Slow change of wind and/or current	There is no compensation for change.	**Drift compensation ON**: Ship follows monitored route, but may need full channel limit area. **Drift compensation OFF**: Ship may have troubles to follow monitored route inside the channel limit.
Sudden change of wind and/or current (For example sudden change from no current to 5 kn current perpendicular to track)	There is no compensation for change.	**Drift compensation ON**: 1) Ship follows monitored route, but may need full channel limit area. 2) Ship may go outside channel limit and return back inside channel limit. **Drift compensation OFF**: Ship may have troubles to follow monitored route inside the channel limit.
Slow change of speed	There is no compensation for change.	**Drift compensation ON**: Ship follows monitored route. **Drift compensation OFF**: Ship may have troubles to follow monitored route inside the channel limit.
Fast change of speed (For example speed decreased from 20 to 7 kn)	There is no compensation for change.	**Drift compensation ON**: 1) Ship follows monitored route, but may need full channel limit area. 2) Ship may go outside channel limit and return back inside channel limit. **Drift compensation OFF**: Ship may have troubles to follow monitored route inside the channel limit.

2.7.2 Expected steering performance for turns

Environmental conditions	Heading control	Track
Calm sea, no wind, no current	There is no position control of turn. Turn is controlled by rudder angle limit.	**Drift compensation ON or OFF**: Ship follows monitored route.
Moderate wind and/or current	There is no position control of turn. Turn is controlled by rudder angle limit.	**Drift compensation ON**: Ship follows monitored route, but may need full channel limit area. **Drift compensation OFF**: Ship goes inside or outside of turn.
High wind and/or current	There is no position control of turn. Turn is controlled by rudder angle limit.	**Drift compensation ON**: Ship follows monitored route, but may go outside channel limit area. **Drift compensation OFF**: Ship goes fast inside or outside of turn.
Slow change of wind and/or current	There is no position control of turn. Turn is controlled by rudder angle limit.	**Drift compensation ON or OFF**: Ship goes inside or outside of turn.
Sudden change of wind and/or current (For example sudden change from no current to 5 kn current perpendicular to track)	There is no position control of turn. Turn is controlled by rudder angle limit.	**Drift compensation ON or OFF**: Ship goes fast inside or outside of turn.
Slow change of speed	There is no position control of turn. Turn is controlled by rudder angle limit.	**Drift compensation ON or OFF**: Ship follows monitored route, but may need full channel limit area.
Fast change of speed (For example speed decreased from 20 to 7 kn)	There is no position control of turn. Turn is controlled by rudder angle limit.	**Drift compensation ON or OFF**: Ship goes inside or outside of turn.

Note: Drift Compensation is set ON/OFF in Ship and Route Parameters of Navigation Parameters setting. For more information, see section 27.1.4 "Navigation parameters setting" in the ECDIS Operator's Manual.

2.8 Expected Steering Performance Under Critical Failure

Below is a summary of system behavior in various failures when NAVI steering mode is selected to be used.

2.8.1 Lost heading from autopilot (ECDIS may also have lost heading)

	Associated alert	Expected system performance	What operator should do
Immediately	• Autopilot Alert "EMERGENCY-05 Gyro Compass" is generated on Auto pilot control panel. • Sensor alert "755: Gyro error (PT-500A)" is generated at ECDIS.	• If ship is turning, rudder order is frozen for last value in order to approximately continue ahead. • If ship is turning, rudder order is frozen for last value in order to approximately continue rate of turn.	• Change immediately to manual control of rudder. • Acknowledge alerts. • Monitor situation.
Within few seconds	• Alert "497 Route Stop-Sensor fail. • Alert "471 AP mode conflict - Use AUTO" on ECDIS"		• Change immediately to manual control of rudder. • Acknowledge alerts. • Monitor situation.
Repeat every 2 minutes	• Alert "498 Use manual rudder control" is generated at ECDIS.	• Reminder	• Change immediately to manual control of rudder.

2.8.2 Lost heading from ECDIS (autopilot still has heading)

	Associated alert	Expected system performance	What operator should do
	• Sensor alert, for example Alert "705: Gyro error" or "706: Gyro error."		• Acknowledge alerts. • Monitor situation.
Within few seconds	• Alert "402 No heading available" and alert "400 Filter: POSN Unreliable". • Alert "497 Route Stop-Sensor fail"		• Acknowledge alerts. • Monitor situation. •
After Alert "497 Route Stop-Sensor fail."	• Alert "471AP mode conflict - Use AUTO" in ECDIS is generated. CAUT ALM lamp turns on at the autopilot Steering Control Unit.	• If ship is running straight, actual heading is used as set course. • If ship is turning, last-set course and radius are used to complete the turn.	• Acknowledge alerts • Study situation. • Change steering mode to AUTO.

2.8.3 Lost speed

	Associated alert	Expected system performance	What operator should do
	• Sensor alert, for example Alert "708: Log error", "712…716: Position equipment error", etc.		• Acknowledge alerts. • Monitor situation.
Within 30 seconds	• Alert "476 Route Needs log sensor"		• Acknowledge alerts. • Monitor situation.
After 2 minutes then every 4 minutes	• If ship is in running straight, route alert "506 Route: Use AUTO control" appears. • If ship is turning, alert "514 Route: NAVI complete turn" appears.	• Guidance for navigator	• Acknowledge alerts. • Monitor situation. • If ship is in turning part then either keep steering mode NAVI to complete the turn or change to steering mode AUTO to stop turning.
After 4 minutes then every 4 minutes	• Alert "476 Route Needs log sensor"	• Reminder	• Acknowledge alerts. • Monitor situation. • If ship is in turning part then either keep steering mode NAVI to complete the turn or change to steering mode AUTO to stop turning.
Within 10 minutes	• Alert "497 Route Stop-Sensor fail."		• Acknowledge alerts. • Monitor situation.
After Alert "497 Route Stop-Sensor fail."	• Alert "471AP mode conflict - Use AUTO" in ECDIS is generated. CAUT ALM lamp turns on at the autopilot Steering Control Unit.	• If ship is running straight, actual heading is used as set course. • If ship is turning, last-set course and radius are used to complete the turn.	• Acknowledge alerts • Study situation. • Change steering mode to AUTO.

2.8.4 Low speed

	Associated alert	Expected system performance	What operator should do
	• Alert "408 Filter: SPD below xx KN."		• Acknowledge alerts. • Monitor situation.
Within 90 seconds	• Alert "410 Filter: POSN source CHG".		• Acknowledge alerts. • Monitor situation.
Within 30 seconds	• Alert "501 Route: Needs higher Speed."		• Acknowledge alerts. • Monitor situation.
After 2 minutes then every 4 minutes	• If ship is running straight, alert "506 Route: Use AUTO control" appears. • If ship is turning, route alert "514 Route: NAVI complete turn."	• Guidance for navigator	• Acknowledge alerts. • Monitor situation. • If ship is in turning part then either keep steering mode NAVI to complete the turn or change to steering mode AUTO to stop turning.
After 4 minutes then every 4 minutes	• Alert "501 Route: Needs higher Speed."	• Reminder	• Acknowledge alerts. • Monitor situation. • If ship is turning, either keep the NAVI steering mode to complete the turn or change to AUTO steering mode to stop turning.
Within 10 minutes	• Alert "497 Route Stop-Sensor fail."		• Acknowledge alerts. • Monitor situation.
After Alert "497 Route Stop-Sensor fail."	• Alert "471AP mode conflict – "Use AUTO in ECDIS is generated." CAUT ALM lamp turns on at the autopilot Steering Control Unit.	• If ship is running straight, actual heading is used as set course. • If ship is turning, last set course and radius are used to complete the turn.	• Acknowledge alerts • Study situation. • Change steering mode to AUTO.

2.8.5 Total lost position

	Associated alert	Expected system performance	What operator should do
	• Alert "712…716: Position equipment error" OR • Kalman filter detects jump, etc.		• Acknowledge alerts. • Monitor situation.
Within 30 seconds	• Alerts "400 Filter: POSN unreliable" and "406 Route: CRS jump possible."	• Kalman Filter is turned OFF and system uses dead reckoning for positioning. • If you have log or dual-axis log, then dead reckoning is based on them and gyro. • If you have log or dual-axis log, then dead reckoning is based on last plausible speed from position sensors. This is indicated by showing own ship position, SOG and COG in red. The source indication for SOG and COG is "(LAST)".	• Acknowledge alerts. • Monitor situation.
After 2 minutes then every 4 minutes	• If ship is running straight, route alert "506 Route: Use AUTO control" appears. • If ship is turning, route alert "514 Route: NAVI complete turn" appears.	• Guidance for navigator	• Acknowledge alerts. • Monitor situation. • If ship is turning, either keep the NAVI steering mode to complete the turn or change to AUTO steering mode to stop turning.
After 4 minutes then every 4 minutes	• Alert "475 Route Needs filter ON"	• Reminder	• Acknowledge alerts. • Monitor situation. • If ship is turning, then either keep steering mode NAVI to complete the turn or change to steering mode AUTO to stop turning.
Within 10 minutes	• Alert "497 Route Stop-Sensor fail."		• Acknowledge alerts. • Monitor situation.
After Alert "497 Route Stop-Sensor fail."	• If ship is running straight, alert "471 AP mode conflict - Use AUTO" in ECDIS and alert "CAUTION-01 Navigation" on Autopilot control panel. • If ship is turning, alert "515 Conflict-NAVI compl. turn" in ECDIS and alert "CAUTION-01 NAVI COMPL TURN" in the autopilot Steering Control Unit. After the turn is completed, the alert changes in ECDIS to "471 AP mode conflict - Use AUTO" and at the autopilot Steering Control Unit as "CAUTION-01 Navigation".	• If ship is running straight, actual heading is used as set heading. • If ship is turning, last-set heading and radius are used to complete the turn as long as the steering mode is kept at NAVI.	• Acknowledge alerts. • Monitor situation. • If ship is running straight, change steering mode to AUTO. • If ship is turning, either keep the NAVI steering mode to complete the turn or change to AUTO steering mode to stop turning.

2.8.6 Lost differential position and position discrepancy

	Associated alert	Expected system performance	What operator should do
Precondition	If sensors in Filter calculation are NOT inside user-selected position discrepancy limit. • Alert "407 Position discrepancy"		• Acknowledge alerts. • Monitor situation.
Within 30 seconds	• Alert "478 Route: Needs good Pos"		• Acknowledge alerts. • Monitor situation.
After 2 minutes then every 4 minutes	• If ship is running straight, route alert "506 Route: Use AUTO control" appears. • If ship is turning, route alert "514 Route: NAVI complete turn." Appears.	• Guidance for navigator	• Acknowledge alerts. • Monitor situation. • If ship is in turning part then either keep steering mode NAVI to complete the turn or change to steering mode AUTO to stop turning
After 4 minutes then every 4 minutes	• Alert "478 Route: Needs good Pos"	• Reminder	• Acknowledge alerts. • Monitor situation. • If ship is turning, either keep steering mode NAVI to complete the turn or change to steering mode AUTO to stop turning.
Within 10 minutes	• Alert "497 Route Stop-Sensor fail"		• Acknowledge alerts. • Monitor situation.
After Alert "497 Route Stop-Sensor fail."	• Alert "471AP mode conflict - Use AUTO" in ECDIS is generated. CAUT ALM lamp turns on at the autopilot Steering Control Unit.	• If ship running straight, actual heading is used as set course. • If ship is turning, last set course and radius are used to complete the turn.	• Acknowledge alerts • Study situation. • Change steering mode to AUTO.

2.8.7 Lost communication between ECDIS and autopilot

	Associated alert	Expected system performance	What operator should do
Within 15 seconds	• Alert "488 Steering: Stop-system fail" generated at ECDIS.		• Acknowledge alerts. • Study situation.
After Alert "488 Steering: Stop-system fail"	• Alert "471AP mode conflict - Use AUTO" in ECDIS is generated. CAUT ALM lamp turns on at the autopilot Steering Control Unit.	• If ship is running straight, actual heading is used as set course. • If ship is turning, last-set course and radius are used to complete the turn.	• Acknowledge alerts • Study situation. • Change steering mode to AUTO.

2.8.8 Lost communication between autopilot and ECDIS

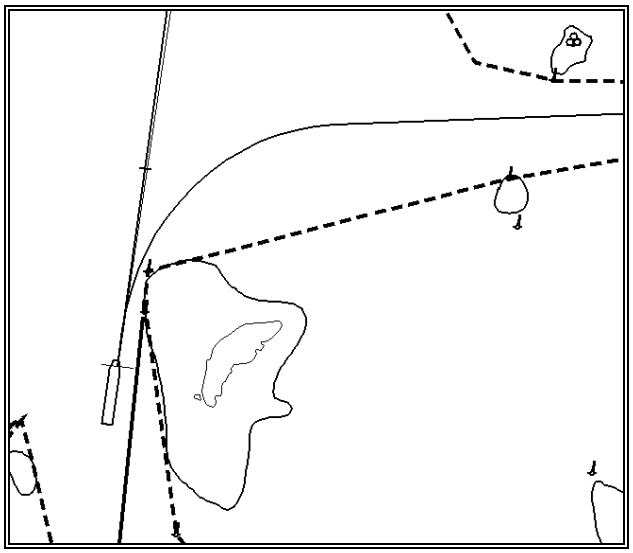
	Associated alert	Expected system performance	What operator should do
Within 15 seconds	• Alert "488 Steering: Stop-system fail" and "480 Autopilot FAP-2000 Receive error" is generated at the ECDIS.		• Acknowledge alerts. • Study situation.
After Alert "488 Steering: Stop-system fail"	• Alert "471AP mode conflict - Use AUTO" in ECDIS is generated. CAUT ALM lamp turns on at the autopilot Steering Control Unit.	• If ship is in running straight, actual heading is used as set course. • If ship is turning, last set course and radius are used to complete the turn.	• Acknowledge alerts • Study situation. • Change steering mode to AUTO.

2.9 How to Use the Curved EBL

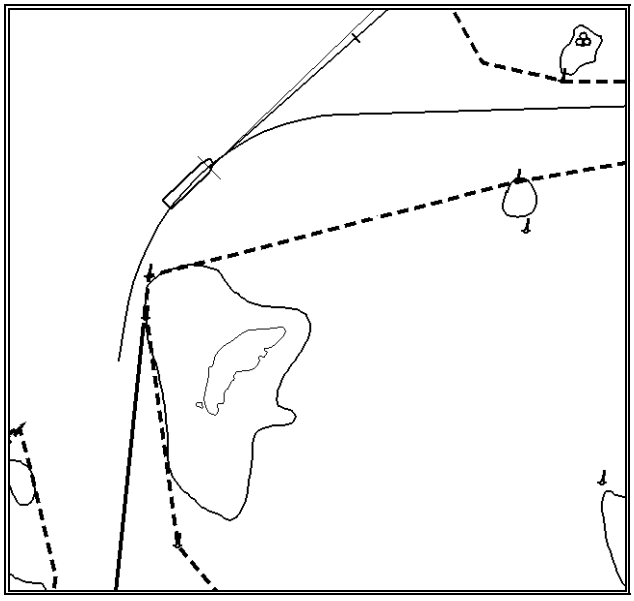
The curved EBL is a control tool to monitor automatic operation of the Track (=NAVI) steering mode. This EBL is available on the ECDIS display and selected radar displays.

After approaching a waypoint, but before the start of a turn, the curved EBL appears next to the intended turn. When your ship starts a turn initiated by route steering, the curved EBL is locked to its position.

During the turn you can monitor how your ship performs the intended maneuver against the planned turn by comparing the curved EBL position and your current your ship's position.



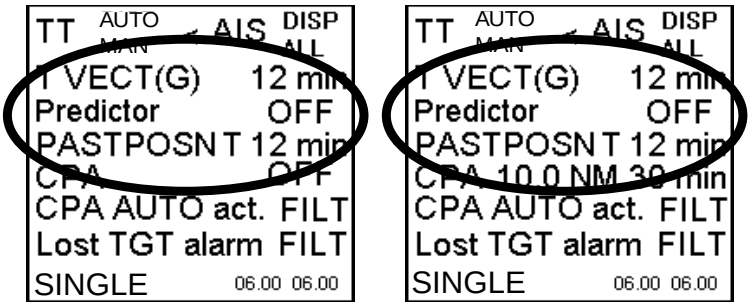
Curved EBL, at wheel over point



Curved EBL, locked during turn

2.10 How to Use the Predictor

The Predictor is a tool for estimating your ship's future positions and behavior, and it is available in the information area. Put the cursor on the text "Predictor" then use the left mouse button to toggle the predictor ON/OFF. The current setting is shown in the mouse functions area. To set the time for the predictor, put the cursor on the time indication next to Predictor, spin the scrollwheel to select a time then push the scrollwheel. The time from current position to the last predicted position may be selected between 30 and 180 seconds, in 30-second intervals. The on-screen Predictor graphic consists of five pieces of your ships drawn in true scale to successive future positions.

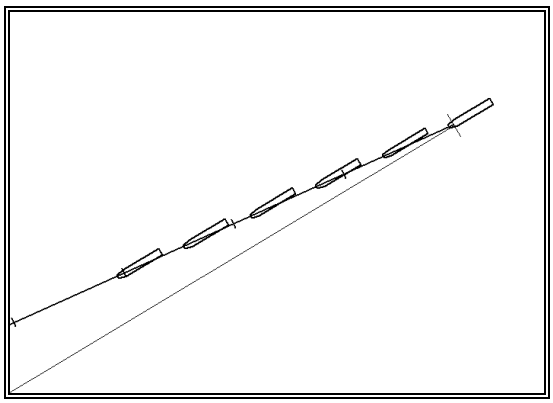


The predictor is calculated using current speed and rate of turn:

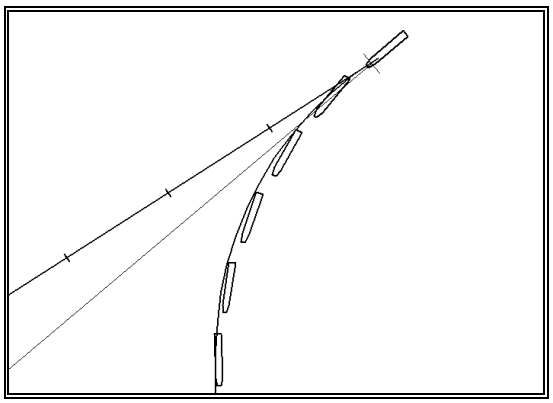
- Docking speed components:
  - Transversal bow speed
  - Transversal stern speed
  - Longitudinal center speed
- Rate of turn

These components are assumed to be stable during the prediction period.

The predictor can be used in every steering-state, even when steering without the autopilot.



Predictor shows drift



Predictor in a turn

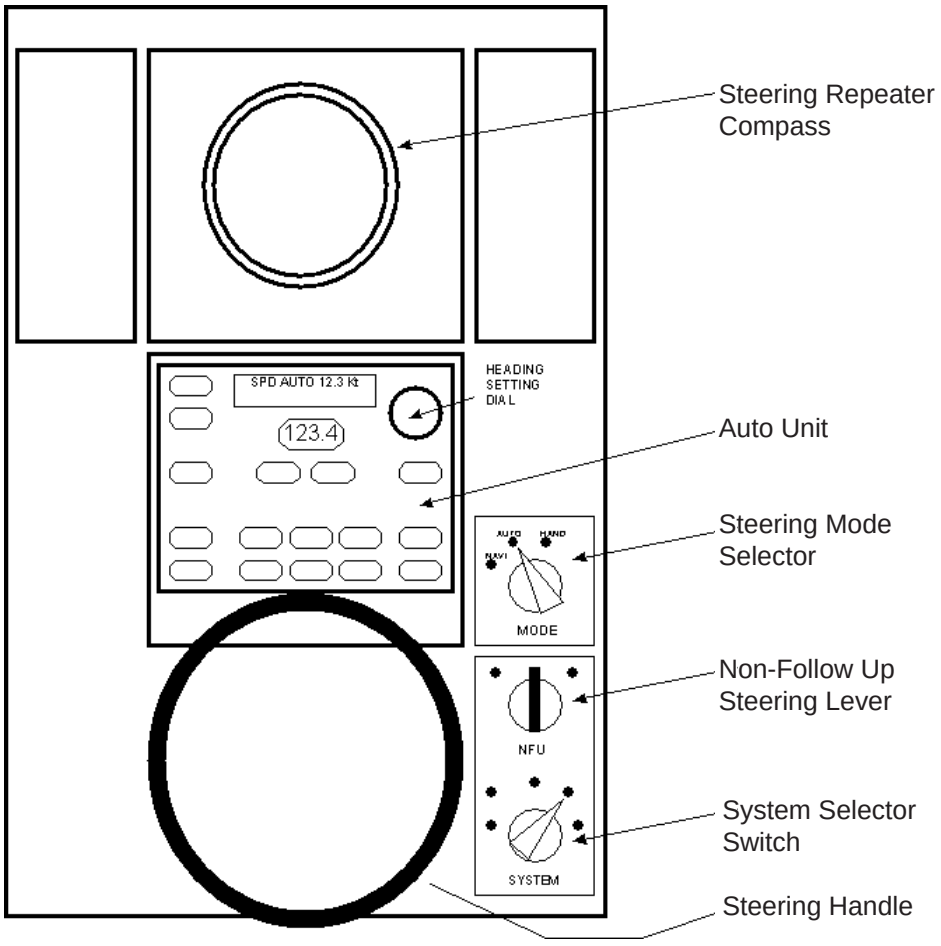
3. YOKOGAWA Autopilot PT-500A (category C)

3.1 Introduction

This chapter describes the steering functions available with the YOKOGAWA Autopilot PT-500A (category C).

3.2 Steering Control Unit

Below is the layout of the Steering Control Unit.



3.3 Steering Modes

All steering-related functions are available only if the ECDIS system is also connected to the PT-500A (category C) autopilot processor. To use any steering mode, the **System Selector** switch must be in the **FU** (Follow Up) position.

3.3.1 Hand steering mode (Mode selector: HAND)

Set the **Steering Mode Selector** switch to HAND. The ECDIS displays the rudder angle and indicates the steering mode.

3.3.2 Autopilot steering mode (Mode selector: AUTO)

Autopilot steering mode:

- The operator sets the required heading of the ship using the "Heading Setting Dial".
- The rudder limit controls all turns.
- The operator initiates all turns.

In this mode, the ECDIS system displays the rudder angle and the steering mode. The curved EBL is not available because the use of it requires radius-controlled turns.

3.3.3 Route steering mode (Mode selector: NAVI)

GoSEA mode (Open Sea mode)

In the GoSEA mode, the planned track is followed at moderate and "economical accuracy" between waypoints and also during turns (position-controlled turn).

When approaching the next waypoint, the ECDIS alerts the operator both well before the turn and just before the turn.

GoAW Mode (All Waters mode)

In the GoAW mode, the planned track is followed at the "maximum accuracy" between waypoints and also during turns (position-controlled turn).

When approaching the next waypoint, the ECDIS alerts the operator both well before the turn and just before the turn.

Summary of route steering modes

	GoSEA	GoAW
Set course	Automatic	Automatic
Set radius	Automatic	Automatic
Radius control	Yes	Yes
Design before execution	Yes	Yes
Full curved EBL on radar screen	Yes	Yes
Wind, current, etc. compensation running straights between WPT	Low gain	High gain
Wind, current, etc. compensation in turns	Yes	Yes
Needs gyro	Yes	Yes
Needs log	Yes	Yes
Precision of position equipment	Good(GPS)	High(DGPS)
Needs direct SOG/COG sensor	No	Yes

Preconditions for route steering

Route steering requires that the position filter be active. For details see section 19.8 "Filter Operation" in the ECDIS Operator's Manual.

If you try to activate any of the route steering modes without the filter, you get alert "**470 Disabled**: **Needs filter on**" and "**471 AP mode Conflict - Use AUTO**". First change the steering mode to AUTO or HAND at the autopilot, then turn ON the Kalman filter. Switch to the NAVI steering mode again.

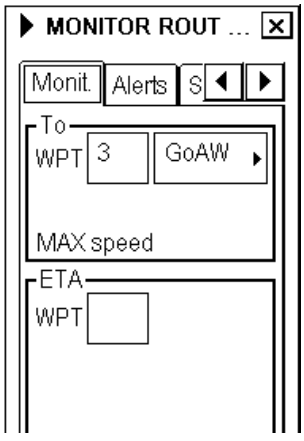
The ship's heading must point to the next waypoint and the ship must be located inside the channel limits of the route, otherwise the alert "**468 Disabled - out of course**" or "**477 Disabled**: **Out of channel**" appears.

If you loose the filter position during route steering, first the alert "**475 Route**: **Needs filter on**" appears then the alert "**506 Use Heading Control**" appears.

How to activate route steering

Do the following to activate route steering.

1. First select a route from the monitor mode on the ECDIS then open the route monitor dialog box.

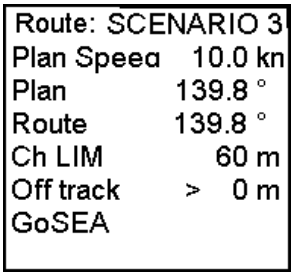


2. Activate route steering by selecting mode NAVI from the autopilot.

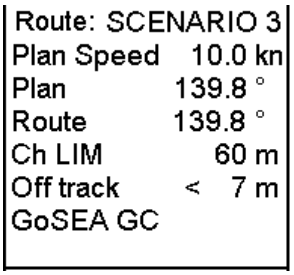
Route steering related indications on ECDIS

GoSEA

When GoSEA is activated, the indication "GoSEA" appears in the route monitor window on the ECDIS display.

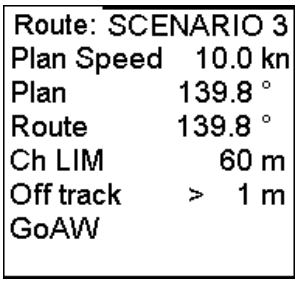


If the planned course to approach a To WPT is defined using Great Circle, the indication "GoSEA GC" appears in the route monitor window on the ECDIS display.

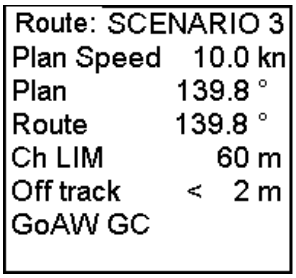


GoAW

When GoAW is activated, the indication "GoAW" appears in the route monitor window on the ECDIS display.

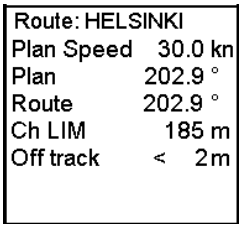


If the planned course to approach a To WPT is defined using Great Circle, the indication "GoAW GC" appears in the route monitor window on the ECDIS display.



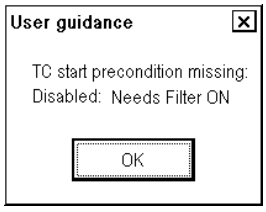
Missing preconditions for route steering

When route steering is not used or the ECDIS did not accept the requested route steering mode, there is no indication of the route steering mode in the route monitor window, as shown right.

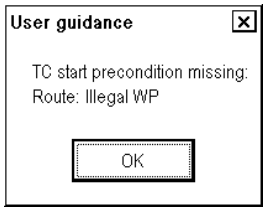


There are several requirements necessary to start route steering. When you make a selection in the route monitor window in ECDIS, user guidance may appear if preconditions are not fulfilled. The user guidance window may appear when you try to start any route steering mode or if you try to change one route steering mode to another. See section 19.8 "Filter Operation" in the ECDIS Operator's Manual.

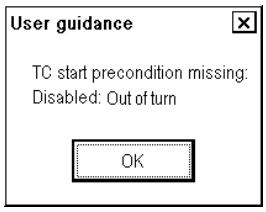
When you attempt to activate route steering without fulfilling preconditions, an appropriate user guidance dialog box appears:



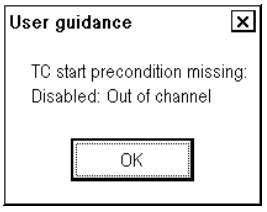
Reason: You tried to activate a route steering mode without the Kalman filter.
Remedy: Turn ON the Kalman filter and try again.



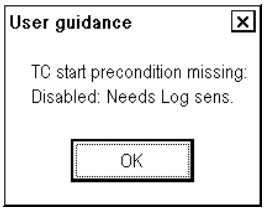
Reason: You tried to activate a route steering mode when the selection of the TO or FINAL waypoint is missing or illegal.
Remedy: Check the TO and FINAL waypoints.



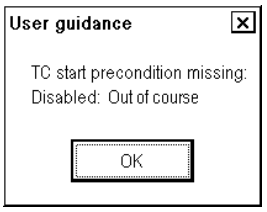
Reason: You tried to activate a route steering mode when the system detects that your ship is turning, but your location is not within the turn.
Remedy: Check and reset correct To WPT for route monitoring.



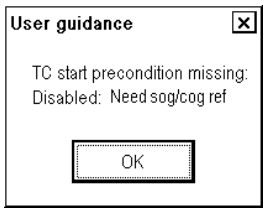
Reason: You tried to activate route steering outside of channel limits.
Remedy: Steer ship inside channel and try again.



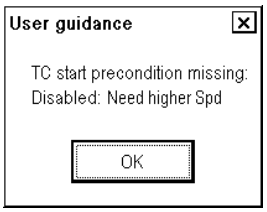
Reason: You tried to activate a route steering mode without an independent speed source. You need either a log, a dual-axis log or two position receivers.
Remedy: Check your selection of the sensors.



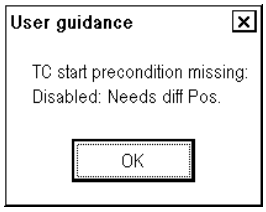
Reason: You tried to activate a route steering mode when there is a difference between current heading and the required set heading that is greater than set with **Route start limit angle** in the Route Parameters dialog box.
Remedy: Steer ship heading inside the limit of the required set heading.



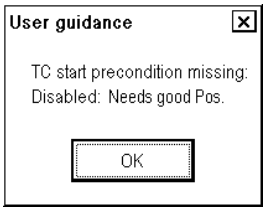
Reason: You tried to activate a route steering mode without SOG/COG reference.
Remedy: Check your selection of the sensors.



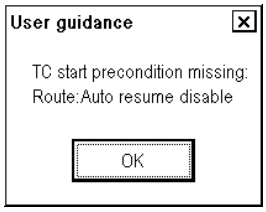
Reason: You tried to activate a route steering mode when your ship's speed is less than defined for route steering.
Remedy: Raise speed over the set limit then try again.



Reason: You tried to activate the GoAW steering mode without a high-precision positioning device (GPS in differential correction mode).
Remedy: Check that GPS in differential mode is selected in the Sensors menu.



Reason: You tried to activate a route steering mode when Alert 407 Position discrepancy is active.
Remedy: Switch off "bad" sensor in the Sensors page to remove alert 407.



Reason: If alert 471 has been generated and later the condition for alert 471 is resolved without changing steering mode from NAVI to AUTO or HAND.
Remedy: First change the steering mode to AUTO or HAND then check that the preconditions for route steering are fulfilled before changing back to NAVI.

Alerts when route steering cannot be accepted

When you select GoSEA or GoAW and change the steering mode to NAVI to activate route steering, but preconditions have not been fulfilled, one of the following alerts occur:

Alert "**464 Route**: **No selected route**" informs you that there is no route selected for route monitoring.

Alert "**465 Route**: **Illegal WPT**" informs you that there is a route selected for route monitoring, but the selection of the next or final waypoint is missing or illegal.

Alert "**468 Disabled**: **Out of course**" informs you that there is a difference between the current heading of your ship and the required set heading (set by the operator in the **Route start limit angle** of route parameters).

Alert "**470 Disabled**: **Needs filter on**" informs you that the Kalman filter was not ON at the time of the request. Route steering requires that you use the Kalman filter, because the filter eliminates sudden jumps of the position and thus prevents unwanted movement of your ship. Check your selection of the sensors. See section 19.8 "Filter Operation" in the ECDIS Operator's Manual.

Alert "**471 AP mode Conflict - Use AUTO**" informs you that ECDIS and the autopilot cannot start the route steering mode. First change the steering mode from NAVI to AUTO then check that preconditions for route steering are fulfilled.

Alert "**477 Disabled**: **Out of channel**" informs you that the current location of your ship is not inside the channel of a monitored route.

Alert "**490 Disabled**: **Needs log sens.**" informs you that the Kalman filter did not have an independent speed source. You need either a log, a dual-axis log or two position receivers. Check your selection of the sensors. See section 19.8 "Filter Operation" in the ECDIS Operator's Manual.

Alert "**510 Disabled**: **Out of turn**" informs you that your ship is located outside of the graphical area of turning (i.e. is linear part of track) and the Track Control System steering mode is GoSEA Turn or GoAW Turn. Reselect correct TO WPT for monitoring.

Alert "**518 Disabled**: **Not accepted**" informs you that the 30-second timeout has passed before you changed the mode to NAVI at the autopilot. After you select GoSEA or GoAW at the ECDIS, you have 30 seconds to change the mode to NAVI, otherwise alert 518 is given.

When you arrive at a waypoint

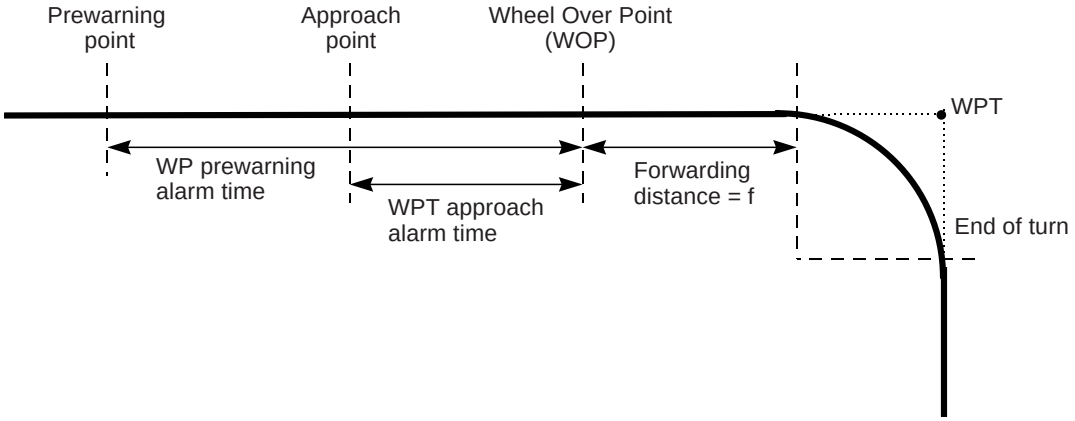
Route steering navigation tries to keep the ship always inside the channel limits and going to the next waypoint. Well before the next waypoint, the alert "**485 ROUTE WPT prewarning**" appears. As soon as the alert appears, verify that the maneuver is safe and there are no dangerous targets. If the maneuver is safe, press the **ALARM ACK** key on the ECDIS control unit. If the maneuver is not safe, quit the route steering by change the steering mode to NAVI to AUTO or to HAND mode at the autopilot.

TURN IS ALWAYS ENABLED. THE ONLY WAY TO DISABLE THE AUTOMATIC TURN IS TO SELECT ANOTHER STEERING MODE EXCEPT NAVI FROM YOKOGAWA AUTOPILOT.

Note that alert 485 is programmable (the time before turn) and it is relative to the starting point of the maneuver. See the figure below.

At the moment the next waypoint is about to be reached, there will be a second alert "**451 Route: WPT approach alarm**".

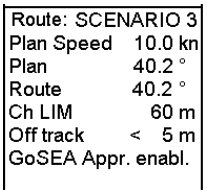
Note that also alert 451 is programmable (the time before turn) and it is relative to the starting point of the maneuver. See the figure below.

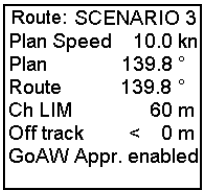


As soon as the ship arrives at the wheel over point, the ECDIS sends a new course command to the autopilot and the maneuver is started. During a maneuver, the radar display and the ECDIS display show the curved EBL, which indicates the planned radius for the maneuver.

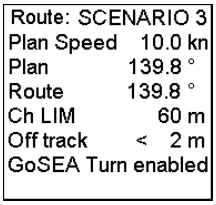
Waypoint-related indications at ECDIS

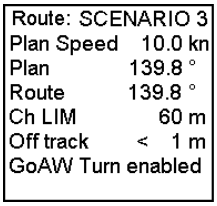
After acknowledging alert "**485 Route**: **WPT prewarning**", the text "**GoSEA Appr. enabl.**" or "**GoAW. Appr. enabled**" appears in the route monitor window on the ECDIS display.



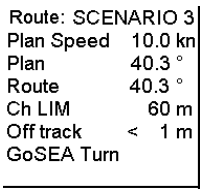


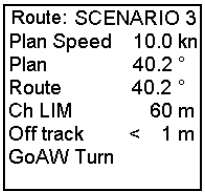
After acknowledging the waypoint approach alert, the text "**GoSEA Turn enabled**" or "**GoAW Turn enabled**" appears in the route monitor window on the ECDIS display.





During the turn, the text "**GoSEA Turn**" or "**GoAW Turn**" appears in the route monitor window on the ECDIS display.





Note: When you approach the last waypoint, the alert "**458 Route**: **Last WPT approach**" appears. If you acknowledge alert **458** when the autopilot is still in the NAVI mode, route steering is automatically terminated and the system generates alert "**471 AP mode Conflict - Use AUTO**".

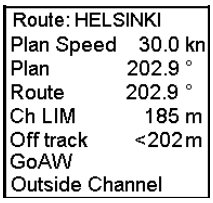
Route steering alerts

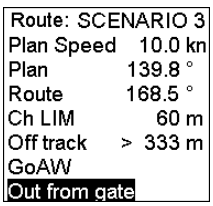
There are two types of alerts relevant to automatic steering, permanent and intermittent.

Permanent route steering alerts

Permanent alerts are available regardless of the steering mode.

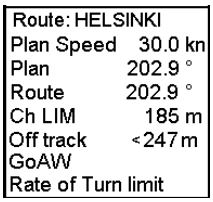
- "Off track" value is red.
- "Outside Channel" is orange.
- "Out of Gate" is orange. Out of gate indicates that, if the ship continues using the current course, then the ship will be outside of the channel at the wheel over point.





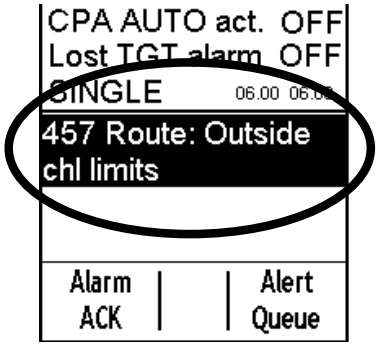
The permanent alert shown right is available only during the route steering mode:

- "Rate of Turn limit" is orange.



Intermittent route steering alerts

- Visual alert and buzzer are generated from the ECDIS.
- Alert number and text are shown at the bottom right corner of the ECDIS screen (see example below).



Alert "**455 Route**: **off course**" appears if the system needs more than the set limit to keep the track. (The limit is set in the installation parameters.) This alert is repeated every 5 minutes, if the condition continues.

Alert "**456 Route**: **WPT approach error**" appears if; for example, ship speed is decreased more than the waypoint approach alert time + 100 seconds away from the wheel over point after the user has already acknowledged alert "451 Route: WPT approach alarm" to enable the next automatic turn. After the alert 456 appears, the next turn is not enabled and the system will generate a new alert "451 Route: WPT approach alarm" when appropriate.

Alert "**457 Route**: **Outside chl limits**" appears if the ship is outside the planned channel.

Alert "**460 Pilot**: **ROT will be exceed**" appears if the set radius value together with the current speed of the ship-requested rate of turn is over the limit set with **Max. rate of turn** in the route parameters.

Alert "**461 Route**: **ROT will be exceed**" appears if the planned radius for the next waypoint together with the current speed of the ship-requested rate of turn is over the limit set with **Max. rate of turn** in the route parameters. This alert is activated if the own ship is within the value of **WPT approach alert time**, set in the route parameters, from the wheel over point.

Alert "**469 Autopilot**: **off course**" appears if the autopilot needs more than the set limit. (The limit is set in the installation parameters for the route steering mode.) This alert is repeated every 5 minutes, if the condition continues.

Alert "**471 AP mode Conflict - Use AUTO**" informs you that the ECDIS and autopilot cannot start the Track steering mode. First change the steering mode from NAVI to AUTO then check that the preconditions for route steering are fulfilled.

Alert "**475 Route**: **Needs filter on**" appears if the position from the Kalman filter is not available. This alert is repeated every 15 seconds, if the condition continues.

Alert "**476 Route**: **Needs log sensor**" appears if the position from the Kalman filter cannot be compared against an independently operating log. This alert is repeated every 15 seconds, if the condition continues.

Alert "**488 Integrated Steering lost**" appears if the connection to the autopilot is lost during route steering and the used integrated steering mode cannot be continued. (Normally you get the alert "**480 Autopilot Receive error**" first.

Alert "**489 Route**: **Changed to GoSEA**" appears when alert 492 or 507 has been valid 10 minutes. The steering mode is automatically changed to GoSEA.

Alert "**497 Route**: **Stop - Sensor Fail**" appears if no gyro data is received or if conditions of alert 475 or 476 has been valid for last minute.

Alert "**505 Route**: **Use GoSEA**" is instruction for the operator to change the steering mode to GoSEA. This alert is generated if there are not sufficient conditions to continue GoAW (alert 492 or 507 has been valid two minutes). This alert is repeated every four minutes.

Alert "**506 Route**: **Use AUTO control**" is instruction for the user to change the steering mode to AUTO. This alert is generated if there are not sufficient conditions to continue the Track mode (i.e. alert 475 or 476 has been valid 10-15 seconds).

Alert "**511 Route**: **Auto resume disable**" appears if alert 471 has been generated and later the condition for alert 471 is resolved without changing the steering mode from NAVI to AUTO or HAND. First change the steering mode to AUTO or HAND then check that the preconditions for route steering are fulfilled.

Alert "**512 Use NFU rudder control**" appears if the rudder servo unit cannot be controlled by the Steering Control Unit. This alert is generated to request a change to Non-Follow-Up control of rudder(s). First use the **System Selector Switch** from "**FU**" to NFU then use **Non-Follow Up steering lever** to control the rudder(s).

Alert "**514 Route**: **Complete turn**" is generated if there are not sufficient conditions to continue the Track mode during a turn (i.e. alert 475 or 476 has been valid 10-15 seconds). Ship will complete the turn with planned conditions.

Alert "**515 Conflict - NAVI compl. turn**" informs you that ECDIS and the autopilot cannot activate the Track steering mode after a turn. The autopilot uses the planned radius to complete the turn. After the turn is completed, change the steering mode from NAVI to AUTO then check that the preconditions for route steering are fulfilled to start the Track steering mode again.

Alert "**516 Trackpilot**: **Drift limit**" informs you that the trackpilot needs more than a set limit to compensate drift. (The limit is available in the installation parameters for the Track mode (max drift compensation)). This alert is repeated every 5 minutes, if the condition continues.

Alert "**788 System Frozen**" appears as an early warning indication that the system may enter state of freeze. You need to restart the ECDIS EC1000C processor.

Collision avoidance maneuver during route steering

Often route steering is interrupted by a collision avoidance maneuver, but there are also several other reasons to interrupt route steering.

There are several possibilities to set the collision avoidance or any other maneuver:

- Use the Non-Follow-Up steering lever to control directly rudder pumps.
- Use the Override steering.
- Use the Follow-Up rudder control (Change mode from NAVI to HAND).
- Use the local Autopilot Heading control (Change mode from NAVI to AUTO).

Now route steering is disabled until the NAVI mode is reselected at the autopilot. To return to route steering, the ship's heading must point to the next waypoint and the ship must be located inside the channel limits, otherwise an alert is given.

How to stop or modify an pre-enabled turn in route steering

There are two cases that the automatic route turn must be stopped or modified.

- The turn cannot be performed up to the final value.
- The turn that the ship is to perform goes outside of the planned turn. (Too fast or too slow).

How to stop a turn

To stop turn, change steering mode from NAVI to HAND on the Steering Control Unit.

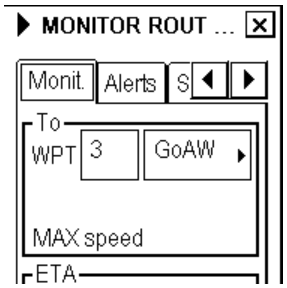
How to modify a turn

What to do	How to do it
Use different final value of set course	The problem is that Radius Control is only available in the NAVI steering mode. As soon as you change the steering mode to something other than NAVI, the ship stops following the radius. Below is what you can do: • Change the steering mode from NAVI to AUTO. This stops the turn completely and the current gyro heading is selected as the new set course for the autopilot. Then set a new final value for the set course and select a suitable max. rudder angle to prevent too fast turning. • Turn the steering wheel to a suitable angle to continue with a new radius (i.e. to equal previous rudder angle). Then change the steering mode from NAVI to HAND. Continue manual steering. • Change the steering mode from NAVI to NFU, then use the NFU steering lever. Manually steer the ship.
Compensate too fast turning	As soon as you change the steering mode to something other than NAVI, the ship stops following the radius. Below is what you can do: • Change the steering mode from NAVI to AUTO. This stops the turn completely and the current gyro heading is selected as the new set course for the autopilot. Then set a final value for the set course and select a suitable max. rudder angle to prevent too fast turning. • Set the steering wheel to a suitable angle to continue with a larger radius (i.e. smaller than previous rudder angle). Then change the steering mode from NAVI to HAND. Manually steer the ship. • Change the steering mode from NAVI to NFU. Manually steer the ship.
Compensate too slow turning	As soon as you change the steering mode to something other than NAVI, the ship stops following the radius. Below is what you can do: • Set the steering wheel to a suitable angle to continue with a smaller radius (i.e. higher rudder angle than before). Then change the steering mode from NAVI to HAND. Continue manual steering. • Change the steering mode from NAVI to NFU". Manually steer the ship.

How to change the route steering mode

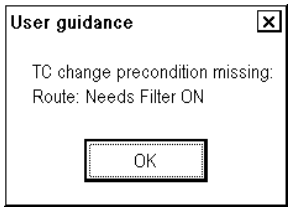
The route steering mode can be changed as follows:

1. Open the route monitor window.

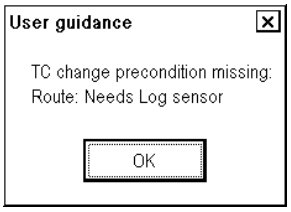


2. Select either GoSEA or GoAW from the list box that is located in the "To WPT" field.

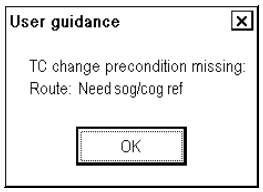
If you try to change the route steering mode without fulfilling preconditions, an appropriate User guidance dialog boxes appears.



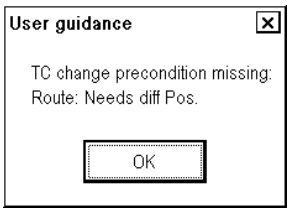
Reason: Change of route steering modes without the filter.
Remedy: Turn ON the Kalman filter and try again.



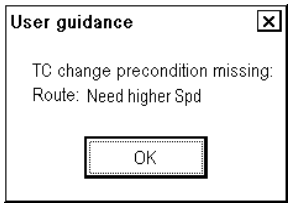
Reason: Change of route steering mode without independent speed source. You need either a log, a dual-axis log or two position receivers.
Remedy: Check your selection of the sensors.



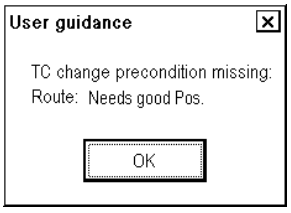
Reason: Change of route steering mode without SOG/COG reference.
Remedy: Check your selection of the sensors.



Reason: Changed steering mode from GoSEA to GoAW steering without high precision positioning device (GPS in differential correction mode).
Remedy: Check that there is a GPS in differential mode available and selected to be used.



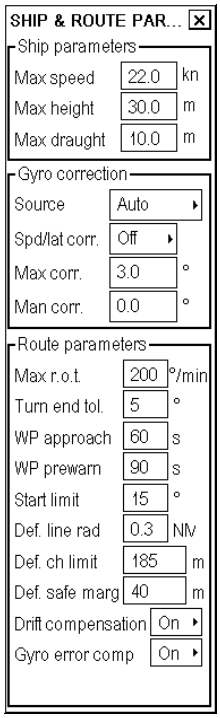
Reason: Change of route steering mode when speed of ship is less than defined for route steering.
Remedy: Raise speed of ship over set limit then try again.



Reason: Change of route steering mode when Alert "407 Position discrepancy" is active.
Remedy: Switch off "bad" sensor in the Sensors page to remove alert 407.

Accuracy of route steering

Accurate route steering is defined as small cross-track error when automatically following a route. One of the Route Parameters - Drift compensation - has a significant effect for accuracy of route steering.



If you need more accurate route steering, then turn on "Drift comp".

3.4 Other Operations

Speed used

- In NAVI Mode: Speed Data (serial) from ECDIS only.
- In AUTO Mode: Direct input (LOG Speed) to Autopilot or Manual Speed that set in Autopilot.
- In HAND Mode: N/A

Control strategy

- The operator may choose among ECONOMY, PRECISION 1 and PRECISION 2 by using the **OPERATION MODE** button.
- Control strategy (ECONOMY, PRECISION 1 and PRECISION 2) chooses course-keeping accuracy.

Load conditions

- The operator may choose among BALLAST, MIDDLE and FULL by using the **DRAFT MODE** button.
- Load condition (BALLAST, MIDDLE and FULL) chooses rudder gain.

3.5 Alerts Generated by ECDIS

3.5.1 Operational alerts

- The lamp in the **ALARM ACK** key on the ECDIS control unit goes on.
- The type of alert is displayed on the ECDIS display as number and text.
- Acknowledge an alert by pushing the **ALARM ACK** key on the ECDIS control unit.

451	Route: WPT approach alarm
452	Route: Turning disabled
455	Route: Off course
456	Route: WPT approach error
458	Route: Last WPT approach
460	Pilot: ROT will be exceed
461	Route: ROT will be exceed
468	Disabled - out of course
469	Autopilot: Off course
470	Disabled: Needs filter ON
471	AP mode Conflict - Use AUTO
475	Route: Needs filter ON
476	Route: Needs log sensor
485	Route: WPT prewarning
489	Route: Changed to GoSEA
497	Route: Stop - Sensor Fail
505	Route: Use GoSEA
506	Route: Use AUTO control
511	Route: Auto resume disable
512	Use NFU rudder control
514	Route: Use AUTO control
515	Conflict TC Stop – Use AUTO.
516	Trackpilot: Drift limit

3.5.2 Error alerts

Errors that occur during normal operation are related to internal problems.

- The lamp in the **ALARM ACK** key on the ECDIS control unit goes on.
- The type of alert is displayed on the ECDIS display as number and text.
- Acknowledge an alert by pushing the **ALARM ACK** key on the ECDIS control unit..
- Typical error alerts:

480	Autopilot receive error
488	Track control stopped.

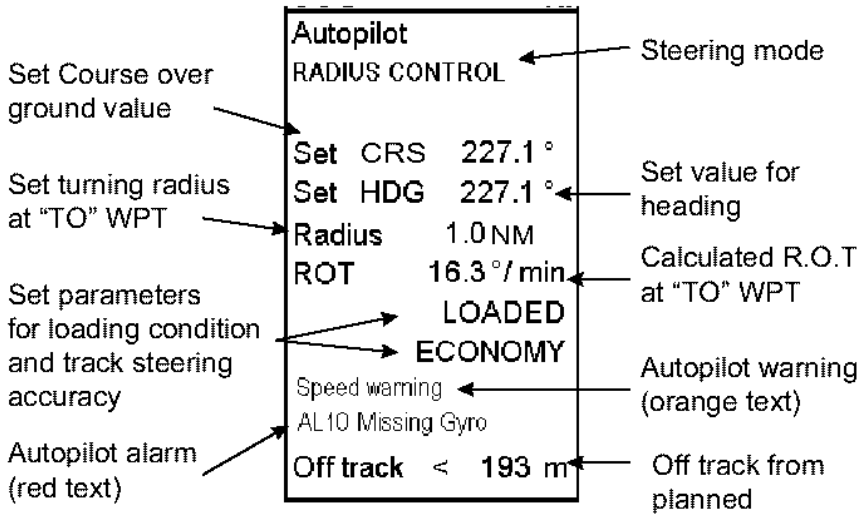
3.6 Autopilot Display in Sidebar

You can show the autopilot display in the sidebar on the ECDIS display. This display provides information about autopilot status.

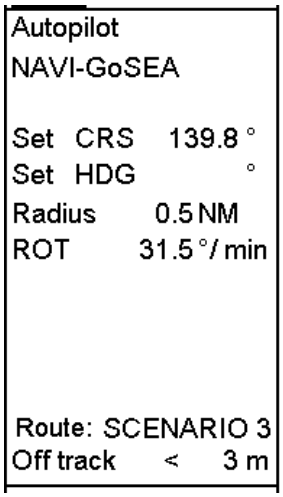
To show the autopilot display:

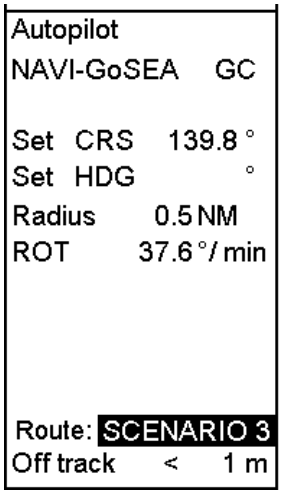
1. Put the cursor on the right hand side of the route monitor window to show "Menu/ /Select Sidebar" in the mouse guidance box.
2. Press the right mouse button to open the Sidebar menu.
3. Select Autopilot from the menu.

Radius control steering mode

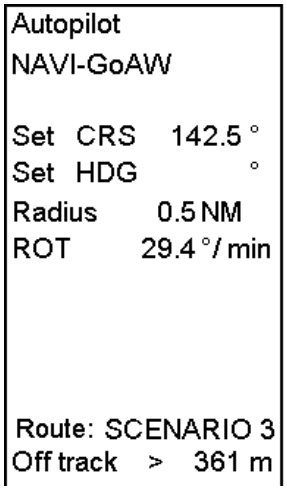


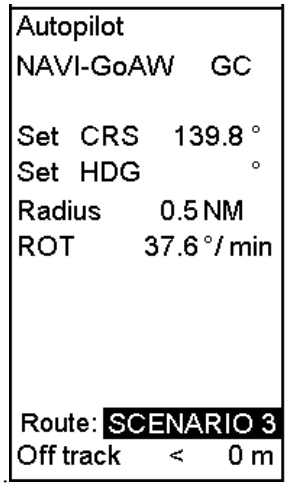
GoSEA steering mode





GoAW steering mode





3.7 Expected Steering Performance Under Various Conditions

The system has many kinds of steering modes. Below is a summary of how various environmental conditions affect steering performance. The Control System uses a combination of drift compensation and off track compensation to keep the ship inside the channel limit.

3.7.1 Expected steering performance for going ahead

Environmental conditions	Heading control = AUTO	GoSEA+NAVI	GoAW+NAVI
Calm sea, no wind, no current	COG is about the same as Set Course in Autopilot.	**Drift compensation ON or OFF**: Ship follows monitored route.	**Drift compensation ON or OFF**: Ship follows monitored route.
Moderate wind and/or current	Ship has a tendency to drift.	**Drift compensation ON**: Ship follows monitored route. **Drift compensation set as OFF**: Ship follows monitored route, but may need full channel limit area.	**Drift compensation ON or OFF**: Ship follows monitored route.
High wind and/or current	Ship is drifting.	**Drift compensation ON**: 1) Ship follows monitored route.* 2) Ship may have trouble in following monitored route inside the channel limit. **Drift compensation OFF**: Ship may have trouble in following monitored route inside the channel limit.	**Drift compensation ON**: 1) Ship follows monitored route*. 2) Ship may have trouble in following monitored route inside the channel limit. **Drift compensation OFF**: Ship may have trouble in following monitored route inside the channel limit.
Wind and/or current changes slowly.	There is no compen-sation for change.	**Drift compensation ON**: Ship follows monitored route, but may need full channel limit area. **Drift compensation OFF**: Ship may have trouble in following monitored route inside the channel limit.	**Drift compensation ON**: Ship follows monitored route. **Drift compensation OFF**: Ship may have trouble in following monitored route inside the channel limit.
Sudden change of wind and/or current (For example sudden change from no current to 5 kn current perpendicular to track)	There is no compen-sation for change.	**Drift compensation ON**: 1) Ship may go outside channel limit and return back inside channel limit.* 2) Ship may have trouble in following monitored route inside the channel limit. **Drift compensation OFF**: Ship may have trouble in following monitored route inside the channel limit.	**Drift compensation ON**: 1) Ship may go outside channel limit and return back inside channel limit.* 2) Ship may have trouble in following monitored route inside the channel limit. **Drift compensation OFF**: Ship may have trouble in following monitored route inside the channel limit.
Fast change of speed (For example, speed decreased from 20 to 7 kn)	Ship performs normal autopilot turn under this condition.	**Drift compensation ON or OFF**: Ship follows monitored route, but may need full channel limit area.	**Drift compensation ON or OFF**: Ship follows monitored route, but may need full channel limit area.

***** The Track Control System is able to compensate drift up to 25 degrees depending on the installation parameters. If the drift is larger, your ship may go outside the channel limit.

3.7.2 Expected steering performance for turns

Environmental conditions	Heading control = AUTO	GoSEA+NAVI	GoAW+NAVI
Calm sea, no wind, no current	Ship performs normal Autopilot turn under this condition.	**Drift compensation ON or OFF**: Ship follows monitored route.	**Drift compensation ON or OFF**: Ship follows monitored route.
Moderate wind and/or current	Ship performs normal autopilot turn under this condition.	**Drift compensation ON**: Ship follows monitored route. **Drift compensation OFF**: Ship follows monitored route, but may need full channel limit area.	**Drift compensation ON or OFF**: Ship follows monitored route.
High wind and/or current	Ship performs normal autopilot turn under this condition.	**Drift compensation ON**: 1) Ship follows monitored route, but may go outside channel limit area.* 2) Ship may have trouble in following monitored route inside the channel limit. **Drift compensation OFF**: Ship goes inside or outside of turn.	**Drift compensation ON**: 1) Ship follows monitored route.* 2) Ship may have trouble following monitored route inside the channel limit. **Drift compensation OFF**: Ship goes inside or outside of turn.
Slow change of wind and/or current	Ship performs normal autopilot turn under this condition.	**Drift compensation ON**: Ship follows monitored route **Drift compensation OFF**: Ship may have troubles in following monitored route inside the channel limit.	**Drift compensation ON**: Ship follows monitored route. **Drift compensation OFF**: Ship may have troubles in following monitored route inside the channel limit.
Sudden change of wind and/or current (For example sudden change from no current to 5 kn current perpen-dicular to track)	Ship performs normal autopilot turn under this condition.	**Drift compensation ON**: 1) Ship may go outside channel limit and return back inside channel limit.* 2) Ship may have trouble in following monitored route inside the channel limit. **Drift compensation OFF**: Ship goes inside or outside of turn.	**Drift compensation ON**: 1) Ship may go outside channel limit and return back inside channel limit.* 2) Ship may have trouble in following monitored route inside the channel limit. **Drift compensation OFF**: Ship goes inside or outside of turn.
Slow change of speed	Ship performs normal autopilot turn under this condition.	**Drift compensation ON or OFF**: Ship follows monitored route, but may need full channel limit area.	**Drift compensation ON or OFF**: Ship follows monitored route.
Fast change of speed (For example, speed decreased from 20 to 7 kn)	Ship performs normal autopilot turn under this condition.	**Drift compensation ON or OFF**: Ship follows monitored route, but may need full channel limit area.	**Drift compensation ON or OFF**: Ship follows monitored route, but may need full channel limit area.

Note: Drift compensation is turned on or off in the Ship and Route parameters in the Navigation Parameters dialog box. For further details, see section 27.1.4 "Navigation parameters setting" in the ECDIS Operator's Manual.

***** The Track Control System is able to compensate drift up to 25 degrees depending on the installation parameters. If the drift is larger, your ship may go outside the channel limit.

3.8 Expected Steering Performance Under Critical Failure

Below is a summary of the system behavior in various failures when the GoSEA or GoAW steering mode is in use.

Note: The backup navigator alert is activated if the alert is not acknowledged within 30 seconds. For more information about this alert, see section 30.11 "Backup Navigator Alert" in the ECDIS Operator's Manual.

3.8.1 Lost heading from autopilot (ECDIS may also have lost heading)

	Associated alerts	Expected system performance	What operator should do
Immediately	• Sensor alert "706: Gyro error" is generated at ECDIS. • EMRG ALARM lamp turns on autopilot control panel.	• If ship is running straight, rudder order is frozen at last value in order to approximately continue ahead. • If ship is turning, rudder order is frozen at last value in order to approximately continue rate of turn.	• Change immediately to manual control of rudder. • Acknowledge alerts. • Monitor situation.
Within few seconds	• Alert "497 Route Stop-Sensor fail. • Alert "471 AP mode conflict - Use AUTO" on ECDIS"		• Change immediately to manual control of rudder. • Acknowledge alerts. • Monitor situation.
Repeat every 2 minutes	• Alert "498 Use manual rudder control" is generated at ECDIS.	• Reminder	• Change immediately to manual control of rudder.

3.8.2 Lost heading from ECDIS (autopilot still has heading)

	Associated alerts	Expected system performance	What operator should do
	• Sensor alert, for example Alert "705: Gyro error" or "706: Gyro error. "		• Acknowledge alerts. • Monitor situation.
Within few seconds	• Alert "402 No heading available". • Alert "497 Route Stop-Sensor fail".		• Acknowledge alerts. • Monitor situation.
After Alert "497 Route Stop-Sensor fail."	• Alert "471 AP mode conflict - Use AUTO" in ECDIS is generated. CAUT ALM lamp turns on at the autopilot Steering Control Unit.	• If ship is running straight, actual heading is used as set course. • If ship is turning, last-set course and radius are used to complete the turn.	• Acknowledge alerts • Study situation. • Change steering mode to AUTO.

3.8.3 Lost speed

	Associated alerts	Expected system performance	What operator should do
	• Log error", "712Sensor alert, for example Alert …716: Position equipment error", etc.		• Acknowledge alerts. • Study situation.
Within 30 seconds	• Alert "476 Route Needs log sensor".		• Acknowledge alerts. • Study situation.
After 2 minutes then every 4 minutes	• Alert "506 Route: Use AUTO control".	• Guidance for navigator.	• Change immediately to local autopilot control. • Acknowledge alerts.
After 4 minutes then every 4 minutes	• Alert "476 Route Needs log sensor".	• Reminder	• Acknowledge alerts. • Study situation.
Within 10 minutes	• Alert "497 Route Stop-Sensor fail".		• Acknowledge alerts. • Study situation.
After Alert "497 Route Stop-Sensor fail."	• Alert "471AP mode conflict - Use AUTO" in ECDIS is generated. CAUT ALM lamp turns on at the autopilot Steering Control Unit.	• If ship is running straight, actual heading is used as set course. • If ship is turning, last set course and radius are used to complete the turn.	• Acknowledge alerts • Study situation. • Change steering mode to AUTO.

3.8.4 Low speed

	Associated alerts	Expected system performance	What operator should do
	• Alert "408 Filter: SPD below xx KN."		• Acknowledge alerts. • Study situation.
Within 90 seconds	• Alert "410 Filter: POSN source CHG".		• Acknowledge alerts. • Study situation.
Within 30 seconds	• Alert "501 Route: Needs higher Speed".		• Acknowledge alerts. • Study situation.
After 2 minutes then every 4 minutes	• Alert "506 Route: Use AUTO control".	• Guidance for navigator	• Change immediately to local autopilot control. • Acknowledge alerts.
After 4 minutes then every 2 minutes	• Alert "501 Route: Needs higher Speed".	• Reminder	• Acknowledge alerts. • Study situation.
Within 10 minutes	• Alert "497 Route Stop-Sensor fail".		• Acknowledge alerts. • Study situation.
After Alert "497 Route Stop-Sensor fail."	• Alert "471AP mode conflict - Use AUTO" in ECDIS is generated. CAUT ALM lamp turns on at the autopilot Steering Control Unit.	• If ship is running straight, actual heading is used as set course. • If ship is turning, last set course and radius are used to complete the turn.	• Acknowledge alerts • Study situation. • Change steering mode to AUTO.

3.8.5 Lost SOG/COG reference in GoAW mode

	Associated alerts (generated at ECDIS)	Expected system performance	What operator should do
	• Alert "507 Route: Need SOG/COG ref."		• Acknowledge alerts. • Monitor situation.
After 2 minutes then every 4 minutes	• Alert "505 Route: Use GoSEA."	• Instruction for navigator	• Change to GoSEA steering mode. • Acknowledge alerts.
After 4 minutes then every 4 minutes	• Alert "507 Route: Need SOG/COG ref."	• Reminder	• Acknowledge alerts. • Monitor situation.
Within 10 minutes	• Alert "489 Route: Changed to GoSEA"	• Automatic change of steering mode to GoSEA mode.	• Acknowledge alerts. • Monitor situation.

3.8.6 Total lost position

	Associated alerts	Expected system performance	What operator should do
	• Alert "712…716: Position equipment error" OR • Kalman filter detects jump, etc.		• Acknowledge alerts. • Monitor situation.
Within 30 seconds	• Alerts "400 Filter: POSN unreliable" and "406 Route: CRS jump possible."	• Kalman Filter is turned OFF and system uses dead reckoning for positioning. • If you have log or dual-axis log, then dead reckoning is based on them and gyro. • If you have log or dual-axis log, then dead reckoning is based on last plausible speed from position sensors. This is indicated by showing own ship position, SOG and COG in red. The source indication for SOG and COG is "(LAST)".	• Acknowledge alerts. • Monitor situation.
After 2 minutes then every 4 minutes	• Alert "506 Route: Use AUTO control."	• Guidance for navigator	• Change immediately to local autopilot control. • Acknowledge alerts.
After 4 minutes then every 4 minutes	• Alert "475 Route Needs filter ON."	• Reminder	• Acknowledge alerts. • Monitor situation.
Within 10 minutes	• Alert "497 Route Stop-Sensor fail. "		• Acknowledge alerts. • Monitor situation.
After Alert "497 Route Stop-Sensor fail."	• Alert "471AP mode conflict - Use AUTO" in ECDIS is generated. CAUT ALM lamp turns on at the autopilot Steering Control Unit.	• If ship is running straight, actual heading is used as set course. • If ship is turning, last set course and radius are used to complete the turn.	• Acknowledge alerts • Study situation. • Change steering mode to AUTO.

3.8.7 Lost differential position in GoAW mode

	Associated alerts (generated at ECDIS)	Expected system performance	What operator should do
	• Alert "727…731: Lost DGPS" or "712…716: Position equipment error."		• Acknowledge alerts. • Monitor situation.
Within 90 seconds	• Alert "410 Filter: POSN source CHG."		• Acknowledge alerts. • Monitor situation.
Within 30 seconds	• Alert "492 Route: Needs diff pos."	• GoAW requires differential position.	• Acknowledge alerts. • Monitor situation.
After 2 minutes then every 4 minutes	• Alert "505 Route: Use GoSEA."	• Guidance for navigator	• Change to GoSEA steering mode. • Acknowledge alert.
After 4 minutes then every 4 minutes	• Alert "492 Route: Needs diff pos."	• Reminder	• Acknowledge alerts. • Monitor situation.
Within 10 minutes	• Alert "489 Route: Changed to GoSEA."	• Automatic change of steering mode to GoSEA mode.	• Acknowledge alerts. • Monitor situation.

3.8.8 Lost differential position and position discrepancy

	Associated alert	Expected system performance	What operator should do
Precon-dition	• If sensors in Filter calculation are NOT inside operator chosen position discrepancy limit. • Alert "407 Position discrepancy"		• Acknowledge alerts. • Study situation.
	• Alert "727…731: Lost DGPS" or "712…716: Position equipment error"		• Acknowledge alerts. • Study situation.
Within 90 seconds	• Alert "410 Filter: POSN source CHG."		• Acknowledge alerts. • Study situation.
Within 30 seconds	• Alert "478 Route: Needs good Pos"		• Acknowledge alerts. • Study situation.
After 2 minutes then every 4 minutes	• Alert "506 Route: Use Radius control"	• Guidance for navigator	• Change to local autopilot control. • Acknowledge alerts.
After 4 minutes then every 2 minutes	• Alert "478 Route: Needs good Pos"	• Reminder	• Acknowledge alerts. • Study situation.
Within 10 minutes	• Alert "497 Route Stop-Sensor fail".		• Acknowledge alerts. • Study situation.
After Alert "497 Route Stop-Sensor fail."	• Alert "471AP mode conflict - Use AUTO" in ECDIS is generated. CAUT ALM lamp turns on at the autopilot Steering Control Unit.	• If ship is running straight, actual heading is used as set course. • If ship is turning, last set course and radius are used to complete the turn.	• Acknowledge alerts • Study situation. • Change steering mode to AUTO.

3.8.9 Lost communication between ECDIS and autopilot

	Associated alerts	Expected system performance	What operator should do
Within 15 seconds	• Alert "488 Steering: Stop-system fail" generated at ECDIS.		• Acknowledge alerts. • Study situation.
After Alert "488 Steering: Stop-system fail"	• Alert "471AP mode conflict - Use AUTO" in ECDIS is generated. CAUT ALM lamp turns on at the autopilot Steering Control Unit.	• If ship is running straight, actual heading is used as set course. • If ship is turning, last-set course and radius are used to complete the turn.	• Acknowledge alerts • Study situation. • Change steering mode to AUTO.

3.8.10 Lost communication between autopilot and ECDIS

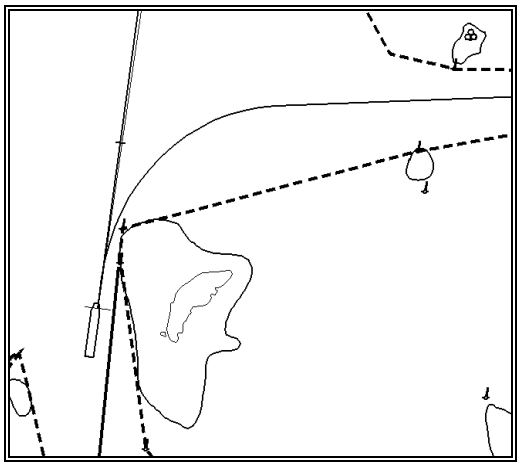
	Associated alerts	Expected system performance	What operator should do
Within 15 seconds	• Alert "488 Steering: Stop-system fail" and "480 Autopilot FAP-2000 Receive error" is generated at the ECDIS.		• Acknowledge alerts. • Study situation.
After Alert "488 Steering: Stop-system fail"	• Alert "471AP mode conflict - Use AUTO" in ECDIS is generated. CAUT ALM lamp turns on at the autopilot Steering Control Unit.	• If ship is running straight, actual heading is used as set course. • If ship is turning, last set course and radius are used to complete the turn.	• Acknowledge alerts • Study situation. • Change steering mode to AUTO.

3.9 How to Use the Curved EBL

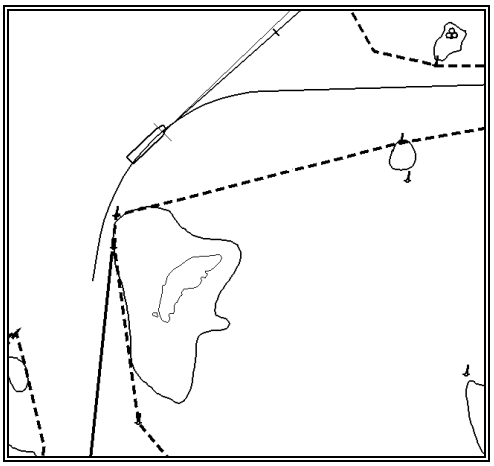
The curved EBL is a control tool to monitor automatic operation of Track (=NAVI) steering mode. This EBL is available on the ECDIS display and selected radar displays.

After the near the WPT, but before the start of the turn the curved EBL displays next intended turn. When your ship starts a turn initiated by Route steering the curved EBL is locked to its position.

During the turn you can monitor how your ship performs the intended maneuver against the plan by comparing the curved EBL position and your current your ship's position.



Curved EBL, at wheel over point



Curved EBL, locked during turn

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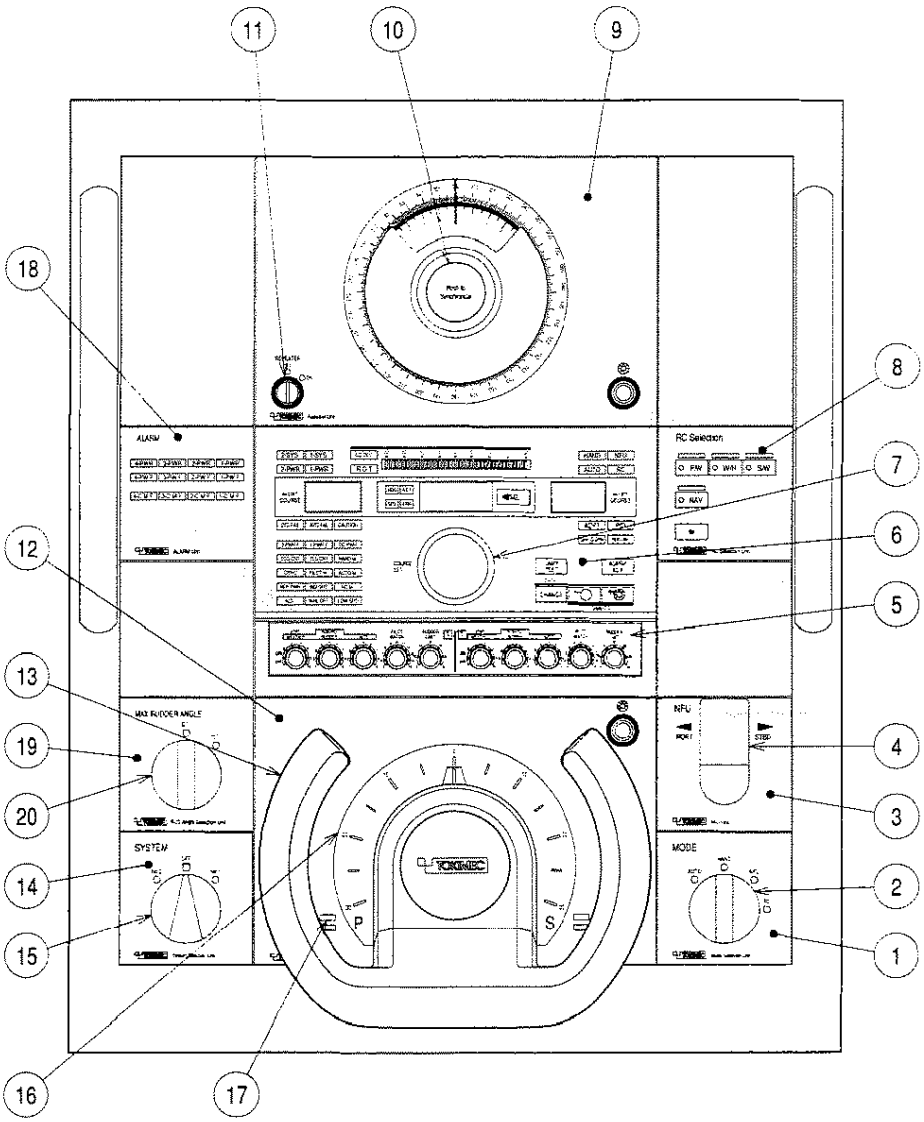
4. TOKYO KEIKI Autopilot PR-6000

4.1 Introduction

This chapter describes the steering functions available with the TOKYO KEIKI Autopilot PR-6000.

4.2 Steering Control Unit

Below is the control layout of the Steering Control Unit.



PR-6000 Steering Control Unit

1. Mode selection unit
2. Mode selection switch
3. Non-Follow-Up unit

4. Non-Follow-Up steering lever
5. Auto steering control knobs
6. Auto unit
7. Course setting knob
8. Remote control steering selection unit
9. Repeater unit
10. Repeater synchronising knob
11. Repeater switch
12. Helm unit
13. Steering wheel
14. System selection unit
15. System selection switch
16. Order rudder angle indicator
17. PS display lamps
18. Alert unit
19. Max rudder angle selection unit
20. Max rudder angle selection switch

4.3 Steering Modes

4.3.1 Hand steering mode (Mode selector: HAND)

Set the **Mode selection** switch to HAND.

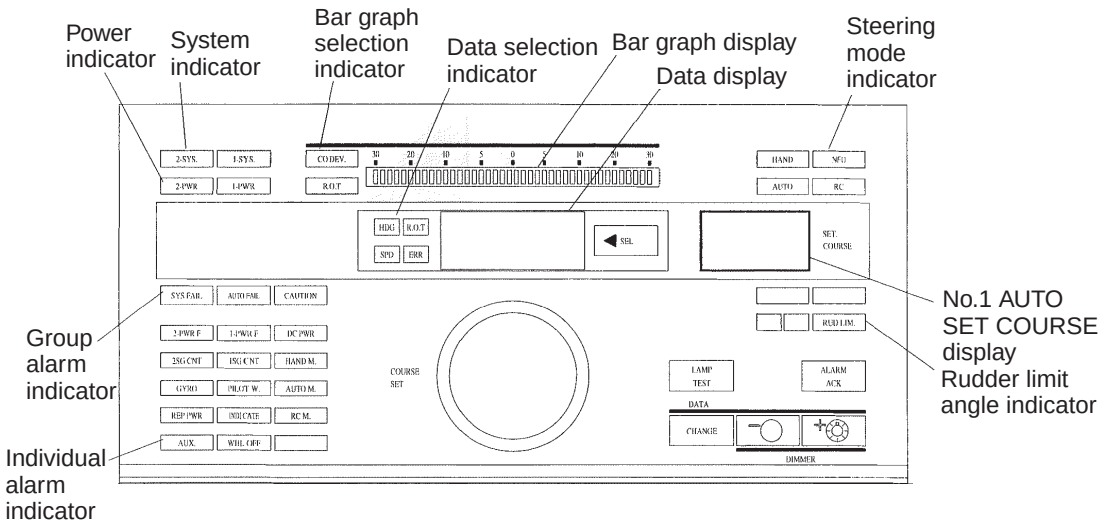
In this mode the ECDIS system displays the rudder angle and steering mode.

4.3.2 Autopilot steering mode (Mode selector: AUTO)

The operator sets the required heading of the ship by operating the **Course Setting** knob. Turns are controlled by the rudder limit or rate of turn and are initiated by the operator.

Turn the **Mode selection** switch to the AUTO position, and the set course is shown in the SET. COURSE display. The initial value of the set course is the ship's heading at that time. To change the course, press the **Course setting** knob and release it when desired course appears. At this time, the course deviation (CO.DEV: COURSE DEVIATION) is shown in the bar graph and AUTO is lit. AUTO goes off when the ship is on the new course. See the figure below.

When the loading condition changes remarkably, yawing may be large at the departure. In this case, perform auto course changing by 20º of port and starboard two or three times, and observe the state for approx. 15 minutes.



Turn controlled by rudder angle

When a new course is set, turns are controlled by the rudder angle. You can set the desired rudder angle limit using the **Rudder limit** knob. For more information, see section 4.4 Auto Steering Adjustments.

Turn controlled by rate of turn

Pressing the AUTO unit **<-SEL** switch a number of times lights the data selection indicator **R.O.T.** and shows the rate of turn (unit deg/min). At this time, pressing the **DATA CHANGE** switch (located at the lower right) shows the turn rate order and the displayed value can be changed by pressing **-** or **+** while pressing the **DATA CHANGE** switch.

This value becomes the turn of rate order during automatic course changing. The setting, however, cannot be changed during automatic course changing.

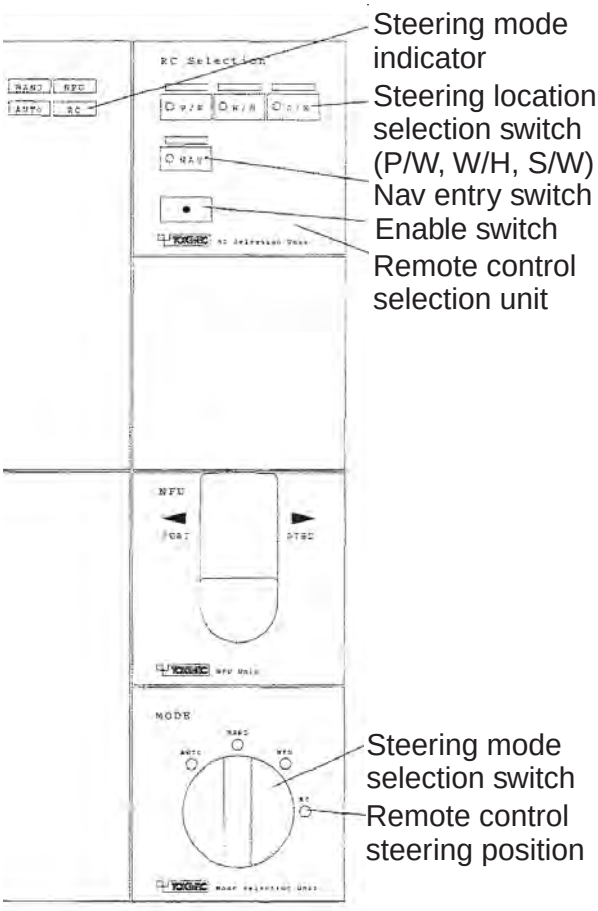
4.3.3 Non-Follow-Up steering mode (Mode selector: NFU)

The operator sets the steering mode selector to NFU, then he can use steering with the Non-Follow-Up lever. While in the NFU steering mode the ECDIS system displays the rudder angle and indication of the steering mode.

4.3.4 Remote hand steering mode (Mode selector: RC)

When the **Mode selection** switch mode is set to RC, the mode becomes RC, not the selected condition. (The steering mode indicator RC blinks. The hand steering is in use as long as RC blinks; the operation is same as in HAND mode.) At this time pressing the **Enable switch** button while pressing the **Steering location selection** switch moves the mode to the remote steering mode and the lamp of the steering location comes on. The state of the steering mode indicator RC changes from blinking to lighting.

Turn the **Remote control steering position** knob to steer.

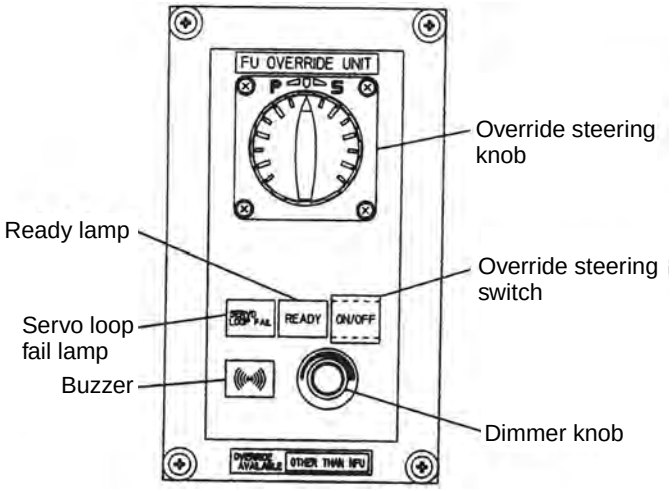


4.3.5 Steering override units

FU override unit

Starting steering override

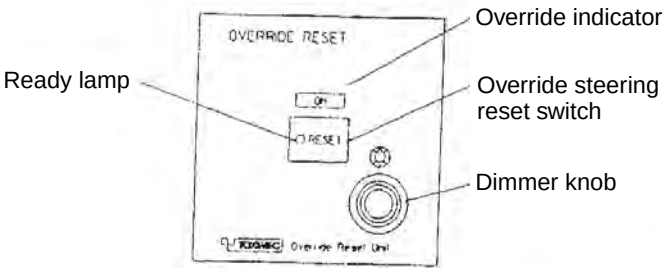
1. Confirm that the Ready lamp in the FU unit is ON.
2. Press the **Override steering** switch to enable control of the steering from this unit, by the **Override steering** knob. At this time a beeps sound intermittently from the steering then the selected steering mode indicator blinks.



FU override unit

Stopping steering override

1. Push the **ON/OFF** switch to show ON in the FU override unit or push the **RESET** switch on the Override reset unit in the steering stand to return to the previous steering mode.
2. If the steering mode was AUTO, the heading at the time override steering became active is set as heading. Auto resume is disabled if the steering mode was RC/NAV. In this case, you have to turn the mode selection switch to another steering mode and select the RC mode again.



Override reset unit

Override NFU controller

Starting steering override

1. Confirm that the Ready lamp in the NFU controller is ON.

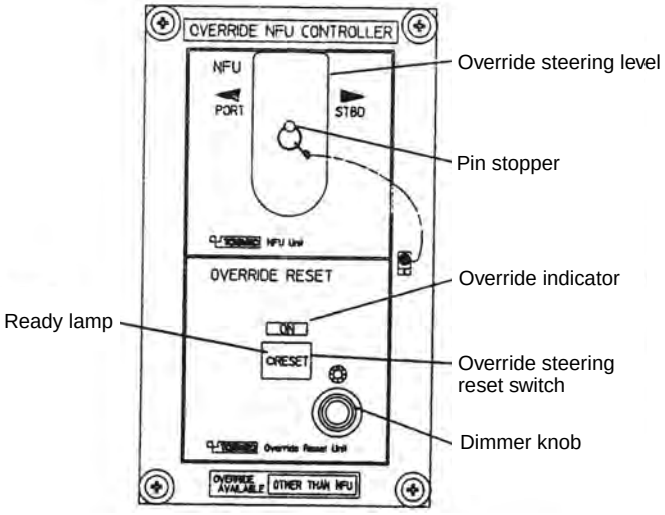
2. Pull out the pin stopper inserted in the override NFU controller and turn the lever to the desired direction. At this time, beeps sounds from the steering then the selected steering mode blinks. The ON lamp in the override reset unit is lit.

3. The rudder is taken when the lever is turned, and the rudder stops when the lever is returned to the neutral position.

Stopping steering override

1. Push the **Override steering reset** switch on the override reset unit in the steering stand to return to the previous steering mode.

2. If the steering mode was AUTO, the heading at the time the override steering became active is set as heading. Auto resume is disabled if the steering mode was RC/NAV. In this case, you have to turn the mode selection switch to the other steering mode and select the RC mode again.



Override NFU controller

4.3.6 Route steering mode, RC/Nav (Mode: RC)

There are two types of route steering modes: GoSEA and GoAW. Route steering can be used with a predefined monitored route.

The GoSEA and GoAW steering modes can be activated when your ship is located inside a channel of a monitored route and in the linear part of a monitored route.

GoSEA mode

In the GoSEA mode, the planned track is followed at moderate and economical accuracy between waypoints and also during turns (position-controlled turn). When approaching the next waypoint, the ECDIS alerts the operator both well before the turn and just before the turn.

- Select GoSEA at the route monitor dialog box in the ECDIS.
- Set the **Mode selection** switch on the Steering Control Unit to RC.
- Press the **NAV** and **Enable** buttons together on the remote control steering unit to activate the automatic steering mode.
- Available for use when the position source is outputting accurate position.

GoAW mode

In the GoAW mode, the planned track is followed at the maximum accuracy between waypoints and also during turns (position-controlled turn).

When approaching the next waypoint, the ECDIS alerts the operator both well before the turn and just before the turn.

- Select GoAW at the route monitor dialog box in the ECDIS:
- Set the **Mode selection** switch on the Steering Control Unit to RC.
- On the autopilot, press the **NAV** and **Enable switch** buttons together on the Remote Control Steering unit to activate the automatic steering mode.
- This mode is available when the position source is outputting accurate position.

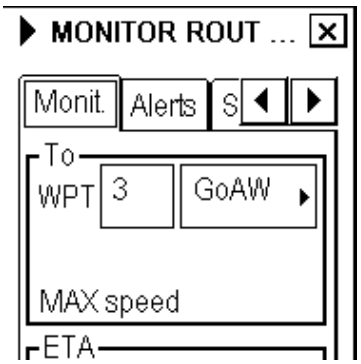
Summary of route steering modes

	GoSEA	GoAW
Set course	Automatic	Automatic
Set radius	Automatic	Automatic
Radius control	Yes	Yes
Design before execution	Yes	Yes
Full curved EBL on radar screen	Yes	Yes
Wind, current, etc. compensation running straights between WPT	Low gain	High gain
Wind, current, etc. compensation in turns	Yes	Yes
Needs gyro	Yes	Yes
Needs log	Yes	Yes
Precision of position equipment	Good	High
Needs direct SOG/COG sensor	No	Yes

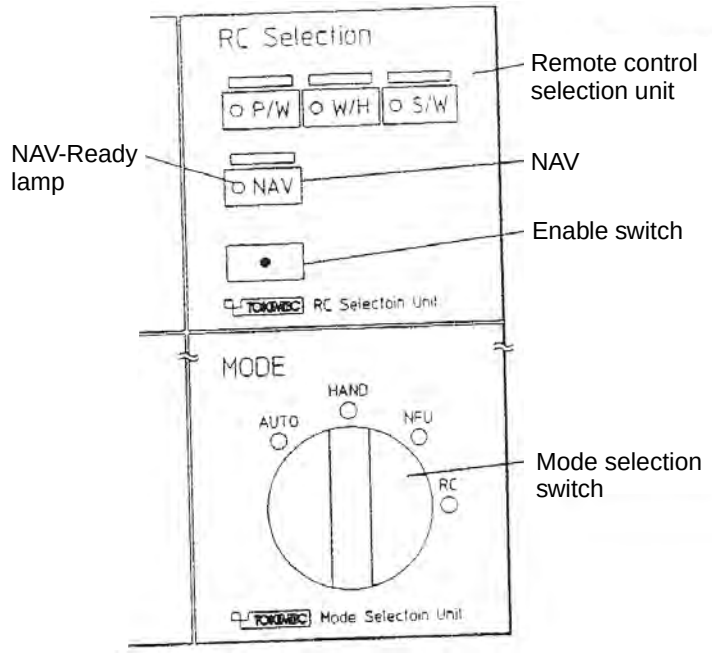
How to activate route steering

Do the following to activate route steering.

1. First select a route in the monitor mode on the ECDIS then open the route monitor window.



2. Select either GoSEA or GoAW from the list box, which is located in the To WPT field. After you have selected a route in the monitor mode and desired steering mode (GoSEA or GoAW), the NAV-Ready lamp comes on.



3. Turn the **Mode selection** switch to RC.

4. On the Steering Control Unit, press the **NAV** and **Enable switch** buttons together.
Note that before you press the **NAV** and **Enable switch** buttons, the HAND mode is active. Therefore it is important that before turning the **Mode selection** switch to RC, check that the wheel is in the center position (mid ship).

5. The steering mode indicator RC on the autopilot panel lights continuously.

Route steering related indications on ECDIS

GoSEA

When GoSEA is activated, the indication "GoSEA" appears in the route monitor window on the ECDIS display.

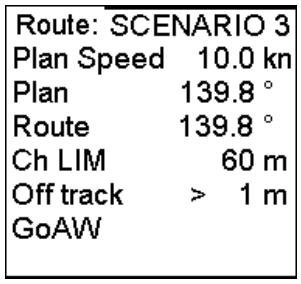
Route:	SCENARIO 3
Plan Speed	10.0 kn
Plan	139.8 °
Route	139.8 °
Ch LIM	60 m
Off track	> 0 m
GoSEA	

If the planned course to approach a To WPT is defined using Great Circle, the indication "GoSEA GC" appears in the route monitor window on the ECDIS display.

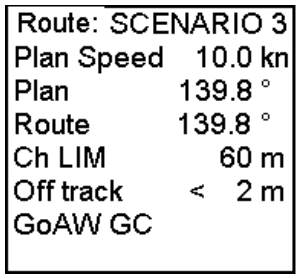
Route:	SCENARIO 3
Plan Speed	10.0 kn
Plan	139.8 °
Route	139.8 °
Ch LIM	60 m
Off track	< 7 m
GoSEA GC	

GoAW

When GoAW is activated, the indication "GoAW" appears in the route monitor window on the ECDIS display.

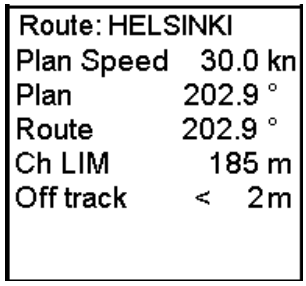


If the planned course to approach a To WPT is defined using Great Circle, the indication "GoAW GC" appears in the route monitor window on the ECDIS display.



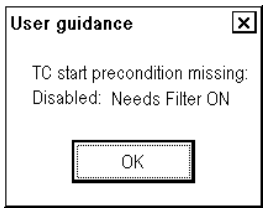
Missing preconditions for route steering

When route steering is not used or the ECDIS did not accept the requested route steering mode, there is no indication of route steering mode in the route monitor window, as shown right.

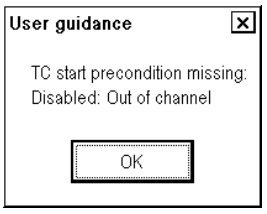


There are several requirements necessary to start route steering. When you make a selection in the route monitor window in ECDIS, user guidance may appear if preconditions have not been fulfilled. The user guidance window may appear when you try to start any route steering mode or if you try to change one route steering mode to another. See section 19.8 "Filter Operation" in the ECDIS Operator's Manual.

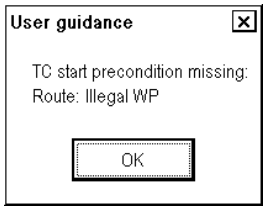
When you attempt to activate route steering without fulfilling preconditions, an appropriate user guidance dialog box appears:



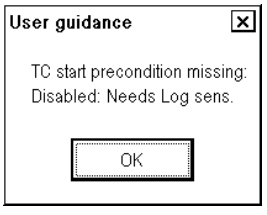
Reason: You tried to activate a route steering mode without the Kalman filter.
Remedy: Turn the Kalman filter ON and try again.



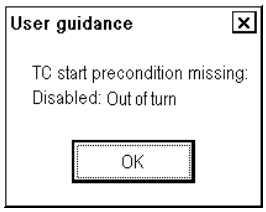
Reason: You tried to activate route steering outside of channel limits.
Remedy: Steer ship inside channel and try again.



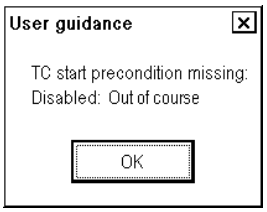
Reason: You tried to activate a route steering mode when the selection of the TO or FINAL waypoint is missing or illegal.
Remedy: Check the TO and FINAL waypoints.



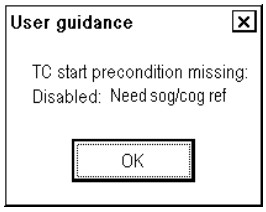
Reason: You tried to activate a route steering mode without an independent speed source. You need either a log, a dual-axis log or two position receivers.
Remedy: Check your selection of the sensors.



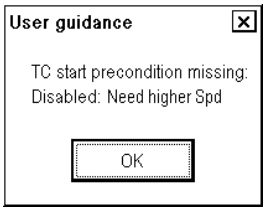
Reason: You tried to activate a route steering mode when the system detects that your ship is turning, but your location is not within the turn.
Remedy: Check and reset correct To WPT for route monitoring.



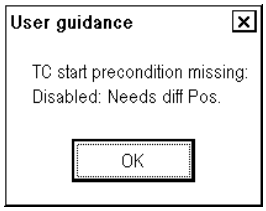
Reason: You tried to activate a route steering mode when there is a difference between current heading and the required set heading that is greater than set with "Route start limit angle" in the Route Parameters dialog box.
Remedy: Steer ship heading inside the limit of the required set heading.



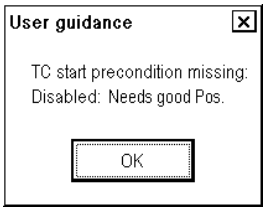
Reason: You tried to activate a route steering mode without SOG/COG reference.
Remedy: Check your selection of the sensors.



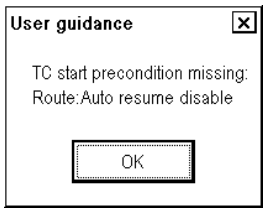
Reason: You tried to activate a route steering mode when your ship's speed is less than defined for route steering.
Remedy: Raise speed over the set limit then try again.



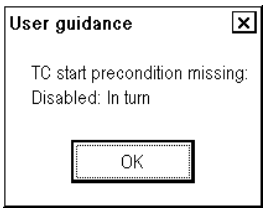
Reason: You tried to activate the GoAW steering mode without a high-precision positioning device (GPS in differential correction mode).
Remedy: Check that GPS in differential mode is selected in the Sensors menu.



Reason: You tried to activate a route steering mode when Alert 407 Position discrepancy is active.
Remedy: Switch off "bad" sensor in the Sensors page to remove alert 407.



Reason: If alert 471 has been generated and later condition for alert 471 disappears without changing steering mode from NAVI to AUTO or HAND.
Remedy: First change the steering mode to AUTO or HAND then check that the preconditions for route steering are fulfilled before changing back to NAVI.



Reason: You tried to start a route steering mode when your ship is making a turn in a monitored route.
Remedy: Steer ship to straight part of the monitored route then try again.

Alerts shown when route steering cannot be accepted

If the precondition exists when GoSEA or GoAW is selected, but are missing when you pressed the **NAV** and **Enable switch** buttons, one of the following alerts appears.

Alert "**464 Route**: **No selected route**" informs you that there is no route selected for route monitoring.

Alert "**465 Route**: **Illegal WPT**" informs you that there is a route selected for route monitoring, but the selection of the next or final waypoint is missing or illegal.

Alert "**468 Disabled**: **Out of course**" informs you that there is a difference between the current heading of your ship and the required set heading than that set by the operator in the **Route start limit angle** of route parameters.

Alert "**470 Disabled**: **Needs filter on**" informs you that the Kalman filter was not ON at the time of the request. Route steering requires that you use the Kalman filter, because the filter eliminates sudden jumps of the position and thus prevents unpredictable maneuvers of your ship. Check your selection of the sensors. See section 19.8 "Filter Operation" in the ECDIS Operator's Manual.

Alert "**471 RC/NAV - TC STOP - Use AUTO**" informs you that the ECDIS and the autopilot cannot start the route steering mode. First change the mode from RC to AUTO then check that preconditions for route steering are fulfilled.

Alert "**477 Disabled**: **Out of channel**" informs you that the current location of your ship is not inside the channel of a monitored route.

Alert "**490 Disabled**: **Needs log sens.**" informs you that the Kalman filter did not have an independent speed source. You need either a log, a dual-axis log or two position receivers. Check your selection of the sensors. See section 19.8"Filter Operation" in the ECDIS Operator's Manual.

Alert "**510 Disabled**: **Out of turn**" informs you that your ship is located outside of the graphical area of turning (i.e. is linear part of track) and the Track Control System steering mode is Ass. Turn or Track Turn. Reselect correct TO WPT for monitoring.

Alert "**517 Disabled**: **In turn**" informs you that the current location of your ship is in a turn of a monitored route. Steer to a linear part of the monitored route to activate the Track steering mode.

Alert "**518 Disabled**: **Not accepted**" informs you that the 30-second timeout has passed after you pressed the **NAV** and **Enable** buttons on the Control Steering Unit. After you select GotoOS or GotoAW at the ECDIS, you have 30 seconds to press the **NAV** and **Enable switch** buttons on the Control Steering Unit, otherwise alert 518 is given. Another reason can be that your ship has moved into a turning part of a monitored route before you pressed the **NAV** and **Enable switch** buttons on the Control Steering Unit.

When you arrive at a waypoint

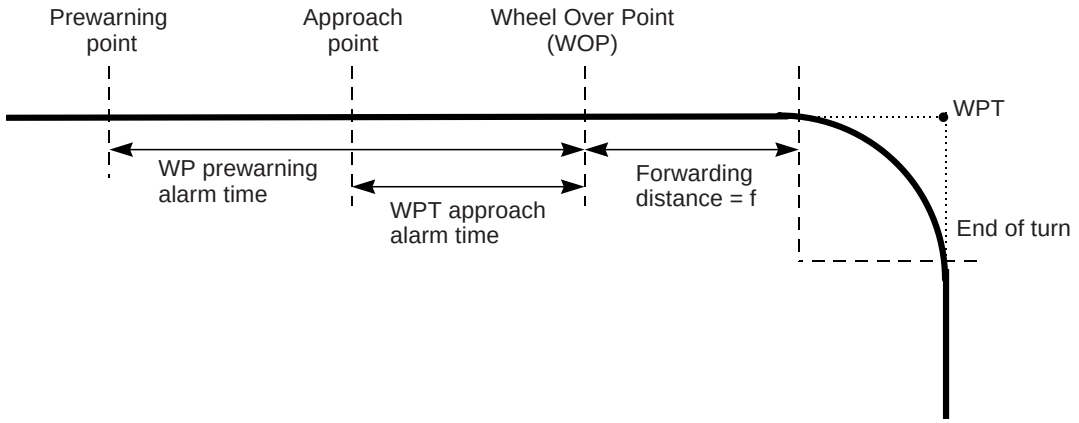
Route steering navigation tries to keep your ship inside the channel limits and going to the next waypoint. Well before arriving at the next waypoint, the alert "**485 Route**: **WPT prewarning**" appears. As soon as the alert appears, verify that the maneuver is safe and there are no dangerous targets. If the maneuver is safe, press the **ALARM ACK** key on the ECDIS control unit. If the maneuver is not safe, quit the route steering by changing RC to AUTO or to HAND mode at the Steering Control Unit.

TURN IS ALWAYS ENABLED. THE ONLY WAY TO DISABLE THE AUTOMATIC TURN IS TO SELECT ANOTHER STEERING MODE FROM THE AUTOPILOT, FOR EX. RC OR AUTO, ETC.

Note that alert 485 is programmable (the time before turn) and it is relative to the starting point of a maneuver. See the figure below.

At the moment you are about to arrive at the next waypoint, a second alert "**451 Route: WPT approach alarm**" appears. If you have acknowledged alert 485, then alert 451 is indicated (silent).

Note also that alert 451 is programmable (the time before turn) and it is relative to the starting point of a maneuver. See the figure below:



As soon as your ship arrives to a wheel over point, the ECDIS sends a new course command to the autopilot and the maneuver is started. During a maneuver, the radar display and the ECDIS display show the curved EBL, indicating the planned radius for maneuver.

After the waypoint approach alert is acknowledged, the text "GoOS Appr. enabled" appears in the route monitor window on the ECDIS display, when the steering mode is GoSEA.

Route: HELSINKI	
Plan Speed	30.0 kn
Plan	202.9 °
Route	202.9 °
Ch LIM	185 m
Off track	< 2m
GoOS Appr. enabled	

After you acknowledge the waypoint approach alert, the text "GoAW Appr. enabled" appears in the route monitor window on the ECDIS display, when the steering mode is GoAW.

Route: HELSINKI	
Plan Speed	30.0 kn
Plan	202.9 °
Route	202.9 °
Ch LIM	185 m
Off track	< 2m
GoAW Appr. enabled	

During the turn, the text "GotoOS Turn" appears in the route monitor window on the ECDIS display, when the steering mode is GoSEA.

Route: HELSINKI	
Plan Speed	30.0 kn
Plan	202.9 °
Route	202.9 °
Ch LIM	185 m
Off track	< 2m
GoOS Turn enabled	

During the turn, the text "GotoAW Turn" appears in the route monitor window on the ECDIS display, when the steering mode is GoAW.

Route: HELSINKI	
Plan Speed	30.0 kn
Plan	202.9 °
Route	202.9 °
Ch LIM	185 m
Off track	< 2m
GoAW Turn enabled	

Note: When you approach the last waypoint, the alert "**458 Route**: **Last WPT approach**" appears. Leave the RC mode before acknowledging the alert **458**. This will terminate the route correctly. If you acknowledge alert **458** when the autopilot is still in the RC mode, route steering is automatically terminated, steering control is transferred to the autopilot, and ECDIS indicates the alert "**471 RC/NAV - TC STOP - Use AUTO**". Change the steering mode from RC to AUTO. When alert 471 occurs, the current heading value is used for set course value.

Route steering alerts

There are two types of route steering alerts, permanent and intermittent.

Permanent route steering alerts

Permanent alerts are available regardless of the steering mode.

- "Off track" value is red.
- "Outside Channel" is orange.

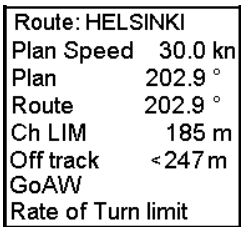
Route: HELSINKI	
Plan Speed	30.0 kn
Plan	202.9 °
Route	202.9 °
Ch LIM	185 m
Off track	<202m
GoAW	
Outside Channel	

- "Out of Gate" is orange. Out of gate indicates that, if your ship continues using the current course, then your ship will be outside the channel at the wheel over point.

Route: SCENARIO 3	
Plan Speed	10.0 kn
Plan	139.8 °
Route	168.5 °
Ch LIM	60 m
Off track	> 333 m
GoAW	
Out from gate	

The permanent alert shown right is available only during the route steering mode:

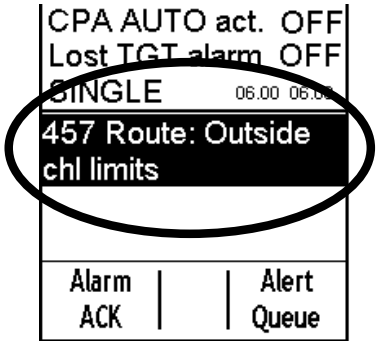
- "Rate of Turn Limit" is orange.



Intermittent route steering alerts

Intermittent audiovisual alerts appear as follows:

- Visual alert and buzzer are generated from the ECDIS.
- Alert number and text are visible at the bottom right corner of the ECDIS screen (see example below).



Alert "**455 Route**: **off course**" compares the planned course and actual heading, if the TCS (Track Control System) requires a high attack angle towards the planned course to perform track control. This alert is repeated every five minutes, if the condition continues.

Alert "**456 Route**: **WPT approach error**" appears when, because of a decrease in speed, the time to the waypoint approach alert is more than 100 seconds away from the wheel over point after the operator has already acknowledged alert "451 Route: WPT approach alarm" (to enable the next automatic turn). After the alert 456, the next turn is not enabled and the system generates a new alert "451 Route: WPT approach alarm" when appropriate.

Alert "**457 Route**: **Outside chl limits**" appears when your ship is outside the planned channel.

Alert "**460 Pilot**: **ROT will be exceed**" appears when the set radius value together with the current speed of the rate of turn is over the limit set with **Max. rate of turn** in the Route Parameters dialog box.

Alert "**461 Route**: **ROT will be exceed**" appears when the planned radius for the next waypoint together with the current speed of the rate of turn is over the limit set with **Max. rate of turn** in the Route Parameters dialog box. This alert is activated if your ship is within the value set for **WPT approach alert time**, which is in the Route Parameters dialog box.

Alert "**471 RC/NAV-TC STOP - Use AUTO**" informs you that neither the ECDIS nor the autopilot can activate the Track steering mode. In this case, change the mode from RC to AUTO then check that the preconditions for route steering are fulfilled.

Alert "**475 Route**: **Needs filter on**" appears when the position from the Kalman filter is not available. This alert is repeated every 15 seconds, if the condition continues.

Alert "**476 Route**: **Needs log sensor**" appears when the position from the Kalman filter cannot be compared against an independently operating log. This alert is repeated every 15 seconds, if the condition continues.

Alert "**488 Steering Stop-System Fail**" appears when the connection to the autopilot is lost during route steering and the used integrated steering mode cannot be continued. (Normally you get alert "**480 Autopilot Receive error**" first.)

Alert "**489 Route**: **Changed to GoSEA**", appears when alert 492 or 507 has been valid 10 minutes. The steering mode is automatically changed to GoSEA.

Alert "**492 Route**: **Needs diff Pos**" appears for any use of **GoAW** with the Kalman filter but without a high-precision sensor (example: DGPS). Alert 492 will be repeated every four minutes for the next 10 minutes. If the condition continues, alert "**489 Route**: **Changed to GoSEA**" is generated and the steering mode is automatically changed to GoSEA.

Alert "**497 Route**: **Stop - Sensor Fail**" if no gyro data is received or if conditions of alert 475 or 476 have been valid for last minute.

Alert "**505 Route**: **Use GoSEA**" is instruction for the operator to change the steering mode to **GoSEA**. This alert is generated if there are not sufficient conditions to continue **GoAW** (alert 492 or 507 has been valid two minutes). This alert is repeated every four minutes.

Alert "**506 Route**: **Use AUTO control**" is instruction for the operator to change the steering mode to AUTO. This alert is generated if there are not sufficient conditions to continue the Track mode (alert 475 or 476 has been valid 10-15 seconds).

Alert "**507 Route**: **Need SOG/COG ref.**" appears when **GoAW** is used with the Kalman filter but without direct Speed Over Ground (SOG) and Course Over Ground (COG), available from position sensor(s) or from bottom track of a dual-axis log. If the condition continues after 10 minutes, alert "**489 Route**: **Changed to GoSEA**" is generated and the steering mode is automatically changed to **GoSEA**.

Alert "**511 Route**: **Auto resume disable** appears when alert 471 has been generated and later the condition for alert 471 disappears without changing the steering mode from RC to AUTO or HAND. First change the steering mode to AUTO or HAND then check that the preconditions for route steering are fulfilled.

Alert "**512 Use NFU rudder control**" appears if the rudder servo unit cannot be controlled by the autopilot's Steering Control Unit. This alert is generated to request a change to Non-Follow-Up control of the rudder(s). First use the **System Selector Switch** to switch to NFU then use the **Non-Follow-Up steering lever** to control the rudder(s).

Alert "**514 Route**: **Use AUTO control**" informs you that there are not sufficient conditions to continue the Track mode during turn (i.e. alert 475 or 476 has been valid 10-15 seconds). Your ship will complete the turn with planned conditions.

Alert "**515 RC/NAV-TC STOP - Use AUTO**" informs you that the ECDIS and the TOKYO KEIKI autopilot cannot activate the track steering mode. First change the mode from RC to AUTO then check that the preconditions for route steering are fulfilled.

Alert "**517 Disabled**: **In turn**" informs you that the current location of your ship is in a turn of a monitored route. Steer to a linear part of the monitored route to activate the Track steering mode.

Alert "**518 Disabled**: **Not accepted**" informs you that the 30-second timeout has passed after you pressed the **NAV** and **Enable switch** buttons on the autopilot control panel. After you select "GotoOS" or "GotoAW" at the ECDIS, you have 30 seconds to press the **NAV** and **Enable switch** buttons on the autopilot control panel, otherwise alert 518 is given. Another reason can be that your ship has moved into a turning part of a monitored route before you pressed the **NAV** and **Enable switch** buttons on the control panel.

Alert "**519 Trackpilot**: **XTE comp.LIM**" warns you if the TCS is unable to get your ship to approach the track. An alert is triggered if your ship is outside the channel limit and if the cross-track error is still increasing.

Alert "**788 System Frozen**" appears as an early warning indication that the system may freeze. In this case, restart the ECDIS EC1000C processor.

Collision avoidance maneuver during route steering

Route steering is often interrupted by a collision avoidance maneuver, but there are also several other reasons to interrupt the route steering.

There are several possibilities to set the collision avoidance or any other maneuver:

- Use the HAND steering control. (Change mode from RC to HAND).
- Use the local Autopilot Heading control. (Change mode from RC to AUTO).
- Use the Non Follow Up steering lever to control the rudder pumps directly. (Change mode from RC to NFU).

Now the route steering is disabled until the RC mode in Autopilot panel is selected again. Then, press the **NAV** and **Enable switch** buttons together. To go back to route steering, the ship heading must be pointed toward the next waypoint and the ship must be located inside the channel limits, otherwise an alert is given.

How to stop or modify an pre-enabled turn in route steering

There are two reasons that an automatic route turn must be stopped or modified.

- The turn cannot be performed up to the final value.
- The turn that the ship is to perform goes outside of the planned turn. (Too fast or too slow.).

How to stop a turn

To stop a turn, change the steering mode from RC to HAND on the Steering Control Unit.

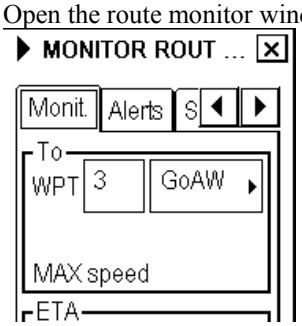
How to modify a turn

What to do	How to do it
Use different final value of set course	The problem is that Radius Control is only available in the NAVI steering mode. As soon as you change the steering mode to something other than NAVI, the ship stops following the radius. Below is what you can do: • Change the steering mode from NAVI to AUTO. This stops the turn completely as the current gyro heading is selected as the new set course for the autopilot. Then set a new final value for the set course and select a suitable max. rudder angle to prevent too fast turning. • Turn the steering wheel to a suitable angle to continue with a new radius (i.e. to equal previous rudder angle). Then change the steering mode from NAVI to HAND. Continue manual steering. • Change the steering mode from NAVI to NFU then use the NFU steering lever. Manually steer the ship.
Compensate too fast turning	As soon as you change the steering mode to something other than NAVI, the ship stops following the radius. Below is what you can do: • Change the steering mode from NAVI to AUTO. This stops the turn completely as the current gyro heading is selected as the new set course for the autopilot. Then set a final value for the set course and select a suitable max. rudder angle to prevent too fast turning. • Set the steering wheel to a suitable angle to continue with a larger radius (i.e. smaller than previous rudder angle). Then change the steering mode from NAVI to HAND. Manually steer the ship. • Change the steering mode from NAVI to NFU. Manually steer the ship.
Compensate too slow turning	As soon as you change the steering mode to something other than NAVI, the ship stops following the radius. Below is what you can do: • Set the steering wheel to a suitable angle to continue with a smaller radius (i.e. higher rudder angle than before). Then change the steering mode from NAVI to HAND. Continue manual steering. • Change the steering mode from NAVI to NFU. Manually steer the ship.

How to change route steering mode

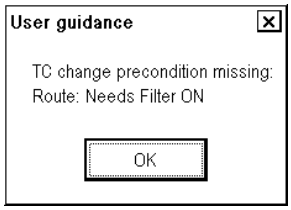
The route steering mode can be changed as follows:

1. Open the route monitor window.

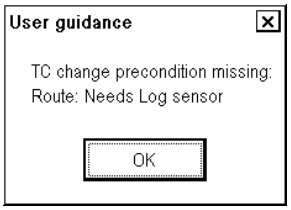


2. Select either GoSEA or GoAW from the To WPT window.

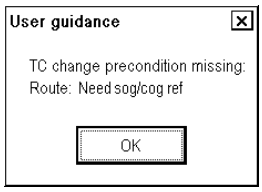
If you try to change the route steering mode without fulfilling preconditions, an appropriate User guidance dialog box appears.



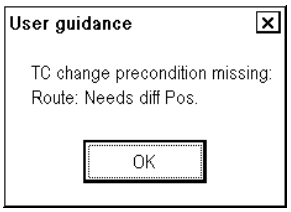
Reason: Change of route steering mode without the filter.
Remedy: Turn ON the Kalman filter and try again.



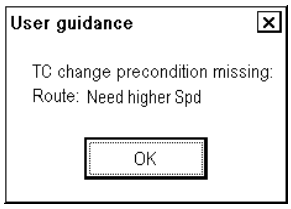
Reason: Change of route steering mode without independent speed source. You need either a log, a dual-axis log or two position receivers.
Remedy: Check your selection of the sensors.



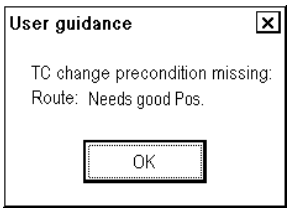
Reason: Change of route steering mode without SOG/COG reference.
Remedy: Check your selection of the sensors.



Reason: Change steering mode from GoAW to GoSEA without high precision positioning device (GPS in differential correction mode).
Remedy: Check that there is a GPS in the differential mode available and selected for use.

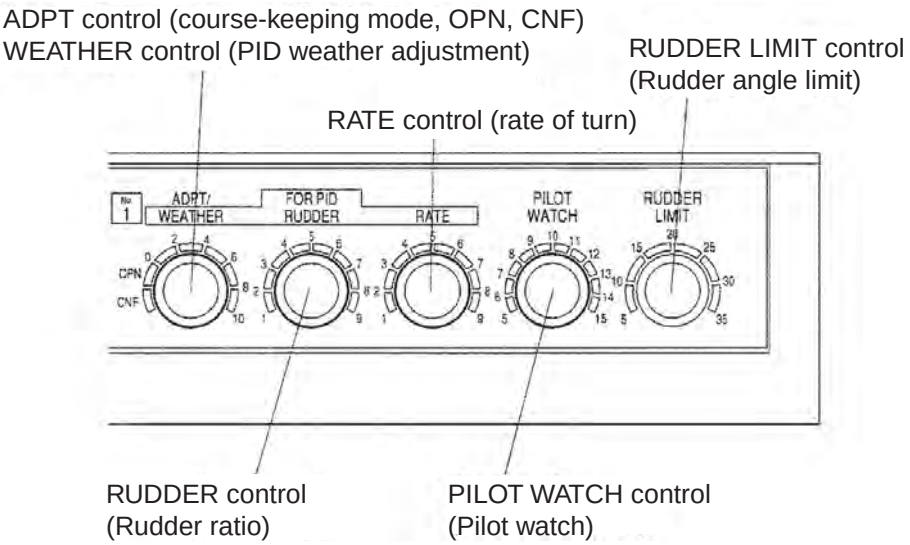


Reason: Change of route steering mode when speed of vessel is less than defined for route steering.
Remedy: Raise speed of ship over set limit then try again.



Reason: Change of route steering mode when Alert "407 Position discrepancy" is active.
Remedy: Switch off "bad" sensor in the Sensors page to remove alert 407.

4.4 HCS Unit Controls



ADPT control: Select OPN (Open Sea) when economic condition is preferred. Course is kept with the least necessary steering, permitting a little meandering such as when sailing on the open sea. The CNF (Confined) position keeps the ship straight on course, for better route steering accuracy. Large rudder may be necessary. ADPT and CNF/OPN lights are turned on.

WEATHER control: The weather adjustment becomes necessary when weather or sea state changes. It is a desirable condition that the ship goes straight with a rudder angle as small as possible (a lower angle than 5 degrees is desirable) and few rudder operations (less than six times a minute is desirable). The PID lamp goes on when the manual PID is active.

RUDDER control: Set the optimum value of the rudder ratio changes according the ship's speed.

RATE control: Set the optimum value of the rate of turn changes according to the loading condition.

PILOT WATCH control: During auto steering, when the course deviation exceeds the value set as the pilot watch, this alert sounds.

RUDDER LIMIT control: Limit the rudder motion to the least necessary rudder angle during AUTO steering.

4.5 Alerts Generated by ECDIS

4.5.1 Operational alerts

- The lamp in the **ALARM ACK** key on the ECDIS control unit goes on.
- The type of alert is displayed on the ECDIS display as number and text.
- Acknowledge an alert by pushing the **ALARM ACK** key on the ECDIS control unit.

451 Route: WPT approach alarm
452 Route: Turning disabled
455 Route: Off course
456 Route: WPT approach error
458 Route: Last WPT approach
460 Pilot: ROT will be exceed
461 Route: ROT will be exceed
468 Disabled - out of course
470 Disabled: Needs filter ON
471 RC/NAV - TC STOP - Use AUTO
475 Route: Needs filter ON
476 Route: Needs log sensor
485 Route: WPT prewarning
489 Route: Changed to GoSEA
492 Route: Needs diff Pos
497 Route: Stop - Sensor Fail
505 Route: Use GoSEA
506 Route: Use AUTO control
507 Route: Need SOG/COG ref
510 Disabled: Out of Turn
511 Route: Auto resume disable
512 Route: Use NFU rudder control
514 Route: Use AUTO control
515 RC/NAV - TC STOP - Use AUTO
517 Disabled: In turn
518 Disabled: Not accepted
788 System Frozen

4.5.2 Error alerts

Errors that occur during normal operation are related to internal problems.

- The lamp in the **ALARM ACK** key on the ECDIS control unit goes on.
- The type of alert is displayed on the ECDIS display as number and text.
- Acknowledge an alert by pushing the **ALARM ACK** key on the ECDIS control unit.
- Typical error alerts:
  480 Autopilot receive error
  488 Steering Stop-System Fail

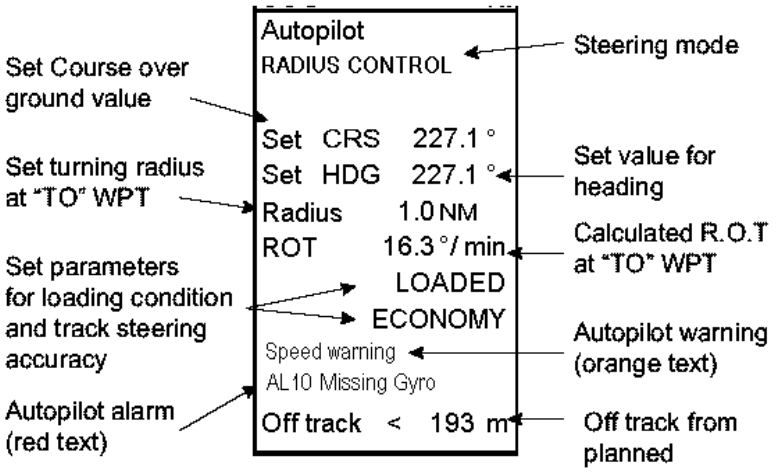
4.6 Autopilot Display in Sidebar

You can show the autopilot display in the sidebar on the ECDIS display. This display provides information about autopilot status.

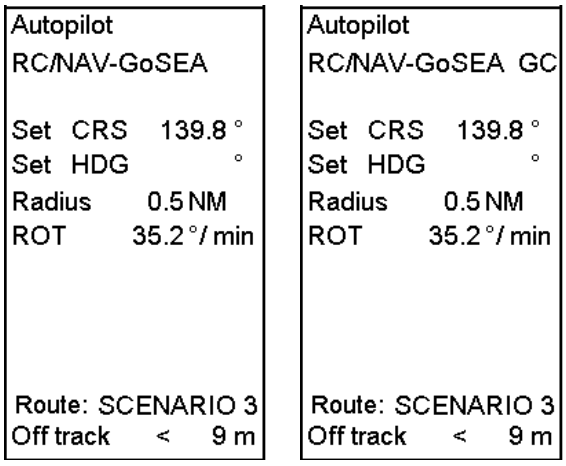
To show the autopilot display:

1. Put the cursor on the right hand side of the route monitor window to show "Menu/ /Select Sidebar" in the mouse guidance box.
2. Press the right mouse button to open the Sidebar menu.
3. Select Autopilot from the menu.

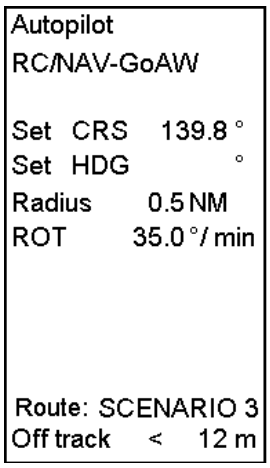
Radius control steering mode

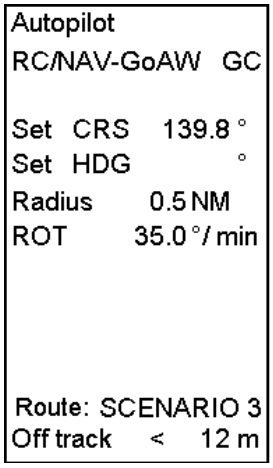


GoSEA steering mode



GoAW steering mode





The steering modes:

HAND: Hand steering
AUTO: Autopilot steering
NFU: NFU Steering
OVERRID: Override steering
RC/NAV-GoSEA: Track steering in GoSEA mode
RC/NAV-GoAW: Track steering in GoAW mode
RC/NAV-TC STOP: Track steering stopped. Change the steering mode from RC to some other steering mode.

Failure texts shown on autopilot sidebar:

Missing gyro: Gyro data is missing or not received correctly at autopilot.

Rudder servo: Rudder feedback signal is missing or the rudder servo unit is not working correctly.

TC Stop: Track Steering (RC/NAV) cannot be continued and it has been stopped.

Caution texts shown on autopilot sidebar:

Rudder on limit: The autopilot has determined that a larger rudder angle is needed to reach set course but rudder is already on limit.

Off course: The autopilot has detected that ship heading deviates from set course more than the set limit.

OffCrs Rud Limit: Combination of two cautions above.

Manual speed: Manually entered speed is used by the autopilot.

Speed warning: Ship's speed is less than half of the service speed during ADPT auto steering mode.

4.7 Expected Steering Performance Under Various Conditions

The system has many kinds of steering modes. Below is a summary of how various environmental conditions affect steering performance. The Track Control System uses a combination of drift compensation and off track compensation to keep the ship inside the channel limit.

Note: The backup navigator alert is activated if the alert is not acknowledged within 30 seconds. For more information about this alert, see section 30.11 "Backup Navigator Alert" in the ECDIS Operator's Manual.

The Track Control System uses a combination of drift compensation and off track compensation to keep your ship inside the channel limit. During a turn and after a turn for first 4 minutes this Track Control System uses drift compensation based on the drift situation before the turn. If drift situation changes a lot during the turn (current or wind) then ship may sail outside the channel if the off track compensation cannot compensate the non-ideal drift compensation decided before the turn.

4.7.1 Expected steering performance for going ahead

Environmental conditions	**Heading control** = AUTO	**GoSEA + RC**	**GoAW + RC**
Calm sea, no wind, no current	COG is about the same as set course in autopilot.	**Drift compensation ON or OFF**: Ship follows monitored route.	**Drift compensation ON or OFF**: Ship follows monitored route.
Moderate wind and/or current	Ship has a tendency to drift.	**Drift compensation ON**: Ship follows monitored route. **Drift compensation set as OFF**: Ship follows monitored route, but may need full channel limit area.	**Drift compensation ON or OFF**: Ship follows monitored route.
High wind and/or current	Ship is drifting.	**Drift compensation ON**: Ship follows monitored route.[1] Ship may have trouble following monitored route inside the channel limit.[2] **Drift compensation OFF**: Ship may have trouble following monitored route inside the channel limit.[2]	**Drift compensation ON**: Ship follows monitored route.[1] Ship may have trouble following monitored route inside the channel limit.[2] **Drift compensation OFF**: Ship may have trouble following monitored route inside the channel limit.[2]
Wind and/or current changes slowly.	There is no compensation for change.	**Drift compensation ON**: Ship follows monitored route, but may need full channel limit area. **Drift compensation OFF**: Ship may have trouble following monitored route inside the channel limit.	**Drift compensation ON**: Ship follows monitored route. **Drift compensation OFF**: Ship may have trouble following monitored route inside the channel limit.

(Continued from previous page)

Environmental conditions	Heading control = AUTO	GoSEA + RC	GoAW+ RC
Sudden change of wind and/or current (For example sudden change from no current to 5 kn current perpendicular to track)	There is no compensation for change.	**Drift compensation ON**: Ship may go outside channel limit and return back inside channel limit.[1] Ship may have trouble in following monitored route inside the channel limit.[2] **Drift compensation OFF**: Ship may have trouble in following monitored route inside the channel limit.	**Drift compensation ON**: Ship may go outside channel limit and return back inside channel limit.[1] Ship may have trouble in following monitored route inside the channel limit.[2] **Drift compensation OFF**: Ship may have trouble in following monitored route inside the channel limit.
Slow change of speed	There is no compensation for change.	**Drift compensation ON**: Ship follows monitored route. **Drift compensation set as OFF**: Ship follows monitored route, but may need full channel limit area.	**Drift compensation ON**: Ship follows monitored route. **Drift compensation set as OFF**: Ship follows monitored route, but may need full channel limit area.
Fast change of speed (For example speed decreased from 20 to 7 kn)	Ship performs normal autopilot turn under this condition.	**Drift compensation ON or OFF**: Ship follows monitored route, but may need full channel limit area.	**Drift compensation ON or OFF**: Ship follows monitored route, but may need full channel limit area.

[1] The Track Control System is able to compensate drift up to 45 degrees. If the drift is larger, your ship may go outside the channel limit.

[2] The Track Control System is able to compensate cross-track error up to 30 degrees. However, the full compensation is not available immediately. Two alerts will warn the operator if the Track Control System estimates that it is not able to keep your ship within channel limits. Alert "**519 Trackpilot**: **XTE comp.LIM**" informs you that no further cross-track error based compensation is possible. **Alert** "**455 Route**: **Off course**" informs you that the Track Control System cannot use a higher attack angle towards the track.

4.7.2 Expected steering performance for turns

Environmental conditions	Heading control = AUTO	GoSEA + RC	GoAW + RC
Calm sea, no wind, no current	Ship performs normal autopilot turn under this condition.	**Drift compensation ON or OFF**: Ship follows monitored route.	**Drift compensation ON or OFF**: Ship follows monitored route.
Moderate wind and/or current	Ship performs normal autopilot turn under this condition.	**Drift compensation ON**: Ship follows monitored route. **Drift compensation set as OFF**: Ship follows monitored route, but may need full channel limit area.	**Drift compensation ON or OFF**: Ship follows monitored route.

(Continued from previous page)

Environmental conditions	Heading control = AUTO	GoSEA + RC	GoAW + RC
High wind and/or current	Ship performs normal autopilot turn under this condition.	**Drift compensation ON**: Ship follows monitored route, but may go outside channel limit area.[1] Ship may have trouble in following monitored route inside the channel limit.[2] **Drift compensation OFF**: Ship goes inside or outside of turn.	**Drift compensation ON**: Ship follows monitored route.[1] Ship may have trouble in following monitored route inside the channel limit.[2] **Drift compensation OFF**: Ship goes inside or outside of turn.
Slow change of wind and/or current	Ship performs normal autopilot turn under this condition.	**Drift compensation ON**: Ship follows monitored route **Drift compensation OFF**: Ship may have troubles in following monitored route inside the channel limit.	**Drift compensation ON**: Ship follows monitored route. **Drift compensation OFF**: Ship may have troubles in following monitored route inside the channel limit.
Sudden change of wind and/or current (For example sudden change from no current to 5 kn current perpendicular to track)	Ship performs normal autopilot turn under this condition.	**Drift compensation ON**: Ship may go outside channel limit and return back inside channel limit.[1] Ship may have trouble in following monitored route inside the channel limit.[2] **Drift compensation OFF**: Ship goes inside or outside of turn.	**Drift compensation ON**: Ship may go outside channel limit and return back inside channel limit.[1] Ship may have trouble in following monitored route inside the channel limit.[2] **Drift compensation OFF**: Ship goes inside or outside of turn.
Slow change of speed	Ship performs normal autopilot turn under this condition.	**Drift compensation ON or OFF**: Ship follows monitored route, but may need full channel limit area.	**Drift compensation ON or OFF**: Ship follows monitored route.
Fast change of speed (For example speed decreased from 20 to 7 kn)	Ship performs normal autopilot turn under this condition.	**Drift compensation ON or OFF**: Ship follows monitored route, but may need full channel limit area	**Drift compensation ON or OFF**: Ship follows monitored route, but may need full channel limit area.

[1] The Track Control System is able to compensate drift up to 45 degrees. If the drift is larger, your ship may go outside the channel limit.

[2] The Track Control System is able to compensate cross-track error up to 30 degrees. However, the full compensation is not available immediately. Two alerts will warn the operator if the Track Control System estimates that it is not able to keep your ship within channel limits. Alert "**519 Trackpilot**: **XTE comp.LIM**" informs you that no further cross-track error based compensation is possible. Alert "**455 Route**: **Off course**" informs you that the Track Control System cannot use a higher attack angle towards the track.

Note: Drift compensation is turned on or off in the Ship and Route parameters in the Navigation Parameters dialog box. For further details, see section 27.1.4 "Navigation parameters setting" in the ECDIS Operator's Manual.

4.8 Expected Steering Performance Under Critical Failure

Below is a summary of the system behavior in various failures when the GoSEA or GoAW steering mode is in use.

Note: The backup navigator alert is activated if the alert is not acknowledged within 30 seconds. See section 30.11 "Backup Navigator Alert" in the ECDIS Operator's Manual.

4.8.1 Lost heading from autopilot (ECDIS may also have lost heading)

	Associated alerts	Expected system performance	What operator should do
Immediately	• Sensor alert "755: Gyro error (Trackpilot)" is generated at ECDIS. • Warning lamp RC turns on. Mode lamp indicators AUTO and RC start flashing in the autopilot Steering Control Unit.	• If ship is running straight, Rudder order is frozen for last value in order to approximately continue ahead. • If ship is turning, rudder order is frozen for last value in order to approximately continue rate of turn.	• Change immediately to manual control of rudder. • Acknowledge alerts. • Monitor situation.
Within few seconds	• Alert "497 Route Stop-Sensor fail. • Alert "471 RC/NAV-TC STOP - Use AUTO" on ECDIS".		• Change immediately to manual control of rudder. • Acknowledge alerts. • Monitor situation.
Repeated every 2 minutes	• Alert "498 Use manual rudder control" is generated at ECDIS.	• Reminder	• Change immediately to manual control of rudder.

4.8.2 Lost heading from ECDIS (autopilot still has heading)

	Associated alerts	Expected system performance	What operator should do
	• Sensor alert, for example Alert "705: Gyro error" or "4006: Gyro error."		• Acknowledge alerts. • Monitor situation.
Within few seconds	• Alert "402 No heading available". • Alert "497 Route Stop-Sensor fail".		• Acknowledge alerts. • Monitor situation.
After Alert "497 Route Stop-Sensor fail."	• Alert "471 RC/NAV-TC STOP - Use AUTO" in ECDIS is generated. Warning lamp RC turns on and steering mode indicator lamp RC start flashing in the autopilot Steering Control Unit.	• If ship is running straight, actual heading is used as set course. • If ship is turning, last-set course and radius are used to complete the turn.	• Acknowledge alerts • Monitor situation. • Change steering mode to AUTO.

4.8.3 Lost speed

	Associated alerts	Expected system performance	What operator should do
	• Sensor alert, for example Alert "708: Log error", "712…716: Position equipment error", etc.		• Acknowledge alerts. • Monitor situation.
Within 30 seconds	• Alert "476 Route Needs log sensor".		• Acknowledge alerts. • Monitor situation.
After 2 minutes then every 4 minutes	• Alert "506 Route: Use AUTO control".	• Guidance for navigator.	• Change to local autopilot control immediately. • Acknowledge alerts.
After 4 minutes then every 4 minutes	• Alert "476 Route Needs log sensor".	• Reminder	• Acknowledge alerts. • Monitor situation.
Within 10 minutes	• Alert "497 Route Stop-Sensor fail".		• Acknowledge alerts. • Monitor situation.
After Alert "497 Route Stop-Sensor fail."	• Alert "471 RC/NAV-TC STOP - Use AUTO" in ECDIS is generated. Warning lamp RC turns on and steering mode indicator lamp RC starts flashing in the autopilot Steering Control Unit.	• If ship is running straight, actual heading is used as set course. • If ship is turning, last set course and radius are used to complete the turn.	• Acknowledge alerts • Monitor situation. • Change steering mode to AUTO.

4.8.4 Low speed

	Associated alerts	Expected system performance	What operator should do
	• Alert "408 Filter: SPD below xx KN."		• Acknowledge alerts. • Monitor situation.
Within 90 seconds	• Alert "410 Filter: POSN source CHG".		• Acknowledge alerts. • Monitor situation.
Within 30 seconds	• Alert "501 Route: Needs higher Speed".		• Acknowledge alerts. • Monitor situation.
After 2 minutes then every 4 minutes	• Alert "506 Route: Use AUTO control".	• Guidance for navigator	• Change to local autopilot control immediately. • Acknowledge alerts.
After 4 minutes then every 2 minutes	• Alert "501 Route: Needs higher Speed".	• Reminder	• Acknowledge alerts. • Monitor situation.
Within 10 minutes	• Alert "497 Route Stop-Sensor fail".		• Acknowledge alerts. • Monitor situation.
After Alert "497 Route Stop-Sensor fail."	• Alert "471 RC/NAV-TC STOP - Use AUTO" in ECDIS is generated. Warning lamp RC turns on and steering mode indicator lamp RC start flashing in the autopilot Steering Control Unit.	• If ship is running straight, actual heading is used as set course. • If ship is turning, last set course and radius are used to complete the turn.	• Acknowledge alerts • Monitor situation. • Change steering mode to AUTO.

4.8.5 Lost SOG/COG reference in GoAW steering mode

	Associated alerts (generated at ECDIS)	Expected system performance	What operator should do
	• Alert "507 Route: Need SOG/COG ref."		• Acknowledge alerts. • Monitor situation.
After 2 minutes then every 4 minutes	• Alert "505 Route: Use GoSEA"	• Instruction for navigator	• Change to GoSEA steering mode. • Acknowledge alerts.
After 4 minutes then every 4 minutes	• Alert "507 Route: Need SOG/COG ref."	• Reminder	• Acknowledge alerts. • Monitor situation.
Within 10 minutes	• Alert "489 Route: Changed to GoSEA"	• Automatic change of steering mode to GoSEA mode.	• Acknowledge alerts. • Monitor situation.

4.8.6 Total lost position

	Associated alerts	Expected system performance	What operator should do
	• Alert "712…716: Position equipment error" OR • Kalman filter detects jump, etc.		• Acknowledge alerts. • Monitor situation.
Within 30 seconds	• Alerts "400 Filter: POSN unreliable" and "406 Route: CRS jump possible."	• Kalman Filter is turned OFF and system uses dead reckoning for positioning. • If you have log or dual-axis log, then dead reckoning is based on them and gyro. • If you have log or dual-axis log, then dead reckoning is based on last plausible speed from position sensors. This is indicated by showing your ship's position, SOG and COG in red. The source indication for SOG and COG is "(LAST)".	• Acknowledge alerts. • Monitor situation.
After 2 minutes then every 4 minutes	• Alert "506 Route: Use AUTO control"	• Guidance for navigator	• Change to local autopilot control immediately. • Acknowledge alerts.
After 4 minutes then every 4 minutes	• Alert "475 Route Needs filter ON"	• Reminder	• Acknowledge alerts. • Monitor situation.
Within 10 minutes	• Alert "497 Route Stop-Sensor fail."		• Acknowledge alerts. • Monitor situation.
After Alert "497 Route Stop-Sensor fail."	• Alert "471 RC/NAV-TC STOP - Use AUTO" in ECDIS is generated. Warning lamp RC turns on and steering mode indicator lamp RC start flashing in the autopilot Steering Control Unit.	• If ship is running straight, actual heading is used as set course. • If ship is turning, last set course and radius are used to complete the turn.	• Acknowledge alerts • Monitor situation. • Change steering mode to AUTO.

4.8.7 Lost differential position in GoAW steering mode

	Associated alerts (generated at ECDIS)	Expected system performance	What operator should do
	• Alert "727…731: Lost DGPS" or "712…716: Position equipment error."		• Acknowledge alerts. • Monitor situation.
Within 90 seconds	• Alert "410 Filter: POSN source CHG".		• Acknowledge alerts. • Monitor situation.
Within 30 seconds	• Alert "492 Route: Needs diff pos."	• GoAW requires differential position.	• Acknowledge alerts. • Monitor situation.
After 2 minutes then every 4 minutes	• Alert "505 Route: Use GoSEA."	• Guidance for navigator	• Change to GoSEA steering mode. • Acknowledge alert.
After 4 minutes then every 4 minutes	• Alert "492 Route: Needs diff pos."	• Reminder	• Acknowledge alerts. • Monitor situation.
Within 10 minutes	• Alert "489 Route: Changed to GoSEA."	• Automatic change of steering mode to GoSEA mode.	• Acknowledge alerts. • Monitor situation.

4.8.8 Lost differential position and position discrepancy

	Associated alerts	Expected system performance	What operator should do
Precon-dition	• If sensors in Filter calculation are NOT inside operator selected position discrepancy limit. • Alert "407 Position discrepancy"		• Acknowledge alerts. • Monitor situation.
	• Alert "727…731: Lost DGPS" or "712…716: Position equipment error"		• Acknowledge alerts. • Monitor situation.
Within 90 seconds	• Alert "410 Filter: POSN source CHG!.		• Acknowledge alerts. • Monitor situation.
Within 30 seconds	• Alert "478 Route: Needs good Pos"		• Acknowledge alerts. • Monitor situation.
After 2 minutes then every 4 minutes	• Alert "506 Route: Use Auto control"	• Guidance for navigator	• Change to local autopilot control. • Acknowledge alerts.
After 4 minutes then every 2 minutes	• Alert "478 Route: Needs good Pos"	• Reminder	• Acknowledge alerts. • Monitor situation.
Within 10 minutes	• Alert "497 Route Stop-Sensor fail".		• Acknowledge alerts. • Monitor situation.
After Alert "497 Route Stop-Sensor fail."	• Alert "471 RC/NAV-TC STOP - Use AUTO" in ECDIS is generated. Warning lamp RC turns on and steering mode indicator lamp RC start flashing in the autopilot Steering Control Unit.	• If ship is running straight, actual heading is used as set course. • If ship is turning, last set course and radius are used to complete the turn.	• Acknowledge alerts • Monitor situation. • Change steering mode to AUTO.

4.8.9 Lost communication between ECDIS and autopilot

	Associated alerts	Expected system performance	What operator should do
Within 15 seconds	• Alert "488 Steering: Stop-system fail" generated at ECDIS.		• Acknowledge alerts. • Monitor situation.
After Alert "488 Steering: Stop-system fail"	• Alert "471 RC/NAV-TC STOP - Use AUTO" in ECDIS is generated. Warning lamp RC turns on and steering mode indicator lamp RC start flashing in the autopilot Steering Control Unit.	• If ship is running straight, actual heading is used as set course. • If ship is turning, last set course and radius are used to complete the turn.	• Acknowledge alerts • Monitor situation. • Change steering mode to AUTO.

4.8.10 Lost communication between autopilot and ECDIS

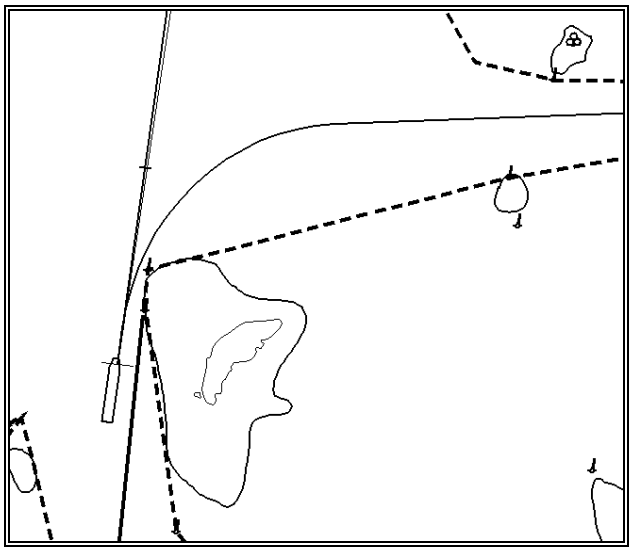
	Associated alerts	Expected system performance	What operator should do
Within 15 seconds	• Alert "488 Steering: Stop-system fail" and "480 Trackpilot Receive error" is generated at the ECDIS.		• Acknowledge alerts. • Monitor situation.
After Alert "488 Steering: Stop-system fail"	• Alert "471 RC/NAV-TC STOP - Use AUTO" in ECDIS is generated. Warning lamp RC turns on and steering mode indicator lamp RC start flashing in the autopilot Steering Control Unit.	• If ship is running straight, actual heading is used as set course. • If ship is turning, last set course and radius are used to complete the turn.	• Acknowledge alerts • Monitor situation. • Change steering mode to AUTO.

4.9 How to Use the Curved EBL

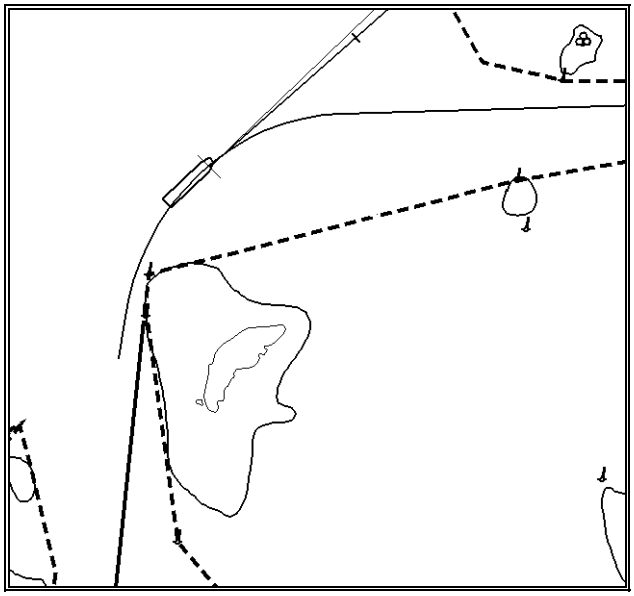
The curved EBL is a control tool to monitor automatic operation of GoSEA and GoAW (="RC/Nav") steering modes. The curved EBL is available on the ECDIS screen and on some selected radar displays.

After nearing a WPT but before the start of a turn, the curved EBL displays the next intended turn. When your ship starts a turn (initiated by the route steering) the curved EBL is locked to its position.

During the turn you can monitor how your ship performs the intended maneuver against the planned maneuver by comparing the curved EBL position and your current position.



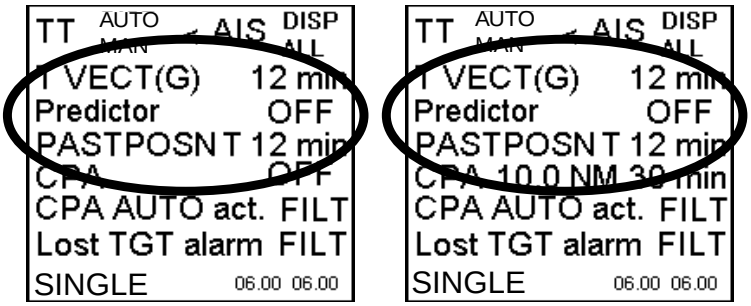
Curved EBL, at wheel over point



Curved EBL, locked during turn

4.10 How to Use the Predictor

The Predictor is a tool for estimating your ship's future positions and behavior, and it is in the information area. Put the cursor on the text "Predictor" then use left mouse button to toggle the predictor ON/OFF. The current setting is shown in the mouse functions area. To set the time for the predictor, put the cursor on the time indication next to Predictor, spin the scrollwheel to select a time then push the scrollwheel. The time from current position to the last of the predicted position may be selected by the between 30 and 180 seconds, in 30-second intervals. The on-screen Predictor graphic consists of five pieces of your ships drawn in true scale to successive future positions.

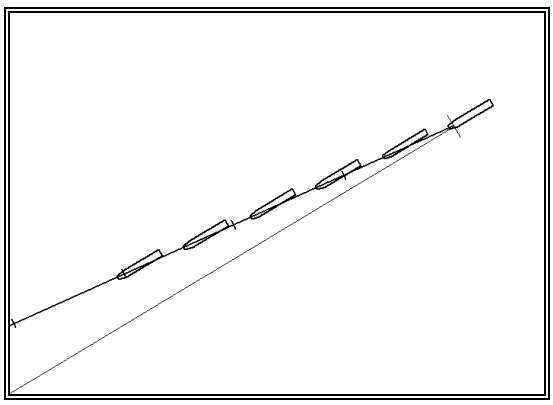


The predictor is calculated using current speed and rate of turn:

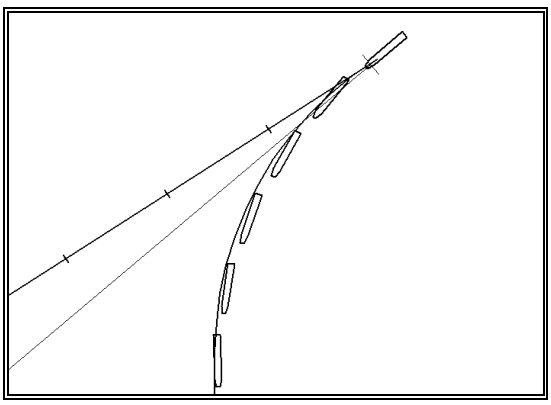
- Docking speed components:
  - Transversal bow speed
  - Transversal stern speed
  - Longitudinal center speed
- Rate of turn

These components are assumed to be stable during the prediction period.

The predictor can be used in every steering-state, even when steering without the autopilot.



Predictor shows drift



Predictor in a turn

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Autopilot PT-500A (category B)

Autopilot PT-500A (category C)