

JAN-7201/9201
ECDIS

ADDITIONAL INSTRUCTION MANUAL
(Instruction for Track Control)
TCS model Category C
(YDK Technologies PT900)

PREFACE

This is the Additional Instruction Manual for JAN-7201/9201 ECDIS (TCS Category C IEC 62065 Ed2).

The equipment consists of ECDIS (Electronic Chart Display and Information System) and YDK Technologies PT900 Autopilot.

As to the ECDIS operation, refer to the INSTRUCTION MANUAL for ECDIS.

As to the Autopilot (PT900) operation, refer to the INSTRUCTION MANUAL for Autopilot.

- Be sure to read this manual for full comprehension before using the equipment.
- Keep this manual in a convenient place for the future.
Make use of this manual when experiencing operation difficulties.
- The information in this manual is subject to change without notice at any time.

Classification of Track control

Major Category	Category	Alias	Contents
TCS	Category-A	-	Track control for a single straight leg or multiple legs containing no turning
	Category-B	Assisted Turn	Track control for multiple legs (except when turning) ■ Specified turn radius control when turning (Assisted Turn)
	Category-C	Full Automatic	Track control for multiple legs ■ Track deviation correction when turning (Full Automatic)
Conventional JRC's Automatic Sailing Control System	-	-	■ Setting the Way Point Circle and turn radius when route planning ■ Alert occurrence when arriving at the Way Point Circle during track control ■ Turning at the specified turn radius after confirming the circumstance and pressing the turning buttons ■ Automatic re-start of the track control after turning ■ Alert occurrence in accordance with regulations when abnormality detected

Before Operation

Pictorial Indication

Various pictorial indications are included in this manual and are shown on these equipment so that you can operate them safely and correctly and prevent any danger to you and / or to other persons and any damage to your property during operation. Such indications and their meanings are as follows. Please understand them before you read this manual.



DANGER

This indication is shown where incorrect equipment operation due to negligence may cause death or serious injuries.



WARNING

This indication is shown where any person is supposed to be in danger of being killed or seriously injured if this indication is neglected and these equipments are not operated correctly.



CAUTION

This indication is shown where any person is supposed to be injured or any proper damage is supposed to occur if this indication is neglected and these equipments are not operated correctly.

Examples of Pictorial Indication



Electric shock

The $\triangle$ mark represents CAUTION (including DANGER and WARNING). Detailed contents of CAUTION (“Electric Shock” in the example on the left) are shown in the mark.



Disconnect the power plug



Prohibition

The $\otimes$ mark represents prohibition. Detailed contents of the prohibited action (“Disassembling Prohibited” in the example on the left) are shown in the mark.



Disassembling prohibited



Instruction

The $\bullet$ mark represents instruction. Detailed contents of the instruction (“Disconnect the power plug” in the example on the left) are shown in the mark.

Warning label

There is a warning label on the equipment.

Do not try to remove, break or modify the label.

Precautions Upon Equipment Operation

CAUTION



In an emergency, change the steering mode of the autopilot from NAV to Manual and cancel track control.

Negligence of changing the steering mode of the autopilot may cause an accident.



In danger of collision, perform “overriding” to avoid the collision. (For information on how to perform “overriding”, see section “4.2.7 How to start the NFU steering (NFU mode)”(PT900).) When override function is executed, track control automatically stops.

Before starting track control, be sure to check the safety of the route and crossing safety contour. Negligence of checking the safety may cause an accident.



Do not neglect the confirmation of the own ship’s position and bearing during sailing, regardless of the setting ON/OFF of track control.

Negligence of the confirmation may cause an accident.

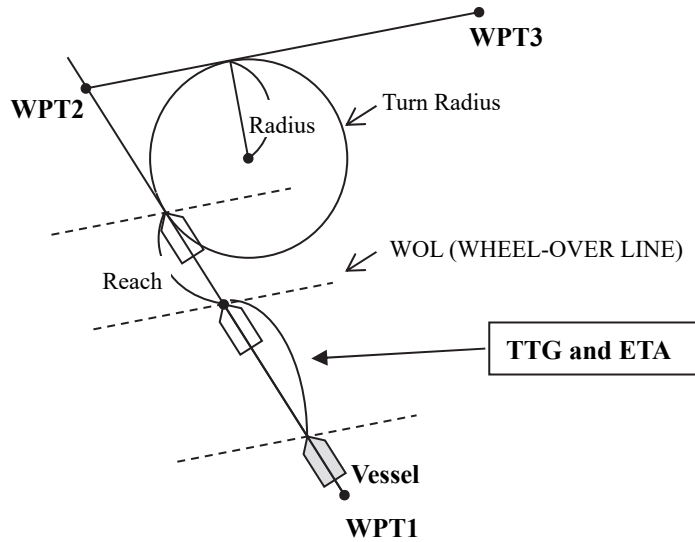


Do not set the turn radius too much small.

The rudder angle will be large when the ship will turn along small radius.

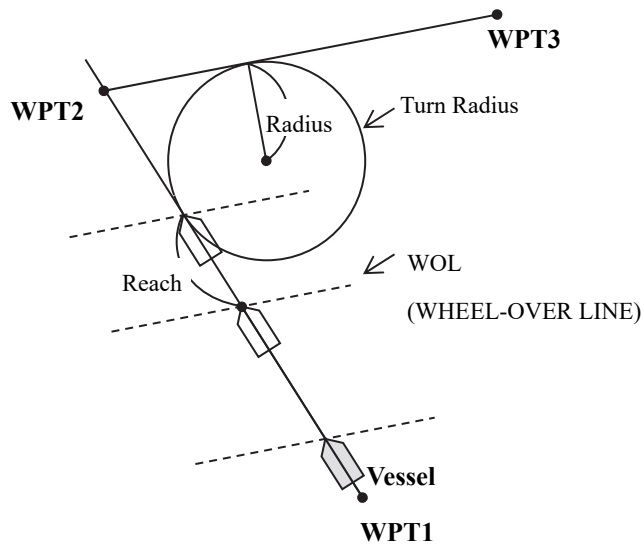
Note:

TTG and ETA are calculated by the distance between own ship and WOL of “TO-WPT”. (Not by the distance between own ship and “TO-WPT”)



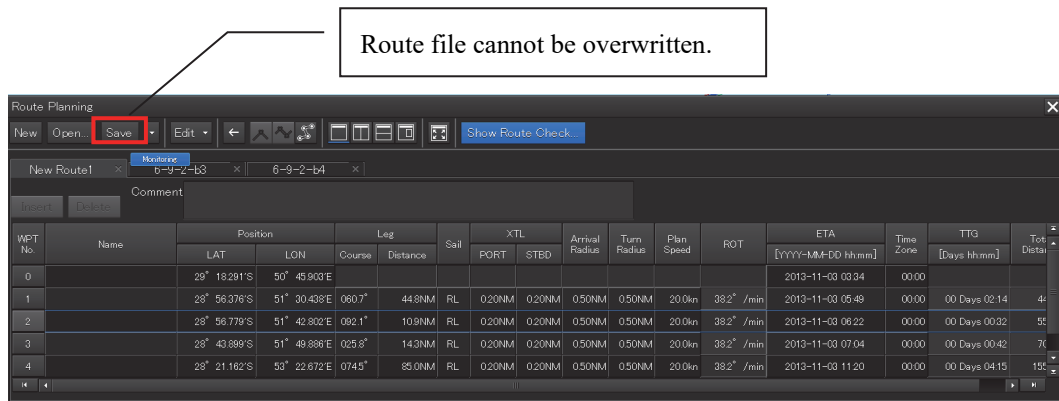
Note:

Destination WPT information is calculated based on the total distance of the straight legs. The distance from the ship position to WPT3 in the drawing below, for instance, is calculated as follows: the distance from the ship position to WPT2 + the distance from WPT2 to WPT3.



Note:

Route file cannot be overwritten during track control.



Note:

Be sure to monitor track control. Stop track control if an alarm occurs. Release all alarm before re-start track control.

Note:

For further information on route planning, refer to the Instruction Manual.

Note:

If the limit check error occurs, you should modify the route in reference to range of limit.

To check the ship's parameters, do the following: Move cursor at the Left Tool Bar and then select [Menu]-[Route Planning]-[Show Route Check...]-[Limit check].

Route Planning

New Open... Save Edit Show Route Check...

*New Router x *New Route1 x *New Route2 x

Insert Delete Comment

WPT No.	Name	Position		Leg		Sail	XTL		Arrival Radius
		LAT	LON	Course	Distance		PORT	STBD	
0		32° 43.547'S	61° 26.958'E						
1		32° 43.437'S	61° 30.609'E	088.0°	3.1NM	RL	0.20NM	0.20NM	0.50NM
2		32° 43.316'S	61° 33.607'E	087.3°	2.5NM	RL	0.20NM	0.20NM	0.50NM
3		32° 43.375'S	61° 37.138'E	091.1°	3.0NM	RL	0.20NM	0.20NM	0.50NM
4		32° 43.346'S	61° 41.287'E	089.5°	3.5NM	RL	0.20NM	0.20NM	0.50NM

Check Route

Safety Check Limit check

WPT	Cause
001-002	The Leg length is shorter the MIN Leg length.

Ship's limit

MIN leg length 0.1 NM

MIN turn radius 0.50 NM

MAX course change 150.0 °

MAX speed 30.0 kn

MIN speed 5.0 kn

MAX ROT 200.0 ° /mi

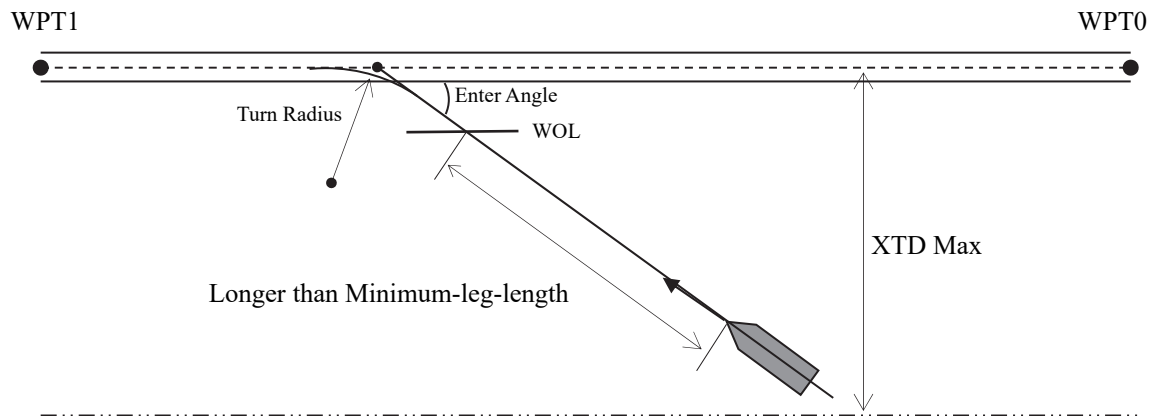
MIN ROT 000.1 ° /mi

Note:

It is recommended the ship is on the current leg before starting track control.

Note:

Minimum-leg-length = (Pre Run Speed x Pre Run Time) + Pre Run Distance + Reach



Note:

If a ship's status does not match the parameter in the simulation, one of the following messages is displayed.

- Can not create the temporary route because the course is inappropriate.
- Can not create the temporary route because the XTD exceed XTD MAX.
- Can not create the temporary route because own ship may pass through the WOL.
- Can not create the temporary route because own ship may pass through the planned route leg.
- Safety errors are detected on the temporary route. Confirm the result on the Check Route dialog box.

Note:

Please start the track control immediately after the "Start Autosail?" message is displayed.

Note:

The track used by track control cannot be modified during track control.

Note:

The track control shall be operated in accordance with the method written in this Additional Instruction Manual, and not with the method written in Instruction Manual accompanied by ECDIS.

Note:

The rudder limit is set to 35 degrees during track control.

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1. Definition and Abbreviation

1.1 Definition

Active track

Track activated for track control.

Alarm

The highest priority of an alert as defined in MSC.252(83). Announcing a situation or condition requiring immediate attention, decision and if necessary action by the bridge team, to maintain the safe navigation of the ship.

Alert

Announcing abnormal situations and conditions requiring attention, decision and/or action.

Alerts are divided in three priorities: alarms, warnings and cautions.

Along track speed control

Automatic control of the ship's speed during track control based on a pre-planned track.

Autosail

Control of the ship's movement along a track, where corrections made by the controller are based on the cross track error and not only on the bearing to the destination waypoint (TO-waypoint).

Back-up Navigator

Any individual, generally an officer, who has been designated by the ships master to be on call if assistance is needed on the bridge.

Consistent common reference system

Sensor input data, providing identical and obligatory reference pertaining to position, course, heading, bearing, speed, velocity, etc. and horizontal datum to different sub-systems within an integrated navigation system.

Course

For marine navigation, course is the horizontal direction in which a vessel is steered or intended to be steered, expressed as angular distance from north, usually 000° at north, clockwise through 360°.

Course difference limit

Maximum difference between track course and heading before an alarm is activated.

Cross track distance (also known as cross track error, XTD)

Perpendicular distance of the ship from the track including direction ('P' means the ship is port side of the track and 'S' means the ship is starboard side of the track.).

Cross-track limit (XTL)

Maximum cross track distance before an alarm is activated.

Curved track

Non-straight track between two straight legs.

Fall-back arrangements

Automatic reaction of the system to a failure to provide the best possible functionality.

FROM-waypoint

The last passed waypoint.

Great circle sailing

Sailing on the intersection of the earth surface and a plane containing the points A, B and the centre of the sphere.

GP

Geometrical point, radii starts

Heading

The horizontal direction in which a ship actually points or heads at any instant, expressed in angular units from a reference direction, usually from 000° at the reference direction clockwise through 360°.

Heading control

Control of the ship's heading.

Heading monitor function

Monitoring the actual heading sensor by an independent second source.

Indication

Visual display of any message to the user which may be accompanied by a low intensity acoustic signal to gain attention

Leg

Line between two waypoints defining the track.

Main conning position

Place on the bridge with a commanding view providing the necessary information and equipment for the conning officer to carry out his functions.

Minimum maneuvering speed for track control

Lowest fore/aft speed through the water at which the track control system is capable of maintaining its performance within the specified accuracy limits. The value depends on the ship's design and loading and on the present environmental conditions.

NEXT-waypoint

The waypoint following the TO-waypoint.

Override facility

A control to perform the override function.

Override function

An intentional fast change-over from automatic to temporary manual control.

Position monitor function

Monitoring the actual position sensor by an independent second source.

Primary position-fixing system

Electronic position-fixing system (EPFS) used for track control and approved by the International Maritime Organization.

Radius of turn

Radius of a curved track.

Rate of turn

Change of heading per time unit.

Reach

Reach is the distance that the ship keeps going straight during the time lag between steering the rudder and the ship's turning.

Rhumb line sailing

Sailing on a line on the surface of the earth making the same angle with each meridian crossed.

Ship maneuvering characteristics

These define the range-of-maneuver possible for the ship (for example, maximum turn rate, minimum turn radius, maximum turn acceleration and deceleration).

Single operator action

An action which is directly accessible and immediately effected, for example by:

- dedicated controls;
- primary access in an associated menu;
- alternative solutions which meet the functional requirements.

Speed

The absolute value of velocity. May either be the ship's speed through the water, or the speed made good over the ground.

Steering mode selector

A switch provided for the selection of manual steering modes and automatic steering devices.

Temporary track

A track that originates at the current position of the ship and joins the pre-planned track. The temporary track may include temporary waypoints which can be identified as different from the waypoints of the pre-planned track.

TO-waypoint

The waypoint which the ship is approaching.

Track

Path to be followed over ground.

Track control

Control of the ship's movement along a track, where corrections made by the controller to compensate for wind, drift and other influences, are based on the cross track error and not only on the bearing to the destination waypoint (TO-waypoint).

Track course

The direction from one waypoint to the next, a constant course on a rhumb line track and a varying course on a Great Circle track.

Track planning

Preplanning of a track including waypoint data and optionally speed data, commonly referred to as passage planning or voyage planning.

Warning

Announcing a situation or condition requiring attention but no-immediate attention or action by the bridge team.

Warnings are presented for precautionary reasons to make the bridge team aware of changed conditions which are not immediately hazardous, but may become so, if no forward-looking decision is made or action is taken.

Waypoint

A geographic position together with its associated data.

Wheel-over-line

Line where the ship has to initiate a curved track to eliminate the effect of any offset with

respect to the new course, taking into consideration the distance required for the ship to build up the necessary rate of turn.

Wheel-over-point

Wheel-over-point where the ship starts steering for turning. The point where the ship passed the WOL.

1.2 Abbreviations

ACCW

Actual course change warning

ACK

Acknowledge

BNWAS

Bridge Navigational Watch Alarm System

COG

Course over the ground

CSE

Course

DGPS

Differential GPS

DR

Dead reckoning, Dead Reckoned Position

ECCA

Early course change alarm

ECCW

Early course change warning

ENC

Electronic navigational chart

EOT

End of track

EPFS

Electronic position fixing system

EUT

Equipment under test

ETA

Estimated time of arrival

GC

Great circle

GPS

Global positioning system

HDG

Heading

RL

Rhumb line

SDME

Speed and distance measuring equipment

TCS

Track control system

TTG

Time to go

WOL

Wheel-over line

WOP

Wheel-over point

WPT

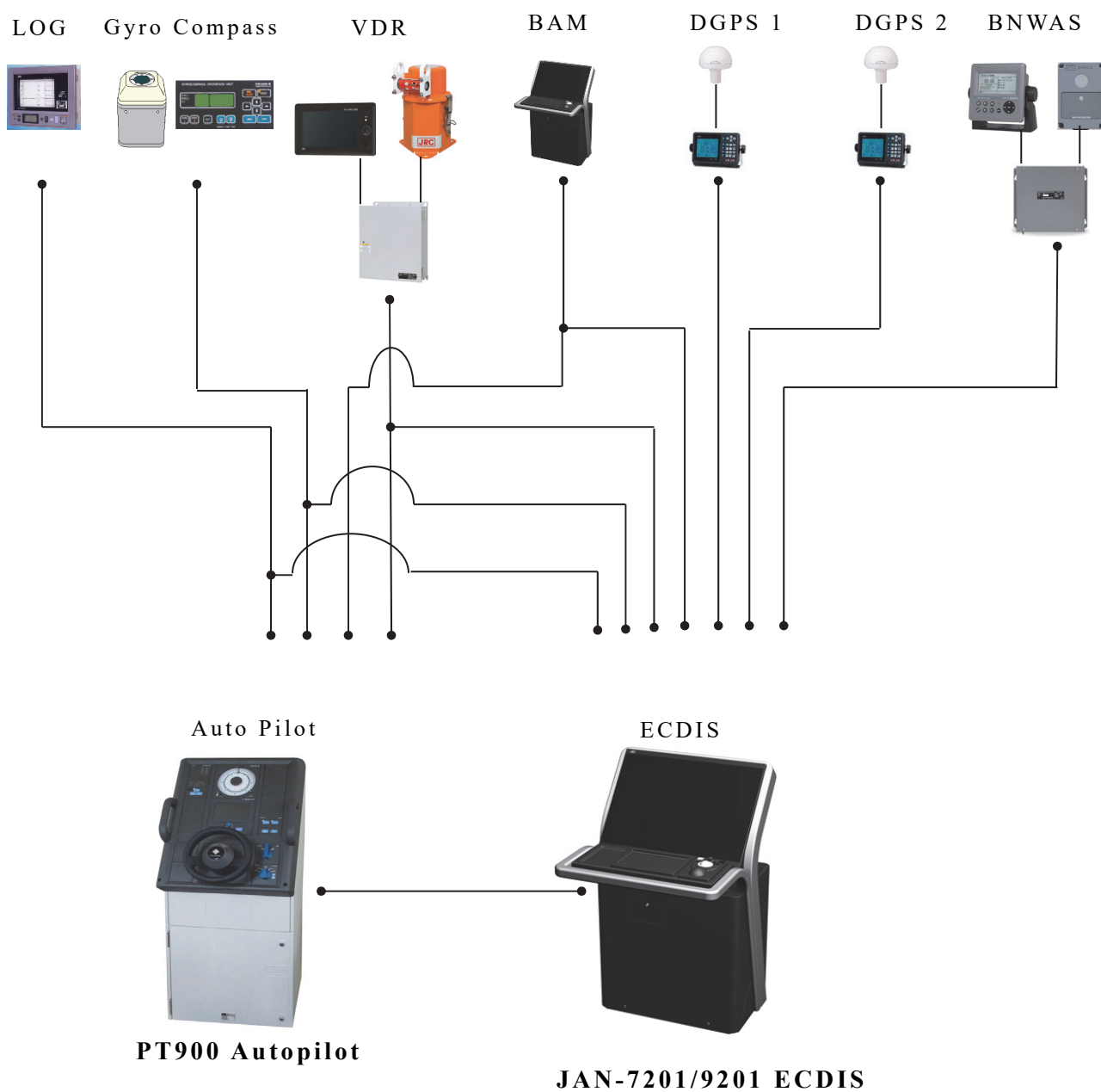
Waypoint

XTD

Cross Track Distance

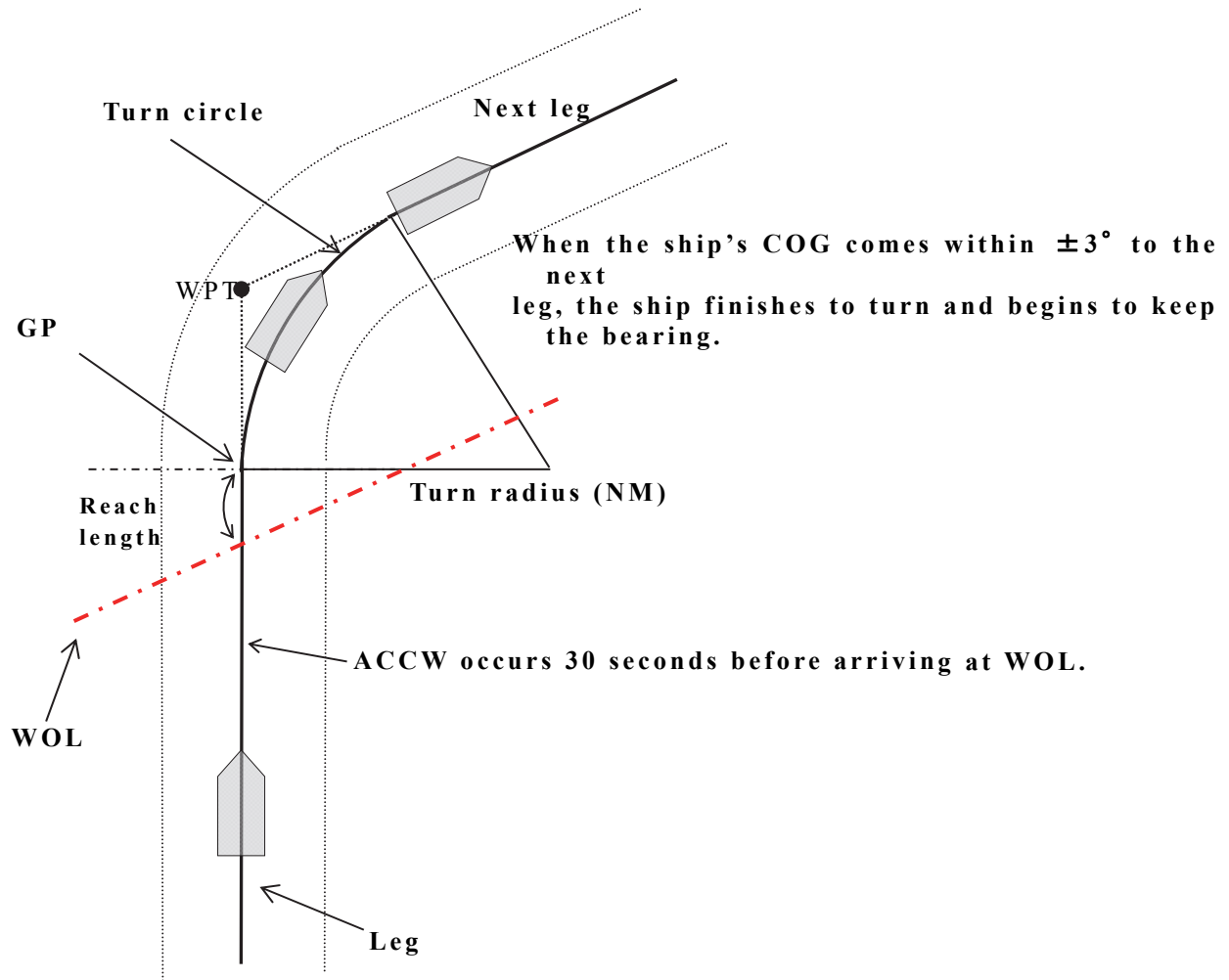
2. Function

2.1 System Configuration



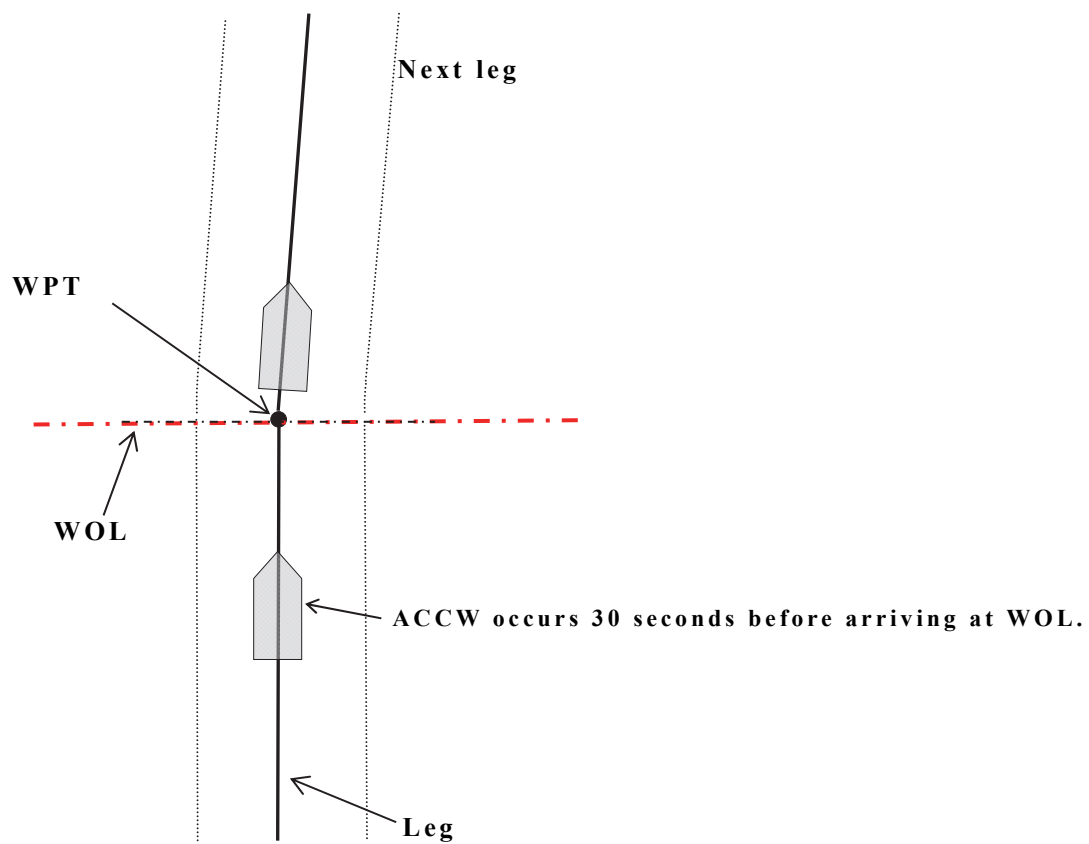
2.2 Route

(1) GP is the contact point of the leg and the turn circle as shown below. When on TCS Route, WOL is displayed as the parallel line to the next leg with passing through the point of ship's reach length before GP. ECCW and ACCW during Track control are calculated based on the time of arriving at WOL.



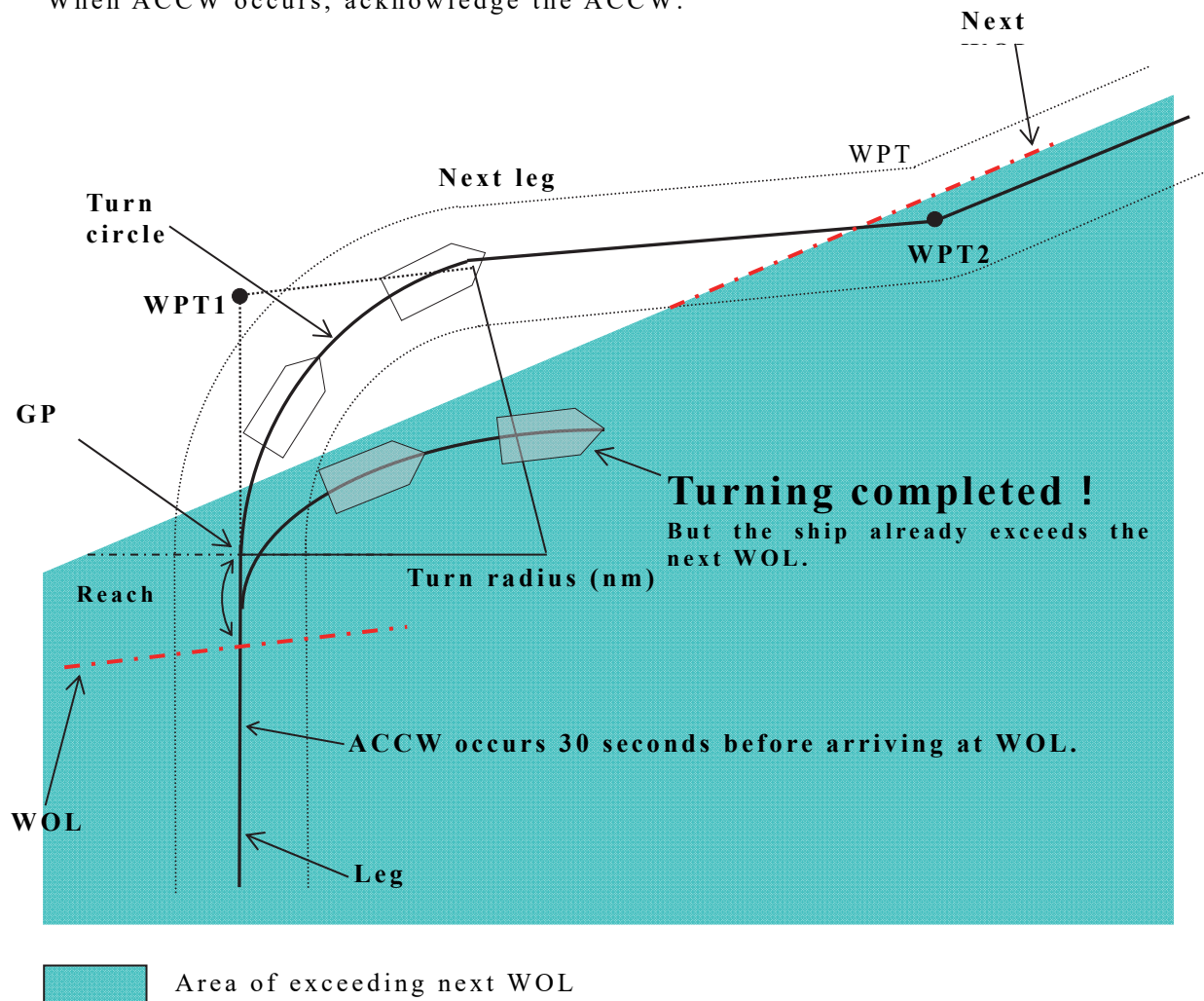
ECCW occurs 3 to 6 minutes before arriving at WOL.

(2) When the angle difference between the leg and the next leg is within ± 3 degrees, the angle of the WOL will be vertical to the leg.



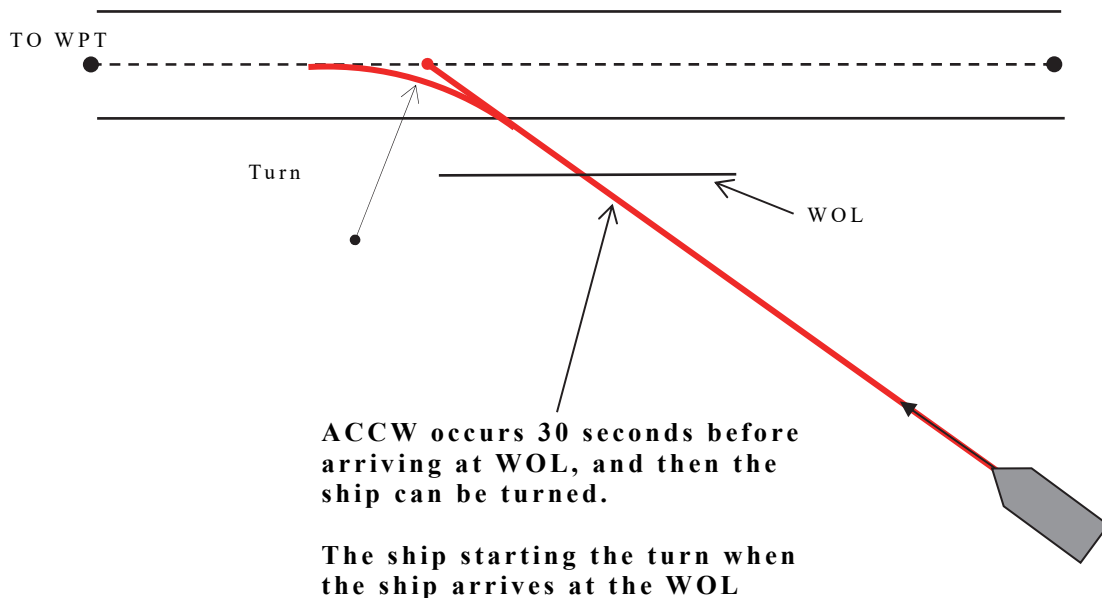
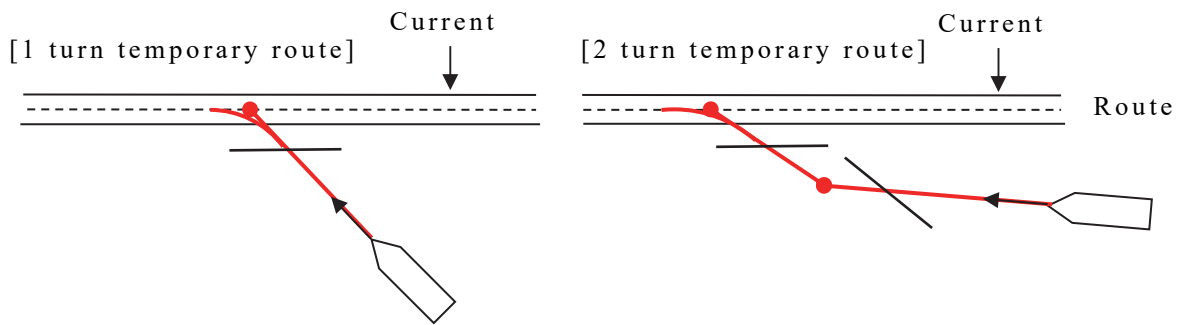
(3) If the ship exceeds the next WOL when completed the turning, follow the procedures below.

When ACCW occurs, acknowledge the ACCW.



2.3 Temporary route

If the own ship is outside the route leg when starting track control, a temporary route will be automatically made after it is judged as possible to make. The ship sails automatically along the temporary route until enters in the route. There are two types of temporary route, one-turn and two-turn, and the suitable one will be selected if a temporary route is possible to make. The number of turning is determined by the position and the direction between the ship and the route. As similarly on the route, the ship on the temporary route starting the turn when the ship arrives at the WOL. When the ship completes to turn at the last turning point of the temporary route, the temporary route automatically vanishes and the ship switches to track control on the pre-planned route. When the ship's COG comes within $\pm 3^\circ$ to the current leg, the temporary route is vanished and keep the leg course of the route.



2.4 Route steering function and Route turning function

A track control system steers the ship from its position along a track containing a sequence of waypoints using rhumb line or great circle sailing. A steering function mechanism is described below.

(1) Route Steering Function

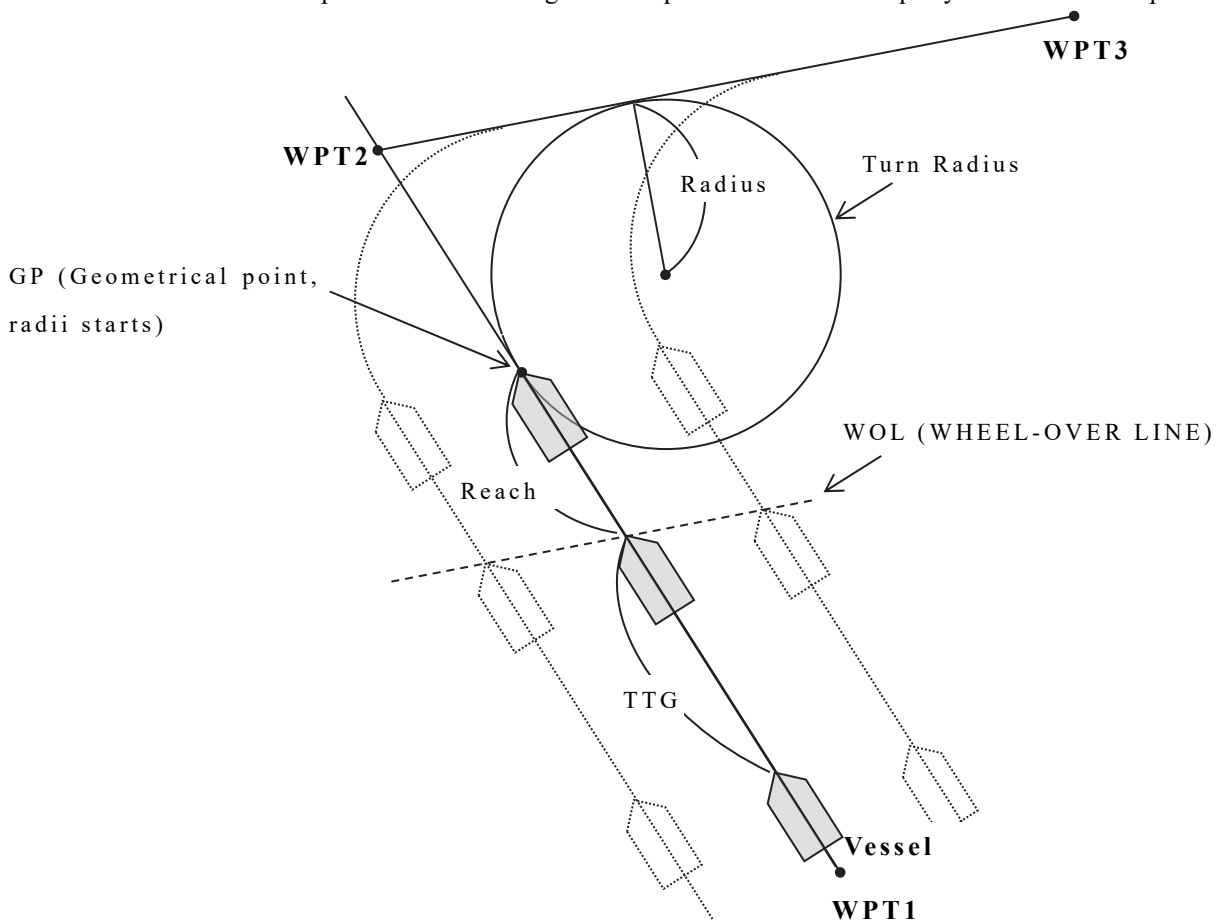
This function allows steering the ship along a route consisting of straight lines by sending the Set Course from ECDIS to Autopilot. And this function includes the “Automatic Navigation”.

The Set Course is the course from the ship’s present position to the virtual destination point on the planned route.

(2) Route turning function

Between two straight legs, the ship sails on a curved track. To turn the ship along the curved track, you need to input a turn radius of the curved track when creating the route and the ship starting the turn when the ship arrives at the WOL.

The meaning of the special terms regarding this function is as follows: *TTG* is the estimated navigation time from the current ship's position to the WOL. *ETA* is the estimated clock time when the ship passes the WOL. *Reach* is the distance that the ship keeps going straight during the time lag between steering the rudder and the ship's turning. Reach length of the To WPT are different depending on the ship type, loading condition and actual speed. Reach length except To WPT is displayed double ship length.



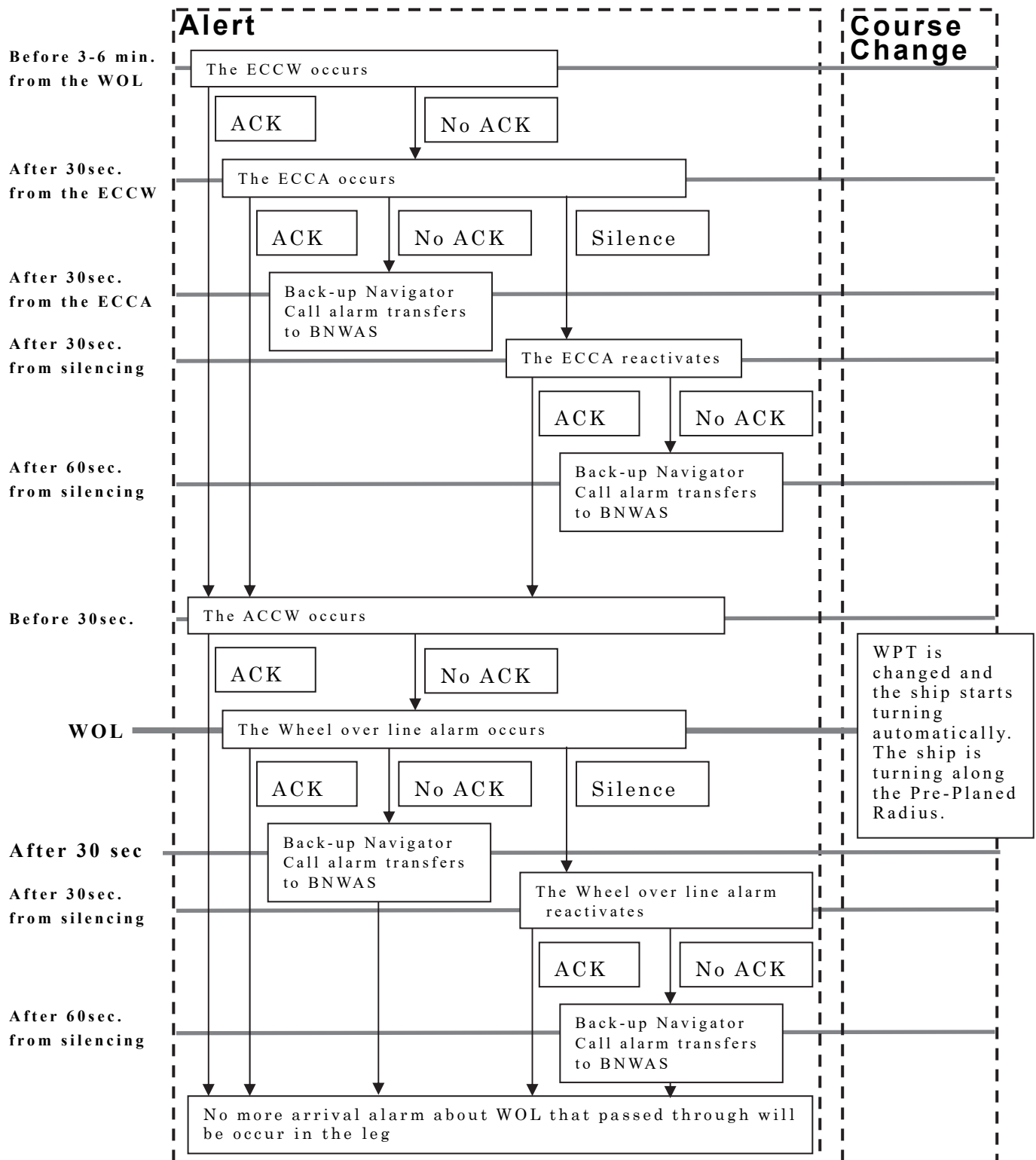
● TCS Category C

When the ship arrives at the WOL, WPT is changed and the ship starts turning automatically. The ship is turning along the Pre-Planed Radius. For Category C, the ship sails while correcting the amount of breaking away from the track.

(3) The Flow Chart of TCS Alert Sequence

•TCS Category C

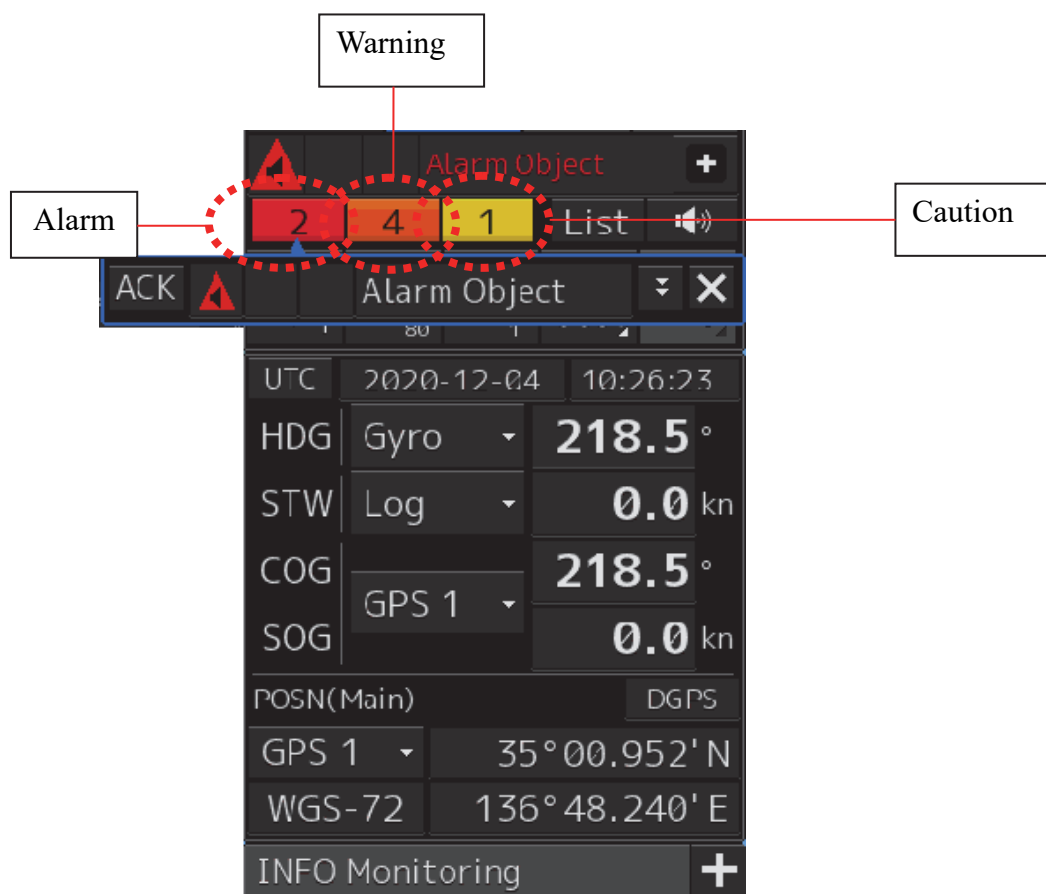
The following alarms and warnings occur in response to approach to and arrival at the destination. Regardless of whether or not any action is taken to validate the alarms and warnings, the ship sails automatically according to the track (Pre-planned route).



(4) Difference between Alarm, Warning and caution.

Alarm, Warning and caution are indicated on the upper right side of the screen.

<Alarm, Warning and Caution>



Acknowledgement : Click the [ACK] button or press the [ALERT ACK] key.

(5) When Back-up Navigator Call alarm transfers

The Back-up Navigator Call alarm will be sent to the BNWAS.

<Occurrence Conditions>

- During track control
- 30 seconds passed without acknowledging the ECCA
- 60 seconds passed since 1st silencing without acknowledging the ECCA
(See section 2.4(3) “The Flow Chart of TCS Alert Sequence”)
- 30 seconds passed without acknowledging the Wheel over Line alarm
- 60 seconds passed since 1st silencing without acknowledging the Wheel over Line alarm
(See section 2.4(3) “The Flow Chart of TCS Alert Sequence”)
- 30 seconds passed without acknowledging the Arrived at LAST WPT alarm
- 60 seconds passed since 1st silencing without acknowledging the Arrived at LAST WPT alarm
 - Arrived at LAST WPT alarm occurrence condition : 3 to 6 minutes before arriving at Final WPT
(See section 2.7 “End Of Track”)
- 30 seconds passed without acknowledging the Track Control Stopped alarm
- 60 seconds passed since 1st silencing without acknowledging the Track Control Stopped alarm
 - Track Control Stopped alarm occurrence conditions :
 - When POSN(Sensor Failure) alarm or POSN(Jump) caution occurs
 - When HDG(Sensor Failure) alarm occurs
 - When Autopilot Failure occurs

<Response to the occurrence>

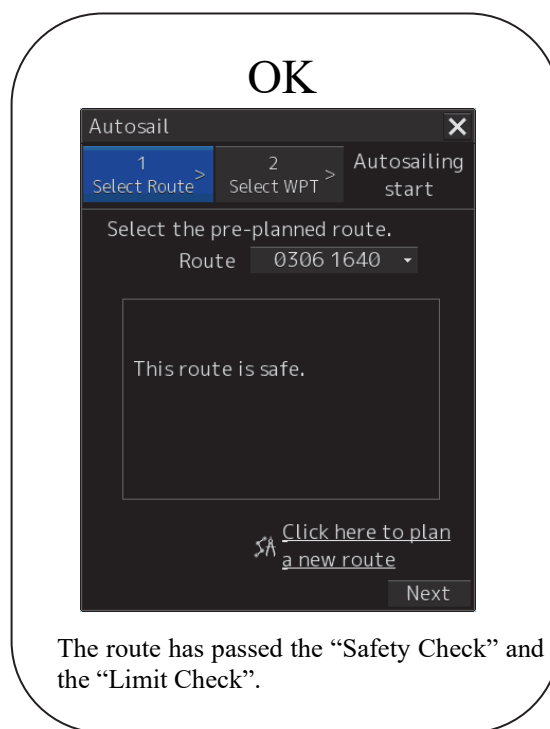
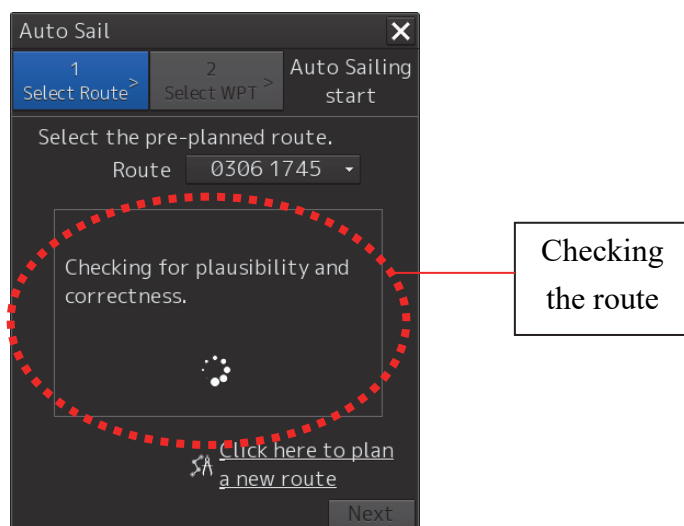
- 1) Acknowledge the Back-up Navigator Call.
- 2) Change the autopilot steering mode to the Manual.
- 3) Check the safety around the ship.

2.5 Starting requirements

In order to start track control, it is necessary to check the Limit Check, the Safety Check, and the Temporary Route Condition.

(1) Route Checking

Route checking is performed automatically when the pre-planned route is selected from the [Route] combo box.



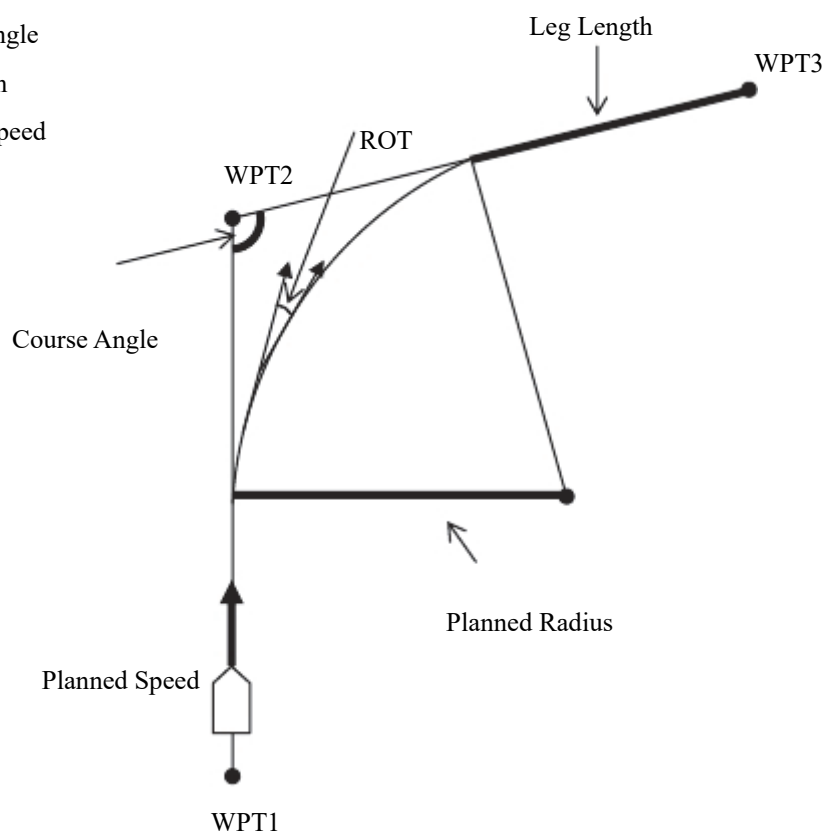
When an error is detected in the selected route, an error message is displayed.

Change the route file or modify the selected route.

(2) Limit Check

Before starting track control, it is necessary to perform the Limit Check of the pre-planned route. (For Limit Check, refer to Section 3.3.2, “Limit Check”.) The Limit Check is automatically performed when editing the route or starting track control. The limit conditions are as below:

- Turn Radius
- Course Angle
- Leg length
- Planned speed
- ROT



The pre-planned route needs to meet the following conditions:

Item			Limit Value
Turn Radius (R_s)	Max	$R_{\max}$	$3 V_s / \pi \Psi_{\min}$
	Min	$R_{\min}$	Service Engineer Input
Course Angle (θ_s)	Max	$\theta_{\max}$	Service Engineer Input
Leg length (L_s)	Min	$L_{\min}$	τL
Planned Speed (V_s)	Max	$V_{\max}$	Service Engineer Input
	Min	$V_{\min}$	Service Engineer Input
ROT(Ψ_s)	Max	$\Psi_{\max}$	Service Engineer Input
	Min	$\Psi_{\min}$	Service Engineer Input

$$\pi \doteq 3.14$$

$\Psi_{\max}$: Maximum ROT

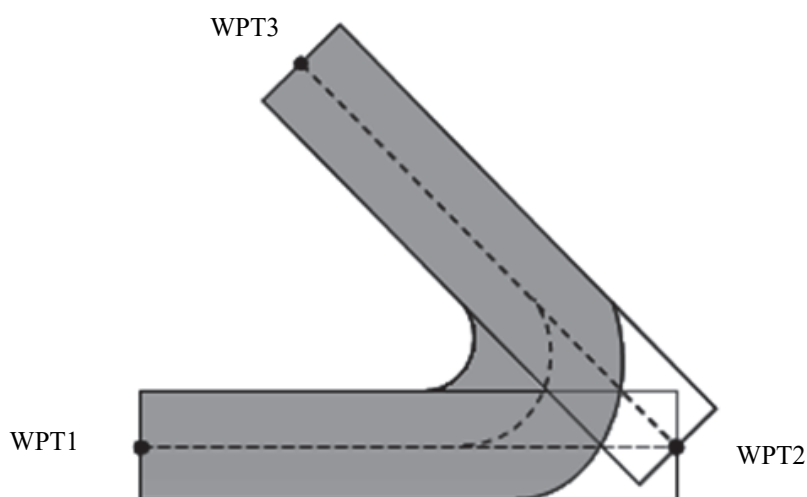
$\Psi_{\min}$: Minimum ROT

τ : Multiplier (User input 1/2/4/6/8 in the [Menu] - [Settings] - [Route] menu.)

L : Ship Length

(3) Safety Check

Before starting track control, it is necessary to perform the Safety Check of the pre-planned route. (For Safety Check, refer to Section 3.3.3, “Safety check”.) The Safety Check is automatically performed when editing the route or starting track control. Check area does not exactly synchronize with Route area and is limited to the area between the last WPT and the next. (In the figure below, for instance, the gray-colored area is the Check area.) Safety Check Symbol list is shown below.



[Safety Check Symbols]

- Traffic separation zone
- Traffic crossing
- Traffic roundabout
- Traffic precautionary
- Two way traffic
- Deeper water route
- Recommended traffic lane
- Inshore traffic zone
- Fairway
- Restricted area
- Caution area
- Offshore production area
- Military practice area
- Seaplane landing area
- Submarine transit area
- Canal
- Fishing ground
- Fishing prohibited
- Pipeline area

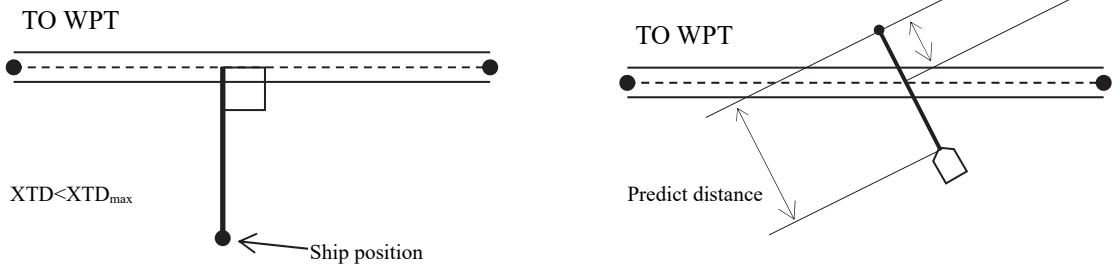
-
- Cable area
 - Anchorage area
 - Anchorage prohibited
 - Dumping ground
 - Cargo transshipment area
 - Incineration area
 - Specially protected area
 - Safety contour
 - Coast line
 - Obstruction
 - Under water rock
 - Wreck
 - Spoil ground
 - Sensitive sea area
 - Archipelagic sea lane
 - Marine farm/aquaculture
 - AtoN
 - Vertical Clearance
 - Hazard
 - Caution Object
 - Warning object
 - Alarm Object
 - Sounding
 - PSSA (Particularly Sensitive Sea Area)
 - Areas to be avoided

(4) Temporary-route condition

In order to start track control, the current ship's position and heading need to meet the following conditions of the position condition, the heading condition, and the leg condition.

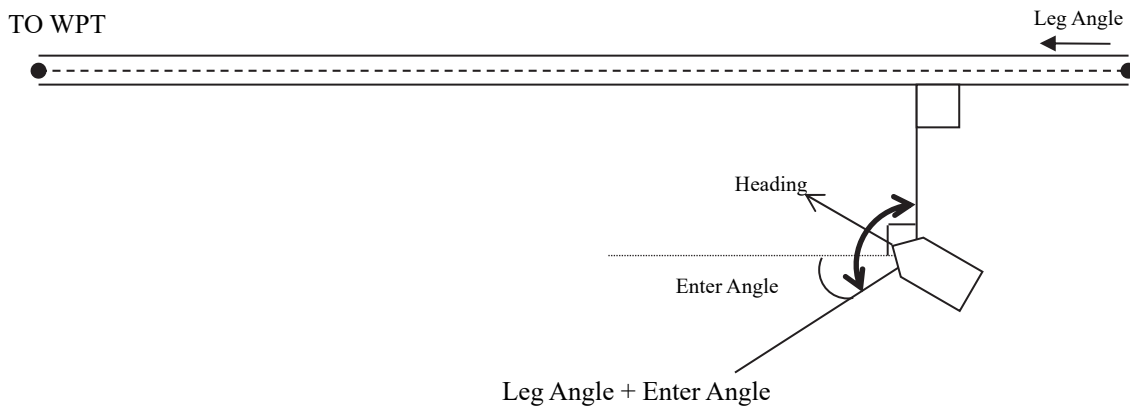
[Position condition]

XTD is defined as the distance from the ship's position to the leg. XTD must be smaller than the limit value, XTD_{max} . However, track control cannot be started if XTD is too small, because sufficient predict distance is required.



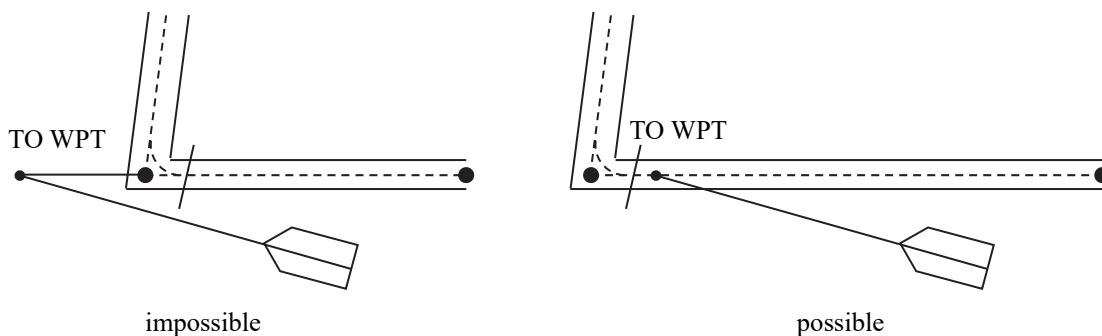
[Heading condition]

Ship's heading needs to be within the angle of "the Enter Angle plus the right angle" with the leg. (See below.) Enter Angle is inputted by the user.

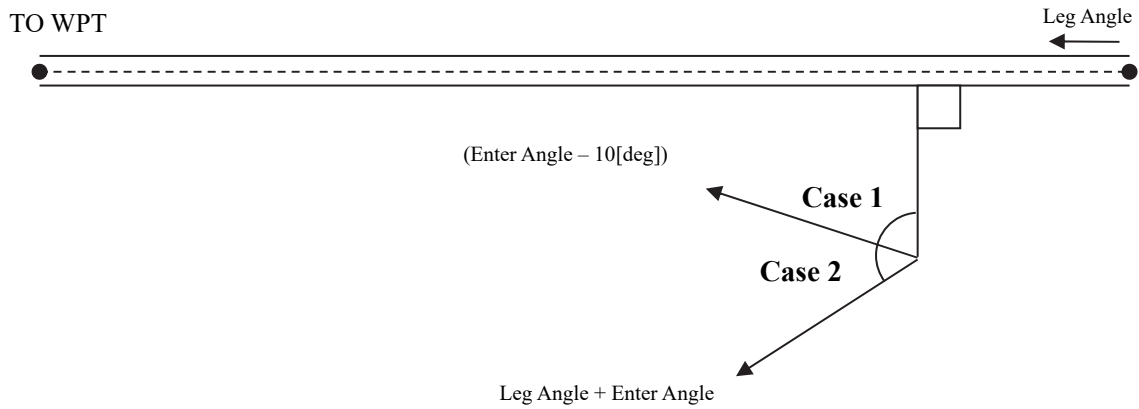


[Leg condition]

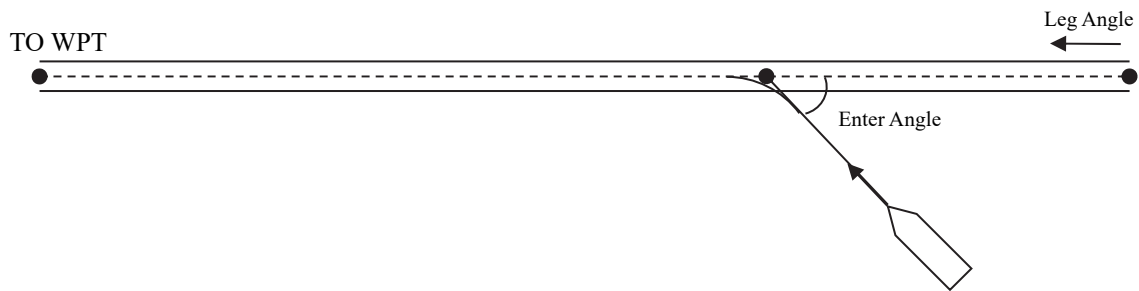
The ship must be entered in a straight leg.



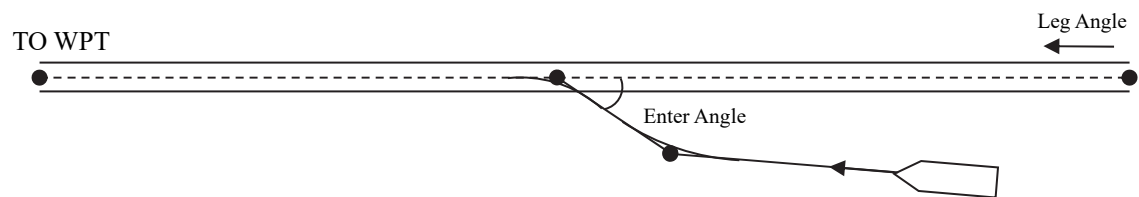
The temporary route is the route on which the ship goes before entering into the pre-planned route. The temporary route changes with ship's direction (See case 1–2 below).



[Case 1] : 1 turn pre-planned route



[Case 2] : 2 turn pre-planned route

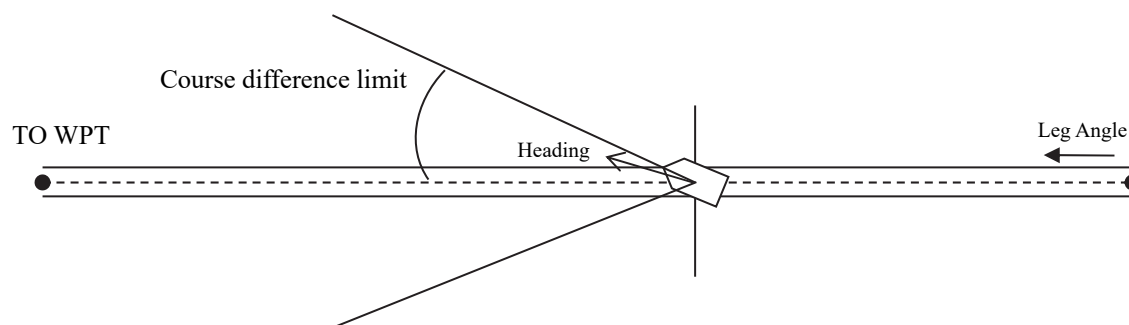


(5) Start-up condition of heading angle

In order to start track control, the current ship's heading angle need to meet the following conditions.

[Heading condition]

Ship's heading needs to be within course difference limit degree the angle with the leg. (See below.)



2.6 Position monitoring

2.6.1 Position sensor fail

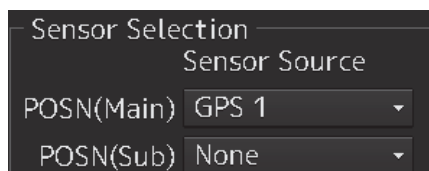
The ship's position is monitored by a second or additional independent position source. However, if GPS1 and GPS2 Position Error occurs during track control, the system automatically provides, by dead reckoning (DR), the estimated position of the ship derived from a ship borne heading sensor and a speed and distance measuring equipment (SDME). In this case, track control continues in DR mode for 10 minutes, and then automatically stops.

If POSN(Main) source (GPS1) error occurs during track control, POSN(Automatic Changed) warning is activated in 30 seconds and the system change the POSN(Main) source from GPS1 to GPS2 and change the POSN(Sub) source automatically from GPS2 to GPS1 to continue track control. If there is difference of position when the POSN(Main) sensor is changed, ECDIS gradually changed by moving average. And autopilot gradually changed rudder by moving average.

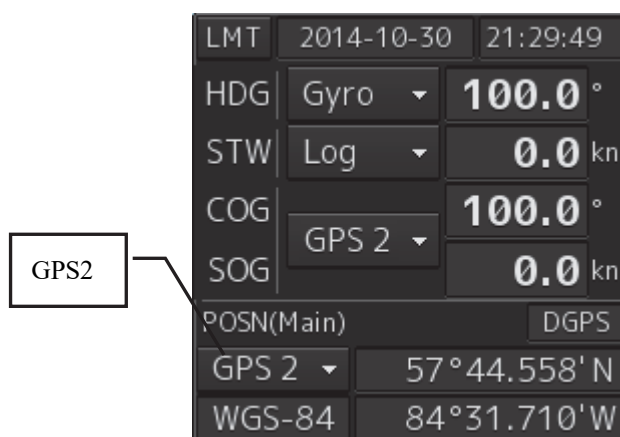


Note:

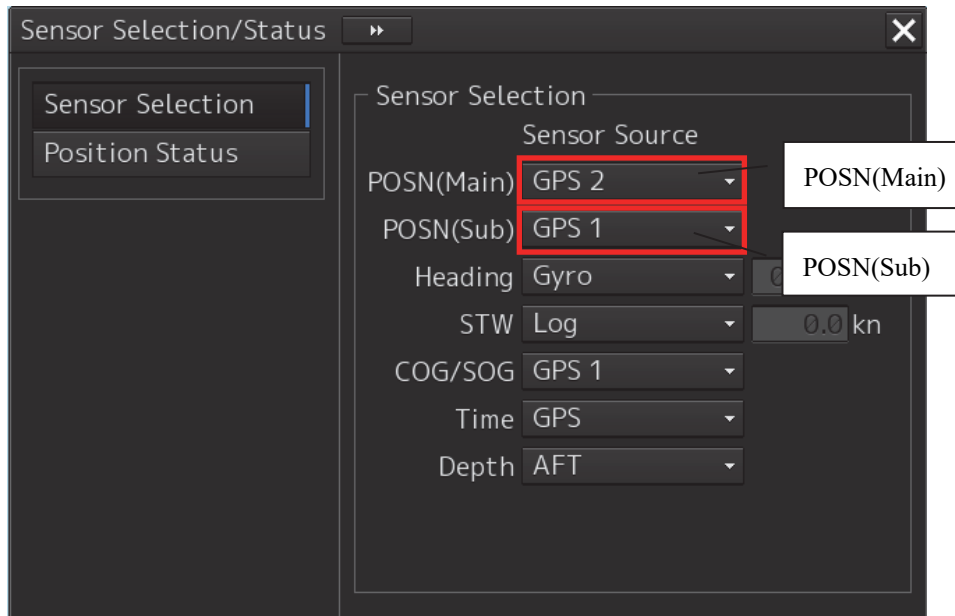
When POSN (Sub) is set to None, If POSN(Main) source (GPS1) error occurs during track control, track control continues in DR mode for 10 minutes, and then automatically stops.



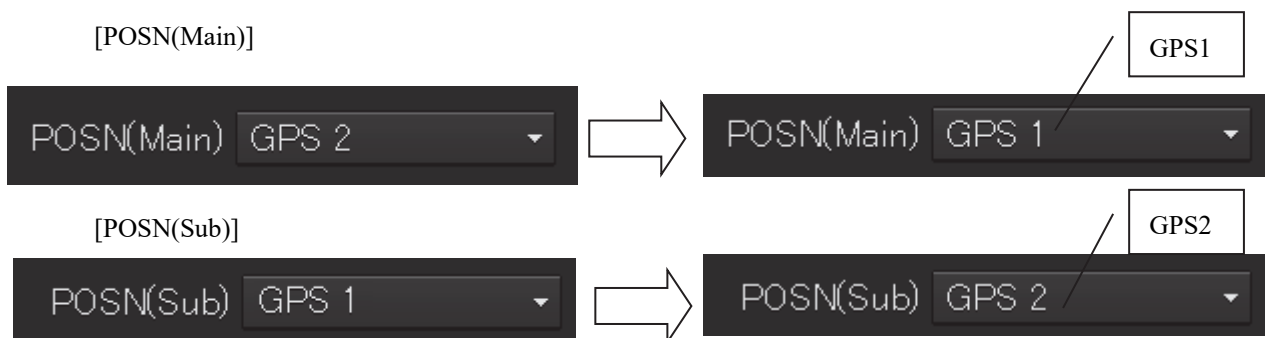
If GPS1 Position Error cause rectified, change the POSN(Main) source from GPS2 to GPS1 and change the POSN(Sub) source from GPS1 to GPS2 manually by following the procedure below.



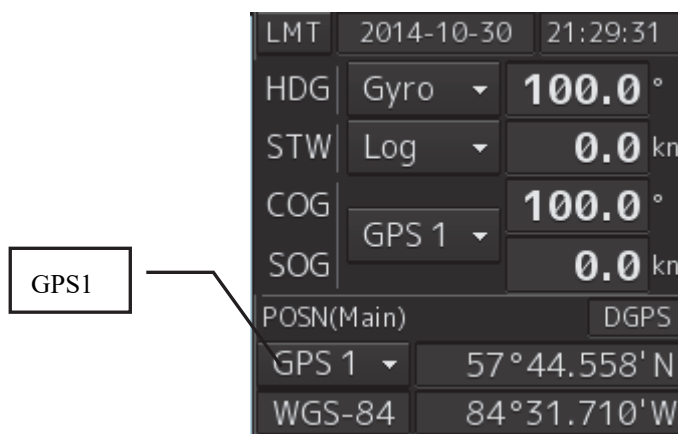
- 1) To display the Sensor Connection panel, move cursor at the Left Tool Bar and then select [Menu] - [Maintenance] - [Sensor Selection/Status].



- 2) Change POSN(Main) from “GPS2” to “GPS1”.
Change POSN(Sub) from “GPS1” to “GPS2”.

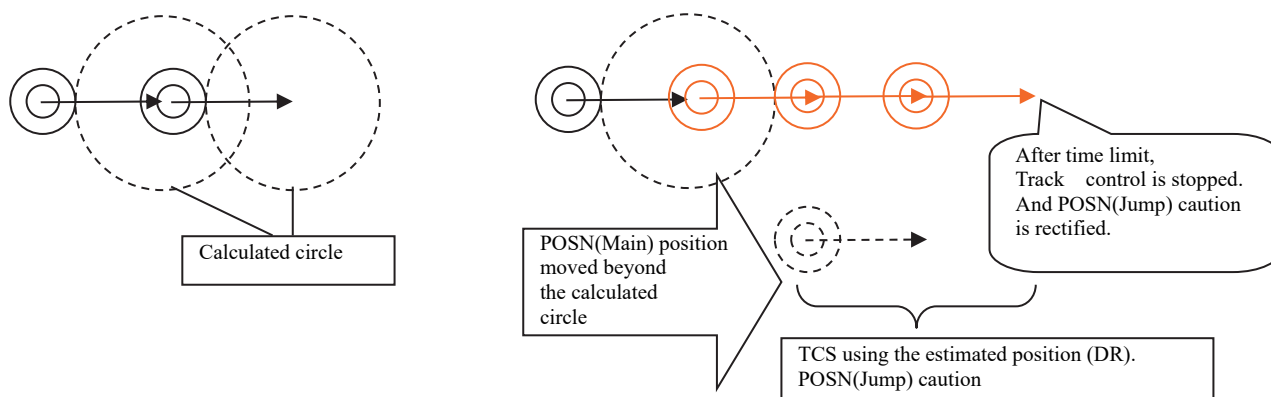


- 3) Confirm that the POSN(Main) has been changed to “GPS1”.



2.6.2 Position integrity

ECDIS calculate circle range of next position every second. When POSN(Main) position not entered calculating circle, ECDIS continue TCS using the estimated position instead of POSN(Main) position and POSN(Jump) caution is displayed. When POSN(Main) have been keeping the position beyond the calculated circle even after the time limit, track control is stopped and ship navigate with POSN(Main) position again.

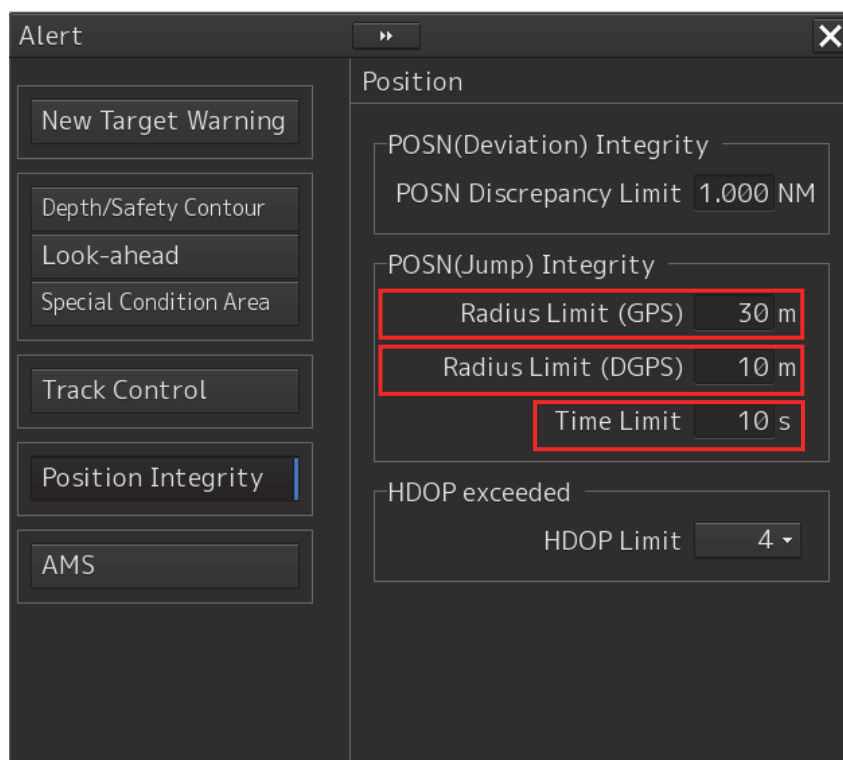


Note:

Time limit and Radius limit can be changed.

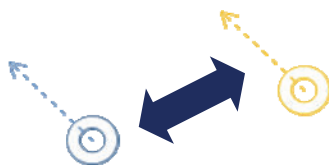
From the Left Tool Bar, select [Menu] - [Alert] - [Position integrity].

Set each value.



2.6.3 Position monitor

When difference between POSN(Main) and POSN(Sub) is increased beyond Position Difference Limit, POSN(Deviation) warning is displayed and ECDIS continue TCS.

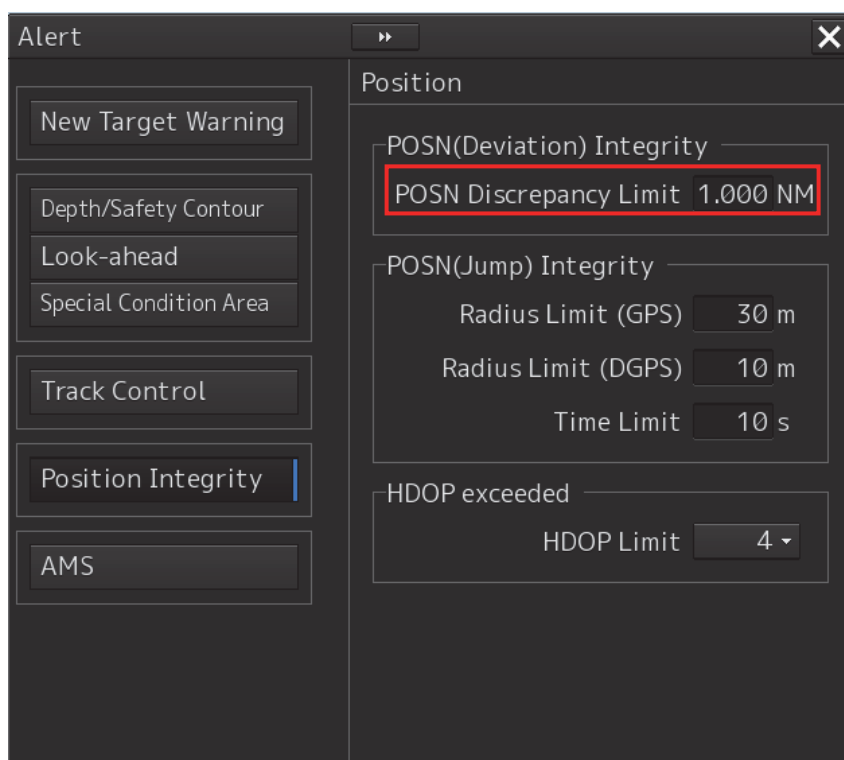


Note:

Position Difference Limit can be changed.

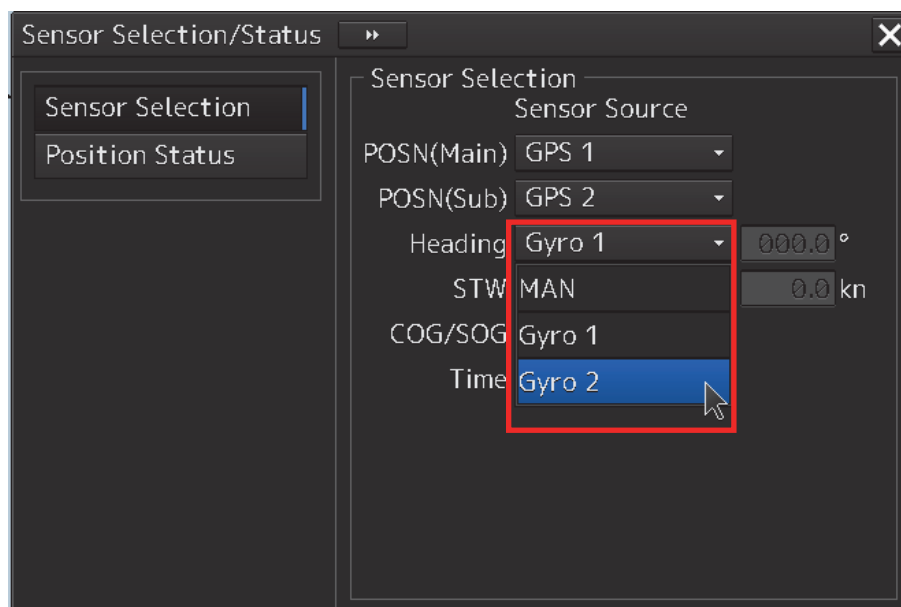
From the Left Tool Bar, select [Menu] - [Alert] - [Position integrity].

Set the Position Difference Limit value.



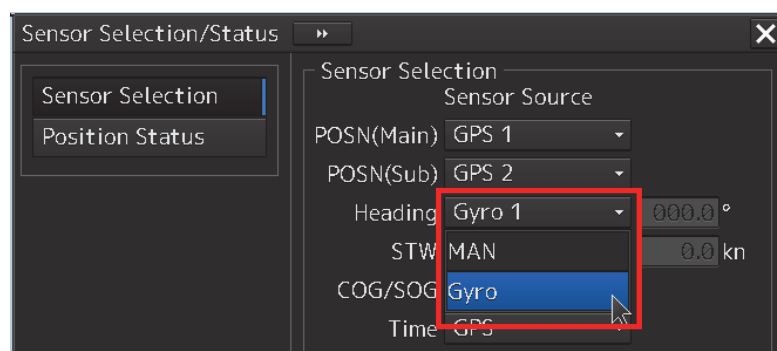
2.7 Heading sensor fail

The ship's heading is monitored by selected gyro source. If selected gyro source error occurs during track control, track control will automatically stop. To select gyro source, move cursor at the Left Tool Bar and then select [Menu] -[Maintenance] - [Sensor Selection/Status].



Note:

If ECDIS and the autopilot are connected to a gyro system that automatically controls the gyro source, when the selected gyro source error occurs during track control, the gyro system will automatically switch the selected gyro source and track control will continue. When ECDIS is connected to a gyro system, the selected gyro source can not be selected. ECDIS automatically displays the GYRO source number received from the GYRO system.



2.8 End Of Track (EOT)

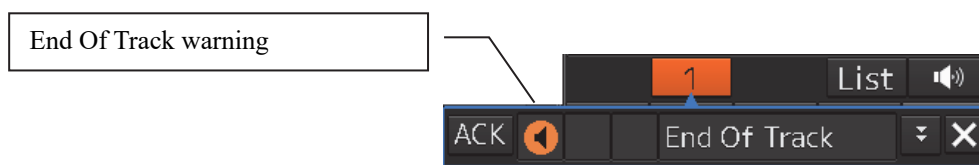
- a) 3–6 minutes before the arrival at the final destination, End Of Track warning is generated.
- b) If the End Of Track warning is not acknowledged, Arrived at LAST WPT alarm is generated after 30 seconds.
- c) If the Arrived at LAST WPT alarm is not acknowledged, Back-up Navigator Call alarm is transferred to BNWAS after 30 seconds.

If the Arrived at LAST WPT alarm is not acknowledged but is silenced temporary, Back-up Navigator Call alarm is transferred to the BNWAS after 60 seconds.

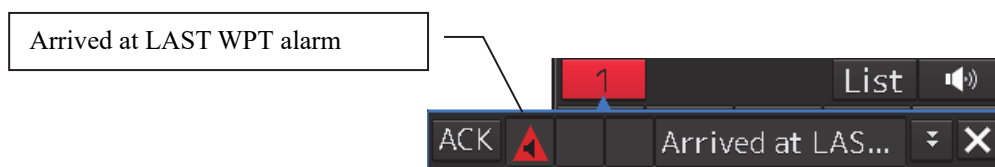
- d) When the ship arrives at the final destination, "Arrived at LAST WPT" alarm is issued and track control stops automatically. At that time, "Track Control Stopped" will be displayed in "Action" of the alert details display.
- e) Until the user takes over, the system follows the track course of the final leg and, after the end of the leg, keeps the ship going straight while maintaining the actual heading.

2.8.1 Alert and indication for "End Of Track"

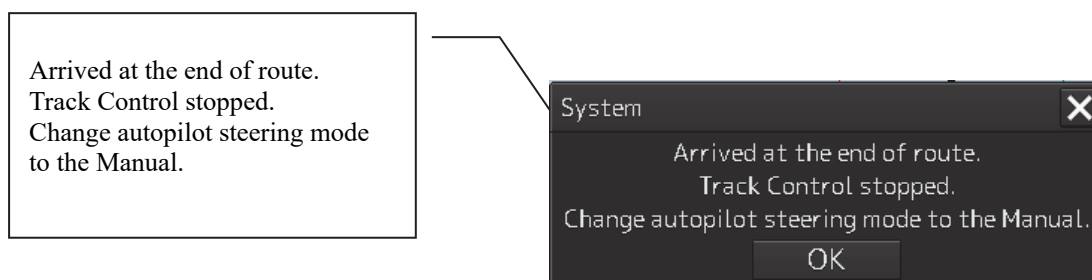
a)



b)

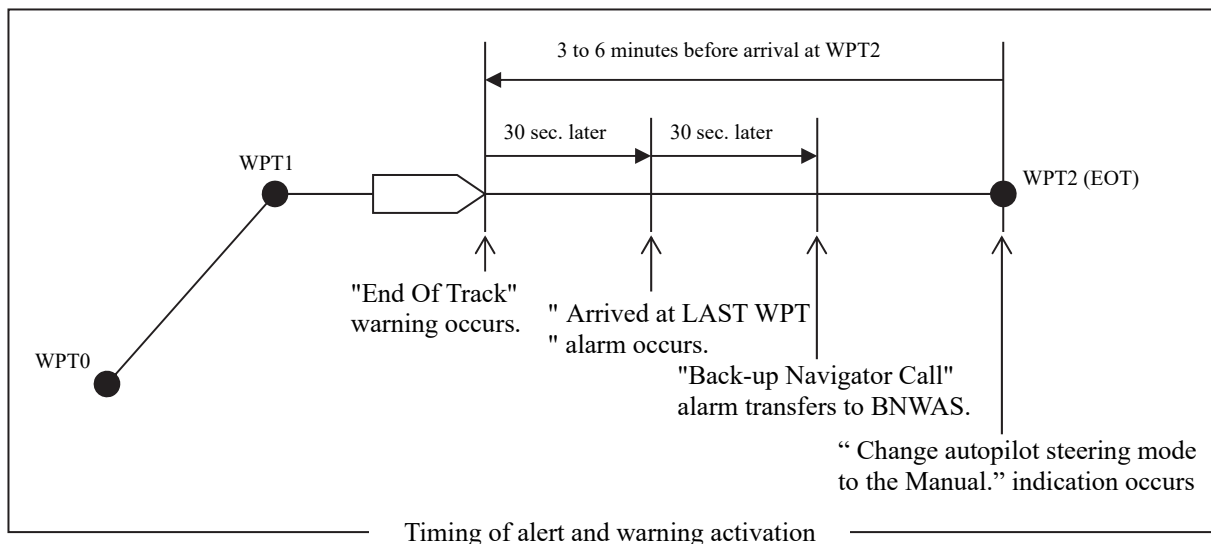
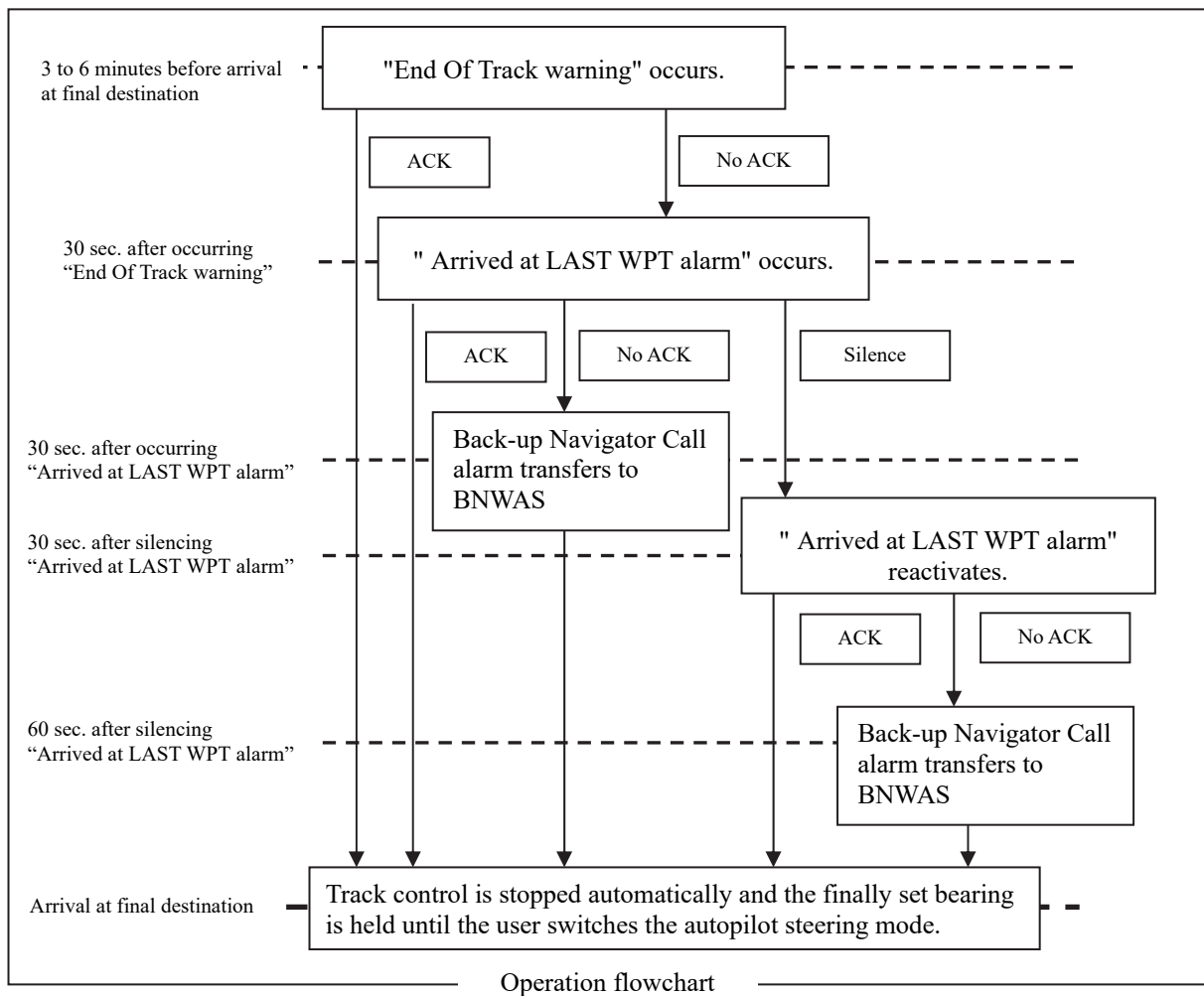


c)



2.8.2 Alert and indication related to approach to the final destination

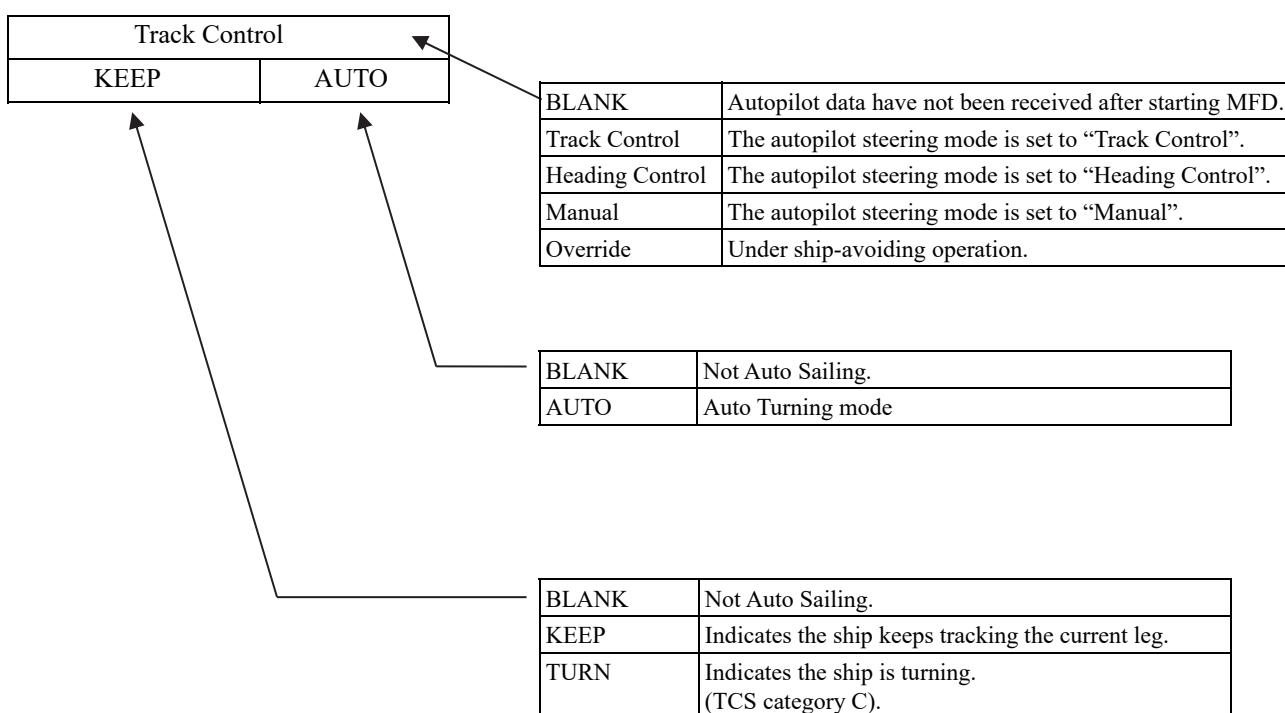
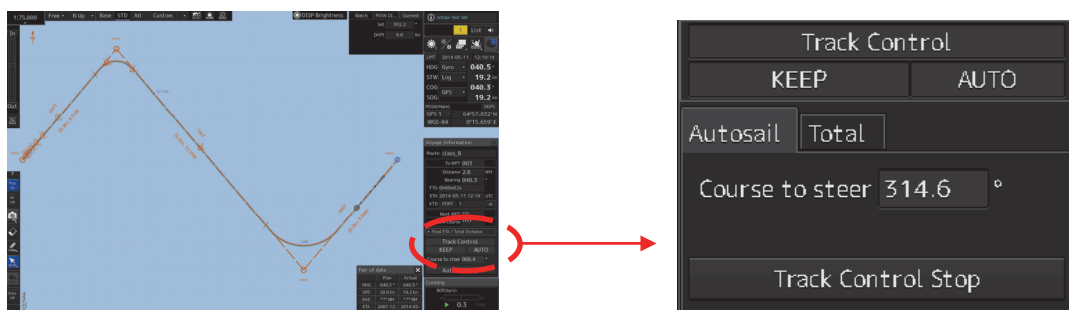
The following alarms and warnings occur in response to approach to and arrival at the destination. "End Of Track warning" is issued 3–6 minutes before the arrival at the final destination. If no action is taken to validate the warning within 30 sec, "Arrived at LAST WPT alarm" is issued. If no action is taken to validate the alarm within 30 sec, "Back-up Navigator Call alarm" is sent to the BNWAS. After the arrival at the final destination, the finally set bearing (bearing on the extension of the final leg) is maintained until the steering mode of the Autopilot is switched.



2.9 Information display for TCS

2.9.1 Steering mode indication

The steering mode of the autopilot and the status of ECDIS can be displayed. For the display contents, refer to the following:



2.9.2 Heading monitoring

Heading is displayed on the ECDIS display panel. Refer to the following.

LMT	2021-01-25	01:21:20	
HDG	Gyro	000.0°	Ship's heading. (GYRO)
STW	Log	10.0 kn	Log speed (speed through the water)
COG	GPS 1	000.0°	Course and speed of primary (The vector of the vessel's motion over the ground). Selected GPS or LOG.
SOG		10.0 kn	
POSN(Main)		DGPS	
GPS 1		35°30.328' N	
WGS-84		139°50.000' E	
INFO Monitoring			+

2.9.3 Route Monitoring dialog

The Route Monitoring dialog contains the information on the following: to Voyage Information, Voyage calculation and Pair of data.

Route Monitoring

X

Route UNLOAD

To WPT Auto Select

Voyage Information

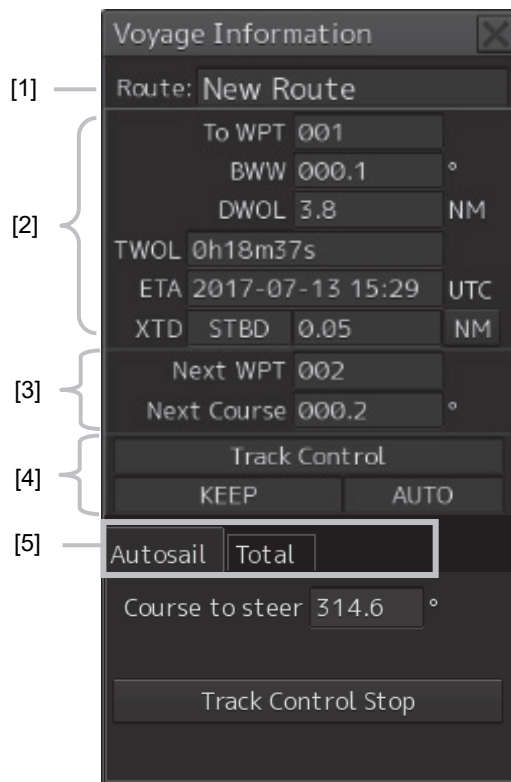
Voyage Calculation

Pair of data

[Voyage Information:]

The "Voyage Information" dialog box is used to monitor voyage statuses.

In addition to voyage monitoring, execution of course change and termination of automatic navigation can also be performed.



[1] Route name display

A file name of the route that is being monitored is displayed.

[2] To WPT information

The To WPT information that was selected in Route Monitoring is displayed.

[3] Next WPT information

Displays a Next WPT number, displays a leg bearing of the Next WPT.

[4] Track control information

This section displays the status of Auto Pilot that is installed.

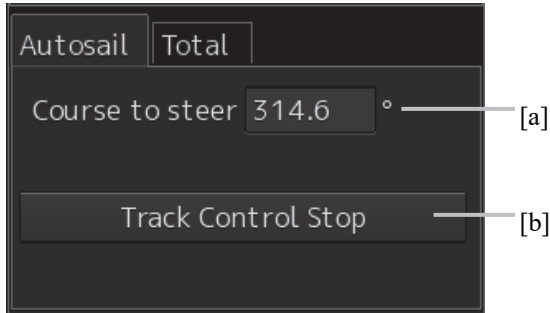
For displayed contents, refer to "2.8.1 Steering mode indication".

(5) Switching tab

When this tab is clicked on, the contents of the following dialog are switched.

[Clicking on the [Autosail] tab]

The dialog is switched to [Autosail] (automatic ailing) dialog.



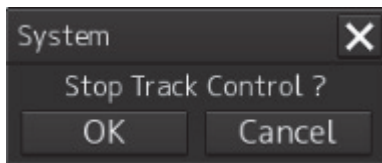
(a) Course to steer

Displays the course to steer to be transmitted to auto pilot.

(b) [Track Control Stop] (stop automatic sailing) button

To stop automatic sailing, click on this button.

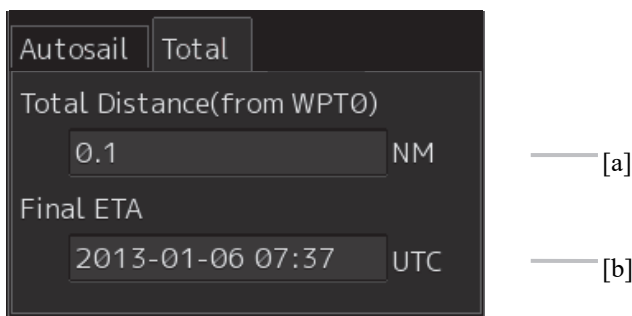
The following message dialog is displayed.



When the [OK] button is clicked on, automatic sailing terminates.

[Clicking on the [Total] tab]

The dialog is switched to the [Total] dialog.



[a] [Total Distance (from WPT0)]

Displays the total distance from WPT0 to own ship.

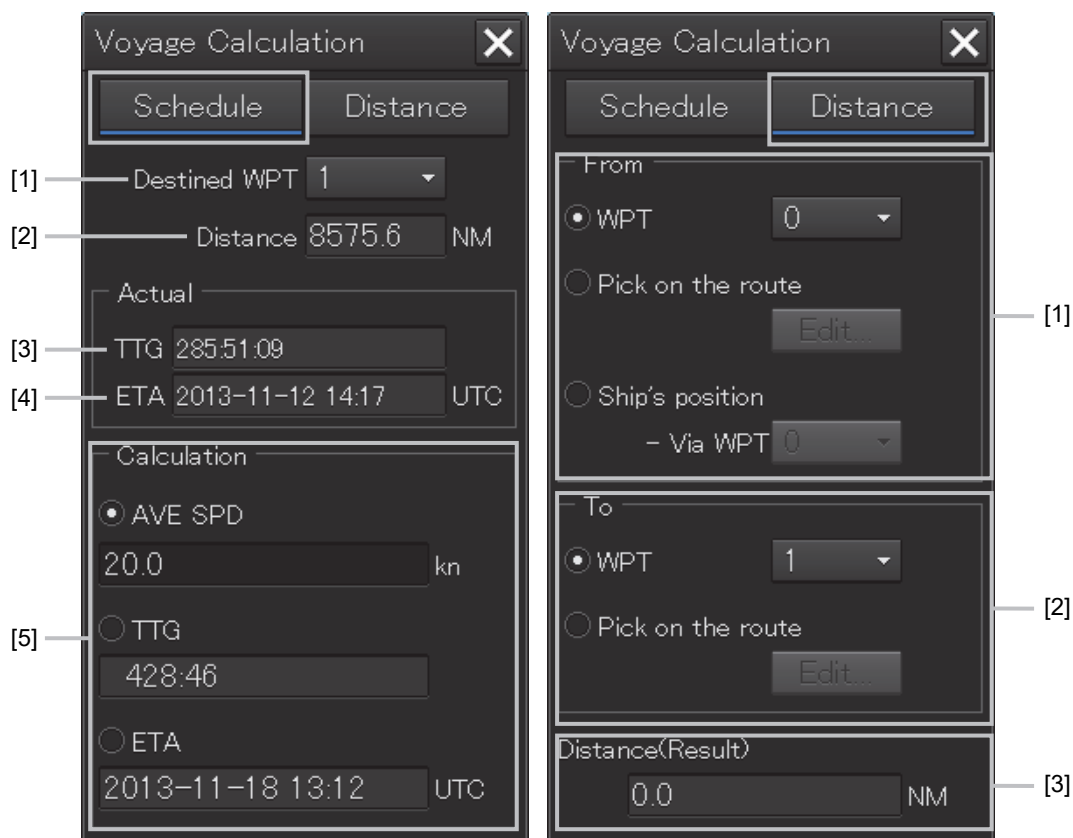
[b] [Final ETA]

Displays the expected time of arrival to the final WPT that is calculated based on the current ship's speed.

[Voyage Calculation:]

The "Voyage Calculation" dialog box is used to calculate the expected WPT arrival time, the time required, and required ship speed

It is also possible to calculate a distance between two points such as between WPTs, from the own ship's position to WPT, or any position on the route to WPT.



"Schedule" Dialog

[1] [Destined WPT] combo box

Select a destined WPT.

[2] [Distance] (Distance up to the destined WPT)

Displays a distance from the own ship's position to the selected WPT.

[3] [TTG] (Expected traveling time)

Displays a traveling time required based on the position from the current SOG value to the destined WPT.

[4] [ETA] (Expected time of arrival)

Displays a time at arrival of the destined WPT from the current SOG value.

[5] [Calculation] (Calculation)

Selects a calculation method and enters the values.

"Distance" Dialog

[1] [From]

Selects a starting point calculation method and enters the values.

[2] [To]

Selects an ending point calculation method and enters the values.

[3] [Distance (Result)] (Distance calculation result)

Displays distance from the starting point and ending point that were obtained from the setting.

[Pair of data]

The "Pair of data" dialog box enables comparison of data between the planned route and the actual route.

Pair of data			✕	
	Plan	Actual		
[1]	HDG	008.6 °	045.0 °	[5]
[2]	SPD	20.0 kn	11.8 kn	[6]
[3]	RAD	0.01 NM	0.01 NM	[7]
[4]	ETA (UTC)	2004-10-05 04:40	2013-11-12 14:19	[8]

Planned data is displayed in [Plan] (route plan) and the actual route data is displayed in [Actual] (actual route) in the dialog.

[1] Planned route heading

Displays a planned course.

[2] Planned ship's speed

Displays a planned ship's speed.

[3] Planned turn radius

Displays a planned turn radius.

[4] Planned ETA

Displays a planned expected time of arrival.

[5] Actual ship's heading

Displays an actual ship's heading.

[6] Actual speed

Displays an actual ship's speed.

[7] Actual turn radius

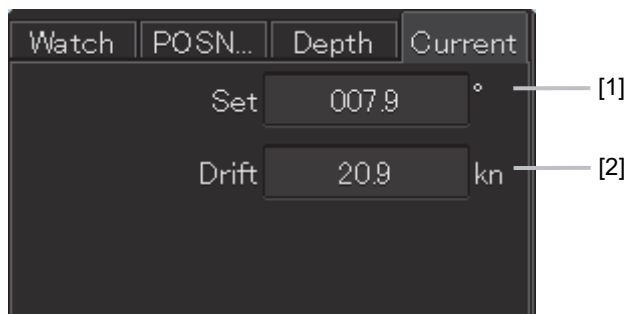
Displays an actual turn radius.

[8] Actual ETA

Displays an expected time of arrival (ETA) that is calculated from the actual ship's speed.

2.9.4 Current Information

Displays the speed and direction of the tidal in Current dialog of Sub Information Area.

**[1] Set**

Display the bearing of the tidal.

[2] Drift

Display the speed of the tidal.

2.9.5 Route information during Track control

You can confirm Route information during Track control by following the procedure below.

- 1) To display Table Editing screen, from the Left Tool Bar select [Menu] - [Route Planning].

WPT No.	Name	Position		Leg		Sail	XTL		Arrival Radius	Turn Radius
		LAT	LON	Course	Distance		PORT	STBD		
		**° **.*	**° **.*							

- 2) Click Open button to open Route file.

Route file cannot be saved.

WPT No.	Name	Position		Leg		Sail	XTL		Arrival Radius	Turn Radius	Plan Speed	ROT	ETA [YYYY-MM-DD hh:mm]	Time Zone	TTG [Days hh:mm]	Total Distance
		LAT	LON	Course	Distance		PORT	STBD								
0		32° 22 015'S	61° 07 738'E										2005-02-21 01:12	+09:00		
1		32° 24 845'S	61° 08 484'E	167.4°	2.9NM	RL	0.10NM	0.10NM	0.10NM	0.50NM	20.0kn	382° /min	2005-02-21 01:20	+09:00	00 Days 00:08	2.9N
2		32° 25 943'S	61° 09 536'E	140.9°	1.4NM	RL	0.10NM	0.10NM	0.10NM	0.50NM	20.0kn	382° /min	2005-02-21 01:25	+09:00	00 Days 00:04	4.3N
3																

(a) (b) (c) (d) (e)

- 3) Confirm the following Route information:

- (a) Waypoint numbers
- (b) Co-ordinates
- (c) Courses between waypoints
- (d) Distances between waypoints
- (e) Turn radius or rates of turn.

Note: Route file cannot be overwritten during track control.
(Save as different name.)

2.10 Changeover the TCS operation rights between two ECDIS

2.10.1 Configuration

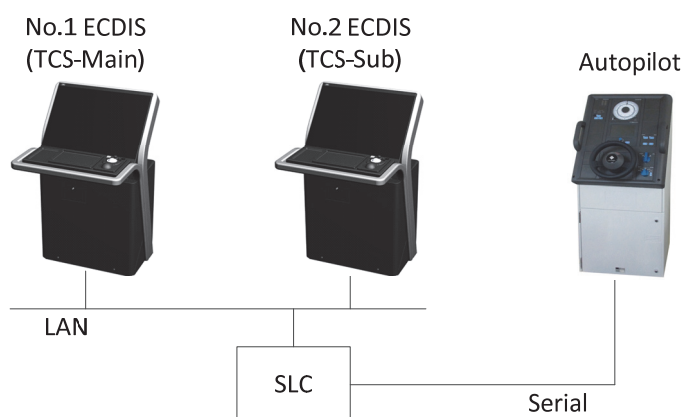
No.1 ECDIS(TCS-Main) TCS-Main is primary equipment for TCS. The equipment has TCS operation rights first. The equipment having the rights communicates with Autopilot and can start TCS.

No.2 ECDIS(TCS-Sub) TCS-Sub is backup equipment for TCS. When equipment of TCS-Main is failure, this equipment gets TCS operation rights.

Autopilot

SLC

Serial LAN Converter



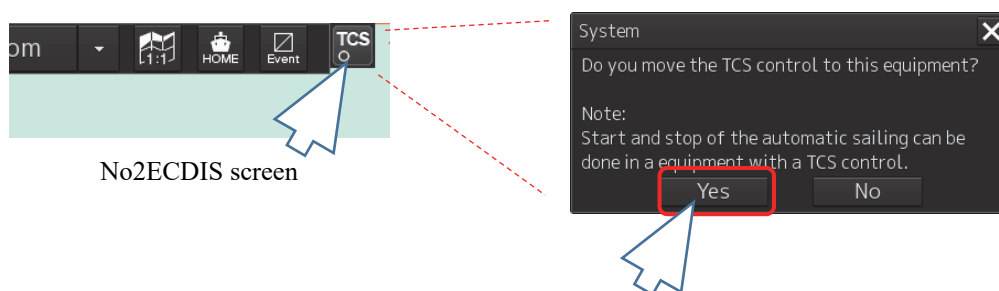
2.10.2 How to change TCS operation rights

a) TCS-Main is normal condition

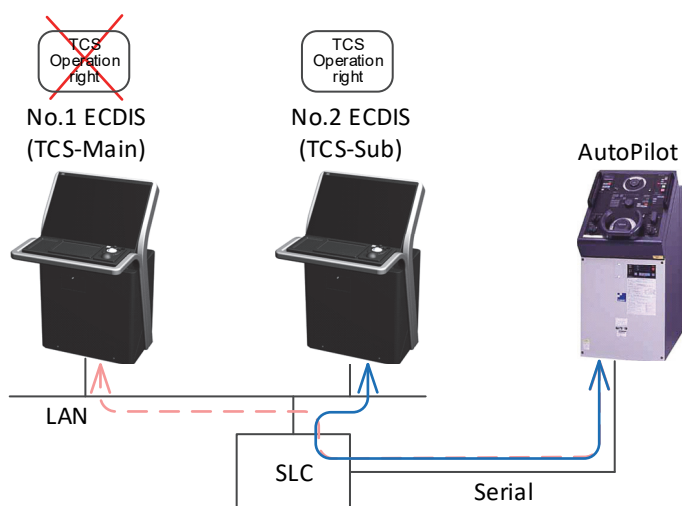
Only equipment having TCS operation rights communicates with Autopilot and can start TCS. First No.1 ECDIS (TCS-Main) has the right and can start TCS. No.2 ECDIS (TCS-Sub) cannot start TCS. To start TCS with No.2 ECDIS (TCS-Sub), need to change TCS operation rights by operation of ECDIS screen.

[Change TCS operation right from ECDIS screen]

Click the TCS icon at the top of the ECDIS screen and select "Yes" at the popup displayed. After selection, the TCS operation right is changed from No. 1 ECDIS (TCS-Main) to No. 2 ECDIS(TCS-Sub).



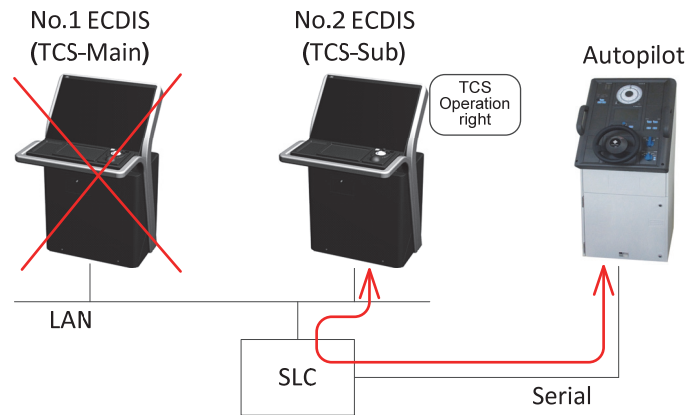
The TCS operation right is changed from No. 1 ECDIS to No. 2 ECDIS.



Note: TCS operation right can not change during TCS.

b) Case of equipment of TCS-Main is failure (include Power OFF).

When No.1 ECDIS (TCS-Main) is failure, No.2 ECDIS (TCS-Sub) takes over TCS operation rights and communicates with autopilot. If No.1 ECDIS (TCS-Main) is failure during of TCS, TCS is stopped and TCS is needed to restart on No.2 ECDIS (TCS-Sub).



c) Case of equipment of TCS-Main is recovered from failure

When No.1 ECDIS (TCS-Main) is recovered from failure, No.1 ECDIS (TCS-Main) takes over TCS operation rights again.

If No.1 ECDIS (TCS-Main) is recovered during of TCS on No.2 ECDIS (TCS-Sub), No.2 ECDIS (TCS-Sub) continue TCS until TCS stop. After that, No.1 ECDIS (TCS-Main) takes over TCS operation rights.

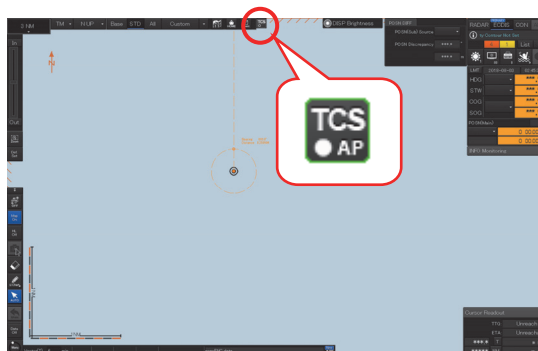
2.10.3 Difference of display by TCS operation right

The display is different by TCS operation right as follows.

[TCS icon]

The status of the TCS icon at the top of the ECDIS screen is different.

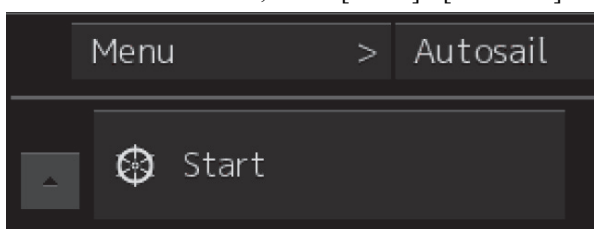
	TCS operation right available
	TCS operation right not available
	TCS operation right available (When TCS is running on self unit)
	TCS operation right not available (When TCS is running on other unit)



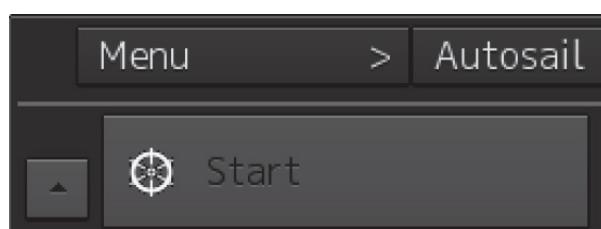
TCS icon position on the ECDIS screen

[Menu]

From the Left Tool Bar, select [Menu] - [Auto Sail]

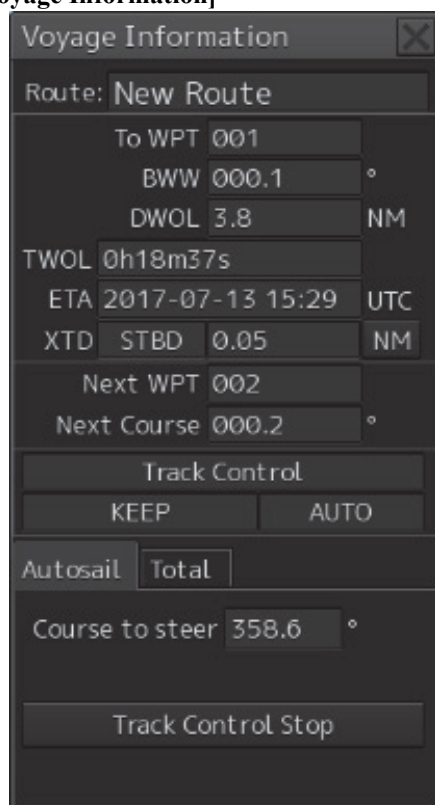


When ECDIS have TCS operation right

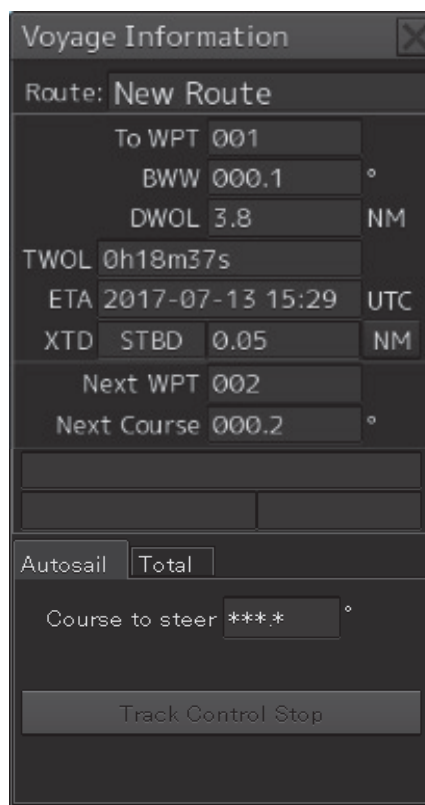


When ECDIS have not TCS operation right

[Voyage Information]



When ECDIS have TCS operation right during track control.



When ECDIS have not TCS operation right during track control.

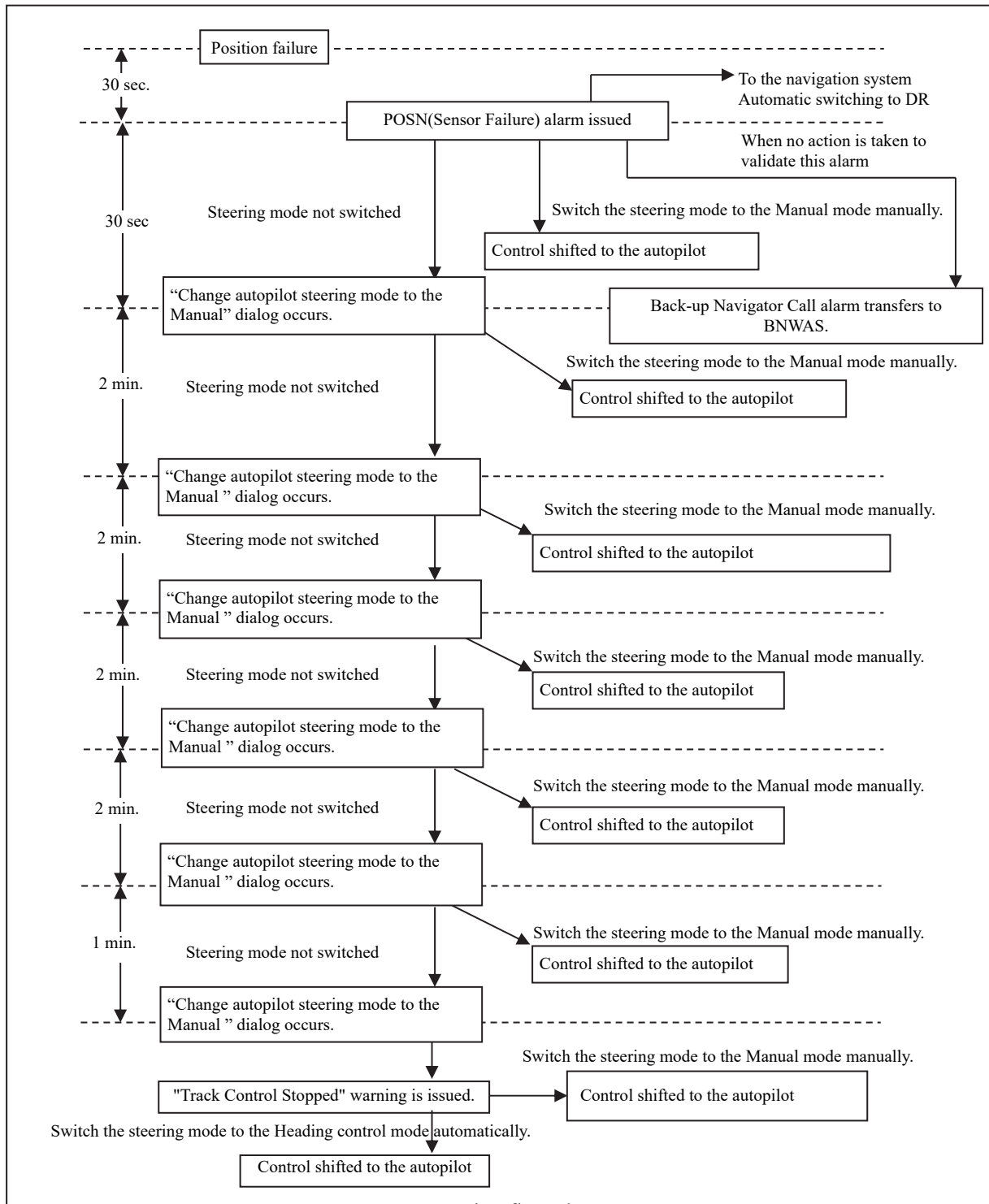
2.11 Alarm

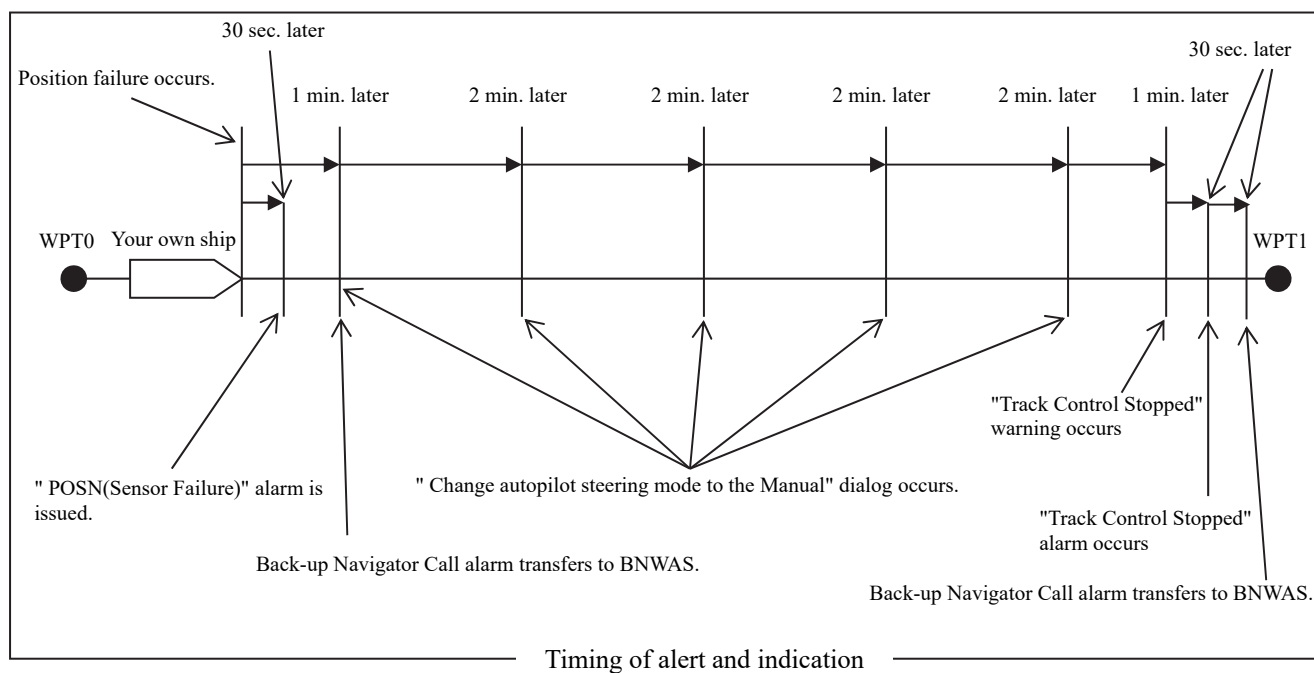
During Track control, the system always monitors the alarms listed in the table below. When an alarm occurs, change the steering mode of autopilot from “NAV” to “HAND” to stop track control as needed. To restart track control, remove the cause of the alarm and perform track control startup operation again. These Alarm are displayed on ECDIS.

Alert message	Condition	Continuation of track control	Back-up Navigator Call	Control mode after alarm is generated	Recommend mode
Track Control Stopped	DR navigation has continued for 10 minutes after all Position sensor error.	Possible for 10 minutes by DR (See “Alarm for primary position failure”).	Activated	Heading control (The course is maintained)	AUTO or HAND
	Heading sensor error occurs. (ECDIS only)	Impossible	Activated	Heading control (The course is maintained)	AUTO or HAND
	Heading sensor error occurs. (ECDIS and Autopilot)	Impossible	Activated	The current heading is maintained on the straight leg. The current rudder angle is maintained on the curved path.	HAND
	Autopilot error occurs. (Heading control is unavailable)	Impossible	Activated	The current heading is maintained on the straight leg. The current rudder angle is maintained on the curved path.	AUTO or HAND
	Communication error between the autopilot and ECDIS occurs.	Impossible	Activated	Heading control (The course is maintained)	AUTO or HAND
Arrived at LAST WPT	2 and a half minutes to 5 and a half minutes before arrival at final destination.	Track control continues along the present leg. (See the section “Alert and indication related to approach to the final destination)	Activated	Track control	—
POSN(Sensor Failure)	All Position sensor error occurs.	Possible for 10 minutes by DR.	Activated	Track control by DR mode for 10 minutes	AUTO or HAND
HDG(Sensor Failure)	Heading sensor error occurs. (ECDIS only)	Impossible	Activated	Heading control (The course is maintained)	HAND
	Heading sensor error occurs. (ECDIS and Autopilot)	Impossible	Activated	The current heading is maintained on the straight leg. The current rudder angle is maintained on the curved path.	HAND
STW(Sensor Failure)	LOG sensor error occurs.	Possible	Activated	Track control by using final valid value.	AUTO or HAND
Cross Track	Ship is off the route width.	Possible	Not Activated	Track control	—

2.11.1 Alert for position failure

If the all position sensor is faulty, shift the operation to the autopilot through the process shown in the chart below. When position failure has been found out, POSN(Sensor Failure) alarm is issued and the navigation system is switched to DR automatically. One minute after the switching, the system issues an alarm, “Change autopilot steering mode to the Manual” to prompt the operator to change the steering mode of the autopilot. Even if any action is taken to validate the alert, the alert is issued repeatedly every two minutes until the operator switches the steering mode. If the steering mode is not switched within ten minutes after DR starts, Track Control Stopped alarm is issued. Track Control Stopped alarm is issued.

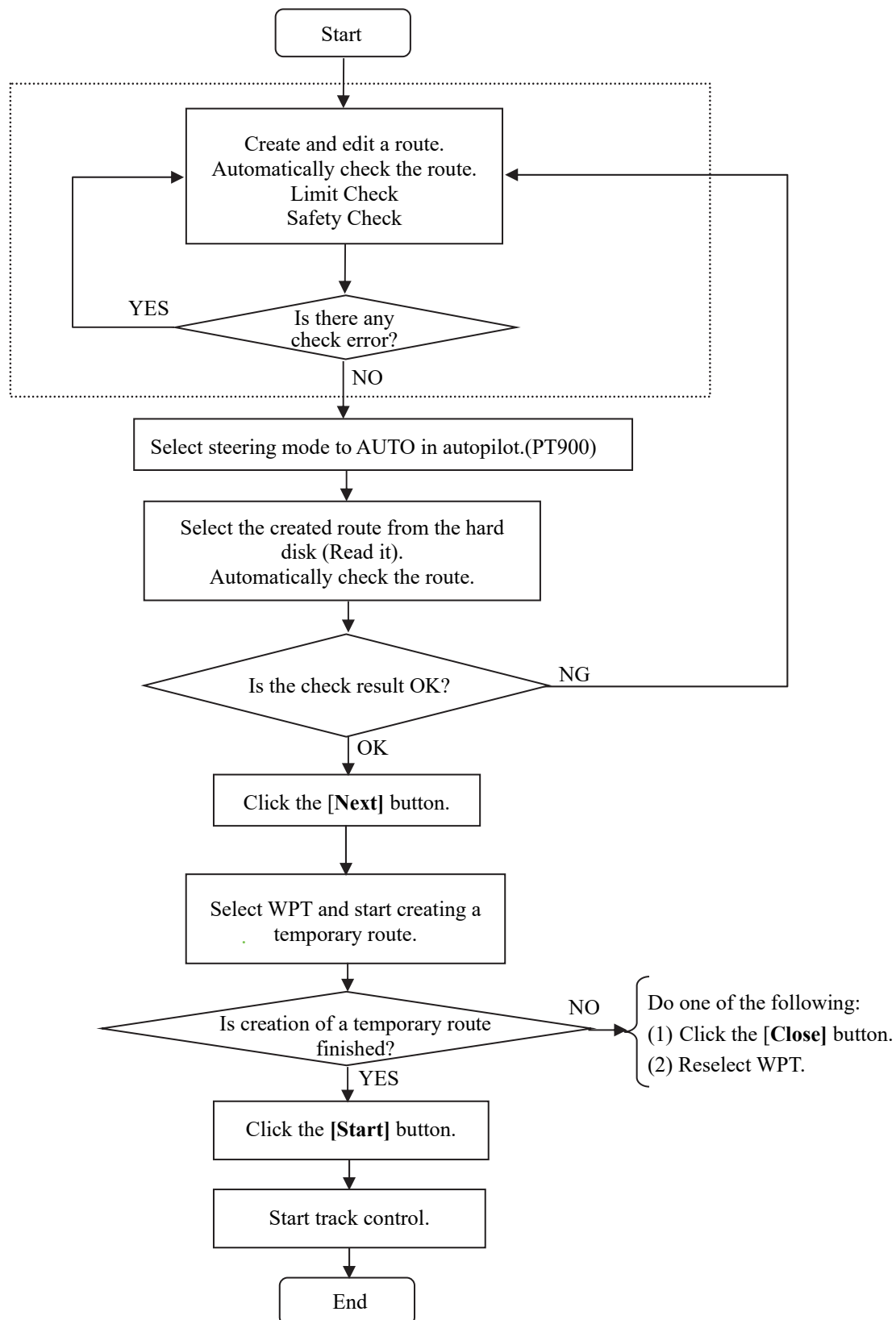




3. TCS Operation

3.1 TCS start procedure

(1) The following shows the conceptual flowchart for starting track control.



Note: Be sure to monitor track control. Stop track control if an alert occurs.
Release all alert before re-start track control.

(2) Startup conditions

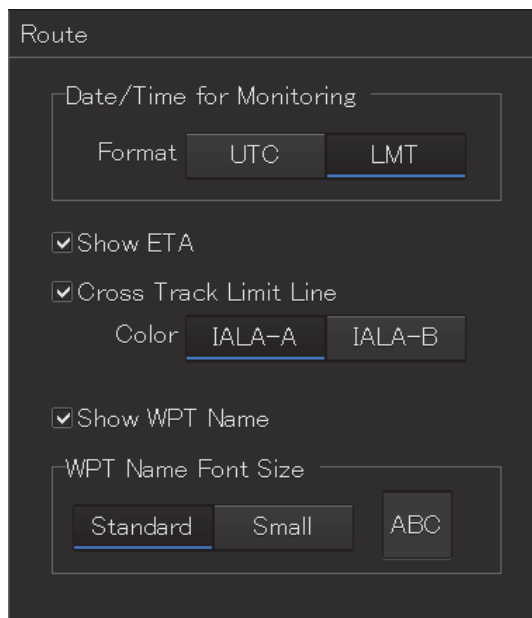
All the following conditions must be met to start track control. If any of them is not met, an error occurs.

No.	Conditions
1	The selected route has been checked.
2	Data communication with Autopilot is correctly performed.
3	Position sensor works properly.
4	Heading sensor works properly.
5	Heading sensor don't use the Magnetic compass in ECDIS and Autopilot
6	Speed sensor works properly.
7	Position geodetic datum fits display datum (WGS-84).
8	Manual input is not selected as Heading/STW sensor or DR is not selected as Position sensor.

3.2 Setting the Route Plan Setting

Setting from “View”

- 1) From the Left Tool Bar, select [Menu] - [View] - [Options] - [Route].
Then a route setting window will open.

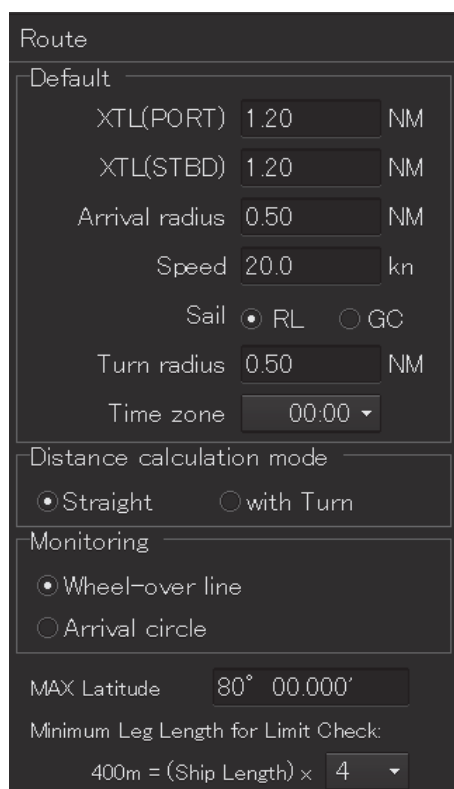


The 'Route' settings window displays the following options:

- Date/Time for Monitoring**
 - Format: ☐ UTC ☒ LMT
- ☒ Show ETA
- ☒ Cross Track Limit Line
 - Color: ☒ IALA-A ☐ IALA-B
- ☒ Show WPT Name
 - WPT Name Font Size: ☒ Standard ☐ Small ☐ ABC

Setting from “Settings”

- 1) From the Left Tool Bar, select [Menu] - [Settings] - [Route].
Then a route setting window will open.



The 'Route' settings window displays the following options:

- Default**
 - XTL(PORT): NM
 - XTL(STBD): NM
 - Arrival radius: NM
 - Speed: kn
 - Sail: ☒ RL ☐ GC
 - Turn radius: NM
 - Time zone:
- Distance calculation mode**
 - ☒ Straight ☐ with Turn
- Monitoring**
 - ☒ Wheel-over line ☐ Arrival circle
- MAX Latitude:
- Minimum Leg Length for Limit Check:
 $400\text{m} = (\text{Ship Length}) \times$

- 2) Select an item, and enter the value in the numeric input box as needed.

Then, left-click the [OK] button to close the dialog box.

- a) Date/Time for monitoring

Select UTC/LMT for arrival time display during route monitoring.

UTC display

LMT display

Actual

TTG 0:31:36

ETA 2013-12-26 02:30 UTC

Actual

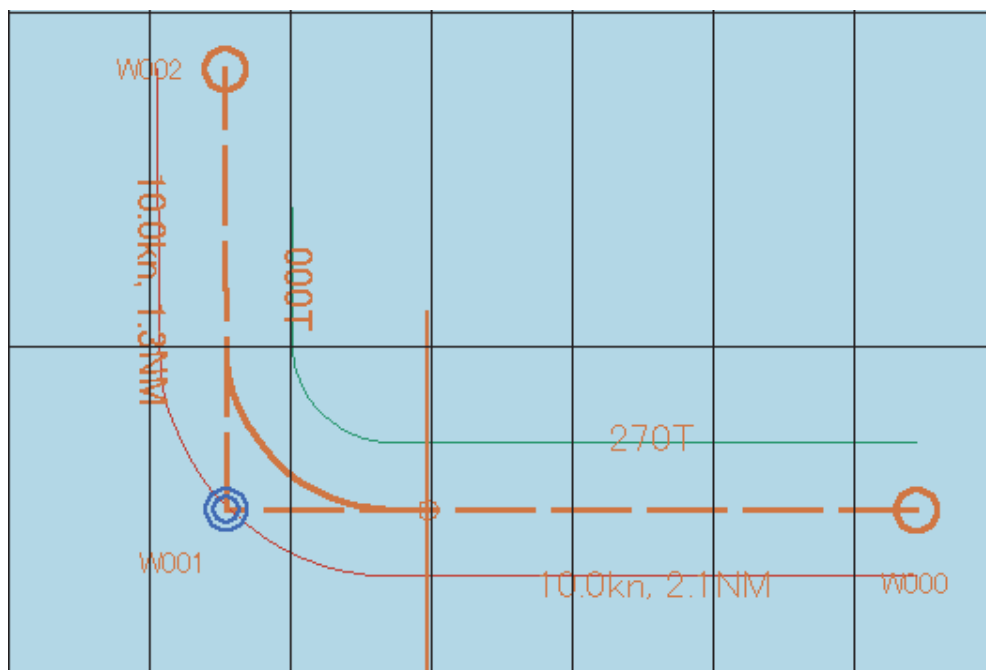
TTG 0:34:22

ETA 2013-12-26 11:36 LMT

- b) Show ETA

When the checkbox of Estimated Time of Arrival is on (with a checkmark), the arrival time is display at WPT during route monitoring.

When Estimated Time of Arrival is off (no checkmark):



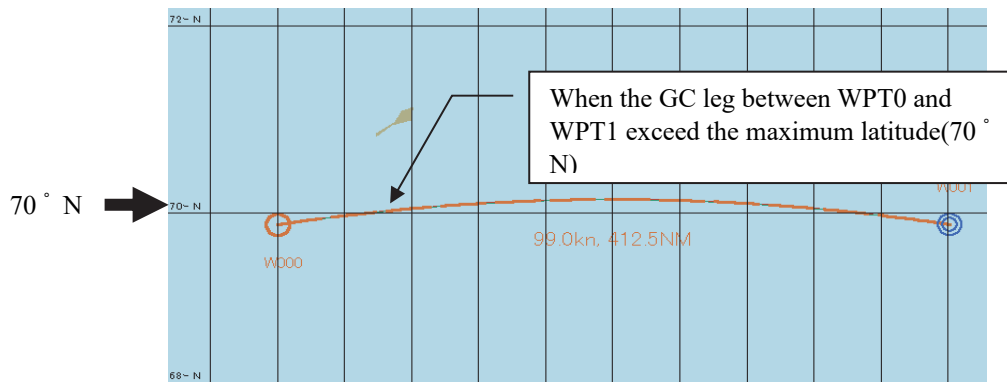
c) Default

Set the default of the route to be created during route planning.

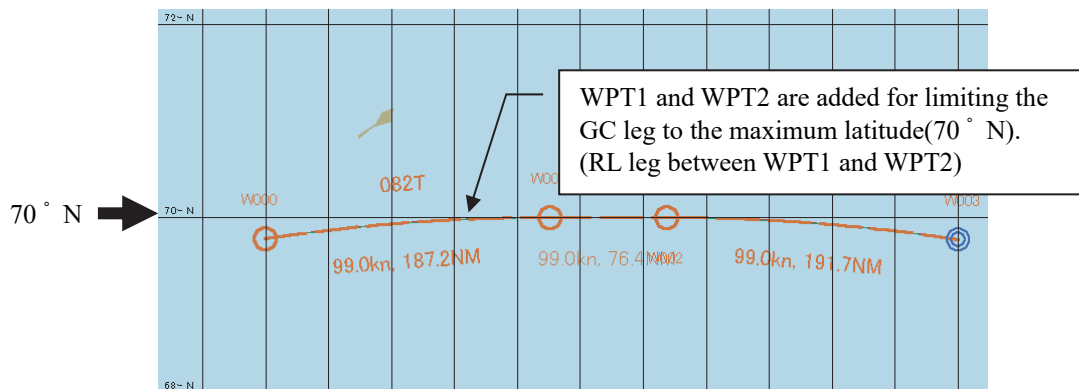
- XTL (PORT): Port side width
- XTL (STBD): Starboard side width
- Arrival radius: Arrival radius
- Speed: Planned ship's speed
- Sail: RL(Rhumb line)/GC(Great circle)
- Turn Radius: Turn radius
- Time Zone: Time zone

d) Max.Latitude

Waypoints cannot be set in latitudes higher than the set latitude. If a GC leg is higher than the set latitude, waypoints are added for limiting the GC leg to the maximum latitude.



When the maximum latitude is 70° or more, a GC leg exceeding 70° can be input.

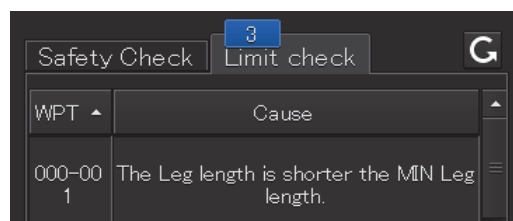


Waypoints are added at intersections between the GC leg and 70°, so a leg exceeding 70° is not input.

e) Tau Multiplier for Limit Check

Set the magnification ratio of leg length (ship's reach length x τ) by the Limit Check.

The Limit Check regards the leg length shorter than the set value as an error.

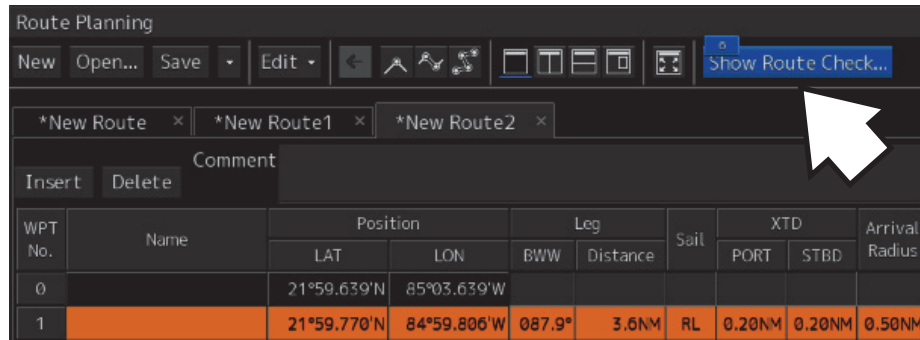


f) Check Safety in Editing

During editing the route, safety check is automatically conducted.

(You can manually conduct safety check with the [Safety Check] button in the Route Planning dialog box.)

(Route Planning dialog box)



If an error is detected during the safety check, the route will have to be reset.

(After safety check, the error port on the chart is highlighted in black and the error line on the route table is in red.)

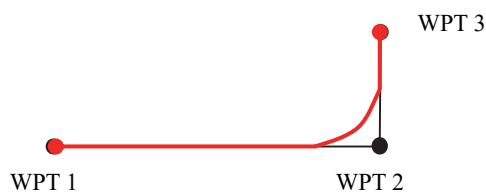
g) Distance calculation mode

Set a method for calculating a distance between WPTs.

When [Straight] is selected, a distance between WPTs is calculated with a straight line.



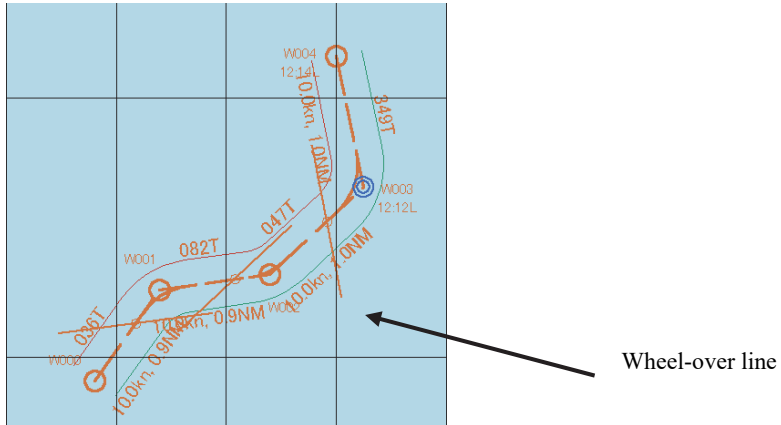
When [with Turn] is selected, a distance between WPTs is calculated based on the expected route.



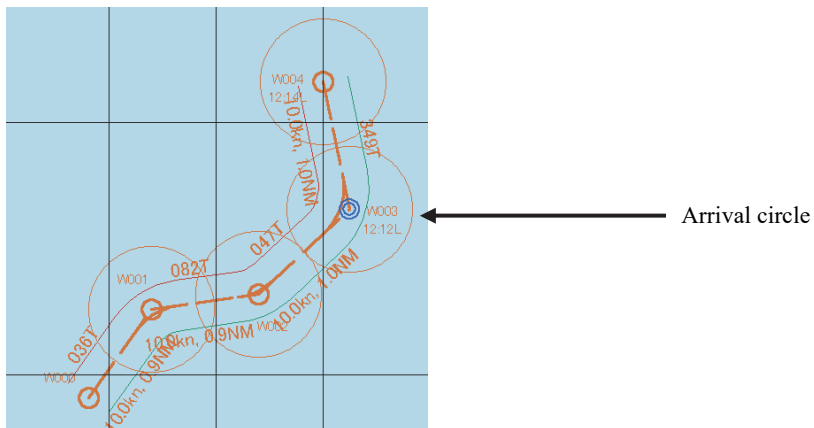
h) Monitoring

Set a route monitoring method.

When [Wheel-over line] (steering line) is selected, monitoring is performed by using Wheel-over line (WOL) along each WPT.



When [Arrival circle] is selected, monitoring is performed by using the arrival circle along each WPT.



3.3 Checking the Pre-planned route

To run a Safety Check or a Limit Check, the following two methods are available:

- Check the points changed each time the route was edited.
- Press the recheck button on the property screen.

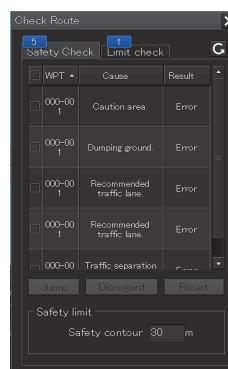
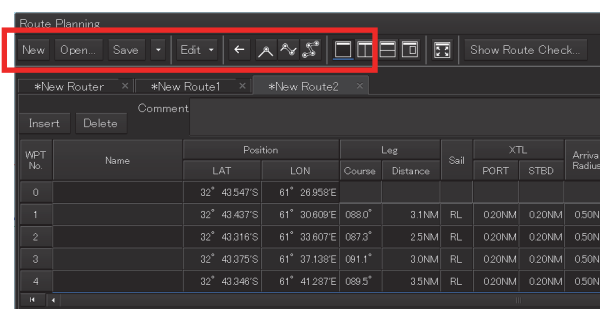
3.3.1 Checking the points changed each time the route was edited

Run Safety Check and Limit Check on the points changed each time the route was edited.

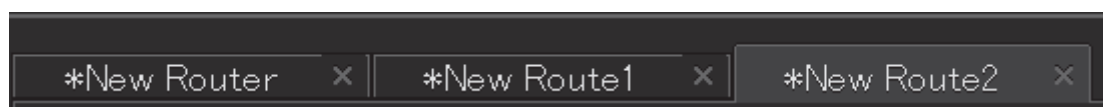
In this case, the routes for the tab being selected are to be checked.

Check results are stored for each tab. Switching the tab also switches the “Check Route” screen.

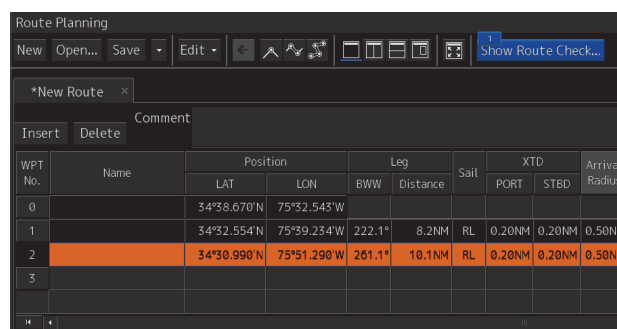
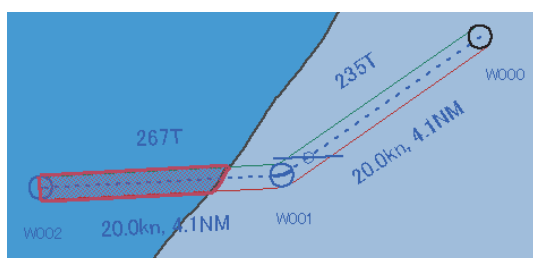
If a tab is switched during check processing, the check processing will be stopped.



[Tab]



When a Safety Check or Limit Check is detected, it will be highlighted in orange.

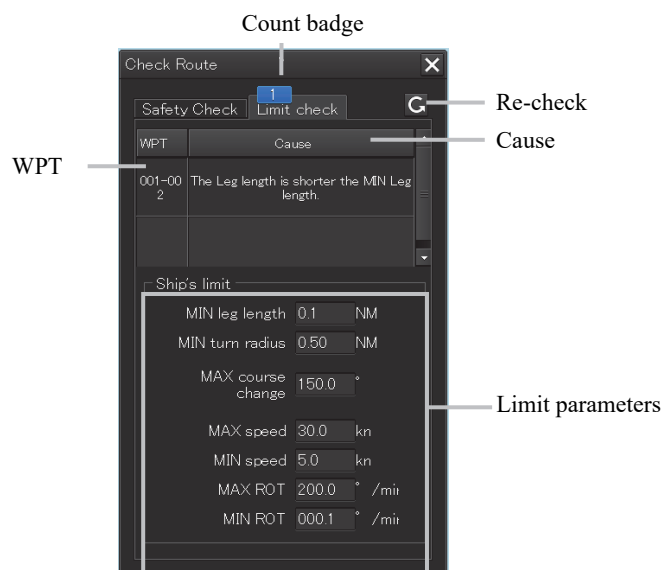


When a Safety Check is detected from
WPT 001 to WPT 002

WPT001 to WPT002 will be highlighted in
orange.

3.3.2 Limit Check

The result of limit check is displayed on the "Limit check" tab.



When limit errors are detected, the error count is displayed on the count badge. When the error count exceeds 999, "More" is displayed instead of the count.

The cause of the error that was detected is displayed for each of WPTs prior to and following the error occurrence point.

The following causes are displayed.

Cause	Countermeasure
The planned radius is beyond the MAX turn radius.	Make the planned radius small.
The planned radius is under the MIN turn radius.	Make the planned radius large.
The course angle of leg is beyond the MAX course angle.	Make the course angle small.
The planned speed is beyond the MAX planned speed.	Make the planned speed small.
The planned speed is under the MIN planned speed.	Make the planned speed large.
The planned ROT is beyond the MAX ROT.	Make the planned ROT small
The planned ROT is under the MIN ROT.	Make the planned ROT large.
The Leg length is shorter the MIN Leg length.	Make the Leg length large.
The straight route cannot be created.	Make the planned radius small or make the planned speed small or make ROT large or make the Leg length large.

Note:

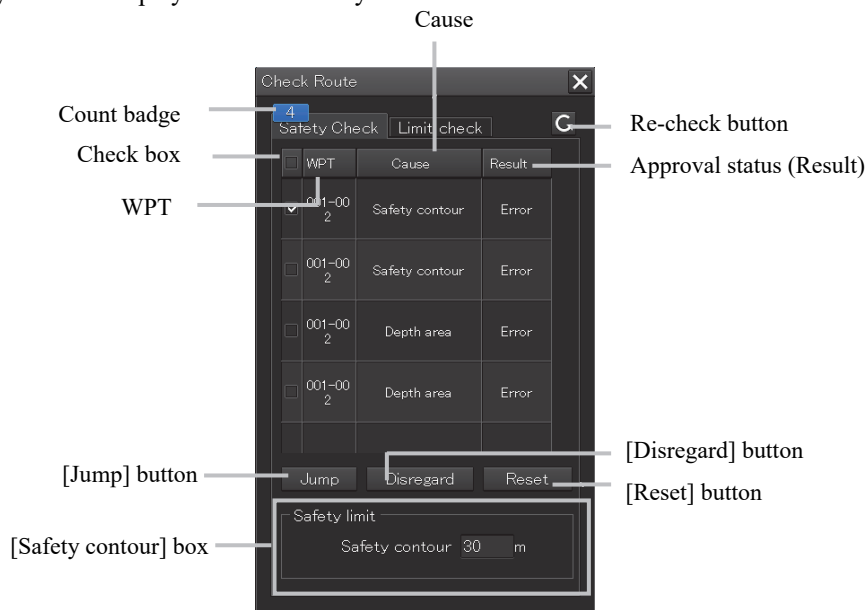
If the limit check error occurs, you should modify the route in reference to range of limit.

Select [Menu] - [Route Planning] - [Show Check Route...] and click [Re-check] button.

Ship's limit		
MIN leg length	0.4	NM
MIN turn radius	0.50	NM
MAX course change	150.0	°
MAX speed	30.0	kn
MIN speed	5.0	kn
MAX ROT	200.0	° /min
MIN ROT	000.1	° /min

3.3.3 Safety check

The result of safety check is displayed on the "Safety check" tab.



When safety errors are detected, the number of errors is displayed on the count badge. When the error count exceeds 999, "More" is displayed instead of the count.

Updating an error list

By clicking on the Re-check button, the latest error information is displayed by rechecking the information.

Sorting error display

By clicking on any of the items on the title line, error display can be sorted based on the item. A sort mark (▲ or ▼) is displayed on the title of the selected item.

Whenever an item is clicked on, the error display is sorted based on the ascending (▲) or the descending (▼) order.

Selecting an error to be processed

Select the check box of the error to be processed. To select all the errors, select the check box on the title line.

When the [Jump] button is clicked on, control jumps to the occurrence point of the error that was selected on the error list.

Ignoring an error

Click on the [Disregard] button. To restore the error that was once ignored, click on the [Reset] button.

Checking an error target on the list

When an error is detected, the WPT under which the error occurred is highlighted in orange.

Route Planning														
New Open... Save Edit Show Route Check...														
*New Route														
Insert Delete Comment														
WPT No.	Name	Position		Leg	Sail	XTD		Arrival Radius	Turning Radius	Planned Speed	ROT	ETA		TWOL
		LAT	LON			PORT	STBD					[YYYY-MM-DD hh:mm]	Time Zone	
0		34°58.670'N	75°52.545'W									2018-09-27 09:18	00:00	
1		34°52.554'N	75°59.234'W	222.1°	8.2NM	RL	0.20NM	0.20NM	0.50NM	20.0kn	38.2°/min	2018-09-27 09:45	00:00	00 Days 00:24
2		34°50.990'N	75°51.290'W	261.1°	10.1NM	RL	0.20NM	0.20NM	0.50NM	20.0kn	38.2°/min	2018-09-27 10:13	00:00	00 Days 00:30
3														

3.4 Setting TCS parameters

You can change the following TCS parameters:

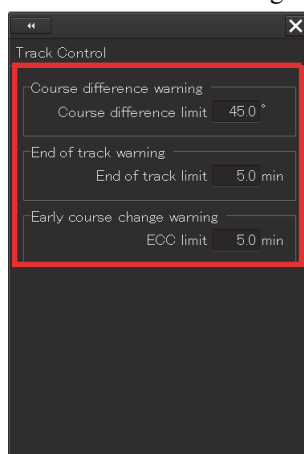
- Course difference limit : Setting of Course difference limit.
- End of track limit : Setting of End of track limit.
- ECC limit : Setting of ECCW limit.

Items for setting differ depending on the Autopilot to be connected.

Set the parameters by following the procedure below.

- 1) From the Left Tool Bar, select [Menu] - [Alert] - [Track Control].

The “Track Control” setting screen will be displayed.



- 2) Set “Course difference limit”, “End of track limit” and “ECC limit”.

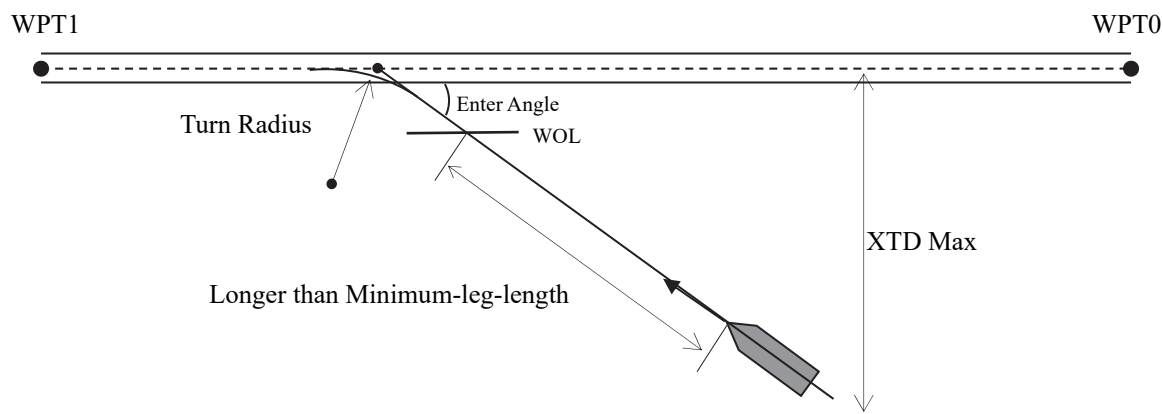
3.5 Starting Track control

You can set the following predicted route parameters:

- Pre Run Speed : Prerunning speeds of predicted route to calculate Minimum Leg length.
- Pre Run Time : Prerunning time of predicted route to calculate Minimum Leg length.
- Pre Run Distance : Prerunning distance of predicted route.
- Enter Angle : Entrance angles of predicted route.
- Turn Radius : Default turn radius of predicted route.
- XTD MAX : Maximum XTD of predicted route.
- Course Difference Limit : Course Difference limit of predicted route.

Note:

To set the route paramertrs, from the Left Tool Bar, select [Menu] - [Settings] - [Auto Sail] - [Temporary Route].



Note:

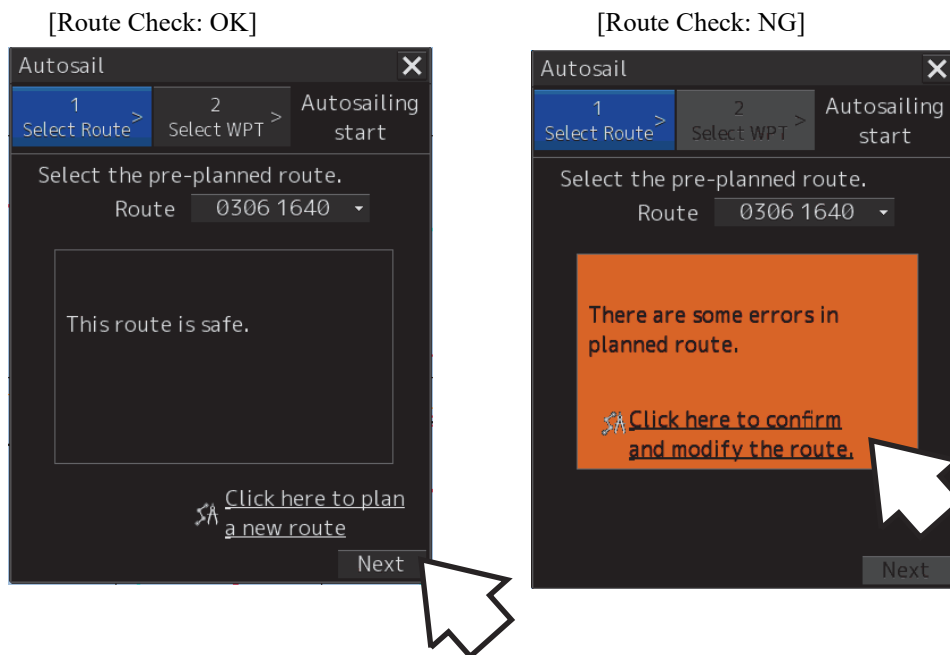
It is recommended that the ship be on the current leg before starting track control.

Note:

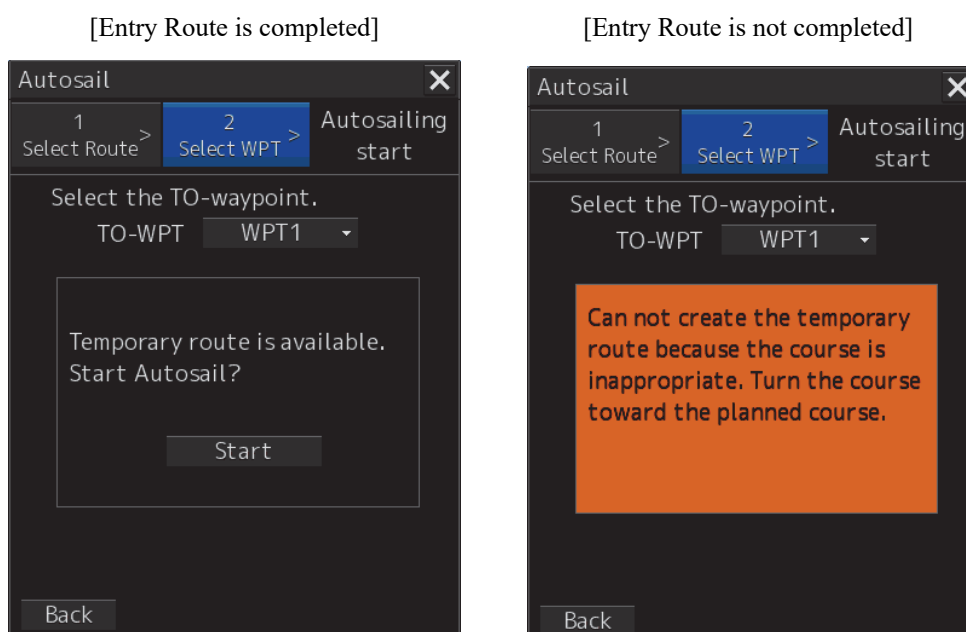
$\text{Minimum-leg-length} = (\text{Pre Run Speed} \times \text{Pre Run Time}) + \text{Pre Run Distance} + \text{Reach}$

You can start Track control by following the procedure below.

- 1) From the Left Tool Bar, select [Menu] - [Auto Sail]. The “Auto Sail” dialog box will then appear.
- 2) From the “Route” combo box, select the route. Route Check will then start.
 - Route Check is OK: Click the [Next] button, and the WPT selection screen will appear.
 - Route Check is NG: Click [[Click here to confirm and modify the route.](#)], and a new route creation screen will appear under the “Route Plan” menu.



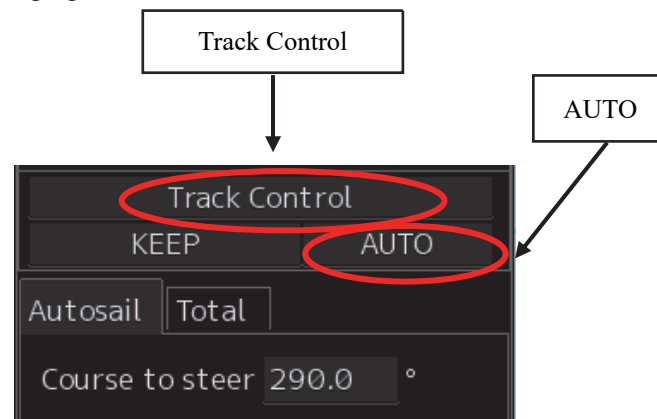
- 3) When Route Check is OK: From the “TO-WPT” combo box, select the WPT.
 - Entry Route is completed: The [**Start**] button will appear.
 - Entry Route is not completed: Either click the [×] button to close the window or reselect a WPT and create a temporary route again.



- 4) Click the [**Start**] button to start Track control.

The route monitoring information screen will then appear.

- 5) At this time Steering mode and ECDIS status respectively become “Track Control” and “AUTO” as shown in the following figure.



Note: The track cannot be modified during track control.

If a temporary route cannot be created, the following message is displayed. Operate according to the displayed message:

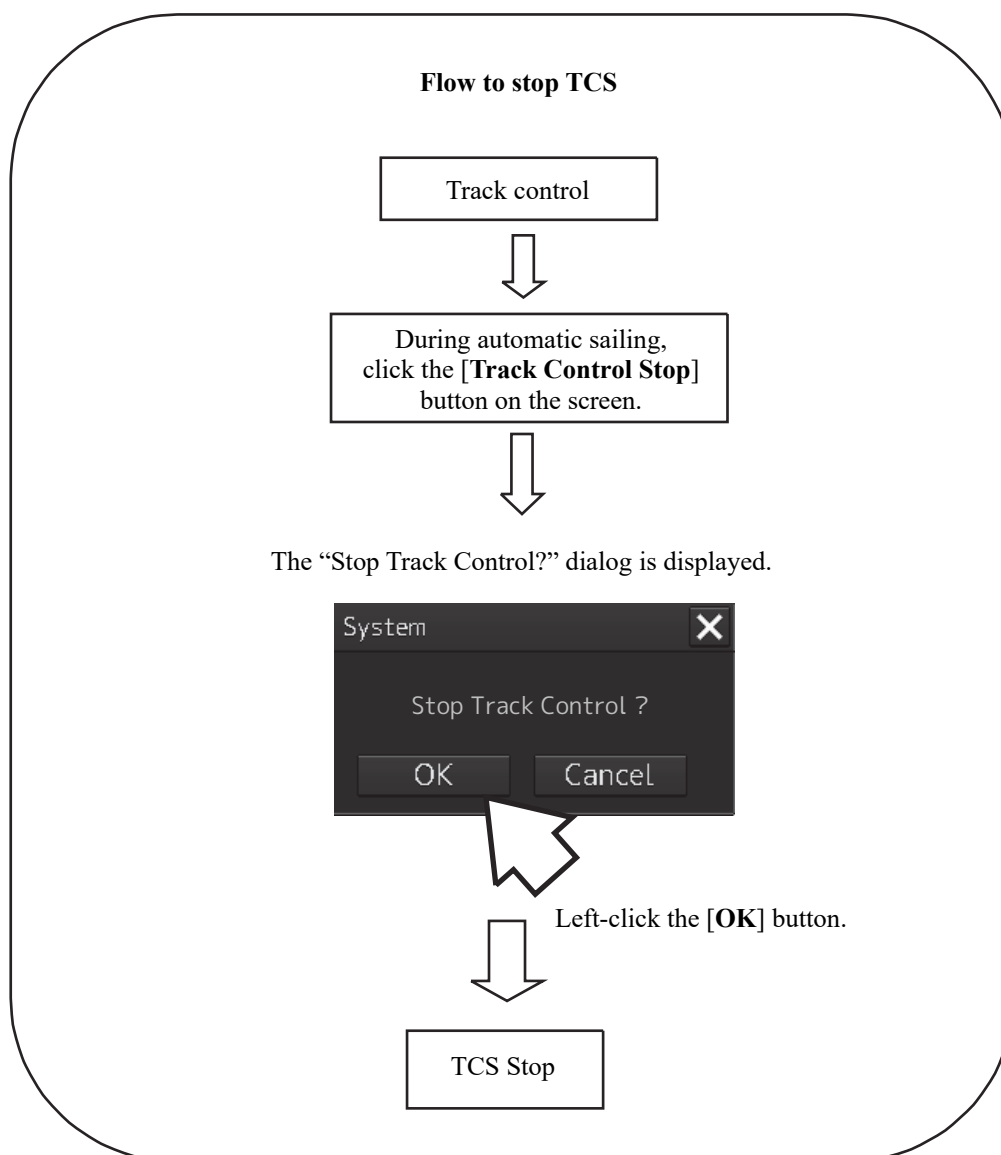
- Can not create the temporary route because the course is inappropriate. Turn the course toward the planned course.
- Can not created the temporary route because the XTD exceed XTD MAX. Move own ship toward the planned route.
- Can not create the temporary route because own ship may pass through the WOL. Select the TO-Waypoint again.
- Can not create the temporary route because own ship may pass through the planned route leg. Select the TO-Waypoint again.

3.6 Stop Track control

You can terminate track control by following the procedure below.

ECDIS

- 1) During Track control, click the [**Track Control Stop**] button on the screen.
A screen prompting to confirm termination of Track control will then appear.
- 2) Click the [**OK**] button on the confirmation screen.
- 3) Screen then switches to a screen prompting to confirm switching steering mode. The steering mode switches from NAV to AUTO mode.



Autopilot(PT900)

- 1) During Track control, long press the steering mode in CDU.
- 2) Track control is stopped. The steering mode switches from NAV to AUTO mode.

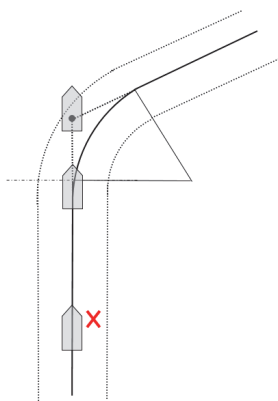
3.7 Heading Control Mode during Track Control

The steering mode will be changed into Heading Control Mode when TCS is abnormally ended or steering mode is changed to heading control manually.

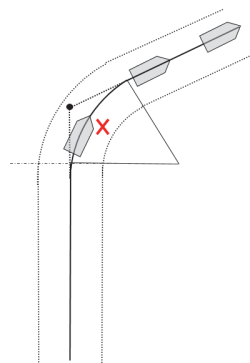
When the following fail occurs, the ship will go straight with keeping the Heading. If sailing on a curved path, Autopilot has completion of turning and takes the next leg course as the preset heading for the Heading control. Change A/P into Manual and check the safety around the ship as needed.

- Communication error between the autopilot and ECDIS occurs.
- All Position sensor error occurs.
- Heading sensor error occurs. (ECDIS only)
- Steering mode is changed to heading control manually

[On the straight leg]
The course is maintained



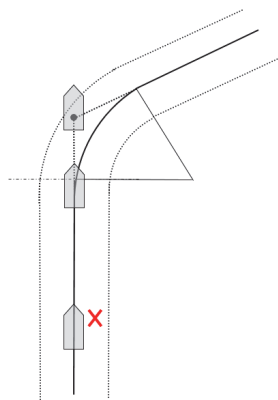
[On the curved path]
The course is maintained



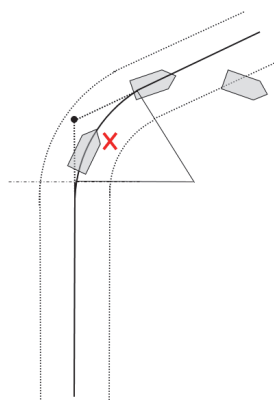
When the following fail occurs, the ship will go straight with keeping the Heading. If sailing on a curved path, Autopilot fix the rudder and keep the actual rate of turn. Change A/P into Manual and check the safety around the ship

- Auto pilot error occurs. (Heading control is unavailable)
- Heading error occurs. (ECDIS and Autopilot)

[On the straight leg]
The current heading is maintained



[On the curved path]
The current rudder angle maintained



Cautions about emergency



CAUTION



In an emergency, change the steering mode of the autopilot from NAV to Manual and cancel track control.

Negligence of changing the steering mode of the autopilot may cause an accident.



In danger of collision, perform “overriding” to avoid the collision. (For information on how to perform “overriding”, see section “5.2.7 How to start the NFU steering (NFU mode)”(PT900).) When override function is executed, track control automatically stops.

Before starting track control, be sure to check the safety of the route and crossing safety contour. Negligence of checking the safety may cause an accident.

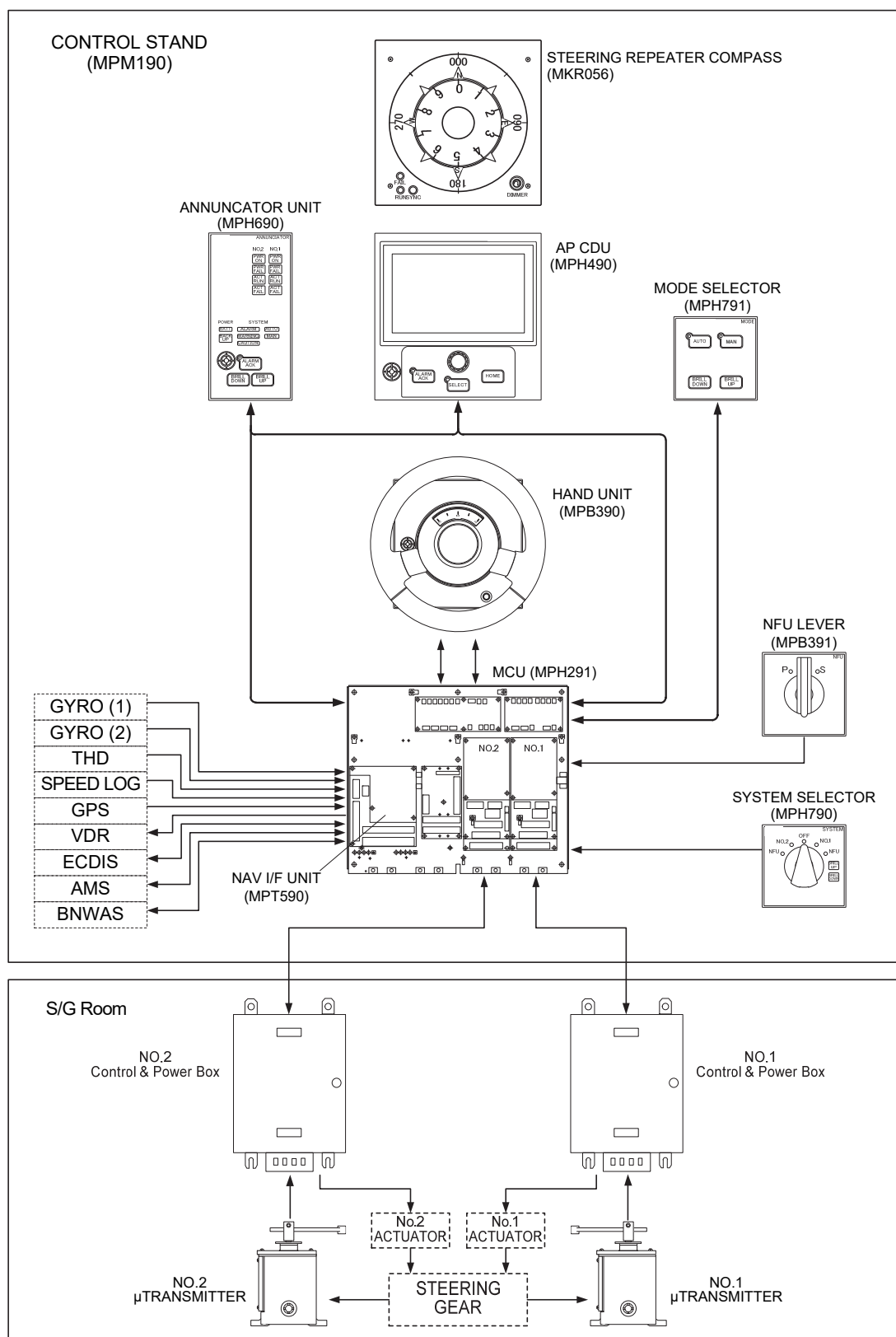


Do not neglect the confirmation of the own ship’s position and bearing during sailing, regardless of the setting ON/OFF of track control.

Negligence of the confirmation may cause an accident.

4. PT900

4.1 System Configuration



4.2 Summary of Autopilot system operation

This chapter shows the outline of PT900 operation.

4.2.1 Checking items before power ON

Check if the following items are normal before you turn on PT900.

- (1) Check that the steering gear is ready to operate.
- (2) Check that CONTROL & POWER BOX is turned on. Check also that the test switch of the CONTROL & POWER BOX is set to “NOR” (Normal).
- (3) Check that “PWR ON” indication of ANNUNCIATOR UNIT is on.
- (4) Check that STEERING REPEATER COMPASS shows correct heading.
- (5) Check that HAND STEERING UNIT is set to midship position.

4.2.2 How to startup and shut down

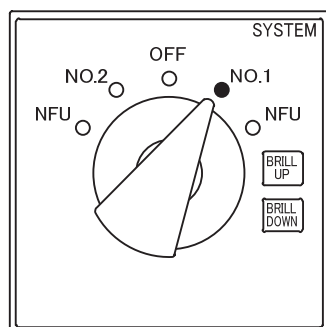
SYSTEM SELECTOR has the following 2 functions;

- Power ON/OFF of PT900
- Select the system in operation

Select “NO.1” or “NO.2” position of SYSTEM SELECTOR to startup PT900.

Steering mode is same one that PT900 was turned off.

Select “OFF” position of SYSTEM SELECTOR to shut down PT900.



4.2.3 How to select the Steering mode

Steering mode which is same as the last one is selected when PT900 is turned on.

NFU mode is selected by SYSTEM SELECTOR, MAN/AUTO mode is selected by MODE SELECTOR, AUTO/CRS mode is selected by AP CDU. TRACK mode is only selectable by ECDIS operation.

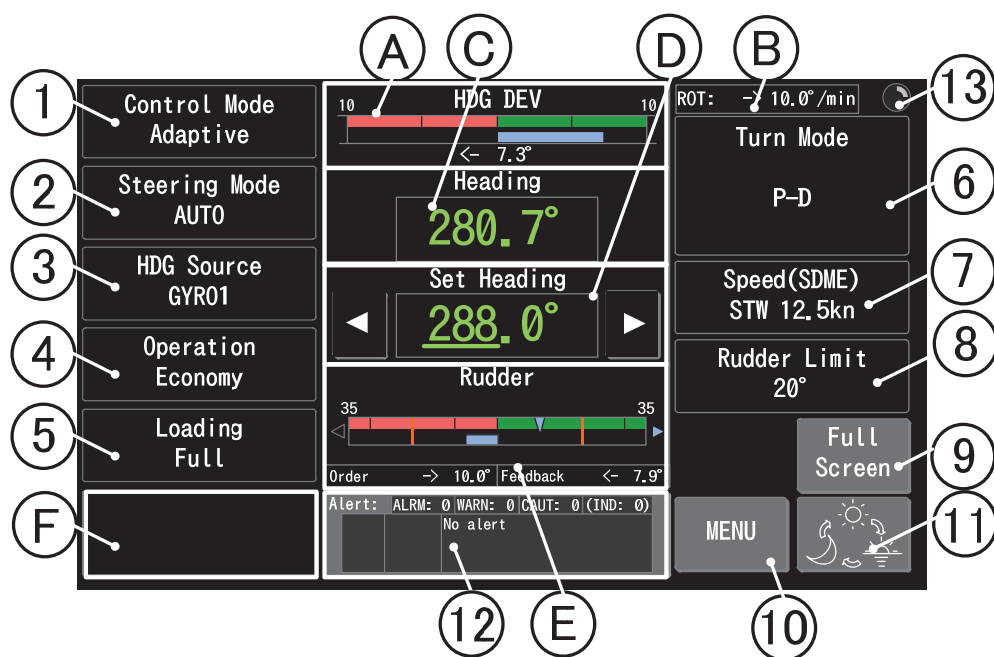
When you change the steering mode, the buzzer (1 short audible signal (once)) on AP CDU sounds to inform the navigator.

SYSTEM SELECTOR	MODE SELECTOR	AP CDU Steering Mode	Steering mode	Remark
NO.1/NO.2	AUTO	AUTO	Heading control is selected.	
		CRS	Course control is selected.	Option
		TRACK	Track control is in control.	Option
	MAN	—	FU HAND wheel is	
NFU	—	—	NFU LEVER operation is selected.	

4.2.4 [HOME] Screen

Below figure shows the [HOME] screen of AP CDU. [HOME] screen indicates the navigation information and each setting.

See 4.3.1



A: Heading deviation

B: Rate of turn

C: Heading

D: Set Heading

E: Rudder angle

F: Guidance area

1: Control mode

2: Steering mode

3: Selected compass

4: Operation mode

5: Draft mode

6: Turn mode

7: Speed

8: Rudder Limit

9: Full screen button

10: MENU button

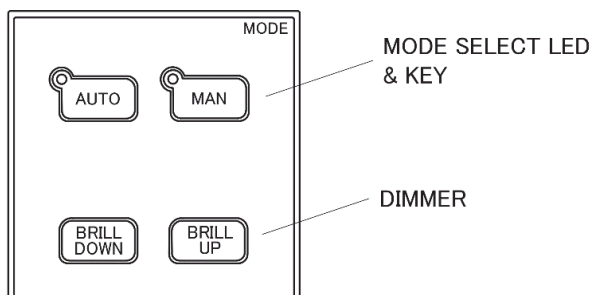
11: Display mode

12: Top alert button

13: Spinner

4.2.5 How to start the Heading Control (AUTO mode)

- (1) Select “NO.1” or “NO.2” position of SYSTEM SELECTOR.
- (2) Press “AUTO” key on MODE SELECTOR.
- (3) Current ship’s heading is set as the preset heading and heading control starts.
- (4) After you select the turn mode (P-D, Rate[°]/min”, “[°]/τ” or Radius) on [HOME] screen, you can change the set course.
- (5) Set course can be changed by set course dial or touchscreen.



Operation / Indication	Function
AUTO key	It lights during AUTO steering mode.
MAN key	It lights during manual steering mode.
BRILL DOWN key	Decrease of the brightness
BRILL UP key	Increase of the brightness

4.2.6 How to start the Track Control (TRACK mode)

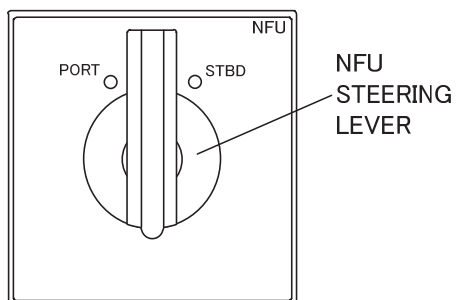
- (1) Select “NO.1” or “NO.2” position of SYSTEM SELECTOR.
- (2) Press “AUTO” key on MODE SELECTOR.
- (3) After you edit the planned route on ECDIS, track control starts on ECDIS side operation. Steering mode on PT900 is automatically changed from AUTO to TRACK mode.
- (4) Track control can be finished by long tap of [Steering Mode] button on [HOME] screen except ECDIS side operation.

4.2.7 How to start the Manual steering (HAND mode)

- (1) Select “NO.1” or “NO.2” position of SYSTEM SELECTOR.
- (2) Press “MAN” key on MODE SELECTOR.
- (3) You can steer the rudder by manual
- (4) Order rudder angle can be changed by HAND STEERING UNIT.

4.2.8 How to start the Non-Follow-Up steering (NFU mode)

- (1) Select “NFU” position of SYSTEM SELECTOR.
- (2) Manual steering by NFU LEVER is available.
- (3) Rudder is steered while NFU LEVER is turned.



Operation / Indication	Function
NFU STEERING LEVER	It activates the rudder actuator directly.

4.3 Steering functions

4.3.1 Manual steering

Press the “MAN” key on MODE SELECTOR, and you can steer the rudder by Follow-Up with HAND STEERING UNIT.

You can use the [Set Heading] on [HOME] screen of AP CDU as COURSE REMINDER during “MAN” mode.



WARNING

■ When changing over to manual steering

- When changing over to Manual (Hand) mode (HAND or RC), confirm if the steering wheel and all of the dial steering units are turned to midship position. Also confirm the rudder is fixed at midship position. If there is a large difference between the actual rudder angle and steering wheel position before changing the steering mode, the rudder may be steered excessively.
-



CAUTION

■ How to select steering mode when Mode Selector is not equipped

- Steering mode changeover procedure is different when the system is not equipped with a Mode Selector.
 - Long press AP CDU SELECT key when selecting Heading Control.
 - Use Take-Over Unit when selecting Manual steering.
-

4.3.2 Auto steering

Press the “AUTO” key on MODE SELECTOR, and you can steer the rudder automatically with AP CDU.
That means that the heading control starts.



WARNING

■ **When changing over to auto steering**

- The validity of the gyrocompass heading shall be confirmed before starting Auto mode. Incorrect heading could make the vessel unavailable to maintain correct set course and lead to a collision or stranding.
- Rate of turn shall be steady when changing over from Manual mode to Auto mode. Otherwise the rudder may steer excessively according to the counter rudder function.
- When using Auto mode at the congested area or narrow waterway, give adequate considerations to the situation of the surrounding area. Otherwise it could lead to a collision or stranding.
- Use Auto mode (heading, course, or track control) only if the accurate steering required to sail in the concerned marine area can be expected. Special attention shall be paid in this situation.

■ **During the auto steering**

- A watchman is always required during Auto mode. Otherwise it could lead to a collision or stranding.
- Always confirm the course deviation if the vessel is in low speed. It may not be able to maintain the set course.
- Do not turn OFF the system during Auto mode. Steering signal stops and rudder become uncontrollable.

■ **Operation during the failure or error**

- When failure or error is occurred during Auto or Track mode or maneuvering with steering wheel or remote control, immediately turn System Selector to NFU (Non Follow-up) to start NFU steering. If System Selector is not equipped due to the system configuration (ex. Steering Gear is Analog control type or special specification due to the ship's class), use emergency steering of the steering gear, or if available, changeover to NFU override steering. If NFU steering is not working as well, switch-over S/G pump or stop abnormal S/G pump in parallel operation. When this switching-over or stopping is not effective, execute emergency steering of the steering gear.
-

4.3.2.1 Preparation for Auto steering

Take the following procedure to prepare for auto steering:

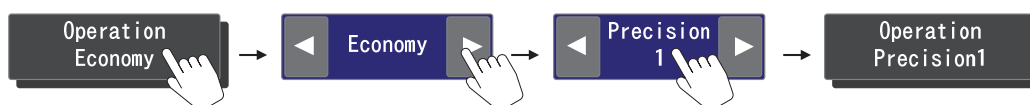
OPERATION MODE setting

Select OPERATION MODE according to the navigating area, weather and sea conditions.

OPERATION MODE	Description
Economy	“Economy” is for fuel saving steering in the open sea area.
Precision 1	“Precision 1” steers more frequently to decrease the HDG DEV and yawing during AUTO mode than “Economy” does.
Precision 2	“Precision 2” steers more frequently to decrease the HDG DEV and yawing during AUTO mode than “Precision 1” does.

- (1) Tap [Operation] button on [HOME] screen to set OPERATION MODE.
- (2) Tap the arrow button to select OPERATION MODE.
- (3) Tap the operation indication space to fix OPERATION MODE.

The example of OPERATION MODE changing from “Economy” to “Precision 1” is shown in figure below.



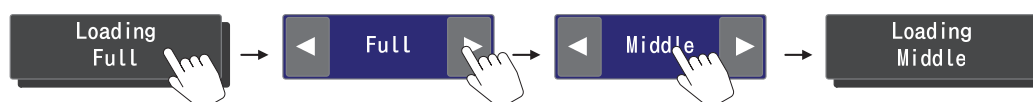
LOADING MODE setting

Select DRAFT MODE according to the vessel's loading condition.

DRAFT MODE	Description
Full	“Full” is 80 to 100% of designed full load draft.
Middle	“Middle” is 55 to 80% of designed full load draft.
Ballast	“Ballast” is less than 55% of designed full load draft.

- (1) Tap [Loading] button on [HOME] screen to set DRAFT MODE.
- (2) Tap the arrow button to select DRAFT MODE.
- (3) Tap the loading indication space to fix DRAFT MODE.

The example of DRAFT MODE changing from “Full” to “Middle” is shown in figure below.



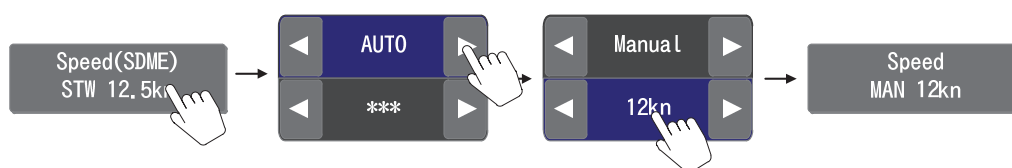
SPEED setting

Select the input method of current ship's speed. SDME is an abbreviation of "Speed and Distance Measuring Equipment".

Speed	Description
AUTO (A or A-PLUS)	PT900A or PT900A Plus receives speed sensor data from electromagnetic log, doppler log and so on. Setting "AUTO" means that these controllers update speed data automatically according to the sensor data. Speed through the water (STW) is more important for heading control than speed over the ground (SOG). So they usually use STW. But in case STW becomes unavailable, they use SOG data of VBW sentence. STW or SOG is indicated to show which speed source is being used.
Manual	Setting "Manual" is used for PT900D or PT900A/PT900A Plus with speed sensor error to input ship's speed manually. Setting range of "Manual" is from 1 to 65kn.

- (1) Tap [Speed] button on [HOME] screen.
- (2) Tap the arrow button to select "AUTO" or "Manual".
- (3) In case you select "Manual", set adequate ship's speed in the lower column

The example of speed setting change from "AUTO" to "Manual" is shown in figure below.



4.3.2.2 Start Auto steering

Press the "AUTO" key on MODE SELECTOR, and you can steer the rudder automatically with AP CDU.

Buzzer sounds to inform the change of steering mode.

Current heading is applied as "Set Heading" which you change the steering mode from "MAN" to "AUTO".

First decimal place of "Set Heading" is rounded off.

4.3.2.3 Mode selection of Auto steering

There are 3 modes as auto steering, Heading/Course/Track control. Selected mode is indicated on [HOME] screen [Steering Mode] section of AP CDU. The difference of these auto steering is shown in table below.

Auto steering	Description	Remarks
AUTO	“AUTO” means heading control. “AUTO” keeps ship’s heading based on the “Set Heading”.	Standard
CRS	“CRS” means course control. “CRS” keeps ship’s course based on the virtual course. AP CDU plans virtual course automatically based on the “Set Course”.	Option
TRACK	“TRACK” means track control. “TRACK” keeps ship’s position based on the preplanned route on ECDIS.	Option

AUTO mode

Press the “AUTO” key on MODE SELECTOR, and you can steer the rudder automatically with “AUTO” mode. Buzzer sounds to inform the change of steering mode

TRACK mode

“TRACK” mode is optional auto steering mode. PT900 connected with ECDIS has this mode.

“TRACK” mode can be automatically selected by the operation of ECDIS with buzzer sound.

Please refer to the user manual of ECDIS about how to start.

How to end “TRACK” mode and the steering mode at that time is as follows:

- Press “MAN” key on MODE SELECTOR, and “TRACK” mode is ended to be switched to “MAN” mode.
- Select “NFU” in SYSTEM SELECTOR, and “TRACK” mode is ended to be switched to “NFU” mode.

Sailing on straight leg

- In case you stop track control on ECDIS operation, current heading is set as “Set Heading” and heading control starts.
- In case you stop track control by long tap of [Steering Mode] on [HOME] screen of AP CDU, heading control starts. Current heading is set as “Set Heading”.

Sailing on curved track

- In case you stop track control on ECDIS operation, heading control starts after the turn is completed. Next leg is set as “Set Heading”.
- In case you stop track control by long tap of [Steering Mode] on [HOME] screen of AP CDU, heading control starts after the turn is completed. Next leg is set as “Set Heading”.

Buzzer sounds to inform the change of steering mode after above operation,

Track control uses following parameters which are set on

- PT900 : OPERATION mode, DRAFT mode, Ship's speed
- ECDIS : Turn radius, Channel limit

Especially, forwarding distance is based on DRAFT mode, Ship's speed and Turn radius.

Please refer to 4.7.6 about the setting of forwarding distance.

Course change during AUTO/CRS mode

After you select the TURN mode, vessel can turn automatically by changing the [Set Heading] or [Set Course] during AUTO or CRS mode.

TURN MODE setting

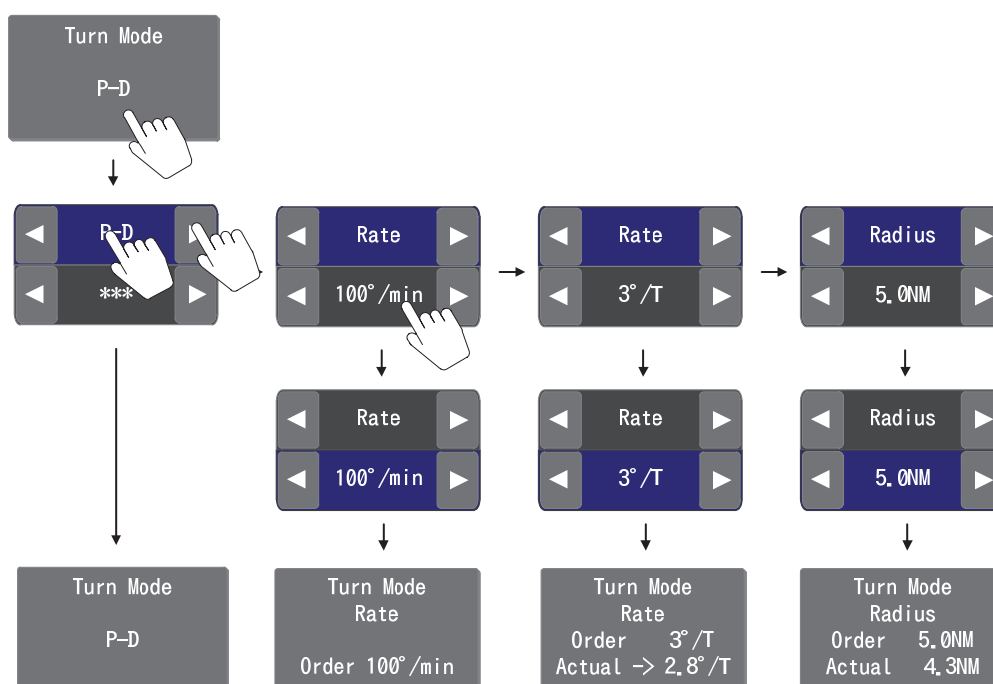
There are 3 TURN MODEs for auto course change. Select TURN MODE before changing [Set Heading] or [Set Course].

TURN MODE	Function	Setting range
P-D	“P-D” mode can turn the vessel in shortest time. This mode is useful in ocean going.	-
Rate Note1	“Rate” mode can turn the vessel with constant ROT. This mode use ship's speed and length of itself. τ is time which vessel takes to go own length.	Turn rate 1 ~ 200°/min or 1 ~ 25°/ τ
Radius Note1	“Radius” mode can turn the vessel with set radius.	Radius 0.1 ~ 10.0NM

Note1: “Rate” mode and “Radius” mode is selectable on PT900A and PT900A Plus.

- (1) Tap [Turn Mode] button on [HOME] screen to set TURN MODE.
- (2) Tap the arrow button to select TURN MODE.
- (3) Tap the turn mode indication space to fix TURN MODE.

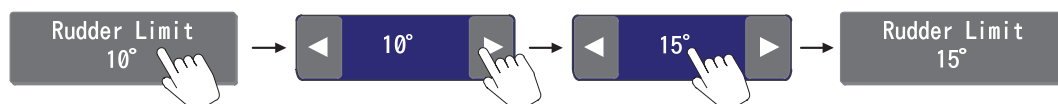
The figure shows the example of selecting each TURN MODE.



Rudder Limit setting

While Auto course change, rudder is steered within this setting value.

- (1) Tap [Rudder Limit] button on [HOME] screen.
- (2) Tap the arrow button to set rudder limit. (range:2 to 35 degree)
- (3) Tap the rudder limit indication space to fix.



Set Heading / Set Course

You can change [Set Heading] / [Set Course] during AUTO/CRS mode.

[Set Heading] / [Set Course] change		Operation
Name	Outline	
COURSE SETTING DIAL		- Press and rotate it to the clockwise, and [Set Heading] / [Set Course] increases. - Press and rotate it to the counterclockwise, and [Set Heading] / [Set Course] decreases. - Press for 2 seconds, and setting digit changes.
TOUCH PANEL		- Tap the right side arrow key, and [Set Heading] / [Set Course] increases. - Tap the left side arrow key, and [Set Heading] / [Set Course] decreases. - Tap the value, and setting digit changes.
SELECT KEY Note1		- Current heading is set as [Set Heading] / [Set Course] during AUTO/CRS mode. - First decimal place of “Set Heading” is rounded off.

Note1: In case the vessel has two or more AP CDUs and SELECT LED is off, operation right changes to itself by pressing SELECT KEY. See 4.2.2.1

4.3.3 NFU steering

Select “NFU” on SYSTEM SELECTOR, and you can steer the rudder with NFU LEVER.

- NFU LEVER is a self-return on-off cam switch.
- While you maneuver the vessel with NFU lever, watch the rudder angle indicator to avoid the rudder steered up to the mechanical limit.



WARNING

■ Non-follow up steering confirmation and warnings

- When steering operator is switched, always once execute NFU mode in order to confirm the behavior of the system and steering gear.
- Rudder steers while NFU lever is tilted during NFU steering, therefore keep on watching rudder angle indicator. Otherwise it may lead to a collision or stranding when the rudder angle is too small or large than expected.

<Cautions to variable discharged pump: K□T、Y□A、T□ type>

- If the rudder angle become more than a constant value, it takes time for the hydraulic pump tilting lever to move back to midship position although NFU lever is in center position. This case, rudder would not stop immediately. Therefore in order to avoid the gear hitting on the mechanical limit, turn NFU lever to center position immediately when the rudder angle indicator is reached at more than 30 deg. Also, this phenomenon occur when the limit switch inside μ -transmitter works, since it disconnects the power supply to torque motor or proportional solenoid valve. Especially, exceeding value would become more than 2 deg. when the rudder turning speed is fast (ex. parallel pump running). Therefore take special attention when steering around the limit switch angle. The steering operator shall clearly understand the characteristic of the steering gear well.
-

4.4 Setting functions

4.4.1 Alert

[4-1 Alert] screen consists of 9 items shown in figure and table below.

You can set the detection values (thresholds) and detection time for each alert on this screen.

Item	Parameter
1 Off heading alert limit angle	10°
2 Off heading alert detection time	8s
3 Off heading alert limit angle	10°
4 Off course alert detection time	3s
5 Heading monitor limit angle	10°
6 Heading monitor detection time	5s

Heading 280.7°
Set Heading 278.4°

Control Mode : Adaptive
Steering Mode : AUTO
HDG Source : GYRO
Operation : Economy
Turn Mode : P-D
Speed(SDME) : STW 12.5kn
HDG DEV : -> 2.3°
ROT : -> 2.3°/min
Rudder Limit : 20°
Rudder : Order <-10.0°
Feedback <- 8.0°

Alert: ALRM: 0 WARN: 0 CAUT: 0 (IND: 0)
No alert

Back Home

● Description of item

Item	Default value	Setting range	Description
1 Off heading alert limit angle	10	2~45 deg	Detection angle and time for off heading (course deviation) alert are set. See 4.7.2.1
2 Off heading alert detection time	8	2~20 sec	
3 Off course alert limit angle	10	1~90 deg	Detection angle and time for off course (course deviation based on the unselected compass) alert are set. See 4.7.2.2
4 Off course alert detection time	3	1~120 sec	
5 Heading monitor alert limit angle	10	1~45 deg	Detection angle and time for heading monitor (Deviation between two compasses) alert are set. See 4.7.2.3
6 Heading monitor alert detection time	5	1~20 sec	
7 Limit of low speed	Disable	Disable, 1~35kn	Limit value of low speed alert is set. See 4.7.2.4
8 ROT limit error: limit ROT	Disable	Disable, 1~100 deg/min	Detection rate and time for ROT limit error alert are set. See 4.7.2.5
9 ROT limit error: detection time	5	1~10 sec	
10 ECOP HTS alert	Disable	Disable, 1~10 deg	Detection angle of course deviation in CRS mode (option)

Heading monitor

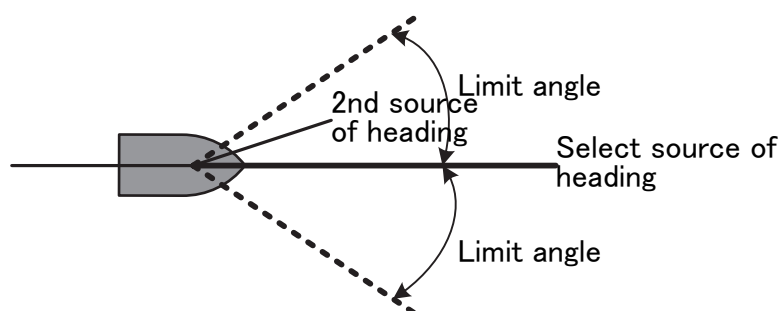
Note

Heading monitor alert can be detected on PT900 which is connected 2 or more compasses.

Heading monitor alert monitors the difference (deviation) between selected compass heading and unselected compass heading during all steering mode. Heading monitor alert appears in case the deviation which is over the detection angle lasts for detection time.

YDK Technologies's authorized service engineer selects whether PT900 detects heading monitor alert or not on [4-9-3-1 Monitor] screen. Default value (Factory value) is set not to detect heading monitor alert because this alert is optional function which uses 2 compasses.

Heading monitor alert is fundamentally detected in gyrocompass system side in case YDK Technologies's gyrocompass is connected to PT900.



Low speed alert

Low speed alert appears when ship's speed is less than detection time for more 10seconds in AUTO/CRS/TRACK mode. Lift of rudder is reduced while ship's speed is low. In that case, PT900 may not provide performance sufficiently.

Default value (Factory value) is set not to detect low speed alert because this alert is optional function.

4.4.2 Forwarding distatnce

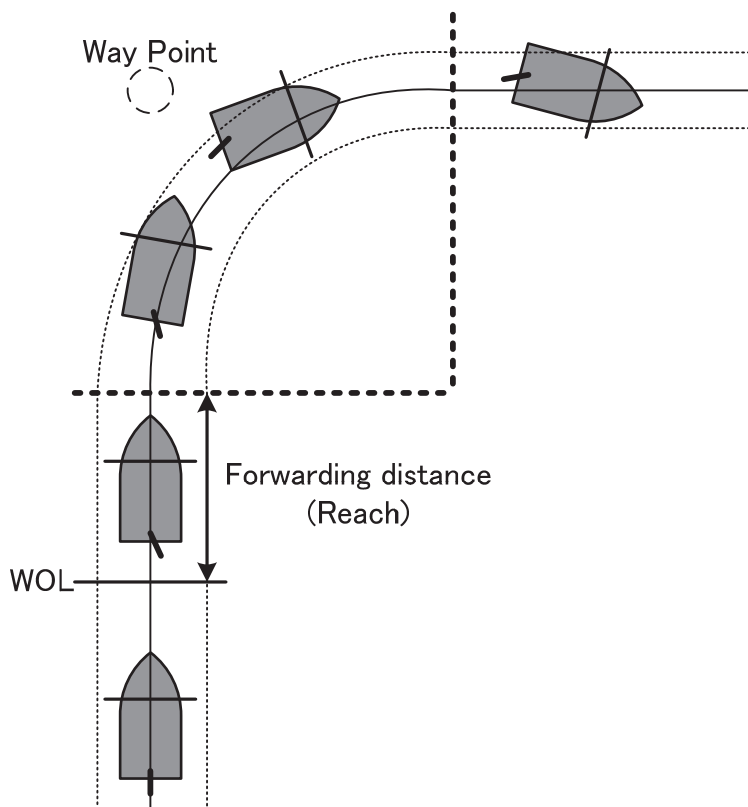
FWD DIST (Forwarding distatnce) is the distance between WOL (Wheel Over Line) and start of curved track. Its length depends on the ship's speed, turn radius and loading condition. PT900 has tables whose vertical axis is ship's speed and horizontal axis is turn radius on each draft mode. Factory setting of all FWD DIST is 0.100NM. YDK Technologies's authorized service engineer adjusts it according to the vessel's particular in sea trial. But it is hard for service engineer to adjust in all draft modes completely. So user has to adjust FWD DIST eventually. Adjustment points are shown below. Please adjust it in calm sea.

- Vessel overshoots from the center of the channel...

FWD DIST is short. Add the distance which vessel overshoots to current FWD DIST. Change the value of cell which is equivalent to current draft mode, turn radius and ship's speed.

- Vessel undershoots from the center of the channel...

FWD DIST is long. Decrease the distance which vessel undershoots to current FWD DIST. Change the value of cell which is equivalent to current draft mode, turn radius and ship's speed. Proportional gain used in TRACK mode may not be correct. Please contact our Service Department to readjust it.



FWD DIST table

Loading = Full		Turn radius		
		RAD1 or less	More than RAD1 to less than RAD2	RAD2 or more
Speed	SPD1 or less	Setting item 5	Setting item 6	Setting item 7
	More than SPD1 to less than SPD2	Setting item 8	Setting item 9	Setting item 10
	SPD2 or more	Setting item 11	Setting item 12	Setting item 13

Loading = Middle		Turn radius		
		RAD1 or less	More than RAD1 to less than RAD2	RAD2 or more
Speed	SPD1 or less	Setting item 14	Setting item 15	Setting item 16
	More than SPD1 to less than SPD2	Setting item 17	Setting item 18	Setting item 19
	SPD2 or more	Setting item 20	Setting item 21	Setting item 22

Loading = Ballast		Turn radius		
		RAD1 or less	More than RAD1 to less than RAD2	RAD2 or more
Speed	SPD1 or less	Setting item 23	Setting item 24	Setting item 25
	More than SPD1 to less than SPD2	Setting item 26	Setting item 27	Setting item 28
	SPD2 or more	Setting item 29	Setting item 30	Setting item 31

Setting screen

Screen	Item name	Setting item
4-5-1 Radius/Speed range	1 Radius range 1	Radius range1 (RAD1)
	2 Radius range 2	Radius range1 (RAD2)
	3 Speed range 1	Speed range1 (SPD1)
	4 Speed range 2	Speed range1 (SPD2)
4-5-2 Forwarding distance (full)	1 Speed1 – Radius1	Setting item 5
	2 Speed1 – Radius2	Setting item 6
	3 Speed1 – Radius3	Setting item 7
	4 Speed2 – Radius1	Setting item 8
	5 Speed2 – Radius2	Setting item 9
	6 Speed2 – Radius3	Setting item 10
	7 Speed3 – Radius1	Setting item 11
	8 Speed3 – Radius2	Setting item 12
	9 Speed3 – Radius3	Setting item 13
4-5-3 Forwarding distance (middle)	1 Speed1 – Radius1	Setting item 14
	2 Speed1 – Radius2	Setting item 15
	3 Speed1 – Radius3	Setting item 16
	4 Speed2 – Radius1	Setting item 17
	5 Speed2 – Radius2	Setting item 18
	6 Speed2 – Radius3	Setting item 19
	7 Speed3 – Radius1	Setting item 20
	8 Speed3 – Radius2	Setting item 21
	9 Speed3 – Radius3	Setting item 22
4-5-4 Forwarding distance (ballast)	1 Speed1 – Radius1	Setting item 23
	2 Speed1 – Radius2	Setting item 24
	3 Speed1 – Radius3	Setting item 25
	4 Speed2 – Radius1	Setting item 26
	5 Speed2 – Radius2	Setting item 27
	6 Speed2 – Radius3	Setting item 28
	7 Speed3 – Radius1	Setting item 29
	8 Speed3 – Radius2	Setting item 30
	9 Speed3 – Radius3	Setting item 31

Appendix A IEC 61162 interface

Appendix A shows IEC 61162 sentences for transmitting and receiving data for the track control system.

- IEC 61162 sentences transmitted by the track control system : Refer to Table A.1.
- IEC 61162 sentences received by the track control system : Refer to Table A.2.

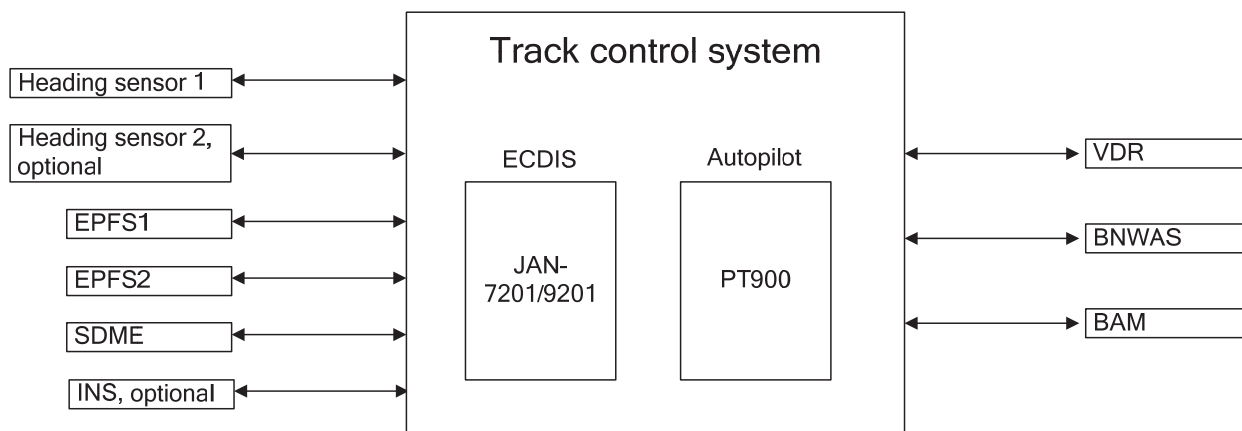


Table A.1 – IEC 61162-1 sentences transmitted by the track control system.

Mnemonic	Interface	Name	Comment	Interval	Talker
ALC	VDR , BAM , INS	Cyclic alert list	List of current alert	1 to 30sec	TC
ALF	VDR , BAM , INS	Alert sentence	Details of a new alert	1 time when alert status changed or alert escalated.	TC
ALR	BNWAS	Set alarm state	Alert transfer to BNWAS	1 to 60sec	TC
ARC	BAM , INS	Alert command refused	Alert command not accepted	1 time per event	TC
EVE	BNWAS	Operator activity	Optional interface to reset dormant period of the BNWAS	1 time per equipment	EI
HBT	BAM , INS	Heartbeat	Support reliable alert related communication	1 to 30sec	TC

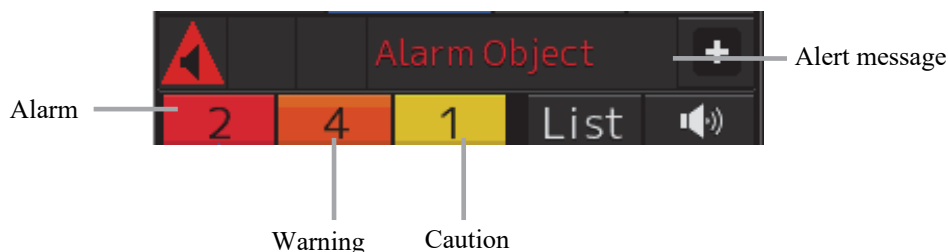
Table A.2 – IEC 61162-1 sentences received by the track control system.

Mnemonic	Interface	Name	Comment
ACN	BAM , INS	Alert command	Alert command e.g. Acknowledge
DTM	EPFS 1 , EPFS 2 , INS	Datum reference	
GLL GGA GNS RMC	EPFS 1 , EPFS 2 , INS	Geographic position – latitude/longitude	
HBT	BAM , INS	Heartbeat	Support reliable alert related communication
THS	Heading sensor 1 , Heading sensor 2 , INS	Heading source	
HCR	Heading sensor 1 , Heading sensor 2 , INS	Heading correction report	
VBW VLW	SDME , INS	Speed log	
VTG	EPFS 1 , EPFS 2 , INS	Speed and course from EPFS	

Appendix B Alert List

ECDIS

When an alert occurs, alert information is displayed in the alert notification area.



The numbers displayed in the buttons indicate the number of such alerts that have occurred.

Memo

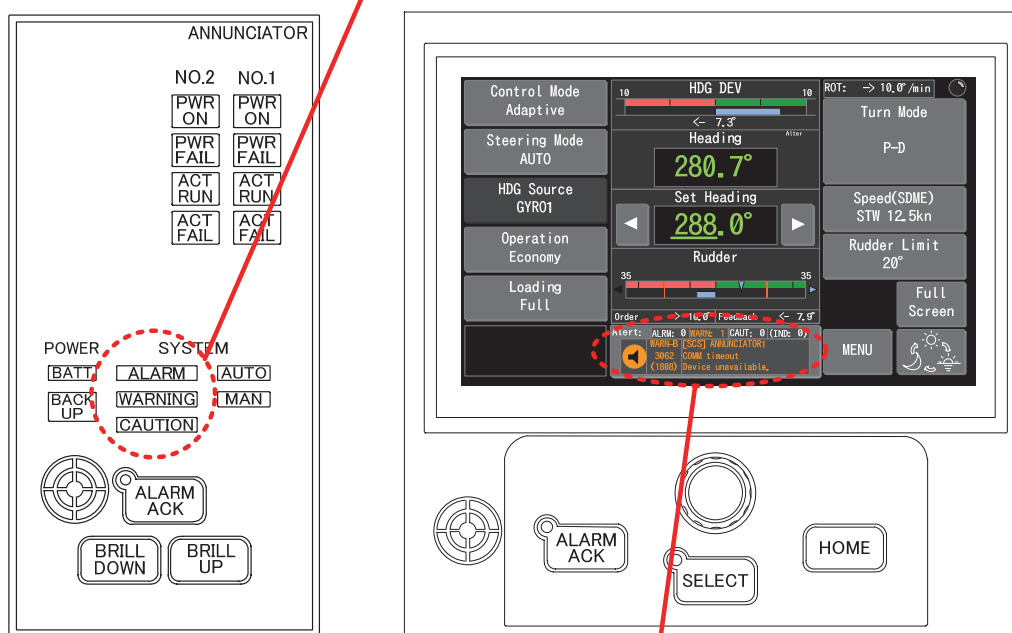
The alert button of a category that has not occurred will not be displayed.

Autopilot

In case that PT900 detects any trouble, audible and visible alerts are generated at AP CDU and ANNUNCIATOR UNIT shown in the figure below.

This information is categorized as “Alert” having three priorities (Alarm, Warning and Caution) and “Important indication”.

Alert indication (ALARM/ WARNING/CAUTION)



Alert indication (ALRM/ WARN/CAUT), Important indication (IND)

The display colors of alert messages are defined as follows according to the type and seriousness of alerts.

Alert Type	Alert Class (Seriousness)	Display Color	Alert Display Status	Alert Sound
Alarms (An alert indicating a state asking sailors to pay immediate attention and take immediate action.)	Alarms	Red	Before alarm acknowledgement: Blinking After alarm acknowledgement: Lighting	3 short audible signals (repetitive)
Warnings (An alert indicating that the state has changed, which although not immediately dangerous, but may become so in the near future if no action is taken. Warnings are alerts displayed for preventing possible future hazardous states.)	Warnings	Orange	Before warning acknowledgement: Blinking After warning acknowledgement: Lighting	2 short audible signals (repetitive)
Cautions (Although these are neither alarms nor warnings, these alerts indicate that it is necessary to pay more than normal attention to cautions, statuses, or to the supplied information.)	Cautions	Yellow	Lighting	No sound
No Alarm	-	Green	-	-

The list of TCS alert messages by alert type is shown below.

B.1 Alerts

Alarms

Cause	Conditions to raise	Conditions to rectify	Detail	Category	Required standard	Display
Arrived at LAST WPT	End Of Track warning was not acknowledged for 30 seconds. If the alarm is not acknowledged for an extra period of 30 seconds, Back-up Navigator Call is transferred to BNWAS.	Track control is stopped.	Check on the DISP.	A	IEC 62065	ECDIS
Cross Track	The ship deviated from the track beyond a preset cross-track limit during the track control.	The ship is deviated from the track within a preset cross-track limit during track control.	Check the DIST from TRK on the DISP	A	IEC 62065	ECDIS
Early Course Change	An early course change warning was not acknowledged for 30 seconds. If the alarm is not acknowledged for an extra period of 30 seconds, Back-up Navigator Call is transferred to BNWAS.	Alarm is acknowledged. Or Track control is stopped.	Almost the WOT. Check on the DISP.	A	IEC 62065	ECDIS
HDG(Sensor Failure)	Heading sensor data is lost or invalid during the track control.	Sensor data switched to a valid or available data during the track control.	Switch the AP to manual mode	B	IEC 62065	ECDIS
POSN(Sensor Failure)	Position sensor data was lost or invalid during the track control.	Sensor data switched to a valid or available data during the track control.	Switch the AP to manual mode	B	IEC 62065	ECDIS
STW(Sensor Failure)	Speed sensor data is lost or invalid during the track control.	Sensor data switched to a valid or available data during the track control.	Switch the AP to manual mode	B	IEC 62065	ECDIS
Track Control Stopped	Track Control Stopped warning was not acknowledged for 30 seconds. If the alarm is not acknowledged for an extra period of 30 seconds, Back-up Navigator Call is transferred to BNWAS.	Alarm is acknowledged.	Switch the AP to manual mode	B	IEC 62065	ECDIS

Cause	Conditions to raise	Conditions to rectify	Detail	Category	Required standard	Display
Track Control Stopped (Reboot)	Equipment restarted during the track control.	Alarm is acknowledged.	Switch the AP to manual mode	B	-	ECDIS
Wheel Over Line	An actual course change warning was not acknowledged for 30 seconds. If the alarm is not acknowledged for an extra period of 30 seconds, Back-up Navigator Call is transferred to BNWAS.	Alarm is acknowledged. Or Track control is stopped.	Check on the DISP.	A	IEC 62065	ECDIS

Warnings

Cause	Conditions to raise	Conditions to rectify	Detail	Category	Required standard	Display
Actual Course Change	30 s before the wheel over line. If Actual course change warning is not acknowledged for 30 seconds, the warning escalates to Wheel-over Time alarm.	Warning is acknowledge. Or Track control is stopped.	Few sec to WOT. Check on the DISP.	A	IEC 62065	ECDIS
Change Autopilot steering mode	The steering mode was not switched within 30 seconds after the start of DR.	Warning is acknowledged .	Switch the AP to manual mode	B	IEC 62065	ECDIS
Course difference	The actual heading deviated from the course beyond a preset course difference limit.	The actual heading is deviated from the course within a preset course difference limit.	Check HDG on the DISP	A	IEC 62065	ECDIS
Early Course Change	3-6 minutes before the wheel-over line. If Early course change warning is not acknowledged for 30 seconds, the warning escalates to Early course change alarm.	Warning is acknowledge. Or Track control is stopped.	Few min to WOT. Check on the DISP.	A	IEC 62065	ECDIS
End Of Track	3-6 minutes before the arrival at final WP. If End Of Track warning is not acknowledged for 30 seconds, the warning escalates to Arrived at LAST WPT alarm.	Track control is stopped.	Few min to Last WPT. Check on the DISP.	A	IEC 62065	ECDIS

Cause	Conditions to raise	Conditions to rectify	Detail	Category	Required standard	Display
POSN(Automatic Changed)	POSN source was automatically changed.	Warning is acknowledged .	POSN source was automatically changed	B	IEC 62065	ECDIS
POSN(Deviation)	Deviation between position source exceeded beyond a preset POSN Discrepancy limit.	The Deviation between position source is deviated within a preset POSN Discrepancy limit.	Deviation exceeded between source	A	IEC 62065	ECDIS
STW(Automatic Changed)	STW source was automatically changed	Warning is acknowledged .	STW source was automatically changed	B	IEC 62065	ECDIS
Track Control Stopped	DR navigation has continued for 10 minutes after all position sensor failure.	Warning is acknowledged .	Switch the AP to manual mode	B	IEC 62065	ECDIS
	Heading sensor error occurs					
	Autopilot error occurs					
	Communication error between the autopilot and ECDIS occurs.					
Low speed	Ship's speed becomes less than set value	Ship's speed exceeds set value	Ship speed is too low for AUTO steering.	B	IEC 62065	Autopilot
Doubtful HDG	Deviation between selected heading source's heading and unselected heading source's heading becomes more than set value for more than detection time	Deviation becomes less than set value	DEV between two HDG sources exceeded LMT.	A	IEC 62065	Autopilot
Controller C/O	MPU was changed over automatically due to detection of selected MPU failure	Automatically rectified after notification	AUTO STEER controller changed automatically.	B	-	Autopilot

Cautions

Cause	Conditions to raise	Conditions to rectify	Detail	Category	Required standard	Display
HDG(Unmatched Source)	Primary gyro of ECDIS is different from primary gyro of Autopilot.	Primary gyro of ECDIS is the same as primary gyro of Autopilot.	Select the same HDG sensor as AP	B	IEC 62065	ECDIS
POSN(Jump)	Position is jumped beyond radius limit.	Position is jumped beyond radius limit during time limit.	-	B	-	ECDIS

B.2 Indication

Cause	Conditions to raise	Conditions to rectify	Detail	Configuration-dependent text	Display
<1> COMM	Valid heading data cannot be received from No.1 heading source Factor: Source device is power-off / abnormal, communication route failure, etc.	Receiving valid data	No valid HDG.	<1> No.1 heading source (Ex. "GYRO")	Autopilot
<1> COMM	Valid heading data cannot be received from No.2 heading source Factor: Source device is power-off / abnormal, communication route failure, etc.	Receiving valid data	No valid HDG.	<1> No.2 heading source (Ex. "MAG")	Autopilot
<1> COMM	Valid heading data cannot be received from No.3 heading source Factor: Source device is power-off / abnormal, communication route failure, etc.	Receiving valid data	No valid HDG.	<1> No.3 heading source (Ex. "THD")	Autopilot

Cause	Conditions to raise	Conditions to rectify	Detail	Configuration-dependent text	Display
SPD LOG COMM	Valid speed data cannot be received from speed source Factor: Source device is power-off / abnormal, communication route failure, etc.	Receiving valid data	No valid SPD.	-	Autopilot
ECDIS COMM	Valid data cannot be received from ECDIS Factor: Source device is power-off / abnormal, communication route failure, etc.	Receiving valid data	No valid data. TCS unavailable.	-	Autopilot

B.3 List of Alert escalation

There are unacknowledged alert that escalates as follows.

- Alarm to Back-up Navigator Call

If the alarm is not acknowledged for an extra period, Back-up Navigator Call is transferred to BNWAS.

- Warning to Alarm

If warning is not acknowledged, the warning escalates to alarm.

- Warning to Warning

An unacknowledged warning will be generated repeatedly until it is acknowledged.

The Alerts to escalation are as shown below.

Cause	Escalation	Time	Explanation	Display
Arrived at LAST WPT alarm	Alarm to Back-up Navigator Call	30s	If the alarm is not acknowledged for an extra period of 30 seconds, Back-up Navigator Call is transferred to BNWAS.	ECDIS
Cross Track alarm	Alarm to Back-up Navigator Call	30s	If the alarm is not acknowledged for an extra period of 30 seconds, Back-up Navigator Call is transferred to BNWAS.	ECDIS
Early course change alarm	Alarm to Back-up Navigator Call	30s	If the alarm is not acknowledged for an extra period of 30 seconds, Back-up Navigator Call is transferred to BNWAS.	ECDIS
POSN(Sensor Failure) alarm	Alarm to Back-up Navigator Call	30s	If the alarm is not acknowledged for an extra period of 30 seconds, Back-up Navigator Call is transferred to BNWAS.	ECDIS
HDG(Sensor Failure) alarm	Alarm to Back-up Navigator Call	30s	If the alarm is not acknowledged for an extra period of 30 seconds, Back-up Navigator Call is transferred to BNWAS.	ECDIS
STW(Sensor Failure) alarm	Alarm to Back-up Navigator Call	30s	If the alarm is not acknowledged for an extra period of 30 seconds, Back-up Navigator Call is transferred to BNWAS.	ECDIS
Track Control Stopped alarm	Alarm to Back-up Navigator Call	30s	If the alarm is not acknowledged for an extra period of 30 seconds, Back-up Navigator Call is transferred to BNWAS.	ECDIS
Wheel-over Line alarm	Alarm to Back-up Navigator Call	30s	If the alarm is not acknowledged for an extra period of 30 seconds, Back-up Navigator Call is transferred to BNWAS.	ECDIS
Actual course change warning	Warning to Alarm	30s	If Actual course change warning is not acknowledged for 30 seconds, the warning escalates to Wheel-over Time alarm.	ECDIS

Cause	Escalation	Time	Explanation	Display
Early course change warning	Warning to Alarm	30s	If Early course change warning is not acknowledged for 30 seconds, the warning escalates to Early course change alarm.	ECDIS
End Of Track warning	Warning to Alarm	30s	If End Of Track warning is not acknowledged for 30 seconds, the warning escalates to Arrived at LAST WPT alarm.	ECDIS
Track Control Stopped warning	Warning to Alarm	30s	If Track Control Stopped warning is not acknowledged for 30 seconds, the warning escalates to Track Control Stopped alarm.	ECDIS
Other warning	Warning to Warning	60s	An unacknowledged warning will be generated repeatedly until it is acknowledged.	ECDIS Autopilot

B.4 List of Alerts with responsibility-transferred state

The responsibility-transferred state is a state for priority reduction. When the equipment managing the alert in the system requests a transfer of responsibility of alert, the requested equipment changes state of the alert to responsibility transferred.

Alerts in responsibility transferred state will not be displayed on the active alert list. Whether to display of the responsibility have been transferred alerts on the active alert list can be switched to ON or OFF in the setting. Refer to JAN-7201/9201 instruction manual.

These alerts with responsibility transferred states are as shown below.

Cause	Priority	Category	Display
HDG(Sensor Failure)	Alarm	B	ECDIS
POSN(Sensor Failure)	Alarm	B	ECDIS
STW(Sensor Failure)	Alarm	B	ECDIS
Track Control Stopped	Alarm	B	ECDIS
Track Control Stopped (Reboot)	Alarm	B	ECDIS
POSN(Automatic Changed)	Warning	B	ECDIS
STW(Automatic Changed)	Warning	B	ECDIS
Track Control Stopped	Warning	B	ECDIS
Change Autopilot steering mode	Warning	B	ECDIS
Low speed	Warning	B	Autopilot

B.5 List of Alert Icons

The alert icons displayed in the alert status area are listed below.

No.	Name of alert icon	Functional outline	Alert icon
1	Active – unacknowledged alarm	A flashing red triangle. A symbol of loudspeaker in the middle of the triangle.	
2	Active – silenced alarm	A flashing red triangle. A symbol as in icon number 1 with a prominent diagonal line above it.	
3	Active – acknowledged alarm	A red triangle. An exclamation mark in the middle of the triangle.	
4	Active - responsibility transferred alarm	A red triangle. An arrow pointing towards the right in the middle of the triangle.	
5	Rectified – unacknowledged alarm	A flashing red triangle. A tick mark in the middle of the triangle.	
6	Active - unacknowledged warning	A flashing yellowish orange circle. A symbol of loudspeaker in the middle of the circle.	
7	Active – silenced warning	A flashing yellowish orange circle. A symbol as in icon number 6 with a prominent diagonal line above it.	
8	Active – acknowledged warning	A yellowish orange circle. An exclamation mark in the middle of the circle.	
9	Active - responsibility transferred warning	A yellowish orange circle. An arrow pointing towards the right in the middle of the circle.	
10	Rectified – unacknowledged warning	A flashing yellowish orange circle. A tick mark in the middle of the circle.	
11	Caution	A yellow square. An exclamation mark in the middle of the square.	
a	Aggregation	A plus sign. To be presented together with icons number 1 to 11	
b	Acknowledge not allowed for alarm	A red triangle with a cross in the middle of triangle. To be presented together with icons number 1, 2 and 5.	
c	Acknowledge not allowed for warning	A yellowish orange circle with a cross in the middle of circle. To be presented together with icons number 6, 7 and 10.	

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