

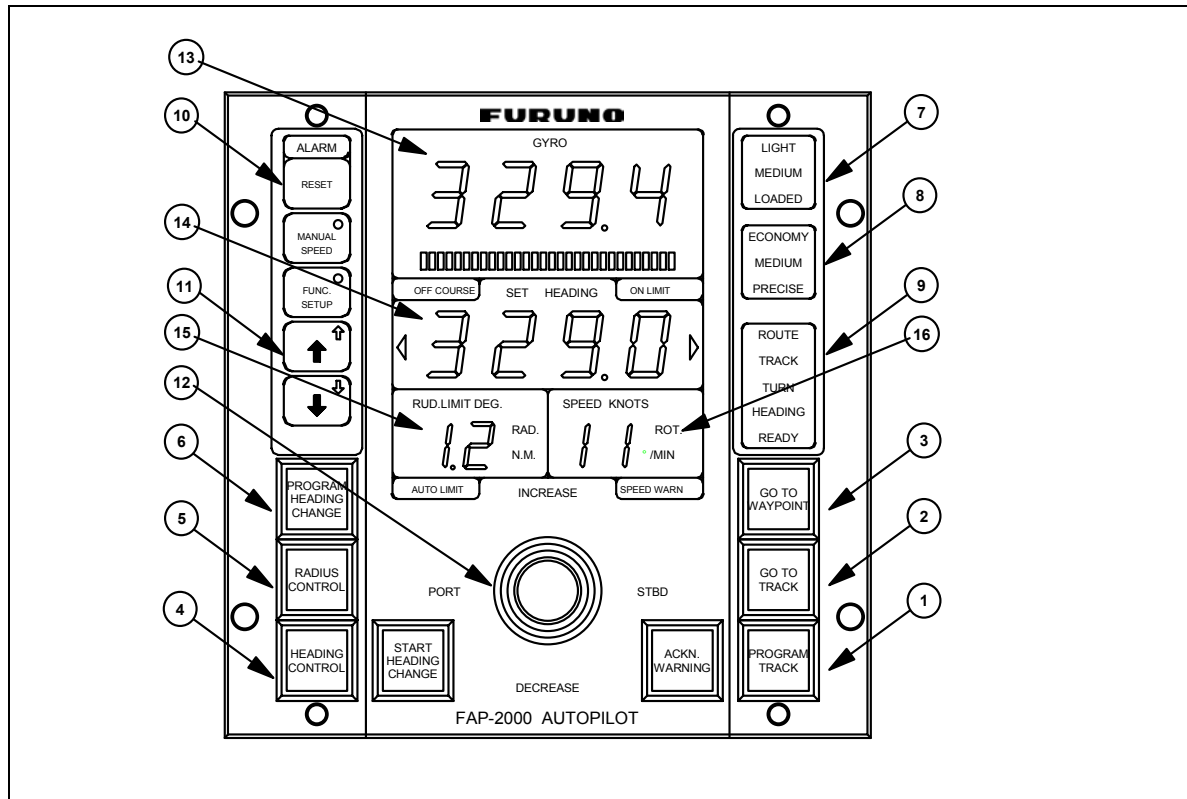
## 2. USER INSTRUCTION .

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## 2.1 SHORT PANEL DESCRIPTION

FIG. 1 (MIP41-000 panel function overview)



- Item 1-5: Auto pilot Control mode take-over push buttons.  
Local modes: Heading Control. Radius Control.  
Nav. Comp. assisted modes: Program Track, Go To Track, Go To Waypoint.
- Item 6: Autopilot Program Heading Change mode push button.  
Selection of preplanned Heading change.
- Item 7: Condition indicator. (Light, Medium, Loaded).
- Item 8: Performance indicator. (Economy, Medium, Precise).
- Item 9: Autopilot status indicator. Showing selected mode, readiness.
- Item 10: Autopilot alarm indicator and buzzer cancel.
- Item 11: Special function keypad.  
Manual Speed select, Panel dimmer and Set-up of: Manual speed value, Auto by speed rudder limit function, Performance and Condition.
- Item 12: Heading Change & Radius/Rudder-limit tiller.  
Left <-> Right to Change Heading, Up <-> Down to set Radius or Rudder limit.
- Item 13: Gyro reading & Bar-graph giving an impression of rate of turn.
- Item 14: Set Heading display incl. Off Course Alarm, Turn side & Rudder on limit indication.
- Item 15: Displays Radius set-point in Radius control mode or Rudder Limit in Heading control mode.  
AUTO LIMIT indicates selection of Automatic Speed dependent rudder limit function.
- Item 16: Displays Rate Of Turn in Radius control mode or Speed in Heading control mode.  
Speed warning indicator (Log failure or low speed).

## 2.2 AUTOPILOT CONTROL TAKE-OVER & MODE SELECTION.

The autopilot is made READY for mode selection from an external rudder control mode selector. (Not a part of the autopilot supply).

- The READY field in the status indicator will illuminate.

Operate one of the Autopilot take-over push buttons to select a control mode:

Local modes: Heading control. - Radius control.

Remote modes: Program Track - Go To Track - Go To Waypoint.

- The selected push button lamp will start flashing and go to steady light when the mode has been established.
- The status display will show: HEADING in local Heading and Radius control modes.  
ROUTE in Go To Track and Go To Waypoint modes.  
TRACK in Program Track and Go To Track mode + TURN when on a curved track.

Any of the five modes can be selected from any ongoing mode.

### MULTI PANEL INSTALLATIONS:

Press one of the five mode push buttons on any panel:

- The control will automatically be transferred from one panel to another.
- The requested mode will be enabled.

Taking away the control from a panel by panel transfer or going to HAND control will make the buzzer sound shortly.

## 2.3 AUTOPILOT HEADING CHANGE FUNCTIONS.

The heading to steer can be adjusted from the MIP panel in the following modes:

HEADING CONTROL, RADIUS CONTROL, PROGRAM TRACK.

Operate the tiller left <-> right to adjust the heading to steer. Port / Stbd indicators left and right of the tiller is illuminated, when the tiller is ready for operation.

Heading changes can either be performed IMMEDIATELY when entered, or be preplanned in the PROGRAM HEADING CHANGE and the PROGRAM TRACK mode - waiting for the navigator to start the turn.

The TURN SIDE triangle indicators in the set heading display will show the turn direction.

**IMMEDIATE HEADING CHANGE operation** is the default heading change mode in HEADING and RADIUS CONTROL modes.

The heading to steer can be adjusted 180 degrees left or right of the gyro reading.

**PROGRAM HEADING CHANGE operation** can be selected only when operating in the HEADING and RADIUS control modes.

To select: Press the PROGRAM HEADING CHANGE push button.

- The PROGRAM HEADING CHANGE illuminates. The RADIUS CONTROL or HEADING CONTROL lamp stays on.
- Move the tiller left <-> right to adjust the heading to steer.  
The heading to steer can be adjusted 240 degrees left or right of the gyro reading.
- The START HEADING CHANGE push button will start flashing.
- Operate The START HEADING CHANGE push button to start the turn.

The Program Heading Change mode will automatically be cancelled upon a start heading change operation.

To cancel a pending programmed heading change and restore the actual heading to steer:

- Press the ongoing or wanted mode push-button again
- either press Heading Control
- or press Radius Control.

The PROGRAM HEADING CHANGE mode will be cancelled and returned to the default immediate mode.

To return to the immediate heading change mode without cancelling the programmed new heading. for intermediate modification of the actual set-heading:

Press the PROGRAM HEADING CHANGE push-button again and carry out the modifications of the actual set-heading value.

Press the PROGRAM HEADING CHANGE push-button again to toggle back to the Programmed set-heading value ready for Execution.

If the intermediate modification of the actual set-heading brings the programmed heading change above 300 degrees either port or stbd, or a programmed set-heading with turn-side flag is again passed by the intermediate set-heading in immediate mode, then the programmed value will automatically be cancelled.

Further any programmed set heading value will be automatically cancelled if hidden in the background while operating in immediate heading change mode for more than 15 minutes.

**PROGRAM TRACK operation:** see how to operate in the Users Instructions for the Nav. Computer system.

#### **HEADING TO STEER FUNCTION WHEN CHANGING MODE.**

HAND steering to any autopilot mode:

The heading to steer is equal to the gyro reading. "Steady as she goes".

Between RADIUS and HEADING CONTROL:

Present heading to steer is kept.

From a REMOTE mode (Nav Comp. mode assisted mode) to RADIUS or HEADING CONTROL:

The heading to steer will be set equal to the gyro reading. "Steady as she goes".

From a LOCAL mode to a remote mode:

During the mode transfer the local operating mode will continue on the currently used heading to steer order. When control is transferred the heading to steer will follow Nav. Computer orders.

## 2.4 THE SPECIAL FUNCTION KEYPAD.

- ◆ MANUAL SPEED - selection.
- ◆ FUNC. SET-UP.
- ◆ Arrow up/down keys.

### MANUAL SPEED:

Select MANUAL SPEED in case of a log failure.

Activate the key to select manual speed input.

- The led-lamp in the MANUAL SPEED key turns on.
- If in HEADING CONTROL mode: The RATE OF TURN / SPEED display will always be in the SPEED display mode.
- If in any other mode: The display will automatically shift from RATE OF TURN mode to the SPEED display mode.

To adjust the manual speed value see FUNC. SET-UP below.

**NOTE: Incorrect speed input will lead to incorrect RADIUS control.**

### FUNC. SET-UP:

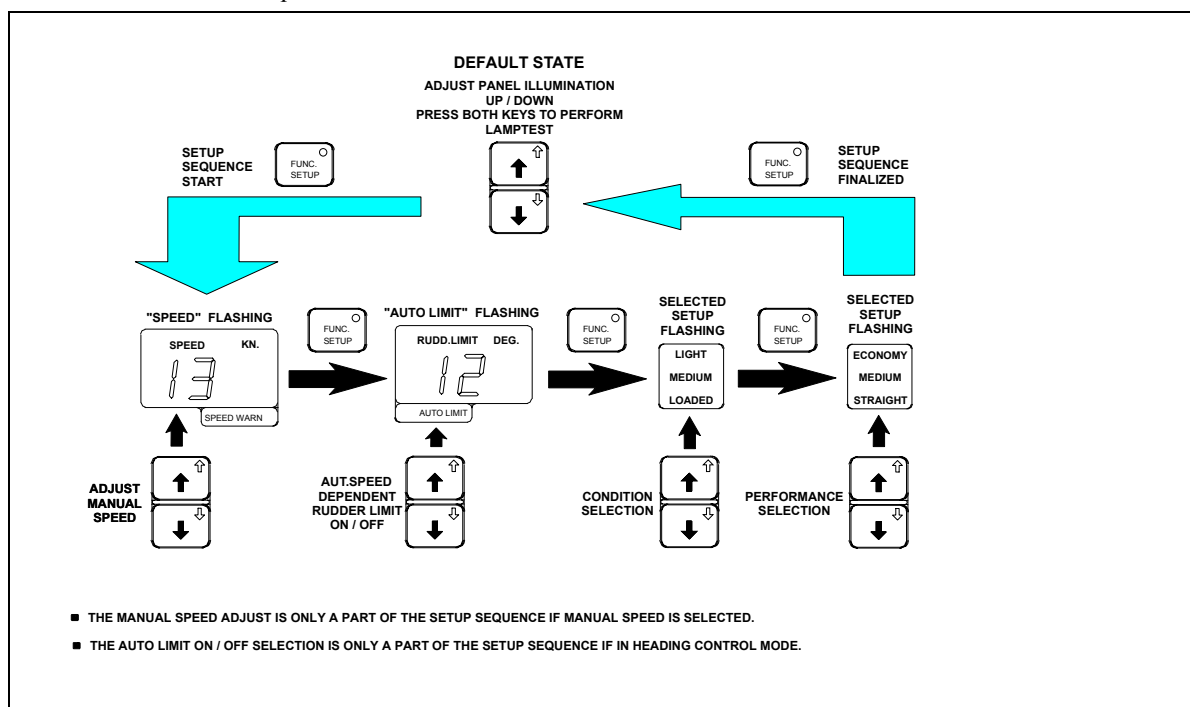
Activate the key to start the following set-up functions:

- ◆ MANUAL SPEED adjust.
- ◆ AUTO LIMIT ON/OFF. Automatic speed dependent rudder limit on/off.
- ◆ CONDITION (LIGHT/MEDIUM/LOADED) selection.
- ◆ PERFORMANCE (ECONOMY/MEDIUM/PRECISE) selection

Use the FUNC. SET-UP key to step through the sequence. The set-up process will automatically time out if the set-up sequence is not finalised.

Use the arrow-up/down keys to alter a value or selection. The specific item under set-up is shown by flashing displays (See specific indication in fig. 2).

FIG. 2 FUNC SET-UP sequence



## 2.5 THE RUDDER LIMIT FUNCTION.

The rudder limit can either be manually adjusted or be an automatically selected value as a function of the speed, AUTO LIMIT. See below how the default selection of rudder limit function depends on selected mode.

### **Manual rudder limit:**

Operate the tiller up/down to increase/decrease the rudder limit value.

Rudder limit adjustment range: 5 degrees to 30 degrees

INCR. / DECR. indicators above and below the tiller shows that the tiller is enabled and ready for operation.

### **AUTO LIMIT (Automatic speed dependent rudder limit):**

The rudder limit will increase automatically with decreasing speed.

The rudder limit at max. cruising speed is an internal adjustable value.

Two different values are available:

- one for heading control mode (typically set to 10 deg.)
- one for radius and nav. comp. assisted modes (typically set to a value above 10deg.)
- one for use only on the counter rudder, if this facility is selected by parameter because of an unstable vessel steering characteristic. (This value is to be even higher than the above values).

If the tiller is operated up or down, the rudder limit adjustment will shift to manual mode.

### **The RUDDER LIMIT function in HEADING CONTROL mode:**

Selecting the local HEADING CONTROL mode will:

- automatically turn the RADIUS/RUDDER LIMIT display into a RUDDER LIMIT display.
- default select the AUTO LIMIT function if this function was used last time in HEADING CONTROL.
- default come up with the last used rudder limit setting if MANUAL rudder limit function was used.
- default come up with the AUTO LIMIT function after power up.

If the rudder order is limited during a manoeuvre, the rudder limit value and the ON LIMIT indicator in the heading to steer display will be flashing to announce limitation of the manoeuvre.

To shift between AUTO LIMIT and MANUAL limit function, see the func. set-up description above.

### **Rudder limitation in other autopilot control modes:**

The AUTO LIMIT function will default be active in RADIUS and Nav. Computer controlled remote modes.

If the rudder order is limited:

- the ON LIMIT indicator is lit.

If the rudder order is limited for a longer period (internal parameter) during a manoeuvre:

- the OFF COURSE alarm is activated, to announce that the heading of the vessel cannot follow the rotation of the tangent to the curve defined by the ordered radius.
- the alarm buzzer will sound.

Proceed in this condition by:

- cancelling the panel buzzer by pressing RESET.
- and then dependent on the navigational situation:
  - either select the HEADING CONTROL mode.
  - or shift to HAND control

**NOTE: Limitation of the rudder will lead to incorrect RADIUS control.**

## 2.6 THE RADIUS OF TURN ADJUSTMENT.

The RADIUS of turn value can be adjusted when both:

- The RADIUS/RUDDER LIMIT display is in RADIUS mode.
- and the INCR/DECR fields at the tiller are illuminated.

The RADIUS of turn value is adjusted (INCR / DECR) in steps of 0.1 NM. The equivalent RATE OF TURN is shown on the ROT display in deg./min. Values above 99 deg/min is displayed as "HI".

The RADIUS upper adjustment limit is: 9.9 NM.

The lower limit is selected by internal parameter set-up to fit manoeuvring characteristics of the vessel. (0.1, 0.2, 0.3 or 0.4 NM).

## 2.7 THE CONDITION SET UP.

3 selections possible: LIGHT - MEDIUM - LOADED.

Set according to loading conditions.

Use setting LOADED in shallow waters if the autopilot control performance is reduced.

## 2.8 THE PERFORMANCE SET UP.

3 selections possible: ECONOMY - MEDIUM - PRECISE.

Use ECONOMY or MEDIUM to obtain a relaxed control to save fuel by minimising use of rudder.

Use PRECISE during manoeuvres and when in confined waters.

## 2.9 THE AUTOPILOT STATUS INDICATOR.

Displays:

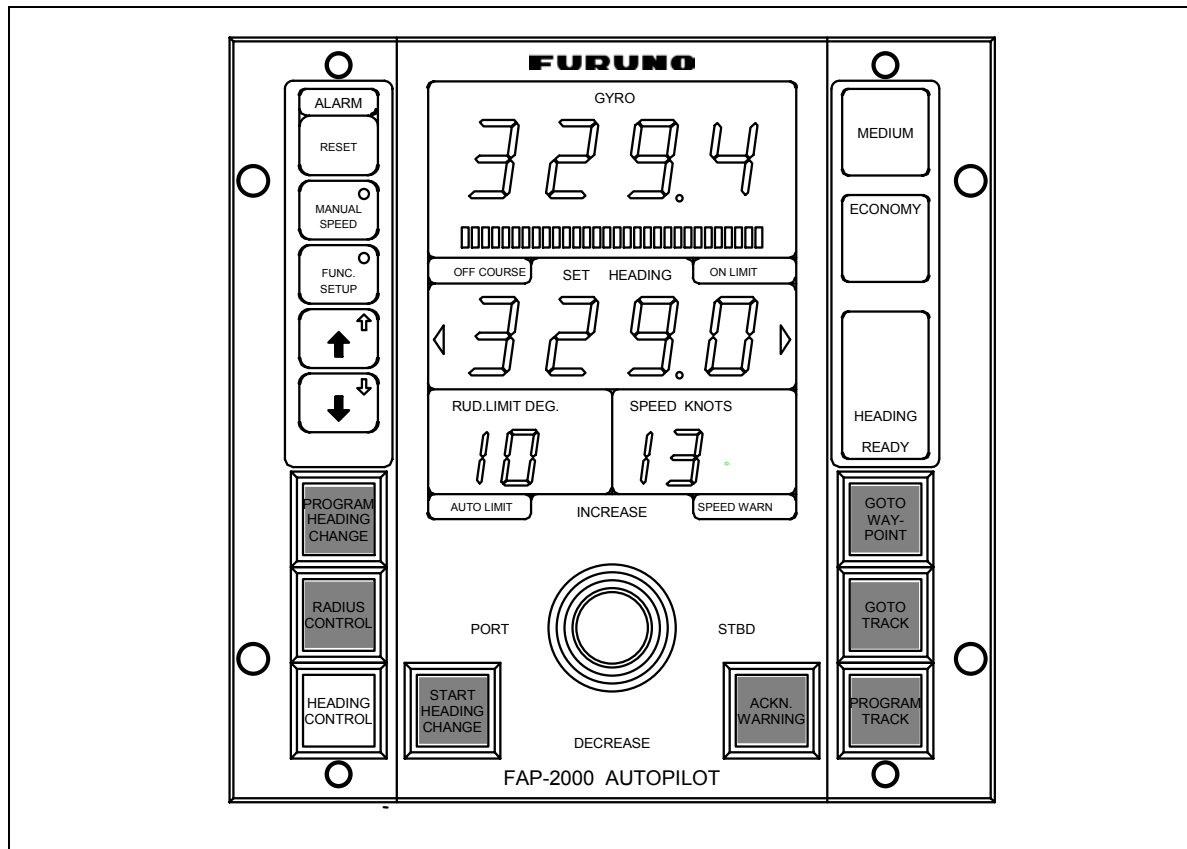
- Autopilot READY:
  - signalling - autopilot is ready for mode selection.
- Selected autopilot control mode:
  - HEADING in local Heading and Radius control modes.
  - ROUTE in Go To Track and Go To Waypoint modes.
  - TRACK in Program Track mode and Go To Track mode.

The status indications are equal on all panels in installations with more panels.

The selected mode push button will only be illuminated on the panel in control

## 2.10 AUTOPILOT HEADING CONTROL MODE.

FIG. 3 Typical MIP41-000, autopilot control panel, in heading control mode.



- ◆ The HEADING CONTROL lamp is illuminated.
- ◆ The status display is showing HEADING, READY
- ◆ The RADIUS/RUDDER LIMIT display is automatically shifted to a RUDDER LIMIT display and the rudder limit function/value is restored from last time the Heading Control mode was selected..
- ◆ The RATE OF TURN/SPEED display automatically shifts to a SPEED display.
- ◆ The PROGRAM HEADING CHANGE mode is default off.

Move the tiller up / down to set the rudder limit.

Move the tiller left / right to start an immediate heading change.

- rudder angles up to the rudder limit value can be ordered to carry out the heading change.

Press the PROGRAM HEADING CHANGE to make a pre-planned heading change.

Move the tiller left / right to read in a new pre-planned heading to steer value.

- The START HEADING CHANGE push-button starts flashing.

Enforce the manoeuvre by pressing the START HEADING CHANGE push button.

- The PROGRAM HEADING CHANGE mode is automatically cancelled.

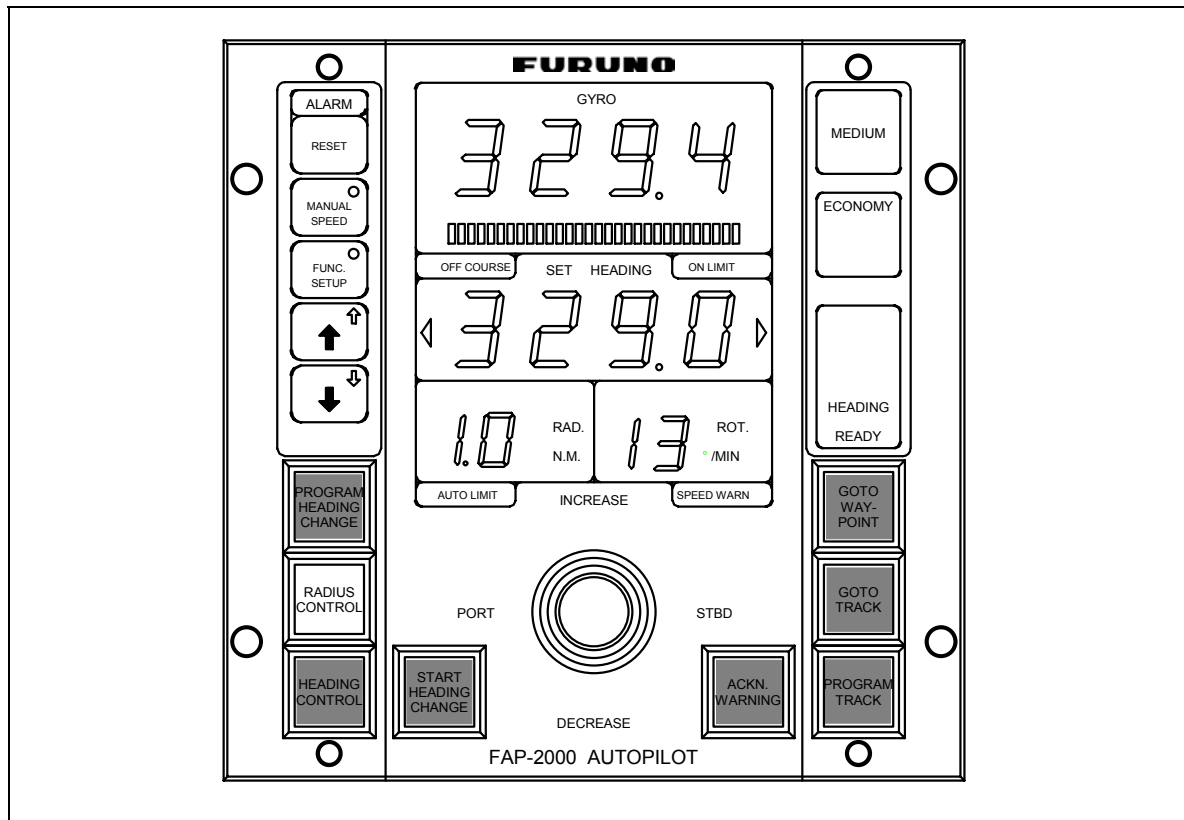
Press MANUAL SPEED and make manual speed adjustment (Use Func. Set Up) in case of a log failure.

Select suitable CONDITION and PERFORMANCE settings. (Use Func. Set Up)



## 2.11 AUTOPILOT RADIUS CONTROL MODE.

FIG. 4 Typical MIP41-000, autopilot control panel, in RADIUS control mode.



- ◆ The RADIUS CONTROL lamp is illuminated.
- ◆ The status display is showing HEADING & READY
- ◆ The RADIUS/RUDDER LIMIT display is in a RADIUS display mode.
- ◆ The RATE OF TURN/SPEED display is in a RATE OF TURN display mode.
- ◆ The PROGRAM HEADING CHANGE mode is default off.

Move the tiller up / down to set the RADIUS OF TURN. The RATE OF TURN display value will follow with a value calc. through the speed. Rate of turn values above 99 deg./min are displayed as "HI".

Move the tiller left / right to start an IMMEDIATE HEADING CHANGE.

- The heading change is executed at a rate of turn calculated from the RADIUS setting and the speed of the vessel.

The rudder angle is limited by the AUTO LIMIT function. See sec. 2.5 how to operate in case of a rudder ON LIMIT condition.

**Note:** There is no position reference, External influence from wind and sea will make the position of the vessel deviate from the ordered radius curvature. Wrong speed value or a limitation of the manoeuvre will lead to incorrect radius control.

Press the PROGRAM HEADING CHANGE to make a pre-planned heading change.

Move the tiller left / right to read in a new pre-planned value.

- The START HEADING CHANGE push-button starts flashing.

Enforce the manoeuvre by pressing the START HEADING CHANGE push button.

- The PROGRAM HEADING CHANGE mode will automatically be cancelled.
- The manoeuvre will be carried out like under immediate heading change.

Cancel a pre-planned heading change by selecting RADIUS CONTROL again.

Press MANUAL SPEED and make manual speed adjustment (Use Func. Set Up) in case of a log failure. Select suitable CONDITION and PERFORMANCE settings. (Use Func. Set Up)



**GO TO WAYPOINT mode:**

Select GO TO WAYPOINT:

Lamps GO TO WAYPOINT and ROUTE goes on

The tiller can be used to set radius, but not heading to steer.

(The INCR / DECR fields at the tiller is illuminated, PORT / STBD is off)

The steering is heading control with set radius

- between waypoints: If wind, current etc. effects the ship, the system tries to prevent the ship from drifting away from the planned route
- during turns: If wind, current etc. effects the ship, it will drift away (inside or outside) from the planned designed turn which is displayed on radar/ECDIS screen. No track control in turns.

The GO TO WP mode can be used when the ship has a good position source available.

**GO TO TRACK mode:**

Select GO TO TRACK.

Lamps GO TO TRACK and ROUTE on.

The tiller can be used to set radius, but not heading to steer.

(The INCR / DECR fields at the tiller is illuminated, PORT / STBD is off)

The steering is track controlled with set radius

- always, if wind, current etc. effects the ship, the system tries to prevent the ship from drifting away from the planned route, both between waypoints and during turns.

The GO TO TRACK mode can be used when the ship has high precision position source available.

**PROGRAM TRACK mode:**

Select PROGRAM TRACK

Lamps PROGRAM TRACK, TRACK on.

The autopilot steers the vessel on a track with a leg course equal to the set heading when the mode was entered.

When a new course and radius is entered by the tiller the programmed turn can be observed on the radar screen.

(The INCR / DECR fields and the PORT / STBD fields at the tiller is all illuminated)

The START HEADING CHANGES flashes, as soon as the new heading to steer value is different from the currently used value.

The heading change is activated by pushing START HEADING CHANGE

After activation the autopilot will carry out a track controlled turn to the new leg and continue from there on a linear track.

The heading change is track controlled with set radius

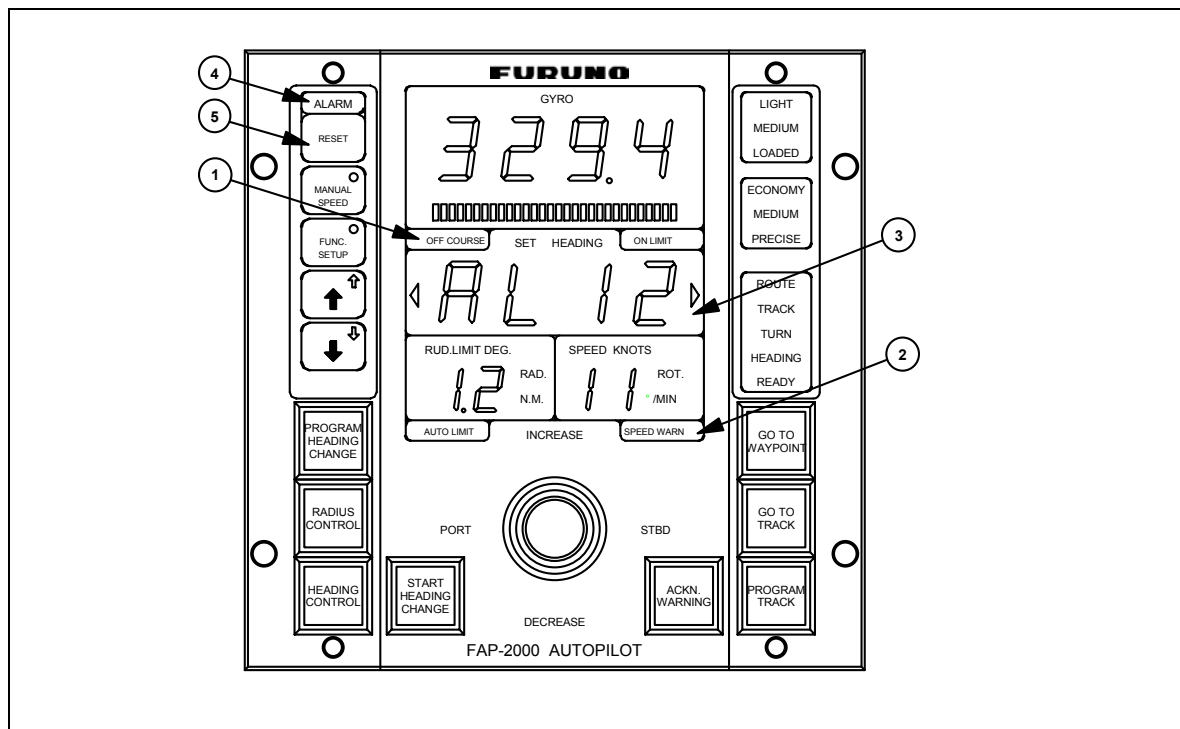
- if wind, current etc. effects the ship, the system tries to prevent the ship from drifting away (inside or outside) from the planned, designed turn, which is displayed on the radar screen.

A new turn can be programmed to the operators wishes and the PROGRAM TRACK mode can be continued this way.

The PROGRAM TRACK mode can be used when the ship has high precision position source available. It is designed to perform a drift compensated Heading control (COURSE control).

## 2.13 THE AUTOPILOT ALARM/WARNING SYSTEM.

FIG. 5 MIP41-000, Autopilot control panel, showing different alarm conditions.



### The Off-course alarm and the autopilot to gyro interface:

The off-course alarm is given in case of:

Either the difference between the set-course and the secondary heading source is larger than a preset value (Typ. 10 deg., intern. parameter) or the heading of the vessel cannot follow the rate of turn of the tangent to the curve in a Radius controlled mode, because the rudder is on limit for too long time. (This time is an internal parameter value).

In case of an alarm:

Item 1 & 4 is illuminated. Item 1 is flashing until acknowledged. Acknowledge and cancel buzzer by operating RESET= Item 5 OR the externally fitted, overall RESET device, entered the AEU-box as a dry, closing contact. When acknowledged, The ALARM is under dimmer control.

Two heading reference sources can be received by the autopilot.

The off-course alarm is backed up by a GYRO COMPARISON ALARM. The alarm is activated, If the difference between the autopilot ref. gyro reading and a secondary gyro reading is above a preset value. (Typ. 10 deg., intern. parameter set up).

An automatic change over to the secondary gyro will take place, if the signal from the autopilot ref. gyro is missing. There will be no transient in the heading control as the stationary difference between the two gyro sources is faded away slowly. (Parameter: typical ramp time 1 degree / minute, shall be set dependent on ships size).

AL10 is released if the ref. gyro fails.

AL11 is released if the secondary gyro fails.

The gyro reference to the autopilot can follow the bridge repeater system gyro change-over system selection through a contact input to the autopilot. The above ramping is active in case of a change-over while in autopilot control.

In case both gyro signals are lost the rudder position is frozen, - or if the FreezeRudder parameter is set to 0, the better fail to safe approach is used: Setting the heading error equal to zero.

### **The Speed signal inputs and the Speed warning system.**

Signals from two speed sources can be received:  
The main SPEED signal and the backup speed signal.

If the autopilot is interfaced to an ECDIS system (Track control), the main speed signal will normally be received from the ECDIS.

Speed information is used for two different purposes in the autopilot:

- Feed forward information to the autopilot controller. A water speed signal is used if available either in the main speed signal or the backup speed signal, else a ground speed related value or manual speed value is used.
- Calculation of Rate of turn from a Set Radius value. A ground speed signal from the main speed source is used if available, else a ground speed value from the back-up speed source is used, or else a water speed value or a manual speed value is used from any source.

A SPEED WARN will be issued in case of:

- The water speed signal (either a main or back-up source water speed signal , or if these are not available then a ground speed signal) is below 20% or above 120% of MCR speed.
- The main speed signal is lost (regardless of number of speed sources).

In case of a speed warn:

- Item 2 & 4 is illuminated. Item 2 flashing until acknowledged.
- Acknowledge and cancel buzzer by operating RESET, Item 5.
- When acknowledged, The SPEED WARN lamp is under dimmer control.

If the autopilot speed signal is lost,  
or manual speed is selected when operating in the RADIUS or TRACK mode and the parameter  
RadiusSpeedWarn=1,  
then:

- The Speed warn lamp will continue flashing, and the panel buzzer will restart every 2. minutes to indicate that the operating mode is unsafe.

### **The alarm system.**

System detected alarms will be shown in the GYRO display. Ex. AL 12 , item 3.  
The display will be alternating between the AL NO. and the GYRO display.  
(See The SYSTEM OVERVIEW section to get a detailed list of possible alarms).

- In case of an alarm:
- The ALARM indication, item 4, will be on (Not dimmed).
  - Acknowledge and cancel buzzer by operating RESET, Item 5.
  - When acknowledged, The ALARM is under dimmer control.
  - Change to HAND control, or change to a simpler autopilot control mode dependent on the type of alarm. (Ex. in case of AL 12, "missing communication to the Nav. Computer" normal Heading control or Radius control can be selected).

In case of a failure inside a control panel the GYRO display will show "ERR" and a specific error no. will be shown in the SET HEADING display.

- In case of an error:
- The ALARM indication, item 4, will be on (Not dimmed).
  - Acknowledge and cancel buzzer by operating RESET, Item 5.
  - Change to HAND control or to another autopilot control panel, if available.

If the Autopilot is connected to a Central Navigation alarm system, mutual resetting of buzzers can be done, if these features are installed.

Pushing the MIP panel Reset to cancel the MIP panel buzzer will then cancel the Navigation alarm system buzzer and the MIP panel buzzer can be cancelled from the central navigation alarm reset push button.

## 2.14 PRE-SAILING CHECK.

- Start one or two steering gear pumps.
- Select AUTOPILOT steering, either on the MODE switch or by pressing HEADING CONTROL .
- Select HEADING CONTROL, if not already done.
- If no speed signal is available from the log, then a SPEED WARN ALARM will show up. Acknowledge this by pressing RESET.
- Press MANUAL SPEED and then FUNC. SETUP. The speed flashes.
- Press the UP/DOWN arrows to set a normal sailing speed in the SPEED KNOTS window.
- Operate the Rocker tiller INCREASE / DECREASE to adjust the rudder limit, until 10 deg is shown.
- Move the tiller left to order a new, lower HEADING TO STEER value, 20 deg below the GYRO heading.
- Check that the rudder moves to 10 deg PORT.
- Move the tiller right to order a new, higher HEADING TO STEER value, 20 deg above the GYRO heading.
- Check that the rudder moves to 10 deg STBD.
- In 9. and 11, you shall see a warning light come up in the ON LIMIT field.
- Normally the rudder should follow to within 1 deg error from the 10 deg order. If the rudder indicator shows a rudder angle more than 2 deg OFF the 10 deg values, something is wrong. Either in the autopilot, or in the steering control system, or in the rudder indicator system.  
In this case, run the pre-sailing check of the steering control system to find the problem.
- If the ship is fitted with 2 rudders, normally both rudders should show the same value.
- If the ship is fitted with 2 AZIMUTH propellers, there could be asymmetric angles involved, but 1 device must be within tolerance.
- Press again the MANUAL SPEED button to return to log speed input. The Small LED in the MANUAL SPEED button goes dark; and the SPEED window should read zero or whatever the speed log is outputting.
- Finally select HAND steering again on the MODE Selector , and check that the HEADING TO STEER value returns to the GYRO heading.
- This concludes a standard PRE-SAILING CHECK.