

**Welcome to**



## Documentation for FAP-3000 Autopilot

♦ [Autopilot Manual FAP-3000 / MIP241: 8487-2](#)

### Guidance

All files are in PDF format, and your computer must have the Adobe Acrobat reader installed to read the files.

You can navigate through the files from this 1-START.PDF page by clicking on the blue hyperlinks.

There is an entry from this document to the Autopilot Manual. Mouse click on the hyperlinks will bring you to the index page of the manual. From this level hyperlinks leads to the individual Manual sections which again holds hyperlinks to views of the relevant drawings.

Use the RETURN buttons to get step by step back again.

Note:

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## 1. FAP-3000 Autopilot User Manual Introduction

- v Autopilot system consists of one Interface Electronic Unit and minimum one control panel (MIP) and optional an additional control panel and optional 1 or 2 Arm Rest Panels (ARP11). Factory supplied cables with plugs ready for connection of Panel and Interface Unit.
- v Optionally an additional Electronic Unit can be setup as a hot standby unit to continue bump less operation in case of a failure on the active system.  
  
(Only allowed in Heading/Course Control modes. Local Heading control with Radius controlled turns is the Fall Back in case of an autopilot failure in track control mode).
- v MIP with 6.5 inch TFT displays with LED backlight with high luminance. (800 cd/m<sup>2</sup> ). Presentation of information according to IEC62288.
- v Direct access to set-point changes from the panel tiller without any other operator activity.
- v Mode selections and other functions are controlled by few logically arranged overlay pushbuttons on the panel front.
- v Interface to external Mode Selection System for direct call from the installed work stations (Autopilot Control Panels) and with facility for unconditional call to the Master Workstation only.
- v Facility for Programming the Next Set Heading/Course and next set Radius (if in Radius Controlled turns). A built in feature in EMRI autopilots for the last 2 decades.
- v Data ready on serial interface for displaying “Curved Electronic Bearing Line” on ECDIS and Radars. E.g. useful when programming Next Turns.
- v Alarm interface based on dry contacts or NMEA \$xxALR and \$xxACK.
- v BNWAS reset interface based on dry contact or NMEA \$xxEVE.
- v Separate rudder order outputs to give possibilities for improving propulsion and steering efficiency.
- v Dual gyro input with bump less change-over of steering reference in case of a failure.
- v Digital input to make gyro selection follow the gyro change over system setting.
- v Many years of experience have proven safe autopilot controller setup based on known ships data.
- v The Commissioning / Sea trial are supported by helpful setup wizards and performance data recording on laptop.
- v Alarm interface for BAM.

## 1.1 Document revision Status

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## 2. FAP-3000 Autopilot User Instruction

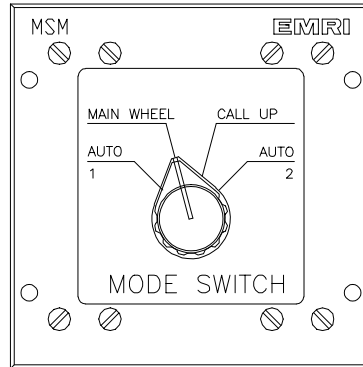
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## 2.1 Control selection

Autopilot control can be selected from the mode switch directly here shown as **Autopilot 1** or **Autopilot 2** (Two autopilots installed).



**Fig. 1**

The Selected autopilot will default enter the **HEADING** control mode with **RADIUS** controlled turns and continue “Steady as she goes”.

With the Mode switch in position **CALL UP**, the Autopilot control can be selected from the wanted Autopilot by pushing a mode push button (Either MIP or ARP)

## 2.2 Autopilot steering modes: Heading -, Course - & Remote-control

**Heading control:** Use the CALL HEADING CTRL push button to request Course control mode. When the mode is active the button lamp is lit. The set-Heading is followed. The gyro signal is used as reference.

PORT ↔ STBD on the tiller will set heading value in steps of 1 deg.

When the Heading control mode is active the panel will look like Fig. 2. Radius control is default selected.



Fig. 2

**Course control:** Use the CALL COURSE CTRL push button to request Course control mode. When mode is active the button lamp is lit. Uses the gyro as dynamic reference, and then the GPS speed direction signal as static reference. Drift compensated Heading control. Use PORT ↔ STBD on the tiller for setting the set-course.

The Course control is automatically changed to Heading Ctrl (Drift compensation cancelled) when the ships speed goes below 20% of nominal max speed. Continues steady as she goes as the set heading is aligned to the actual heading.

Changing between Heading and Course control will be bump-less as the Gyro reading is used as set-heading when entering Heading Control mode. The set angle will be added to the set gyro reading to create the new set Course value.

*The Course mode is not entered if:*

- The speed is too low. (<6 Kt)
- Or the rate of turn is too high. (>20 deg/min)

While operating in Course mode, the Drift compensation angle is maintained at the existing value if the ships rate of turn is too high. (Under Course changes)

The GPS antenna position has to be recalculated to the fore part of the vessel to maintain the Course mode stable. See section 3.

When the Course control mode is active the panel looks like Fig 3. Radius control is default selected.



**Fig. 3**

**Remote control:** Press the CALL REMOTE CTRL push button to initiate integrated control with external Navigation Equipment such as an ECDIS. (The type of equipment is selected by parameter setup.)

The display is shown in Fig. 4. The Track Course and the Turning Radius is displayed.



**Fig. 4**

**Radius control:** The autopilot can perform Course/Heading changes either as a **rudder limited** turn or as a **Radius (Rate)** controlled turn.

The Radius control will default be selected together with a selection of the Heading and the Course mode.

Press the RADIUS push button to toggle radius control on or off. Green lamp on means Radius selected.

When Radius control is selected the radius is set by moving the tiller INCREASE ↑ DECREASE.

#### **Rudder Limit:**

When Radius control is not selected the autopilot is using Rudder Limit. The limit is set by moving the tiller INCREASE ↑ DECREASE.

**Gyro Display:** Actual heading is always displayed in the upper part of the display.

The sensor is shown together with the reading.

Gyro 1, Gyro 2, GPS Compass, TMC...



## 2.3 The Program mode

Use the Program mode to plan the next maneuver (turn) and use execute to start it. Press PROGRAM NEXT push button to start programming. The next Heading / next Course and next Radius /Next Rudder Limit Field will pop up when the PROGRAM NEXT push button is pressed. The fields will initially display actual set-point values.

The Execute yellow lamp starts flashing when the Next Heading/Course is changed by using the tiller PORT ↔ STBD.

Press the PROGRAM NEXT push button again to go back for changing the Active set-point values (Could be in order to change an ongoing turn when the next one has already been programmed.)

The Next values are transferred to the Set values when the EXECUTE push button is pressed, and the Next field disappears again.

Press either CALL COURSE CTRL or CALL HEADING CTRL again to cancel the programmed mode and discard the next values.

The system is now ready to respond immediate to tiller operations.



Fig. 5

## 2.4 Default set-point when entering modes

### Default “SET” points when Entering Heading Mode.

From Main wheel steering: The Set Heading is set equal to the actual Heading.  
From Course mode: The Set Heading is set equal to the Gyro reading plus the remaining turn to be carried out in the previous Course mode. (Steady rudder order).  
The Set Radius is the last used Radius value.  
The Rudder Limit setting is the last used value.

### Default “SET” points when Entering Course Mode.

From Main wheel steering: The Set Course is set equal to the actual Course.  
From Heading Mode: The Set Course is set equal to the actual Course plus the remaining turn to be carried out in the previous Heading mode. (Steady rudder order).  
The Set Radius is the last used Radius value.  
The Rudder Limit setting is the last used value.

## 2.5 User Parameter Setup Menu

Press the SELECT push button to enter the Setup Menu.

A set of User setup parameters are shown in the display upper left corner:

Condition	Light, Medium, Loaded.
Performance	Economy, Medium, Precise.
Palette	Day, Dusk, Night
Select Manual Speed	Select Manual Speed Setting, -ON/OFF
Set Manual Speed	This comes up if Manual Speed is ON.
Rudder limit	Set By Tiller, or Auto by Speed.
Off Course Alert	5 to 25 degrees. (Alarm limits for both Heading & Course Mode)
Permanent Helm	0 to 5 degrees (Negative values for Stbd Rudder)
Exit	

Use the arrow UP and DOWN push buttons to scroll in the menu.

Press the SELECT push button again to open a specific item for modification.

Use the arrow push buttons to change the selection.

Press the SELECT push button again to store the value.



Fig. 6

**The Condition Selection:**

3 selections available: Light – Medium – Loaded.

Set according to the loading conditions.

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

**The Performance Selection:**

3 selections possible: Economy – Medium – Precise.

Use Economy or Medium to obtain a relaxed control to save fuel by minimizing use of rudder.

Use Precise during maneuvers and when in confined waters or use Precise if needed to keep directionally stability due to hull structure, loading condition or trim.



## 2.6 Operator selected Toe angle Display (For dual rudder ships)

One more User Parameter setting is available in the Setup menu:

Toe angle                      Adjustable in the range [+8deg. : -8deg]. “+4” = Rudders in 2 deg. each.

The Toe angle value is set in the Parameter menu above.

Positive Toe angles mean that rudder tips are pointing in towards ships center-line.

(Stbd rudder having neutral offset to port and port having neutral offset to stbd)

The entered angle is equal to the difference between the rudder angles.

Toe Angle = Stbd\_Rudder\_Angle – Port\_Rudder\_Angle



Fig. 7

Fig. 7 shows the Toe angle when it differs from 0°.

A Toe Angle can be entered as a NMEA sentence, (Parameter ToeAngleNmea=x, x=ch no.)  
(Used for ABB sentence \$PAADO,A, and \$PAADO,B)

This removes the Toe angle function described above, but the Toe angle will still be shown on the display.

A Toe angle can also be added to the rudder orders outside the autopilot.

The Toe angle can then be calculated based on the feedbacks. (Parameter setup).

The value will be displayed only if it is different from zero.

Note the Rudder scales are shown at Fig. 8 with the text “Azipod” (Text selection through setup)



**Fig. 8**

The Toe angle will be set equal to zero if only one rudder is under autopilot control. The Azipod/Rudder Ready information must be available to the Autopilot. The text “not rdy” can be displayed if the device is not under autopilot control. See Fig. 9. (Parameter Notreadytext=“Not Rdy”)



**Fig. 9**

## 2.7 Panel Illumination

To match the panel illumination to the surrounding ambient light, the display backlight and push button lamps can be dimmed. The illumination level is set by pressing the UP (To dim up) or DOWN arrow push button (To dim down).

From the setup menu it is possible to select one of 3 different display color palettes:

- Day
- Dusk
- Night

See section 2.5 User Parameter Setup Menu for description.

Day:



Dusk:



Night:



In case of a power break, the panel will after power on come up with the last used screen on a panel in control.

The Autopilot can be interfaced to an integrated bridge illumination system, where the Screens and Dimming levels can be set centrally.

The panel in control will be the master for selection of the palette and the setting of the illumination level. Panels not being in control will slave the Master setting. However, the palette selection and illumination setting on the slave panel can afterwards be changed locally. If the autopilot is not in control, the illumination and screen settings are done separately on the

panels.

Press both UP and DOWN arrow push buttons simultaneously to initiate a lamp test. The lamp test turns on all lamps and brings the illumination to maximum for a short time.



## 2.8 Autopilot system alerts

This autopilot complies to the IEC 62923-1 and IEC 62923-2 Bridge Alert Management system (BAM). BAM is default enabled, which implies that alerts are transmitted to and manageable from a Central Alert Management system (CAM) if available. A full list of defined alerts is placed in section 3.6.1 of this manual.

Alerts are shown at the bottom of the display in single line. All alerts are related to the Navigation cluster....



Fig.10





The lower line on the MIP display shows the alert with highest display priority.

In the left side, an icon indicates the priority and state of the alert.  
If the alert is an unacknowledged alarm or warning, the icon will be flashing.





An **A**, **W** or **C** icon will be displayed at the right end of the line,  
if there are more active alarms, warnings or cautions in the alert list.

In that case, press the ALERT ACKN. push button to get these listed on screen.

**The Icon Graphics for Alarms, presented together with the alert**

ICON				
ICON name	Active-unacknowledged Alarm	Active Silenced Alarm	Active-acknowledged Alarm	Rectified-unacknowledged Alarm
ICON description	Red Flashing triangle	Red Flashing triangle	Red triangle	Red Flashing triangle

**The Icon Graphics for Warnings, presented together with the alert**

ICON				
ICON name	Active-unacknowledged Alarm	Active Silenced Alarm	Active-acknowledged Alarm	Rectified-unacknowledged Alarm
ICON description	Yellowish Flashing circle	Yellowish Flashing circle	Yellowish circle	Yellowish Flashing circle

**The Icon Graphics for Cautions, presented together with the alert**


ICON				
ICON name			Active Caution	
ICON description			Yellow square	



Fig.11

An **A**, **W** or **C** icon will be displayed in the lower right corner, if there are more active alarms, warnings or cautions to show on following pages.

With the UP/DOWN arrow push buttons, one alert can be selected. The selected alert is indicated by highlighted alert description text.

If the panel is in control, the alert highlighted can be acknowledged by pressing the ALERT ACKN push button.

Return to main display is made by pressing the SELECT push button or any of the autopilot mode control push buttons.

If the panel is not in control, the alert list can still be called up, but alerts cannot be acknowledged from this panel.

Unacknowledged alerts, that cannot be handled from this panel, are indicated by icons at the end of the alert description texts:



Acknowledge not allowed for Alarm on this panel	
Acknowledge not allowed for Warning on this panel	

FIG.12



Fig.13

Not active panel showing that alert handling is disabled.

## 2.9 The Heading sensor signals & related Alerts

One or two heading signals installed.

Gyro 1 is used as steering reference

Gyro 2 is used for comparison and off-heading alarm.

The use of the Gyro signals can be swapped if a closed contact from the gyro change-over system informs the autopilot about a change to Gyro 2 as the used Gyro signal.

The Gyro used as steering reference is displayed on the MIP panel.

In case of a Gyro signal failure to the one used as steering reference; the autopilot will automatically shift to the other Gyro signal. The change in heading reference will be ramped slowly so that there will not be a transient rudder response when changing over to the other reference. An alert will announce the loss of heading signal as the working (steering reference) lost, or the secondary heading signal lost.

A gyro difference alarm comes up if the difference between the heading signals exceeds the threshold. (Parameter typ. 10 degrees)

*Fall Back in case of no heading signal: The rudder order output is frozen.*

## 2.10 The Speed selection and Speed related Alerts

The Autopilot uses internally both water related and a ground related speed.

The **Water speed** signal is used to adapt the heading controller to the actual speed situation.

The **Ground speed** is used to convert the set radius to a rate of turn value for performing a turn following a Radius.

Both the Ground Speed and The Water Speed are shown on the display.

One or two speed signals are entered to the Autopilot (if none use Manual Speed Set).

The Speed Source and the Backup Speed Source.

The Water and Ground speed signals are taken from the Speed Source if available, if not then the signal(s) is taken from the Backup Speed Source.

If the ground speed or the water speed is not available, then it is read from the other source, resulting in the two speed signals being equal. This will be followed by an alarm if the situation is caused by a lost sensor signal.

Select the Manual Speed Setting in case of no speed signal.

This is done through the Select Menu.

The Manual Speed value is entered both as the Water speed and as the Ground Speed values.

Press the SELECT push button.

Scroll to the Select Manual Speed by using the UP/DOWN arrow push buttons and then press Select again.

Now the list has got one more line: Set Manual Speed.

Selecting this one opens up for setting the Manual speed value by the Arrow Keys.

Note: When using Manual Speed Setting, be aware that the curve followed in a Radius Turn is depending on the Set Speed value.

*Fall Back in case of no speed signal: The Last Received Speed value is maintained and the Manual Speed Setting must be used.*



## 2.11 Autopilot Ready & In Control signals from Steering devices

(Steering device related mode selection)

Steering devices (Rudder or Azimuth steering devices) can be designed including the autopilot mode selection system.

In other words: the Autopilot is called into control device by device, and consequently the autopilot controller must adapt to the number and type of steering device connected.

The autopilot display shows the rudders/azimuths under control.

The order bar is switched off if the steering device is not under autopilot control.

Up to 3 steering devices can be connected:



**Fig. 14**

The order signals to the three steering devices are shown on the lower part of the display. Also the actual feedback signals are shown on the lower 3 bars.

**Fig. 15**

Each steering device can be controlled by the autopilot in control. (If it is setup for that). In Fig. 10 only one device (Center Rudder) is controlled. The order bar is switched off on the “not ready devices” (Port and stbd azipull).

In this case the autopilot controller is only using the Center rudder for steering, and the controller is reconfigured to match this situation.

**Fig. 16**

It is still possible to use Toe angle offset on the two outer steering devices when running with 3 unit.

## 2.12 Pre-sailing check

- Start one or two steering gear pumps each rudder.
- 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 ALERT ACKN.
- Press SELECT and set-up the normal sailing speed value manually. (Manual Speed Menu)
- Operate the 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.
- 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.
- Open again the SELECT MANUAL SPEED Menu and set the Manual Speed Selection OFF.
- 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.

### **2.13 Standby autopilot control function. (Hot Stby)**

An independent autopilot controller is needed to maintain the autopilot control function in case of malfunction to the autopilot in use.

The back-up autopilot function can be based on:

1. A standby Autopilot Electronic Unit that can carry on the control function.
2. A second complete autopilot including Autopilot Electronic Unit and an autopilot control panel.

Case 1 will secure immediate continuation of the ongoing autopilot operation, an Alert is activated, autopilot OK contact goes open, and/or an Alert is sent to the integrated alarm system is sent if possible. The standby operation will continue also if the autopilot becomes “alive” again, and the display shows: “Cut Off by Standby autopilot”.

Select Manual control to end the session.

Case 2 will like in case 1 secure immediate continuation of the operation, and an alarm from the “dead” autopilot is issued.

The Standby autopilot will issue the alert: “In Standby Operation”

The control can now be carried on from complete standby autopilot. The standby autopilot control will be maintained even if the selected autopilot becomes “alive” again. In such case the Alert “Cut Off by Standby autopilot” will be displayed.

Select the standby autopilot or go to manual control to release the standby session.

The autopilot control panel will when in control display “Has Hot Standby” if it is backed up by a standby unit.

The standby unit will display “Hot Standby” in a dual autopilot case with display unit connected to the standby AEU.

## 2.14 Use of Arm Rest Panel(s), ARP.

The ARP is designed to allow for easy control of the essential Autopilot functions from the navigator's armchair.



**Fig. 17**

### 2.14.1 Control selection

The ARP is called into control like any other of the Autopilot control panels (MIP or ARP) when the mode switch is set to CALL UP.

### 2.14.2 Steering modes: Heading-Radius or Remote control

Press the wanted mode: CALL HEADING RADIUS or CALL REMOTE (Track)

This to take over the control or change the ARP panel control mode.

The control is active at one position only when operating in an autopilot control mode. (ARP or MIP). The Green mode lamp will be illuminated on the live panel in control.

#### Remote control mode

Selecting CALL REMOTE (track) will initiate the Remote control mode. The green lamp above the push button will turn on.

The basic use is to follow a route on the ECDIS (or other navigational screen) going on straight legs and through turns.



### Heading Radius mode

Selecting CALL HEADING RADIUS mode will initiate Heading control mode with Radius control. The green lamp above the push button and the PROGRAM NEXT mode lamp will turn on.

**The panel always default operates in the Programmed mode as described in section 2.14.3!** Observe the text “Next Radius” / “Next heading” on MIP display(s).

The preprogramming of heading and turns can be done from the ARP panel and executed when time is, related to the ECDIS picture. Read the Next Heading and Next Radius values on the MIP panel(s).

Note that the ARP will inherit the setting from the MIP panel. If radius mode is selected on the MIP panel, the ARP will be in radius mode. If not, the ARP will change the rudder limit. Observe the setting on MIP display. Note also that course mode cannot be done from the ARP panel.

### 2.14.3 Programmed mode and immediate mode

The ARP panel will be in programmed mode as default. This is opposite to the MIP panel(s).

The PROGRAM NEXT push button is basically a toggle function. Toggle the button to enter immediate mode – direct access to heading and radius changes.

The use of indication lamps is described below:

#### In programmed mode

The PROGRAM NEXT lamp is steady ON.

The EXECUTE lamp will flash if the “set values” and “programmed values” differ.

#### In immediate mode

The PROGRAM NEXT lamp will flash if the “set values” and “programmed values” differ. Otherwise, the lamp is steady OFF.

The EXECUTE button is not used in immediate mode as no need for execution.

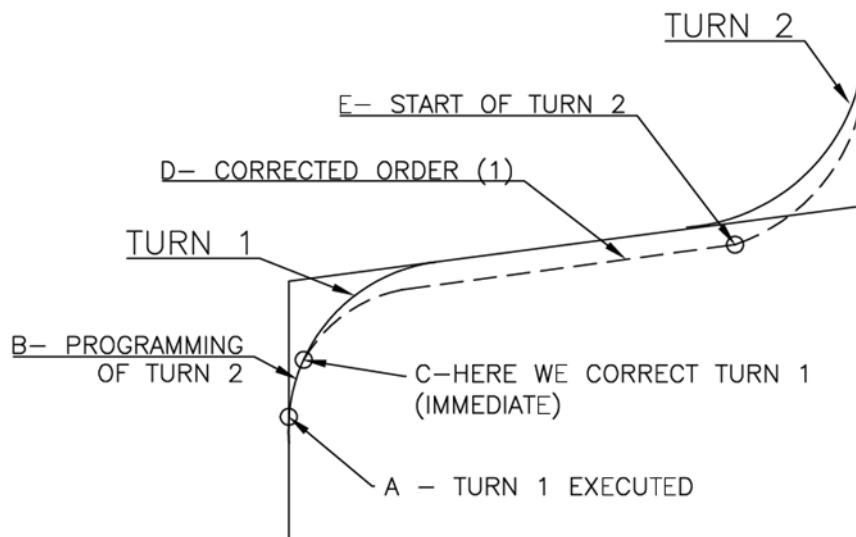
The tiller direction texts are flashing.

The operation strategy can be interrupted in two ways:

- You have started programming a new Set Heading or Radius for this turn and want to return to the ongoing Set values:
  - o *Press the CALL HEADING RADIUS mode button*  
The programmed values are removed. Ongoing set heading and radius are resumed and displayed on the MIP panel(s) in the fields “Next Radius” / “Next heading”.
- You have pressed the Execute (point A) and is in the middle of a turn and want to modify the heading or set radius value for the ongoing turn (see example Fig. 14)
  - o *Toggle the PROGRAM NEXT push button to enter immediate mode*  
Now the system operates in an immediate mode with direct access to heading and radius changes without Execution (point C). Observe the values in the fields “Set Radius” / “Set heading” on MIP display(s).

- Toggle the *PROGRAM NEXT* push button to return to *Programmed mode*. The set orders are now the corrected order (point D). Continue programming the next turn and execute when time is (point E).

### SKETCH OF FUNCTIONAL DESCRIPTION



**Fig. 18**

#### **2.14.4 Default set mode when entering mode**

Same as the MIP panel(s) as described in section 2.4 (except no course mode).

#### **2.14.7 Dimming**

Same as the MIP panel(s) as described in section 2.7.

#### **2.14.8 Alarm handling from chair when ARP is in control**

Remote alarm requests are achieved by pressing the active mode button.

- *Remote control request – no handshake:*  
ARP panel stays in HEADING RADIUS mode. Press CALL HEADING RADIUS to acknowledge the alarm.
- *Remote control is active:*  
When reaching a turnover of the track the MIP panel buzzer will sound.  
Press CALL REMOTE to acknowledge the alarm.
  - If the autopilot drops unwanted out of remote (track) control the ARP panel will enter HEADING RADIUS mode. Press CALL HEADING RADIUS to acknowledge the alarm.

#### **When ARP is not in control and no control take-over is possible during request:**

The ARP panel buzzer will sound 3 beeps indicating no handshake.