Instruction Manual for SEM300 (8488-2) and FAP-3000 (8487-2) Autopilot

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Table of Contents

1 Introduction 11

2 Autopilot User Instructions 13

2.1 Abbreviations 13

2.2 Control Panel Overview 13

2.2.1 Main Screen Overview 14

2.2.2 Buttons Overview 14

2.2.3 Tiller Overview 15

2.3 Control selection 15

2.4 Autopilot steering modes: Heading-Course-Remote control 15

2.4.1 Heading control 16

2.4.2 Course control 17

2.4.3 Remote control 18

2.4.4 Radius control Mode 18

2.4.5 Rudder Limit Mode 19

2.4.6 Gyro Display 20

2.5 Program Next mode 21

2.6 Default set-point when entering heading and course mode 22

2.6.1 Default “SET” points when Entering Heading Mode 22

2.6.2 Default “SET” points when Entering Course Mode 22

2.7 User Menu 23

2.7.1 Condition Selection 24

2.7.2 Performance Selection 24

2.7.3 Operator selected Toe angle Display (For dual rudder ships) 25

2.8 Panel illumination and palette theme 28

2.8.1 Panel Illumination 28

2.8.2 Lamp test 28

2.8.3 Palette Themes 29

2.8.4 Palette theme selection 30

2.8.5 Central illumination Control 30

2.9 Autopilot system alerts 31

2.9.1 Alert List Screen 32

2.9.2 Alert Icons 33

2.9.3 Alert List Screen – Panel not in control 34
2.10 Heading sensor signals & related Alerts 35
2.11 Speed selection and Speed related Alerts 35
2.11.1 Manual Speed Selection 36
2.12 Autopilot Ready & In Control signals from Steering devices 37
2.13 Pre-sailing check 39
2.14 Standby Autopilot control function. (Hot Standby) 41
2.15 Use of Arm Rest Panel(s), ARP11 42
2.15.1 Control selection 42
2.15.2 Steering modes: Heading-Radius or Remote control 42
2.15.3 Programmed mode and immediate mode 43
2.15.4 Default set mode when entering heading control mode 45
2.15.5 Dimming 45
2.15.6 Alarm handling from chair when ARP is in control 45
2.16 Use of AutoPilot Mini Display 46
2.16.1 Main Screen Overview 47
2.16.2 Steering modes 48
2.16.3 Alert bar 49
2.16.4 Alert Menu 49
2.16.5 Settings Menu 50

3 Autopilot System Functional Description 54
3.1 System Overview 54
3.2 The Steering Mode Selection 57
3.3 The System Power Supplies & enclosure 61
3.4 The AEU I/O Signals 62
3.4.1 Power and CAN Bus 62
3.4.2 Digital input/outputs for alarm signals 63
3.4.3 Digital inputs, aux. features 64
3.4.4 Digital input/outputs for mode ctrl systems 65
3.4.5 Serial NMEA 66
3.4.6 Analog output & input 67
3.4.7 Opto FET outputs 68
3.4.8 Multi pin terminals 68
3.5 CAN bus 69

3.6 Alert-System 71
3.6.1 Alerts defined for BAM 72
3.6.2 Alerts defined for legacy systems 76
3.7 Serial Interfaces 80
3.7.1 The Autopilot can receive the following list of Standard NMEA sentences: 82
3.7.2 The Autopilot can transmit the following list of Standard NMEA sentences: 83
3.7.3 HEADING signal input 83
3.7.4 NMEA Talker Identifier 84
3.7.5 Serial Interface to the ECDIS 85
3.7.6 Serial Interface to the VDR/Alarm computer system 98
3.7.7 Serial Interface to the BAM Bridge Alert Management system 99
3.7.8 BNWAS Event interface sentence $AGEVE 104
3.7.9 Serial Interface to for dimming control 105
3.8 System Parameter Setup 106
3.9 System Software Update. AEU, MIP 114
3.10 Autopilot Standby operation. (Hot Standby function) 115
3.11 Calculation and display of external added rudder/(azimuth) toe angle 116
3.12 Soft transition to TRC mode 117
3.13 Select calculation of antenna positions to improve Course mode 117
3.14 Configuration of aux. Arm Rest Panel(s), ARP. 118
3.14.1 System overview 118
3.14.2 Mode selection 118
3.14.3 Power supply and enclosure 118
3.14.4 CAN 119
3.15 Special Functions 120
3.15.1 External Heading Control 120

4 Autopilot Maintenance 121
4.1 Maintenance 121
4.2 Servicing 121
4.3 Trouble shooting and repair 121
4.3.1 Troubleshooting 122
4.3.2 Repair 122
4.3.3 Replacement of modules 123

5 Autopilot System Installation....124
5.1 Location of items....124
5.1.1 Compass safe distance....124
5.2 Cable installation....124
5.3 Installations for Track/Route steering (TCS)....125
5.4 Sea trial Adjustments....126
6 Autopilot Software Tools....126
6.1 Autopilot Setup....126
6.2 Introduction....126
6.3 System Requirements....126
6.4 Get started (Establishing connection from PC to Autopilot)....126
6.4.1 Connection with Ethernet....126
6.4.2 Start using the SEM300Manager program....128
6.4.3 Setting up the Autopilot at commissioning or service....129
6.4.4 Service, e.g. change of a faulty AME11 microprocessor board....130
6.5 Functional description of SEM300Manager....130
6.5.1 Main Window....131
6.6 Main Window menus....138
6.6.1 File Menu....138
6.6.2 Edit Menu....138
6.6.3 Autopilot Menu....138
6.6.4 Tools Menu....139
6.6.5 Options Menu....139
6.7 Reading back parameters from AME....140
6.8 Writing parameters to AME....140
6.9 Terminal window....141
6.9.1 Terminal window commands....142
6.10 Autopilot Parameter Editor Window....144
6.11 Compare Parameters Window....144
6.12 AME11 Firmware update....145
6.12.1 AME11 upgrade old firmware....146
6.13 MIP211/MIP241 Firmware Update....147
6.13.1 Introduction....147
6.13.2 System Requirements for MIP211/MIP241 Firmware Update....147

6.13.3 Installation of FlashMagic flashing tool 147
6.13.4 Preparing the panel.....147
6.13.5 Using the FlashMagic program.....148
7 Autopilot Setup Instructions 150
7.1 Setup process 150
7.2 Setup from MIP Panel 150
7.2.1 Setup Menu Pin-code 150
7.2.2 Setup-Menu overview 151
7.2.3 Parameter Menu 151
7.2.4 Parameter Selection.....152
7.2.5 Parameter Edit 153
7.2.6 Parameter List 154
7.2.7 Parameters QR code 155
7.2.8 NMEA Input Monitor.....156
7.2.9 Step Response Plot 157
7.3 Dock-side commissioning of Autopilot:.....160
7.4 Sea trial commissioning of Autopilot:.....163
Appendix – Autopilot Electronic Unit (AEU611).....167
Appendix – Spare Parts 168
Appendix – Dimensions for Autopilot Control Panel, FURUNO type (MIP241) 169
Appendix – Dimensions for Autopilot Control Panel, EMRI type (MIP211).....170
Appendix – Internal Wiring for Autopilot Electronic Unit (AEU611) 171
Appendix – Internal Arrangement for Autopilot Electronic Unit (AEU611).....172
Appendix – Internal Arrangement for Autopilot Motherboard (AME11).....173
Appendix – Internal Wiring for Arm Rest Panel (ARP11) 174
Appendix – Dimension Drawing for Arm Rest Panel, EMRI type (ARP11).....175
Appendix – Dimension Drawing for AutoPilot Mini Display 176
Appendix – Plug and Cable Specification (CE2MM-8-xxM).....177
Appendix – Internal Wiring for MIP2xx Cable.....178
Appendix – Terminal list for AEU with 2 Panels (AEU611-2P) 179

Appendix – Terminal list for Arm Rest Panel (ARPx1) 183
Appendix – Dimensions Drawing of Junction Box for Arm Rest Panel (JBXARP-1) .184
Appendix – Internal Wiring of Junction Box for Arm Rest Panel (JBXARP-1) 185
Appendix – Dimensions Drawing of Junction Box for MIP Panel (JBXMIP-2).....186
Appendix – Internal Wiring of Junction Box for MIP Panel (JBXMIP-2) 187
Appendix – Generic Installation of SEM300 / FAP-3000 188

Table of Tables

Table 2-1: Control Mode Selection....15
Table 2-2: Alarm Icon Overview....33
Table 2-3: Warning Icon Overview....33
Table 2-4: Caution Icon Overview....33
Table 2-5: Unknowledgeable Alert Icon Overview....34
Table 3-1: PESSA message format – from auto pilot....86
Table 3-2: PESSA Alarm bitmask – from Autopilot....87
Table 3-3: PESSD Message format - from Autopilot....89
Table 3-4: PESSD Option-I bitmask – from Autopilot....90
Table 3-5: PESSD Option-II bitmask – from Autopilot....91
Table 3-6: PESSA Message format - to Autopilot....92
Table 3-7: PESSD Message format - to Autopilot....94
Table 3-8: PESSD Option-I bitmask - to Autopilot....95
Table 3-9: PESSD Option-II bitmask - to Autopilot....96
Table 3-10: PESSX Message format - to Autopilot....97

Table of Figures

Figure 1-1: Overall Autopilot Overview 11
Figure 2-1: Control Panel Front-side 13
Figure 2-2: Control Panel Main Screen Overview 14
Figure 2-3: Autopilot control panel with active heading control mode 16
Figure 2-4: Autopilot control panel with active course control mode 17
Figure 2-5: Autopilot control panel with active remote-control mode 18
Figure 2-6: Autopilot in rudder limit mode 19
Figure 2-7: Autopilot control panel in program next mode 21
Figure 2-8: Autopilot control panel with user menu displayed. 23
Figure 2-9: Autopilot control panel with toe angle configuration active. 25
Figure 2-10: Autopilot with alternative azipod rudder name. 26
Figure 2-11: Autopilot control panel showing "not rdy" label 27
Figure 2-12: Palette themes per time of day 29
Figure 2-13: Palette theme selection menu 30
Figure 2-14: Autopilot control panel showing a Heading Control Failure. 31
Figure 2-15: Autopilot alert conditions screen. 32
Figure 2-16: Autopilot control panel not active showing that alert handling is disabled. 34
Figure 2-17: Autopilot control panel with 3 steering devices connected. 37
Figure 2-18: Autopilot control panel with 3 steering devices connected but only one active. 38
Figure 2-19: Autopilot control panel with outer steering devices using toe angle offset. 39
Figure 2-20: Arm rest panel 42
Figure 2-21: Sketch of functional description of the Autopilot control. 45
Figure 2-22 AutoPilot Mini Display and ARP (greyed out) 46
Figure 2-23: AutoPilot Main Screen Overview 47
Figure 2-24 Autopilot Mini Display when the autopilot is in each of the three steering modes 48
Figure 2-25 Autopilot Mini Display in Heading Control mode and Rudder limit mode 49
Figure 2-26 Main page of Mini Display (with and without alert) 49
Figure 2-27 Alert Menu (not in control and in control) 50
Figure 2-28 Settings menu 51
Figure 2-29 Palette menu 51
Figure 2-30 Status page 52
Figure 2-31 Service page 52

Figure 2-32 Test Alert page 53
Figure 3-1: Autopilot functional system overview 54
Figure 3-2: Control installation examples 60
Figure 3-3: CANBUS Termination scheme 69
Figure 3-4: Illustration of isolated serial input channel. 80
Figure 3-5: Illustration of isolated serial output channel. 80
Figure 6-1: Bottom view of the AEU611 box. 127
Figure 6-2: Autopilot screen displaying the IP address of the unit. 127
Figure 6-3: SEM300 manager UDP Communication Settings window 128
Figure 6-4: SEM300Manager network search window 128
Figure 6-5: SEM300Manager tabs 129
Figure 6-6: Main screen of the SEM300Manager 131
Figure 6-7: SEM300Manager Serial No. and Jumper setup tab 132
Figure 6-8: SEM300Manager DIP-Switch setup tab 133
Figure 6-9: SEM300Manager Quick Setup Parameters Tab 134
Figure 6-10: SEM300Manager Serial Channel Setup Tab 135
Figure 6-11: SEM300Manager Forwarding Distance tab 136
Figure 6-12: SEM300manager Inputs/Outputs tab 137
Figure 6-13: SEM300manager secondary/terminal window 141
Figure 6-14: SEM300Manager parameter editor window 144
Figure 6-15: SEM300Manager Compare parameters window 144
Figure 6-16: AME flash program utility window 145
Figure 6-17: MIP panel board connection with parameter cable 148
Figure 6-18: Flashmagic program window 148
Figure 6-19: Flashmagic program flash progress bar 149
Figure 7-1: Setup Menu Item in User Menu 150
Figure 7-2: Setup Menu Overview Window 151
Figure 7-3: Parameter Selection Window 152
Figure 7-4: Parameter Edit Window 153
Figure 7-5: Parameter List Window 154
Figure 7-6: Parameter QR code Window 155
Figure 7-7: NMEA input monitor 156
Figure 7-8: Step Response Plot 157

Revision Log

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1 Introduction

The EMRI (SEM300) and FURUNO (FAP-3000) Autopilot is a system for automatically controlling the heading of a ship.

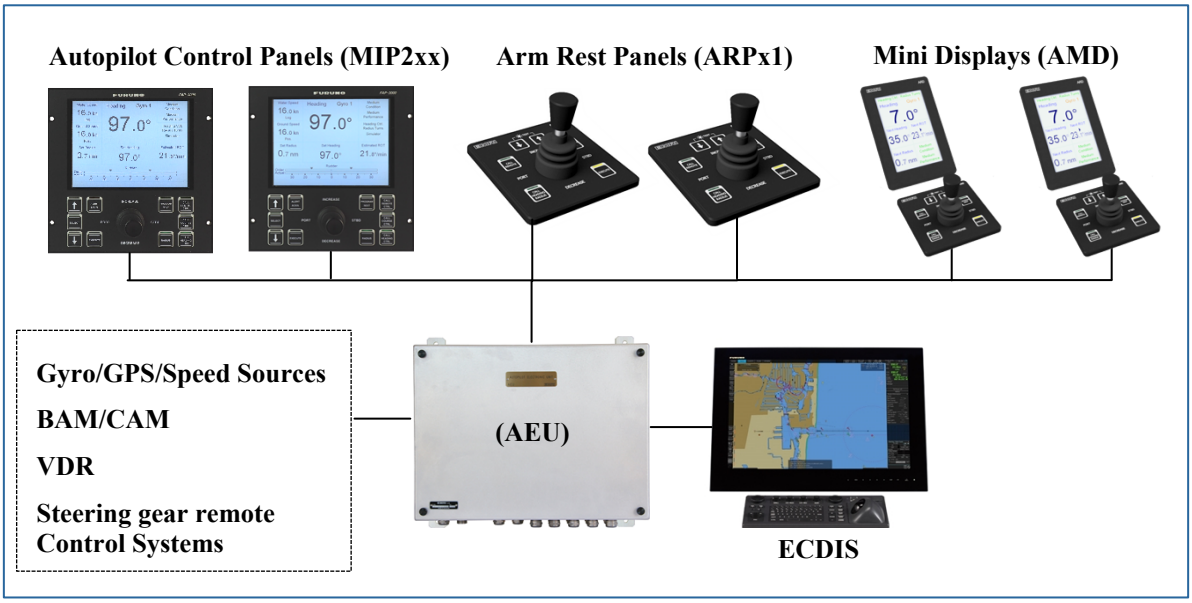


Figure 1-1: Overall Autopilot Overview

The Autopilot system consists of:

- Autopilot Electronic Unit (AEU611-xxx),
- Control panel (EMRI: MIP211 / FURUNO: MIP241) minimum 1 and,
- Optionally, one or more Arm Rest Panels (EMRI: ARP11)
- Optionally, one or more AutoPilot Mini Displays (EMRI: AutoPilot Mini Display and ARP11)
- Optionally: one or more JBXMIP-X or JBXARP-X in case of multiple MIP and ARP panels.

The system provided has factory supplied cables with plugs ready for connection of Panels and Electronic Unit. Optionally, an additional Electronic Unit (AEU611) and an AutoPilot Change Over unit (ACOxxx) can be set up as a hot standby unit to continue seamless operation in case of a failure on the active system (a Naut AW DNV requirement).

The Autopilot system has the following features and characteristics:

- Control panel with 6.5-inch TFT displays with LED backlight with high luminance (800 cd/m2), with information display compliant to IEC62288.
- Direct access to set-point changes from the panel tiller without any other operator activity.
- Mode selections and other functions are controlled by a few logically arranged overlay pushbuttons on the panel front.
- Interface to external Mode Selection System for direct call from the installed workstations (Autopilot Control Panels) and with facility for unconditional call to the Master Workstation only.
- Next Set Heading/Course and next set Radius configurable through the control panel (if in Radius Controlled turns).

- Data ready on serial interface for displaying “Curved Electronic Bearing Line” on ECDIS and radars. E.g., useful when programming Next Turns.
- Alarm interface based on dry contacts or NMEA $xxALR and $xxACK.
- Alarm interface for BAM according to IEC62923.
- BNWAS reset interface based on dry contact or NMEA $xxEVE.
- Separate rudder order outputs to allow for improved propulsion and steering efficiency.
- Dual gyro input with seamless change-over of steering reference in case of a failure.
- Digital input to make gyro selection follow the gyro change-over system setting.
- The Commissioning / Sea trial are supported by helpful setup wizards and performance data recording on a standard PC/laptop.
- It is possible to setup the system from the MIP panel.

2 Autopilot User Instructions

2.1 Abbreviations

AME	Autopilot Motherboard Ver. E
ARP	Arm Rest Panel
CTRL	Control
STBD	Starboard
Diff.	Difference
VHW	Velocity, Heading, Water
RSR	EMRI Relay expansion box (RSR unit)
Perf.	Performance
Est.	Estimated

2.2 Control Panel Overview

The Autopilot can be controlled from a control panel (MIP211 or MIP241). The panel has:

- 1 graphical display
- 10 Push buttons with LED indication
- 1 four-directional tiller



Figure 2-1: Control Panel Front-side

2.2.1 Main Screen Overview

The control panel has one main screen showing the most important information pertained to the Autopilot steering. The general organization of the main screen is depicted below.

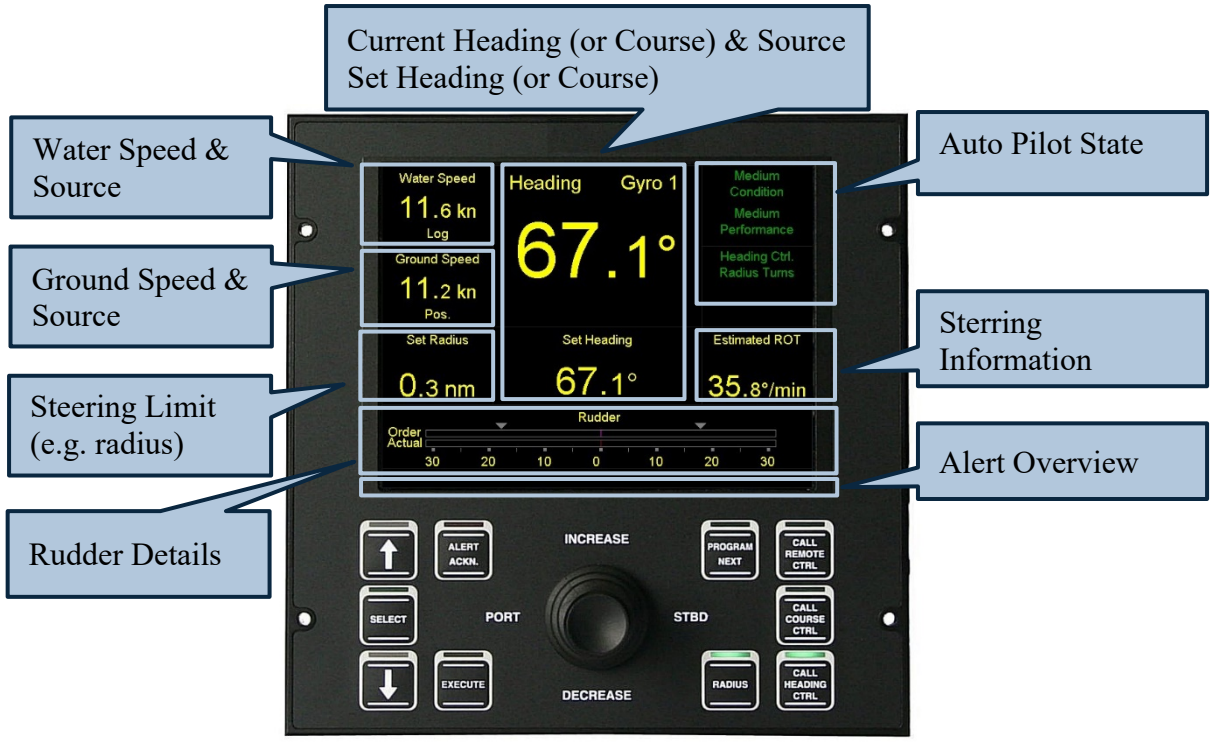


Figure 2-2: Control Panel Main Screen Overview

The center of the screen displays the current heading of the ship and the desired set-heading. The main purpose of the Autopilot is to steer the ship towards the set-heading, aligning the ship's current heading and the set-heading.

The left side of the screen displays water and ground speed, and the steering limit currently applied by the Autopilot (e.g. radius limit). The upper right side of the screen display the current state of the Autopilot.

The lower part of the screen displays rudder information (i.e. order to the rudder and actual feedback from the rudder).

The button line of the screen is reserved for displaying Autopilot alert information.

2.2.2 Buttons Overview

The control panel has the following buttons for user input:

- UP/DOWN button, for illumination control and user menu control.
- SELECT button, for user menu selection and confirmation.
- ALERT ACKN button, for alert acknowledgement and alert management.
- PROGRAM NEXT/EXECUTE buttons, for programming heading/course changes.
- CALL HEADING CTRL button, for entering heading control mode.
- CALL COURSE CTRL button, for entering course control mode.
- CALL REMOTE CTRL button, for integrated control by remote navigation system.
- RADIUS button, for select radius/rudder limit mode selection.

Each button additionally has a colored LED for visual indication of state information related to the specific button.

2.2.3 Tiller Overview

The control panel tiller provides horizontal and vertical user input. The main purpose is:

- PORT/STBD side changes for heading/course and left/right scrolling in user menus.
- INCREASE/DECREASE for changing limits, and up/down scrolling in user menus.

2.3 Control selection

The Autopilot control mode defines if the Autopilot is in control and steers the ship, and from which panel the Autopilot can be controlled.

AutoPilot In Control	Panel In Control	Description
Not in control	Not in control	Autopilot is not in control.
In control	Main Panel Only	Autopilot is in control, and controlled from the main panel only.
	Free Panel Select	Autopilot is in control, and controlled from one of the panels. Main panel will take control by default. Other panels can request control by pressing Call Heading/Course Ctrl button on the panel.

Table 2-1: Control Mode Selection

The Autopilot in control mode is selected using digital input X4-1/2 & X4-3/4 (e.g. connected to physical mode switch).

The panel in control is selected using one of the CALL CTRL buttons on the panel taking control.

An Autopilot taking control will by default enter HEADING control mode (see section 2.4.1) with RADIUS controlled turns and continue “Steady as she goes”.

2.4 Autopilot steering modes: Heading-Course-Remote control

The autopilot supports the following main steering modes:

- Heading Control (see section 2.4.1)
- Course Control (see section 2.4.2)
- Remote Control (see section 2.4.3)

The Heading/Course Control mode are local modes where heading/course is set by the user using the control or ARP panels of the Autopilot.

The Remote-control mode integrate with external navigation system (e.g. ECDIS), to control the Autopilot remotely.

2.4.1 Heading control

In heading control mode, the Autopilot follows the set-Heading, using the gyro heading input signal as reference.

Use the CALL HEADING CTRL push button to request heading control mode. When the mode is active, the button lamp is lit, and the Radius control is selected by default (see Figure 2-3).

Move the tiller left or right (PORT ↔ STBD) to change the set-heading value in steps of 1 deg.



Figure 2-3: Autopilot control panel with active heading control mode

2.4.2 Course control

Course control provide drift compensated Heading control. The Autopilot can compensate for the drift (e.g. imposed by current and wind). In course control mode, the gyro course signal is used as dynamic reference, and the GPS speed direction signal as static reference.

Use the CALL COURSE CTRL push button to request Course control mode. When the mode is active the button lamp is lit, and the Radius control is selected by default (see Figure 2-4).

Move the tiller side to side (PORT ↔ STBD) to configure the set-course.

The Course control requires minimum level of ground speed. If the ground speed goes to 20% (or lower) of nominal max speed, an alert is raised suggesting change to heading control mode.

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. (Less than 20% of the nominal speed (parameter: u_norm)))
- 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 must be re-calculated to the fore part of the vessel to maintain the Course mode stable see section 3.13.



Figure 2-4: Autopilot control panel with active course control mode

2.4.3 Remote control

In Remote control mode, the Autopilot is controlled remotely from external Navigation Equipment (e.g. ECDIS).

Press the CALL REMOTE CTRL push button to initiate integrated control with external Navigation Equipment.

In this mode, the "Track Course" and the "Turn Radius" is displayed (see Figure 2-5).



Figure 2-5: Autopilot control panel with active remote-control mode

2.4.4 Radius control Mode

The Autopilot can perform Course/Heading mode changes either as a:

- Radius (Rate) controlled turn or
- Rudder limited turn

In Radius mode, the Autopilot will perform radius limited turns.

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

See Figure 2-4 for Autopilot in radius mode. The control panel show that radius mode is selected, and the current "Set Radius" and "Estimated ROT".

Press the RADIUS push button to toggle radius control on or off (i.e. rudder limit). The green lamp above the RADIUS push button indicates if the mode is selected.

When Radius control is selected, the radius is set by moving the tiller up and down (INCREASE ↕ DECREASE).

2.4.5 Rudder Limit Mode

In rudder limit mode the Autopilot will perform turns according to the rudder limits defined. The Autopilot will not exceed the applied rudder limits.

Press the RADIUS push button to toggle between radius and rudder limit mode. The green lamp above the RADIUS push button shall be off to indicated if the rudder limit mode is selected.



Figure 2-6: Autopilot in rudder limit mode

Use tiller up and down (INCREASE ↕ DECREASE) to change the "Rudder Limit.

The "rudder limit" is displayed numerically in the left column and as triangles on the rudder bar display in the button of the screen.

2.4.5.1 Rudder Bar Display

The Rudder Bar display shows rudder control information (see Figure 2-6). Two bars are shown for:

- Order: Rudder order describes the desired rudder position ordered by the Autopilot.
- Actual: Rudder Actual described the actual rudder feedback received by the Autopilot.

Two triangles on top of the Rudder Bar indicate the markers where rudder limit is enforced by the Autopilot. If a rudder limit is reached, the associate marker changes color to red.

Figure 2-6 show a ship with 1 rudder configuration.

Note: For 2 & 3 rudder configuration multiple smaller rudder bars are displayed. One rudder bar is displayed per rudder.

Note: Rudder Bar display is currently not supported for 4 rudder configurations.

Note: The "Actual" Rudder Bar is only displayed if Rudder Feedback is supported and configured.

2.4.6 Gyro Display

The Actual heading is always displayed in the upper part of the display (See Figure 2-5). The sensor used to determine the heading is shown together with the reading; this may be Gyro 1, Gyro 2, GPS compass, or other, depending on the configuration.

2.5 Program Next mode

Use the PROGRAM NEXT mode to plan the next maneuver (turn) and use EXECUTE to start it.

Press the 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 (see Figure 2-7).



Figure 2-7: Autopilot control panel in program next mode

The Next values are transferred to the Set values when the EXECUTE push button is pressed, and the Next field disappears again. The system is now ready to respond immediately to tiller operations.

Note: Before pressing EXECUTE the programmed mode/values can be changed by:

- Press the PROGRAM NEXT push button to revert the next values to Active set-point values.
  Press either CALL COURSE CTRL or CALL HEADING CTRL to cancel the programmed mode and discard the next values.

2.6 Default set-point when entering heading and course mode

2.6.1 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.

2.6.2 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.

2.7 User Menu

Press the SELECT push button to enter the Setup Menu. A set of User setup option are shown in the display upper left corner.



Figure 2-8: Autopilot control panel with user menu displayed.

The following user option are available:

Condition	Set Condition Mode: **Light**, **Medium**, **Loaded**.
Performance	Set Performance Mode: **Economy**, **Medium**, **Precise**.
Palette	Change Day, Dusk, Night and color palette theme.
Select Manual Speed	Select Manual Speed Setting: **ON/OFF**
Set Manual Speed	Set manual speed (Only available when Manual Speed is **ON**).
Rudder limit	Set Rudder Limit by: **Tiller**, or **Auto by Speed**.
Off Heading Alert	Set Off Heading alert threshold: 5 to 30 degrees (threshold for both Heading & Course Mode)
Doubtful Hdg. Al.	Set Doubtful heading alert threshold: 5 to 50 degrees (threshold for difference to reference gyro)
Permanent Helm	Set manual helm: 0 to 5 degrees (Negative values for STBD Rudder)
Toe Angle	Set toe angle: -10° to +10° (Negative values for Toe-out)

Setup Menu	Enter setup menu. Only available when the Autopilot is not in control, or user has previously logged-in to setup menu. See section 7.2.
Exit	Leave user menu

In the user menu:

- Use the arrow UP and DOWN push buttons to scroll in the user menu.
- Press the SELECT push button 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.

2.7.1 Condition Selection

The following condition selection options are available:

- Light
- Medium
- Loaded

Set according to the loading conditions.

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

2.7.2 Performance Selection

The following performance selection options are available:

- Economy
- Medium
- Precise

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

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

2.7.3 Operator selected Toe angle Display (For dual rudder ships)

In the User Menu, the following Toe angle parameter is available:

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



Figure 2-9: Autopilot control panel with toe angle configuration active.

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 and displayed on the control panels (see Figure 2-9).

Toe Angle = Stbd_Rudder_Angle – Port_Rudder_Angle

A Toe Angle can also 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). In this case, the value of the toe angle will be displayed only if it is different from zero.

On control panel the rudder is by default named: PORT/STBD rudder.

The rudder name can be changed (e.g Azipod) as shown in Figure 2-10. The name is configurable using parameters: Rudder1/2/3/4Name.



Figure 2-10: Autopilot with alternative azipod rudder name.

If more than one rudder is available, but only one is under Autopilot control, the Toe angle will be set equal to zero. This means that 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 Figure 2-11). This can be configured using parameter: Notreadytext=”Not Rdy”



Figure 2-11: Autopilot control panel showing "not rdy" label

2.8 Panel illumination and palette theme

2.8.1 Panel Illumination

To match the panel illumination to the surrounding ambient light, the display backlight and push button lamps of the control panel can be dimmed.

The illumination level is set by pressing the UP (To dim up) or DOWN arrow push button (To dim down).

2.8.2 Lamp test

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.

2.8.3 Palette Themes

The Autopilot supports a set of different palette themes to change color theme for the MIP panel. The palette themes is used to adjust the display according to the time of day and for customization and harmony with other equipment on the bridge.

The Autopilot has 4 different palette color themes for each of 3 times of day (i.e. Day, Dusk and Night):

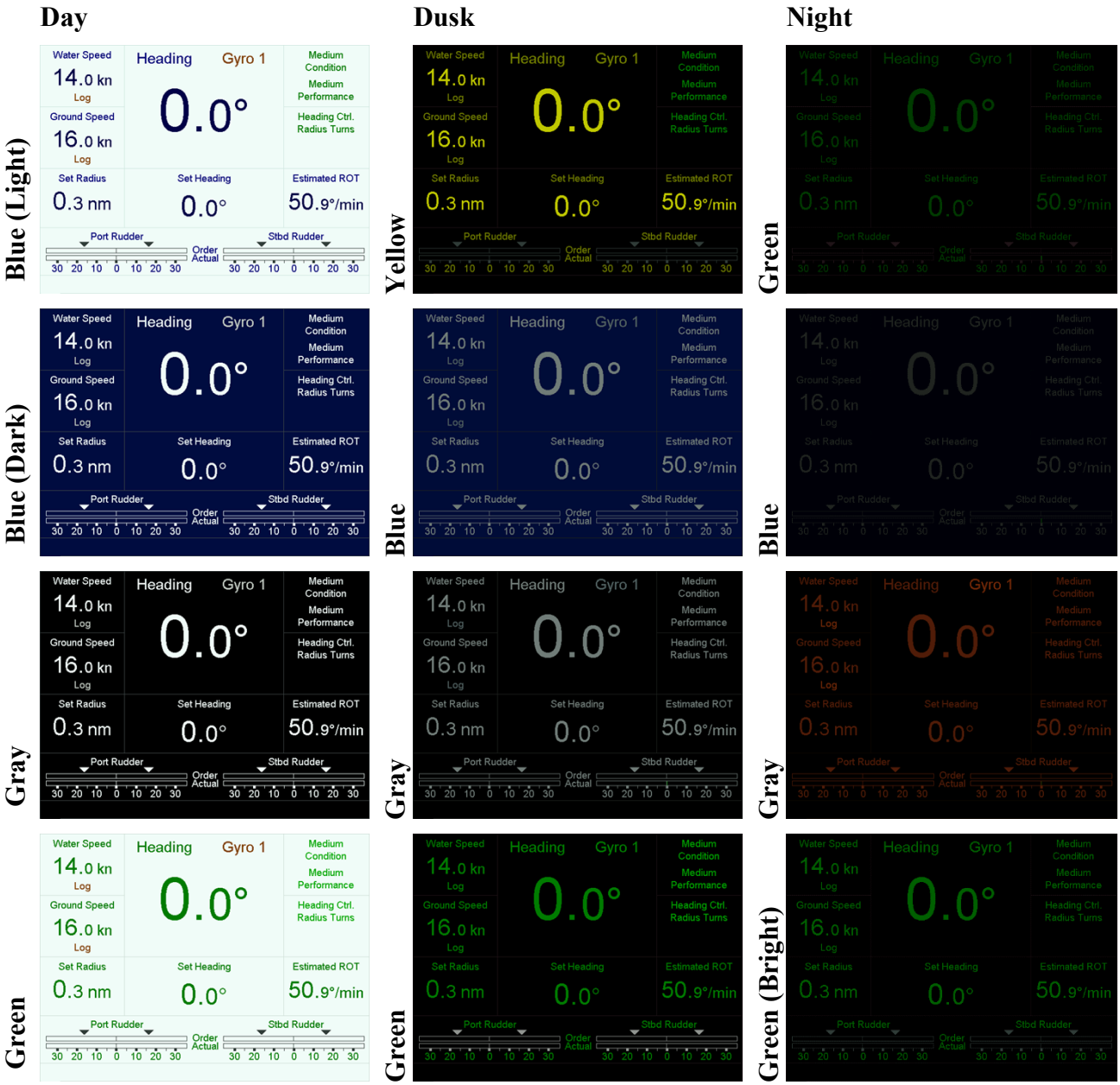


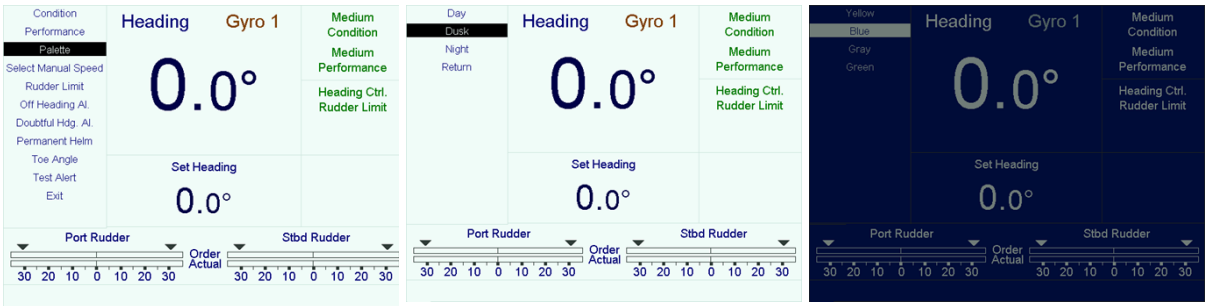
Figure 2-12: Palette themes per time of day

2.8.4 Palette theme selection

Three groups of color palettes can be selected through the setup according to the time of day:

- Day
- Dusk
- Night

For each time of day, one of 4 palette color themes can be selected.



a *b* *c*

Figure 2-13: Palette theme selection menu

Press *SELECT* button to access the main menu and press the UP/DOWN arrow buttons to navigate to the *Palette* menu item. Press SELECT button to enter palette menu.

Press UP/DOWN arrow buttons to choose the time of day (day, dusk, night). In Figure 2-13 the example show a change *Day* to *Dusk*. Press *SELECT* button to confirm. Changes take effect immediately, defaulting to the latest used palette theme for the selected time of day.

Press UP/DOWN arrow buttons to switch between 4 palette theme options for each time of day. The themes are applied instantly as the arrow button are pressed to ease the customization process.

Once a desired palette theme is selected, press *SELECT* button three times to step back through and finally close the menu, or simply wait for the menu to timeout (e.g. 30 sec) and disappear on its own.

2.8.5 Central illumination Control

The panel in control will be the master for selection of the time of day and the illumination level. Panels not being in control will follow the Master setting. However, the illumination setting on a panel can afterwards be changed locally on the panel.

In case of a power break of a control panel, the panel will, after power on, come up with the last used illumination level and time of day palette of the Autopilot.

The Autopilot can be interfaced to an integrated bridge illumination system, where the time of day and Dimming levels can be set centrally. Changes made on the Autopilot can be sent to the central system, and Autopilot can receive changes from the central system.

2.9 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 are manageable from a Central Alert Management system (CAM) if available. A full list of defined alerts is listed in section 3.6.1.

Alerts are shown at the bottom of the main display in single line.



Figure 2-14: Autopilot control panel showing a Heading Control Failure.

The lower line on the main display, shows the currently active alert with highest display priority (see Figure 2-14). On 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(red), W(orange), or C(yellow), icon will be displayed at the right side of the line, if there are more active alarms, warnings or cautions in the alert list (see Figure 2-15). In that case, pressing the ALERT ACKN button will open a list of all the active alerts.

2.9.1 Alert List Screen

The alert list displays the active alerts on the Autopilot.



Figure 2-15: Autopilot alert conditions screen.

Press UP/DOWN arrow buttons to change the highlighted alert in the list. If the panel is in control, the highlighted alert can be acknowledged by pressing the ALERT ACKN button.

The list is sorted by highest display priority. When an alert is acknowledged it changes priority, and therefore position in the list.

Press SELECT button or any of the Autopilot mode control push buttons, to exit the alert list screen and return to main display.

2.9.2 Alert Icons

The icons displayed along with the alerts on the Autopilot are listed below:

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

Table 2-2: Alarm Icon Overview

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	Orange Flashing circle	Orange Flashing circle	Orange circle	Orange Flashing circle

Table 2-3: Warning Icon Overview

Icon Graphics for Cautions, presented together with the alert

ICON				
ICON name			Active Caution	
ICON description			Yellow square	

Table 2-4: Caution Icon Overview

2.9.3 Alert List Screen – Panel not in control

If the MIP panel is not in control, the alert list can still be displayed, but alerts cannot be acknowledged from this panel (see Figure 2-16).

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	

Table 2-5: Unknowledgeable Alert Icon Overview



Figure 2-16: Autopilot control panel not active showing that alert handling is disabled.

2.10 Heading sensor signals & related Alerts

One or two heading signals must be 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 (X3-7/8) 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 Gyro 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 is raised if working heading signal (steering reference) is lost, or the secondary heading signal is lost.

A gyro difference alarm comes up if the difference between the two heading signals exceeds a threshold (default 10 degrees).

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

2.11 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.

If both Water and Ground speed is not available, the last known speed is shown flashing. Select the Manual Speed Setting in case of no speed signal, and adjust to a proper speed.

2.11.1 Manual Speed Selection

A Manual Speed value can be entered on the MIP panel and applied as both Water speed and Ground Speed.

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.

2.12 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 three steering devices can be connected.

The order signals to the three steering devices are shown on the lower part of the display, along with the actual feedback signals (see Figure 2-17).



Figure 2-17: Autopilot control panel with 3 steering devices connected.

The system can be configured such that each steering device can be controlled by the Autopilot in control. In Figure 2-18, 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.

It is still possible to use Toe angle offset on the two outer steering devices when running with 3 unit (Figure 2-19).



Figure 2-18: Autopilot control panel with 3 steering devices connected but only one active.



Figure 2-19: Autopilot control panel with outer steering devices using toe angle offset.

2.13 Pre-sailing check

- Start at least one steering gear pump for 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

2.14 Standby Autopilot control function. (Hot Standby)

An independent Autopilot controller (AEU611) is needed to maintain the Autopilot control function in case of malfunction to the Autopilot controller 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.
3. A change over box (ACOxx) is needed for control the changeover functionality.

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 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.

2.15 Use of Arm Rest Panel(s), ARP11

The ARP11 is designed to allow for easy control of the essential Autopilot functions from the navigator's armchair.



Figure 2-20: Arm rest panel

2.15.1 Control selection

The ARP11 is called into control like any other of the Autopilot control panels (MIP or ARP) when the mode switch is set to CALL UP.

2.15.2 Steering modes: Heading-Radius or Remote control

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

This will 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.

2.15.2.1 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.

2.15.2.2 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.

By default, the panel always operates in the Programmed mode as described in section 2.15.3! 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.

2.15.3 Programmed mode and immediate mode

The ARP panel will be in programmed mode as default. This is opposite to the MIP panel(s). This mean that by default using tiller to change heading, will not take effect before pressing EXECUTE button.

The PROGRAM NEXT push button is basically a toggle function. Toggle the button to:

- Enter immediate mode – direct access to heading and radius changes, or
- Enter programmed mode.

The use of indication lamps is described below:

2.15.3.1 Programmed mode

The PROGRAM NEXT lamp is steady ON.

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

2.15.3.2 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.

2.15.3.3 Interruption of operation strategies

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:
    - *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 Figure 2-21)
    - *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).

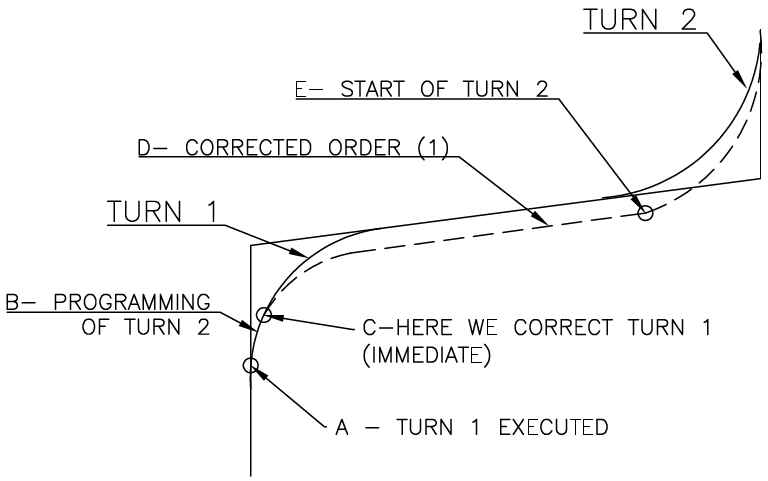


Figure 2-21: Sketch of functional description of the Autopilot control.

2.15.4 Default set mode when entering heading control mode

Same as the MIP panel(s) as described in section 2.6 (except no course mode).

2.15.5 Dimming

Same as the MIP panel(s) as described in section 2.8.1.

2.15.6 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.

2.16 Use of AutoPilot Mini Display

The AutoPilot Mini Display is a compact touchscreen display designed to work in tandem with the ARP, secondary to the MIP in the AutoPilot eco-system.
It provides a local visual interface for AutoPilot information, presenting key data like on the MIP, conveniently on the navigator's chair.



Figure 2-22 AutoPilot Mini Display and ARP (greyed out)

The nominal viewing distance of the AutoPilot Mini Display is 60 cm.

The display has touchscreen interaction. It supports:

- **Tapping** to navigate between pages and interact with menus, buttons and alerts.
- **Scrolling** in select menus where multiple data fields are available.

2.16.1 Main Screen Overview

The AutoPilot Mini Display has one main screen showing the most important information pertaining to the Autopilot steering. The general organization of the main screen is depicted on Figure 2-23.

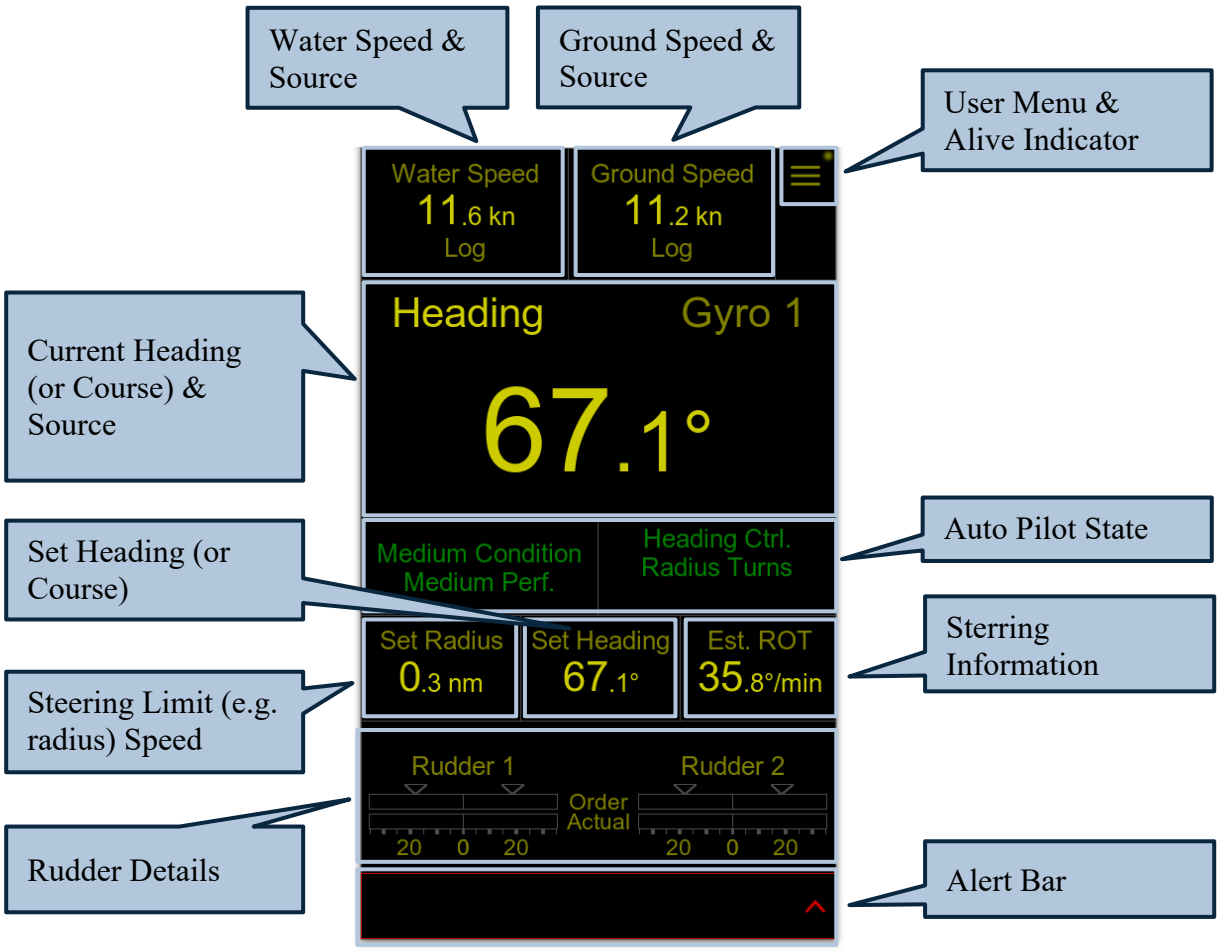


Figure 2-23: AutoPilot Main Screen Overview

The topmost row of tiles displays water speed, ground speed, menu button and an alive indicator, pulsating at a constant rate.

The center of the screen displays the current heading of the ship and the autopilot state, the steering limit currently applied by the Autopilot (e.g. radius limit), the desired set-heading and steering information.

The tile showing “Set Heading” may also show turn side arrows.

The lower part of the screen displays rudder information (i.e. order to the rudder, actual feedback from the rudder and toe angle).

The bottom line of the screen is reserved for displaying Autopilot alert information.

2.16.2 Steering modes

The autopilot supports the following main steering modes:

- Heading Control (see section Heading control2.4.1 Heading control)
- Course Control (see section 2.4.2 Course control)
- Remote Control (see section 2.4.3 Remote control)

On Figure 2-24 the AutoPilot Mini Display is displaying each mode.



Figure 2-24 Autopilot Mini Display when the autopilot is in each of the three steering modes

Furthermore, as also explained in section Radius control Mode and Rudder Limit Mode, when the AutoPilot is in Heading Ctrl mode or Course Ctrl mode the AutoPilot can perform Course/Heading changes either as a radius (Rate) controlled turn or rudder limited turn.

When rudder limited turn is chosen the AutoPilot Mini Display will change the width of the Steering limit, Set Heading and Steering Information fields as depicted on Figure 2-25.

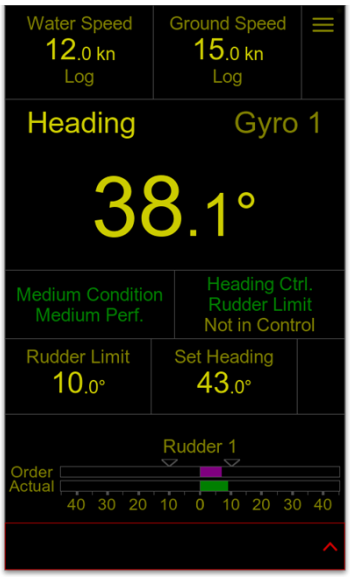


Figure 2-25 Autopilot Mini Display in Heading Control mode and Rudder limit mode

2.16.3 Alert bar

When one or more alerts are active, the alert bar contains the icon, id and description of the highest priority alert. The right most numbers of the alert bar show the total number of alarm, warning and caution alerts, represented by the colored background. The alert bar is empty, when no alerts are active. The icons and their behavior are described in Section Alert Icons.



Figure 2-26 Main page of Mini Display (with and without alert)

When tapping the alert bar, the AutoPilot Mini Display navigates to the alert menu (Section Alert Menu)

2.16.4 Alert Menu

The alert menu shows the current alert conditions (Section 2.9 Autopilot system alerts). The alert menu is accessible by tapping the alert bar on the main page (Figure 2-26).

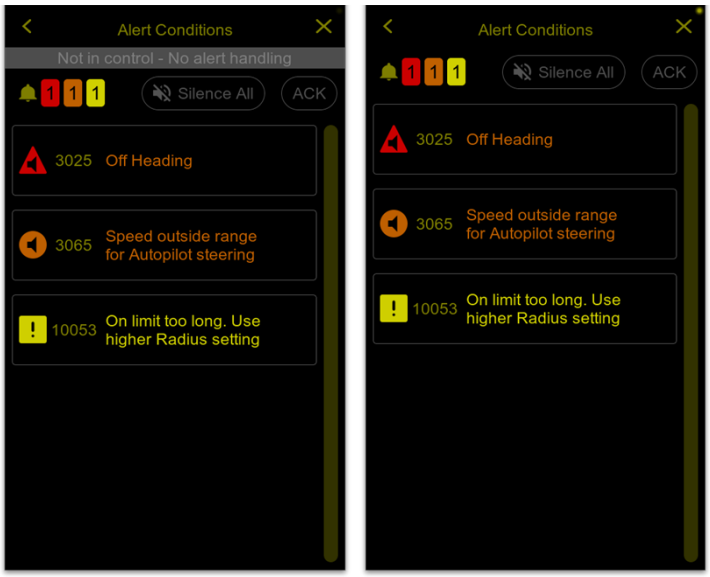


Figure 2-27 Alert Menu (not in control and in control)

The numbers next to the bell icon indicates the total number of alarms, warnings and cautions respectively.

The Alert Menu page show whether the AutoPilot Mini Display is in control or not.
Control is gained by pressing CALL HEADING RADIUS or CALL REMOTE on the ARP (This may change steering mode: see section 2.15)

Figure 2-29: Alert Menu with a buzzing alarm and a selected warning

If the connected ARP is not in control, the AutoPilot Mini Display will still display the alerts but will not allow acknowledgment.
When the ARP is in control, the Silence All and ACK buttons become available, and alerts can be selected by tapping them. Only acknowledgeable alerts can be selected. Selecting one or more alerts enables the ACK button to acknowledge and remove the selected alerts from the list.

If one or more alerts are triggering the buzzer, the Silence All button is enabled. Tapping the Silence All button silences the buzzer temporarily for 30 seconds.

2.16.5 Settings Menu

The Settings menu is accessible by tapping the menu icon in the top right corner of the main screen (Figure 2-23).

Inside the Settings menu, buttons provide navigation to the Palette menu, Status page, Service page, Test Alert page and About page as well as the current brightness level of the display.

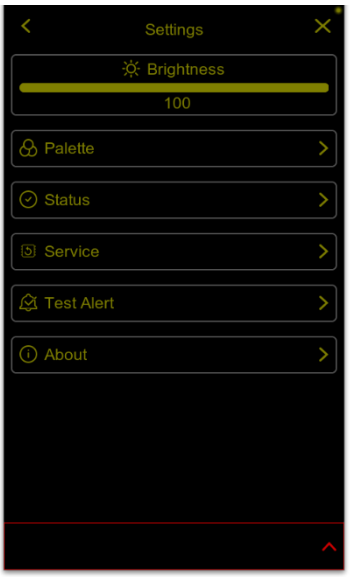


Figure 2-28 Settings menu

Tapping the banners marked with a right chevron opens the corresponding page.
Tapping the left chevron in the top left corner opens the previous page.
Tapping the cross in the top right corner closes the Settings menu.

The Settings menu also closes automatically after a time of inactivity.

2.16.5.1 Palette and Brightness

The AutoPilot Mini Display follows the dimming of the AutoPilot system (section 2.8).

Current brightness-level can be seen in the Settings menu and the current palette in the Palette Menu. In the Palette menu the color theme can be chosen when the connected ARP is in control. The different palettes are shown in section 2.8.3.



Figure 2-29 Palette menu

2.16.5.2 Status

The status page contains information about the connections, commissioning and uptime of the AutoPilot Mini Display.



Figure 2-30 Status page

2.16.5.3 Service

The service page turns on the Wi-Fi hotspot in the AutoPilot Mini Display to enable software update, commissioning and downloading logs.



Figure 2-31 Service page

2.16.5.4 Test Alert

The Test Alert page allows the user, when in control, to send a test alert to the BAM system.



Figure 2-32 Test Alert page

2.16.5.5 About

The About page contains the version numbers of the AutoPilot Mini Display, the connected ARP, and connected AME, as well as information about the open-source licenses used in the application.

3 Autopilot System Functional Description

3.1 System Overview

Principle block diagram of the SEM300/FAP-3000 Autopilot system:

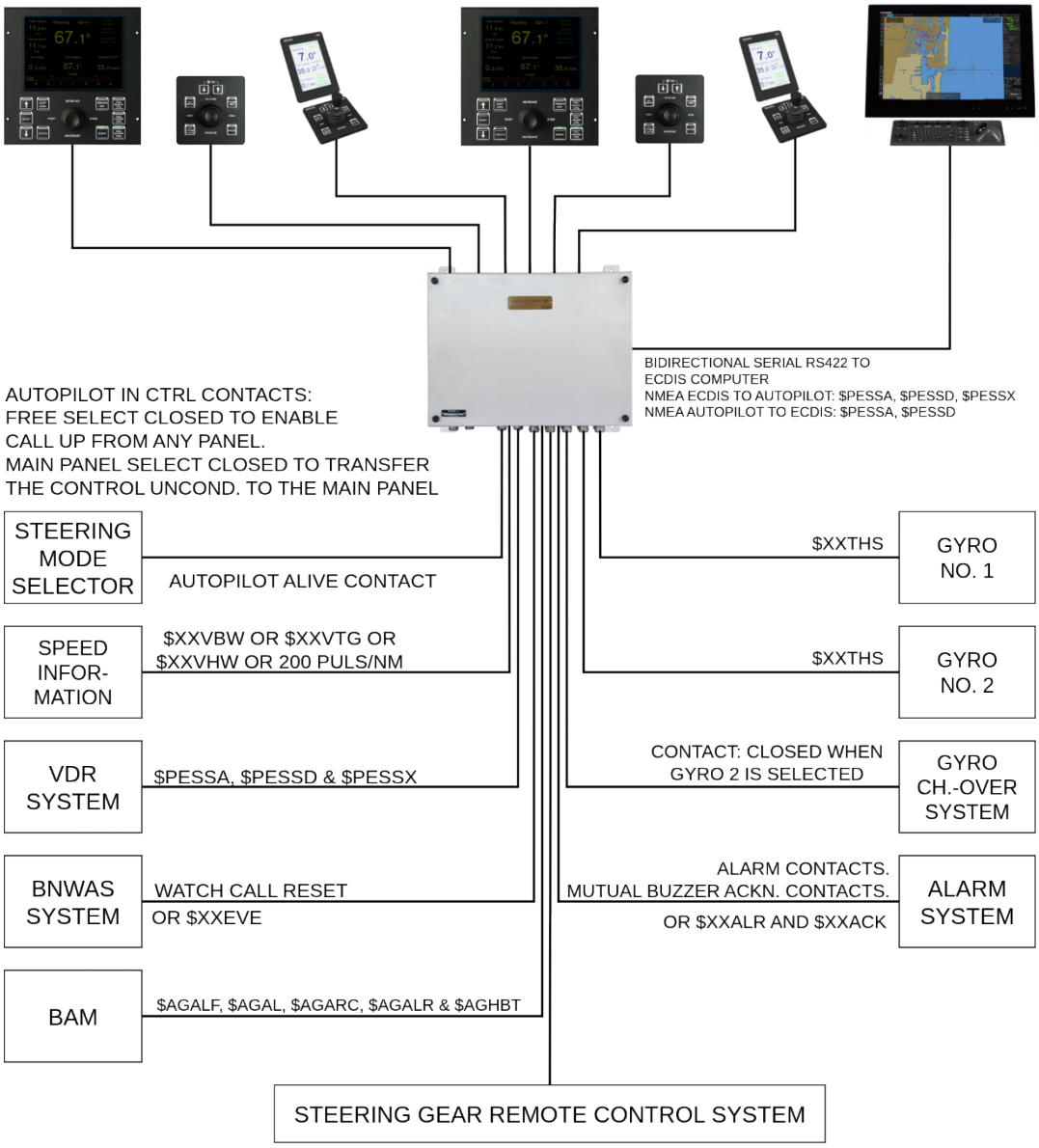


Figure 3-1: Autopilot functional system overview

SEM300/FAP-3000 system parts:

- One or more MIP Autopilot control panel(s).
- AEU611 Autopilot Electronic Unit.

- AEU to MIP Factory supplied cable(s).

- Optional:
  - One or more ARP Autopilot arm rest control panel(s).
    - Yard supplied CAN cables to ARP panels.
  - JBXARP-1 Junction boxes for ease of cable installation.
  - JBXMIP-2 Junction boxes is a special case. See project specific cable plan and terminal list.

One MIP together with the AEU611 Autopilot electronic unit make up a minimal, but complete Autopilot system.

One more MIP/ARP is easily added to the system.

The ARP panel(s) always requires at least one MIP panel as a displaying unit.

The MIP display panel(s) are connected to the AEU through factory supplied cables.

The ARP unit(s) are connected to the AEU using yard supplied CAN cables.

The AEU has two separate CAN bus interfaces, and it is then up to the system designer to decide which one is extended for communication with extra panels.

The AEU unit can supply up to 2 MIP panels and 2 ARP panels. Additional panels require an external junction box (JBXMIP-x or JBXARP-x) for one or more panels for power supply.

It is recommended to distribute the MIP and ARP panels evenly between the two CAN buses for redundancy.

Following configuration has multiple panels per CAN bus:

- CAN bus 1: 1 MIP (Main panel)
- CAN bus 2: 1 MIP + 2 ARP

If multiple MIP panels are connected on CAN bus 1, the one with the lowest serial number will become the main panel.

In the latter configuration it is recommended to constrain to only two connections per terminal to avoid stress in the terminal strip.

The ECDIS system communicates with the Autopilot AEU through proprietary NMEA sentences both ways.

The Mode selector is shown as a separate item on the above block diagram.

Mode selection (Autopilot In-Control selection) can also be done from the steering gears Remote-Control System (RCS). One "In-Control" closing contact from each steering gear is required for individual Autopilot control of each steering device.

3.2 The Steering Mode Selection

The Steering mode selection is not a part of the Autopilot system but related to the steering gear remote control system. The Mode control system shall provide mode contacts for the Autopilot system fulfilling the below requirements.

Mode Contact Inputs	Term.	Description
Autopilot in Control inputs/Ready inputs		**Digital inputs are defined as In Control inputs in the SEM300Manager Tool.** **Typically the following inputs are assigned as In Control** **Inputs:** **X4-1 / X4-2 Main Panel select. (DI13)** **X4-3 / X4-4 Free panel selection. (DI14)** **X3-9 / X3-10 Steer dev. Ready input 1. (DI06)** **X3-11 / X3-12 Steer dev. Ready input 2 (DI07)** **X3-14 / X3-15 Steer dev. Ready input 3 (DI08)** **X3-19 / X3-20 Steer dev. Ready input 4 (DI11)** **The last 4 of these are used as Ready inputs.** **Ready means that the connected steering device is ready to take steering order in.**
Autopilot Main Panel In Ctrl Input	**X4-1 To X4-2**	**A contact closure (steady closed) will allow control from the main panel only. (Disregard any remote control station)** **The main panel is called into control at the same time if the input is assigned "in Control selection".** **Any attempt to call a mode from any of the other control panels will issue a dead panel buzzer signal.**
Autopilot Free Select In Ctrl Input	**X4-3 or X4-5 To X4-4 or X4-6**	**A contact closure (steady closed) will enable the Autopilot control from the Main Control Position, but allow further control take-over from the other panels.** **The Autopilot will enter the mode on a specific steering position if the contact closure comes immediately after pushing a mode key on any of the control panels.** **The Autopilot drops out of control if the contact opens.**

		Two contact inputs for interface to redundant mode ctrl systems.
Mode Contact Outputs	**Term.**	**Description**
Hand Wheel select	**X4-7 To X4-8**	**A contact closure (steady closed) will enable the Hand Wheel steering mode. The rudder order will be taken from the connected Hand Wheel. This rudder order signal will be used as reference to the internal rudder servo controller if this is enabled (Parameter selection), else it will be routed to the rudder order output.**
Ready for Autopilot	**X4-9 To X4-10**	**No Function** **Mode call is done directly from the In Ctrl contact inputs.**
Autopilot Control request	**X4-11 to X4-12 And X4-13 to X4-14**	**Closes as response to activation of a mode call push-button on any panel control keyboard.** **The contact is intended for use in a mode control system having facility for call up of the Autopilot mode externally.** **The mode ctrl system in control contact to the free select input is expected to closes immediately, and the Autopilot will enter the requested.** **Two contact outputs for interface to redundant mode ctrl systems.**
Autopilot In Ctrl (Read-back to the mode ctrl system)	**X4-15 to X4-16 And X4-17 to X4-18**	**Closes as response to the closure of the input in control contact, and is intended for use as read back contact to the Mode control system, or as Autopilot mode selected information to the BNWAS system. The contacts are steady closed as long as the input In Control contact is closed.** **Two contact outputs available.**

Mode Outputs	Contact	Term.	Description
Autopilot Ready		**X4-19 to**	**Contacts are closed when the Autopilot is ready for a call-up.**
		X4-20	**Can be used by a mode control system to block call-up if the Autopilot is not ready.**
		And	
		X4-21 to	**Two contact outputs for interface to redundant mode ctrl systems.**
		X4-22	

Only an “In Control” contact is needed from the mode control system to build the most simple system. The other contact facilities are available to benefit from the more advanced mode control systems.

NOTE.

If the Autopilot system is arranged with more than one control position, it shall be possible to unconditionally return the control to the master station.

Use the Autopilot Main Panel in ctrl input to implement this.

The Main Panel is defined as the one connected to CAN 1.

Two simple mode control system examples see Figure 3-2:

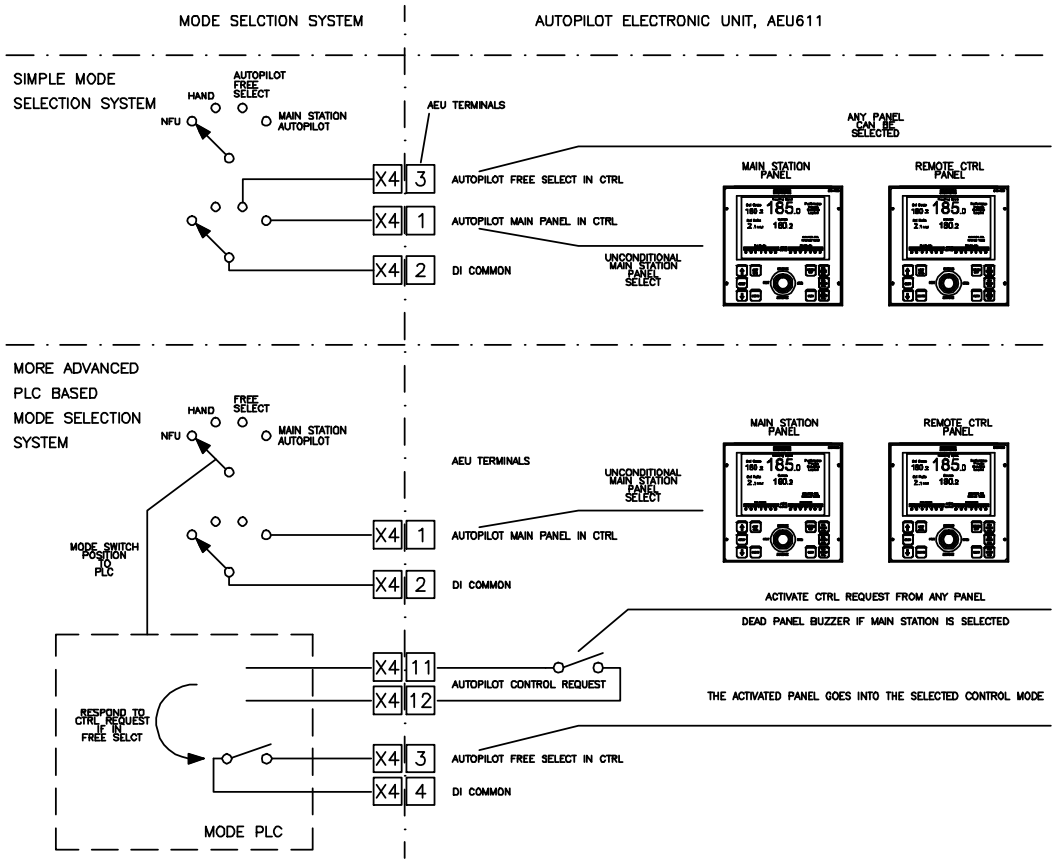


Figure 3-2: Control installation examples

The Autopilot mode can also be called from the steering devices, device by device.

The Autopilot then gets more and more devices under control as the Autopilot mode is selected on the Rudder or Azimuth drives control panel.

In this case more Ready inputs are defined to be able to configure the Autopilot controller for the actual configuration.

At the same time the ready inputs are also defined as “In-Control” inputs. The Autopilot then goes into control if just one steering device is Ready.

Typically used In-Control inputs (Configured in SEM300 manager or by panel parameters):

- X4-1 / X4-2 Main Panel select. (DI13)
- X4-3 / X4-4 Free panel selection. (DI14)
- X3-9 / X3-10 Steer dev. Ready input 1. (DI06)
- X3-11 / X3-12 Steer dev. Ready input 2 (DI07)
- X3-14 / X3-15 Steer dev. Ready input 3 (DI08)
- X3-19 / X3-20 Steer dev. Ready input 4 (DI11)

The last four of these are READY inputs.

3.3 The System Power Supplies & enclosure

The AEU611 box:

- One main navigation supply 24VDC with automatic backup change over. 24VDC +30%/-25%, current consumption max. 2Amp. Max 48 W Switch board fuse 4 Amp.
- Enclosure IP22

The MIP:

- 24VDC from secondary side of the line filter inside the AEU611. 24VDC +30%/-25%, current consumption max. 0.7Amp. Switch board fuse 2 Amp.
- If an additional panel: 24VDC from a battery source. 24VDC +30%/-25%, current consumption max. 0.7Amp. Switch board fuse 2 Amp. To be supplied through a junction box with line filter.
- Enclosure IP22

The AME11 inside the AEU611 carries the following onboard power supplies, all monitored by the power supply alarm system and having each a Power OK LED lamp on the board.

Power supply	OK LED	Description.
1.5VDC	**LED10**	**1.5VDC MCU-core supply**
3.3VDC	**LED8**	**3.3VDC general MCU-system, memory and I/O supply.**
5.0VDC	**LED12**	**5.0VDC Serial I/O supply**
+/-15VDC	**LED13**	**Power supply for analog circuits.**
24V_DI	**LED15**	**24VDC Digital input circuit supply.**
24V_INT	**LED3**	**24VDC supply for internal drive of Digital output relays**
5V_CAN	**LED4**	**5VDC supply to CAN bus drivers.**
12V_CAN	**LED6**	**12VDC supply to CAN bus.**

3.4 The AEU I/O Signals

3.4.1 Power and CAN Bus

Terminal Number(s)	Signal Type	Signal Description	Remarks
XS-1	Supply	24VDC(+)	System Main Supply.
XS-2	Supply	24VDC(-)	
XS-3	Supply out	24VDC(+) Filtered	Auxiliary supply for external use.
XS-4	Supply out	24VDC(-) Filtered	
XS-5	CAN-Bus	CANH_2	CAN interface to extra panels or to standby AEU
XS-6	CAN-Bus	CANL_2	
X1-1	Unused	Do not connect	CAN_1 bus signal. Terminator available on PCB
X1-2	Ground	CAN_SHIELD_1	
X1-3	CAN-Bus	CANH_1	
X1-4	CAN-Bus	CANL_1	
X1-5	Unused	Do not connect	CAN_2 bus signals. Terminator available on PCB
X1-6	Ground	CAN_SHIELD_2	
X1-7	CAN-Bus	CANH_2	
X1-8	CAN-Bus	CANL_2	

3.4.2 Digital input/outputs for alarm signals

Terminal Number(s)	Signal Type	Signal Description	Remarks:
X2-1/2	Contact_Out	Alarm Acknowledge	Cancel Bridge Nav. Alarm system alarm buzzer
X2-3/4	Contact_Out	Autopilot Alive_1	Closed when Autopilot alive, freeze rudder when not alive. Alive means power on and running. Alert states are not incl. in this function. If LowSpeedLimit is defined, the output indicates that speed is above limit.
X2-5/6	Contact_Out	Autopilot Alive_2	
X2-7/8	Contact_Out	Autopilot OK_1	Closed when Autopilot OK. Grouped alarm contact including both hardware and software detected alarms.
X2-9/10	Contact_Out	Autopilot OK_2	
X2-11/12	Contact_Out	Operator Alive	Reset for BNWAS
X2-13/14	Contact_Out	Compass Compare OK	Compass monitoring if two Compass Sources installed. Alternatively in two rudder Bang-Bang systems and parameter StbdSolenoidOutput[1] is 8: STBD solenoid for rudder 2.
X2-15/16	Contact_Out	Power OK Contact 1	Supervision of all internal power supplies. Closed Contact =OK
X2-17/18	Contact_Out	Power OK Contact 2	
X2-19/20	Contact _In	Buzzer Acknowledge	Autopilot alarm buzzer cancel from bridge Nav. Al. Sys. (Not to be used if compliance to IEC 62923 “BAM” is needed)

3.4.3 Digital inputs, aux. features

Terminal Number(s)	Signal Type	Signal Description	Remarks
X3-1/2	Contact _In	Auxiliary DI_1	Used as mode selection input for Hot standby AP. Ext. CC= AEU now Hot Standby
X3-3/4	Contact _In	Auxiliary DI_2	Input for sensing "Aliveness" of selected Autopilot. Open contact activates standby function
X3-5/6	Contact _In	Auxiliary DI_3	Not Defined
X3-7/8	Contact _In	Gyro Change-over	Closed = Swap Gyro_1 and Gyro_2 (to follow gyro ch-over)
X3-9/10	Contact _In	Rudder 1 Ready	The Rudder (Azimuth) 1-3 Ready input contact Closed means Ready for Autopilot.
X3-11/12	Contact _In	Rudder 2 Ready	
X3-13/14	Contact _In	Rudder 3 Ready	
X3-15/16	Contact _In	Two Pumps	Signals Two pumps running to internal Bang-Bang servo, if used.
X3-17/18	Contact _In	Gain Condition 1	Autopilot Controller conditions available for external selection dependent on condition.
X3-19/20	Contact _In	Rudder 4 Ready	The Rudder (Azimuth) 4 Ready input contact Closed means Ready for Autopilot.
X3-21/22	Contact _In	LOG input	200 Pulses/Mile speed signal.

3.4.4 Digital input/outputs for mode ctrl systems

Terminal Number(s)	Signal Type	Signal Description	Remarks
X4-1/2	Contact _In	Main Panel In_Ctrl	Selects Main panel disconnecting Remote Stations. ISO11674
X4-3/4	Contact _In	Free Select	Two contacts in for connection to dual mode ctrl system. Closing one of these inputs will put the Autopilot in ctrl on the panel from where the call was done, else the ctrl will default go to the main panel.
X4-5/6	Contact _In	Free Select	
X4-7/8	Contact _In	Wheel Select	Input for wheel mode in case the int. BB-servo is ON.
X4-9/10	Contact _In	Ready IN	Steering Mode Ctrl system ready. Not Used
X4-11/12	Contact_Out	Ctrl Req.. 1	Closing contacts to one or two mode ctrl systems requesting Autopilot ctrl. Calls after pushing one of the available Autopilot ctrl modes. Momentary contact. (closed minimum 2 sec)
X4-13/14	Contact_Out	Ctrl Req.. 2	
X4-15/16	Contact_Out	In Ctrl 1	Closed contact for external users (e.g BNWAS or mode control system) signaling Autopilot in control.
X4-17/18	Contact_Out	In Ctrl 2	
X4-19/20	Contact_Out	AutoPilot RDY 1	Closed when Autopilot is ready for ctrl take-over. (= power on and running OK.)
X4-21/22	Contact_Out	AutoPilot RDY 2	

3.4.5 Serial NMEA

Terminal Number(s)	Signal Type	Signal Description	Remarks:
X5-1/3	NMEA_In_1	Serial NMEA Input	Isolated (IEC61162), ECDIS proprietary sentences
X5-2/4	NMEA_Out_1	Serial NMEA Output	Ref. to AEU power supl. (IEC61162), ECDIS proprietary sentences.
X5-5/7	NMEA_In_2	Serial NMEA Input	Isolated (IEC61162), . Receives BAM sentences and any NMEA input. See Param.
X5-6/8	NMEA_Out_2	Serial NMEA Output	BAM output sentences See Param.
X5-9/11	NMEA_In_3	Serial NMEA Input	Isolated (IEC61162), Receives any NMEA input. See Param.
X5-10/12	NMEA_Out_3	Serial NMEA Output	NMEA transmitter or EVTP data to ECDIS/RADAR displays
X5-13/15	NMEA_In_4	Serial NMEA Input	Isolated (IEC61162), Receives any NMEA input. See Param.
X5-14/16	NMEA_Out_4	Serial NMEA Output	NMEA transmitter or EVTP data to ECDIS/RADAR displays
X5-17/19 X8-1/3	NMEA_In_5	Serial NMEA Input	Isolated (IEC61162), Receives any NMEA input. See Param.
X5-18/20 X8-2/4	NMEA_Out_5	Serial NMEA Output	NMEA transmitter or EVTP data to ECDIS/RADAR displays
X5-21/23 X8-5/7	NMEA_In_6	Serial NMEA Input	Isolated (IEC61162), Receives any NMEA input. See Param.
X5-22/24 X8-6/8	NMEA_Out_6	Serial NMEA Output	NMEA transmitter or EVTP data to ECDIS/RADAR displays

3.4.6 Analog output & input

Terminal Number(s)	Signal Type	Signal Description	Remarks:
X6-1	Analog_Out	Rudder order. +/-10V	Rudder order to PORT rudder, or center rudder if only one.
X6-2	Signal Ref.	0V_AEU	
X6-3	Analog_Out	Rudder order. +/-10V	Rudder order to STBD rudder. NumOfRudders=2 then. Else same signals as on X6/1 – X6/2
X6-4	Signal Ref.	0V_AEU	
X7-1	Analog_Out	Rudder order. +/-10V	3. rudder order
X7-2	Signal Ref.	0V_AEU	
X7-3	Analog_Out	Rudder order. +/-10V	4. rudder order
X7-4	Signal Ref.	0V_AEU	
X7-5	Power Sup.	+15V_AEU	Connection to Rudder feedback potmeter If Dual rudder, then PORT rudder feedback
X7-6	Analog_In_1	Analog Input +/-10V	
X7-7	Power Sup.	-15V_AEU	
X7-8	Power Sup.	0V_AEU	
X7-9	Power Sup.	+15V_AEU	Connection to Rudder feedback potmeter If Dual rudder, then STBD rudder feedback
X7-10	Analog_In_2	Analog Input +/-10V	
X7-11	Power Sup.	-15V_AEU	
X7-12	Power Sup.	0V_AEU	
X7-13	Analog_In_3	Analog Input +/-10V	Aux. Analog in. No 3 rudder feedback
X7-14	Power Sup.	0V_AEU	
X7-15	Analog_In_4	Analog Input +/-10V	Aux. Analog in. No 4 rudder feedback
X7-16	Power Sup.	0V_AEU	

3.4.7 Opto FET outputs

Terminal Number(s)	Signal Type	Signal Description	Remarks:
X9-1	Power Supl.	24V_INT	Drive voltage for external load
X9-2	Signal Ref.	DI GND (24V_INT ref.)	
X9-3/4	FET_Output	PORT solenoid driver	Opto-isolated FET output contact to drive PORT solenoid when BB-servo function is selected Alternatively, if AuxBuzzerOutput is 0 then output is an auxiliary buzzer output
X9-5/6	FET_Output	STBD solenoid driver	Opto-isolated FET output contact to drive STBD solenoid when BB-servo function is selected Alternatively, if AuxBuzzerOutput is 1 then output is an auxiliary buzzer output
X9-7/8	FET_Output	Aux. FET drive	Stand-by Cutoff. (Standby DO to Main) Alternatively, if AuxBuzzerOutput is 2 then output is, an auxiliary buzzer output Alternatively in two rudder systems and parameter PortSolenoidOutput[1] is 11: PORT solenoid for rudder 2.

3.4.8 Multi pin terminals

Terminal Number(s)	Signal Type	Signal Description	Remarks:
			Ethernet interface
J3	Ethernet	Service port for configuration of the AutoPilot	RJ45 ethernet connector
			USB Interfaces
J6	USB Device	Serial port for configuration of the AutoPilot	Parameter interface B-Connector
J7	USB Host	Port for FAT(32) formatted USB key	Parameter interface A-Connector

3.5 CAN bus

The communication between the AEU611 and the MIP/ARP control panels are run on CANBUS.

The AEU611 box has 2 CANBUS drivers to improve redundancy. They both share the same power supply.

Max. 2 MIP and 2 ARP panels should be powered from the AEU. Extra installed panels should be powered from an external 24VDC supply fed through a junction box with 3EQ1 net-filter.

The CANBUS adhere to the CANBUS standard for highspeed communication, ISO11989-2. It uses a linear bus configuration that terminates in each end with a 120 Ohm resistor.

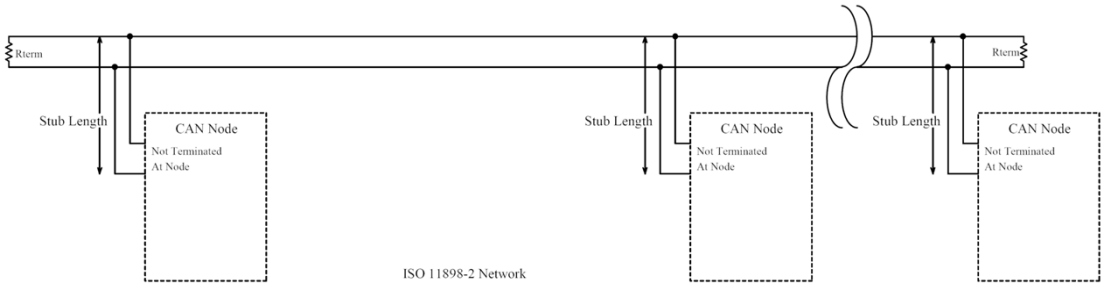


Figure 3-3: CANBUS Termination scheme

VERY IMPORTANT: Correct implementation of end termination in accordance with the CANBUS standard ISO11989-2 must be observed.

The MIP/ARP panels connected are identified on the CANBUS by their serial number. The serial number is entered in the Flash Prom part for protected parameters at the Factory test of the unit.

One panel is defined as the MAIN PANEL.

This is the panel which defaults into control when the Autopilot is selected. The MAIN panel is the only selectable panel if the AEU Main Panel input is activated. (No remote-control access)

The CAN bus 2 is used for extra panels and/or communication of states between a “Hot Standby” AEU and a main AEU. The “Hot Standby” AEU is a redundant unit, used to cut-in and take control in the case that the main AEU gets the state “Not-Alive” (DNV Naut. AW requirement).

Termination resistor

On the MIP and ARP panels, the termination resistor can be set ON or OFF on a small DIP switch on the back. On the ARP panel a green LED will light up when the resistor is ON. On the AEU the DIP switch (SW4) for the termination resistor can be found inside the box on the PCB. Only the resistor in each end of the CANBUS line must be set to ON, the remaining resistors must be set to OFF, so that the CANBUS line is only terminated in each end and nowhere else.

Depending on the version of the AEU there are different possible scenarios for how this can look, and it is recommended to follow the cable plan for the installation or observe which

specific CANBUS line the equipment is communicating on and its place in the chain in accordance with ISO11989-2.

See Appendix Generic Installation of SEM300 / FAP-3000.

See section 3.14.4 for the CAN bus configuration.

3.6 Alert-System

Interface to BNWAS (Bridge Navigational Watch Alarm System).

A closing contact will announce operator activity as a response to all pushbutton- and tiller-operations.

Two closing contacts will be closed as long as the Autopilot is in control. One of these can be used to inform the BNWAS system of when to activate the alarm system.

Compass monitor.

The alarm contact opens if the difference between the heading inputs has exceeded the Gyro Difference Alarm threshold. See the setup description in the User instruction section of this manual.

Power Failure.

Two contacts opens if any of the AME onboard regulated voltage sources is out of range:

Power supply	OK LED	Description.
1.5VDC	LED10	1.5VDC MCU-core supply
3.3VDC	LED8	3.3VDC general MCU-system, memory and I/O supply.
5.0VDC	LED12	5.0VDC Serial I/O supply
+/-15VDC	LED13	Power supply for analog circuits.
24V_DI	LED15	24VDC Digital input circuit supply.
24V_INT	LED3	24VDC supply for internal drive of Digital output relays
5V_CAN	LED4	5VDC supply to CAN bus drivers.

Autopilot OK (or Autopilot Alive):

Two contacts are available. Closed when the Autopilot is OK (Alive).

Alive means:

The Micro Control Unit on the AME board is running, and there is no Watch-dog activity and further that the analog output read-back is correct.

The Autopilot alive contact can be used to force the mode selection system into NFU mode if the contact goes open.

This will freeze the actual rudder position if there is access to selection of the NFU mode or if the steering gear has low drift in NFU mode. (If the steering gear is controlling an azimuth drive it might result in too high drift and other means to keep the steering angle must be chosen.)

If it is necessary to freeze the analog order to the actual rudder position, then use the DTU11 Rudder freeze module. (This requires an independent rudder feedback unit and separate voltage supply).

3.6.1 Alerts defined for BAM

For generic as well as proprietary alerts following statements are valid:

- Priority and escalation abbreviations:

  A: Alarm

  B: Warning

  C: Caution

  N: Notification

  W: Watch
- Escalation time is 60 sec for escalated warnings and 30 sec for escalated alarms. (Default factory setting).
- Responsibility of alerts cannot be transferred from this auto pilot.
- BAM talker ID =”AG”

The following list of generic failure situations are detected in the AEU software:

Alert Id	Instance	Title Sent to CAM	Description Shown on MIP	Comments	Priority	Category	Escalation
260		Emergency Call	Emergency Call	Bridge Navigator Call	A	B	
998		Test alert only	Test Alert only	Test communication to CAM	W	B	W
3002	1	Lost ECDIS Ack.	No response from ECDIS when called from Autopilot.	No handshake signal from ECDIS when called from Autopilot.	W	B	W
3002	2	Lost ECDIS Ctrl.	Remote Control terminated by ECDIS	A remote-control session is terminated. Handshake signal gone.	W	B	W
3003	1	Lost Panel Ctrl.	Communication lost to the Panel in control	No communication to the MIP panel in control.	C	B	

Alert Id	Instance	Title Sent to CAM	Description Shown on MIP	Comments	Priority	Category	Escalation
3003	2	Lost Hot Standby	Lost Communication from Hot Standby Autopilot	State can-bus communication lost	C	B	
3003	3	LostStdbyMaster	Lost Communication from Master Autopilot	State can-bus communication lost	C	B	
3003	4	Lost ECDIS NMEA	Lost Serial signal from ECDIS	NMEA signal lost while under ctrl from ECDIS	C	B	
3007	1	Lost HDG Control	Heading Control Failure	Heading Information Lost	A	B	B N C
3007	2	Lost HDG Control	Rudder response failure.	Actual rudder angle is not following given order. (RudderSupervision=1)	A	B	B N C
3007	3	Lost HDG Control	No rudder movement when ordered	Autopilot On/Off valve control selected, but no rudder movement when ordered.	A	B	B N C
~~3008~~		~~Lost TC~~	~~Lost Track Control~~	~~When Autopilot falls back to heading control~~	~~W~~	~~B~~	~~W~~
3012	1	Doubtful Heading	Secondary GYRO 1 signal lost	Only one GYRO available, thus compare is not possible	W	B	W
3012	2	Doubtful Heading	Secondary GYRO 2 signal lost	Only one GYRO available, thus compare is not possible	W	B	W
3012	3	Doubtful Heading	GYRO compare alarm. Heading difference high between gyros	Working and Secondary GYRO difference too high. (Parameter: typically, 10Deg) Doubtful heading	W	B	W
3012	4	Doubtful Heading	Gyro jump detected	Creates a Gyro Signal Offset that is faded away	W	B	W
3021		HCS Pwr Failure	HCS restarted. Check the settings	Restart after a complete Power OFF	A	B	
3024		Off Heading	Off Heading	3025 escalated to Alarm	A	A	

Alert Id	Instance	Title Sent to CAM	Description Shown on MIP	Comments	Priority	Category	Escalation
3025	1	Off Heading	Off Heading	Parameter setting from Panel	W	A	A
3025	2	OffCourse	Off Course when in Course Mode	Off Course when in Course Mode	W	A	W
3038		CourseChangeSoon	Early course change indication from ECDIS	ECDIS has reported an Alert. Attend to the ECDIS for details.	W	A	W
3062	1	HCS Fault	PORT rudder response failure	Actual rudder angle is not following given order. For dual rudder vessels (RudderSupervision=1)	W	B	W
3062	2	HCS Fault	STBD rudder response failure	Actual rudder angle is not following given order. For dual rudder vessels (RudderSupervision=1)	W	B	W
3062	3	HCS Fault	Idle (No time for Idle). Processor overload.	Processor overload.	W	B	W
3062	4	HCS Fault	Manual Speed Setting when in Radius mode		W	B	W
3062	5	HCS Fault	Missing Course signal when entering Course Mode.	Course Mode entrance prohibited.	W	B	W
3063	1	HCS Fault	Position Speed Lost.	GPS speed is lost. NMEA VTG.	C	B	
3063	2	HCS Fault	Ground Speed is lost.	Doppler LOG GND speed missing	C	B	
3063	3	HCS Fault	Water speed signal from Doppler log lost.	The Doppler LOG Water speed is lost. Auto swap to another speed signal if available.	C	B	
3063	4	HCS Fault	Water Speed VHW lost.	VHW speed signal is missing. Auto swap to another speed signal if available.	C	B	

Alert Id	Instance	Title Sent to CAM	Description Shown on MIP	Comments	Priority	Category	Escalation
3063	5	HCS Fault	Speed signal from ECDIS lost	ECDIS NMEA speed signal lost ($PESSD)	C	B	
3063	6	HCS Fault	Course signal lost.	Course signal from GPS lost	C	B	
3063	7	HCS Fault	No valid Water Speed from pulse log.	Sudden change of speed	C	B	
3063	8	HCS Fault	Steering gear drifting. Hydraulic leak.	Autopilot On/Off valve control selected, but rudder movement without order.	W	B	W
3065	1	Low speed	Speed outside range for Autopilot steering.	The speed is below 20% of nominal speed.	W	B	W
3065	2	LowSpdCourseMode	Speed too low for Course mode, Select Heading.	The speed is too low for Course mode. (Parameter typ. 6 knots)	W	B	W
3065	3	LowSpdForCourse	Speed too low for Course mode. Cannot enter	Course Mode entrance prohibited.	W	B	W
3065	4	RotHighForCourse	ROT too high for Course mode. Cannot enter	The ROT value is above limit for entering Course mode (Parameter typ. 20 deg/min)	W	B	W
3113	1	HDG in fallback	Heading reference GYRO 1 signal lost.	The steering reference GYRO 1 is lost. Auto change to GYRO 2.	C	B	
3113	2	HDG in fallback	Heading reference GYRO 2 signal lost.	The steering reference GYRO 2 is lost. Auto change to GYRO 1.	C	B	
3156		No SPD adaptive	Speed signal lost, Select Manual Speed	No signal for available for feedforward information to Autopilot controller.	C	B	

Test Alert 0998 and 3xxx alert identifiers are defined by ISO11674:2019. Alert identifiers in the 100xx number range are specific for this AutoPilot.

Alert 3007 will send backup officer call after time-out to BNWAS:

$AGALR,,260,A,A,Emergency Call*0A<CS><LF>

The following list of proprietary failure situations are detected in the AEU software:

Alert Id	Instance	Title, CAM Message	Description, MIP "Display text"	Comments	Priority	Category	Escalation
10053		OnLimitTooLong	On limit too long. Use higher Radius setting	The Rudder Limit makes it impossible to follow the radius turn.	C	B	
10102		CutOffByStandby	Cut Off By Standby Autopilot. Select Hand Steering	Primary Autopilot disabled. Hot Standby unit cut in	W	B	W
10105		StandbyOperation	Standby Operation. Select Hand Steering	Alarm from standby AEU	W	B	W
10106		ParamConcistency	Parameter Inconsistency. Check Parameter Setup	Check parameter(s) in MIP setup menu.	W	A	

3.6.2 Alerts defined for legacy systems

The following list of failure situations are detected in the AEU software:

Alarm No	Description. "Display text"	Alarm Group No. in $PESSA to VDR
0	Cold Start	1
3	Heading reference GYRO 1 signal lost.	10
4	Heading reference GYRO 2 signal lost.	10
5	Secondary GYRO 1 signal lost	11
6	Secondary GYRO 2 signal lost	11
7	GYRO comp. Heading diff. high between gyros	11
8	Off Heading	13
9	Position Speed Lost.	14
10	Ground speed is lost.	14
11	Water speed signal from Doppler LOG lost.	14
12	Water Speed, VHW, lost.	14

Alarm No	Description. "Display text"	Alarm Group No. in $PESSA to VDR
13	Speed signal from ECDIS lost	14
14	Water Speed outside range for Autopilot steering	14
15	Speed signal lost, Select Manual Speed	14
16	Remote Control terminated by ECDIS	5
17	No response from ECDIS when called from Autopilot.	7
18	Lost Serial signal from ECDIS	12
19	On limit too long. Use higher Radius setting.	13
20	Communication lost to the Panel in control.	3
21	Course signal lost.	2
23	ROT high for Course mode. Cannot enter.	2
24	Speed too low for Course mode, Cannot enter.	2
25	Speed too low for Course mode, Select Heading.	2
28	Rudder response failure.	4
29	PORT rudder response failure	4
30	STBD rudder response failure	4
31	No rudder movement when ordered	4
32	Steering gear drifting. Hydraulic leak.	4
34	Idle (No time for Idle). Processor overload.	16
53	Early course change indication from ECDIS	
54	Manual Speed Setting when in Radius mode	14
55	Missing Course signal when entering Course Mode.	2
56	Off Course when in Course Mode.	13
57	Cut Off by Standby Autopilot. Select Hand Steering	
58	Lost Communication From Hot Standby Autopilot	
59	Lost Communication From Master Autopilot	
60	Heading Control Failure	10
61	Standby Operation. Select Hand Steering	
62	Gyro jump detected	
63	No valid Water Speed from pulselog.	14
65	Off Heading	13
66	Emergency Call	

The alerts from above are grouped into the following list of alarms reported in the $PESSA sentence. Alerts with no group number defined are not transmitted.

Alarm Group No	Description.
1	Restarted
2	Course mode failure
3	Panel in control missing
4	Rudder feedback response failure
5	Remote mode cancelled by ECDIS
6	
7	No remote request response from ECDIS
8	Wrong parameter checksum
9	ADC / DA failure, Serial Transmitter failure
10	Missing working GYRO
11	Missing secondary GYRO or Gyro diff. High.
12	Missing info from ECDIS
13	Off Heading / Off Course
14	Speed alarm
15	
16	Watchdog failure, No Idle time

3.7 Serial Interfaces

The AME11 main PCB in the AEU611 has 6 input and 6 output serial channels.

The channels are designed to fulfill the requirements of the NMEA standard in IEC61162-1 and the IEC61162-2 (Fast NMEA to 38400baud).

Inputs are opto-isolated from internal signal references. Isolation above 1kV.

The input can withstand 15V both polarities between the input terminal, and it works down to 2V max. 2mA. (Typically, below 1mA at 2V differential input voltage).

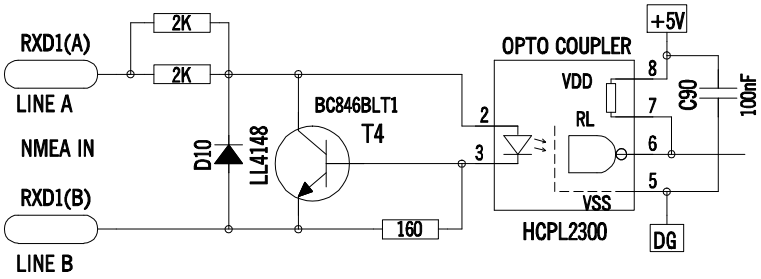


Figure 3-4: Illustration of isolated serial input channel.

The outputs are equivalent to RS-422 drivers with reference to AME internal digital ground.

Drive capability to 25mA at 2V.

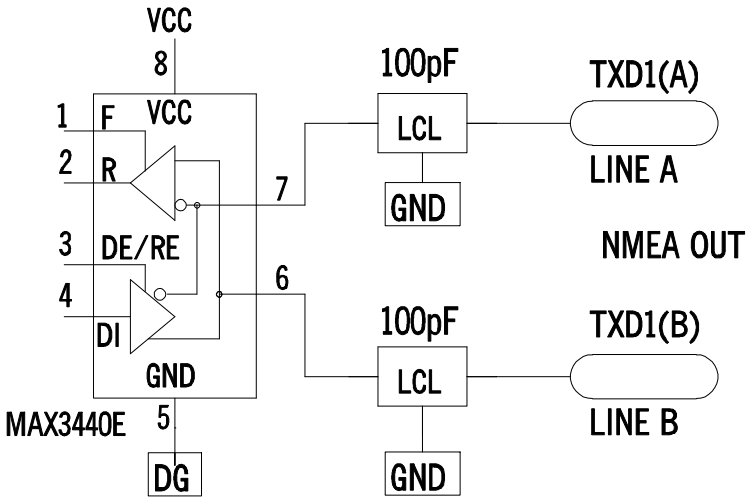


Figure 3-5: Illustration of isolated serial output channel.

The serial communication lines carry information to and from the ECDIS, from navigation signal transmitters like Gyro and Speed signal sources, plus NMEA sentence information to the alarm system and the VDR.

Use the **SEM300MANAGER** program or the service menu on the MIP panel to configure the serial interface.

A Specific number in the range [1:5] is attached each serial channels to define its use.

Channel type no.	Description	Further comments
0	Unused channel.	Means channel not activated.
1	ECDIS	Bidirectional using $PESSA, $PESSD, $PESSX
2	VDR	Bidirectional: ACK, ALR & $PESSA, $PESSD
3	MIP	Bidirectional use for interface to old MIP panels
4	DEBUG	Bidirectional for parameter setup.
5	NMEA	For general NMEA input use for sensor signals.
6	VMS	Bidirectional intf. to Sperry VMS system. Outdated
7	WECDIS	Bidirectional to WECDIS, standard NMEA. Sentences
8	BAM	Bidirectional BAM messages to CAM
9	BNWAS	Bidirectional to Bridge Navigational Watch Alarm System

The Use of the Serial channels from [0:5] is defined by the parameter, SerialChannelUse[x]

Where x is the channel number 0 to 5.

Default configuration of the serial ports:

1. ECDIS (SerialChannelUse[0]=1)
2. VDR (SerialChannelUse[1]=8)
3. NMEA (SerialChannelUse[2]=5)
4. NMEA (SerialChannelUse[3]=5)
5. NMEA (SerialChannelUse[4]=5)
6. NMEA (SerialChannelUse[5]=5)

3.7.1 The Autopilot can receive the following list of Standard NMEA sentences:

In general the sentences must follow the IEC 61162-1 Edition 5, but old sentences are also supported.

NMEA Sentence	Signal input	Remarks.
$xxTHS	Heading True from Gyro	
$xxHCR	Heading Correction report from Gyro	Coming before related THS
$xxHDT	Heading True from Gyro.	Old standard, prefer using THS
$xxHDG	Heading from Magnetic Compass	
$xxHDM	Heading from Magnetic Compass	Specified not recommended in NMEA ver. 2.0
$xxVBW	Speed from Doppler LOG	Both IEC61162 & earlier NMEA standard is received.
$xxVTG	Ground Speed from GPS	Both IEC61162 ed.3 and earlier.
$xxVHW	Water speed and ships Heading	
$PESSA **$PESSD** **$PESSX**	ECDIS	Proprietary EMRI NMEA sentence
$xxROT	Rate Of Turn	
$xxACK	Acknowledged Alerts	
$xxACN	Alert Command	Advanced alert communication

Further the Robertson STX sentence can be received as heading information. 9600 baud.

3.7.2 The Autopilot can transmit the following list of Standard NMEA sentences:

Generally the sentences must follow the IEC 61162-1 Edition 5, but old sentences are also supported.

NMEA Sentence	Signal output	TalkerId	Remarks.
$xxALR	Autopilot Alert sentence	Default: AG Config: AlrTalker	BAM sentence
$xxALF	Alert sentence	Default: AG Config: AlfTalker	BAM sentence
$xxALC	Cyclic Alert List	Default: AG Config: AlcTalker	BAM sentence
$xxARC	Alert command refused, Not used.	Default: AG Config: ArcTalker	BAM sentence
$xxHBT	Heartbeat	Default: AG Config: HbtTalker	BAM sentence
$xxEVE	Event sentence, BNWAS	Default: AG Config: EveTalker	
$PESSA **$PESSD**	ECDIS	PE (fixed)	Proprietary EMRI NMEA sentence

Note: The SEM300 AutoPilot by default uses “AG” talker ID when transmitting standard NMEA sentence, identifying that transmitter is an AutoPilot. The talkerId can be changed using the “yyyTalker” configuration parameters listed above.

3.7.3 HEADING signal input

Heading information is entered in NMEA strings: $xxTHS, $xxHDG or STX. Depricated but still working NMEA strings are $xxHDT, $xxHDM.

It is possible to select one or two heading information inputs (e.g. SEM300MANAGER or control panel).

Selection of 2 heading information sources enables the following facilities:

1. The digital input for Heading source selection is enabled. A closed contact to this input will swap the gyro inputs, making Gyro 2 the Autopilot steering reference and Gyro1 the comparison source. Connecting this input to a contact signal from the gyro change

over system makes it possible for the Autopilot to use same reference as all other repeaters on the bridge.
2. The other source will automatically be selected as backup in case of a failure to the Autopilot steering reference.

Change of steering reference will always be carried out without transient changes in the heading reference to avoid unwanted rudder response to the change. The difference between the heading sources is calculated and used as offset to the new reference in the moment of change. This offset is then slowly faded away if the steering reference is lost.

Same function is executed when correction changes are reported in the HCR sentence.

3.7.4 NMEA Talker Identifier

Above talker identifiers are shown as “xx”. This means that the sentences are received without paying attention to the talker identification.

Use the parameter yyyTalkerIdentifier=”VV”, where yyy is the sentence formatter (THS for gyro signal), VV is the talker identifier (HE for gyro).

Only sentences with specific selected talker identifier will be used.

3.7.5 Serial Interface to the ECDIS

NMEA Sentences to the ECDIS are all of EMRI proprietary types: $PESSA, $PESSD and $PESSX.

The communication to the ECDIS is monitored continuously. Depending on the configuration Alerts can be raised in various situations.

RequireEcdis parameter controls the behavior of the “LOST ECDIS NMEA” alert:

- 0: No ECDIS required. However, ECDIS can still be used, but the alert is not raised if missing.
- 1: ECDIS required all time. Even when the ECDIS is not used the alert will be raised.
- 2: Only if ECDIS was used during the communication loss.

When the alert is raised, the parameter LostEcdisAlertTimeout parameter defines how long the alert condition is active.

- 0: No limit. I.e., as long as the ECDIS communication is missing, and the Autopilot is in control.
- >0: The time in seconds the alert condition is active.

$PESSA to ECDIS:

Sentence $PESSA is transmitted from Autopilot. Default every 2 sec.													
Sentence:	$PESSA	,xxx.x	,xxx.x	,xxx.x	,xx.x	,P	,xx.x	,P	,xx.x	,P	,AAAA	,	*CS<cr><lf>
Field no.:	1	2	3	4	5	6	7	8	9	10	11	12	13
Field no.	**Field name**	**Field description.**											
1	Address:	$PESSA: Proprietary Emri Steering System Sentence A											
2	AC:	Actual Heading from gyro in degrees. - Null field if no gyro information.											
3	CTS:	Autopilot Heading To Steer in degrees: • Actual setpoint value for the Autopilot controller. • Local Heading /radius control, immediate Heading change: Cts =Cts-display value.											

		• Local Heading /radius control, programmed Heading change: Cts = Currently used internal setpoint. • Remote Nav. computer modes: Cts = Readback of remote ordered Cts.
4	PCTS:	Programmed Heading To Steer in degrees. • Programmed CTS value when in Programmed Heading Change mode. • PCTS is transferred to CTS value when activating EXECUTE. • PCTS holds adjusted CTS value in NAV. COMP. control when Heading set from the Autopilot is enabled by the nav. computer.
5	AR:	Actual Rudder angle in degrees. Neg./STBD angles. Null field if no AR information.
6	P or S:	Direction indication for AR. P = PORT, S = STBD.
7	RC:	Autopilot Rudder Command in degrees. Neg./STBD orders.
8	P or S:	Direction indication for RC. P = PORT, S = STBD.
9	ROT:	Actual Rate Of Turn in deg/sec. Positive for STBD turns
10	P or S:	Direction indication for ROT. P = PORT, S = STBD
11	ALARM:	Active alarms. Four hexadecimal digits representing a 16 bit word, where each bit corresponds to an alarm output. See application specific alarm bit mapping table under the alarm description. Note: If **ExtendedPessa** = 0 or 1, this field is empty when no active alerts. Note: If **ExtendedPessa** = 2 or 3, this field is 0000 when no active alerts**.**
12	RL	The rudder limit Note: Field only transmitted if the parameter **ExtendedPessa**=0 or 1.
13	Gyro[0]	Value from Gyro 0 input. Note: Field is only transmitted if the parameter **ExtendedPessa**=1 or 3.
14	Gyro[1]	Value from Gyro 1 input Note: Field is only transmitted if the parameter **ExtendedPessa**=1 or 3
13 or 15	CS:	Checksum.

Table 3-1: PESSA message format – from auto pilot

Field # 11	Bit mapping.	Description
Bit	HEX	Alarm description for alarm field in $PESSA.
1	0001	Restart alarm. Upon power breaks, Watch-dog reset and severe software fail.
2	0002	Course Mode Failure
3	0004	Panel in control not communicating.
4	0008	Rudder response failure.
5	0010	Nav. Comp. cancelled a remote mode, while in operation. Stops transm. "R".
6	0020	
7	0040	Nav. Comp. failed to respond to a remote mode request. Fail. to transm. "R".
8	0080	Parameter part of Flash Prom has wrong checksum.
9	0100	ADC / DA or serial transmitter failure.
10	0200	Missing working gyro.
11	0400	Compass comparison alarm, or missing ref. gyro signal.
12	0800	Remote information missing. Specific fields missing or no transm. at all.
13	1000	Off course alarm or Off Heading alarm.
14	2000	Speed Failure.
15	4000	
16	8000	Idle process stopped execution. Processor overload.

Table 3-2: PESSA Alarm bitmask – from Autopilot

$PESSD to ECDIS:

Sentence $PESSD is transmitted min. 2 times pr sec from Autopilot									
Sentence:	$PESSD	,xxx	,D	,xx.x	,N	,xx.x	,N	,xx.x	,N
Field no.:	1	2	3	4	5	6	7	8	9
Sentence:	,A	,L	,G	,I	,C	,OOOO	,AAAA	,OOOO	*CS<cr><lf>
Field no.:	10	11	12	13	14	15	16	17	18

Field no.	**Field name**	**Field description.**
1	Address:	$PESSD: Proprietary Emri Steering System sentence D
2	RROT	Requested Rate Of Turn. Actual rate of turn setpoint value for the Autopilot controller. Local control variable or readback of Nav. Computer setpoint value.
3	RROT unit	D = Deg/minute. (Resolution: 1 deg/min)
4	RRAD	Requested Radius of turn. (Valid range: 0.10 - 9.99 NM) Radius of turn setpoint from panel in control in all local modes. In Nav. Computer modes: Nav. Computer requested radius of turn from panel in control. else readback of Nav. Computer RRAD setpoint
5	RRAD unit	**N** = Nautical Miles. (Resolution: 0.01 NM)
6	SMG	Speed Made Good. - Log speed or manual speed from control panel Note: If parameter ExtendedPessd = 2 ground speed is used instead.
7	SMG unit	**N** = Knots. (Resolution: 0.1 Knots)
8	SOG	Speed Over Ground. - Null field if no SOG is available from nav. comp. Note: If parameter ExtendedPessd = 2 water speed is used instead.
9	SOG unit	**N** = Knots. (Resolution: 0.1 Knots)
10	SSM	Ships Steering Mode: **A**=Auto, **H**=Not Auto
11	AOM	Autopilot Operating Mode: **L**=Local, **R**=Remote
12	ASM	Autopilot Steering Mode: **G**=Gyro, **A**=Rate, **R**=Radius
13	ACCM	Autopilot Course Change Mode: **I**=Immediate, **A**=Acknowledge

14	ACM	Autopilot Control Mode: **H**=Heading **C**=Course **T**=Track
15	OPTION I:	See application specific option bit mapping table below. 16 bits displayed in 4 ASCII characters representing the value in HEX code. Null field if no options.
16	ALARM:	Acknowledged alarms. Four hexadecimal digits representing a 16 bit word, where each bit corresponds to an alarm output. See application specific alarm bit mapping table. (Same as for $Pessa)
17	OPTION II:	See application specific option bit mapping table below. 16 bits displayed in 4 ASCII characters representing the value in HEX code. Null field if no options.
18	CS	Checksum.

Table 3-3: PESSD Message format - from Autopilot

Field # 15	Bit mapping for $PESSD OPTIONS I field from Autopilot	
Bit	**HEX**	**Description**
1	0001	Alarm reset pressed.
2	0002	Acknowledge Warning pushbutton pressed.
3	0004	State of Watch One Output
4	0008	Turn side flag PORT (bit = 1). Set when heading error > 10deg. PORT.
5	0010	Turn side flag STBD (bit = 1). Set when heading error > 10 deg. STBD.
6	0020	Execute push button pressed.
7	0040	
8	0080	Condition: LIGHT.
9	0100	Condition: MEDIUM.
10	0200	Condition: LOADED.
11	0400	Performance: ECONOMY.
12	0800	Performance: MEDIUM.
13	1000	Performance: PRECISE.
14	2000	
15	4000	Call Remote Ctrl pushbutton pressed.
16	8000	

Table 3-4: PESSD Option-I bitmask – from Autopilot

A push-button pressed signal will be transmitted in minimum 3 consecutive sentences (minimum 3 times)

The turn-side flags can be used by the ECDIS to define the turn direction for course/heading changes over 180 degrees.

Field # 17	Bit mapping for $PESSD OPTIONS II field from Autopilot	
Bit	**HEX**	**Description**
1	0001	Panel 0 in control. (Operation with no panel)
2	0002	Panel 1 in control.
3	0004	Panel 2 in control.
4	0008	Panel 3 in control.
5	0010	Panel 4 in control.
6	0020	Panel 5 in control.
7	0040	Panel 6 in control.
8	0080	Panel 7 in control.
9	0100	Autopilot READY.
10	0200	Manual speed selected.
11	0400	Rudder on limit. 1 = rudder order is limited.
12	0800	Flag RRAD too small. For future use to signal RAD set-point too small.
13	1000	Actual Gyro selection=0:ref.=Gyro[0]; if=1: ref.=Gyro[1]; under ctrl from autoswap Note: These fields are only valid if the Parameter ExtendedPessa=1
14	2000	User Gyro selection=0:ref.=Gyro[0]; if=1: ref.=Gyro[1]; ctrl from gyrosel input Note: These fields are only valid if the Parameter ExtendedPessa=1
15	4000	Ground Speed Source selection. Valid only when ExtendedPessd=1
16	8000	Water Speed Source selection. Valid only when ExtendedPessd=1

Table 3-5: PESSD Option-II bitmask – from Autopilot

NMEA Sentences from the ECDIS: are all of EMRI proprietary types, $PESSA, $PESSD, $PESSX

Sentence $PESSA is transmitted 2 times pr sec to Autopilot from ECDIS													
Sentence:	$PESSA	,xxx.x	,xxx.x	,xxx.x	,xx.x	,P	,xx.x	,P	xx.x	,P	,AAAA	,	*CS<cr><lf>
Field no.:	1	2	3	4	5	6	7	8	9	10	11	12	13

Field no.	**Field name**	**Field description.**
1	Address:	$PESSA: Proprietary Emri Steering System sentence A
3	CTS:	Autopilot Heading To Steer in degrees. Actual setpoint value for the Autopilot controller. Local Heading /radius control, immediate Heading change: Cts =Cts-display value. Local Heading /radius control, programmed Heading change: Cts = Currently used internal setpoint. Remote Nav. computer modes: Cts = Readback of remote ordered Cts.
13	CS:	Checksum.

Table 3-6: PESSA Message format - to Autopilot

Note: Fields 2 and 4 to 12 are all null fields.

Sentence $PESSD is transmitted minimum 2 times pr sec to Autopilot from ECDIS									
Sentence:	$PESSD	,XXX	,D	,X.XX	,N	,XX.X	,N	,XX.X	,N
Field no.:	1	2	3	4	5	6	7	8	9
Sentence:	,A	,L	,G	,I	,C	,OOOO	,AAAA	,OOOO	*CS<cr><lf>
Field no.:	10	11	12	13	14	15	16	17	18

Field no.	Field name	Field description.
1	Address:	$PESSD: Proprietary Emri Steering System sentence D
2	RROT	Requested Rate Of Turn. To be transmitted if ECDIS Rate mode is selected, else to be Null field.
3	RROT unit	D = Deg/minute. (Resolution: 1 deg/min). To be null field if 2 is empty.
4	RRAD	Requested Radius of turn. (Valid range: 0.10 - 9.99 NM) To be transmitted if the ECDIS Radius mode is setup, else to be a null field.
5	RRAD unit	N = Nautical Miles. (Resolution: 0.01 NM). To be null field if 4 is empty.
6	SMG	Speed Made Good. – to be a null field.
7	SMG unit	N = Knots. (Resolution: 0.1 Knots) – to be a null field.
8	SOG	Speed Over Ground. - Null field if no SOG is available from the ECDIS.
9	SOG unit	N = Knots. (Resolution: 0.1 Knots) - to be a null field if 8 is a null field
10	SSM	Ships Steering Mode: A=Auto H=Not Auto
11	AOM	Autopilot Operating Mode: L=Local R=Remote R always to be transmitted when under ECDIS control.

12	ASM	Autopilot Steering Mode: G=Gyro A=Rate R=Radius G or A or R always to be transmitted if under ECDIS control.
13	ACCM	Autopilot Course Change Mode: I=Immediate A=Acknowledge I or A always to be transmitted when under ECDIS control.
14	ACM	Autopilot Control Mode: H=Heading C=Course T=Track C, H or T always to be transmitted when under ECDIS control.
15	OPTION I:	See application specific option bit mapping table below. 16 bits displayed in 4 ASCII characters representing the value in HEX code. Null field if no options.
16	ALARM:	Acknowledged alarms. Four hexadecimal digits representing a 16 bit word, where each bit corresponds to an alarm output. See application specific alarm bit mapping table. (Same as for $Pessa)
17	OPTION II:	See application specific option bit mapping table below. 16 bits displayed in 4 ASCII characters representing the value in HEX code. Null field if no options.
18	CS	Checksum.

Table 3-7: PESSD Message format - to Autopilot

Bit assignment in $PESSD OPTIONS I field from Navigation Computer to Autopilot.		
OPTION I	**HEX**	**Description for option I field in $PESSD.**
1	0001	Alarm buzzer activate. Nav. Comp. announcement to navigator.
2	0002	Flash Acknowledge Warning .
3	0004	
4	0008	Turn Side Flag: 1=PORT.
5	0010	Turn Side Flag: 1=STBD.
6	0020	Flash start Heading/Course change.
7	0040	
8	0080	Condition: LIGHT select.
9	0100	Condition: MEDIUM select.
10	0200	Condition: LOADED select.
11	0400	Performance: ECONOMY select.
12	0800	Performance: MEDIUM select.
13	1000	Performance: PRECISE select.
14	2000	
15	4000	Go to Track lamp/ECDIS lmp ctrl
16	8000	

Table 3-8: PESSD Option-I bitmask - to Autopilot

Bit assignment in $PESSD OPTIONS II field from ECDIS to Autopilot.		
OPTION II	**HEX**	**Description for option II field in $PESSD.**
1	0001	
2	0002	
3	0004	
4	0008	
5	0010	
6	0020	
7	0040	
8	0080	
9	0100	
10	0200	
11	0400	
12	0800	
13	1000	Flag: Enable panel tiller for RRAD adj.
14	2000	Flag: Enable panel tiller for CTS adj.
15	4000	Turning flag (bit = 1). ECDIS has started a turn & throughout the turn.
16	8000	

Table 3-9: PESSD Option-II bitmask - to Autopilot

Sentence $PESSX to be transmitted 2 times pr sec to Autopilot									
Sentence:	$PESSX	,X.XX	,L	,XXX.X	,C	*CS<cr><lf>			
Field no.:	1	2	3	4	5	6			

Field no.	Field name	Field Description.
1	Address:	$PESSX: Proprietary Emri Steering System sentence X
2	XTE	Cross Track Error in meters.
3	L or R	L="steer Left"; R="steer Right"
4	HSC	Heading to steer command (in degrees, default leg course). -Leg Course when linear Track keeping by Autopilot. -Next Leg Course, when curved track-keeping by the Autopilot.
5	C	Optional field for resetting the track controller states. Reset C=1. Not Used.
6	CS	Checksum. Optional.

Table 3-10: PESSX Message format - to Autopilot

3.7.6 Serial Interface to the VDR/Alarm computer system

NMEA Sentences to the VDR are all EMRI proprietary types, $PESSA, $PESSD.

The VDR PESSA/PESSD message format from auto pilot, is identical to ECDIS PESSA/PESSD message format (see Table 3-1 & Table 3-3).

The parameter BamSerialInterface allows to enable BAM sentences to the VDR serial interface. However, it does not change the function for the BAM serial interface:

- BamSerialInterface = 0 disables BAM on VDR serial interface
- BamSerialInterface = 1 enables BAM on VDR serial interface

The BAM sentences are described in the next paragraph.

3.7.7 Serial Interface to the BAM Bridge Alert Management system

This Autopilot conforms to the standard IEC 62923 Bridge Alert Management system (BAM) and is enabled by default.

Serial interface 2 is as default configured to BAM.

$AGALF sentence for transmitting "Alert sentence" to Alert system, BAM:

Manufacturer Mnemonic Code = EMR

Sentence $AGALF is transmitted from Autopilot to report status and alerts															
Sentence	$AGALF	,x	,x	,x	,hhmmss.ss	,a	,a	,a	,aaa	,x.x	,x.x	,x.x	,x	,c….c	*CS<CR><LF>
Field #	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

FieldNo	**Description**
Field # 1	Talker ID and Sentence Formatter: Alert condition and Alert state Note: TalkerId=AG is configurable using: AlfTalker configuration parameter.
Field # 2	Total number of sentences for this message (1 or 2)
Field # 3	Sentence number in message. Order of sentence in the message.
Field # 4	Sequential message identifier. Same number for sentences in same message
Field # 5	Time field = Null Field
Field # 6	Alert Category: A, B or C: A: Alert response to be carried out at specific alert related equip, e.q. B: Alert response to be carried out based on alert information C: Alert for information only, cannot be handled on bridge
Field # 7	Alert Priority: E, A, W or C: E: Emergency Alarm A: Alarm. W: Warning C: Caution
Field # 8	Alert State: V, S, A, O, U or N V: Alert active, Un-acknowledged.

	S: Alert active, Silenced A: Alert active, Acknowledged or Active. O: Alert active, Responsibility transferred. U: Rectified, Un-acknowledged N: Normal state.
Field # 9	Manufacturer Mnemonic Code. Always EMR
Field # 10	Alert Identifier. See Identifier numbers in alert table
Field # 11	Alert Instance [1:999999]. Always Null field
Field # 12	Revision counter. [1:99]. Changed one increment each Alert change. Wrap around at 99.
Field # 13	Escalation Counter. [1:9]
Field # 14	Alert Text See Alarm Table
Field # 15	Check sum. Followed by Car Return Line Feed.

$AGALC sentence for transmission of "Cyclic alert list" to Alert system, BAM:

Manufacturer Mnemonic Code = EMR

Sentence $AGALC is transmitted from Autopilot to send cyclic Alert List										
Sentence	$AGALC	,xx	,xx	,xx	,x.x	,aaa	,x.x	,x.x	,x.x	*CS<CR><LF>
Field #	1	2	3	4	5	6	7	8	9	10

FieldNo	**Field Description**
Field # 1	Talker ID and Sentence Formatter: Cyclic Alert List Note: TalkerId=AG is configurable using: AlcTalker configuration parameter.
Field # 2	Total number of sentences for this message (1 to 99). This Number= Number of Alerts
Field # 3	Sentence number in message. Order of sentence in the message. (1 to 99)
Field # 4	Sequential message identifier. Same number for sentences in same message (00 to 99)

Field # 5	Number of Alert s in sentence. Here 0 or 1.
Field # 6	Manufacturer Mnemonic Code. Always EMR
Field # 7	Alert Identifier. See Identifier numbers in alert table
Field # 8	Alert Instance [1:999999]. Always Null field
Field # 9	Revision counter. [1:99]. Changed one increment each Alert change. Wrap around at 99.
Field # 10	Check sum. Followed by Car Return Line Feed.

Note: Transmitted minimum every 30 sec, or on request by $xxACN

Only one alert is transmitted pr sentence.

$AGARC sentence for transmission of "Alert command Refuse" to Alert system, BAM:

Manufacturer Mnemonic Code = EMR

Sentence $AGARC									
Sentence:	$AGARC	,hhmmss.ss	,aaa	,x.x	,x.x	,c—c	*CS<cr><lf>		
Field no.:	1	2	3	4	5	6	7		

Field no.	**Field name**	**Field description.**
1	Address:	$AGARC: Alert Command Refuse. Note: TalkerId=AG is configurable using: ArcTalker configuration parameter.
2	hhmmss.ss	Release time for the Alert Command Refuse. Or a Null field
3	aaa	Manufacturer Mnemonic Code. Null Field
4	x.x	Alert Identifier. See Identifier numbers in alert table
5	x.x	Alert instance
6	C	Refused Alert command, A (Ackn.), Q (Req. repeat info), O (Resp. transfer) or S (Silence)
7	CS	Check sum. Followed by Car Return Line Feed.

Only used for refusing Ackn and Alerts of category A

$AGALR sentence for transmission of "Set alarm state" to and from Alert system, BAM:

Sentence $AGALR to be transmitted from Autopilot. Default every 30 sec.									
Sentence:	$AGALR	,hhmmss.ss	,XXX	,A	,A	,c—c	*CS<cr><lf>		
Field no.:	1	2	3	4	5	6	7		

Field no.	**Field name**	**Field description.**
1	Address:	$AGALR: Alarm sentence. Note: TalkerId=AG is configurable using: AlrTalker configuration parameter.
2	hhmmss.ss	Time of alarm condition change, UTC. Null field.
3	XXX	Autopilot alarm number, 1 — 16
4	A	Alarm Condition. (A=threshold exceeded, V=not exceeded)
5	A	Alarm Acknowledge State, A=Acknowledged, V=Unacknowledged
6	c—c	Alarm text, See table below.
7	CS	Checksum. Optional.

$AGHBT sentence for transmission of "Heartbeat supervision" to and from Alert system, BAM:

Sentence $AGHBT Heartbeat supervision transmitted from Autopilot. Default every 30 sec.									
Sentence	$AGHBT	,x.x	,a	,x	*CS<CR><LF>				
Field #	1	2	3	4	5				

FieldNo	**Field Description**
Field # 1	Talker ID and Sentence Formatter: Autopilot Heartbeat.
Field # 2	Configured repeat interval. Default set to 30 sec. Repeat interval in seconds
Field # 3	Equipment status, equipment in Normal status: Y=yes; V=No.
Field # 4	Sequential sentence identifier. 0 to 9 increasing for each sentence. Wrap around 9 to 0
Field # 5	Check sum. Followed by Car Return Line Feed.

3.7.8 BNWAS Event interface sentence $AGEVE

These sentences are transmitted to serial port defined to be used for BNWAS communication.

$ AGEVE sentence for transmission of "General event" to BNWAS

Sentence $HCEVE is transmitted minimum 1 times pr sec from Autopilot					
Sentence:	$AGEVE	,hhmmss.ss	,c--c	,c--c	*CS<cr><lf>
Field no.:	1	2	3	4	5

Field no.	**Field name**	**Field description.**
1	Address:	$AGEVE: Event Sentence Note: TalkerId=AG is configurable using: EveTalker configuration parameter.
2	hhmmss.ss	Empty field. No real time clock in AEU
3	c--c	Source of event
4	c--c	Event description.
5	CS	Checksum.
Event List	**Event Source**	**Event**
	BNWAS	Operator Activity

$AGHBT sentence for transmission of "Heartbeat supervision" to BNWAS

Sentence $AGHBT Heartbeat supervision transmitted from Autopilot default set to 30 sec.									
Sentence	$AGHBT	,x.x	,a	,x	*CS<CR><LF>				
Field #	1	2	3	4	5				

FieldNo	**Field Description**
Field # 1	Talker ID and Sentence Formatter: Autopilot Heartbeat. Note: TalkerId=AG is configurable using: HbtTalker configuration parameter.
Field # 2	Configured repeat interval. Repeat interval in seconds
Field # 3	Equipment status, equipment in Normal status: Y=yes; V=No.

Field # 4	Sequential sentence identifier. 0 to 9 increasing for each sentence. Wrap around 9 to 0
Field # 5	Check sum. Followed by Car Return Line Feed.

3.7.9 Serial Interface to for dimming control

Dimming can be controlled from any panel or remotely. If the dimming settings are altered on one panel it will be distributed to other panels connected to the AME.

If the NmeaDimmingPort parameter is configured to a valid serial interface, i.e., 1 to 5, this port will be included in the dimming control by use of the NMEA sentence DDC.

Therefore, if a valid DDC sentence is received on the "NmeaDimmingPort" the dimming settings on all connected panels are altered to match the settings of the DDC sentence. Likewise any change of the dimming on either panel will be distributed to any other panels (if any) connected to the AEU611, and a DDC sentence will be transmitted on the "NmeaDimmingPort".

$DDC sentence for transmission and reception of "Display Dimming Control"

Sentence $DDC Heartbeat supervision transmitted from Autopilot default set to 30 sec.							
Sentence	$DDC	,a	,xx	,a	,a	*CS<CR><LF>	
Field #	1	2	3	4	5	6	

FieldNo	Field Description
Field # 1	Talker ID and Sentence Formatter: Display Dimming Control.
Field # 2	Display Dimming Present (Not used)
Field # 3	Brightness percentage: 00 to 99
Field # 4	Colour palette: • D: Day • K: Dusk • N: Night Other palettes will be ignored.
Field # 5	Sentence status flag (Ignored for reception) • R: Sentence is a status report of current settings

	• C: Sentence is a configuration command to change settings. (Used for transmission)
Field # 6	Check sum. Followed by Car Return Line Feed.

To adjust the dimming level to the remote system the parameters DimmingGain (floating point number) and DimmingOffset (in percent, integer number) can be altered.

3.8 System Parameter Setup

There are multiple ways to alter parameters in SEM300/FAP-3000.

- Use the SEM300Manager Tool. See section 6.
  - Using the "Quick Setup Parameters" window for the most commonly used parameters.
  - Using the "Parameter editor" for all parameters in alphabetic order.
  - The terminal window. Syntax: "set <ParamName> = <ParamValue>"
- If a serial channel is configured to DEBUG, a RS-422 adapter can be used with a terminal emulation. Syntax: "set <ParamName> = <ParamValue>"
- Primary parameters can be altered by using the Control panel display. See section 7.2.

Commonly used Parameters:

Parameter	Index	Description	Units	Setup Values		
				Default	Initial	Final
Ships Basic Parameters						
sleng		Ships length. lpp.	m	100	185	
u_norm		Max. cruising speed.	kn	16	14.500	
PMinRadius		Minimum turning radius in radius mode	NM	0.3	0.300	
manph		Manual permanent helm.	deg.	0	0.000	
Rrudabs		Auto rudder limit at maximum speed. (RADIUS MODE)	deg.	15	15.000	
Grudabs		Auto rudder limit at maximum speed. (GYRO MODE)	deg.	10	10.000	
Mrudabs		Auto CRlimit at maximum speed.	deg.	20	20.000	
LargeCRLimEnable		1 => Enable		0	0	
POnLimitTime		Rudder On Limit Alarm time out	sec.	30	30.000	
NumOfRudders		Number of rudders		1	1	
NumOfFeedbacks		Number of Feedbacks		0	0	
OverrideRudderLimit		Dominant rudder limit value, symmetrical to P and S	deg.	30	30.000	
RudderSupervision				0	2	
Serial Channels						
SerialChannelUse	0	Serial channel use. 1=ECDIS, 2=VDR, 3=MIP2, 4=DEBUG, 5=NMEA, 6=VMS, 7=WECDIS,		1	1	
	1			8	8	
	2			5	5	
	3			5	5	
	4			5	5	

Parameter	Index	Description	Units	Setup Values		
				Default	Initial	Final
	5	8=BAM, 9=BNWAS		5	5	
baudrate	0	Baud rate for serial channel	baud	4800	4800	
	1		baud	4800	4800	
	2		baud	4800	4800	
	3		baud	4800	4800	
	4		baud	4800	4800	
	5		baud	4800	4800	
BamSerialInterface		BAM messages transmitted on VDR serial interface 0 : disabled 1 : enabled		1	1	
ExtendedPessa		1=Add 2 gyro fields to PESSA at the end.		0	0	
ExtendedPessd		1=Add gyro state flags in PESSD.		0	0	
RequireEcdis		0=No ECDIS required. 1=ECDIS required all time. 2=Required after use		2	2	
LostEcdisAlertTimeout		0=No timeout >0=Timeout for lost ECDIS alert	Sec.	0	0	
Other Autopilot Parameters (Non Default Values)						
HdtTimeoutLimit		Time out for incoming HDT message	sec.	1.5	5.000	
Gyro Selection						
GyroErrorLimit		Error limit on gyro input.	deg.	10.0	10.000	
NumOfGyro		Number of gyro input used.		2	2	
GyroType	0	Type of gyro used.		1	1	

Parameter	Index	Description	Units	Setup Values		
				Default	Initial	Final
	1	Index is gyro number. (HDT=1, STX=2, HDM=3, HDG=4, THS=5)		1	4	
GyroNmeaCh	0	Assignment of serial channels to gyro interface. Index is gyro number.		3	3	
	1			4	4	
offCAlim		Offcourse alarm limit.	deg.	10	10.000	
OffCourseRef		1 => Off course alarm ref. is secondary gyro. 0 => Off course alarm ref. is primary gyro.		1	1	
offCAhyst		Off course alarm hysteresis	deg.	5	5.000	
offCAinTrack		0=Off course alarm cut-off in Track mode. 1=Off course alarm active in Track mode		0	0	
GyroDiffDilution		Fade time one to the other under gyro ch.o	deg/sec	0.016667	0.017	
Course Source Selection						
NumOfCourseSources		Number of course inputs used.		1	1	
CourseSource	0	Type of NMEA sentence used. (VTG=2)		2	2	
	1			2	2	
CourseNmeaCh	0	Assignment of serial channels to course interface.		5	5	
	1			6	6	
Log Selection						
NumOfSpeedSources		= 1 if only main speed source, 2 if also backup speed source		2	2	
SpeedSource	0	Selected type of Autopilot		3	2	

Parameter	Index	Description	Units	Setup Values		
				Default	Initial	Final
	1	speed to be used. PULSLOG=0, NMEA_VBW=1, NMEA_VTG =2, NMEA_PESSD=3. NMEA_VHW=4		2	1	
LogNmeaCh	0	Serial channel to use if Speed source is 1-5.		1	5	
	1			3	6	
u_relMin		Speed warn level low		0.2	0.200	
u_relMax		Speed warn level high		1.2	1.200	
RadiusSpeedWarn		= 0 No special warning, 1 Flash speed warn and restart buzzer each 2 min. if no speed or man. speed in Radius or Track.		1	1	
Autopilot Controller Parameters						
fKrstop		Rate stop distance.	1/sec	0.0625	0.063	
fKbta		Drift angle comp.	sec.	0	0.000	
girod		Regulator I reset on delay.	sec.	0	0	
frgilm		Regulator I absolute limit.	n/a	10	10.000	
frgirw		Regulator I reset window (+/-).	deg	10	10.000	
asymli		Symmetrical limit for I - addition on rudder value.	deg.	5	5.000	
fKtih		Autopilot sample rates hold time after entrance of rate stop band. [sec]	sec	10.0	10.000	
fKirw		Autopilot integr. reset window (only in rate and gtrack)	deg.	15	15.000	

Parameter	Index	Description	Units	Setup Values		
				Default	Initial	Final
Bang-Bang Servo Parameters						
BangMode		Bang-bang servo operation mode. 0=OFF, (PORT rudder order is used as OK dig. out). 1=TRADITIONAL and 2=ADVANCED		0	0	
PTwoPumpLimit		If rudder speed is higher than this the servo assumes two pumps running. The digital input TWOPUMPS is used if this parameter is zero.	0.01 deg/s.	700	700	
PLeakLimit		If rudder moves faster than this limit with both valves closed, then a "Hydraulic leak" alarm is given.	0.01 deg/s.	100	100	
PBangDead		In Traditional mode: PBangDead is the dead band. In Advanced mode: PBangDead is the maximum allowed error.	0.01 deg.	70	70	
PMinSpeedLim		If rudder moves slower than this limit with a valve open, then an "Unmovable rudder" alarm is given.	0.01 deg/s.	100	100	
RudderFeedbackScale	0	Rudder feedback scale	Volts/deg.	0.25	0.250	
	1		Volts/deg.	0.25	0.250	
	2		Volts/deg.	0.25	0.250	

Parameter	Index	Description	Units	Setup Values		
				Default	Initial	Final
WheelOrderScale		Wheel input scale	Volts/deg.	0.25	0.250	
PHuntingElim		1=> prevents the hunting elimination routine in increasing the dead band.		1	1	
EnableServoAlarms		Bang-bang servo alarms: 0=OFF, 1=ON		0	0	
Track Controller Parameters						
e2Kp		Track reg. proportional gain (=e2kp x gain-damp-inp). fKp=0.5 x e2Kp, if no extern gain switch	deg./m	0.5	0.203	
e2Klci		Track regulator integral gain. fKlci=0.5 x e2Klci, if no extern gain switch	deg./m*sec.	0.003	0.001	
e2Kdamp		Tr. contr. kalm. filt. split freq. (=e2kdamp x gain-damp-inp)	sec	0.3	0.300	
firw		Track regulator integrator reset limits.	NM	0.05	0.050	
fiondly		Track regulator integrator on delay.	sec	64	64.000	
Miscellaneous						
ctsdef		1 => cts=gyro when leaving remote (Steady as she goes). 0 => cts=hsc when leaving remote (continue turn).		1	1	

Parameter	Index	Description	Units	Setup Values		
				Default	Initial	Final
		2 => cts=hsc when leaving remote in a turn. and cts=gyro when leaving remote on linear part. (for Progr Track use.)				
seldef		1 =>Display hsc as CTS, during turns, in remote gyro track mode. 0 => Display rcts as CTS.		1	1	
lindef		0 (and seldef=1) ==> Display hsc in CTS, also when not turning.		1	1	
lrotdf		Default Rate Of Turn	deg/min	600	600	
lraddf		Default Radius	NM	0.3	0.100	
RudderOrderScale	0	Rudder order output scaling.	Volts/deg.	0.25	0.250	
	1		Volts/deg.	0.25	0.250	
	2		Volts/deg.	0.25	0.250	
PExtAlReset		1 => External alarm reset enabled. 0 => Extern reset of panel buzzer alone.		1	1	
PLowGainEnable		1 => Enables DI (TS4/29) for modified gain select. 0 => No DI for selection of modified gain.		0	0	
PLowGainModifier		PD-Gain modification factor.		0.5	0.500	

Parameter	Index	Description	Units	Setup Values		
				Default	Initial	Final
PDigRemReq		1 => Enables DI (2) ,X4/26, for remote select. 0 => No DI (2) for selection of wheel mode.		0	0	
DefaultRadius		1 => Default Radius when dig inp. In Control is on, or dig inp. Remote goes off. 0 => Def Heading Contr. Mode.		1	1	
FreezeRudder		1=Freeze rudder in case of Gyro fail. 0=Freeze heading error in case of gyro fail.		0	0	
PessdTimeoutLimit				3	5.000	
WarningEscalationTime		Alert escalation time for warnings	sec	60	60	
AlarmEscalationTime		Alert escalation time for alarms	sec	30	30	
AlcTransmissionTime		Transmission interval for ALC messages	sec	30	30	
HbtTransmissionTime		Transmission interval for HBT messages.	sec	30	30	

The parameters can be changed in various ways:

- By SEM300Manager. See section 6.10
- By the MIP panel. See section 7.2

3.9 System Software Update. AEU, MIP

Software update of the AEU611 unit:

See Section 6, SW TOOLS.

Software update of the MIP panel:

See Section 6, SW TOOLS.

3.10 Autopilot Standby operation. (Hot Standby function)

The Hot Standby principle is based on an extra AEU able to take over the control in case of loss of the active controller.

This can either be implemented with one extra AEU611 or by arranging a hot standby interface between two complete Autopilots.

An extra box is included for taking care of the relay change over between the two. Unit model: ACO.

Two parameters are added to enable the Hot Standby Function:

HotStanby =1 to be “set” in the standby unit.

HasHotStandby =1 to be “set” the controlling unit

Both parameters will typically be set equal to one in both AEU units in a dual Autopilot.

The selected Autopilot will display Has Hot Standby when in control.

The standby Autopilot (in dual Autopilot installations) will display Hot Standby.

Basic principle:

1. One unit selected as Autopilot controller, one unit selected as Stand by unit.
2. The Autopilot controller is put into operation reading a closing In Control Contact.
3. The standby unit get in a closing contact on Aux. Dig. IN 1. Term X3/1 and X3/2. Closed brings the unit in standby mode.
4. The rudder (azimuth) orders are routed through the closing contact of the changeover relay as long as the “Alive” output contact from the AEU611 is closed.
5. The standby AEU gets states updated from the AEU in charge over Can-bus ready to cut in if necessary.
6. The standby unit is cut in, if a failure makes the “Alive” contact in the controlling AEU go open. If can-bus communication stops cannot alone cut in the standby function.
7. The aux. digital output on terminals X9/7 and X9/8 now activates K3 in the ACO11 box to cut off the possibility to return to the original AEU. This state is memorized until the original selected Autopilot mode is released.
8. Select the standby AEU as master Autopilot (in a dual Autopilot installation) or switch to hand control to disable the Standby mode.

3.11 Calculation and display of external added rudder/(azimuth) toe angle

Dealing with dual rudder/azimuth steering devices only.

The steering devices can be offset from the MIP control panel menu.

Or instrumentation outside the Autopilot can add offset to order angles to the rudders for optimization of propulsion, toeing rudders in or out.

The sign convention used here:

Toe-angle = Stbd_Rudder_Angle – Port_Rudder_Angle.

Toe angle value is positive if rudders are moved towards each other. Each rudder is offset by half the toe-angle value.

The parameter:

ExternalToeAngle=0, Toe angle is set on the MIP panel.

ExternalToeAngle=1, Toe angle is induced outside the Autopilot.

The Toe-angle information can also be entered in a NMEA sentence

Set ToeAngleNmeaCh=x where x is the port number.

This will exclude the possibility to set a Toe Angle from the MIP panel.

The ABB sentences $PAADO,A is received, and the $PAADO,B is transmitted as readback.

External Toe angle is measured if the actual devices angles are read back to the AEU611.

The Toe Angle value is displayed on the MIP panel. The displayed value is filtered (Time constant typically =10s but can be adjusted by changing the Parameter: ExternalToeAngleFilterTau).

The Toe Angle display disappears if the value is zero.

The Parameter: RudderSupervision = 2 will enable supervision of obtained actual angles corresponds to the given orders.

The Toeangle calculation is used for modification of the orders to avoid false supervision alarms.

Rudder Ready digital inputs can be enabled (Parameter: UseReady=1)

The calculation is then disabled if only one rudder is ready.

3.12 Soft transition to TRC mode

The transition to track control can cause some rudder transients.

These are activated when the track heading is entered ordering a rapid heading change.

Also the introduction of an off-track value will cause rudder activity.

The following parameters are supported to ease off these transients.

- lcor_ramp in deg/tau (default: 6deg/tau)
- Trackattackramp in deg/tau (default: 6deg/tau).
- Trackattackwindow in seconds (default: zero and then not active)

The parameters are scaled in Tau (approx. Speed/length) and therefore supposed to be invariant.

3.13 Select calculation of antenna positions to improve Course mode

The VTG signal is received from GPS antennas on the vessel.

The direction of the VTG vector is used to give the stationary part of the course signal in course mode.

The VTG signal will contain a destabilizing part if it is related to the aft end of the vessel.

The antenna positions on the real vessel are entered as parameters

GPSlocation. Measured in parts of the ship length measured from the bow.

(If in the center of gravity then approximately 0.5)

The GPS antenna position is then fictively repositioned to a point further near to the bow.

Set parameter GPScalc also measured as part of the ship length (Default set to 0.1)

3.14 Configuration of aux. Arm Rest Panel(s), ARP.

3.14.1 System overview

The ARP panel(s) uses the MIP panel(s) display to show the relevant operator values such as:

- Operation mode.
- Set/next heading.
- Set/next radius.
- Gyro heading.
- Estimated rate of turn.

3.14.2 Mode selection

The ARP panel(s) can only be selected as “Free Select” panels,

Meaning that the Autopilot is put into control by connecting X4/3 – X4/4.

The MIP panel on the main control position will be selected when X4/1 – X4/2 are used as Autopilot in control input.

3.14.3 Power supply and enclosure

The ARP panel(s) are installed directly to the AEU611 filtered power supply and CAN bus terminals:

- 24VDC from secondary side of the line filter inside the AEU611. 24VDC +30%/-25%.
- Current consumption of one ARP is max 0.25A
- Enclosure IP2X

If ARP panel(s) are installed using junction boxes:

- JBXARP-1: Direct feedthrough of filtered power and CAN signal from AEU611.
- JBXARP-2: Power from a switchboard is led through a line filter in the junction box.

3.14.4 CAN

Max 2 MIP panels and 2 ARP panels can be powered from the AEU. Extra panels should be powered from external 24VDC supply fed through a junction box with E3Q1 line filter.

The CAN network bus must be terminated at each end of the network. Termination can be activated on all ARP panel(s) and all MIP panel(s).

The termination resistor is accessible from the rear side. An indication LED is ON when terminated.

The main panel CAN bus termination resistor found in the AEU611 must be set ON in the DIP-switch setting (SW4) if only one panel is connected to P1.

The auxiliary panel(s) CAN bus termination resistor found in the AEU611 must be set OFF in the DIP-switch setting (SW5) if more than one AUX panel is connected. If only one AUX panel is connected either on P2 or on the AUX CANBUS port, the termination resistor must be set to on.

The ARP panels are defined (named) by the software automatically and will be listed in the SEM300Manager tool under AME diagnostics, Panels.

Using a terminal window from the SEM300Manager tool the serial number of the processor board inside the ARP can be accessed by typing: “view serial” ENTER.

See Appendix – Generic Installation of SEM300 / FAP-3000

3.15 Special Functions

3.15.1 External Heading Control

The External Heading Control is a special feature mode where AutoPilot is used in conjunction with an external device (e.g. JS-DP) which can control heading of the ship. In this mode the AutoPilot reports the heading error to an external device, and AutoPilot will disable its own control of the ship. The heading error is calculated by AutoPilot as usual based on the heading set-point, set by operator on MIP/ARP panel, and the heading sensor input to the AutoPilot.

The feature is enabled using the following configuration parameters:

Parameter	Description
ExtHeadingErrorOut	Enable/Disable the Output of the heading error from the AutoPilot. 0: Disabled 1: Enabled Default: 0 (Disabled – No Heading Error Output) When enabled, the heading error is reported on an analogue output port: Output Port: X7-1/2 (AO1) Output Value: [-10..+10V] with 0.25 V/degree Example: Heading Error = -15 degree, then output=3.75V
ExtHeadingCtrlEnabled	Enable/Disable the External Heading Control mode 0: Disabled 1: Enabled Default: 0 (Disabled – External heading Control mode cannot be activated) When enabled, the external heading control mode can be activated using a digital input port: Input Port: X3-15/16 (Two pump) Input Value: Low, 0V or Tri-state pull down (Off – Not in external heading control mode). High, 10V (On – In External heading control mode).

When external heading control mode is active the AutoPilot will:

- Disable AutoPilot rudder output
- Reset AutPolit heading controller
- Restrict AutoPilot to Heading/Rudder Limit mode. All other modes (course, radius) cannot be entered
- OffHeading alert from AutoPilot is suppressed

4 Autopilot Maintenance

4.1 Maintenance

No parts of the SEM300/FAP-3000 Autopilot system requires regular maintenance:

- Keep surfaces of control panels clean from dust and moisture.
- Keep box covers closed to keep the inside dry and clean.

4.2 Servicing

On board servicing is recommended down to the level of modules listed in EMRI's parts lists (see *Appendix – Spare Parts* on page 168).

Repair onboard on components level should be limited to emergency cases, as no proper quality assurance facilities are at hand.

It must not be expected that local servicing agents store spare modules.

EMRI use Courier Parcel Service for urgent spare parts delivery.

Please send an E-mail with the type number of the required item to: sales@emri.dk or service@emri.dk

Or consult us by phone: (+45 44 91 82 04).

4.3 Trouble shooting and repair

Necessary tools:

1 screwdriver with a set of Torx-bits and a set of Allen key bits.

1 screwdriver, 3 mm for terminal.

1 or 2 digital voltmeters/multimeters.

The manuals of the system.

4.3.1 Troubleshooting

4.3.1.1 Autopilot item check list

1. The AEU611 Autopilot electronic Unit.
2. The MIP2xx control panels.
3. The ARP11 arm rest control panels
4. The cable connection between AEU and MIP panels.
5. The mode selector system outside the Autopilot system
6. The Interface to the steering gear servo(s).
7. The 24VDC switch board connections.

4.3.1.2 Troubleshooting checklist

- Start all troubleshooting by making a visual inspection of the items listed in the check list.
- Check power 24VDC power supply in AEU terminals.
- Check power supply on AME11 board inside the AEU unit. At following pin headers:
- W2: -15/+15V – W9:+3V3 – W4:+24V – W5:+24V – W6:+5V – W1:+5V
- All located near the canned PSU's on left side of the AME
- Check rudder order output from AME11, 0.25V/deg. neg/sb.
- Refer to section 2 and 0 for information of displayed alarms.
- Green LED "DO15/IDLE" (near center on the AME11) shall be flashing in normal cond.
- Green LED "DO13" (near center on the AME11) shall be flashing on active communication to panels.
- Green LED "TX", "LINK" and "RX" (near Ethernet connector), indicated active Ethernet if used.

4.3.2 Repair

All lamps are of LED type and cannot be replaced.

4.3.3 Replacement of modules

Switch off power before replacing any module. Both 24V alarm supply and main supply.

Check that the pin jumper set-up on the replacement module is equivalent to the set-up on the module to be replaced.

Do not make any other adjustments on spares before installation.

The AME board in the AEU holds the selected parameter setup. In case of a replacement the new board must be updated with the ship's specific parameters.

Upload the parameters from AME to PC using SEM300Manager before switching off the AME11 module.

Reload the parameter from PC to replacement module using SEM300 Manager.

After repair:

- Make a careful check of the Autopilot functions.
- Perform, as a minimum, the presailing check (see section 2.13), and the relevant parts of the dock-side tests.

5 Autopilot System Installation

5.1 Location of items

Operator panel(s) should be placed easily accessible to the operator.

The MIP panel should be positioned so the line of sight from the operator's normal position to the display unit is perpendicular to the display surface in order to obtain the best possible reading of display values and status.

The ARP panel should be positioned so the MIP display is easily seen from the operator's chair. The ARP panel should also be installed with the best possible ergonomics with respect to the operator's arm.

The possibility of direct sun radiation on the MIP display should be avoided as far as practically possible, as the readability of the display in such a case will be reduced.

The Autopilot Electronic Unit should be placed with sufficient surrounding free space to allow removal of box door/lid and to allow access for servicing and adjustments of the electronics inside these units.

Furthermore, there should be left enough space below the box for cable entrance and panel plug connection.

The installation of panel cable(s) should be arranged with a loop at the panel end for service purposes.

5.1.1 Compass safe distance

To avoid influence on the compass' on board. The units must be installed at a minimum distance to this. According to the table below.

Unit	Distance
AEU611	70cm
ARP11	20cm
MIP	90cm
Autopilot Mini Display	50cm

5.2 Cable installation

Select cable type according to specification on the specific installation drawings, which states the requirements needed for correct function of the equipment.

It is the yards responsibility to choose a cable that can be approved by the classification society and the ship's flag national register.

Note that all cables are to be screened or shielded.

Note also that the cable screens must be connected to BOX-GND in both ends of the cables.

All units where 48VAC and above is entered must be connected to HULL-Ground with a 2.5 square mm core.

Separation of Signals. Electronic signals often are in the millivolt range, whereas noise spikes on power lines often are in the kilovolt range.

To avoid harmful disturbances from capacitive or inductive cross coupled noise, the following rule must be followed:

Do not lay the cores of power cables in the same harness as cores of signal cables.

This rule applies for the yard electrician work at all EMRI terminal strips, as well for internal terminals in boxes as for external console terminal strips.

Note: Remember to set the correct CAN Bus terminators on the AEU, MIP and ARP panel(s) according to section 3.5 and section 3.14.4.

In specific cases the JBXMIP-2 junction boxes can be used between the AEU611 and MIP211. In these cases, P1-P2 ports in AEU611 are not used. Use the specific project cable plan and associated terminal list if provided.

5.3 Installations for Track/Route steering (TCS)

The IEC 62065 standard for track control requires facilities for freezing the rudder position in case of loss of Autopilot control.

Three different scenarios are listed below:

1. The Autopilot is connected to a steering control system able to select the NFU mode based on a single contact input opening in case of loss of Autopilot control.

   The steering system then selects NFU control in the following situation:

   (AUTOPILOT MODE selected) & (AUTOPILOT CONTROL LOST).

2. The Autopilot is using the build in Bang-Bang Rudder servo.

   (Only for use in single rudder systems and when retrofitting the Autopilot).

   This requires a feedback potmeter as servo feedback and one independent feedback for comparison as reference.

   The rudder will then be frozen in case of a feedback-failure.

   The output solenoid drive will not be active in case of loss of control, thus freezing the actual rudder position.

3. The Autopilot is interfaced to steering control systems not able to switch to NFU based on an opening “Autopilot control lost contact.” Or the steering control system is of a design that will be drifting in a NFU mode.

   These cases call for an independently supplied rudder tracking equipment to be cut in on the rudder order signal in case of loss of Autopilot control.

   This feature is accomplished by the EMRI DTU11 module, able to hold two independent actual rudder angles (rudders frozen). A separate feedback unit is needed for each rudder.

5.4 Sea trial Adjustments

See section 7.4 covering commissioning and sea trial.

6 Autopilot Software Tools

6.1 Autopilot Setup

This is a description of the “SEM300Manager” software tool.

The program is used to configure new or sailing EMRI Autopilots, using the Ethernet port of the AME microprocessor board.

6.2 Introduction

The EMRI SEM300Manager program is used for configuration of the Autopilot.

Project information and parameters are stored in a project file. File extension *.eac.

The program communicates with the Autopilot through an Ethernet (UDP) connection.

6.3 System Requirements

The PC:

- A screen resolution preferably of 1024 x 768 or better.
- Running Windows 10 or 11.
- A Ethernet port (RJ45).

6.4 Get started (Establishing connection from PC to Autopilot)

6.4.1 Connection with Ethernet

1. Connect the PC and the AEU611 box with a standard RJ45 Ethernet cable though the port on the right side of the bottom of the AEU611 box.

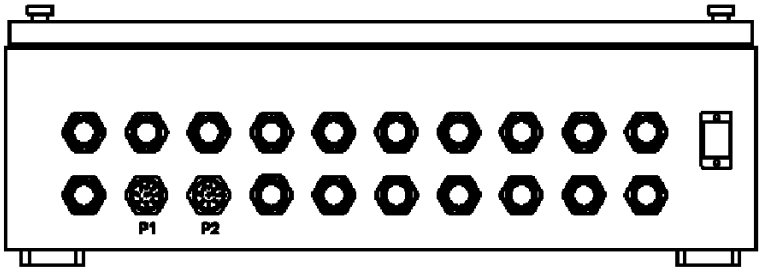


Figure 6-1: Bottom view of the AEU611 box.

2. Verify that link is established. The "Link" LED on the AME board should light steadily. and the "RX" and "SPEED/TX" LED's may be flashing from time to time.

3. The PC must have an IP address in the same range as the Autopilot has. In most cases, it is therefore necessary to set up the PC with a fixed IP address.

   From factory, the Autopilot is set up with an IP address in the 192.168.000.nnn range where nnn is usually replaced by the serial no. of the AME board + 100, but this may have been changed with the parameter IpAddress.

   If in doubt whether or not the IP address has been changed, the MIP panel or Autopilot IP can be seen briefly in the alarm field of the display, when the MIP panel or Autopilot network cable is connected.

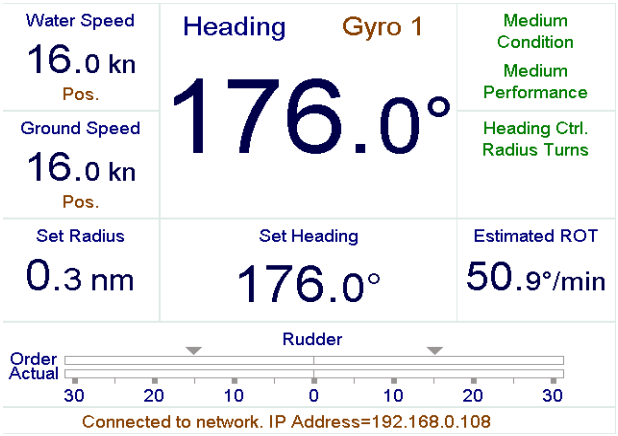


Figure 6-2: Autopilot screen displaying the IP address of the unit.

4) The SEM300Manager program must be set up to use UDP communication.

   Go to Options | Comm. Settings and select UDP.

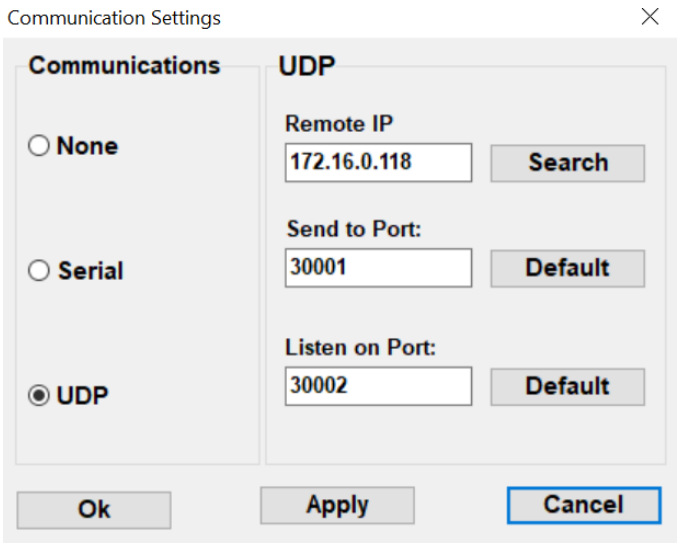


Figure 6-3: SEM300 manager UDP Communication Settings window

Enter the IP address of the Autopilot and the port numbers 30001 and 30002.

If the IP address of the AME board is not known, it is possible to make a network search. The local network is searched for connected EMRI devices, and responding devices are listed with board type, serial no. and actual IP address.

If the wanted device is listed, it can be selected by double-clicking.

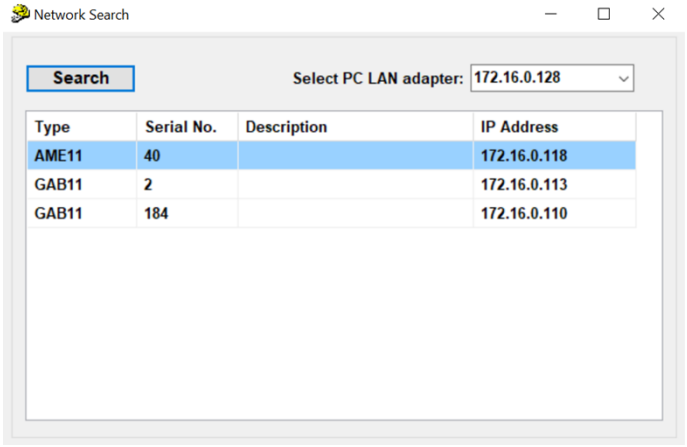


Figure 6-4: SEM300Manager network search window

6.4.2 Start using the SEM300Manager program

1. Open an existing project from the disk or use/edit the default empty project with default parameters.

2. To start communicating with the Autopilot, it is necessary to establish a connection first:

In the Autopilot menu, choose Connect to Autopilot.

Once connected, the functions “Get”, “Send” and “Compare Parameters” are enabled.

The project file, eac file, contains all relevant information about the project, such as vessel name (Yard and new building number), serial numbers and of course the Autopilots parameters. The tabs give an easy access to the information in the eac file.

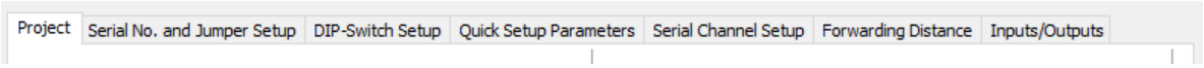


Figure 6-5: SEM300Manager tabs

The "Project" tab, "Serial No. and Jumper Setup" tab and "Dip-Switch Setup" tab contain the *project data*.

The "Quick Setup Parameters" tab and "Serial Channel Setup" tab contain the most commonly used *parameters*. All the *parameters* can be edited/viewed in the Autopilot editor.

The *parameters* are stored in both the project file and in the Autopilot.

It is very important to keep the Autopilot configuration documented and stored back home. On later service on the Autopilot, the current setup must be accessible. Also in case of defective hardware where it is not possible to retrieve the configuration, valuable time spent on adjusting the Autopilot will be lost – and you will have to start from scratch again.

When you are going on a commissioning or a service job, bring the latest version of the project from home. Also remember to document the configuration when you are finished, and store it back home.

To read about the commissioning procedure, please see the Autopilot manual section 7.3 and 7.4.

6.4.3 Setting up the Autopilot at commissioning or service

- To ensure that the start situation is documented, compare the parameters (menu: Autopilot – Compare) from the project that you have brought with you from home with the Autopilot. If the parameters differ, then get the parameters from the Autopilot, and save the project in a new file. Decide which of the parameter sets to continue working on.
- If you make changes, use the "Send and Compare" function to send the changes to the Autopilot.

Due to low communication speed, it is a long process to send all the parameters to the Autopilot. However, it is faster to receive parameters. A complete parameter set, including the switch settings, is first retrieved from the Autopilot, then compared with the setup in the PC, and only the parameters that differ are send to the Autopilot. To make sure nothing went wrong, a final comparison is also made.

- Save the project.

6.4.4 Service, e.g. change of a faulty AME11 microprocessor board

As mentioned above, remember to bring the project from home, especially if it is not possible to communicate with a faulty AME.

- Open the project which should be sent to the Autopilot.
- Revise the project information and update changes.
- Use the "Send and Compare" function.
- Save the project.

6.5 Functional description of SEM300Manager

The Autopilot project file (*.eac) contains two configuration versions; *initial and final project parameters.* When a project is saved, a report is automatically generated (*.xml).

The report shows the initial and final parameters in distinct columns, to make it easy to track changes.

When a new project is created, the *initial project parameters* are edited and saved. When an existing project has been opened, the *final project parameters* are edited and saved. The edit mode is indicated in the upper left corner of the window. If you have opened an existing project, and use "Save As", the project parameters will be saved as *initial project parameters*.

6.5.1 Main Window

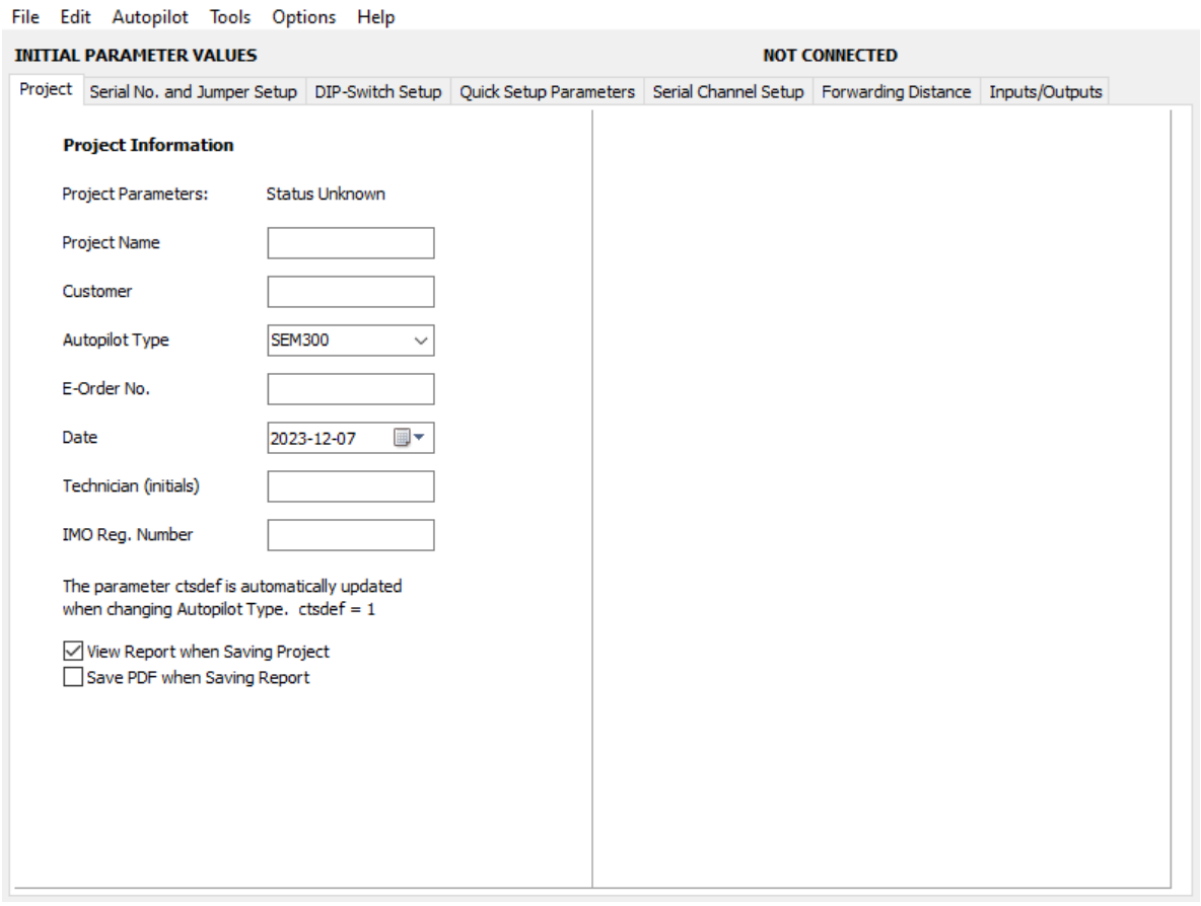


Figure 6-6: Main screen of the SEM300Manager

6.5.1.1 Project Tab

The status of Project Parameters reflects whether the setup is confirmed to match the Autopilot.

The Project Name is used (together with the AEU611 Serial No.) when generating the project file name.

When you change the Autopilot Type, the parameter “ctsdef” is automatically modified.

6.5.1.2 Serial No. and Jumper Setup Tab

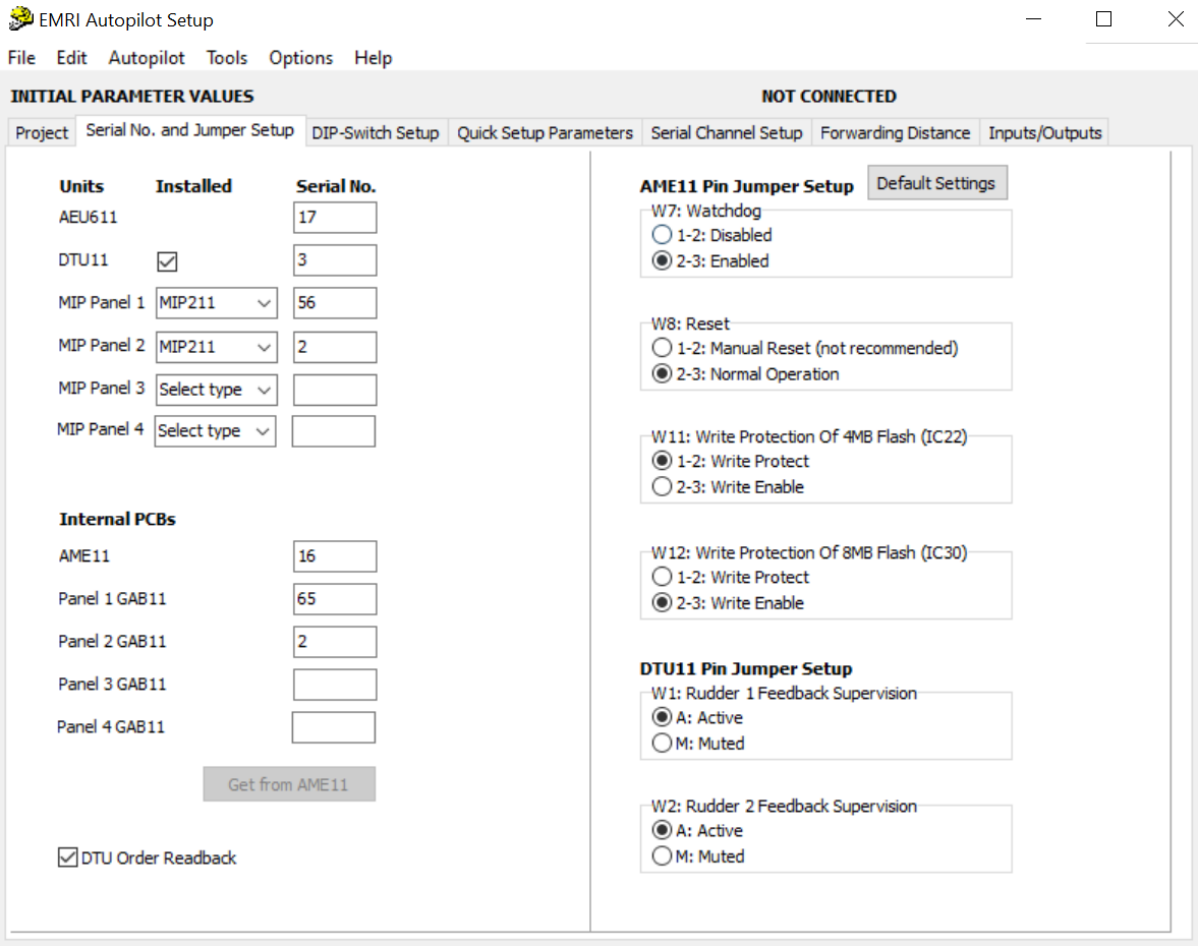


Figure 6-7: SEM300Manager Serial No. and Jumper setup tab

This tab contains the serial numbers of the installed modules in the Autopilot and the pin-jumper setup on the AME module.

The AEU611 Serial No. is used (together with the Project Name) when generating the project file name. This is to make it easier to identify a project with reference to the Autopilot serial number.

The MIP Panel Type & Serial No. are saved in the parameter file.

The Pin Jumper Setup can be set manually or set to default values using the default settings button. If the settings are not defined, this will be indicated with a red text warning.

6.5.1.3 DIP-Switch Setup Tab

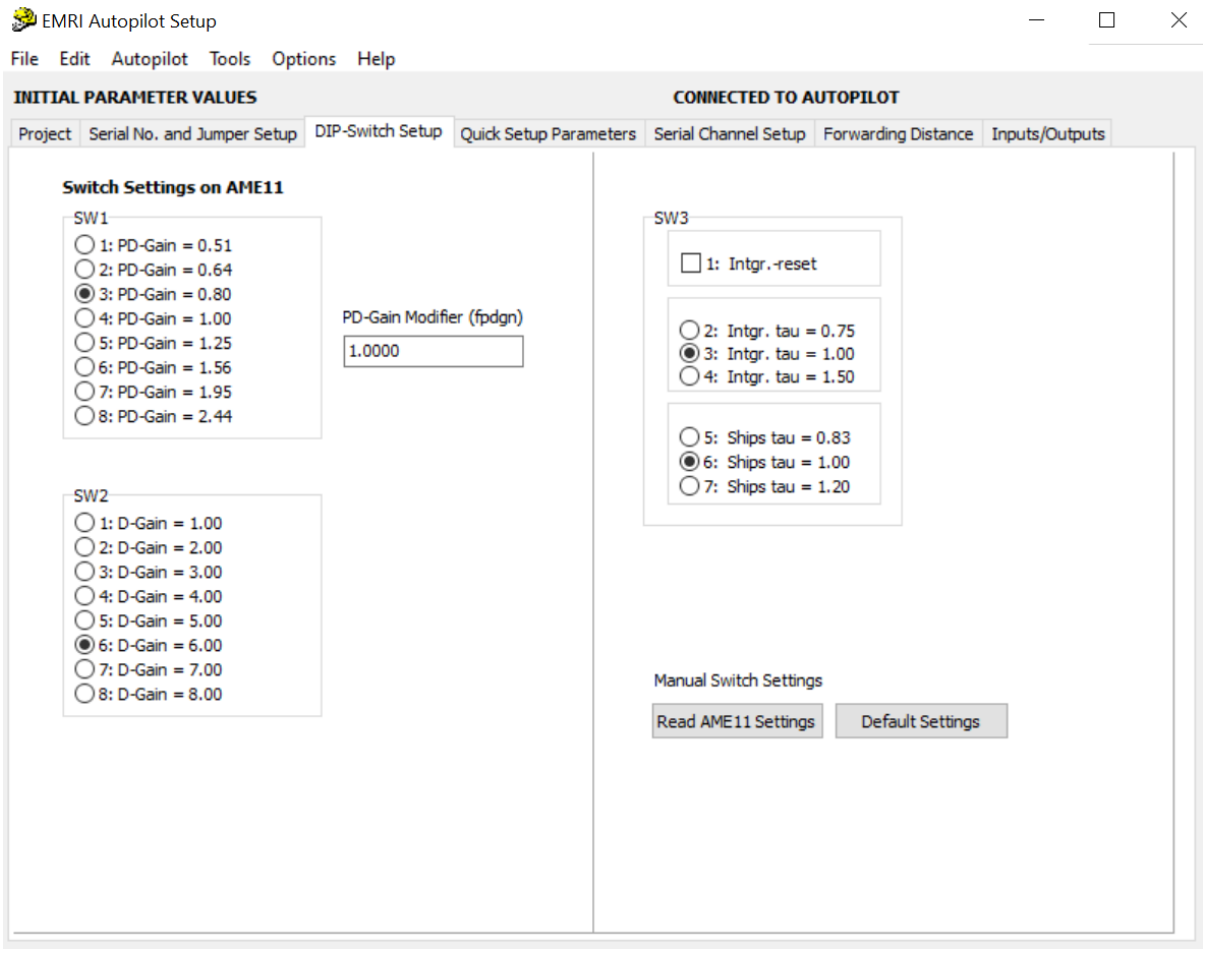


Figure 6-8: SEM300Manager DIP-Switch setup tab

The Switch Settings can either be read from the AME11 (preferred), set to default values or entered manually.

If the connection to the Autopilot is not established, the Read AME11 Settings button is grayed out and cannot be used.

If the settings are not defined, this will be indicated with a red text warning.

Note: Starting AME with DIP SW1 all open, will start by all parameters loaded with default parameters. These default values can be stored persistently, by changing just one parameter.

6.5.1.4 Quick Setup Parameters Tab

On this tab, you can calculate the parameters e2Kp and e2Klci. First enter the values of sleng and u_norm, then press the Calculate button. The values can also be entered manually.

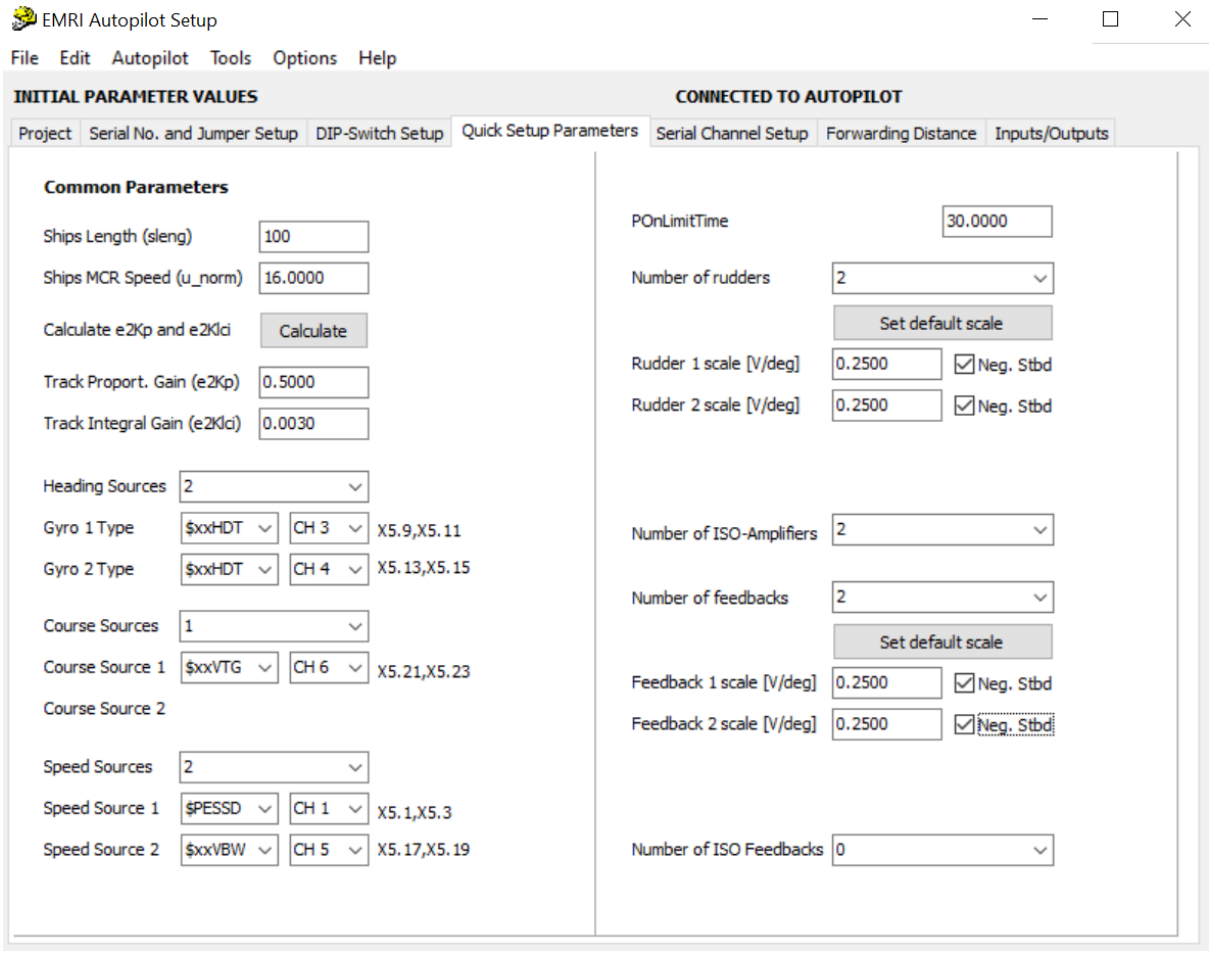


Figure 6-9: SEM300Manager Quick Setup Parameters Tab

When setting the serial channels (CH1, CH2, etc.) for heading and speed source, the Gyro parameters, GyroNmeaCh[0,1], or the Log parameters LogNmeaCh[0,1] are set to the corresponding channels.

The Rudder Order Output can either be set to the standard value or a custom value, where the Rudder Order Output Scaling can be entered as Volts/Deg, stored in parameter RudderOrderScale.

In the report, the terminals for the rudder order are printed as default. They depend on the number of isolation amplifiers. If a non-standard amplifier configuration is used, this information can be omitted by checking the Disable check box.

6.5.1.5 Serial Channel Setup Tab

Configuration of the serial channels CH 1 – CH 6 with selection of baud rate and use of the channel.

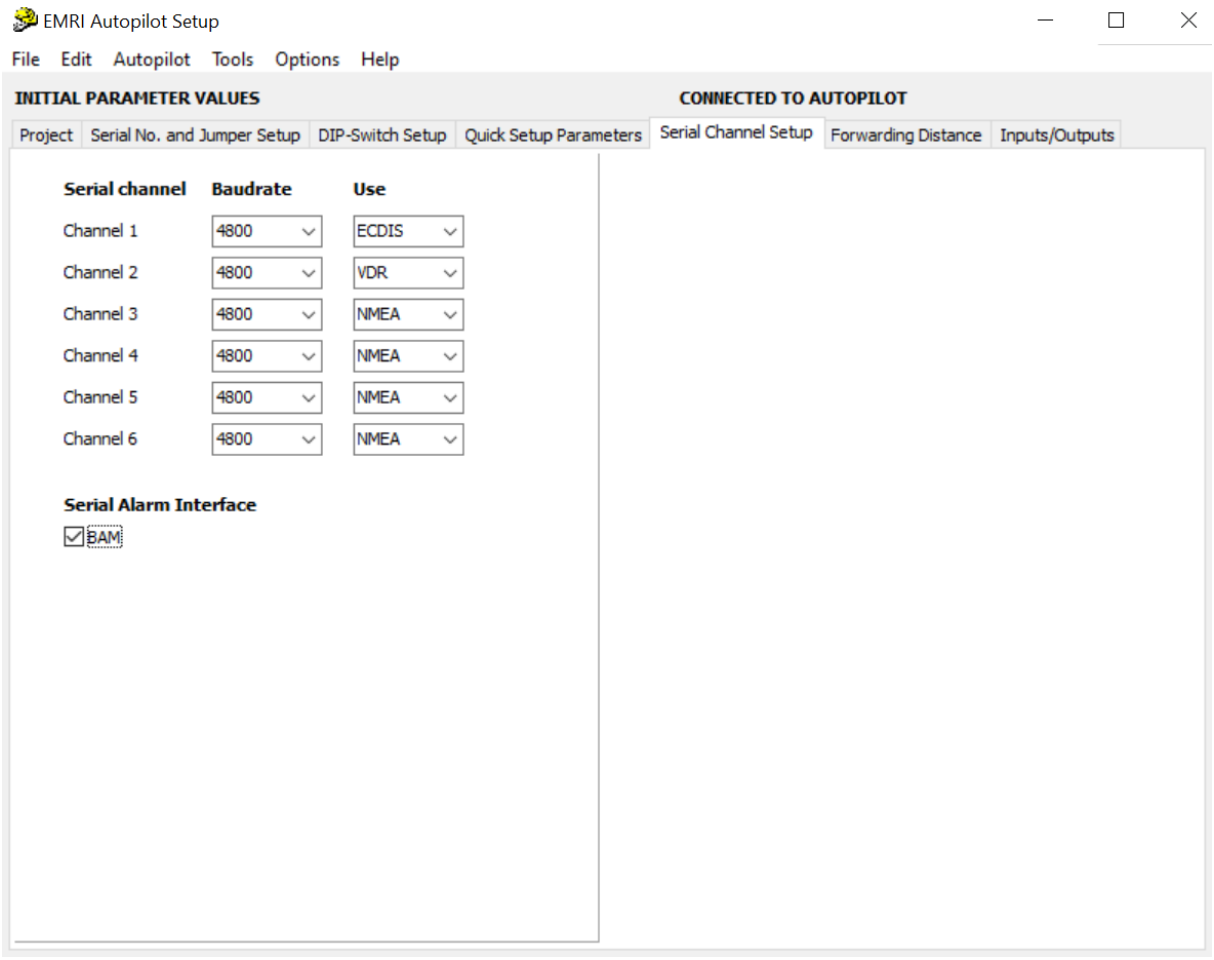


Figure 6-10: SEM300Manager Serial Channel Setup Tab

If NMEA is selected, the channel is used for general NMEA input.

If ECDIS is selected, the channel is used for ECDIS interface.

If VDR is selected, the channel is used for interface with VDR or alarm system.

6.5.1.6 Forwarding Distance Tab

This page is only used in special configurations, where the Autopilot needs to calculate the forwarding distance before a track turn.

Normally the forwarding distance is calculated by the ECDIS, not the Autopilot.

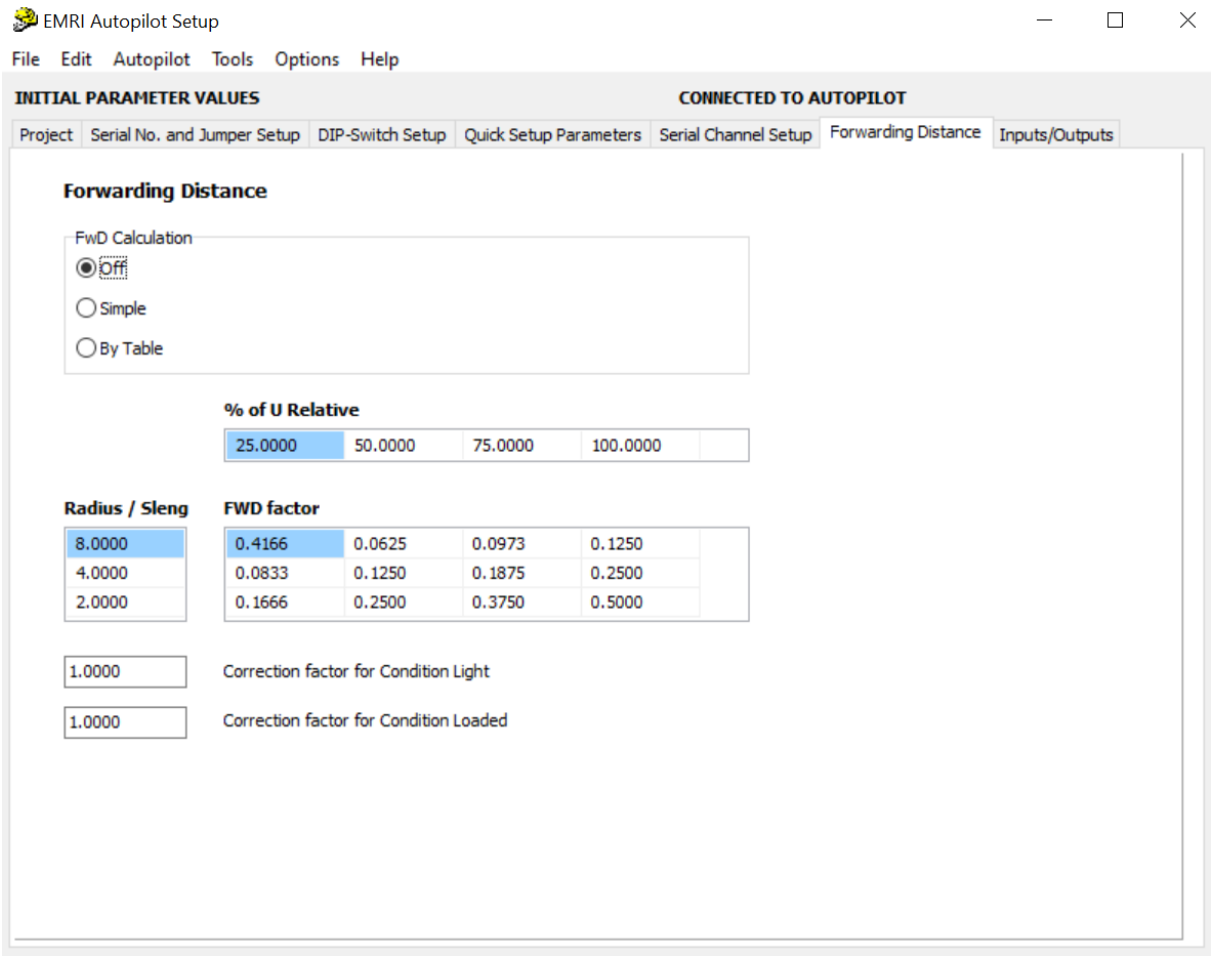


Figure 6-11: SEM300Manager Forwarding Distance tab

6.5.1.7 Inputs/Outputs Tab

This page is used to set up special configurations.

With the **In-Control** panel, it can be selected which of the Autopilot inputs also are to be used to put the Autopilot in control.

The **Configurations** panel is used to define a set of more different rudder configurations.

First the number of rudder configurations is selected.

If no special configuration setup is needed (i.e. only one configuration), the number is set to 0.

Each rudder configuration is defined by the combination of rudders ready in that configuration.

For each rudder configuration, a gain modifier can be entered in the table below.

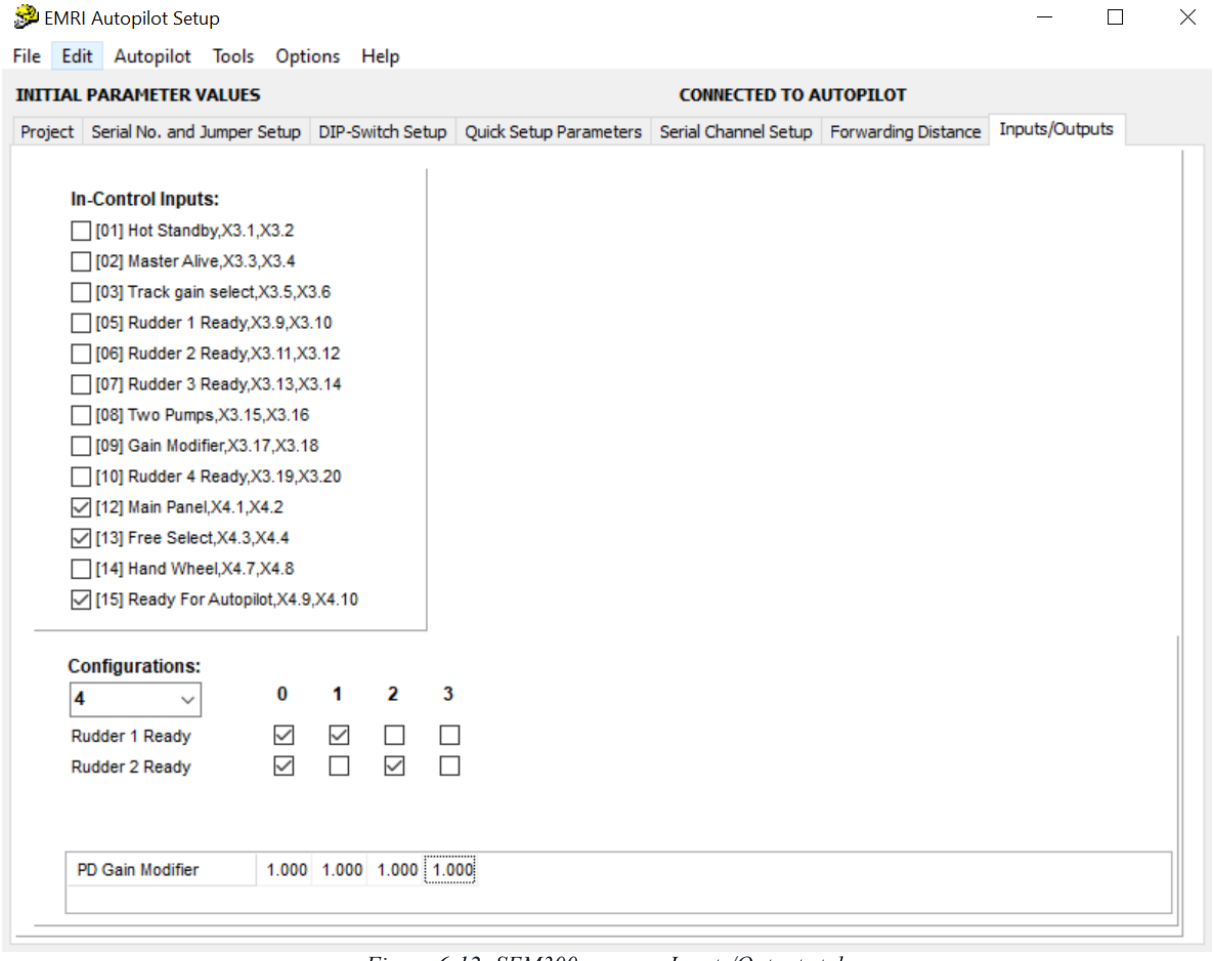


Figure 6-12: SEM300manager Inputs/Outputs tab

6.6 Main Window menus

6.6.1 File Menu

- New Project: creates a new project with default parameters for the Autopilot. The initial parameter set for the Autopilot is edited.
- Open Project: opens a project (file type *.eac). It is also possible to open a parameter file (file type *.par), which will be treated as a project file with no project information. The final parameter set for the Autopilot is edited.
- Save Project: saves the current project (file type *.eac) and generates a report (file type *.xml), which can be opened with a word processor application like Word).
- Save Project As…: the parameter set is saved as initial parameters regardless of the current editing mode (initial/final).
- View Report: creates a temporary report (xml-format) and displays it with an external xml viewer. On exiting SEM300Manager, all temporary xml files are automatically deleted.
- Exit: closes the SEM300Manager program.

6.6.2 Edit Menu

- Clear Project: clears all project information including parameters for the Autopilot.
- Default Parameters: the parameters for the Autopilot are set to default values.

6.6.3 Autopilot Menu

- Autopilot Editor: opens the Autopilot Parameter Editor, in which all Autopilot parameters can be edited.
- Connect to Autopilot: sets the pre-configured baud rate (if enabled in the communications setup) and sends an initialization command to the Autopilot. It is necessary to connect before communicating with the Autopilot. The get/send/compare commands are not available if there is no connection.
- Get Parameters & switch settings: retrieves switch settings and all parameters from the Autopilot.
- Send & Compare Parameters: retrieves switch settings and sends the parameters where the values differ. First, the complete parameter set is retrieved from the Autopilot. Next, a comparison is made to distinguish which parameters to send. A final comparison is made to confirm match.
- Send All Parameters: sends all parameters to the Autopilot. This may take a long time due to the relatively slow communication speed.
- Compare Parameters: compares the current Autopilot parameter set in SEM300Manager with the parameter set in the Autopilot.

6.6.4 Tools Menu

- Terminal Window: opens traditional terminal window. It is possible to enter commands manually to the Autopilot. In addition, the terminal window monitors all automatic communication.

  Note: when parameter values are changed manually using the terminal window, they are NOT automatically updated in the project.

- AME Log: A tool for logging selected data values and plot curves.
- Flash utility: A tool for downloading new firmware to the Flash memory of the AME board.
- AME Diagnostics: A tool for inspecting the status of input/output ports and serial lines on the AME board.

6.6.5 Options Menu

- Comm. Settings: Opens a window to configure the serial port.

6.7 Reading back parameters from AME

If no project file is present for a specific Autopilot, all parameters can be read back to Sem300Manager by using following procedure. Some of the bullets can be omitted if they already have been performed.

- Start Sem300Manager
- Configure the communication by using the Options – Comm settings of the Autopilot setup window.
- Connect to the AME by using the Tools – Connect to Autopilot. A confirmation shows successful connection.
- Receive the parameters by using the Tools – Get parameter & switch settings. Accept the warning of overwriting parameters in PC memory.
- Save the project to the PC by using File – Save Project as...

Now you have made a project file for the Autopilot and can be used as backup.

6.8 Writing parameters to AME

If you have made changes to an Autopilot project or need to reprogram the settings to the Autopilot you need to follow this procedure.

- Move the jumper at W12 to pin 2-3 to disable write protect of the boot flash.
- Start Sem300Manager
- Load the project file for the actual Autopilot.
- Configure the communication by using the Options – Comm settings of the Autopilot setup window.
- Connect to the AME by using the Tools – Connect to Autopilot. A confirmation shows successful connection.
- Write the parameters by using the Tools – Send all parameters. Accept the warning of overwriting parameters in Autopilot memory.
- Move back the jumper at W12 to pin 1-2 to write protect the Flash memory.

6.9 Terminal window

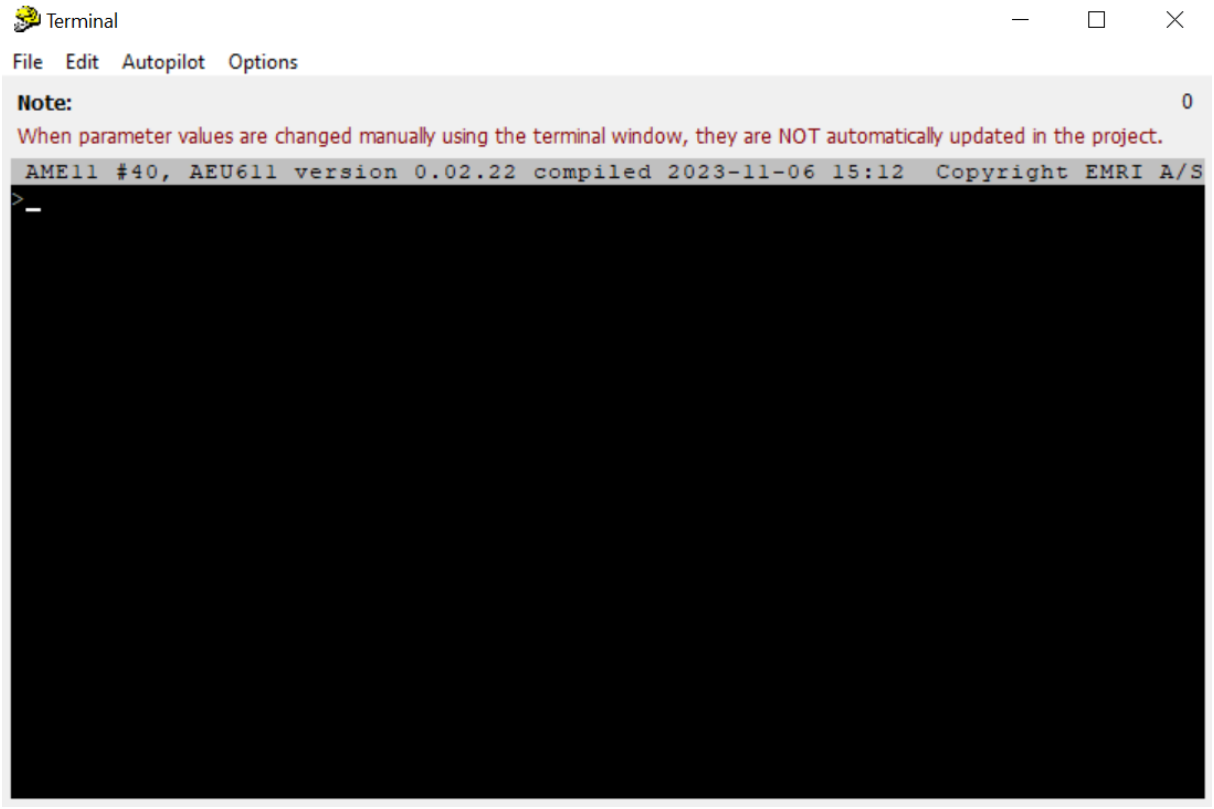


Figure 6-13: SEM300manager secondary/terminal window

This is a traditional terminal, in which you can manually enter commands to the Autopilot or panel. The terminal also monitors the automatic communication.

6.9.1 Terminal window commands

The following commands can be used with the Sem300 debugger on a serial connection, via a physical serial port, or via UDP on the Ethernet port.

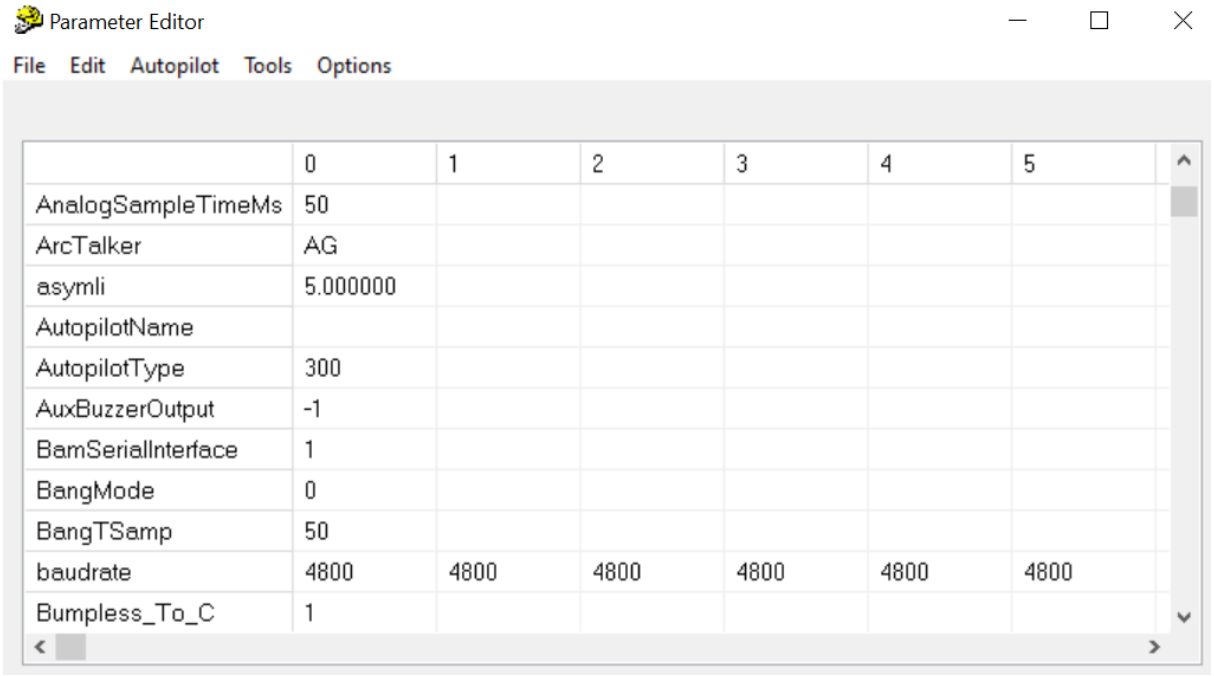
The commands are entered on a line-by-line basis via some terminal or terminal emulating program.

Simple line editing can be done if the terminal supports standard ANSI escape-sequences.

Command	Description
CLEAR PROGRAM	This command clears the memory buffer used for firmware upload.
CLEAR TASKS	This command clears the internal statistics of the multitasking kernel.
DIR FLASH	This command displays a list of files stored in the FAT16 part of the Flash memory.
DUMP <address>	This command makes a hexadecimal dump of 256 bytes, starting from <address>, which can be either decimal or hexadecimal (starting with 0x).
DUMP <name>	This command makes a hexadecimal dump of 256 bytes, starting with the variable or parameter <name>.
ECHO	Cancels the NOECHO command.
ERASE CALIBRATION FLASH	Erases D/A converter calibration parameters from Flash.
ERASE PROGRAM FLASH	Erases the application program from 8MB Flash (IC30). At next restart, the application program from 4MB Flash (IC22) will be used.
ERASE PARAM FLASH	Erases parameters from Flash. At next restart, factory default parameter values will be used.
FORMAT	This command formats the FAT16 part of the Flash memory.
INIT	Clears the screen and writes headline with version info.
LOG	Clears the list of logged variables.
LOG 0	Stops the logging.
LOG <value>	Starts logging for <value> seconds.
LOG <name>	Adds <name> to list of logged variables.
NOECHO	Suppresses echo of entered commands for 10 seconds.
PLAY	Starts playback of recorded data.
PLAY 0	Stops playback of recorded data and reset pointer to start of recording.
PLAY <value>	Playback next <value> samples of recorded data.
RECORD	Stop recording.
RECORD <value>	Starts recording for <value> seconds.
RECORD <name>	Adds <name> to list of recorded variables.
RESET	Forces a system-reset by halting watchdog-refresh.
SAVE CALIBRATION	Saves D/A converter calibration parameters to Flash.
SAVE PARAM	Save all parameters to Flash.

Command	Description
SAVE PROGRAM	Save uploaded application program to 8MB Flash (IC30).Saved program will be used after next restart, if header and checksums are valid. Note: If bytecount and checksum are available, it is recommended to use the command with bytecount and checksum included. See below.
SAVE PROGRAM <bytecount> <checksum>	Save uploaded application program to 8MB Flash (IC30),if <bytecount> and <checksum> matches values calculated during upload. Saved program will be used after next restart, if header and checksums are valid.
SAVE PROGRAM <bytecount> <checksum> 29040	Save uploaded application program to 4MB Flash (IC22),if <bytecount> and <checksum> matches values calculated during upload. Saved program will be used for "booting" at next restart. Note: If anything goes wrong during save, the AME board may fail to restart, so this command should only be used when spares are at hand.
SET <name> = <value>	Sets the parameter (or variable) equal to <value>. For indexed parameters, <name> must be followed by the index in [ ]. If a parameter value is changed, it is automatically saved in Flash.
SET SERIAL <value>	Sets the AME board serial number to <value>.Note: This command works one time only.
VERIFY PROGRAM	Verifies application program in 8MB Flash (IC30) against uploaded program.
VIEW <name>	Displays the value of the parameter (or variable) <name>.For indexed parameters, <name> must be followed by the index in [ ].
VIEW ALL	Displays a list of all available parameters and variables.
VIEW CHAR	Displays a list of all available parameters and variables of character type.
VIEW FLOAT	Displays a list of all available parameters and variables of float type.
VIEW GYRO	Displays actual gyro source and value.
VIEW INT	Displays a list of all available parameters and variables of integer type.
VIEW PANEL	Displays list of connected panels.
VIEW PARAM	Displays list of all parameter values.
VIEW PARAM FLASH	Displays list of all parameter values stored in Flash.
VIEW SERIAL	Displays serial number of AME board.
VIEW SERIAL <number>	Shows data received on the serial port <number>. Note: This function is terminated by any other command.
VIEW SPEED	Displays actual speed source and value.
VIEW TASKS	Displays statistics from multitasking kernel.
VIEW VERSION	Display the software version and serial number for AME and all available MIP panels and Arm Rest panels.
WATCH	Clears the list of watched variables.
WATCH <name>	Add the <name> to list of watched variables.For indexed parameters, <name> must be followed by the index in [ ].Watched variables are displayed once a second in upper rigth part of the screen.Note: Use of watch requires a terminal with support for ANSII cursor addressing.
WATCH GYRO	Add gyro related variables to list of watched variables.
WATCH SPEED	Add speed related variables to list of watched variables.

6.10 Autopilot Parameter Editor Window

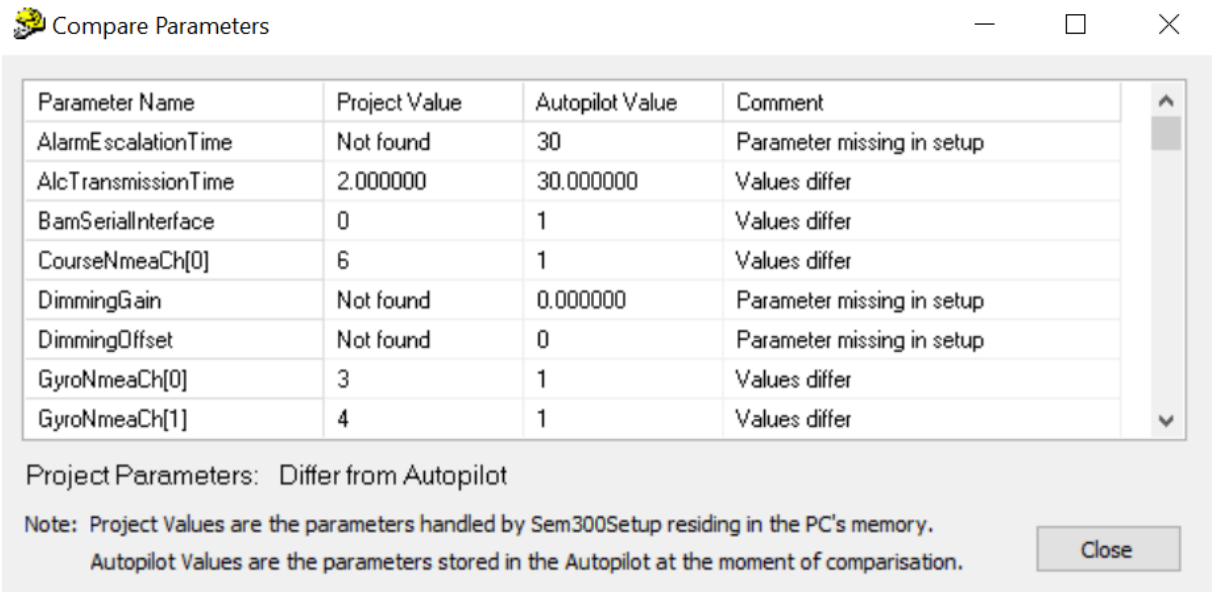


	0	1	2	3	4	5
AnalogSampleTimeMs	50					
ArcTalker	AG					
asymli	5.000000					
AutopilotName						
AutopilotType	300					
AuxBuzzerOutput	-1					
BamSerialInterface	1					
BangMode	0					
BangTSamp	50					
baudrate	4800	4800	4800	4800	4800	4800
Bumpless_To_C	1					

Figure 6-14: SEM300Manager parameter editor window

You can view or edit all Autopilot parameters from the Autopilot Parameter Editor Window.

6.11 Compare Parameters Window



Parameter Name	Project Value	Autopilot Value	Comment
AlarmEscalationTime	Not found	30	Parameter missing in setup
AlcTransmissionTime	2.000000	30.000000	Values differ
BamSerialInterface	0	1	Values differ
CourseNmeaCh[0]	6	1	Values differ
DimmingGain	Not found	0.000000	Parameter missing in setup
DimmingOffset	Not found	0	Parameter missing in setup
GyroNmeaCh[0]	3	1	Values differ
GyroNmeaCh[1]	4	1	Values differ

Figure 6-15: SEM300Manager Compare parameters window

The “Compare Parameters” function (Autopilot menu) compares the project parameters with the parameters currently stored in the Autopilot.

The result of the comparison will either be that the project parameter set is identical with the Autopilot parameter set or that they differ.

The Parameters may differ for the following reasons:

- Parameter is missing in setup (exists in the Autopilot but not in the project)
- Parameter unknown to Autopilot (exists in the project but not in the Autopilot)
- Types differ (exists in both the Autopilot and the project but the types differ)
- Values differ (exists in both the Autopilot and the project but the values differ)

6.12 AME11 Firmware update

With the Flash Utility in Sem300Manager it is possible to send new firmware to the AME and program it into the Flash memory.

Note: It is advisable to do a backup of the parameters as described in section 6.7.

Move the jumper at W12 to pin 2-3 to disable write protect of the boot flash.

With File Load in the Flash Program Utility window, the firmware file is loaded into the memory of the PC:

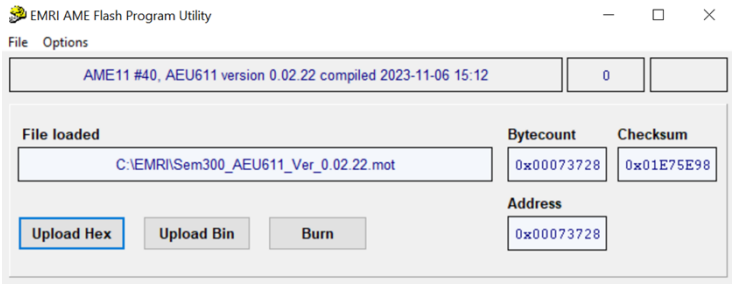


Figure 6-16: AME flash program utility window

Then, by pushing Upload Bin button, the firmware is transferred to the memory of the AME.

The Upload Bin transfer progress is indicated by the Address field. The transfer is finished when the Address field reaches the same value as the Bytecount field. Then the Burn button can be pushed.

The integrity of the program is verified by size and checksum, and if o.k., the program Flash memory is erased, and the transferred program image is programmed into the Flash, followed by the checksum.

If the program is not verified, an error message is shown in the terminal window, and the program Flash is not modified (the old program remains).

The new program will be active next time the Autopilot is restarted.

Move back the jumper at W12 to pin 1-2 to write protect the Flash memory.

Note: The parameters are not modified by this, as they are stored in a separate section of the Flash memory.

6.12.1 AME11 upgrade old firmware

If you have an AME with version 0.1.42 or earlier, you need to upgrade the boot flash.

Please note that upgrading the boot flash comes with a risk of bringing the AME to an unrecoverable state, that cannot be recovered without replacing the boot flash.

6.12.1.1 Procedure

You must use the “Flash Program Utility” window as programming the Flash memory.

Immediately after programming flash memory. If AME has been restarted, the firmware must be uploaded once again as described in section 6.12. It is not needed to “Burn” the firmware to the flash memory again.

Move the jumper at W11 to pin 2-3 to disable write protect of the boot flash.

In the “Options” menu, select “Burn Boot Flash”.

Follow the progress in the terminal window.

Move back the jumper at W11 to pin 1-2 to write protect the boot flash.

6.13 MIP211/MIP241 Firmware Update

6.13.1 Introduction

To update the firmware in the MIP211 panel, the FlashMagic program is used.

The program communicates with the MIP211 panel through a serial cable, connected to the PC.

The program can be requested from EMRI A/S.

6.13.2 System Requirements for MIP211/MIP241 Firmware Update

6.13.2.1 The PC:

- A screen resolution preferably of 1024 x 768 or better.
- Running Windows 10 or 11.
- One serial (COM) port not in use by another program.

6.13.2.2 The cable:

- An EMRI "Parameter Cable", with a DB9 female connector, connected straight-through to a standard 10-pin header.

6.13.3 Installation of FlashMagic flashing tool

To install FlashMagic, run FlashMagic.exe from the installation media.

6.13.4 Preparing the panel

1. Remove the upper back plate from panel.
2. Move the jumpers J5 and J6 to position 1-2 (ISP RST and ISP ENAB respectively), and make sure jumper J7 is set to WE as shown on Figure 6-17.
3. Connect the EMRI Parameter Cable between connector W2 (ISP) and a COM port on the PC.

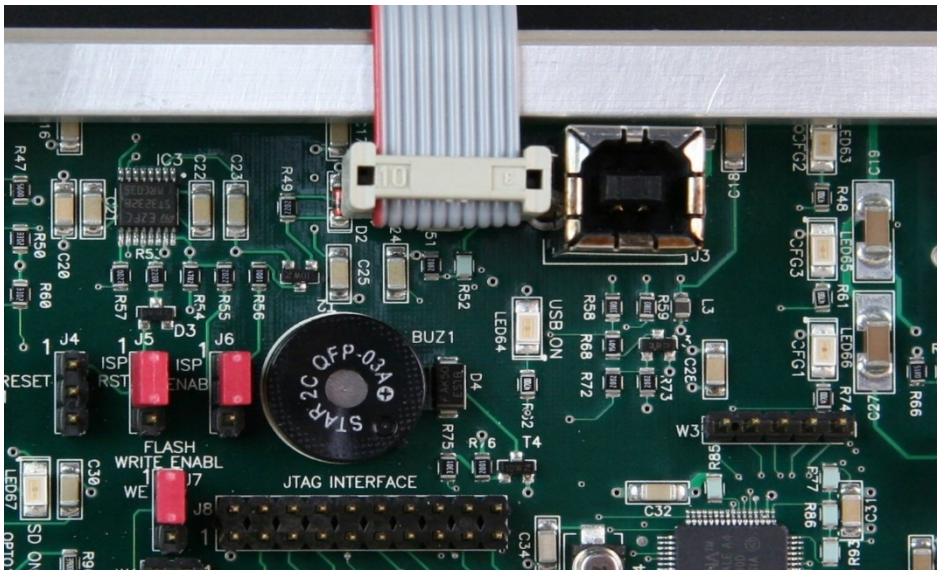


Figure 6-17: MIP panel board connection with parameter cable

4. Power up the panel, if not already powered.

6.13.5 Using the FlashMagic program

Start the FlashMagic program:

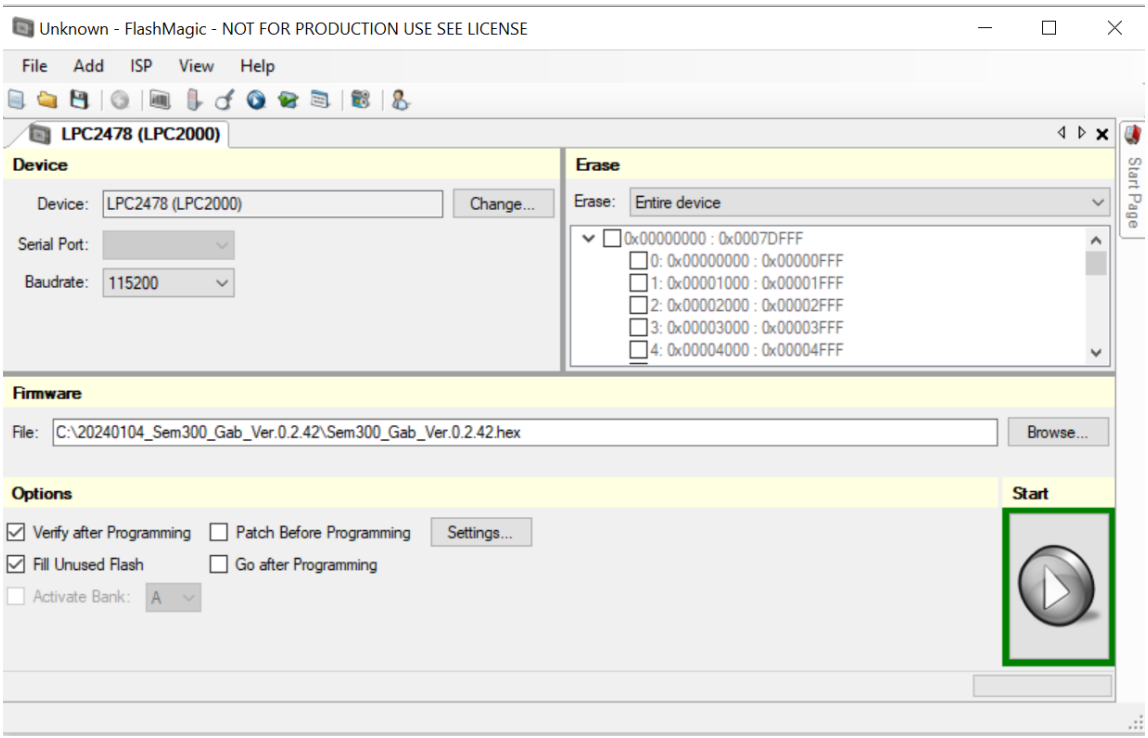


Figure 6-18: Flashmagic program window

Follow the steps described below:

1. Select device LPC2478 (LPC2000 / ARM 7 CPU) and the serial port that is used on your service Laptop.
2. Select what you want to erase (if any).
3. browse to the actual location of the firmware hex file.

4. Select options “Verify after Programming” and “Fil Unused Flash” as shown on: “Figure 6-18: Flashmagic program window”.
5. When Start is pushed, the hex file is loaded (which may take some time), the connection is established, baud rate is negotiated, and the program is uploaded to the panel:



Figure 6-19: Flashmagic program flash progress bar

Finally, the program is verified:

After that, disconnect the cable, set jumpers J4 and J6 back to position 2-3 and reinstall the back plate.

7 Autopilot Setup Instructions

Use the SEM300Setup tool under the Dock Side Commissioning to make the necessary initial parameter setup for the actual installation.

Use the SEM300Setup tool for parameter adjustments and the AMELog tool for recording and performance verification under the Sea-Trial Commissioning. AMELog can be called from the SEM300Setup Wizard.

See section 6 for information on Autopilot Software tools.

7.1 Setup process

The set-up process is usually comprised of the following parts:

1. Definition of delivery, and related parameter settings.
2. Commissioning at the Dockside including checking the Installation.
3. Sea-trial adjustments.

Item 1 is, in most cases, taken care of by the certified engineer installing the equipment.

Commissioning and Sea-trial are a field-job.

7.2 Setup from MIP Panel

The Autopilot can be setup from the MIP panel. The Setup Menu is accessible from the User Menu (see section 2.7). The setup menu is only visible when auto pilot is NOT in control.



Figure 7-1: Setup Menu Item in User Menu

Use button UP/DOWN/SELECT to navigate and select setup menu.

7.2.1 Setup Menu Pin-code

First time the setup menu is entered, a valid PIN code must be provided. The PIN code for accessing the Service Mode is: **1448**

Use button UP/DOWN/SELECT to type in the PIN code.

When a valid PIN code is provided, access is granted to the setup menu. For the next 60 minutes the Setup Menu can freely be reentered, even when the Autopilot is in control.

7.2.2 Setup-Menu overview



Figure 7-2: Setup Menu Overview Window

The setup menu provides the following setup options:

- Parameters (see section 7.2.3)
- Parameter list (see section 7.2.6)
- NMEA Input monitor (see section 7.2.8)
- Step Response (see section 7.2.9)

Use button UP/DOWN/SELECT to select an option.

7.2.3 Parameter Menu

The parameters menu is organized in the following groups:

- Basic parameters (e.g. ship length, rudders, and rudder feedback).
- Serial parameters
- Gyro parameters
- Course parameters
- Speed parameters
- Radius parameters
- Servo parameters
- Track parameters
- Misc parameters (e.g. IP address and dimming options).

Use button UP/DOWN/SELECT to select a parameter group.

7.2.4 Parameter Selection

The parameter selection present information for one of the parameters in the parameter group (e.g. Basic Parameter).



Figure 7-3: Parameter Selection Window

The window shows the following parameter information:

- Name (e.g sleng)
- Description (e.g. ship length)
- Value (e.g. 100)
- Unit (e.g. m)

Use tiller INCREASE ↕ DECREASE to navigate through the parameters in the group.

Some parameters (e.g RudderOrderScale) are an array of values. This is displayed with "[x]" after the parameter name, where n is a number from 1 to n (e.g. maximum number of rudders). Use tiller PORT ↕ STBD to navigate through the array of values.

Press button UP/DOWN to navigate the menu:

- Edit (for Parameter edit, see section 7.2.5)

Use button SELECT to select the menu option.

7.2.5 Parameter Edit

The parameter edit window allow for changing the value of a specific parameter.



Figure 7-4: Parameter Edit Window

The window shows the following parameter information:

- Name
- Description
- Value
- Unit
- Factory default value
- Startup value (when Autopilot AME was powered on)
- Minimum allowed value
- Maximum allowed value

Use tiller INCREASE ↕ DECREASE to change the underlined digit in the parameter value.

Use tiller PORT ↕ STBD to navigate left or right through the digits of the parameter value. It is possible to navigate left or right from the shown digits, to add extra digits.

Press button UP/DOWN to navigate the menu:

- Return (Leave the window. Unsaved changes are discarded)
- Save & Return (Save changes and leave the window)
- Use Factory Value (Use factory default value. The change is not yet saved)
- Use Startup value (Use startup value. The change is not yet saved)
- Use Suggested Value (See section 7.2.5.1)

Use button SELECT to select the menu option.

The bottom line of the window can provide hints and warnings related to the current parameter and its value. The following can be displayed in the bottom line:

- Warning that value exceeds the minimum/maximum value defined for the parameter. A value exceeding the range cannot be saved.
- Warning that current value is not allowed, due to the value of other parameters.
- Notice that current value is not applicable/has no effect due to the value of other parameters.
- Suggested value (See section 7.2.5.1).

7.2.5.1 Parameter Edit – Suggested Value

Some parameters (e.g. e2Klci, e2kp) supports a suggested value. A suggested value is a value dynamically calculated by the Autopilot based on other configurable parameters (e.g. sleng). The suggested value is displayed in the bottom of window. In order to apply the suggested value, use button UP/DOWN/SELECT, to select "Use Suggested Value" and "Save & Return".

7.2.6 Parameter List

The parameter list window can show the commonly used configurable parameters for the Autopilot in list form.



Figure 7-5: Parameter List Window

The parameter list are organized in parameter pages[1-7]. Each page display a set of parameters (name and value).

Use botton UP/DOWN to navigate up and down between the pages or to export as QR code (see section 7.2.7).

7.2.7 Parameters QR code

The commonly used parameter values can be exported using a QR code. The QR code is generated and displayed on the MIP panel.

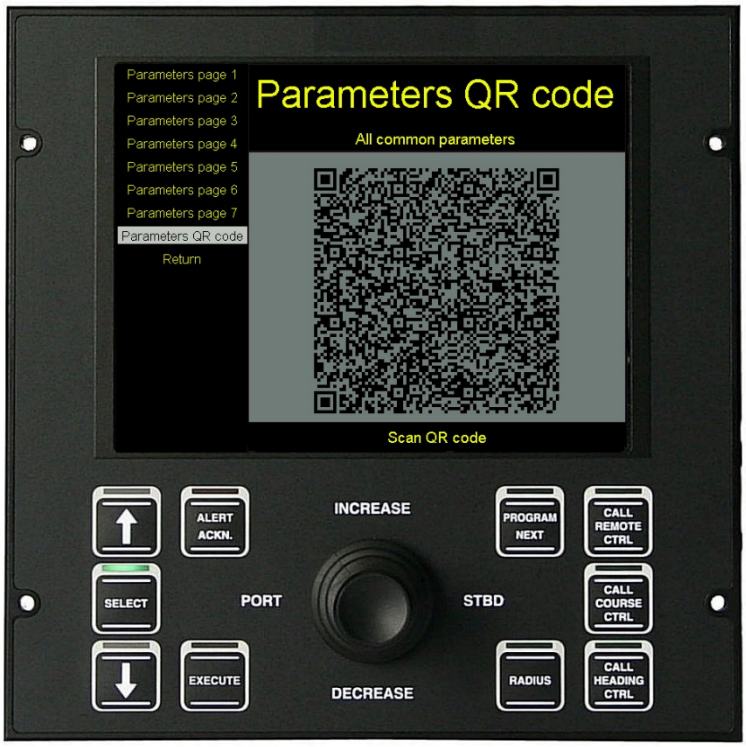


Figure 7-6: Parameter QR code Window

The QR code can be scanned using most smart phones supporting a QR scanner. The QR scanner will detect that the QR code includes:

- Email address (e.g. service@emri.dk)
- Encode text data with parameter values.

Please enter the ship name in the email subject field before sending the email to EMRI support.

7.2.8 NMEA Input Monitor

The NMEA Input monitor can show NMEA sentences received on one of the serial channels.

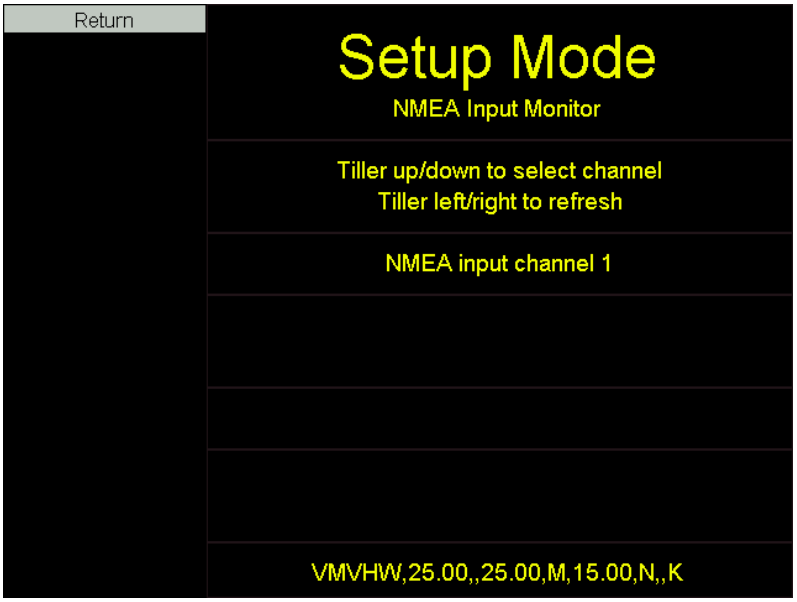


Figure 7-7: NMEA input monitor

The latest received NMEA sentence received on a selected serial channel, is displayed in the bottom line of the screen. The line is empty if no sentence is received, and will show latest unchanged sentence, if communication has stopped. Figure 7-7, shows a NMEA xxVHW sentence received on serial channel 1.

Use tiller INCREASE/DECREASE to select the serial channel to monitor.

Use tiller STBD to update the display to latest received NMEA sentence.

7.2.9 Step Response Plot

A step response plot presents how the Autopilot regulates the ship rudder(s) in a response to a change of the set-Heading. A well configured Autopilot should effectively steer towards the new set-Heading. The plot below shows a 25° turn with a two-rudder ship with a 2° toe angle. The chart does not show a typically well-tuned Autopilot.

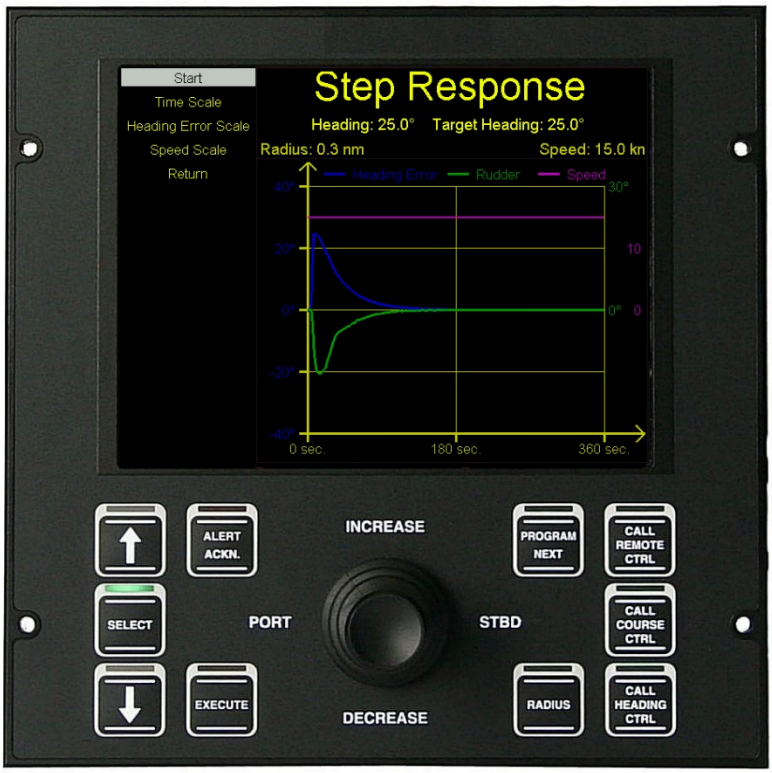


Figure 7-8: Step Response Plot

Use tiller INCREASE/DECREASE to choose a menu option:

- Start, the plot generation is started (see section 7.2.9.4)
- Time Scale, set the time scale (see section 7.2.9.1)
- Heading Error Scale (see section 7.2.9.2)
- Speed Scale (see section 7.2.9.3)
- Return, to leave the menu

Press SELECT button, to select the option.

7.2.9.1 Time Scale

The Time Scale defines the scale of the x-axe and the time interval of the plot. The scale can be:

- 36 seconds (100 ms)
- 72 seconds (200 ms)
- 3 minutes (500 ms)
- 6 minutes (1 sec)
- 12 minutes (2 sec)
- 30 minutes (5 sec)

A full plot consists of data samples at 360 points in time. The sample rate (i.e. time scale / 360), is shown in parentheses.

7.2.9.2 Heading Error Scale

The Heading Error scale defines the left side Y-axe. The scale can be:

- 10°
- 15° (disabled in some configurations)
- 20°
- 25° (disabled in some configurations)
- 30°
- 40°
- 50°

7.2.9.3 Speed Scale

The Speed Scale defines the 2 right side Y-axe. The scale can be:

- Off (Speed is not logged) - Default
- 10°
- 20°
- 40°

7.2.9.4 Step Response Logging

When logging is started, the following parameters are logged and plotted periodically in a graph (see Figure 7-8):

- Heading Error (set – current Heading)
- Rudder Angle
- Water speed

The window will additionally display the current values of the above parameters.

Use tiller INCREASE/DECREASE to choose a menu option:

- Stop, the logging is stopped.
- Return, to leave the menu.

While the logging is active and the step response window is displayed, the set-Heading can still be changed.

Use tiller PORT/STBD to change the set-Heading.

The logging continues until the Time Scale period has elapsed or logging is manually stopped.

Important: A plot can only by generated when Autopilot is in control. To enter setup menu, Autopilot cannot be in control, hence it is necessary to set Autopilot in control sometime after entering the setup menu.

7.2.9.5 Background logging

Logging can be configured and started while the Autopilot is not in control. However, logging is paused until Autopilot gains control.

This allows logging to start automatically from the beginning when the Autopilot gets control without any further user interaction. It is also possible to leave the step response window, while logging is active, and return later to see the generated step response.

7.3 Dock-side commissioning of Autopilot:

1. Installation check:		**OK**
1	Check that all units of the system are mounted correctly.	
2	Check that all cores are connected correctly in the installation to: The Heading source(s). The Log. / GPS The Steering Gear system. The Mode Selector (system). The Ships Alarm System. The BNWAS The 24VDC Switchboard. The ECDIS system. The VDR system.	
3	Are cable-connections to the MIP-panels made correctly: - Plug parts fully engaged?	

2. Check power supply voltage:			**OK**
1	Main supply voltage:	Measurement:_____V.	

3. System start up:		**OK**
1	Connect 24 VDC main supply and observe power supply supervision LED on AME illum. POWER-OK LED ON	
2	Verify the parameter set-up, “SEM300 AUTOPILOT CONFIGURATION REPORT”, or make the necessary modifications. Dump & store for reference the final set-up on a portable PC, using the order: "**view param**", and a logging facility in the terminal program, or save the project parameters using the *SEM300Manager tool*.	
3	Connect Primary heading source and check GYRO display on MIP is correct. Serial:_____From:_____	

4	Connect Secondary heading source and connect a jumper to the GYRO CHO input I X3/7-8 to select secondary GYRO source as Autopilot ref., and check that display on MIP follows secondary GYRO reading. Serial: _____. From: _____.	
5	Observe for Missing Secondary Gyro is on until both heading sources are connected if the Autopilot is set-up to receive two heading signals. Parameter NumOfGyro=2.	
6		

4. Autopilot "Good-function" tests:		**OK**
1	MIP - panel illumination is on and no alarms. (Except a Speed Warn) Select Manual Speed and adjust to the vessels MCR-speed setting. Carry out a lamp test and observe all push-button lamps being lit. (Lamp-Test: Push both arrow up and down simultaneously)	
2	Select mode HEADING CONTROL and Rudder Limit (No Radius) observe: Correct mode indication on MIP-panel Check that the HEADING CHANGE knob is functional. Check that the rudder limit can be adjusted. Check that PROGRAM heading change mode can be selected and that the EXECUTE Button function is live.	
3	Check that the rudder follows the set-heading Tiller. Set the rudder limit to 10deg. and apply a large heading error to bring the rudder to the limit both PORT and STBD. Check that the rudder angle goes to 10deg. +/-1 deg. to the PORT and STBD side to verify the steering gear order scale factor.	
4	Select TEST-function on the log if possible and adjust it to a speed near the MCR speed of the vessel. Observe the SPEED WARN disappears. Check that the SPEED display follows the LOG test value. Check also the SOG display	
5	Select RADIUS CONTROL and check the panel indication. Check adjustment of Radius. Check the Rate of turn display.	

5. Verification of alarm- & watch- system interface		OK
1	Verify the Autopilot OK alarm to the alarm system. Contact or $xxALR or BAM. Break a gyro connection to verify	
2	Make a break of the Autopilot main power supply and verify that the Power Ok alarm comes up.	
3	Verify the Acknowledge Interface either on contact level or through the $xxACK NMEA sentence or from BAM.	
4	If the compass compare alarm contact X2/13-14 is installed, then verify the installation by making compass signal difference or break one of the compass lines to the Autopilot.	
5	If BNWAS interface is installed, then check the Watch reset on X2/11-12 to the BNWAS system (Or the NMEA interface $xxEVE) as response to an operator activity. Check also the Autopilot in ctrl contact interface on X4/15-16 to the BNWAS.	
6	Check the Off Heading alarm by selecting the HEADING CONTROL MODE and select a set-heading 10 degrees off the gyro reading. Wait more than 2xTau seconds and the Off Heading alarm shall be issued. (Tau = Ships length / Ships max. speed)	

6. Verification of navigation computer interface		OK
1	Make the Navigation computer ECDIS) ready to respond to a request from the Autopilot for REMOTE Control.	
2	Select REMOTE CTRL., and observe that the Autopilot goes into Track mode and remains in Track mode, without any alarm: No acknowledge from ECDIS when called No NMEA from ECDIS	

7.4 Sea trial commissioning of Autopilot:

1. Autopilot system set-up:		OK
1	Dock-side commissioning carried out, and parameter set-up finalized. Check ships length parameter: sleng=_____m Check ships MCR speed parameter: u_norm=_____Knots	

2. PD-gain / D-gain / I-gain / Aut. rudder limit adjustments:		OK
1	Switch off the integrator by setting SW3(1)=on (reset intgr.) (This is to eliminate the integrator function in order to improve observations of step responses to a heading change)	
2	Chose as a start settings: D-gain = 6 (SW2[4] = on), and PD-gain = 1.0 (SW1[4]=on). *Or if the vessel has a high efficiency rudder(s) (I.e. flapped rudder(s), then setting the fpdgn parameter down from 1 to 0.7 or 0.5 will re-scale PD-Gain switch linearily, so that pos SW1[4]=on changes from 1 to 0.7 or 0.5.* Select Ships tau modifier = 1 (SW3[6] = on). Select Heading Control. Select Performance = PRECISE Select condition equal to judged loading condition: LIGHT / MEDIUM /LOADED. Select Rudder Limit = 10 Deg. (Or maybe 7 or even 5 if the rudder is very efficient or the Vessel roll sensitive.	
3	Make the following adjustments at max. cruising speed: Make 10 degrees PORT and STBD heading changes and observe the quality of the response to the new set-heading. Be aware that the integrator has been switched off, so a turn might end up with a steady off-course value. Observe the quality of the turn to this steady state. Increase PD-gain setting to get faster response to a heading change. (Decrease to get opposite effect.) Increase D-gain to reduce overshoot on the new heading upon a heading change. (Decrease to get opposite effect.). Stop increasing the D-gain if the step response turns out to be re-bouncing (i.e. the turning of the vessel stops before reaching the new set-heading and then starts the turning again in one or several steps towards the new set-heading) Continue making step responses until a satisfactory result has been achieved, or---.	

	-- If the counter rudder seems to be too transient to stop the turn, then increase the tau-selection by setting SW3[7] = on and 5 and 6 off. Then repeat the step response tests again in order to fine-adjust the PD- & D-gain. -- If the step response tends to be re-bouncing with sufficiently D-gain to stop the turn, then decrease the tau-selection by setting SW3[5]=on and SW[6] = off. Then repeat the step response tests again in order to fine-adjust the PD- & D-gain.	
4	Switch on the integrator again by setting SW3[3] = on and SW[1] = off.	
5	Make again new step responses to see if turns are still carried out nearly without overshoot. If overshoot now gets too high caused by the integrator in the automatic permanent helm system: then increase the integrator tau setting by selecting SW3[4] = on. (SW3[3]=OFF) If the cancellation of a steady state off course is carried out too slow, then decrease the integrator tau setting by selecting SW3[2] = on. NOTE: if the vessel is observed to have permanent helm to one side always, not created by wind or sea effect, but by the hull shape, the propeller and/or the rudder(s) neutral position, then adjust preferably the neutral rudder position in the steering gear servo system, or enter the necessary permanent rudder order in the permanent helm parameter, manph[0]. In [deg]. (And manph[1] if two separate rudders are in use)	
6	Judge the vessels roll- and rate of turn sensitivity to the rudder, and make a selection of the automatic speed dependent rudder angle at full speed. Set the parameter Grudabs [deg] to the wanted value:	
7	Make equivalent judgment of necessary rudder limitation in radius control Set the parameter Rrudabs[deg] to the wanted value:	
8	Verify that the Course Coltrol is working. Drift compensation is observed working.	

3. Normal heading/course control performance verification: incl. verification of the off-heading alarm.			**OK**
1	Select automatic rudder limit (speed dependent) and measure the overshot, **O**[deg] , and the time from start of the turn to being within 1 deg from the final heading (**Tr**[sec] in the following conditions: Or Use the SEM300Manager tool Mpblog to make recordings.	**O**[deg]	**Tr**[sec]
2	Heading control Rudder Limit, 10deg heading change to SB (O < 2 deg)		

	Heading control Rudder Limit, 10deg heading change to PS (O < 2 deg)		
	Heading control Rudder Limit, 40deg heading change to SB (O < 2 deg)		
	Heading control Rudder Limit, 40deg heading change to PS (O < 2 deg)		
	Heading control Radius Turn, 10deg heading change to SB, Radius = 1.0NM (or as appropriate for the vessel) (O < 2.5 deg)		
	Heading control Radius Turn, 10deg heading change to PS, Radius = 1.0NM (or as appropriate for the vessel) (O < 2.5 deg)		
	Heading control Radius Turn, 40deg heading change to SB, Radius = 1.0NM (or as appropriate for the vessel) (O < 2.5 deg)		
	Heading control Radius Turn, 40deg heading change to PS, Radius = 1.0NM (or as appropriate for the vessel) (O < 2.5 deg)		
3	Observe good function at lower speed, at least down to half maximum cruising speed.		**OK**
4	Observe good function in other loading conditions (if possible), by selecting matching Condition-settings. Select loaded condition in shallow waters and if the vessel is loaded, especially if loaded to have even keel or having a bigger draft in the bow than aft.		**OK**
5	-Select Autopilot Heading Control and reduce the rudder limit to 5 deg. -Activate the override device, or other Manual control, and bring the vessel to a high rate of turn. -Then select the Autopilot control again. The Autopilot will now stop the turn by putting the rudder to the limit, and the off-heading alarm shall be issued when the gyro reading deviates more than the Off-Coarse alarm limit from the set heading. Read the difference between the set-heading and the gyro when the alarm sounds. (Typical off factory value: 10Deg. or adjust from the “Select MENU” on the screen)		**OK** **Off Course Alarm** [Deg]
6.	Select course control and verify that drift is now compensated. Difference in Set Course and Heading. Test in both Radius and Rudder Linited operation.		

4. ECDIS control performance verification: Track control / route steering.

1 Select (program) a route with at least one turn, and perform route steering while observing the track control quality.

Route specification: _____

_____

Position system: _____

_____

Weather conditions: _____

Or make a route on the ECDIS specified by the surveyor.

Route section	Leg course [deg]	Turn angle [deg]	Turn radius [NM]	Max.Off-track error [m]
1. leg				
1. turn				
2. leg				
2. turn				
3. leg				
3. turn				
4. leg				
4. turn				
				OK

2 Approach the track from a distance (50 - 100 meters) and observe the track response, and see that the overshoot is minimal.

(Do the test in waters with minimal drift).

If necessary adjust the parameters e2Kp and e2Klci to improve the response. If there is too much overshoot, then decrease e2Klci much and decrease e2Kp until response is acceptable, then increase e2Klci again until it start degrading the step-response.

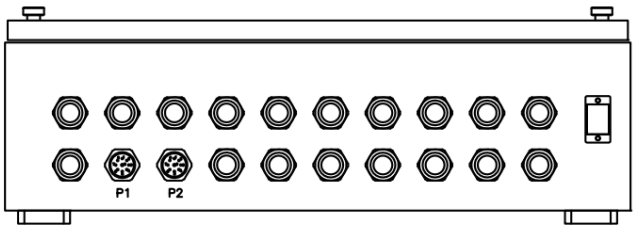
(e2Kp is proportional gain, e2Klci is integral gain).

3 Observe good function at lower speed, at least down to half maximum cruising speed.

4 Observe good function when changing speed during a turn.

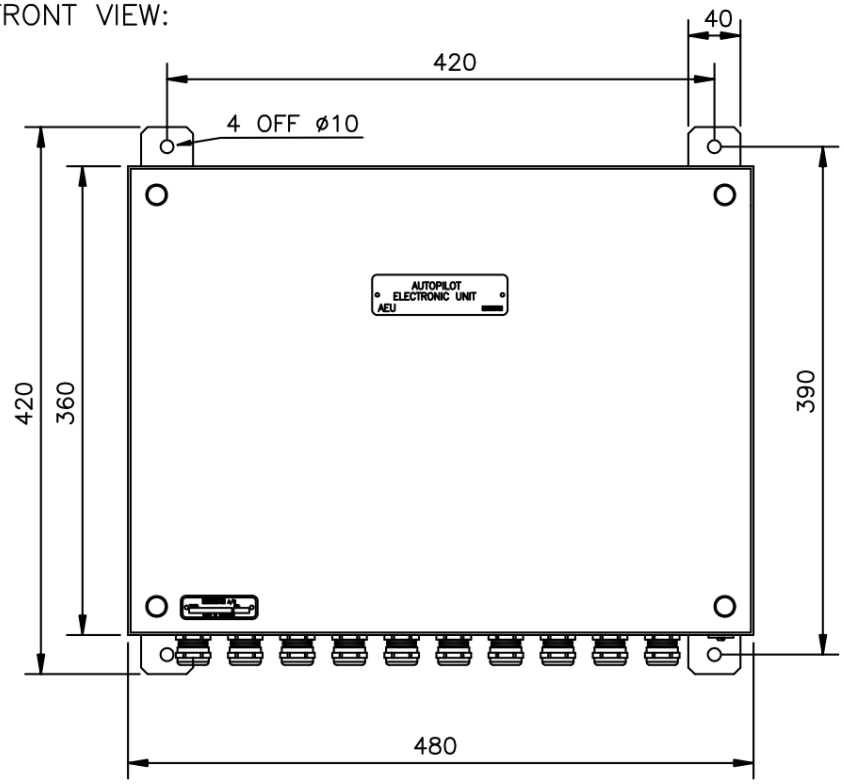
5 Verify that the Autopilot will continue a turn with the preprogrammed radius in case of a communication break between the Autopilot and the ECDIS during a turn.

Appendix – Autopilot Electronic Unit (AEU611)

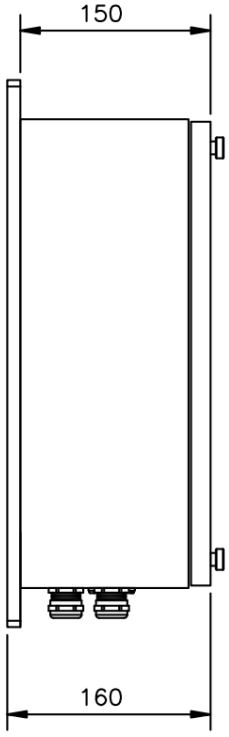


SIB–TEC EMC CABLE GLANDS: 18 x M20

FRONT VIEW:



SIDE VIEW:



WEIGHT 11KG

Appendix – Spare Parts

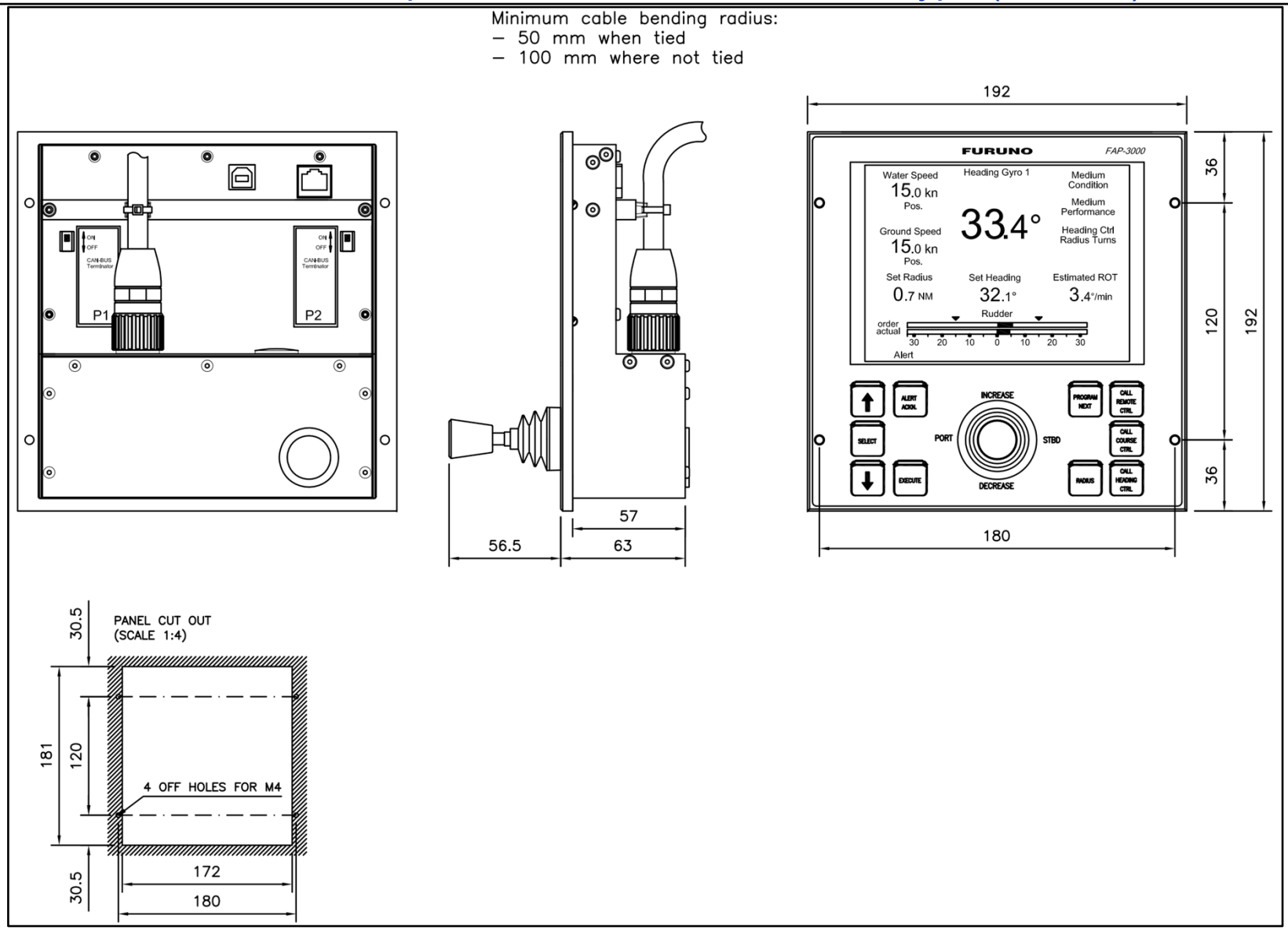
Spare units:

Item	Description	Pcs	Remarks
AEU611-1P….	Autopilot Electronic Unit, for 1 Panel	1	Alternative 1
AEU611-2P….	Autopilot Electronic Unit, for 2 Panels	1	Alternative 2
MIP211	Autopilot Control Panel, EMRI	1/2	Alternative 1
MIP241	Autopilot Control Panel, FURUNO	1/2	Alternative 2
ARP11	Autopilot Arm Rest Control panel, EMRI	0/1/2	Alternative 1
BOX-MOUNT-M5-40	Arm Rest Control panel mount brackets	2/4	Follows ARP11
JBXARP-1	Junction box for ARP11 cable extension	1/2	Optional
JBXARP-2	Junction box for ARP11 power line filter	1/2	Optional - Special case
JBXMIP-2	Junction box for MIP211 cable extension	1/2	Optional - Special case
CE2MM-8-03M	Cable, 2 Male Plugs, 2x4 Pairs, 3 Meter	1	Other lengths available

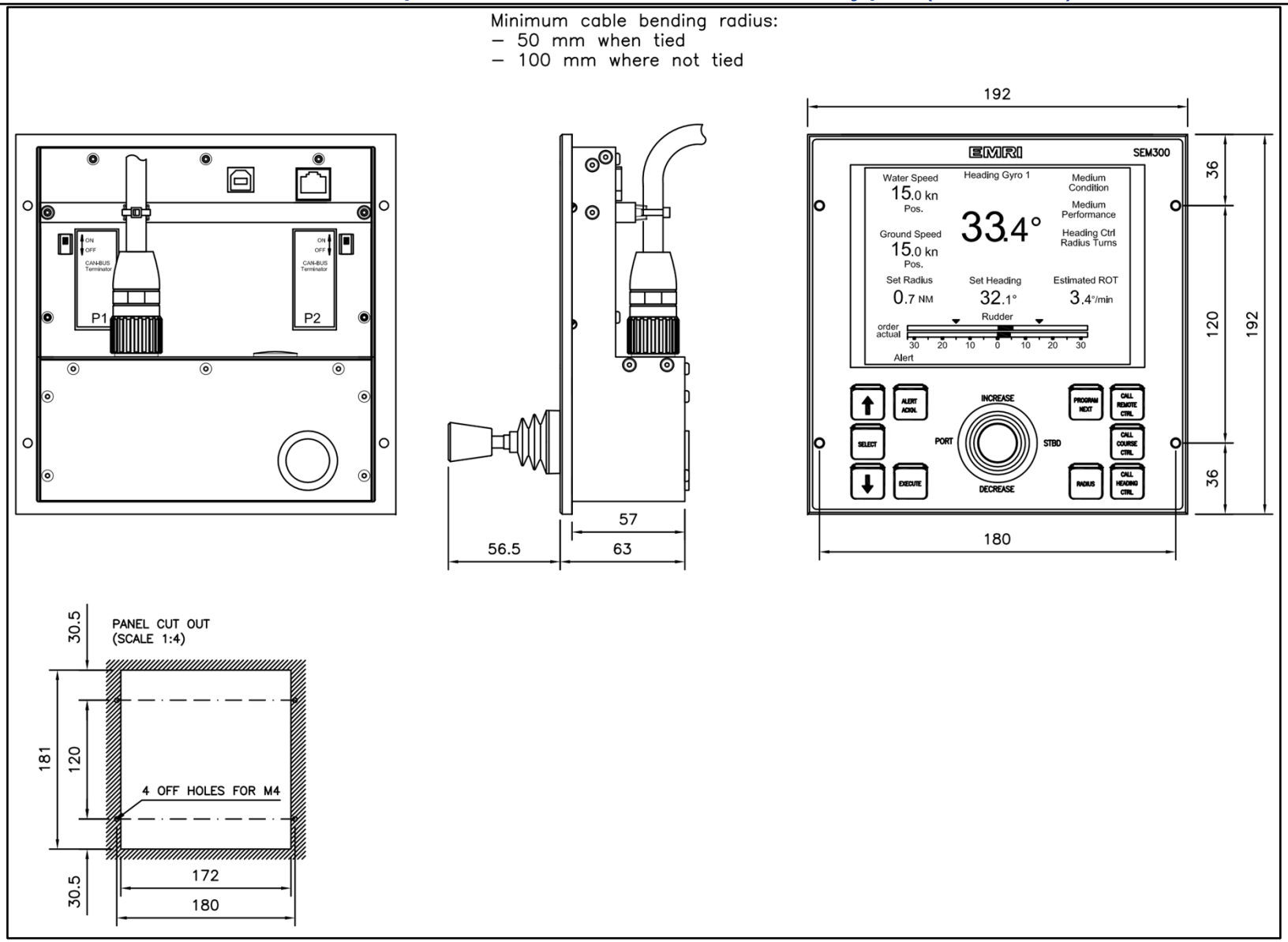
Spare Parts (included inside AEU611 box):

Item	Description	Pcs	Remarks
4-8017	List of content in AEU611-SPARES	1	
FUSE-5A-APPD	Approved Fuse, 6.3x32mm, 5A	2	Spare fuses
PATCH-CABLE-2M	Patch cable, CAT 5e UTP, 2m, green	1	Setup cable
V23105A5305A201	Relay, 2 contacts, 24VDC	2	Spare relays AME11
PIN-JUMPER	PIN-Jumper for square pin header, 2.54mm	3	Spare jumpers, AME11
HCPL2300	Optocoupler High Speed Low Current	3	Spare Optoc., AME11

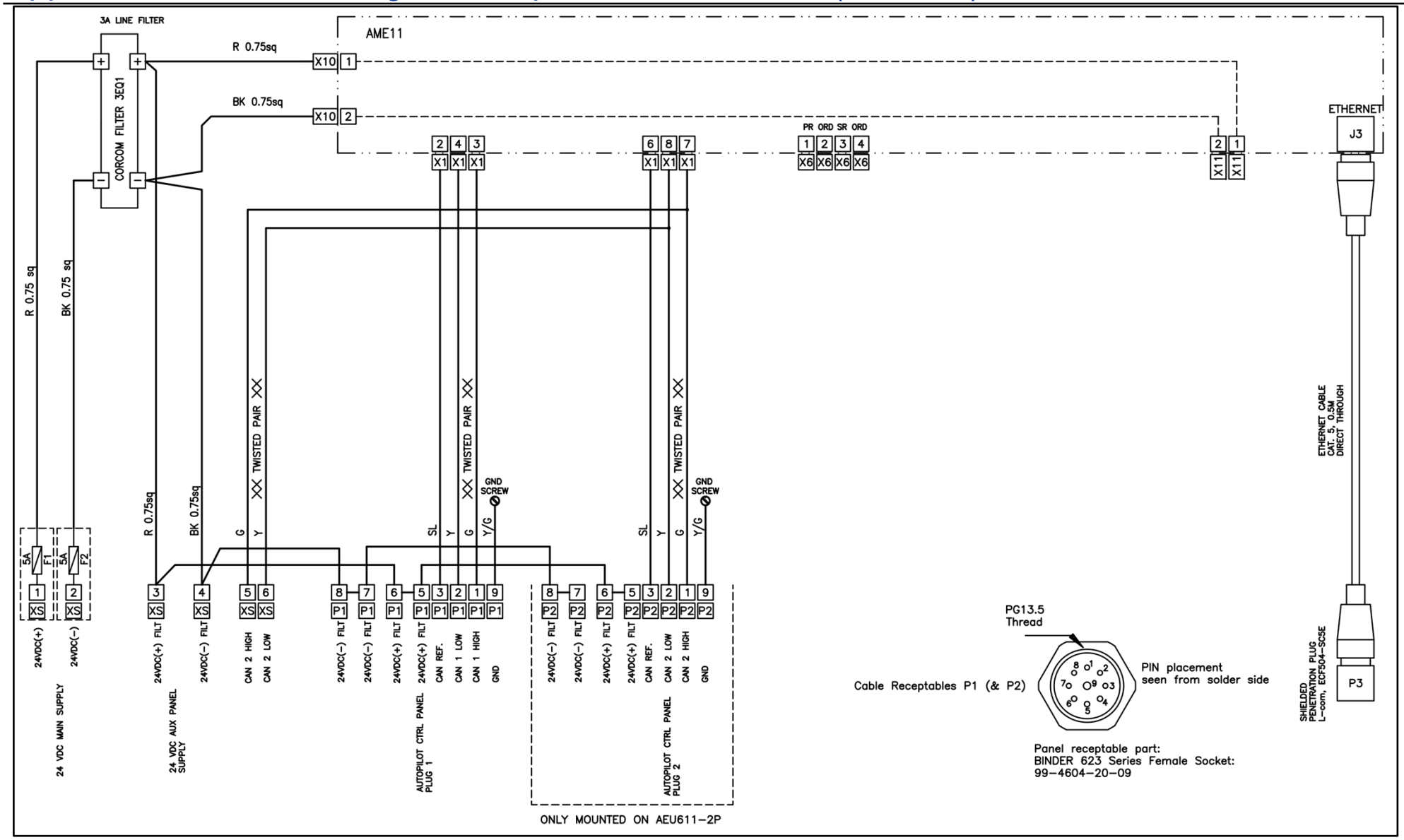
Appendix – Dimensions for Autopilot Control Panel, FURUNO type (MIP241)



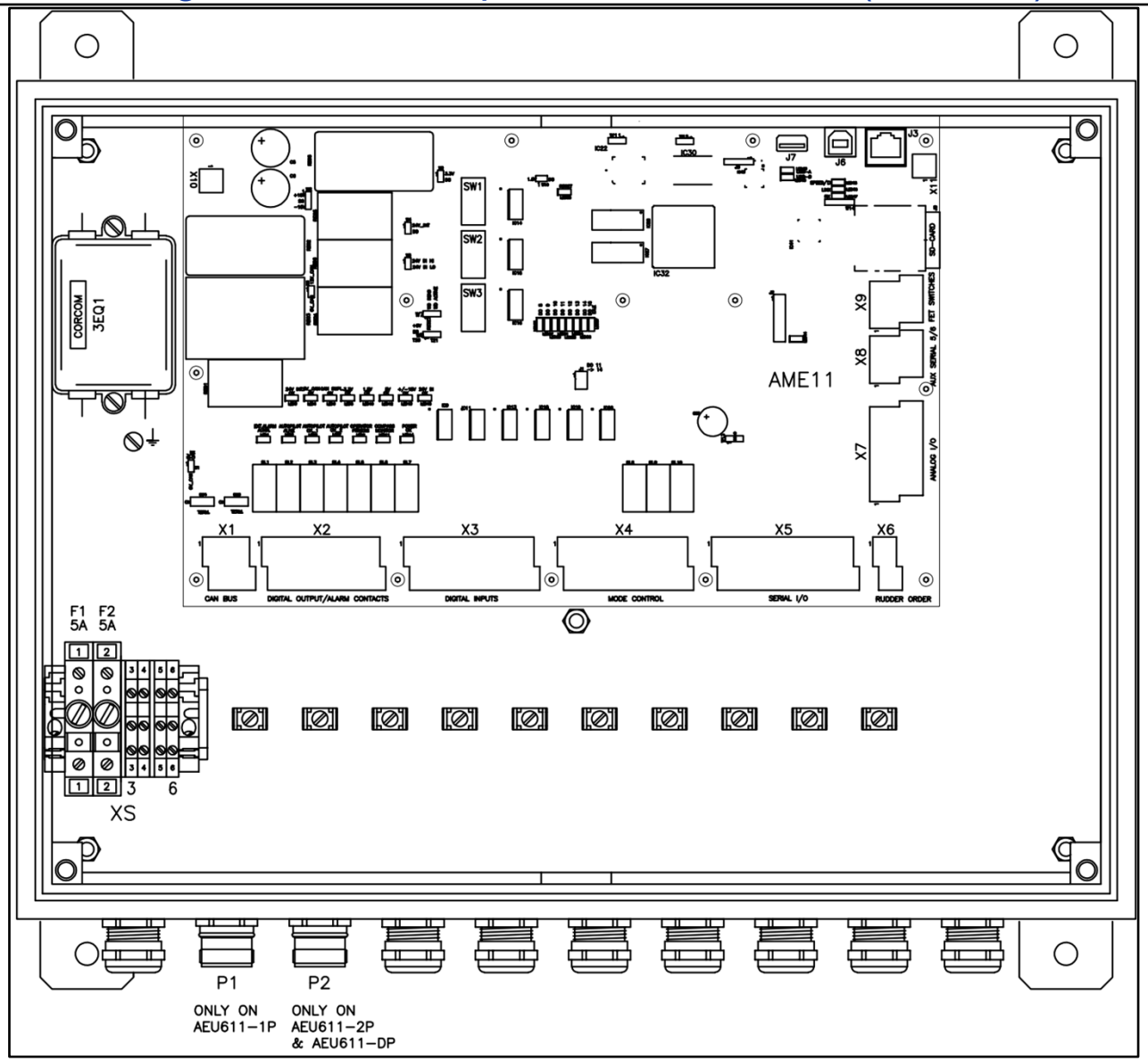
Appendix – Dimensions for Autopilot Control Panel, EMRI type (MIP211)



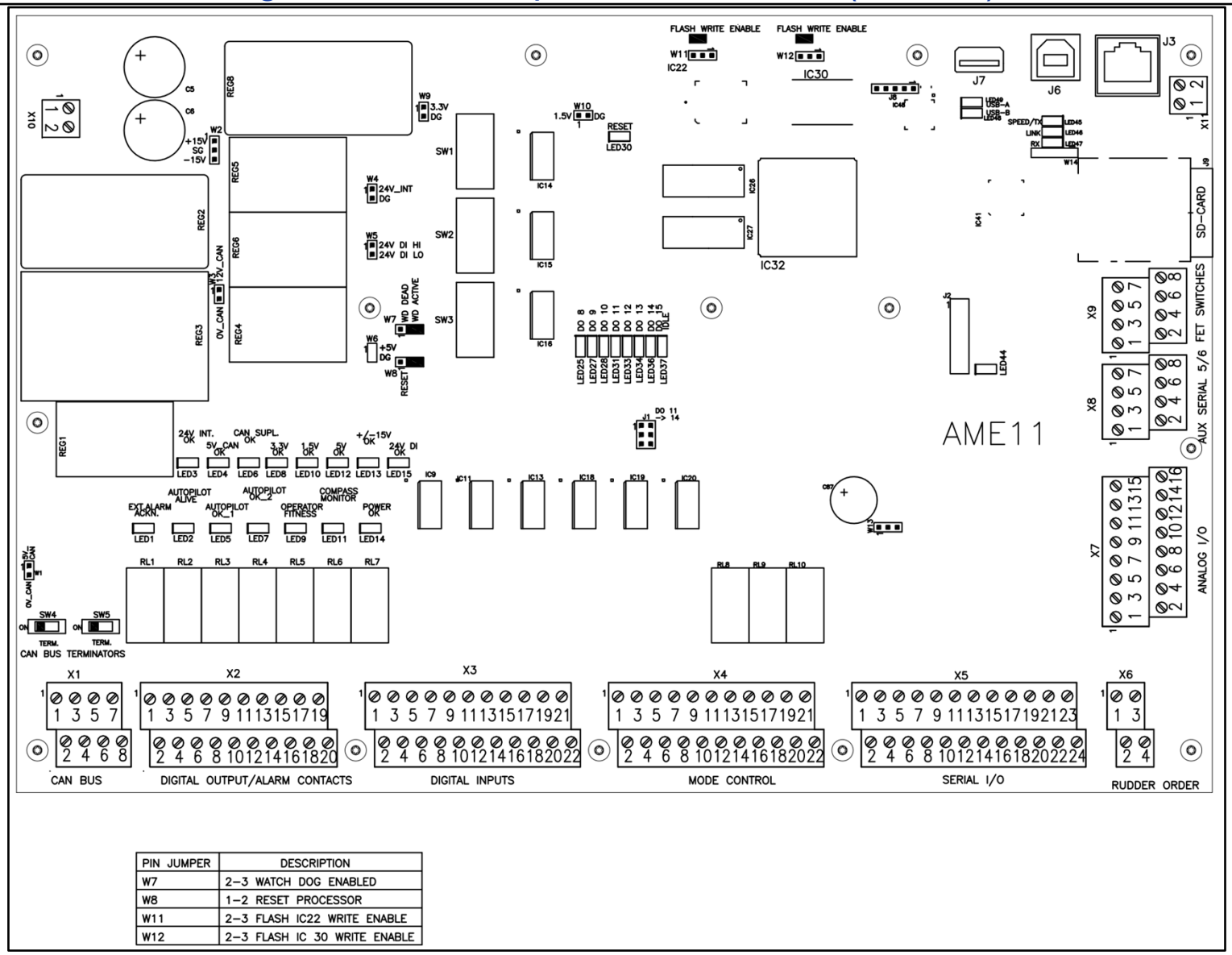
Appendix – Internal Wiring for Autopilot Electronic Unit (AEU611)



Appendix – Internal Arrangement for Autopilot Electronic Unit (AEU611)

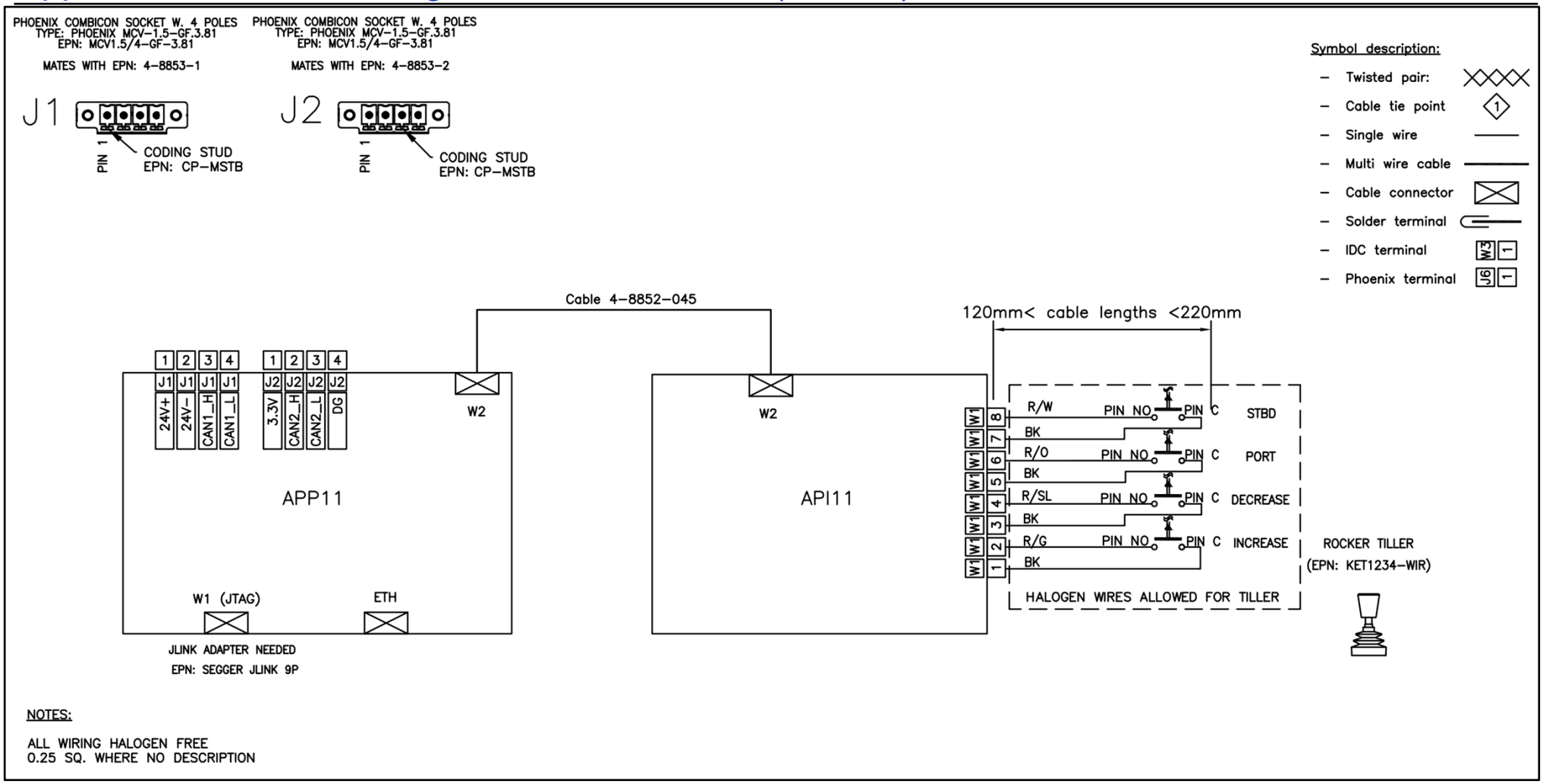


Appendix – Internal Arrangement for Autopilot Motherboard (AME11)

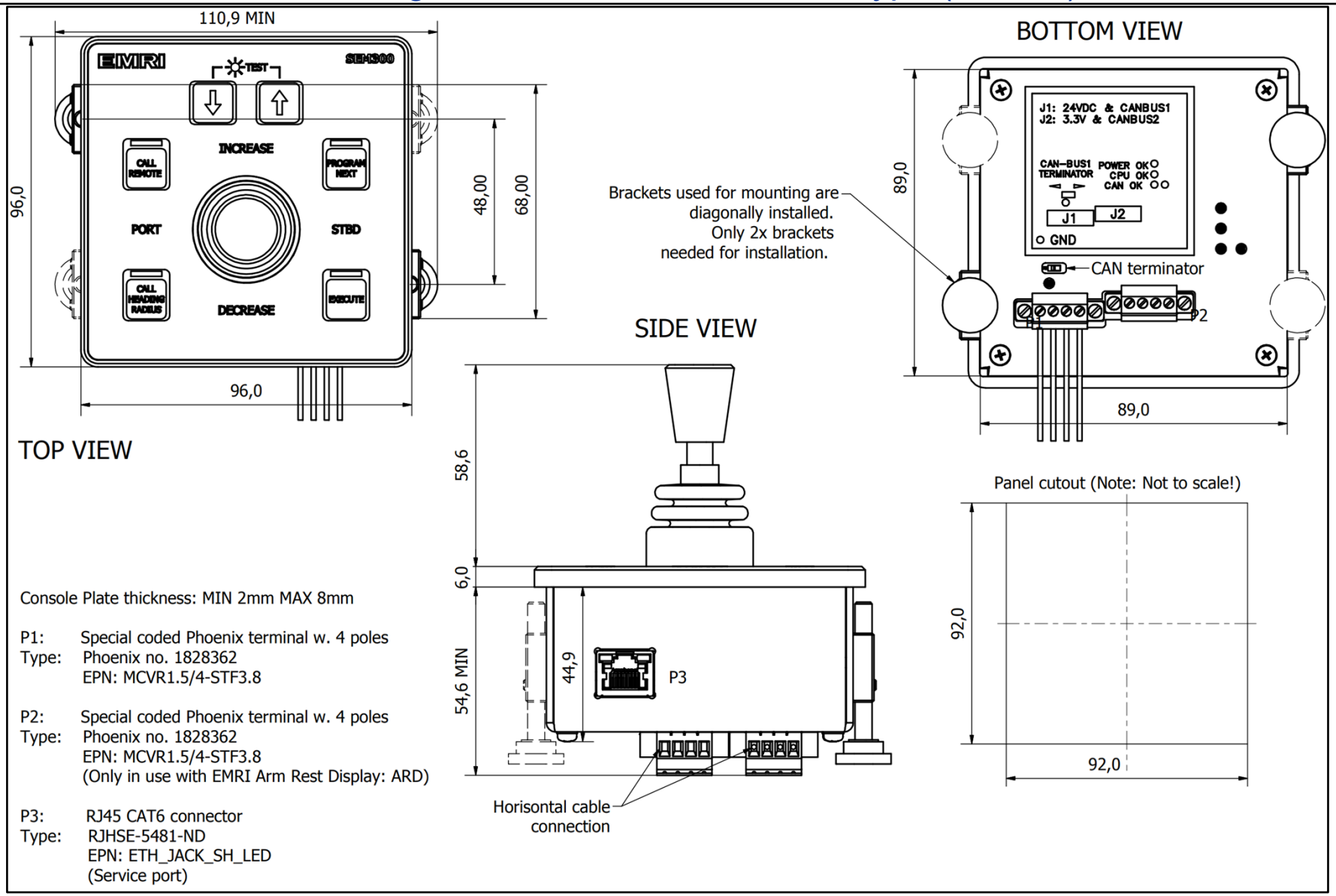


PIN JUMPER	DESCRIPTION
W7	2–3 WATCH DOG ENABLED
W8	1–2 RESET PROCESSOR
W11	2–3 FLASH IC22 WRITE ENABLE
W12	2–3 FLASH IC 30 WRITE ENABLE

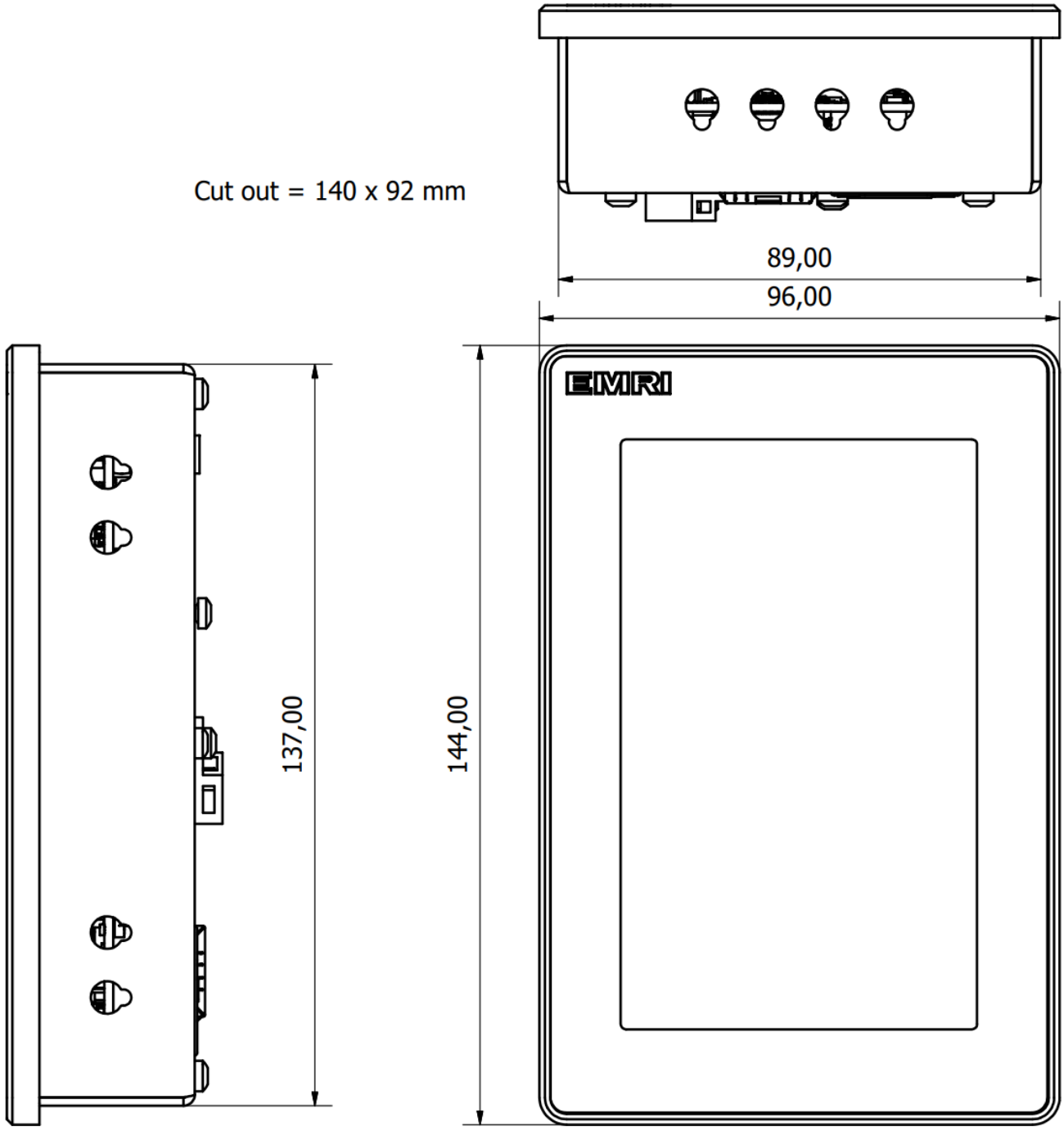
Appendix – Internal Wiring for Arm Rest Panel (ARP11)



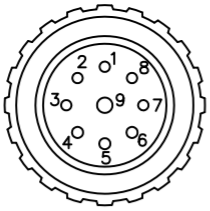
Appendix – Dimension Drawing for Arm Rest Panel, EMRI type (ARP11)



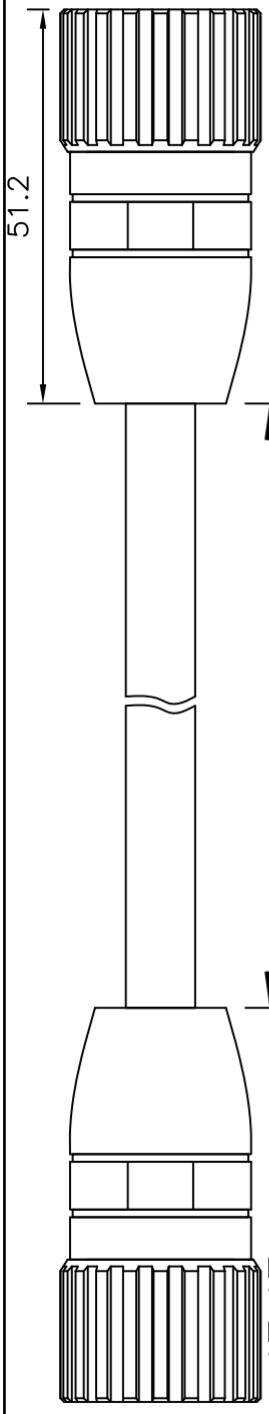
Appendix – Dimension Drawing for AutoPilot Mini Display



Appendix – Plug and Cable Specification (CE2MM-8-xxM)



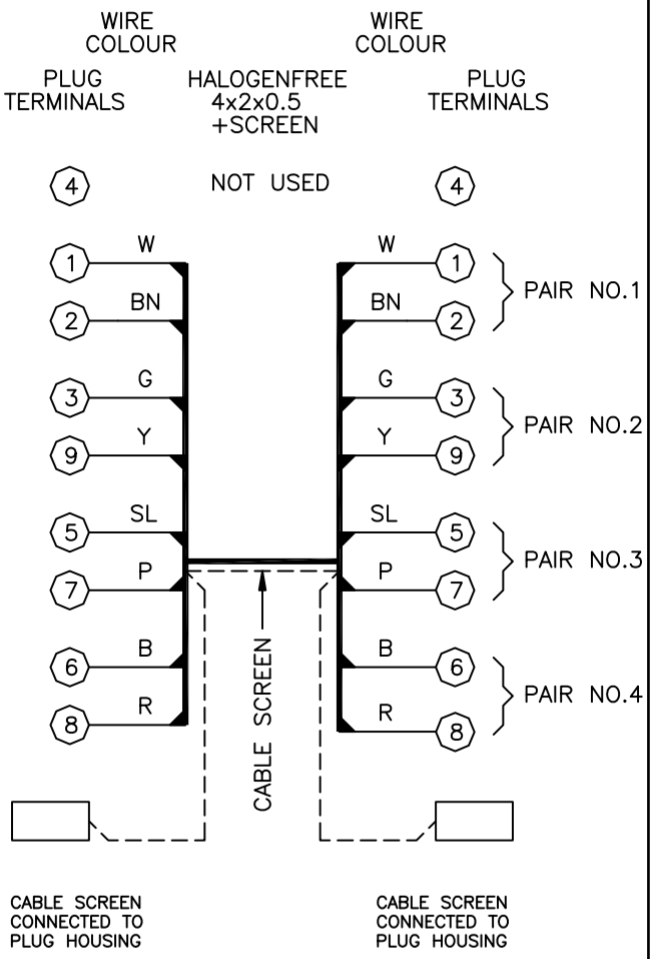
PIN placement seen from solder terminals.



Cable lenght: L

Standard length:
3, 5 & 8 meter.
On request:
10, 20 & 30 meter.

Min Bending Radius:
50 mm tied.
100 mm free.



PLUGS: BINDER Serie 623
Type 99-4619-00-09
Panel receptable part:
Type 99-4604-20-09

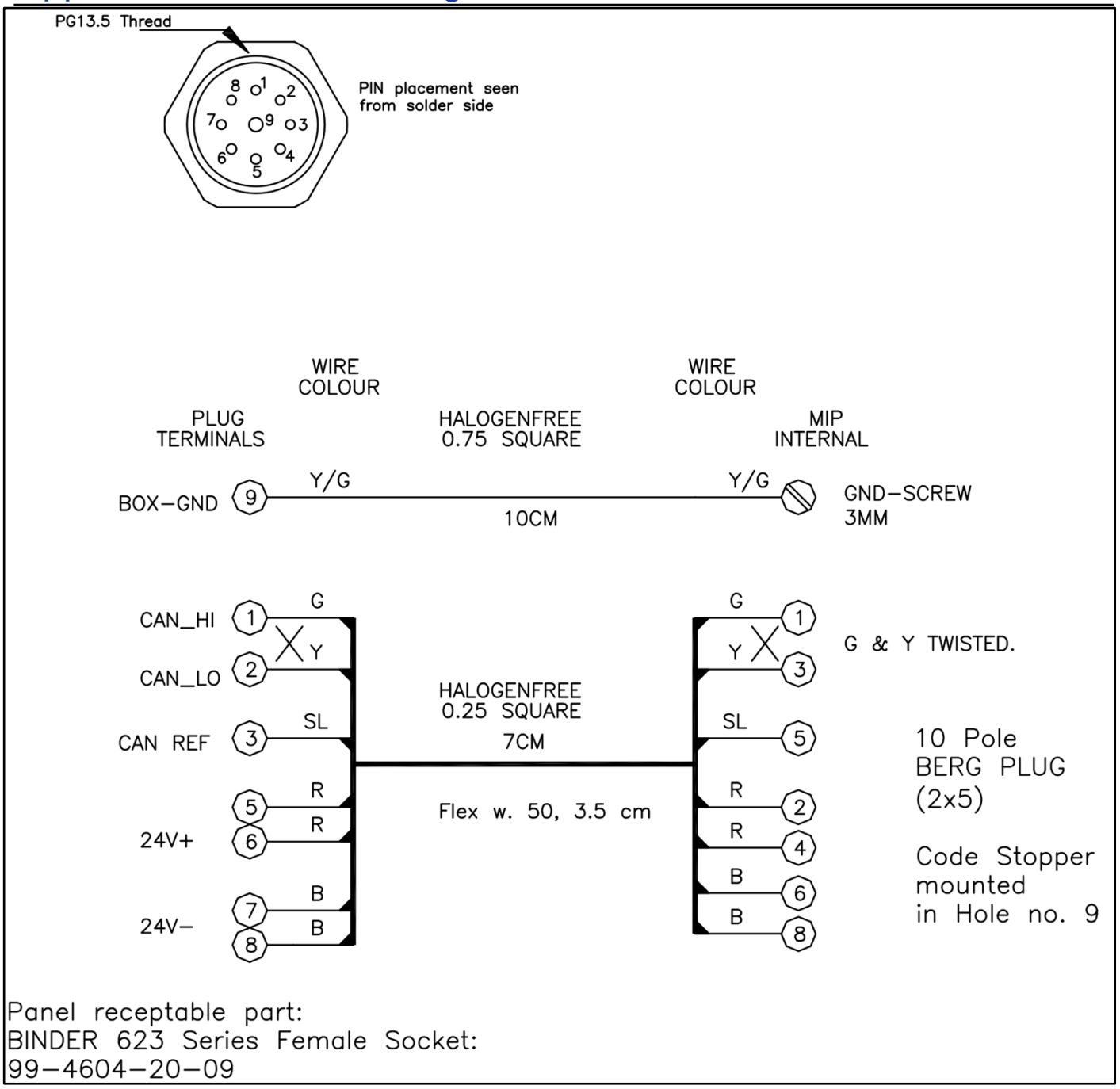
CABLE TYPE:
SAB BRÖCKSKES D-VIERSEN
SABTX D 345 FRNC TP, 4X2X0.5

ALTERNATIVE TYPE:
LI2YCH-P, 4-2-05

COLOUR CODE AFTER DIN 47100

TYPE NUMBER:
CE2MM-8-0XM, X=LENGHT IN METER

Appendix – Internal Wiring for MIP2xx Cable



Appendix – Terminal list for AEU with 2 Panels (AEU611-2P)

Connector	Terminal No.	Signal
XS	1	24VDC+
XS	2	24VDC
XS	3	AUX 24VDC+ OUT, FILTERED
XS	4	AUX 24VDC- OUT, FILTERED
XS	5	CAN 2 HIGH
XS	6	CAN 2 LOW
X1	1	12V CAN
X1	2	12VLO CAN
X1	3	CAN 1 HIGH
X1	4	CAN 1 LOW
X1	5	12V CAN
X1	6	12VLO CAN
X1	7	CAN 2 HIGH
X1	8	CAN 2 LOW
X2	1	AL ACKN. CONTACT IN
X2	2	AL ACKN. CONTACT IN
X2	3	AUTOP.ALIVE 1(CC-X2/4=OK)
X2	4	AUTOP.ALIVE 1(CC-X2/3=OK)
X2	5	AUTOP.ALIVE 2(CC-X2/6=OK)
X2	6	AUTOP.ALIVE 2(CC-X2/5=OK)
X2	7	AUTOP._OK 1(CC-X2/8=OK)
X2	8	AUTOP._OK 1(CC-X2/7=OK)
X2	9	AUTOP._OK 2(CC-X2/10=OK)
X2	10	AUTOP._OK 2(CC-X2/9=OK)
X2	11	OPR. ALIVE/W1-RESET CONT.
X2	12	OPR. ALIVE/W1-RESET CONT.
X2	13	COMPAS COMP. (CC-X2/14=OK)
X2	14	COMPAS.COMP. (CC-X2/13=OK)
X2	15	POWER OK (CC-X2/16=OK)
X2	16	POWER OK (CC-X2/15=OK)
X2	17	POWER OK (CC-X2/18=OK)
X2	18	POWER OK (CC-X2/17=OK)
X2	19	BUZZ.ACKN. IN
X2	20	BUZZ.ACKN. IN
X3	1	AUX. DI1 HIGH
X3	2	AUX. DI1 LOW
X3	3	AUX. DI2 HIGH
X3	4	AUX. DI2 LOW
X3	5	AUX. DI3 HIGH
X3	6	AUX. DI3 LOW
X3	7	GYRO CHO DI HIGH
X3	8	GYRO CHO DI LOW
X3	9	PORT RUDDER RDY F. AP DI H
X3	10	PORT RUDDER RDY F. AP DI L
X3	11	STBD RUDDER RDY F. AP DI H

Connector	Terminal No.	Signal
X3	12	STBD RUDDER RDY F. AP DI L
X3	13	AUX. DI4 HIGH
X3	14	AUX. DI4 LOW
X3	15	TWO PUMPS DI HIGH
X3	16	TWO PUMPS DI LOW
X3	17	GAIN COND.1 DI HIGH
X3	18	GAIN COND.1 DI LOW
X3	19	GAIN COND.2 DI HIGH
X3	20	GAIN COND.2 DI LOW
X3	21	PULSE LOG DI HIGH
X3	22	PULSE LOG DI LOW
X4	1	AP SELECT, MAIN PANEL ONLY
X4	2	AP SELECT, MAIN PANEL ONLY
X4	3	AP SELECT 1, MULTIPANEL
X4	4	AP SELECT 1, MULTIPANEL
X4	5	AP SELECT 2, MULTIPANEL
X4	6	AP SELECT 2, MULTIPANEL
X4	7	WHEEL SELECT DI
X4	8	WHEEL SELECT DI
X4	9	READY IN
X4	10	READY IN
X4	11	CTRL REQUEST 1 (CC X4-12)
X4	12	CTRL REQUEST 1 (CC X4-11)
X4	13	CTRL REQUEST 2 (CC X4-14)
X4	14	CTRL REQUEST 2 (CC X4-13)
X4	15	IN CTRL 1 CONT. (CC X4-16)
X4	16	IN CTRL 1 CONT. (CC-X4-15)
X4	17	IN CTRL 2 CONT. (CC X4-18)
X4	18	IN CTRL 2 CONT. (CC X4-17)
X4	19	AUTOP.RDY 1 OUT (CC-X4-20)
X4	20	AUTOP.RDY 1 OUT (CC X4-19)
X4	21	AUTOP.RDY 2 OUT (CC X4-22)
X4	22	AUTOP.RDY 2 OUT (CC X4-21)
X5	1	RXD1A 422 IN
X5	2	TXD1A 422 OUT
X5	3	RXD1B 422 IN
X5	4	TXD1B 422 OUT
X5	5	RXD2A 422 IN
X5	6	TXD2A 422 OUT
X5	7	RXD2B 422 IN
X5	8	TXD2B 422 OUT
X5	9	RXD3A 422 IN
X5	10	TXD3A 422 OUT
X5	11	RXD3B 422 IN
X5	12	TXD3B 422 OUT

Connector	Terminal No.	Signal
X5	13	RXD4A 422 IN
X5	14	TXD4A 422 OUT
X5	15	RXD4B 422 IN
X5	16	TXD4B 422 OUT
X5	17	RXD5A 422 IN
X5	18	TXD5A 422 OUT
X5	19	RXD5B 422 IN
X5	20	TXD5B 422 OUT
X5	21	RXD6A 422 IN
X5	22	TXD6A 422 OUT
X5	23	RXD6B 422 IN
X5	24	TXD6B 422 OUT
X6	1	RUDDER ORDER 1
X6	2	RUDDER ORDER 1 REF/ SG
X6	3	RUDDER ORDER 2
X6	4	RUDDER ORDER 2 REF/ SG
X7	1	RUDDER ORDER 1
X7	2	RUDDER ORDER 1 REF/ SG
X7	3	RUDDER ORDER 2
X7	4	RUDDER ORDER 2 REF/ SG
X7	5	+15VDC RUDDER FB POT 1
X7	6	WIPER RUDDER FB POT 1
X7	7	-15VDC RUDDER FB POT 1
X7	8	0V SG RUDDER FB POT 1
X7	9	+15VDC RUDDER FB POT 2
X7	10	WIPER RUDDER FB POT 2
X7	11	-15VDC RUDDER FB POT 2
X7	12	0V SG RUDDER FB POT 2
X7	13	ANALOG IN +/-10V, AI3
X7	14	ANALOG IN 0V SG, AI3
X7	15	ANALOG IN +/-10V, AI4
X7	16	ANALOG IN 0V SG, AI4
X8	1	RXD5A 422 IN (=X5.17)
X8	2	TXD5B 422 OUT (=X5.18)
X8	3	RXD5B 422 IN (=X5.19)
X8	4	TXD5B 422 OUT (=X5.20)
X8	5	RXD6A 422 IN (=X5.21)
X8	6	TXD6A 422 OUT (=X5.22)
X8	7	RXD6B 422 IN (=X5.23)
X8	8	TXD6B 422 OUT (=X5.24)
X9	1	24VDC SUPPLY
X9	2	0V DG SUPPLY
X9	3	FET DRIVER OUT1 (PORT SOL)
X9	4	FET DRIVER OUT1 (PORT SOL)
X9	5	FET DRIVER OUT2 (STBD SOL)

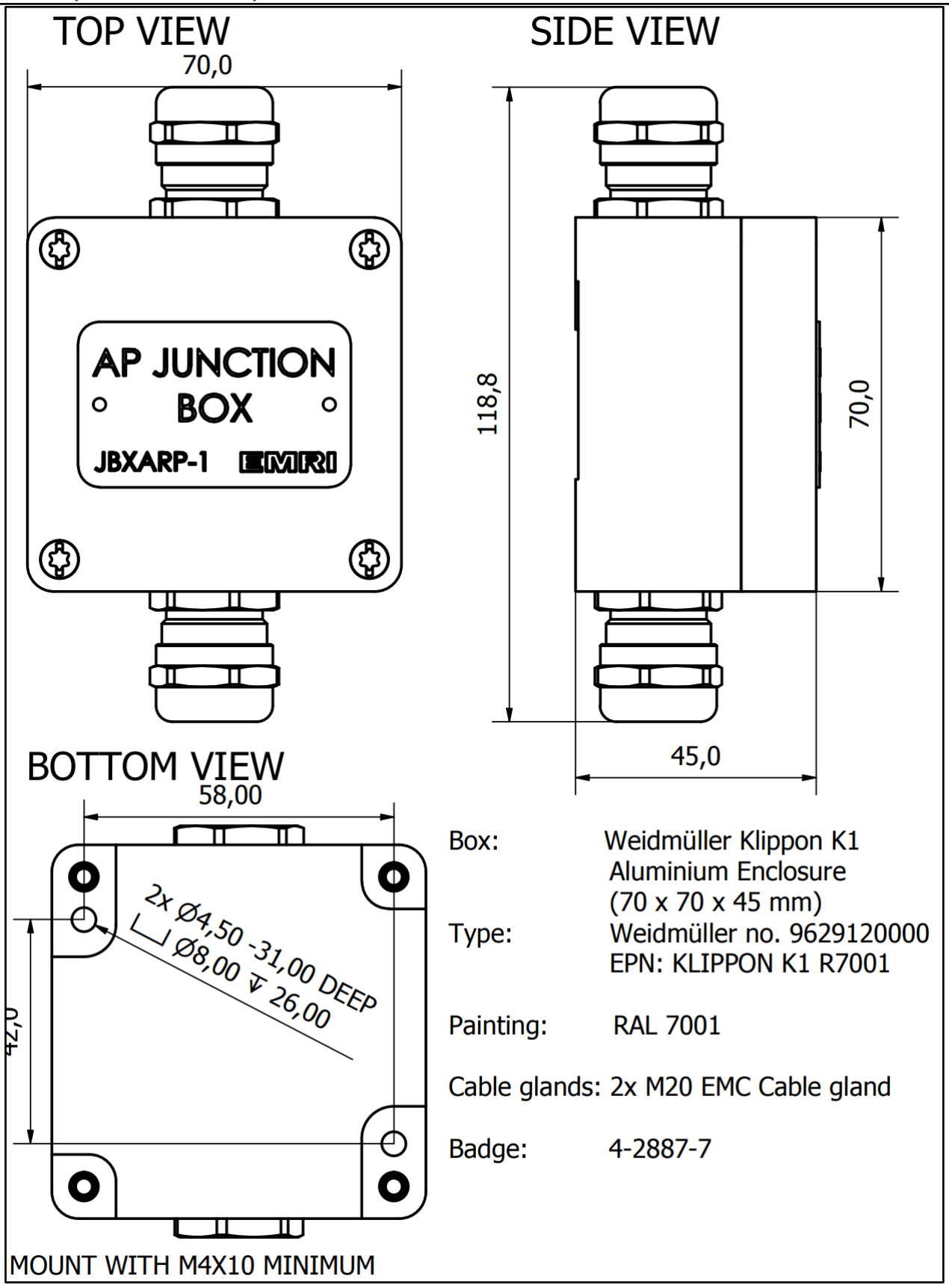
Connector	Terminal No.	Signal
X9	6	FET DRIVER OUT2 (STBD SOL)
X9	7	FET DRIVER OUT3 (AUX)
X9	8	FET DRIVER OUT3 (AUX)
X11	1	AUX 24VDC+ OUT, FILTERED
X11	2	AUX 24VDC- OUT, FILTERED
P1	1	CAN 1 HIGH
P1	2	CAN 1 LOW
P1	3	CAN 1 REF
P1	4	NOT USED
P1	5	24VDC+
P1	6	24VDC+
P1	7	24VDC
P1	8	24VDC
P1	9	GROUND
P2	1	CAN 2 HIGH
P2	2	CAN 2 LOW
P2	3	CAN 2 REF
P2	4	NOT USED
P2	5	24VDC+
P2	6	24VDC+
P2	7	24VDC
P2	8	24VDC
P2	9	GROUND

158 TERMINATIONS IN AEU611-2P = AUTOPILOT ELECTRONIC UNIT, 2PANELS

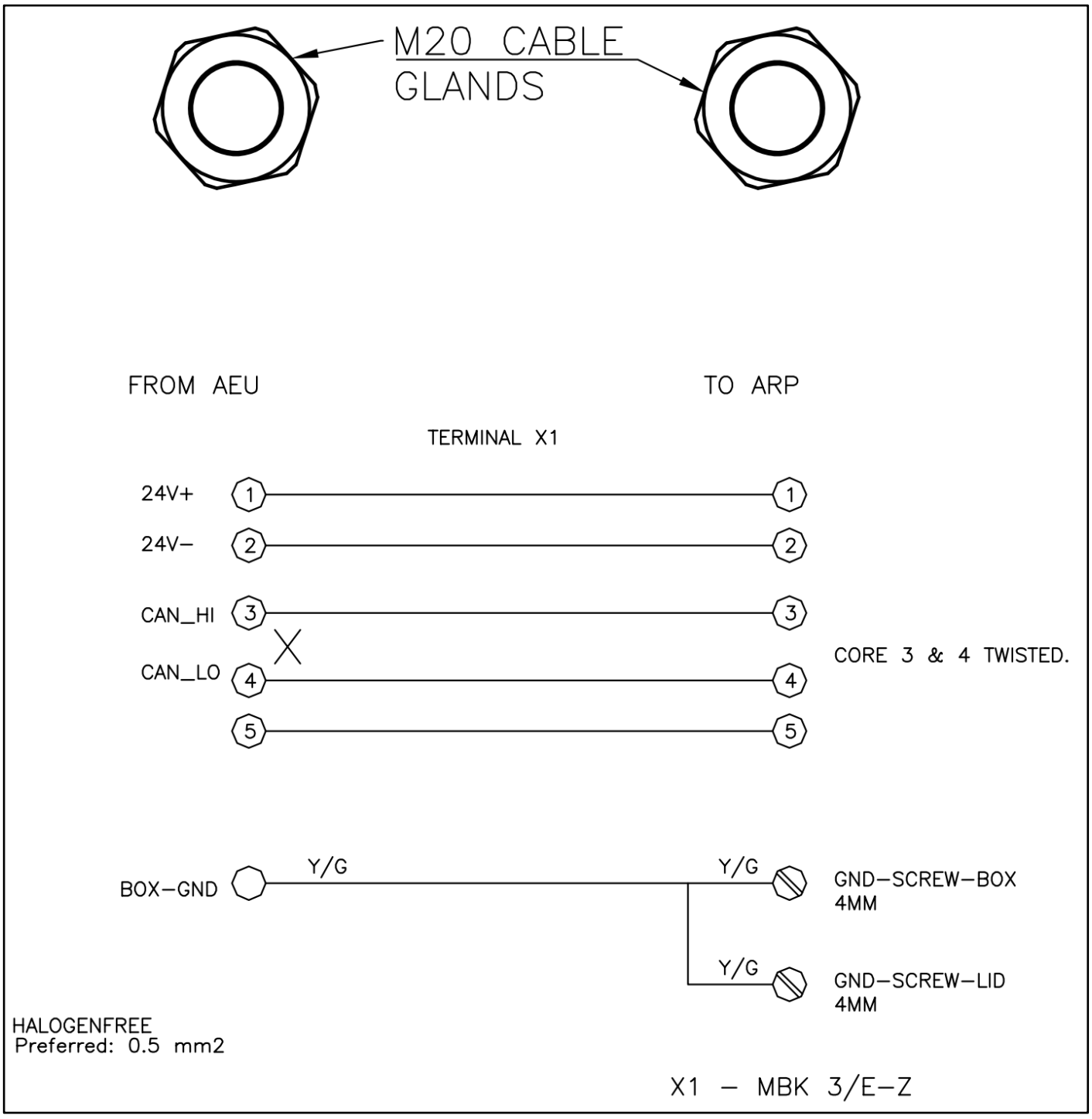
Appendix – Terminal list for Arm Rest Panel (ARPx1)

Connector	Terminal No.	Signal
P1	1	24V+
P1	2	24V-
P1	3	CAN1-HIGH
P1	4	CAN1-LOW
P2	1	+3.3V
P2	2	CAN2-HIGH
P2	3	CAN2-LOW
P2	4	DG (GND)

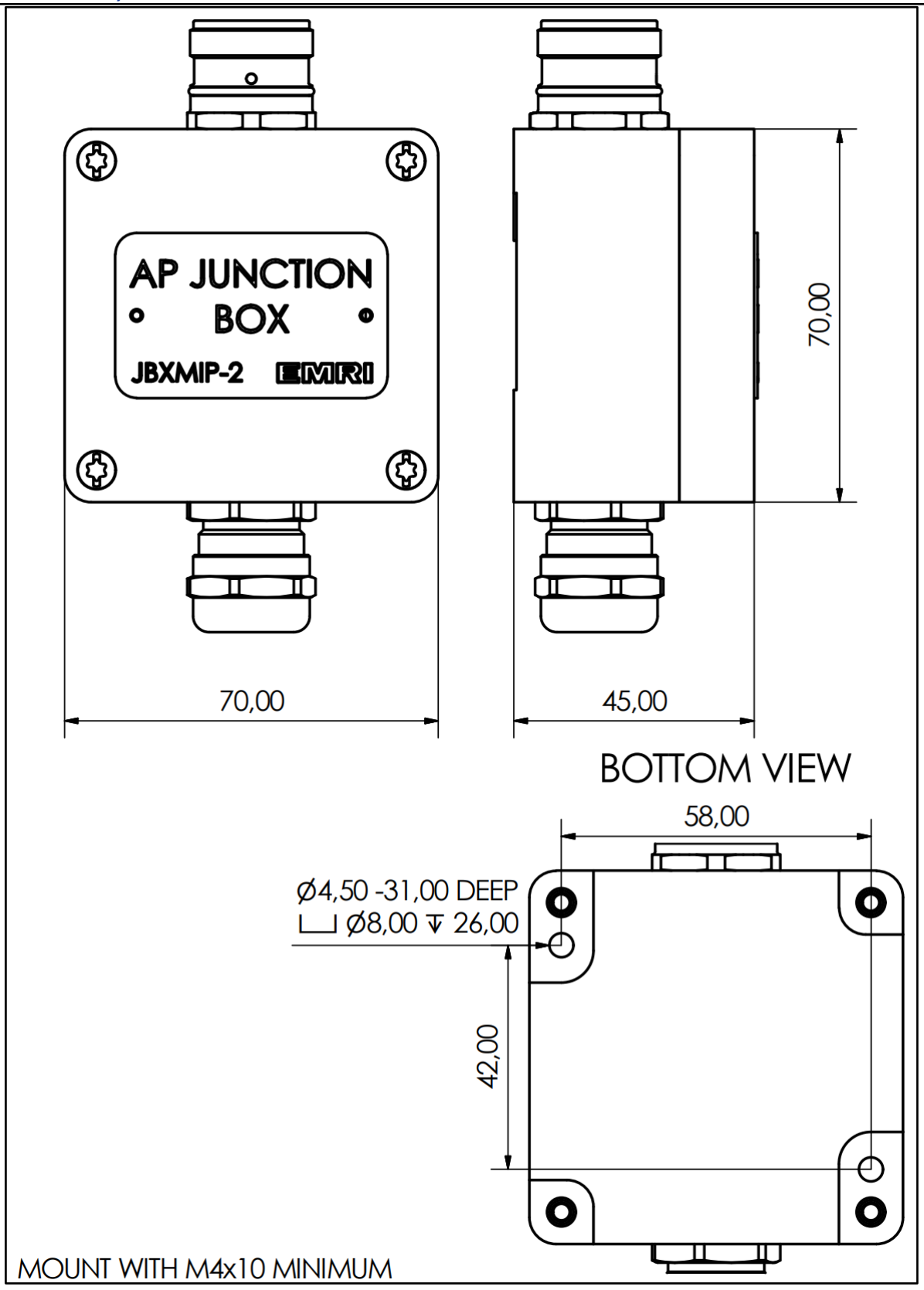
Appendix – Dimensions Drawing of Junction Box for Arm Rest Panel (JBXARP-1)



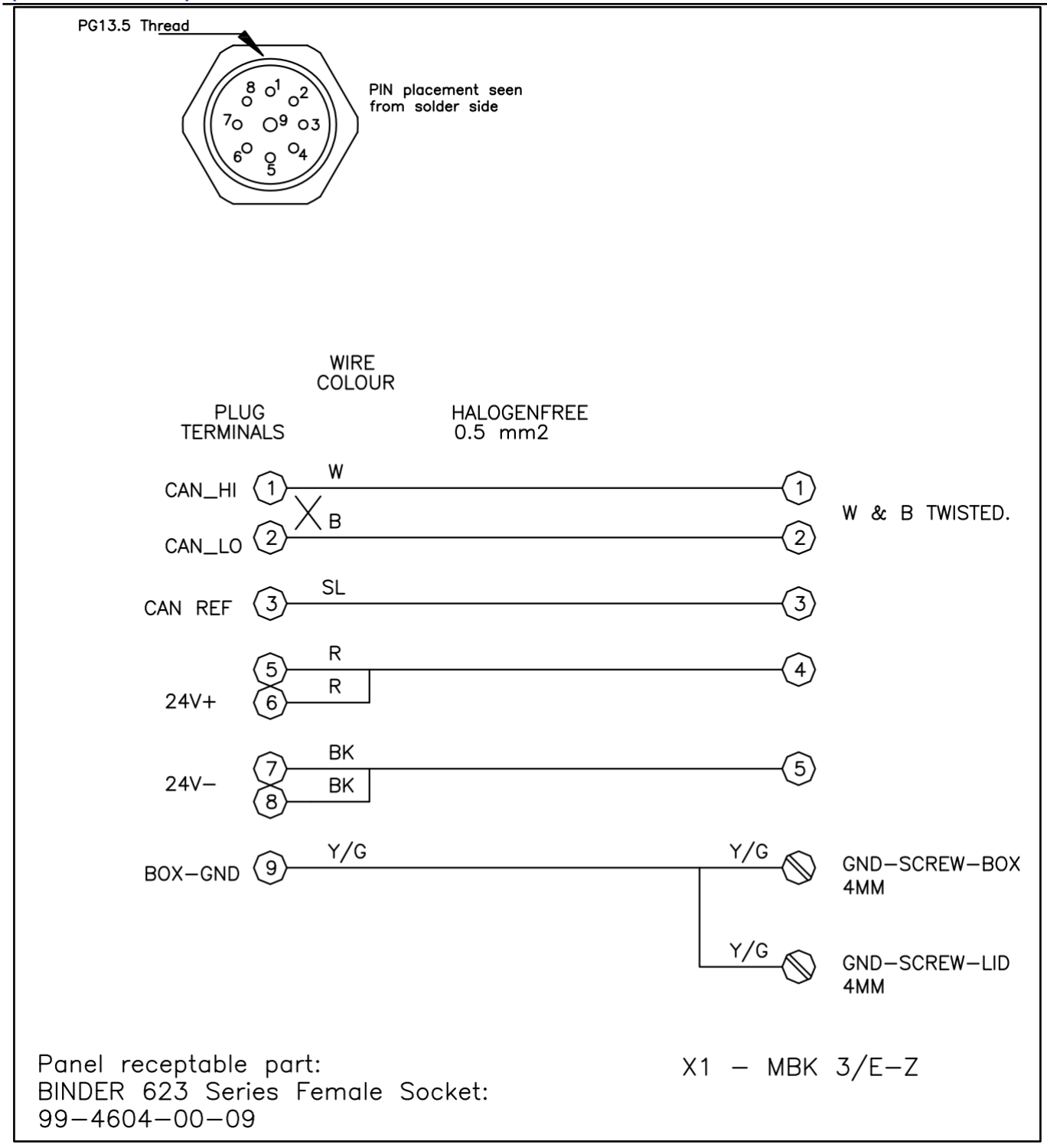
Appendix – Internal Wiring of Junction Box for Arm Rest Panel (JBXARP-1)



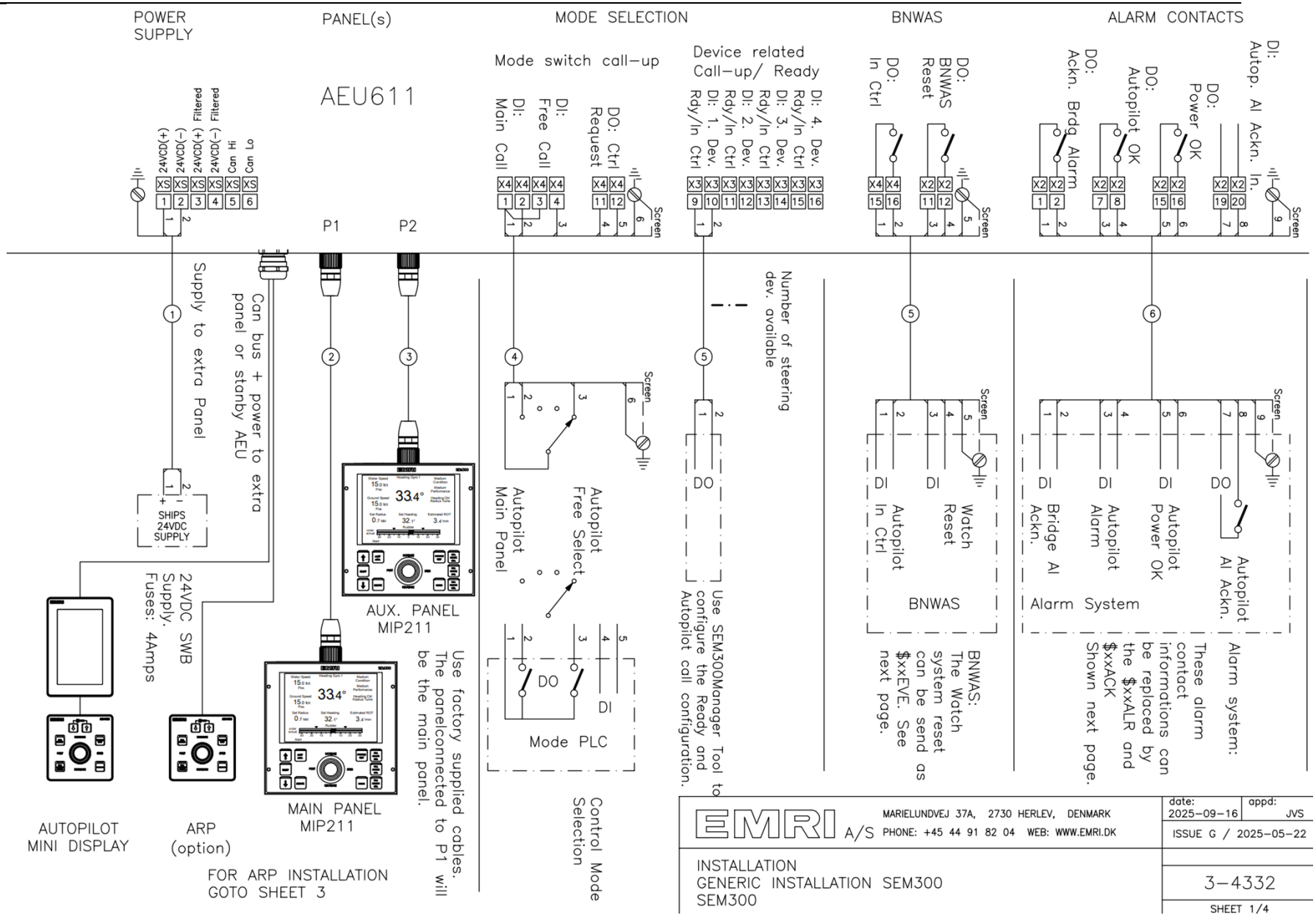
Appendix – Dimensions Drawing of Junction Box for MIP Panel (JBXMIP-2)



Appendix – Internal Wiring of Junction Box for MIP Panel (JBXMIP-2)



Appendix – Generic Installation of SEM300 / FAP-3000

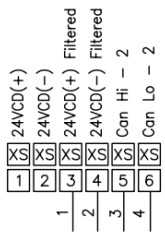


AEU611–P2xxx

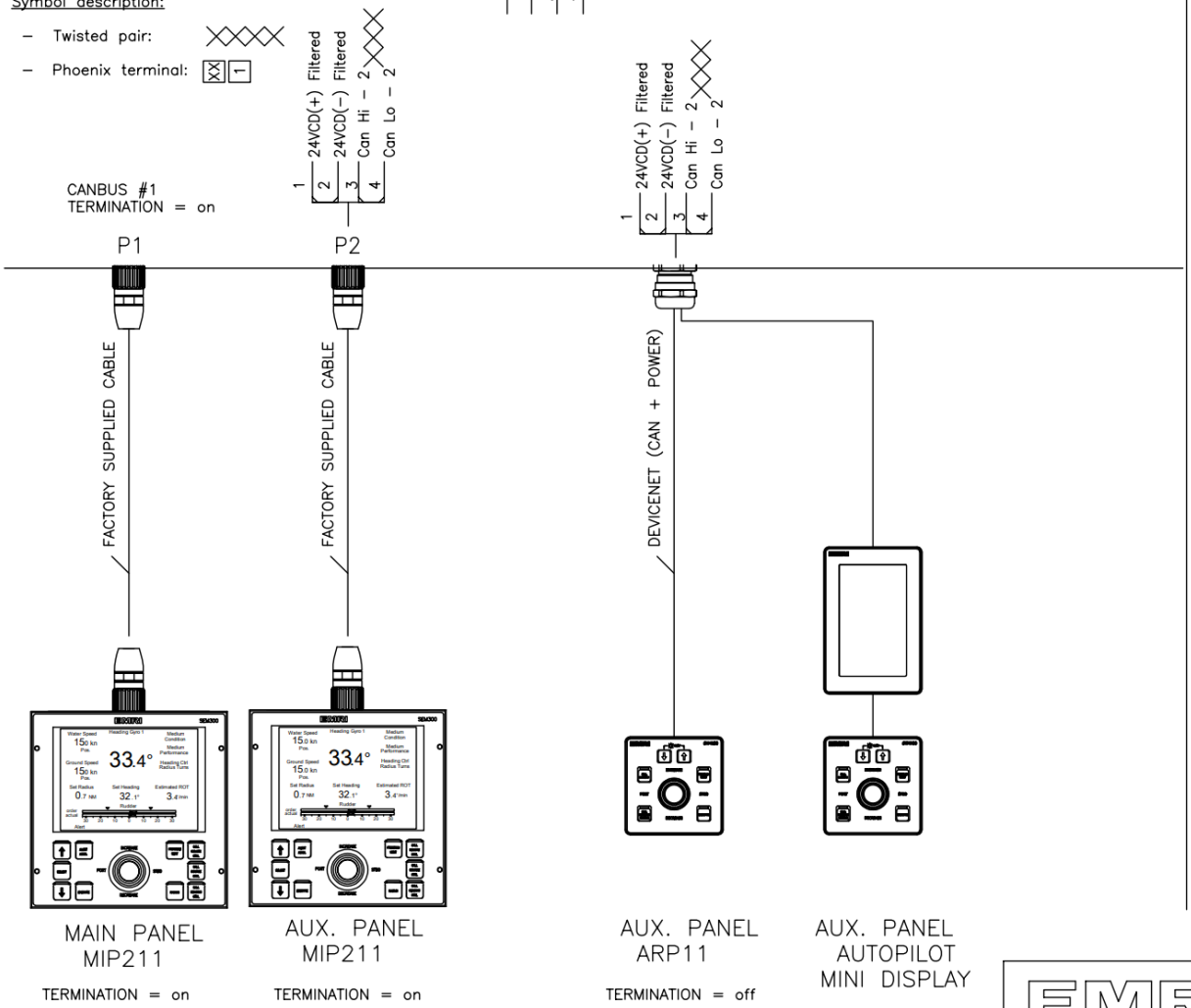
Example of CANBUS connection of one AEU611–P2xxx and two MIP and two ARP panels.

Symbol description:

- Twisted pair:
- Phoenix terminal: XS 1



CANBUS #2
TERMINATION = off



TERMINATION = on

TERMINATION = on

TERMINATION = off

Optional: Junction boxes for each ARP panel can be installed in between the panels and the AEU.

Cables must be screened. Connect screen in both ends to BOX–GND

In the AEU611–P2xxx P1 is connected to CANBUS line 1 and P2 is connected to CANBUS line 2 together with XS.

To add a second ARP panel, the CANBUS line 2 must be daisychained, and the termination on the first ARP panel must be set to OFF. The MIP panel must be set to Termination = ON, in order to terminate one end of CANBUS line 2, the AEU CANBUS line 2 must be set to OFF as the AEU now resides in the middle of the bus. The last ARP panel must set to termination = ON to finish the line.

The second CANBUS connection on the ARP panel only supplies 3V, so in order to power a second ARP a junction box with power inject must be installed between the two ARP panels.

If more ARP panels are required, they can be daisychained to the last ARP panel on the drawing via another junctionbox with power inject. If more panels are added, make sure to lidt the termination on all but the last panel in the chain, so that the setup complies with ISO11989–2.

EMRI A/S MARIELUNDVEJ 37A, 2730 HERLEV, DENMARK
PHONE: +45 44 91 82 04 WEB: WWW.EMRI.DK

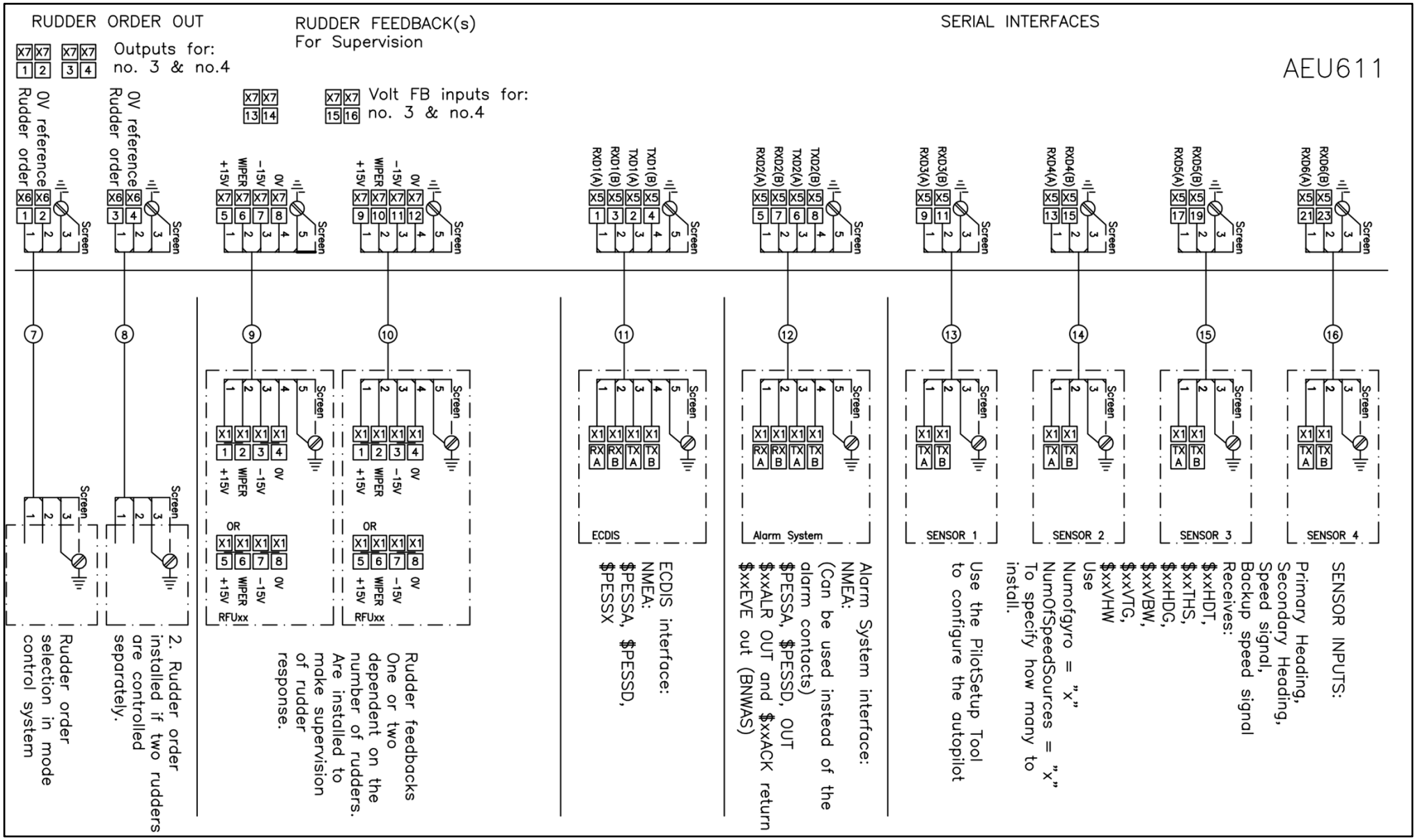
date:	appd:
2025–11–06	JVS

–

INSTALLATION
GENERIC INSTALLATION SEM300
SEM300

3–4332

SHEET 3/4


AEU611
SERIAL INTERFACES
RUDDER FEEDBACK(s)
For Supervision
RUDDER ORDER OUT
Outputs for:
no. 3 & no.4
Volt FB inputs for:
no. 3 & no.4
0V reference
Rudder order
Screen
SENSOR INPUTS:
Primary Heading,
Secondary Heading,
Speed signal,
Backup speed signal
Receives:
$xxHDT,
$xxTHS,
$xxHDG,
$xxVBW,
$xxVTG,
$xxVHW
Use
Numofgyro = "x"
NumOfSpeedSources = "x"
To specify how many to install.
SENSOR_4
SENSOR_3
SENSOR_2
SENSOR_1
Use the PilotSetup Tool
to configure the autopilot
Alarm System interface:
NMEA:
(Can be used instead of the alarm contacts)
$PESSA, $PESSD, OUT
$xxALR OUT and $xxACK return
$xxEVE out (BNWAS)
Alarm System
ECDIS interface:
NMEA:
$PESSA, $PESSD,
$PESSX
ECDIS
Rudder feedbacks
One or two
dependent on the
number of rudders.
Are installed to
make supervision
of rudder
response.
RFUxx
2. Rudder order
installed if two rudders
are controlled
separately.
Rudder order
selection in mode
control system
OR