



# INSTALLATION MANUAL



## **SIMRAD AP50**

Autopilot  
Standard System

20222469/B

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English

## About this document

Rev. A	First issue. The former Instruction Manual P/N 20221032 Rev. C has been splitted into one Operator Manual and one Installation Manual. Manuals are updated according to software version 1.3. S9 Steering Lever has been included. QS50 and JD5X are added to the Technical Specifications. TI50 is replaced by TI51.
Rev. B	Minor corrections.

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# ***Installation Manual***

This manual is intended as a reference guide for the correct installation and commissioning of the Simrad AP50 autopilot.

Great care has been taken to simplify the installation set-up of the AP50; however, an autopilot is a complex electronic system and particular attention has to be paid by the installer.

Please take the time to read this manual together with the Operator Manual to gain a thorough understanding of the Simrad AP50 autopilot system components and operation, as well as their relationship to a complete AP50 autopilot system.

## Contents

<b>1</b>	<b>GENERAL INFORMATION .....</b>	<b>1</b>
1.1	Introduction .....	1
1.2	How to Use This Manual .....	2
<b>2</b>	<b>INSTALLATION .....</b>	<b>3</b>
2.1	General.....	3
2.2	Unpacking and Handling .....	3
2.3	Installation Index .....	3
2.4	Determining System Configuration.....	4
2.5	AP50 System Layout .....	5
2.6	RF300 Rudder Feedback Unit .....	6
2.7	RF45X Rudder Feedback Unit .....	8
	Electrical Connection .....	9
	Mechanical Alignment .....	11
2.8	RF14XU Rudder Feedback Unit .....	12
	Mechanical mounting .....	12
	Electrical installation .....	12
	Final check.....	16
2.9	J50 Junction Unit .....	16
	Cable Connections .....	16
	Grounding and Radio Frequency Interface (RFI).....	17
	Junction Unit Terminals .....	18
	System Select.....	18
	Autopilot Mode Control (AUTO/STANDBY Toggling).....	19
	External Alarm (Non Wheelmark System).....	19
	External Alarm (Wheelmark System) .....	20
2.10	Drive Unit Installation .....	20
	Connecting a Reversible Pump.....	22
	Connecting a Hydraulic Linear Drive.....	23
	Connecting Solenoid Valves .....	23
	Solenoids (externally powered, common positive).....	23
	Solenoids (externally powered, common negative).....	24
	Solenoids (not externally powered) .....	24
2.11	Control Unit.....	25
	Panel-mounting.....	25
	Optional Bracket mounting .....	25
	Robnet Units and Robnet Network Cables.....	26
	AP51 Remote Control Connection .....	29
	AP51 in a Wheelmark System .....	29

JP21 Jack Point Installation .....	29
2.12 RC25 Rate Compass .....	30
RFC35 Fluxgate Compass .....	32
2.13 FU50 Steering Lever .....	33
2.14 TI51 Thruster Interface.....	33
2.15 AD50 Analog Drive.....	33
2.16 S9 Steering Lever .....	33
Mounting .....	33
Connection.....	34
2.17 Remote Control.....	36
2.18 JS10 Joystick .....	37
2.19 S35 NFU Steering Lever .....	37
2.20 F1/2 Remote Control .....	38
2.21 Interfacing to Optional Equipment (THD, Navigation Receiver, etc.).....	38
Single NMEA input/output.....	39
Double NMEA input/output .....	39
Input from “NMEA Compass” .....	40
Radar Clock/Data .....	40
Analog Heading Repeater.....	41
Digital Heading Repeater .....	41
GI51 Gyro Interface.....	41
NI300X NMEA Interface Unit.....	42
CD100A Course Detector.....	43
CDI35 Interface .....	44
CD109 Course Detector.....	44
<b>3 SOFTWARE SET-UP PROCEDURE .....</b>	<b>45</b>
3.1 Description of Installation Set-up.....	45
3.2 Installation Menu .....	46
Language selection .....	47
Dockside .....	47
Master Operation .....	49
Boat Type.....	49
Boat Length.....	49
Drive Unit Voltage.....	49
Rudder Feedback Calibration .....	50
Rudder Calibration.....	51
Rudder Test.....	52
Rudder Limit.....	53
Rudder Deadband.....	54
Thruster.....	54

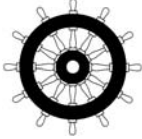
Interface Set-up.....	54
Sea Trial.....	61
Compass Calibration.....	62
Compass Offset.....	63
Set Thrust Direction, On/Off Thruster.....	64
Thruster Calibration, Analog Thruster.....	64
Thruster zero .....	64
Direction and Maximum Thrust STBD, Analog Thruster.....	65
Direction and Maximum Thrust PORT, Analog Thruster.....	65
Minimum Thrust, Analog Thruster.....	66
Speed source .....	66
Set Cruising Speed.....	67
Set Rudder Zero .....	67
Set Rate of Turn.....	67
Adjust rudder angle/Set rate of turn.....	68
Manual Tuning.....	69
Automatic tuning .....	70
Speed Response .....	72
3.3 Final Test.....	72
3.4 Providing User Training.....	73
<b>4 ADVANCED SETTINGS.....</b>	<b>75</b>
4.1 Service Menu.....	75
System Data.....	75
NMEA Data.....	76
NMEA Port Test (J50 hardware).....	77
Master Reset .....	77
4.2 Settings Menu.....	78
Steering.....	78
W Init rudder.....	78
W Autotrim .....	78
Autotrim.....	78
Course Adjust.....	79
Compass difference.....	79
Off Heading lim .....	79
Drive engage .....	80
Drive type.....	81
Drive out .....	81
Prop. gain .....	81
Seastate .....	81
Rudder.....	82

Counter rudder .....	82
W Seastate.....	82
W Rudder .....	82
W Count rudder.....	82
W Rudder limit .....	82
Cruising speed.....	82
Speed response.....	82
Transition Speed .....	83
Nav Gain .....	83
Minimum rudder .....	83
Turn mode .....	84
Rate of Turn .....	84
W Rate of Turn .....	84
Radius .....	84
W Radius.....	84
Added stop time .....	84
Init NAV .....	85
Turn Gain .....	85
W Turn Gain .....	85
Rate Sensitivity .....	85
Thruster.....	86
Thruster inhibit.....	86
Thruster sensitivity.....	86
Thruster gain .....	86
Minimum thrust .....	87
Thruster hyst .....	87
Thruster Drive.....	88
Response delay.....	88
<b>5 SPARE PARTS LIST .....</b>	<b>91</b>
<b>6 TECHNICAL SPECIFICATIONS .....</b>	<b>95</b>
6.1 AP50 Autopilot System .....	95
6.2 AP50 Control Unit.....	96
6.3 AP51 Remote Control .....	97
6.4 Junction Units .....	98
6.5 RC25 Rate Compass .....	99
6.6 CDI35 Course Detector Interface .....	100
6.7 CD100A Course Detector .....	101
6.8 CD109 Course Detector.....	101
6.9 RF300 Rudder Feedback Unit .....	102
6.10 RF45X Rudder Feedback Unit .....	103

6.11	RF14XU Rudder Feedback Unit .....	103
6.12	NI300X NMEA Interface .....	105
6.13	TI51 Thruster Interface.....	106
6.14	AD50 Analog Drive.....	106
6.15	R3000X Remote Control .....	107
6.16	S9 Steering Lever .....	108
6.17	Environmental Protection .....	109
6.18	NMEA Sentences .....	109
<b>7</b>	<b>INDEX.....</b>	<b>111</b>
<b>8</b>	<b>APPROVALS .....</b>	<b>115</b>
8.1	Product compliance schemes.....	115
	CE mark .....	115
	Wheelmark.....	115
8.2	Certificates.....	116

# 1 GENERAL INFORMATION

## 1.1 Introduction



The AP50 system is produced and tested in accordance with the European Marine Equipment Directive 96/98. This means that the AP50 complies with the highest level of tests for non-military marine electronic navigation equipment existing today.

The Marine Equipment Directive 96/98/EC (MED), as amended by 98/95/EC for ships flying EU or EFTA flags, applies to all new ships, to existing ships not previously carrying such equipment, and to ships having their equipment replaced.

This means that all system components covered by annex A1 must be type-approved accordingly and must carry the Wheelmark, which is a symbol of conformity with the Marine Equipment Directive.

While the AP50 may be installed on vessels not needing to comply with the Marine Equipment Directive, those requiring compliance must have one AP50 Control Unit set-up as a “master unit” in order for the installation to be approved. Simrad has no responsibility for the incorrect installation or use of the AP50 autopilot, so it is essential for the person in charge of the installation to be familiar with the relevant requirements as well as with the contents of this manual, which covers correct installation and use.

The purpose of the Marine Equipment Directive is to enhance safety at sea and to prevent marine pollution through the uniform application of the relevant international instruments relating to equipment listed in Annex A1.

As there are many interfacing requirements in the standards/codes, integrated systems and integrated certification lead to more efficient and effective management of safety, environmental, issues and quality.

The Marine Equipment Directive also constitutes a part of the International Safety Management (ISM) Code. The ISM Code was included as a new chapter (IX) of SOLAS in 1994, and is mandatory for: passenger ships not later than 1<sup>st</sup> of July, 1998; oil tankers; chemical tankers; gas carriers; bulk carriers and cargo high speed craft of 500 gross tonnage and upwards not later than 1<sup>st</sup> of July, 1998; and other cargo ships and mobile offshore drilling units of 500 gross tonnage and upwards not later than 1<sup>st</sup> of July, 2002.

It is required that both the shipping company and ships shall be certified by the Administration (the government of the state whose flag the ship is entitled to fly), by an organization recognized by the Administration or by the government of the country acting on behalf of the Administration.

## 1.2 How to Use This Manual

This manual is intended as a reference guide for installing and commissioning the Simrad AP50 autopilot. Great care has been taken to simplify the set-up and operation and of the AP50; however, an autopilot is a complex electronic system. It is affected by sea conditions, speed of the vessel, and vessel hull shape and size.

Please take the time to study the manual carefully together with the Operator Manual to get a thorough understanding of the autopilot system components and their relationship in a complete AP50 autopilot system.

Particularly when setting up and commissioning the system it is important to have both manuals at hand.

At the end of this manual, you will find an index and a glossary, which will help you when studying the manual.

Copies of approval certificates are included in the last section (8) of this manual.

## 2 INSTALLATION

### 2.1 General

This section provides detailed information required to properly install the AP50 Autopilot system.

The AP50 system includes several modules that need to be mounted in different locations on the vessel and that need to interface with at least three different systems on the boat:

- The boat's steering system
- The boat's electrical system (input power)
- Other equipment onboard (NMEA interfacing)

In addition, the advanced capabilities of the AP50 require the installer to perform a series of settings and tests to verify proper operation of the system (refer to the Installation Index below).

### 2.2 Unpacking and Handling

Care should be taken when unpacking and handling the equipment. A visual inspection should be made to ensure that the equipment has not been damaged during shipment and that all parts are present according to the packing list.

A standard scope of supply for a basic AP50 system may include:

- A control unit with standard installation accessories
- A junction unit (J50, J50-40) and one 15 m (49 ft.) Robnet cable
- An RC25 Rate Compass with one 15 m (49 ft.) cable attached
- An RF300 Feedback unit with one 10 m (33 ft.) cable attached and a transmission rod
- An appropriate drive unit for the installation (unless the AP50 is going to operate an existing drive unit)
- Any optional equipment that may have been ordered for the installation

### 2.3 Installation Index

1. Determine the system configuration to be installed (see page 4)
2. Perform the hardware installation (see page 6)
3. Connect the external NMEA devices (inputs and outputs; see page 39)
4. Set the language (see page 48)

5. Select the dockside settings and perform tests (see page 47)
  - a) Master operation
  - b) Boat type selection
  - c) Boat length selection
  - d) Drive unit voltage selection.
  - e) Rudder calibration
  - f) Automatic rudder test
  - g) Rudder limit
  - h) Rudder deadband
  - i) Thruster type (optional)
6. Interface set-up for Junction Unit, GI51 and NI300X (if installed; see page 54)
7. Select the settings in the User Set-up Menu for Speed source, Compass source, and Nav. source. Ref. AP50 Operator Manual.
8. Perform the autopilot pre-tests at the dock (refer to Operation Instructions in the AP50 Operator Manual)
  - a) Test all units (if applicable) - lock/unlock - active/inactive
  - b) Test the Non-Follow-up mode
  - c) Test the Follow-up mode
  - d) Test the AUTO mode
  - e) Test the AUTO-WORK mode
  - f) Test the NAV mode and input the interfaces (if connected), including optional heading sensors
  - g) Test NAV-WORK mode
  - h) Test the interface outputs to the external equipment (if connected)
9. Select the Sea trial settings (see page 61)
  - a) Compass calibration
  - b) Compass offset adjustment
  - c) Thruster adjustment (if connected)
  - d) Speed source
  - e) Set cruising speed
  - f) Set rudder zero
  - g) Set rate of turn (important)
  - h) Manual tuning
  - i) Automatic tuning
  - j) Speed response
10. Testing the autopilot operation at sea (refer to Final Test on page 72)
11. Provide the user with training (see page 73)

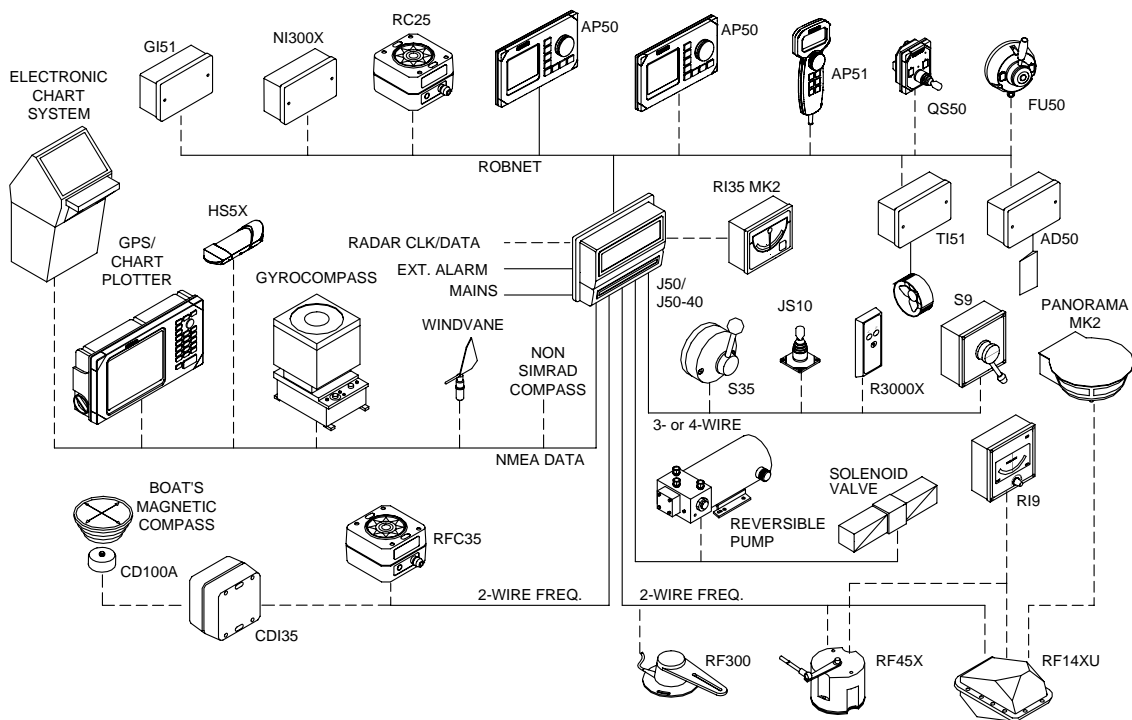
## 2.4 Determining System Configuration

It is important to become familiar with the configuration of the system prior to beginning the installation. Extended system with options is shown in Figure 2-1 on page 5.

Pay particular attention to the junction unit/drive unit combinations on page 21 and the cable length and number of Robnet units on page 27. Also refer to Junction Units in the AP50 Operator manual.

As many of the units are communicating on a common network (Robnet) with identical connectors, the installation is simplified. Mount the units within the standard cable length supplied with each unit, if possible (refer to Technical Specifications, section 4, beginning on page 91. Robnet Extension Cable (10m) is available from your Simrad distributor. Refer to the Spare Parts List on page 91 for part numbers.

## 2.5 AP50 System Layout



**Figure 2-1 AP50 Extended system with options**

**Note !** *The extended system layout does not show all possible layouts.*

## 2.6 RF300 Rudder Feedback Unit

(For small to medium size vessels)

The RF300 Rudder feedback unit mounts close to the rudders, and is mechanically linked to the rudder tiller arm or rudder quadrant (refer to Figure 2-2 on page 7 for the recommended mounting arrangement). Note that the RF300 transmitter arm has two slots for the transmission link. The slots enable maximum flexibility to provide the 1:1 mechanical linkage relationship.

**Note !**

*Do not try to remove the transmitter arm from the feedback unit. The unit is factory-adjusted and needs no further adjustment at installation than that described below.*

As a starting point, it is desirable to set the transmitter rod to the inner limit of the outer slot if possible (refer to Figure 2-2). Drill and tap the rudder tiller arm so that the Y1 dimension is equal to the Y2 dimension (Use 4.2 mm drill and 5 mm tap). Attach the ball joint to the tiller arm and connect the transmitter rod to the ball joint at the rudder tiller arm.

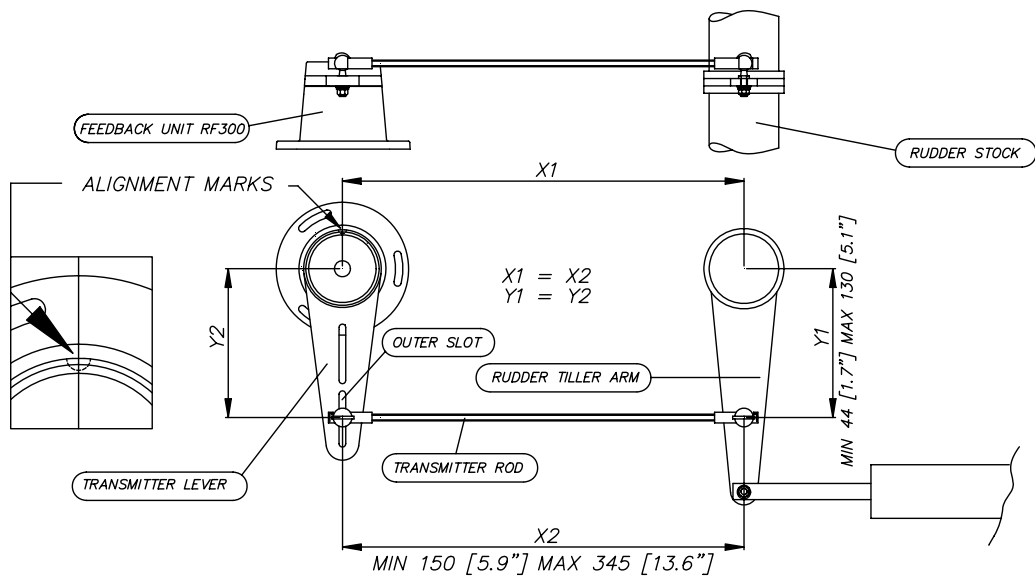
Turn the helm to set the rudder tiller arm to the approximate center position.

Rotate the RF300 transmitter lever until it is set to center position (use the alignment mark to line-up the transmitter lever to be opposite the cable entry into the feedback unit).

**Note !**

*Carefully observe the alignment marks. A rudder feedback alarm may result if the alignment instructions (as per Figure 2-2) are neglected.*

Attach the transmitter rod to the RF300. Mount the RF300 Rudder Feedback Unit in accordance with Figure 2-2. The center of the RF300 should be in line with the center of the rudderpost. Mount the RF300 to a suitable platform using the screws provided. If necessary, add blocking material under the RF300 to adjust the height of the transmission arm to be level with the rudder tiller arm.



**Figure 2-2 RF300 Rudder Feedback Unit Mounting (019356)**

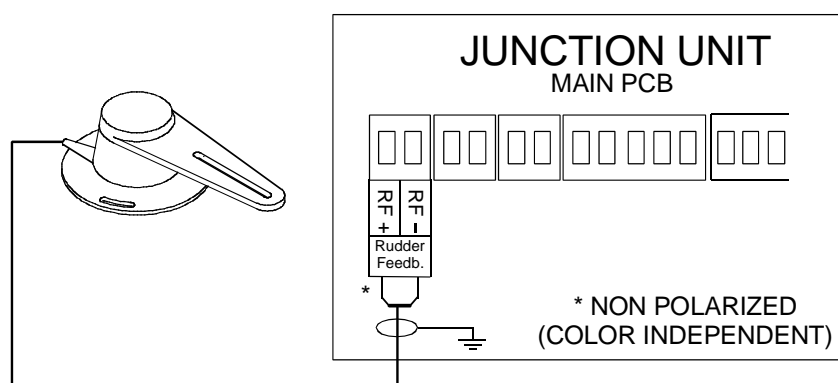
**Note !**

*Due to space limitations, it may be necessary to cut the length of the transmitter rod to move the RF300 closer to the rudderpost.*

Tighten the mounting screws for both the RF300 Rudder Feedback Unit and the transmitter rod ball joint.

Observe the RF300 unit while someone else turns the helm wheel through the complete travel from full port to full starboard rudder to verify that the mechanical linkage to the RF300 is not obstructed.

Connect the RF300 to the J50 Junction Unit as shown in Figure 2-3.

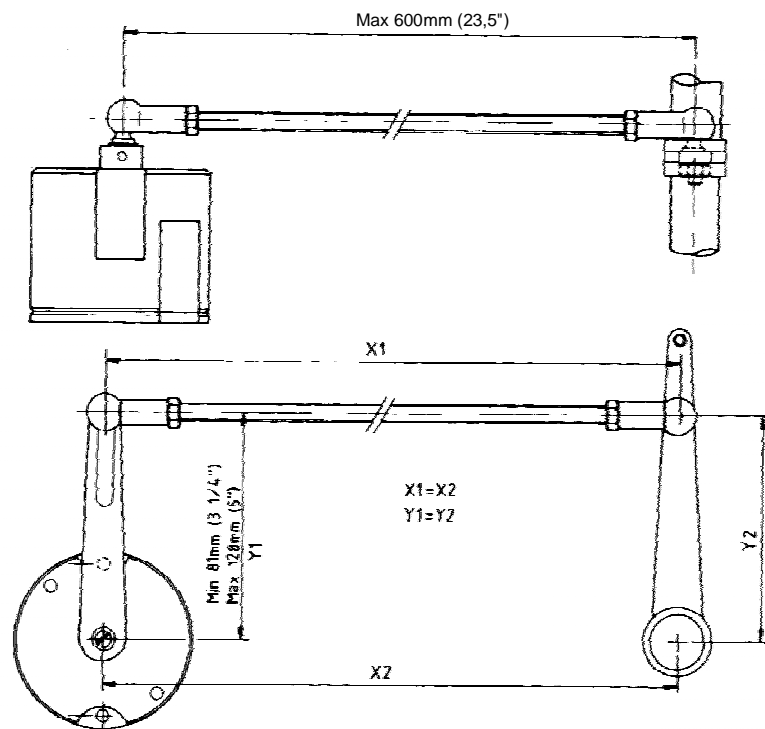


**Figure 2-3 RF300 Rudder Feedback Unit Connection**

## 2.7 RF45X Rudder Feedback Unit

(For medium to large size vessels)

The RF45X Rudder Feedback Unit is normally installed with the shaft pointing upwards. However, it can be mounted with the shaft pointing downwards for increased convenience. The deflection can then be inverted in the AP50 software or as illustrated in Figure 2-5 on page 9. An “upside-down” installation will make access to the unit more efficient as it can be opened without moving it from the mounting base. To open the unit, unscrew the two screws of the unit and remove the cover. Be careful not to damage the wires when you replace the cover.



**Figure 2-4 RF45X Rudder Feedback Unit Mounting**

Use the enclosed template (Drawing 22011225) to drill the required mounting holes. The unit is fastened to the mounting base by the two Allen screws enclosed (other types of screws may be used if it is to be fastened to another type of base, i.e. a wooden base).

Make the parallelogram configuration of the transmission link (see Figure 2-4) and temporarily fasten the link to the RF45X shaft. The transmission rod can be shortened by cutting off a piece using a hacksaw. Move the rudder manually hard over to hard over and make sure the transmission link is moving freely in both directions.

## Electrical Connection

Use a twisted-pair shielded cable, 0.5 mm<sup>2</sup> (AWG20), between the breakout box and the J50 Junction Unit. The cable length is not critical but should be kept to a minimum.

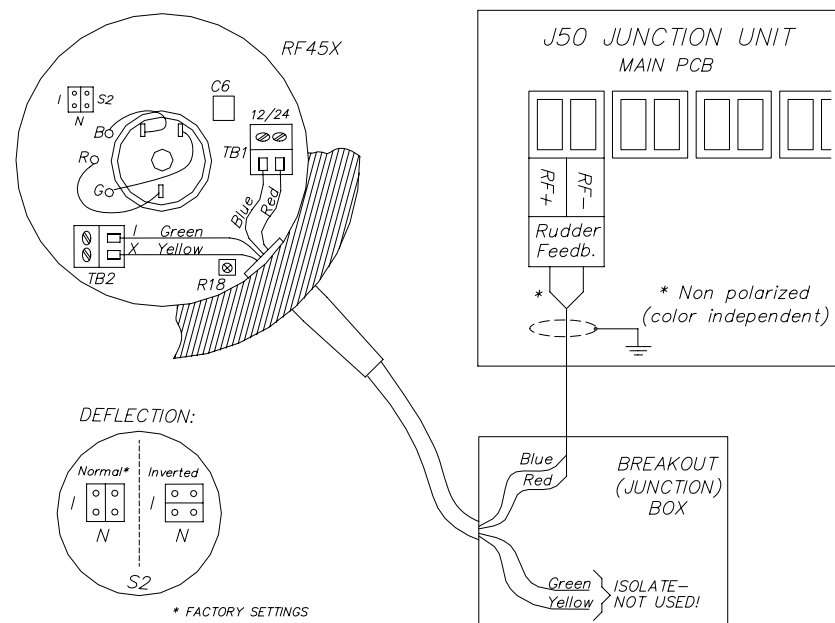
The cable should be connected to the junction unit according to Figure 2-5. When splicing the cables in the breakout box, crimp the enclosed pins on each wire of the extension cable to avoid cutting off the wires at the terminal point when the screws are tightened.

The screen must be connected in the junction unit.

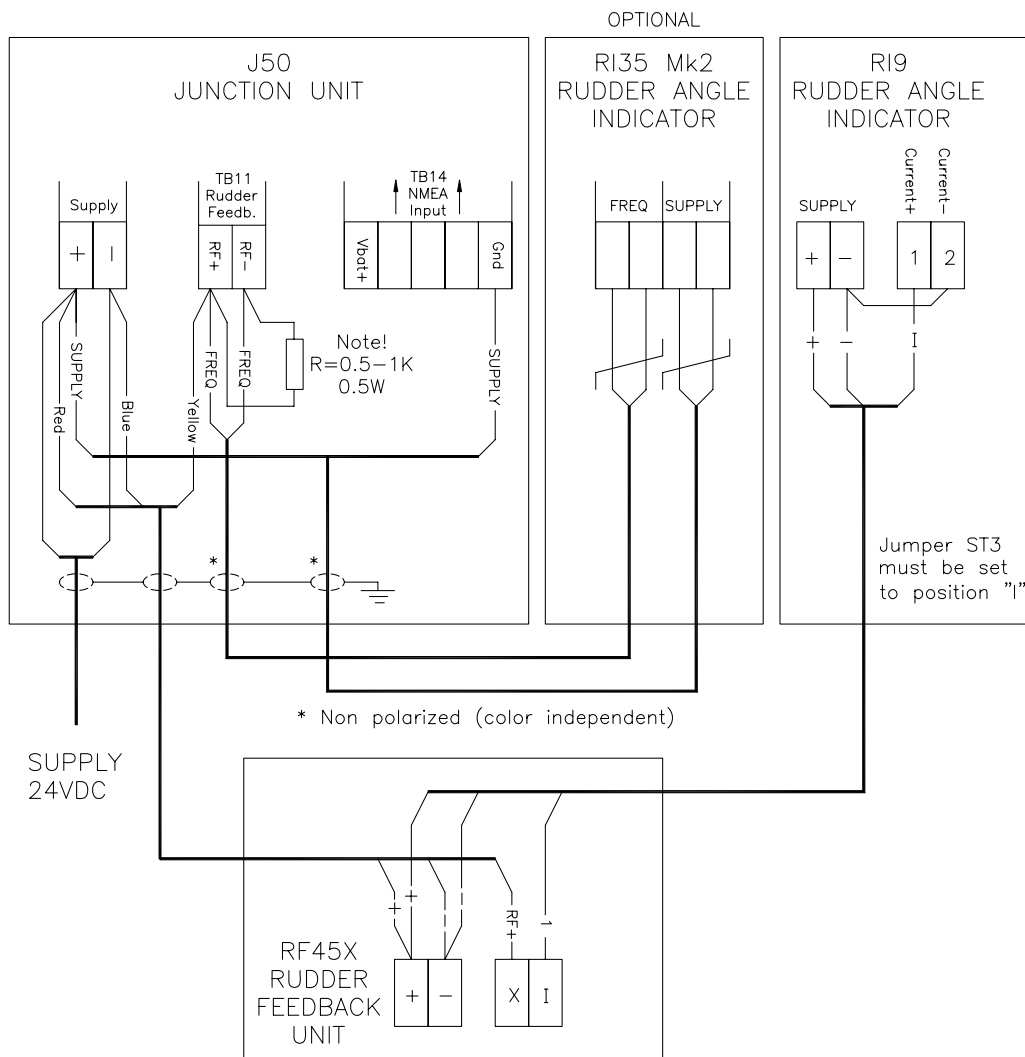
**Note !**

*The green and yellow wires are not used and must be isolated!*

For final alignment, see page 11.



**Figure 2-5 RF45X Rudder Feedback Unit Connection**



**Figure 2-6 RF45X Connection to RI9 Rudder Angle Indicators and RI35 Mk2 (optional)**

The above connection diagram shows how to connect an RI9 Rudder Angle Indicator to a system with RF45X Rudder Feedback Unit. For connection of RI35 Mk2 Rudder Angle Indicators only, refer to the RI35 Mk2 manual.



This connection gives full functioning indicator(s) also with the autopilot switched off. To have the indicator(s) switched off with the autopilot; connect indicator(s) and rudder feedback supply+ to J50 Vbat+ instead of J50 Supply+.

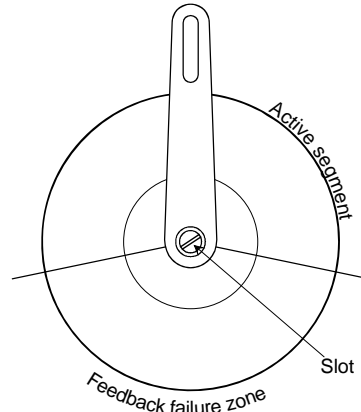
**Note !**

*A resistor R (0.5-1K, 0.5W) has to be mounted. The resistor is not supplied by Simrad.*

## Mechanical Alignment

The purpose of this procedure is to find the zero point and to allow the feedback unit to operate within its active segment. If the unit operates outside this segment, there will be a feedback failure alarm.

1. Position the rudder amidships.
2. Loosen the two screws that secure the transmission lever to the RF45X shaft.
3. Turn on the autopilot by pressing the  (STBY) button and wait until the start-up sequence is finished.
4. Press the  (STBY) button again, if necessary, to read the rudder angle display. You may also read the rudder angle by accessing the User Set-up menu (see Operator Manual) and the SYSTEM DATA menu (page 75).
5. Use a flat screwdriver in the slot and adjust the rudder angle to zero degrees on the display.
6. Secure the transmission lever to the shaft. Return to the Dockside settings and proceed to 'Rudder Feedback Calibration'.



### Note !

*If the autopilot presents a Rudder Feedback Alarm after “turn on”, proceed as follows:*

- *Turn the autopilot off. Use a flat screwdriver in the slot and turn the shaft 180°.*
- *Proceed from item 3 above.*

## 2.8 RF14XU Rudder Feedback Unit

### Mechanical mounting

Before installation, check that the alignment mark on the mounting plate agrees with the mark on the shaft. Bring the rudder to Midships position. The feedback unit should be mounted on a plane surface and secured by bolts through the three holes in the mounting plate. It should be linked to the rudder in accordance with Figure 2-7. It is important that the linkage is linear, i.e. the A-a and D-d are pairs of equal length. This will give a ratio 1:1 between the rudder angle and that of the feedback unit shaft. Final adjustment is made by loosening the fixing screws for the potentiometer, and carefully turn the potentiometer for correct positioning.

Note !

*If the RF14XU is mounted with the shaft pointing upwards, the yellow and the blue lead to the potentiometer inside must be interchanged (See Figure 2-9).*

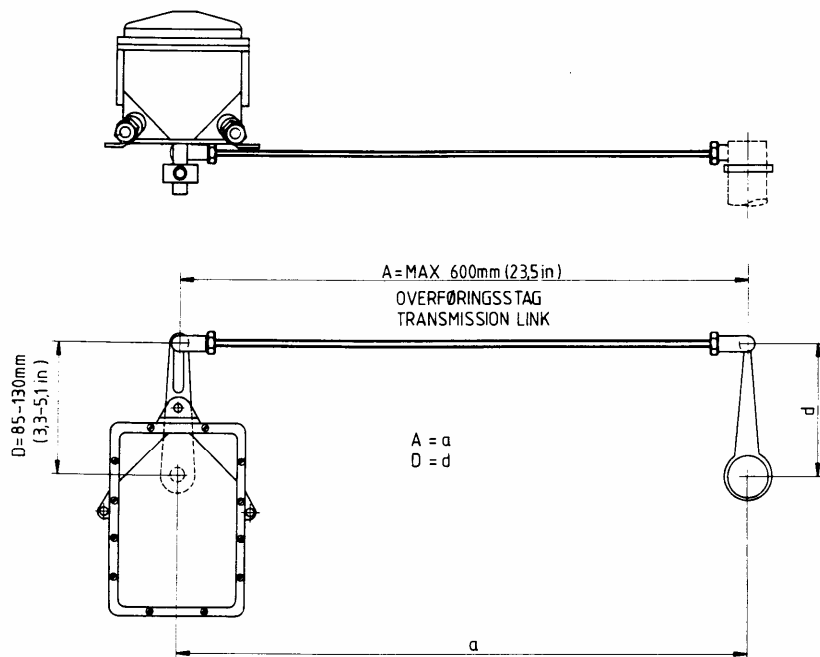


Figure 2-7 RF14XU - Mounting

### Electrical installation

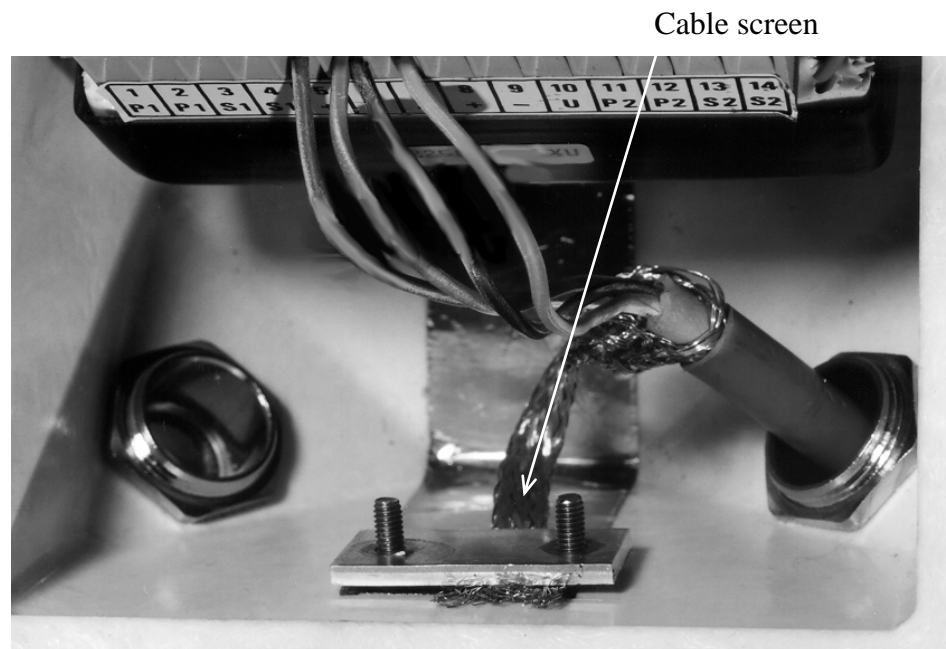
The cables are carried through cable glands. If required, to avoid any mechanical damage, the cables should be run in a conduit between the rudder feedback unit and the junction unit or rudder angle indicator. Electrical connection is shown in the cabling diagram. The cable screen must be connected to the internal ground terminal. Ref. Figure 2-8.

The feedback unit has an external ground terminal and must have a proper ground connection to the hull. The grounding wire should be as short as possible and at least 10 mm wide.

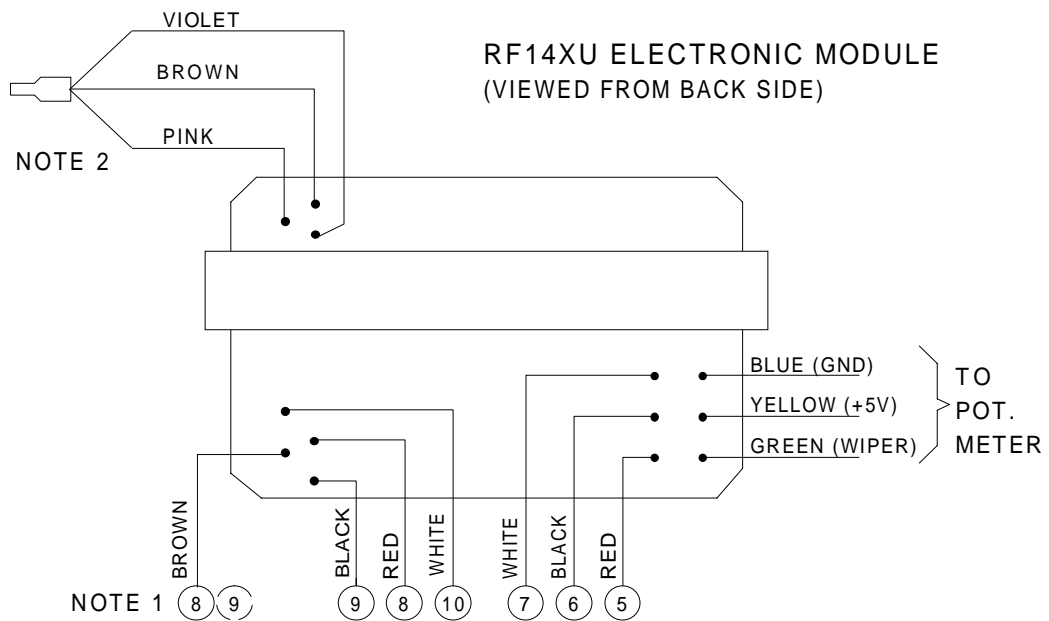
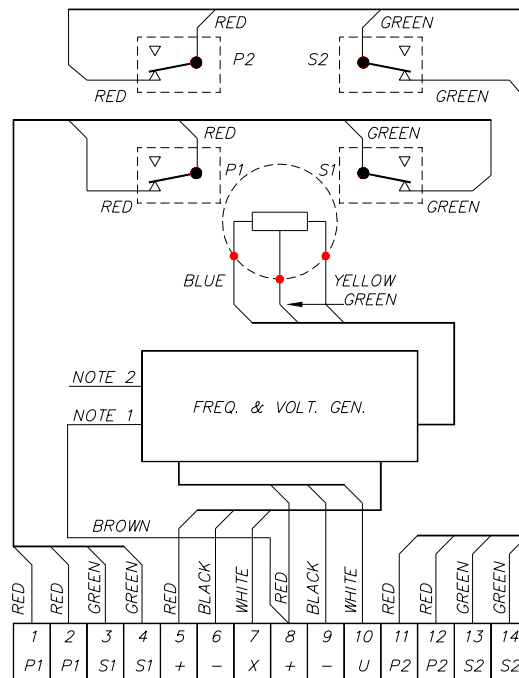
The RF14XU can be powered either from the rudder angle indicator supply (19-40V DC) or directly from the autopilot junction unit. If a rudder angle indicator is connected, the RF14XU is powered from the rudder angle indicator supply. If the rudder angle indicator voltage disappears, or rudder angle indicator is not connected to the RF14XU, the feedback unit is powered directly from the autopilot. The change over is done automatically.

**Note !**

*If RF14XU is connected to rudder angle indicators, and the indicators are powered from an unfiltered 24V supply, the enclosed 470uF capacitor should be connected across the supply. Without the capacitor, a deviation may occur between the autopilot feedback midposition reference and that of the rudder angle indicator(s). Scaling of rudder angle of indicators may be required. Refer to Figure 2-9, note 2.*



**Figure 2-8**  
**Screen termination**



NOTE 1: Brown lead normally connected to 8 .  
Move to 9 to invert the rudder indicator deflection.

NOTE 2: Normally connected for +/-45° rudder angle (violet, brown and pink leads are not connected). For +/-60° connect brown lead to terminal 10, for +/-70° connect pink lead to terminal 10, for +/-90° connect violet lead to terminal 10. White lead must remain connected.

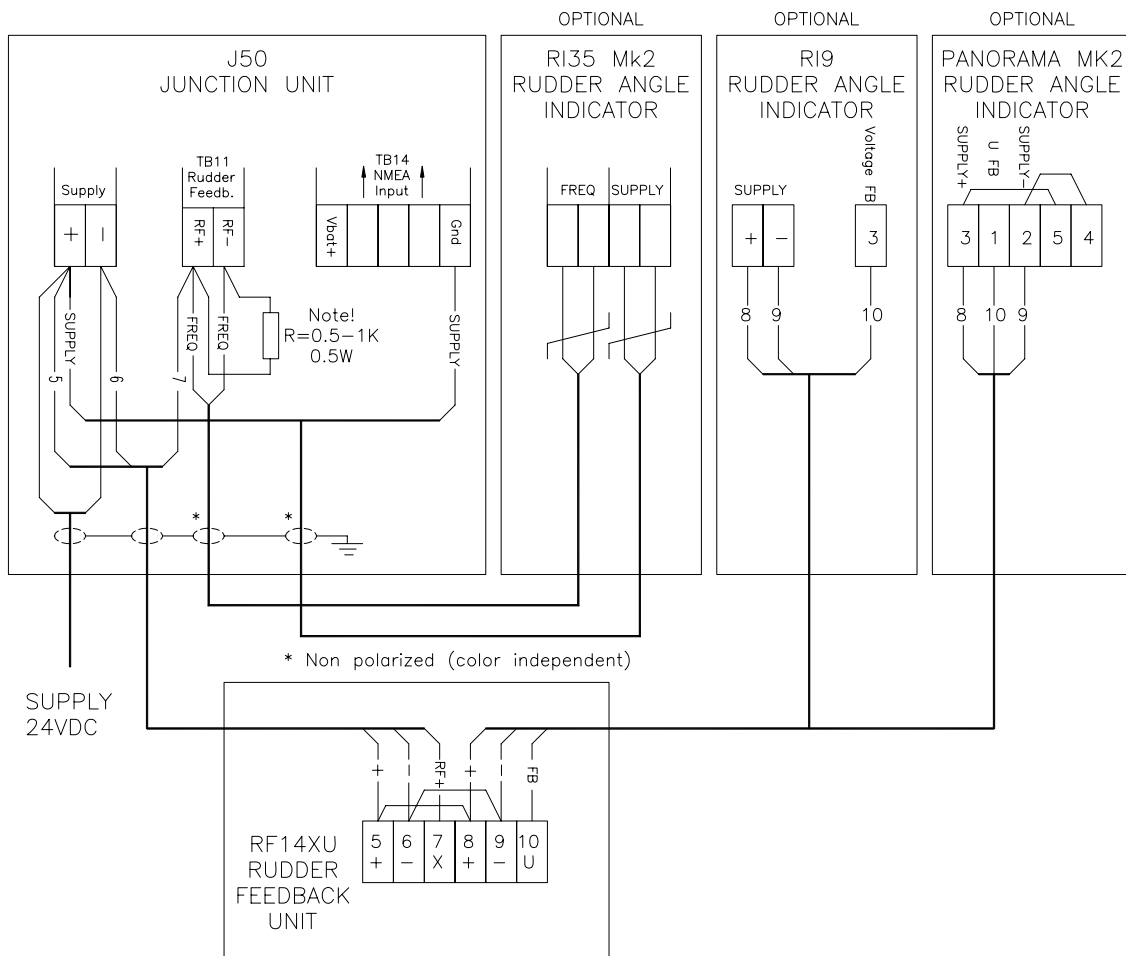
**Figure 2-9**  
**RF14XU Internal wiring**

Figure 2-10 shows how to connect the RF14XU Rudder Feedback Unit to an AP50 system with 24V autopilot supply.

The RI9 Rudder Angle Indicator is connected to the U-terminal on RF14XU, while RI35 Mk2 Rudder Angle Indicator is connected in parallel with the feedback signal for the junction unit. Use the same supply for RI35 Mk2 as for the autopilot.

The connection shown below gives full functioning indicator(s) also with the autopilot switched off. To have the indicator(s) switched off with the autopilot, connect indicator(s) and rudder feedback supply+ to J50 Vbat+ instead of J50 Supply+.

**Note !** *This configuration is only for 24VDC.*



**Figure 2-10 RF14XU connected to an AP50 system and optional rudder angle indicators**

**Note !** *The resistor R (0.5-1K, 0.5W) has to be mounted. The resistor is not supplied by Simrad.*

### Final check

After installation, the cable glands must be sealed with silicon to prevent water from seeping in. Also apply silicon grease to the gasket between the bottom and top cover.

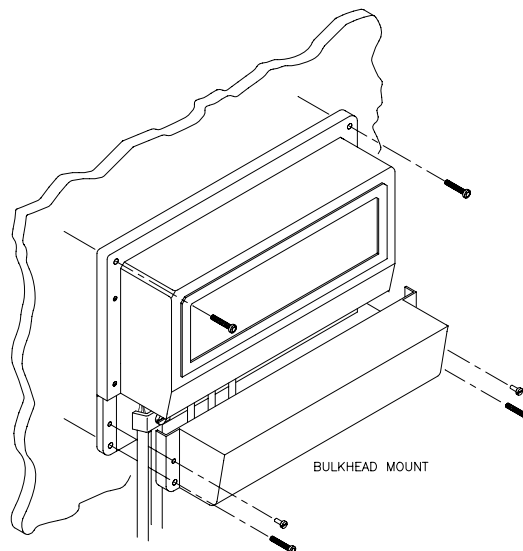
On the inside of the feedback unit cover, a piece of moisture protecting sponge is attached. The sponge produces a corrosion preventive gas, and to increase the efficiency of the gas the cover must be kept tight.

## 2.9 J50 Junction Unit

The J50 Junction Unit is designed to operate in a location that provides ambient temperatures below +55°C (+130°F).

### Note !

*The junction units (J50 and J50-40) are not waterproof and should be mounted vertically, as shown in Figure 2-11, in a dry place between the control unit and the drive unit.*



**Figure 2-11 J50 Junction Unit Mounting**

### Cable Connections

Use only shielded cables. This includes Mains input, drive units, and, if necessary, for the extension of the RF300 Rudder Feedback Unit cable. The clutch/bypass cable and the solenoid cable should be 1.5 mm<sup>2</sup> (AWG14). Signal cables should be 0.5 mm<sup>2</sup> (AWG20) twisted-pairs.

The Mains supply cable and the drive unit motor cable should have sufficient wire gauge. This will minimize voltage drop and allow the drive unit to operate at full power.

Refer to the table below for recommended cable sizes.

Cable length	Drive Unit Voltage			
	12 V		24 V	
1. Distribution Board to Junction Unit. 2. Junction Unit to Drive Unit motor (Length refers to each of the two cables)	mm <sup>2</sup>	AWG	mm <sup>2</sup>	AWG
Up to 3 m (10 ft.)	2,5	12	2,5	12
Up to 6 m (20 ft.)	4	10	2,5	10
Up to 10 m (32 ft.)	6	8	4	10
Up to 16 m (52 ft.)	10	6	6	8

**Table 2-1 Recommended Cable Sizes**

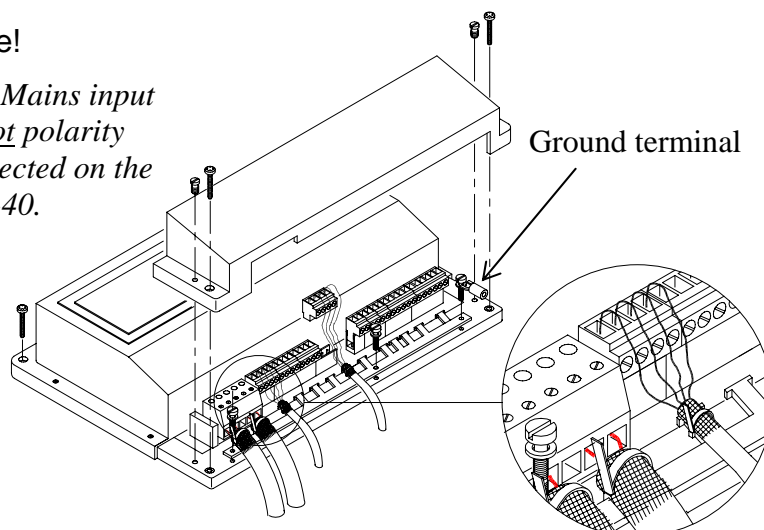
## Grounding and Radio Frequency Interface (RFI)

The AP50 system has excellent radio frequency interference protection and all units use the junction unit as a common ground/shield connection. The junction unit must therefore have a proper ground connection to the hull.

Robnet cables and other signal cables (i.e. compass, feedback, NMEA) should not be run in parallel with other cables carrying radio frequency or high current, such as VHF and SSB transmitters, battery chargers/generators, and winches.

### Note!

*The Mains input is not polarity protected on the J50-40.*



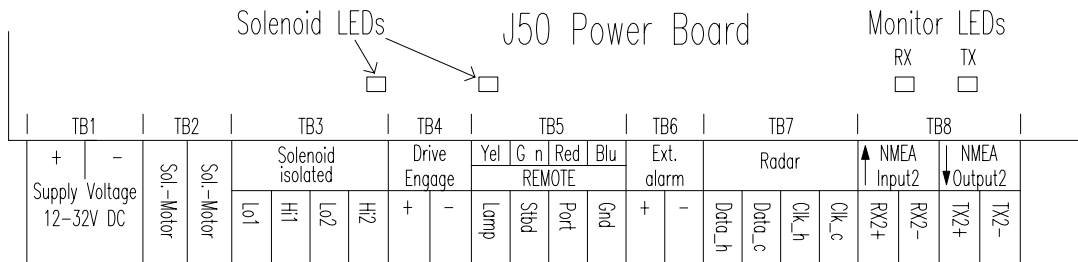
**Figure 2-12 J50 Junction Unit Screen Termination**

Remove the bottom cover to get access to the plug-in terminals. Strip about 1 cm (0.4 in.) of the cable's insulation and pull the screen backwards to cover the insulation. Position the straps as shown and tighten well to make sure the screen makes good contact.

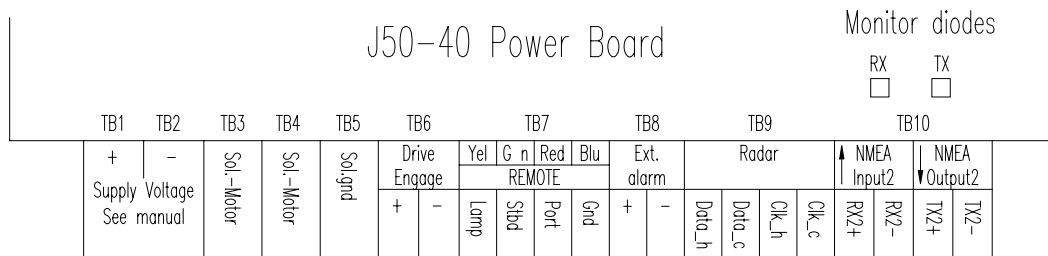
Provide sufficient wire length so that the plug-in terminals can be easily connected and disconnected.

Pull out each terminal before connecting the wires. Remove all the strands before putting on the terminal cover.

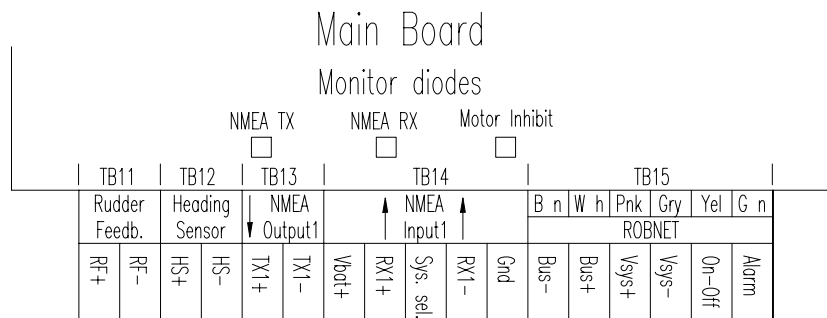
### Junction Unit Terminals



J50 Power Board Terminals



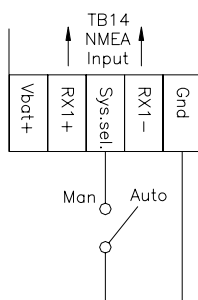
J50-40 Power Board Terminals



Main Board Terminals

### System Select

The “System select” (Sys. Sel.) input signal of the J50 can be used to alternate between the boat’s own steering and the autopilot system from an external system selector (refer to IMO resolution MSC. 64 sec. 4). A ground on TB14 Sys. Sel. will force the system into Disengage mode. The autopilot will be disconnected from the vessel’s steering system and show “Disengaged” on the display (on the FU50, no mode indicators will be lit). When the “Sys. Sel.” input line is re-opened, the autopilot will go to AUTO mode. For wheelmark installation (Master operation = Yes, ref. page 49) the master control unit will be active.



For non-wheelmark installations the autopilot will continue on the present heading, but no course change can be made before a control unit is activated again by pressing the AUTO button.

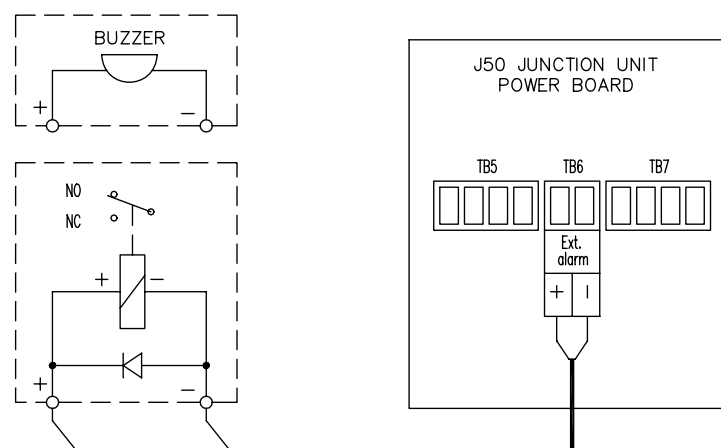
### Autopilot Mode Control (AUTO/STANDBY Toggling)

The Port/stbd lines of the J50 Remote terminal can be used to alternate between automatic and electric hand-steering from the autopilot. This may be used for armrest operation, etc. When in AUTO mode or NAV mode, a simultaneous pulse from the Port and Stbd terminals to the ground terminal on the remote connection will revert the autopilot to STANDBY mode. The next pulse will bring the autopilot to AUTO mode, hence, when the AP50 is set for STBY (NFU) and the system select is shorted to GND, the AP50 display changes from showing STBY to show a blank segment with subtext “Disengaged”. In this mode all rudder commands from the AP50 are disabled (no NFU, FU or Auto).

When the short is removed, the display will show “AUTO” with subtext “Inactive”. This means that the preset heading will be maintained, but no course change can be made before the respective control unit is activated by pressing the AUTO button.

### External Alarm (Non Wheelmark System)

The external alarm circuit has an open collector output for an external alarm relay or buzzer. The alarm voltage is the same as the main supply voltage. The maximum load on the external alarm output is 0.75 ampere.



**Figure 2-13 External Alarm Connections (Non Wheelmark System)**

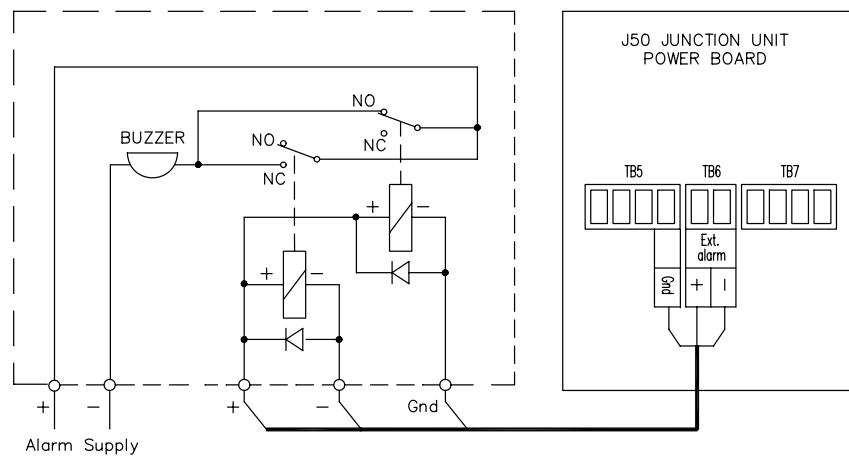
## External Alarm (Wheelmark System)

Note !

*Wheelmark installation requires separate monitoring of power failure.*

Note that Simrad does not supply an external alarm unit, required for a Wheelmark system. The diagram below shows how an arrangement can be made. The buzzer shall provide between 75 and 85 dB of power.

The relay voltages are determined by the autopilot Mains supply and the alarm voltage supply.



**Figure 2-14 External Alarm Connections (Wheelmark System)**

## 2.10 Drive Unit Installation

The relation between drive units, drive unit voltage, input voltage, drive output, and interfacing to steering gear are shown in Table 2-2 and Table 2-3. The AP50 system detects whether a reversible motor or a solenoid is connected and outputs the correct drive signal automatically.

Refer to the connecting diagrams for the different drive units on pages 22 through 24.

Installation instructions for the drive units are found in the manuals for the individual units.

The maximum drive current capabilities of the J50 and J50-40 Junction Units are different. Use the table below as a reference and observe the notes.

**HYDRAULIC PUMPS**

MODEL	MOTOR VOLTS	JUNCTION UNIT	RAM CAPACITY		FLOW RATE AT 10 bar cm <sup>3</sup> /min. (cu. in./min.)	MAX. PRESSURE bar	PWR. CONSUMPTION
			MIN. cm <sup>3</sup> (cu. in.)	MAX. cm <sup>3</sup> (cu. in.)			
RPU80	12	J50	80 (4.9)	250 (15.2)	800 (49)	50	2,5-6 A
RPU160	12	J50	160 (9.8)	550 (33.5)	1600 (98)	60	3-10 A
RPU200	24	J50	190 (11.6)	670 (40.8)	2000 (122)	80	3-10 A
RPU300	12	J50-40	290 (17.7)	960 (58.5)	3000 (183)	60	5-25 A
RPU300	24	J50	290 (17.7)	960 (58.5)	3000 (183)	60	2,5-12 A
RPU3	24	J50	370 (22.4)	1700 (103)	3800/5000 (232/305)	40	7-22 A
RPU1	12	J50	140 (8.5)	600 (36.6)	1400/2000 (120/185)	40	7-22 A

Steering Gear Interface: Hydraulic Plumbing

**Table 2-2 Hydraulic Pumps**

**LINEAR DRIVE UNITS**

MODEL	MOTOR VOLTS	JUNCTION UNIT	MAX. STROKE mm (in.)	PEAK THRUST kg (lb.)	MAX. RUDDER TORQUE Nm (lb./in.)	HARD-OVER TIME sec. (30% load)	PWR. CONSUMP.	TILLER ARM mm (in.)
MLD200	12	J50	300 (11.8)	200 (440)	490 (4350)	15	1.5-6 A	263 (10.4)
HLD350	12	J50	200 (7.9)	350 (770)	610 (5400)	12	2.5-8 A	175 (6.9)
HLD2000L	12	J50	340 (13.4)	500 (1100)	1460 (12850)	19	3-10 A	298 (11.7)
HLD2000D	24	J50	200 (7.9)	1050 (2310)	1800 (15900)	11	3-10 A	175 (6.9)
HLD2000LD	24	J50	340 (13.4)	1050 (2310)	3180 (28000)	19	3-10 A	298 (11.7)
MSD50	12	J50	190 (17.5)	60 (132)	-	15	0.8-2 A	-

Steering Gear Interface: Connects to Quadrant or Tiller.

**Table 2-3 Linear Drive Units**

Note !

1. The motor voltage is stepped down by the junction unit when operating from 24 V or 32 V Mains (except for RPU1 and RPU3).
2. The specified junction unit is necessary to achieve maximum drive unit capacity.
3. Recommended operational thrust or torque is 70% of the listed value.
4. Typical average power consumption is 40% of the listed maximum value.

**PREVIOUS MODELS**

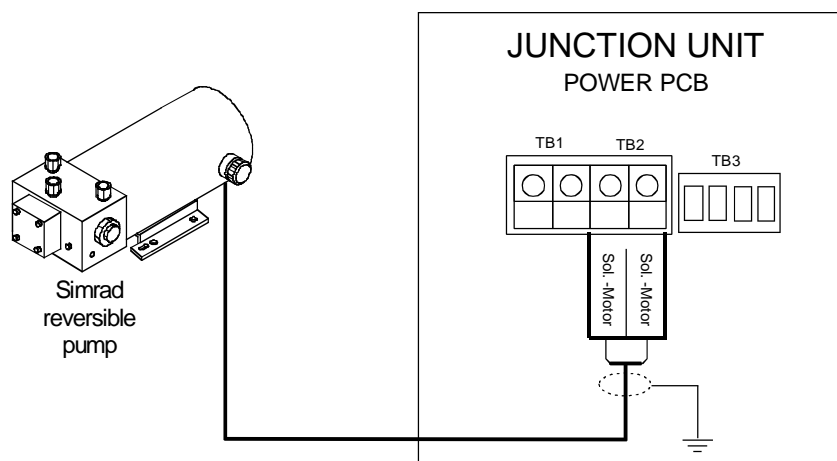
Simrad Drive Unit type	Drive unit voltage	Input voltage (Mains)	Drive output	Interface to steering gear
RPU100, RPU150, (Reversible hydraulic pump)	12	12, 24,32	Proportional rate	Hydraulic plumbing
MRD100 (Reversible mechanical drive)	12 24	12, 24, 32 24, 32	12V to clutch 24V to clutch Proportional rate to motor	Chain/sprockets
MRD150	12 32	12, 24 32	12V to clutch 32V to clutch Proportional rate to motor	Chain/sprocket

**Table 2-4 Previous Models Drive Units**

**Note !**

*When selecting Drive Unit Voltage in the Installation Dockside menu (see page 49), the clutch/bypass voltage must always be set equal to the motor voltage. In a retrofit installation where, for example a HLD2000 has a 12V motor and a 24V bypass valve, the bypass valve solenoid has to be changed back to standard 12V version since the drive engage output voltage follows the motor voltage setting.*

**Connecting a Reversible Pump**



**Figure 2-15 Connecting a Reversible Pump**

### Connecting a Hydraulic Linear Drive

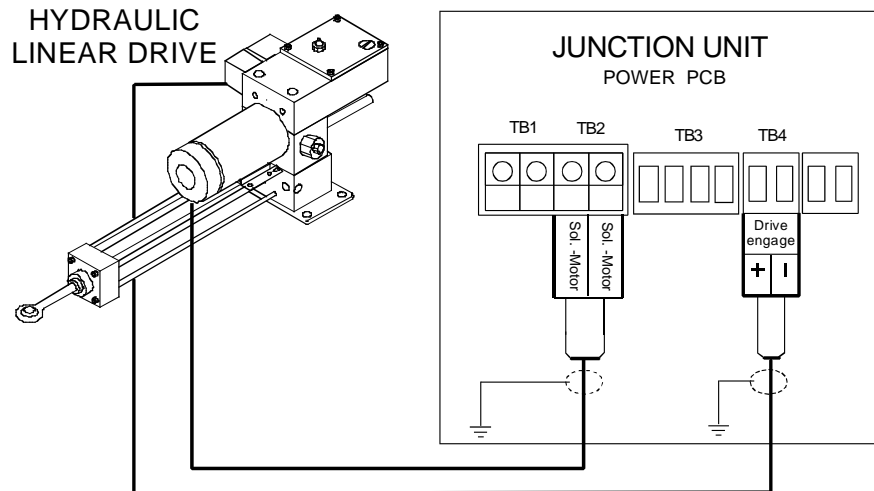


Figure 2-16 Connecting a Hydraulic Linear Drive

### Connecting Solenoid Valves

*Solenoids (externally powered, common positive)*

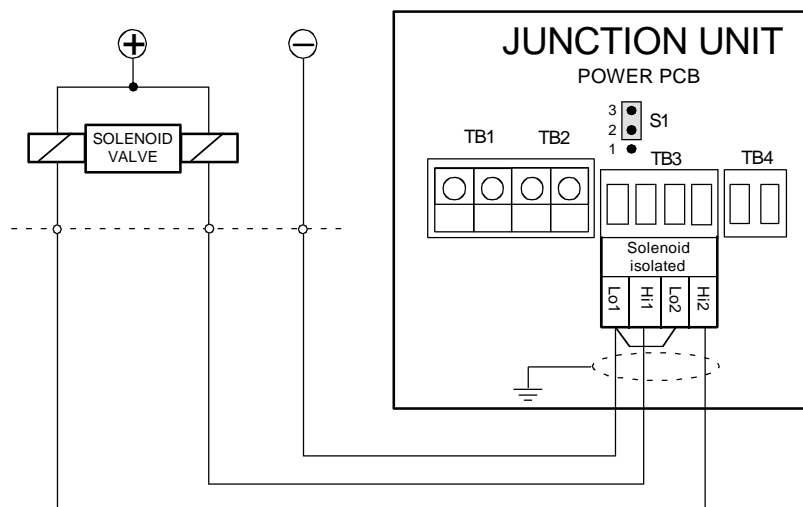


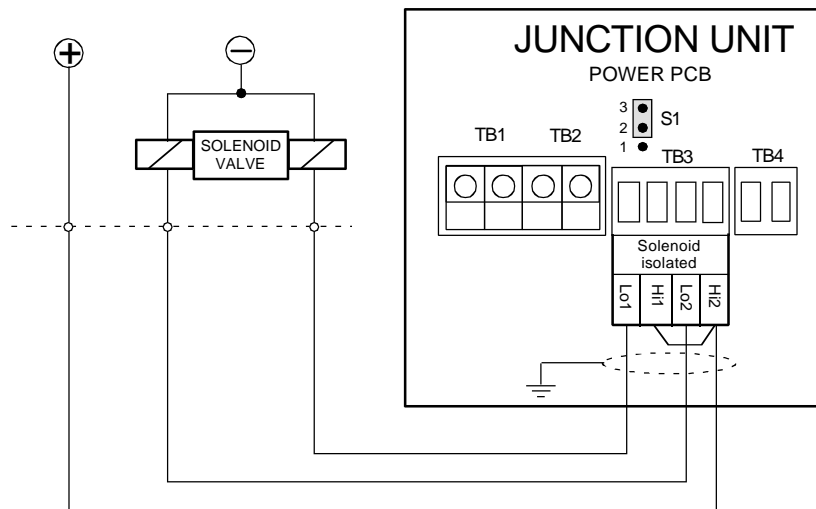
Figure 2-17 Connecting Externally-powered Solenoids with a Common Positive

**Caution !**

*To prevent damage of the J50 Power PCB, ensure that the S1 jumper switch on the Power PCB is set to position 2-3.*

Also refer to priority steering by S9 Steering Lever, Figure 2-32.

**Solenoids (externally powered, common negative)**



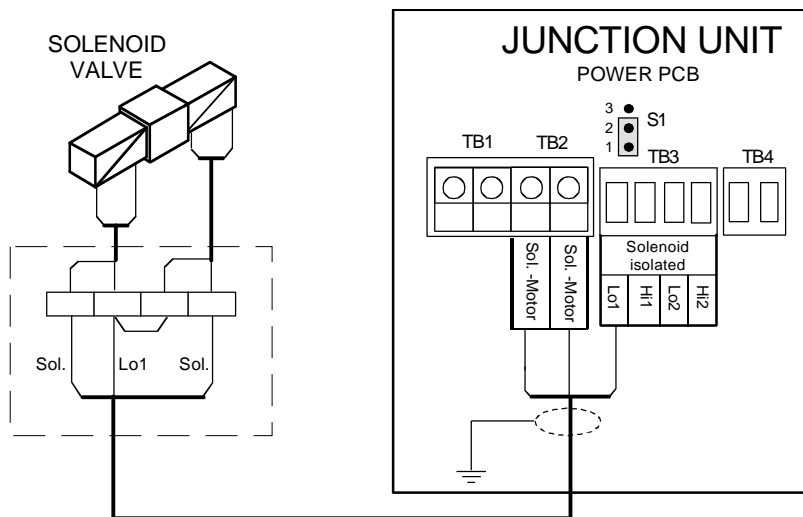
**Figure 2-18 Connecting Externally-powered Solenoids with a Common Negative**

**Caution !**

*To prevent damage of the J50 Power PCB, ensure that the S1 jumper switch on the Power PCB is set to position 2-3.*

Also refer to priority steering by S9 Steering Lever, Figure 2-33.

**Solenoids (not externally powered)**



**Figure 2-19 Connecting Non-powered Solenoids**

**Note !**

*The jumper switch S1 on the J50 Power PCB must be set to position 1-2.*

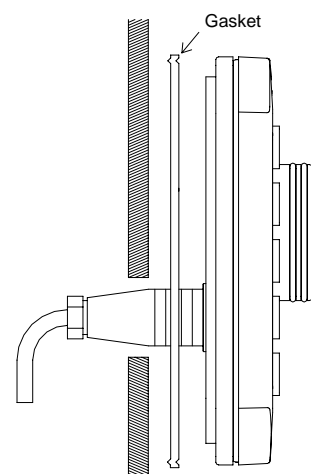
## 2.11 Control Unit

Avoid mounting the control unit(s) where it is easily exposed to sunlight, as this will shorten the lifetime of the display. If this is not possible, make sure the units are always covered with the protective cover when not in use.

### Panel-mounting

The mounting surface must be flat and even to within 0.5 mm.

- Drill the 4 mounting holes and make a panel cutout according to the supplied template.
- Use the supplied gasket between the panel and the unit.
- Use the supplied 19 mm screws to fasten the control unit to the panel.
- Apply the front panel corners.
- Connect the Robnet cable(s) to the control unit connector(s) (see “Note!” on page 28).



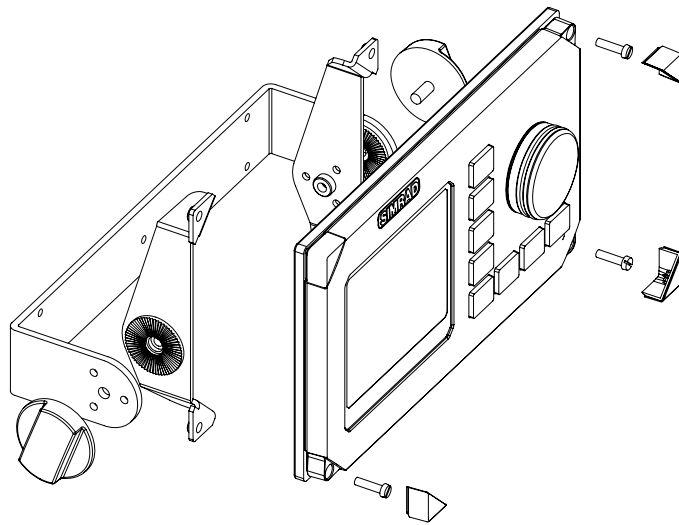
### Optional Bracket mounting

(This may be ordered separately from Simrad, part no. 20212130).

#### Note !

*When the control unit is bracket-mounted, it is not weatherproof from the back due to a breathing hole in the back cabinet. When bracket-mounted, the exposed parts of the plugs should be protected against salt corrosion.*

- Locate the cradle on the mounting site and mark the 4 holes for the screws on the mounting surface.
- Drill the 4 holes and screw the cradle to the mounting surface.
- Use the supplied screws to fasten the control unit to the left and right brackets.
- Apply the front panel corners.
- Use the two locking knobs to assemble the cradle with the left and right brackets and adjust the control head for the best viewing angle.
- Connect the Robnet cable(s) to the control unit connector(s) (see “Note!” on page 28).



**Figure 2-20 AP50 Bracket mounting**

## **Robnet Units and Robnet Network Cables**

The following Robnet units are available in a system:

AP50 Control Unit, AP51 Remote Control, RC25 Rate Compass, FU50 Follow-Up lever, GI51 Gyro Interface, NI300X NMEA Interface, TI51 Thruster Interface and AD50 Analog Drive.

As most Robnet units have two Robnet connectors, they can be used for further expansion of the system. There are no dedicated "in" or "out" connectors. You may connect the cables to any available Robnet connector on the specific unit.

The Robnet cables are available in 7 and 15 m lengths and they contain a 6-pin male connector at one or both ends. The 15 m cable to the junction unit has a connector only at the control unit end.

Additional extension cable (10 m) with a male and a female connector, is available from Simrad (part no. 22192266).

When installing a system, try to minimize the total Robnet cable length by connecting all Robnet units to the nearest available Robnet connector.

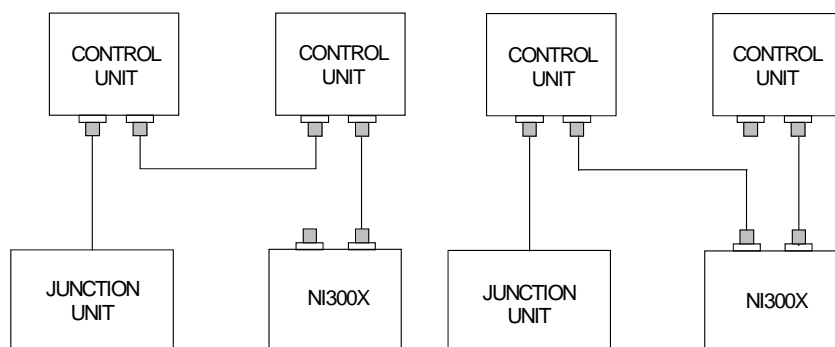
The total length of Robnet cables depends on the number of Robnet units and the voltage drop across the connected units.

Use the following table as a guideline.

Number of Robnet units	Maximum cable length in m (feet)
1	390 (1270')
2	195 (640')
3	130 (425')
4	95 (310')
5	75 (245')
6	65 (210')
7	55 (180')
8	50 (165')
9	45 (150')
10	40 (130')

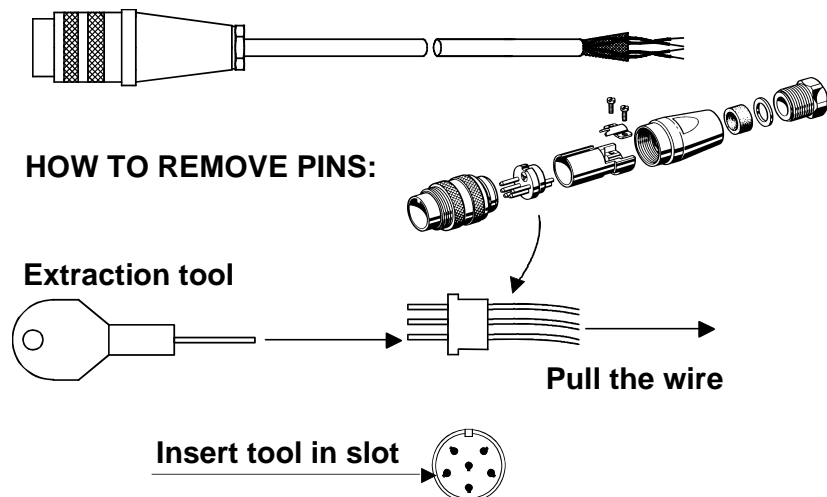
If the total length exceeds the recommended length, please contact your Simrad distributor on how to arrange the system to minimize the voltage drop.

Examples of interconnecting Robnet units:



**Figure 2-21 Interconnecting Robnet Units**

All connectors are crimp-type and can be easily disassembled if desired for ease of installation (see Figure 2-22).

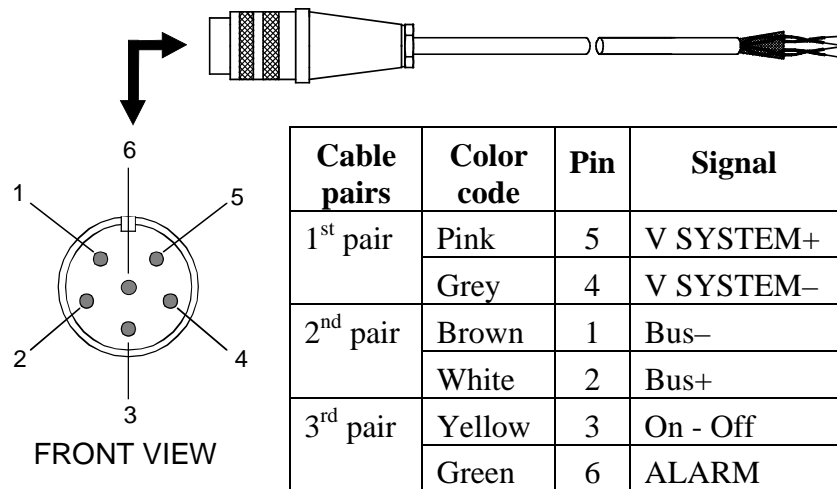


**Figure 2-22 Removing Pin**

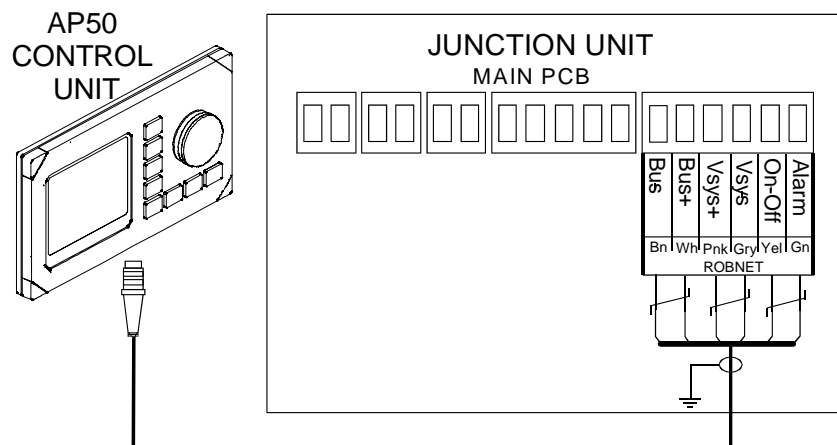
See Table 2-5 for pin configuration and color code of the network cable. **DO NOT MIX THE PINS AND THE CABLE COLORS!**

**Note !**

*Apply a thin layer of pure Vaseline (petroleum jelly) on the connector threads and make sure the connectors are properly secured to the receptacle by the coupling ring. When properly installed, the connectors are weatherproof according to IP56. All unused Robnet plugs must be fitted with plastic caps to keep the connectors free of dirt and moisture. A separate screw cap for the control unit is included in the installation kit.*



**Table 2-5 Robnet Plug Pin Configuration**



**Figure 2-23 Control Unit Connection**

**Note !**

*For installations that require special cable lengths, contact your Simrad distributor for information.*

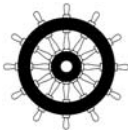
## AP51 Remote Control Connection

If the AP51 Remote Control is part of the system, use the Robnet connector in a free receptacle (see Figure 2-21). Alternatively, cut the connector from the cable and connect the wires in parallel with the cable shown on Figure 2-23 using the same color code.

### Note !

*The AP51 cable contains a ventilation tube. Check that the tube is open after you have cut the cable.*

## AP51 in a Wheelmark System



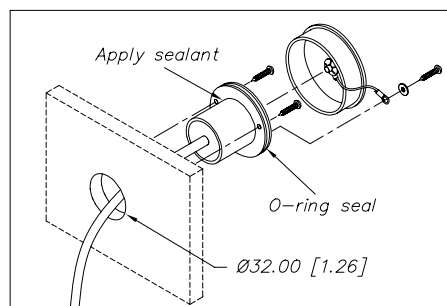
In a Wheelmark system, only the Master Unit may turn the system off. To ensure that the system cannot be switched on or off from the AP51 Remote Control Unit, the yellow wire in the AP51 cable must be cut or not connected. Open the Robnet connector (see Figure 2-22). Remove pin 3 (yellow wire) and cut it off at the end of the wire. Insulate the wire and push it back in the pin 3 slot. Reassemble the Robnet connector.

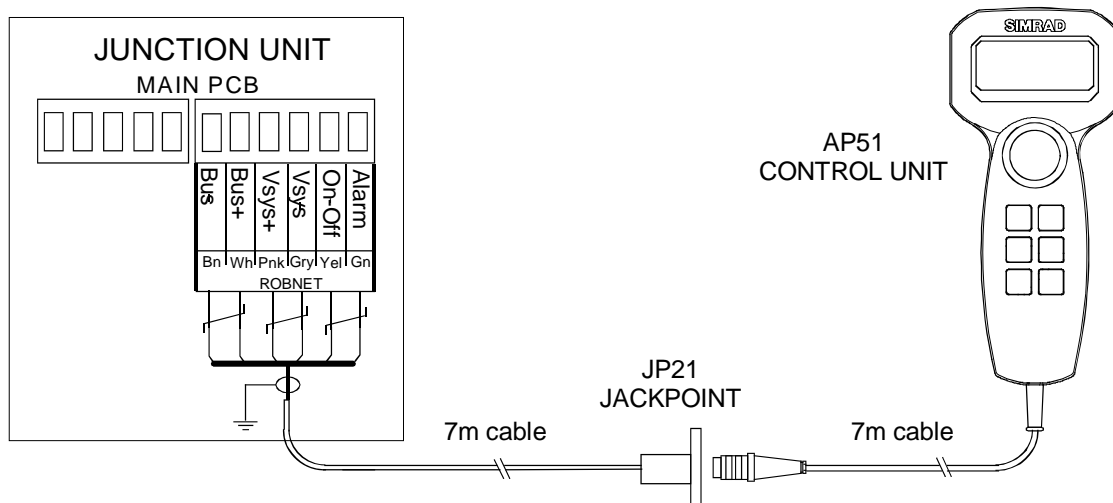
## JP21 Jack Point Installation

The JP21 Jack Point can be used in conjunction with the AP51 Remote Control Unit.

It provides a quick and simple means of connection and disconnection of the AP51 at different locations on the boat.

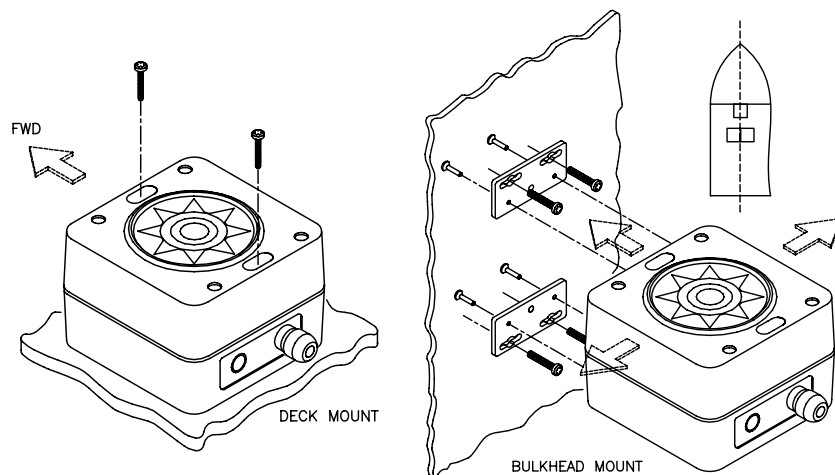
The JP21 includes a watertight connector cover that must be installed as shown below. A 32 mm (1.26 inch diameter) hole must be drilled for flush installation, along with 3 small screw holes. As indicated, a watertight sealant must be applied to the mating surfaces of the JP21 and the mounting panel. Apply a thin layer of Vaseline to the O-ring seal.





**Figure 2-24 JP21 Jack Point Mounting**

## 2.12 RC25 Rate Compass



**Figure 2-25 RC25 Rate Compass Mounting**

The heading sensor is the most important part of the AP50 system and great care must be taken in choosing the mounting location. The heading sensor can be mounted at any location where there is a minimum of magnetic interference and minimum movements. It is not recommended to use the RC25 on steel vessels. However, if this is done, it should be installed 1 meter above the steel deck to obtain optimum performance.

**Note !**

*In order to prevent excessive movements, an autopilot heading sensor should not be installed on the fly bridge or on the mast.*

The rate compass can be deck-mounted or on the bulkhead, athwartship or alongship. The heading offset feature of the AP50 will compensate for the mechanical offsets that may be a result of the selected location and orientation of the RC25.

If the compass is deck-mounted or bulkhead-mounted athwartship with the cable gland pointing aft, little if any offset correction is required. When the cable gland points forward, a 180° correction is required.

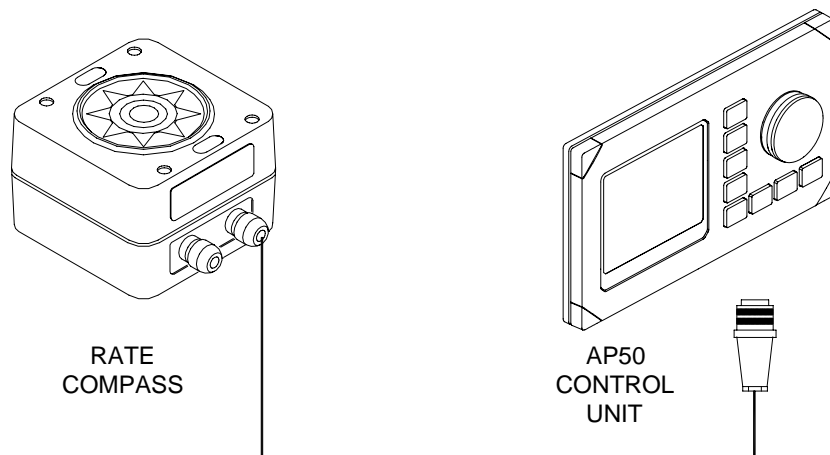
When mounting the compass on a bulkhead alongship, a +90° or -90° correction is needed, dependent on whether it is a port or starboard bulkhead.

Select a location that provides a solid mounting place free from vibration as close to the vessel's center of roll and pitch as possible (i.e. close to the water line). It should be as far as possible from disturbing magnetic influences, such as the engines (minimum of 2 m), the engine ignition cables, the air-conditioning, any refrigerators, other large metal objects, and particularly the drive unit.

Use the supplied mounting kit and drill the holes through the center of the slots in the sensor or the mounting brackets.

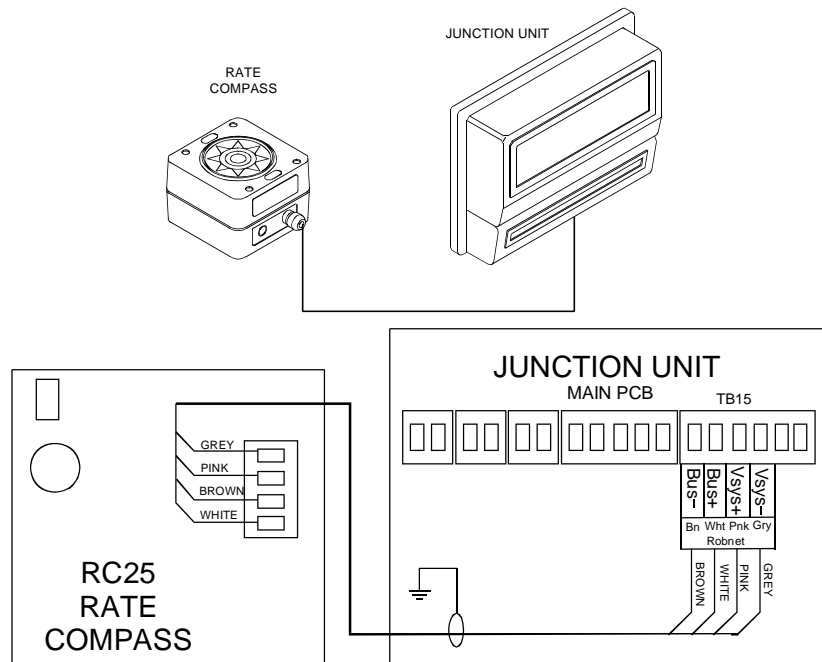
**Note !**

*The compass faceplate on the rate compass is the TOP. NEVER mount it upside down! Level the sensor as close to horizontal as possible.*



**Figure 2-26 RC25 Connection to AP50 Control Unit**

- Connect the Robnet connector to the AP50 Control Unit (or GI51 or NI300X if installed).
- Alternatively, if there is no free receptacle, cut the connector from the cable and connect the wires in parallel with the wires going from the junction unit to the control unit. *Do not connect the yellow and the green wires and ensure that they do not connect with the terminal or chassis.*



**Figure 2-27 Alternative Connection to J50 Junction Unit Robnet Terminal**

- Change in the Installation Interface menu: Select FLUX = ROBNET.
- Select FLUX as compass in the User Set-up Menu to activate the RC25 as the steering compass.
- Perform the compass calibration as described on page 62.

**Note !**

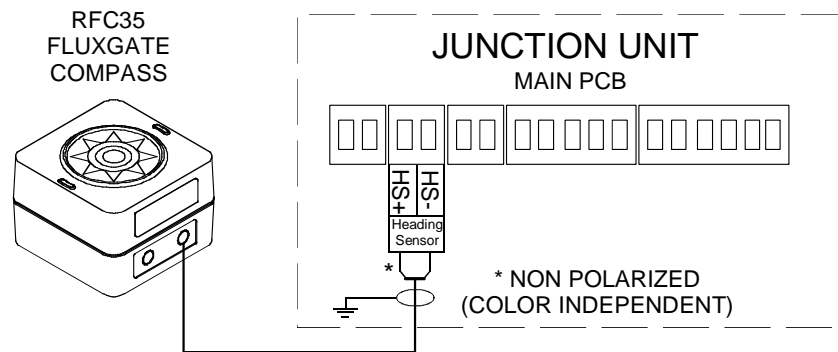
*After turning on, the compass will stabilize in less than 30 seconds, but it will need another 10 minutes to fully utilize information from the rate sensor.*

Refer to Compass Offset on page 63 to compensate for any permanent offset after the calibration is completed.

Calibration data is stored in the compass and will not be deleted by a Master Reset in the autopilot. However, offset compensation must be reset.

**RFC35 Fluxgate Compass**

The RFC35 Fluxgate Compass can be connected to the J50 Junction Unit, but the compass is not recommended for commercial use.



**Figure 2-28 RFC35 connection**

- Change in the Installation Interface menu: Select FLUX = J50-HS.

## 2.13 FU50 Steering Lever

For connection of the FU50 Steering Lever, see the FU50 manual.

## 2.14 TI51 Thruster Interface

The TI51 Thruster Interface is designed to provide control signal for operating one thruster in an AP50 system by either on/off solenoid, continuous control, or Sauer Danfoss PVEM valve.

Refer to separate manual for the TI51 Thruster Interface.

## 2.15 AD50 Analog Drive

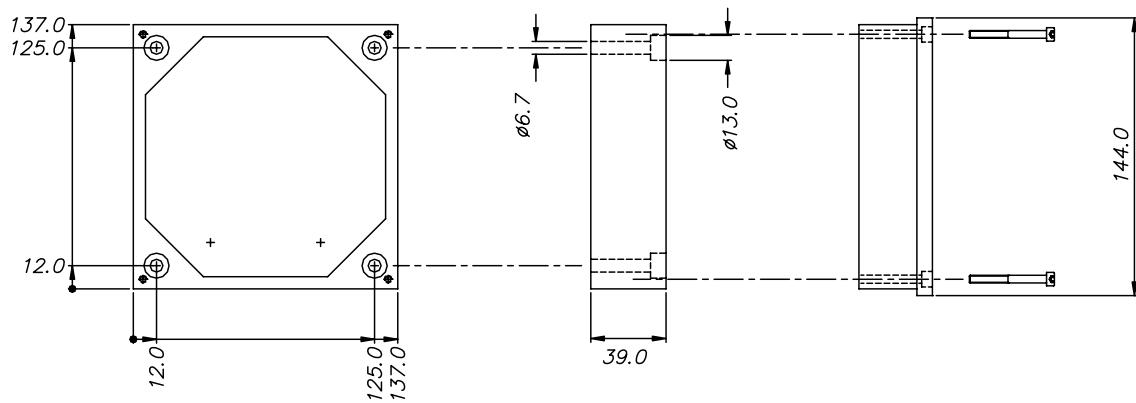
The AD50 Analog Drive is designed to provide analog or proportional control of a rudder in an AP50 system by either continuous voltage, or Danfoss PVEM valve signal.

Refer to separate manual for the AD50 Analog Drive.

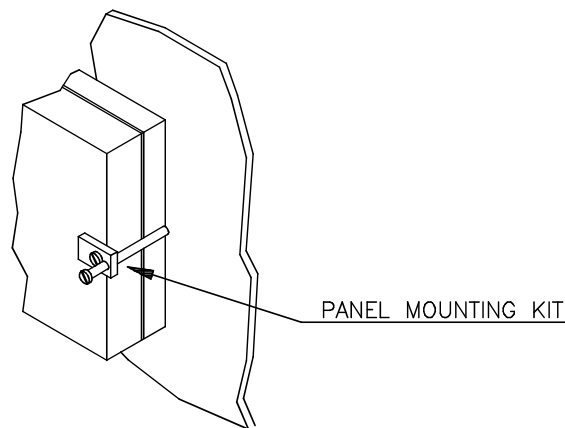
## 2.16 S9 Steering Lever

### Mounting

Refer to Figure 2-29. For bulkhead mounting, use the 8 bushings enclosed with the unit. These are placed two and two against each other and the screws are put through them. Direct contact between S9 and a steel bulkhead is then avoided and corrosion is prevented. The cover plate can be turned 360 degrees for the most convenient position of cable outlet. For panel mounting use the two mounting brackets enclosed with the unit (Figure 2-30).



**Figure 2-29 S9 Steering Lever, bulkhead mounting**

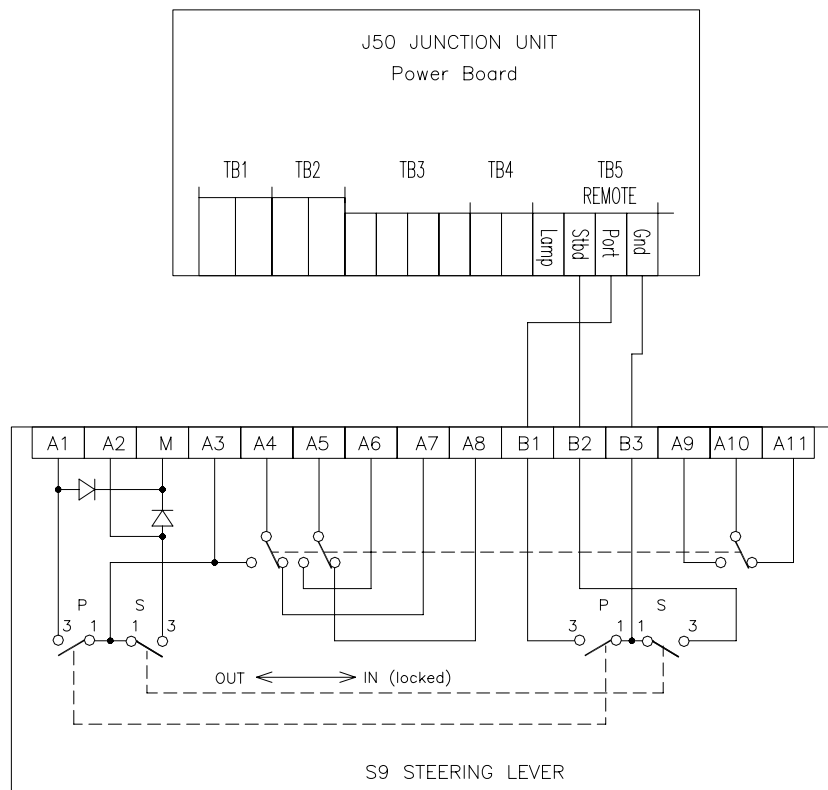


**Figure 2-30 S9 Steering Lever, panel mounting**

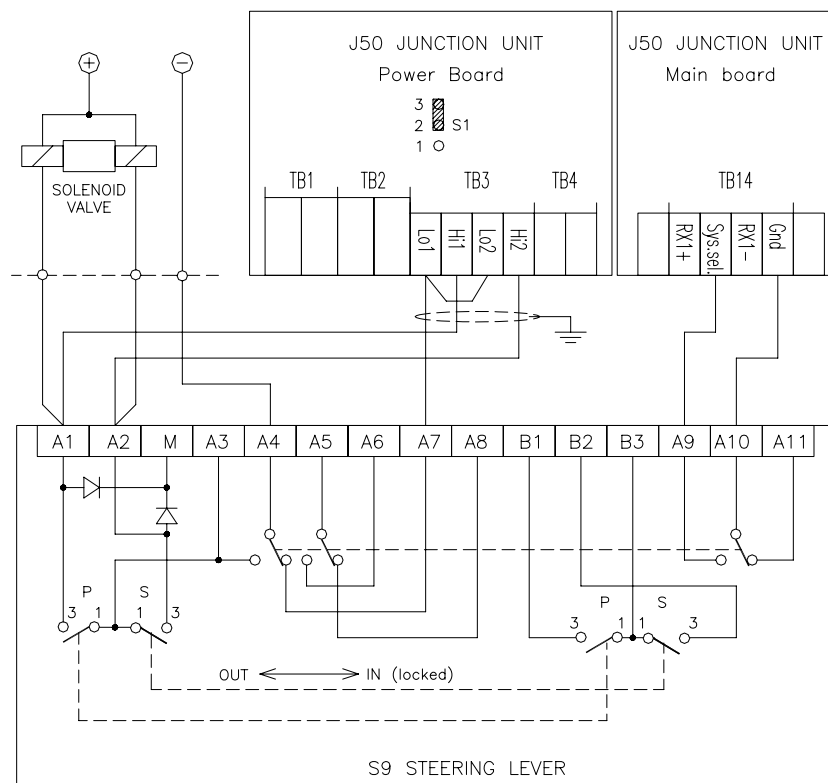
### Connection

If connected according to Figure 2-31, S9 can be used for NFU steering through J50 Junction Unit when the autopilot is in STBY mode and for course change in AUTO mode.

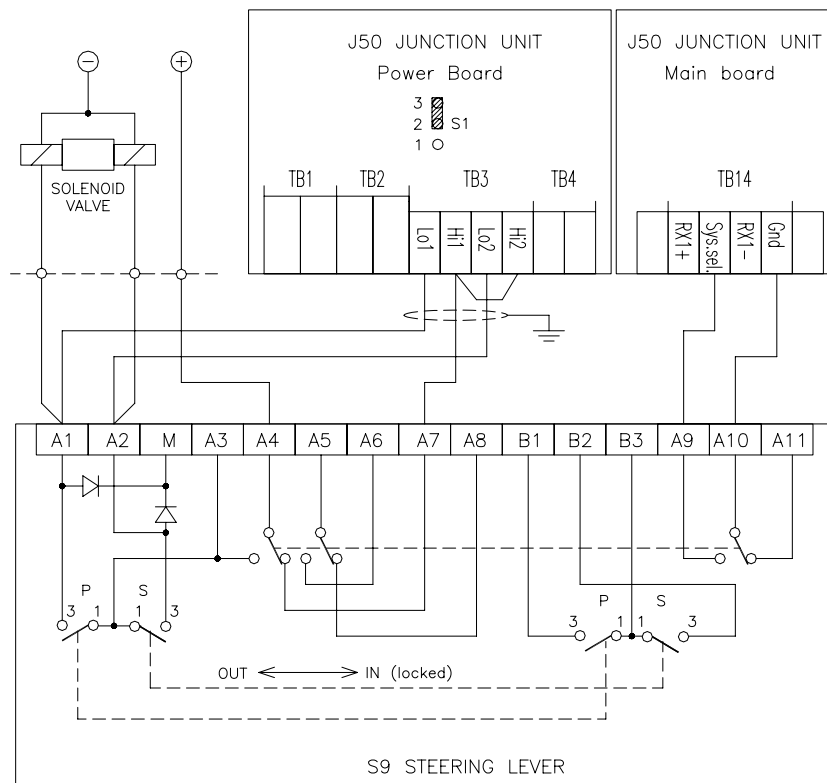
If connected according to Figure 2-32 or Figure 2-33, S9 will disengage the autopilot and operate the solenoids by direct override. When the S9 handle is pushed in, the autopilot will resume in AUTO mode on the present heading.



**Figure 2-31 S9 connection to J50**



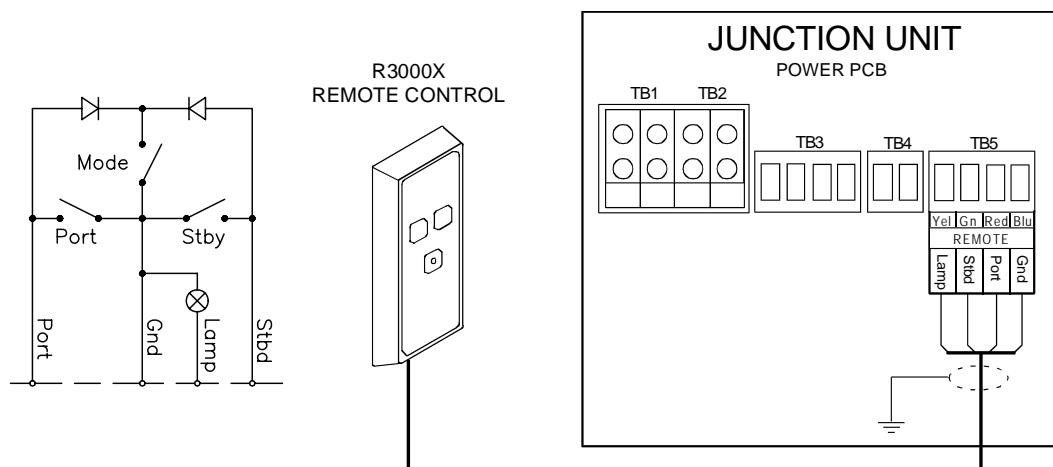
**Figure 2-32 Solenoid valves with priority steering, externally powered, common positive**



**Figure 2-33 Solenoid valves with priority steering, externally powered, common negative**

## 2.17 Remote Control

The R3000X Remote Control is weather proof and can be mounted outdoors in the supplied bracket that is fixed by four mounting screws.



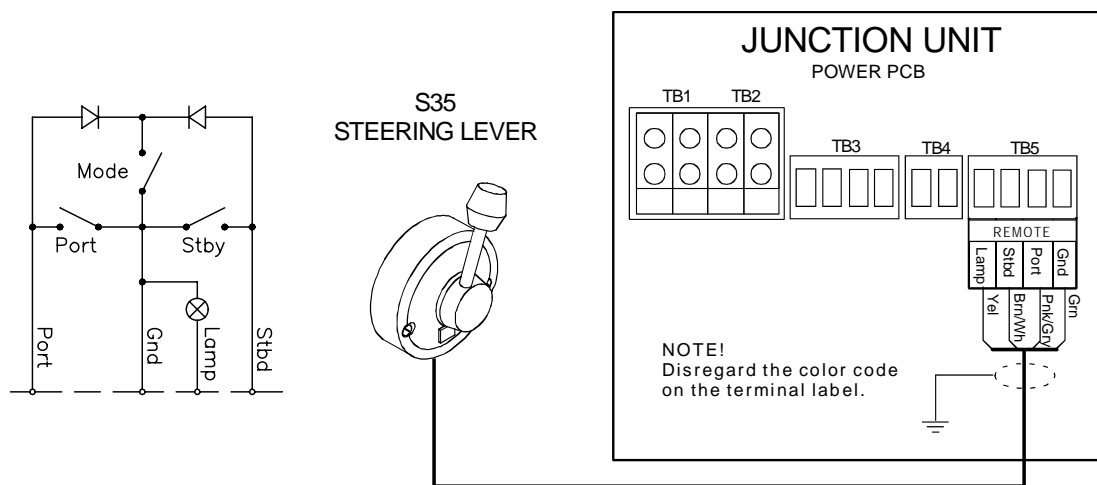
**Figure 2-34 R3000X Remote Control Connection**

## 2.18 JS10 Joystick

Refer to separate installation procedure for JS10 (document no. 20221610)

## 2.19 S35 NFU Steering Lever

The S35 NFU Steering Lever may be mounted to the bulkhead or to a panel by two screws from the front. The cable is connected to the junction unit according to Figure 2-35. If necessary, interchange the Port and Stbd wires to the screw terminals in the junction unit to make the direction of the lever movement coincide with the direction of the rudder movement.



**Figure 2-35 S35 NFU Steering Lever Connection to Junction Unit**

The steering lever is opened by removing the three screws on the back cover. Inside are two sets of micro-switches, a printed circuit board with a plug-in terminal, and a jumper strap.

## 2.20 F1/2 Remote Control

The F1/2 Remote Control comes with 10 m (33 ft.) of cable and is connected to the junction unit as shown in Figure 2-36.

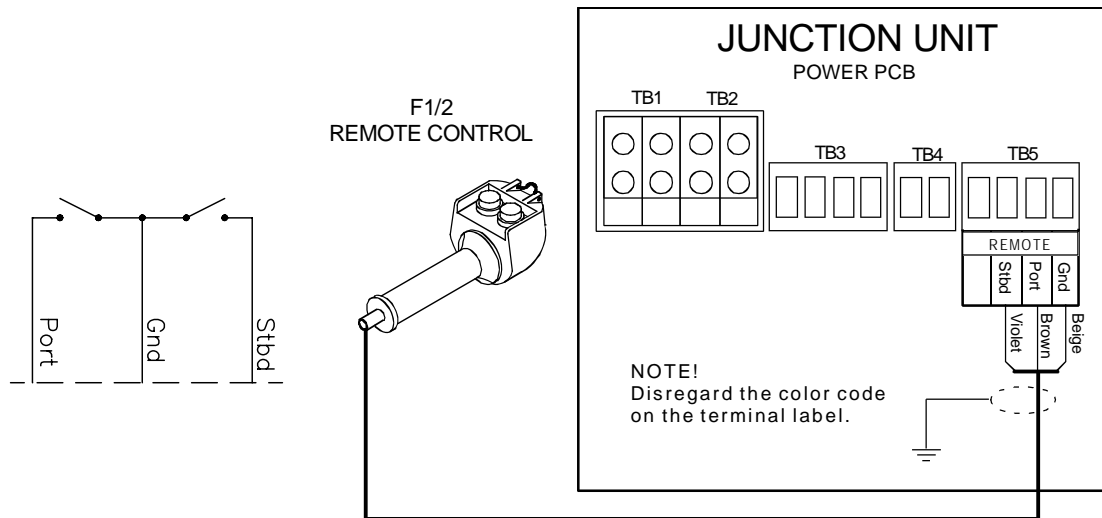


Figure 2-36 F1/2 Remote Control Connection

## 2.21 Interfacing to Optional Equipment (THD, Navigation Receiver, etc.)

With the AP50 autopilot system, there are several options for connection to other equipment for data exchange:

1. The J50 Junction Unit includes two NMEA input/output ports and a Clock Data heading interface to Simrad and Furuno radars. Only the J50-2 port (NMEA input 2) accepts NMEA heading sentences.
2. The optional NI300X NMEA Interface (expansion) Unit includes 4 additional NMEA input/output ports.

The following connecting diagrams illustrate the interfacing possibilities.

Note !

See also "Interface Set-up" page 54 and the NMEA sentence table page 109.

### Single NMEA input/output

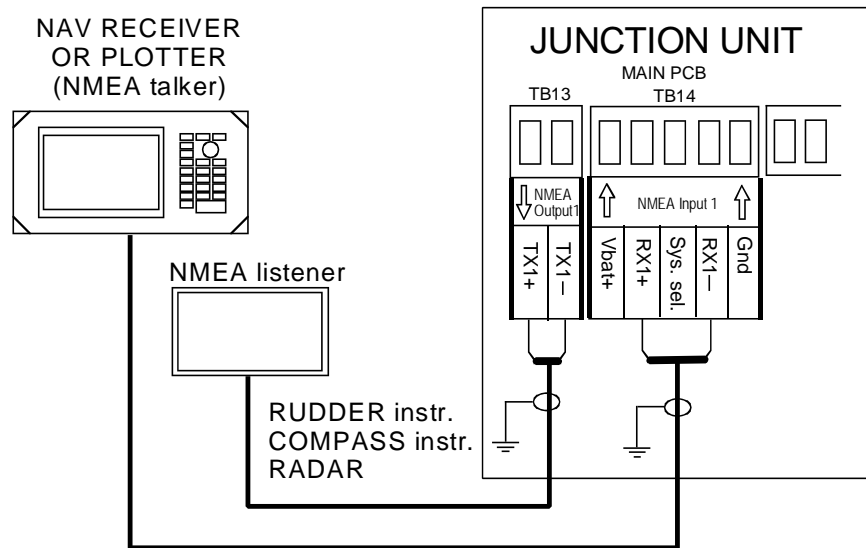


Figure 2-37 Single NMEA Connection

### Double NMEA input/output

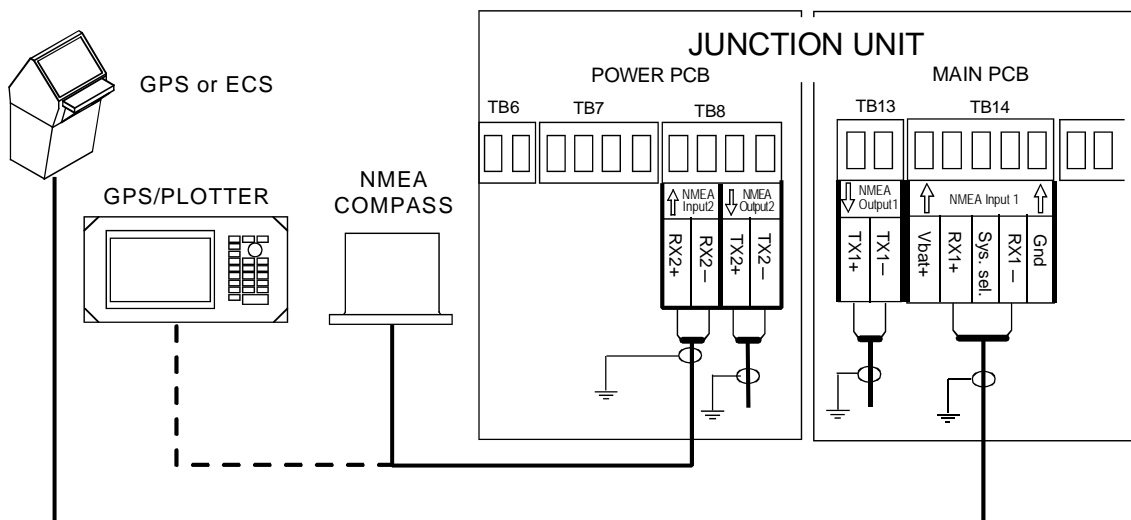


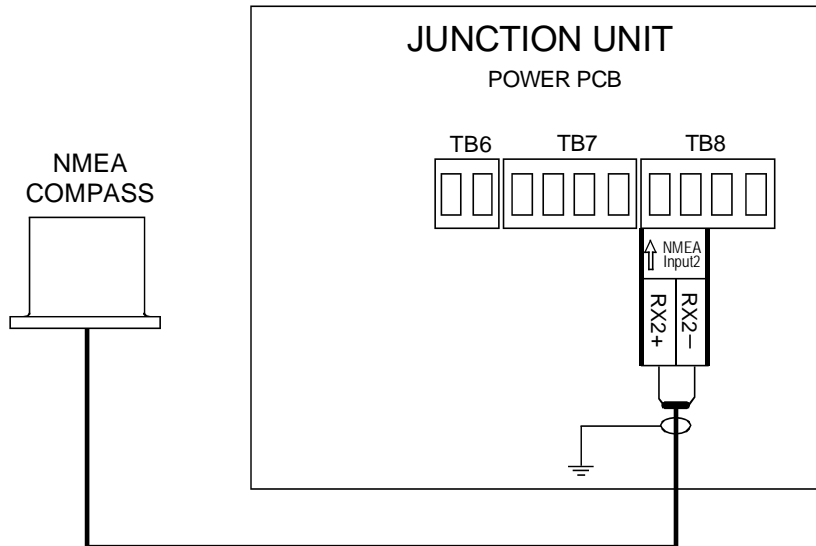
Figure 2-38 Double NMEA Connection

Output signal	Output terminal	Output sentence
Continuous output of 10 Hz NMEA compass heading	Junction unit, Power PCB, NMEA2, TX2+, TX2-	HDT or HDG (steering compass dependent; ref. to the NMEA table)

Table 2-6 Permanent NMEA Output on Port 2

### Input from "NMEA Compass"

A gyro compass or GPS compass (or other) with NMEA 0183 HDT (or HDG, HDM message) is connected to the J50/J50-40 Junction Unit NMEA Input2 terminal.

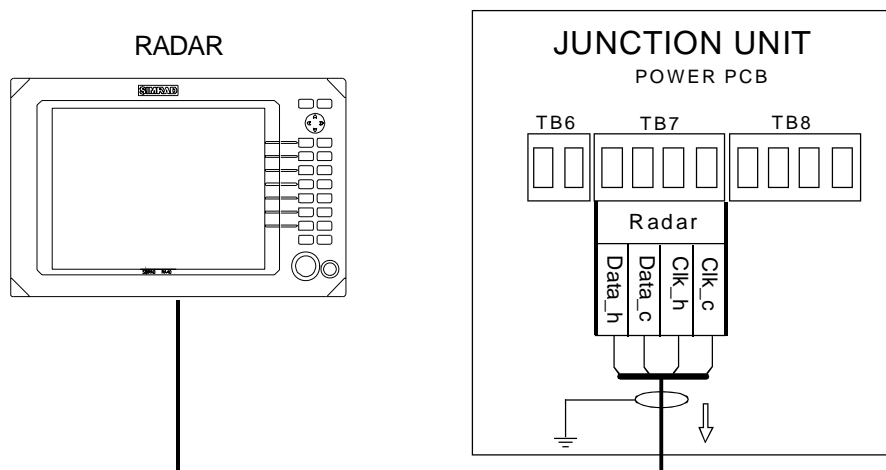


**Figure 2-39 NMEA compass connection**

Note !

*An output of 10 Hz or faster is recommended.*

### Radar Clock/Data



**Figure 2-40 Radar Clock/Data Connections**

## Analog Heading Repeater

AR77 & AR68 ANALOG REPEATER

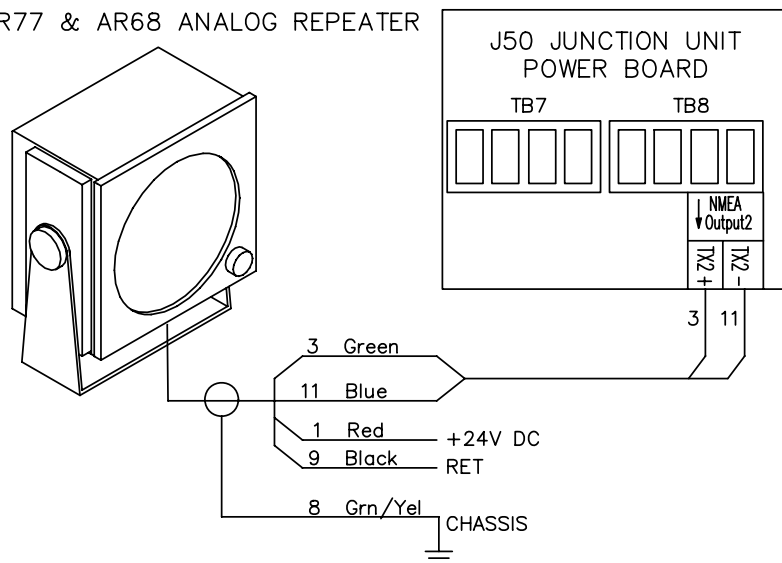


Figure 2-41 AR77 and AR68 Analog Heading Repeater Connections

## Digital Heading Repeater

DR75 DIGITAL REPEATER

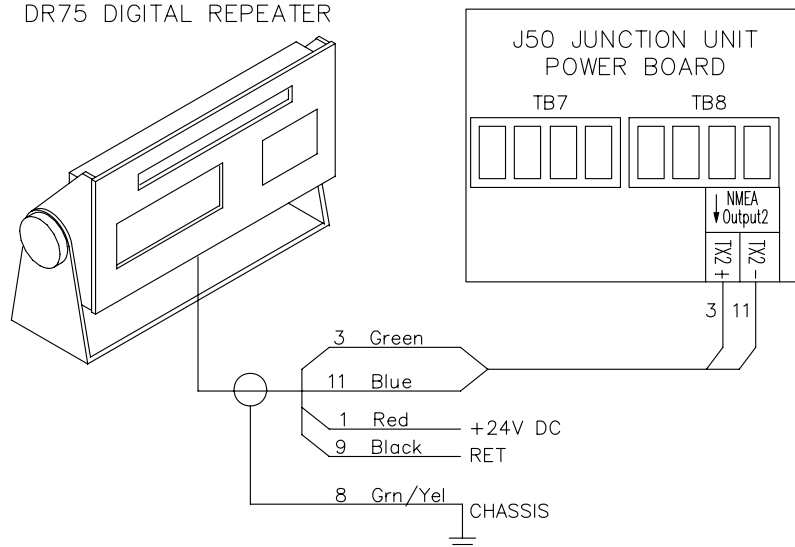


Figure 2-42 DR75 Digital Heading Repeater Connections

## GI51 Gyro Interface

The GI51 Gyro Interface is required when a gyrocompass with geared synchro or stepper signal output is connected to the AP50.

The GI51 is also required when a speed log signal with 200 pulses/NM is connected to the system.

Refer to separate installation manual for GI51 (document no. 20221594)

## NI 300X NMEA Interface Unit

The NI300X NMEA Interface Unit is normally installed inside of a console or locker close to navigation receivers, radar, and instruments to keep the cables short. The unit does not have controls that need to be operated during installation or use, but you should be able to take the lid off for inspections and to view LED indication of received signals. It should be installed with the cable inlet and the Robnet connectors facing down. The NI300X is designed to operate in locations with temperatures below +55°C (+130°F). It is fastened to the panel/bulkhead by the external mounting brackets.

Note !

*The NI300X is not weatherproof and must be installed in a dry location!*

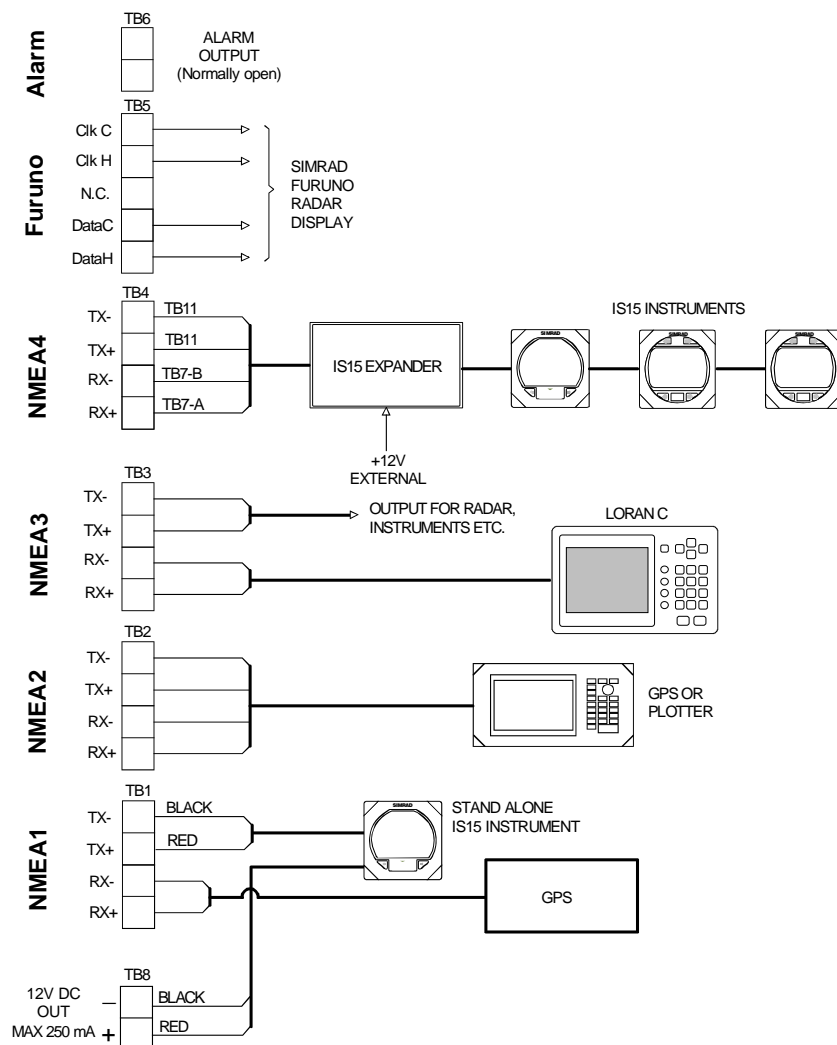


Figure 2-43 NI300X NMEA Interface Unit Connections

The NI300X NMEA Interface (expansion) Unit is designed for installations in which more NMEA lines have to be tied into the system. Four NMEA ports, which are identical in hardware and software, are available and can be connected as desired. An additional output data-port with a DATA/CLOCK signal is capable of generating heading data in the format used by some radar displays made by Simrad and Furuno.

The 12V output is designed for driving instruments with a total maximum load of 250 mA.

Configuration for Simrad or Furuno is selected in the Installation Interface Menu (see page 61).

### CD100A Course Detector

The owner may prefer to use the boat's own compass. The compass must be fully gimbaled and have a flat surface underneath to fit the CD100A. Make a hole for a 6 mm screw in the bottom of the compass and mount the CD100A as shown in Figure 2-44. Secure the 6 mm screw through the center hole of the CD100A. Make sure the cable does not prevent the compass from moving freely in the gimbals.

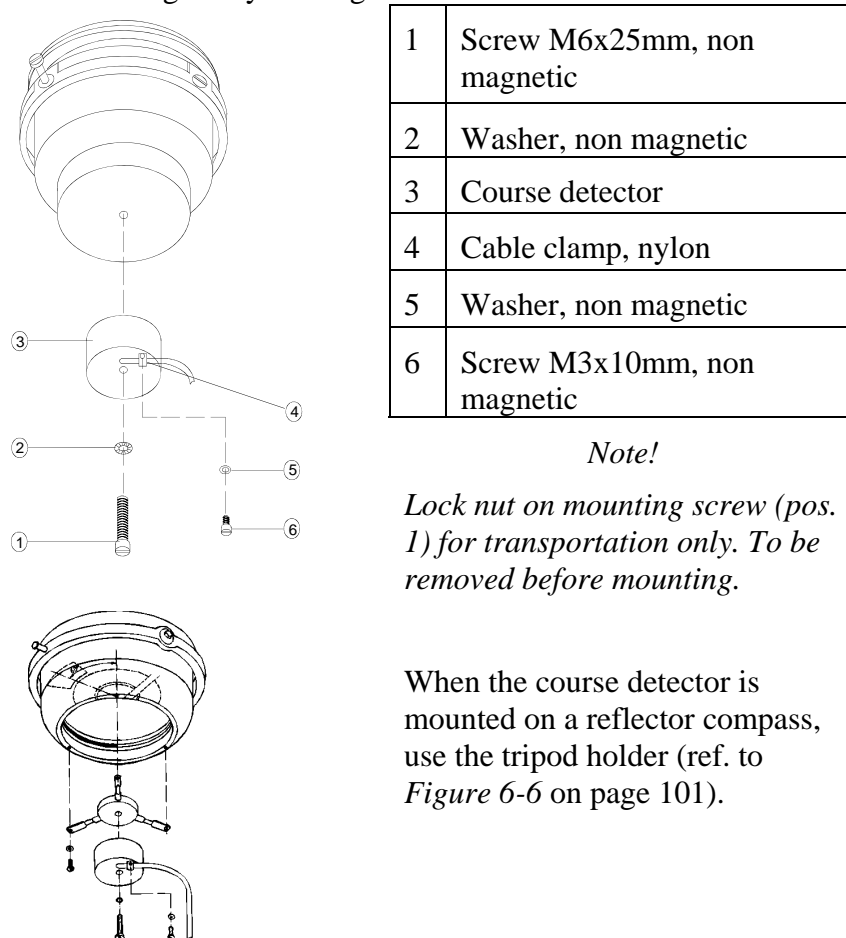


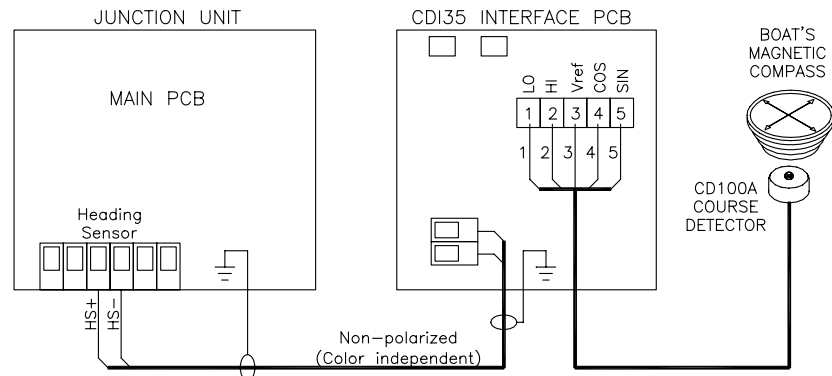
Figure 2-44 CD100A Course Detector Mounting

## CDI35 Interface

Install the CDI35 Interface as close to the compass as possible so that it will be easy to find in the event of servicing.

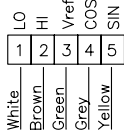
Put the two fixing screws in the slots and secure the unit to the bulkhead. Open the unit to access the screw terminals.

Connect the cables as shown in Figure 2-45.

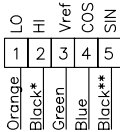


CD100 CONNECTIONS TO CDI35:

ALT. 1



ALT. 2 (new cable)



To identify the black wires, measure 8–12 ohm between orange and black\* and 6–10 ohm between green and black\*\*. Third black wire not in use.

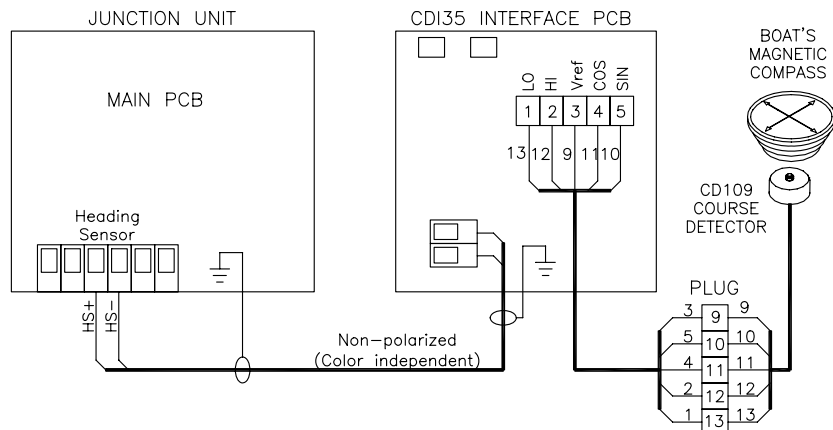
**Figure 2-45 CDI35 Interface Connections**

**Note !**

*The CD100 is a previous model and its cable has a connector that must be cut off for connection in the AP50 system (e.g. to the G151 or the CDI35).*

## CD109 Course Detector

For retrofit installations, a CD109 Course detector may be connected to the CDI35 according to Figure 2-46.



**Figure 2-46 CD109 Course detector connections to CDI35 Interface**

## 3 SOFTWARE SET-UP PROCEDURE

### 3.1 Description of Installation Set-up

The design of the AP50 includes advanced features that have simplified the installation and set-up of an autopilot. The principle advantage is that the manual adjustments that needed to be made on previous models are no longer necessary with the AP50.

**Note !**

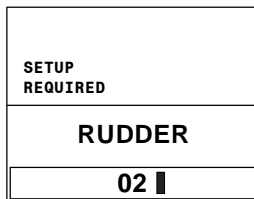
*The Installation Set-up must be performed as part of the installation of the AP50 system. Failure to correctly set the values in the Installation Set-up menu may prohibit the AP50 from functioning properly!*

The Installation Set-up is grouped into the following functional categories:

- **Language:** Selects the language used for display information.
- **Dockside Settings:** Sets the values for items to be set prior to sea trials.
- **Interface Set-up:** Sets the identification of navigation equipment and optional equipment connected to the AP50 system.
- **Sea-trial Settings:** Determines the automatic calibrations and the steering parameters and sets the compass offset.
- **Service:** Used to view system parameters, perform NMEA tests, and Master reset system memories.
- **Settings:** Setting or changing steering and thruster parameters.

Each category is designed to focus on specific functions related to an installation activity and to enable quick access when changes need to be made.

**Some important points regarding the Installation Set-up values:**



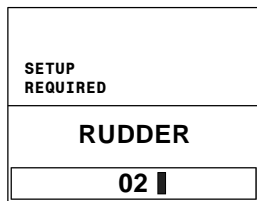
- When the AP50 is delivered new from the factory, (AND ANY TIME AFTER A MASTER RESET OF MEMORIES HAS BEEN PERFORMED), the Installation Set-up values are all reset to preset (default) values. The warning message "Setup Required" will appear at "turn on" and if an attempt to access the AUTO or NAV modes is made.
- The Dockside and Interface settings can only be accessed when the system is in Standby mode.
- The values that are selected in the Installation Menu are


stored in the memory of the AP50 system. No specific action is required to save the selected values to memory. Once the value is changed, it is stored until the next time the menu item is selected and changed.

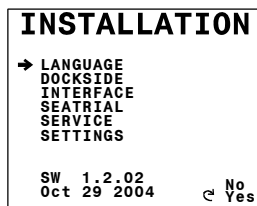
- The Installation Set-up is considered global (except language), which enables the values to be available to all control units in the system.
- The values in the Seatrial Settings are dependent on the successful completion of the Dockside Settings.
- In the table on page 89 the range of each setting is listed. Note the final value selected during the Installation Set-up, and also note any changes of values.

Before attempting to turn on the AP50 and perform an Installation Set-up, the hardware installation and electrical installation must be completed and performed in accordance with the installation instructions.

### 3.2 Installation Menu



A single press on the  (STBY) button switches the system on. After approximately 5 seconds, the unit that was turned on will show the Standby mode display. When the AP50 is delivered new from the factory (and any time after a master reset of memories has been performed), the Installation Set-up values are all reset to preset (default) values. The warning message "Setup Required" will appear at "turn on" and if an attempt to access the AUTO or NAV modes is made.





The Installation Menu is presented on the autopilot display by pressing and holding the  (NAV/SETUP) button for 5 seconds.

Note !

*The Installation Menu is different from the User Set-up Menu. Refer to the flow diagram on page 48 for a pictorial view of the Installation Menu.*

Navigate through the Installation Menu as follows:

- Answer "Yes" to a question by rotating the course knob clockwise.
- Answer "No" to a question by pressing the  (STBD) button. This will allow you proceed to the next menu item.
- Return to the previous menu item by pressing the  (PORT) button.
- Change the selected item shown by rotating the course knob in either direction.

- Exit the Installation Menu by pressing STBY, AUTO or NAV buttons.

On new installations, and whenever a junction unit or software is replaced in an AP50 system, it is recommended that a Master Reset be performed as described under SERVICE in the Installation Menu (see page 77) prior to proceeding with the set-up procedure.

#### Note !

*If a “System Select” switch is installed (page 18) it must be set to the autopilot system, otherwise the rudder can not be calibrated for direction and feedback signal in the Dockside menu.*

When using the Installation Menu refer to Figure 3-1 "Installation Menu Flow Chart" on page 48.



### Language selection

The AP50 can present the display in eight different languages:

- English, Deutsch, Francais, Español, Italiano, Nederlands, Svenska and Norsk.




To access the language selection in the Installation Menu:

1. Answer “Yes” by turning the course knob clockwise.
2. Turn the course knob to select the language you wish to use.
3. Continue to next item in the Installation Menu by pressing the  (STBD) button or leave the Installation Menu by pressing the  (STBY) button.

### Dockside

The following menu items are accessible and can be set up in the Dockside Set-up Menu:

- Master operation
- Boat type
- Boat length
- Drive unit voltage
- Rudder / Feedback calibration
- Rudder test
- Rudder limit
- Rudder deadband
- Thruster type

Select STANDBY mode and enter the Installation Menu as previously described. Select "Dockside" by pressing  (STBD) button and confirm by rotating the course knob clockwise.

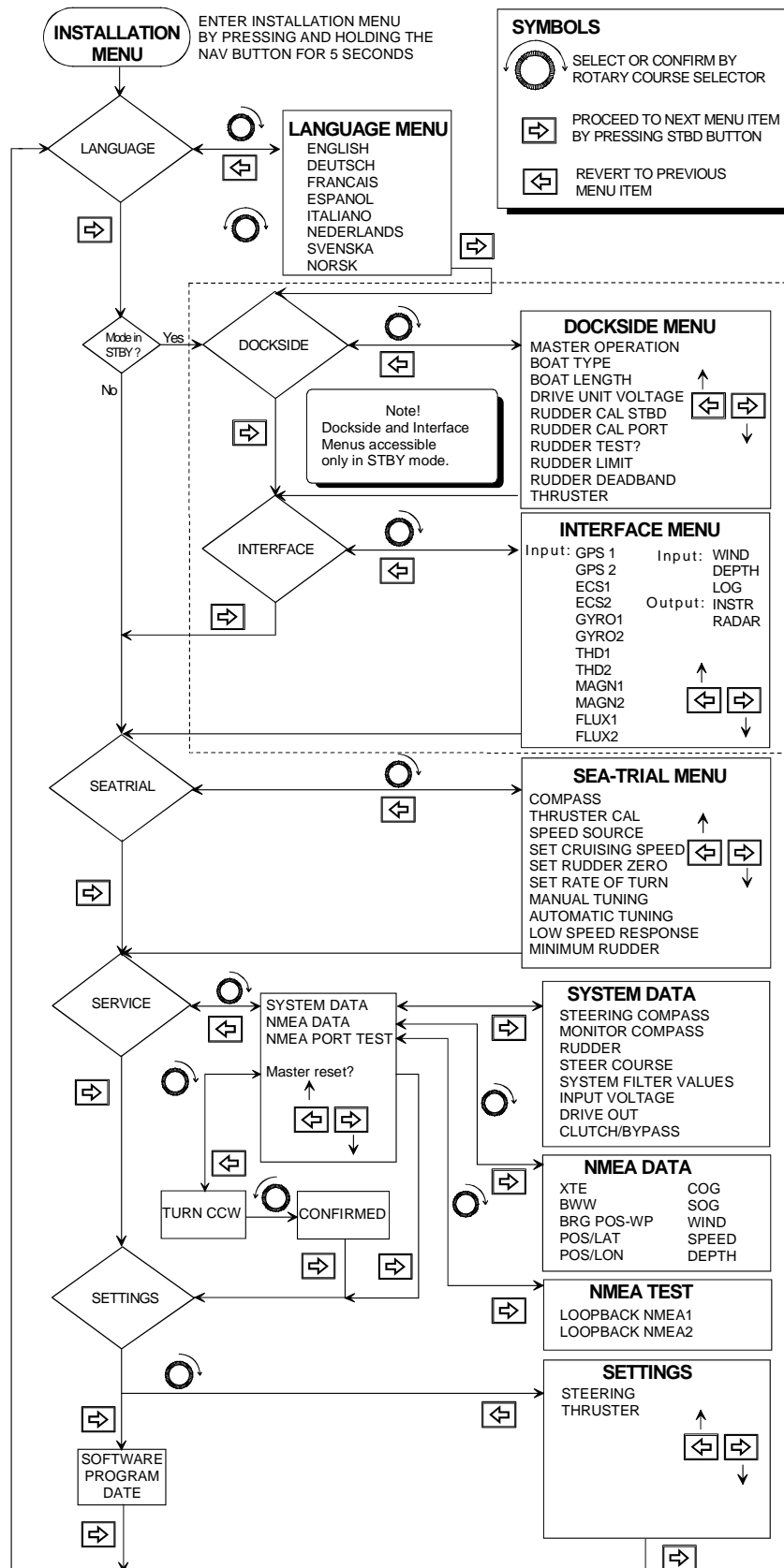
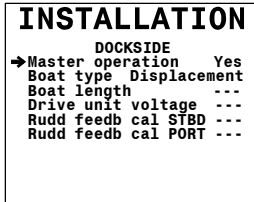
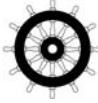



Figure 3-1 Installation Menu Flow Chart



### Master Operation

For vessel that comply with the European Marine Equipment directive, one control unit must be set for **Master operation**, if more than one control unit is connected. The other unit(s) is then automatically set as a “slave”. The system can only be switched off from the master unit (see also Operator Manual, Master Operation).

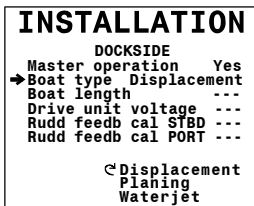
If your system is to be wheelmarked you have to answer yes for **Master operation** on one of the control units by rotating its course knob. This applies only to commercial vessels classed to follow the Marine Directive.

Press the  (STBD) button to proceed to the next menu item.


#### Note !

*Whenever boat type or boat length is changed, all steering parameters will be reset to default values.*

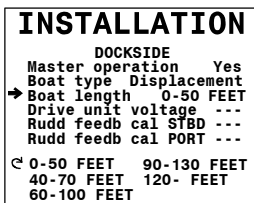
### Boat Type




The actual **Boat type** is selected by turning the course knob. The options are: **Displacement** hull, **Planing** hull, and **Waterjet** propelled.

The type of boat selected will affect the steering parameters and the functions available in the autopilot system. Select the appropriate **Boat type** and press the  (STBD) button.

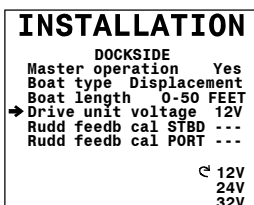
### Boat Length



The actual boat length is selected by turning the course knob. The options are: **0-50 feet**, **40-70 feet**, **60-100 feet**, **90-130 feet**, and **120- feet**. For those boats that may qualify for two categories (e.g. 45 ft.) it is recommended that faster/lighter boats be placed in the shorter category.

The **Boat length** will affect the steering parameters. Select the appropriate boat length and press the  (STBD) button.

### Drive Unit Voltage



This menu option requires the installer to set the reversible motor **Drive unit voltage** to the correct level. The selections are **12V**, **24V**, or **32V** and should be set to the voltage specified for your drive unit. Drive engage/bypass clutch output follows the same voltage as set for the drive unit. This also applies if Drive engage is set to Auto or Handshake 1 (ref. page 80). It is not possible to select a higher voltage than the input voltage.

#### Note !

*Selection of an improper voltage level for your drive unit may damage both the drive unit and junction unit, even if the protection circuits in the junction unit are activated.  
This setting does not apply for solenoid operated pumps ( ref.*


*Rudder Test, page 51). The solenoid voltage will always be equal to the supply voltage.*

Refer to the drive unit tables on pages 20 and 21 for information. The clutch/bypass voltage is automatically set to coincide with the drive unit voltage. During the rudder test, the AP50 system will also automatically detect whether the drive unit is a reversible motor or whether it is solenoid operated.

To change the voltage selection, rotate the course knob.

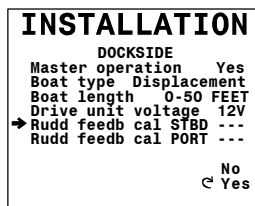
**Note !**

*The **Drive unit voltage** setting does not apply when operating solenoids on a continuous running pump/steering gear. Hence, the output voltage to the solenoids will be the same as the input voltage.*

Proceed to the next menu item by pressing the  (STBD) button.

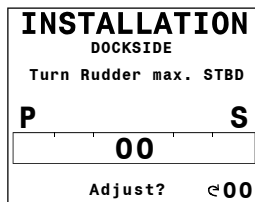
**Rudder Feedback Calibration**

(Not applicable for analog drives).



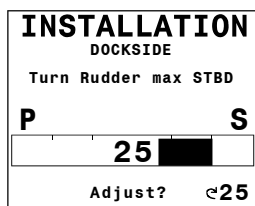
Make sure the rudder feedback unit is installed and aligned as per instructions in section 2.6 (RF300), 2.7 (RF45X) or 2.8 (RF14XU) before attempting the **Rudder feedback calibration**.

This function enables you to compensate for non-linearity in the mechanical transmission between the rudder and the rudder feedback unit.



Select **Rudder feedback calibration STBD** by turning the course knob clockwise. “Turn Rudder max STBD” will be displayed on the screen.


Manually turn the helm wheel to starboard until the rudder stops at maximum starboard rudder.



The value shown on the display is the value read by the feedback unit before any adjustment is made. The bargraph indicates to which side the rudder is positioned. Be sure to set the correct rudder angle and direction by turning the course knob. The autopilot uses this value as physical stop. Physical stop minus 2° will be used as “max. rudder limit” and determines how far the autopilot can under any circumstance, drive the rudder.

**Note !**

*If the rudder feedback unit is mounted upside down, the displayed rudder angle may be to the opposite side before you start the adjustment (arrow pointing to Port). In this case, turn the course knob starboard until the rudder angle indicator displays the correct starboard value.*


Advance to the next step by pressing the  (STBD) button.

Manually turn the helm wheel to port until the rudder stops at maximum port rudder.

Adjust the displayed angle the same way as for starboard adjustment (if the rudder feedback unit is upside down, you need not correct for the opposite side this time).

**Note !** *If no adjustment has been made to the display readout (i.e. not turning the course knob), the AP50 will set the physical stop to 45°. “Max. rudder limit” will be set to 2° less.*

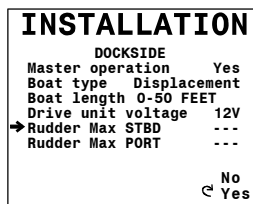
**Note !** *Rudder-zero may still be inaccurate and should be adjusted later during sea trial.*

Proceed to the next menu item (Rudder Test) by pressing the  (STBD) button.

### Rudder Calibration

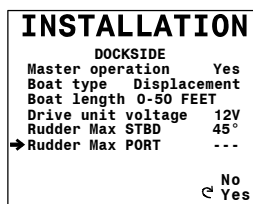
(Only applicable for analog drive).


This setting is used for calibration of analog rudders. ‘Rudder Max’ is displayed instead of ‘Rudder feedback cal’ when an AD50 Analog Drive is connected via the Robnet and a rudder feedback unit is not connected to the system.

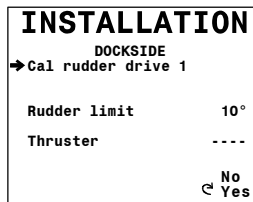



Enter “Installation, Dockside menu and select “Rudder Max STBD”.

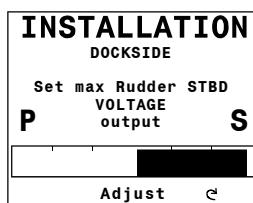
Turn the course knob and set the required max rudder travel to a little less than the extreme hard-over position.



Press the  (STBD) button to enter “Rudder Max PORT” Turn the course knob and select max travel to port. Note that this sets the maximum travel for rudder or azimuth thruster whichever is applicable.

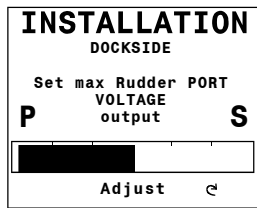



Press the  (STBD) button to enter “Cal rudder drive 1”.

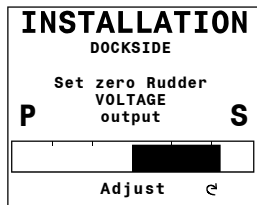



Turn the course knob CW and observe that the display shows “Set max Rudder STBD Voltage output”.

Turn the course knob to obtain STBD rudder by turning the knob CW or CCW. Observe the rudder angle indicator and output voltage and continue to turn the course knob until the rudder has reached the previous selected maximum angle to STBD.



Press the  (STBD) button and observe that the display shows “Set max Rudder PORT Voltage output”. Turn the course knob CCW to obtain max PORT rudder deflection observed by the rudder angle indicator.



Press the  (STBD) button and adjust the zero rudder.

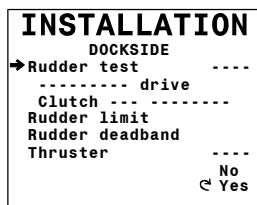
Note that every time the “Voltage output” display is shown, the steering system must be set for autopilot control, either manually or via “System select”. Refer to “System Select” in the AP50 Installation Manual.

### Rudder Test

(Not applicable for analog drives)

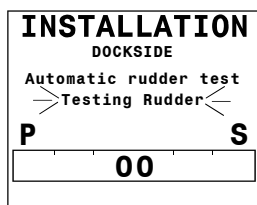
Note !

*Bring the rudder manually to midship position before starting the test. If the boat uses power-assist steering, it is important that the engine or electric motor used to enable the power-assist steering is turned on prior to this test. Stand CLEAR of the wheel and do not attempt to take manual control of the wheel during this test!*



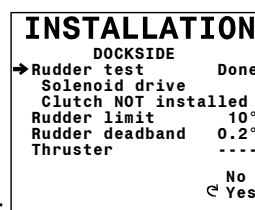
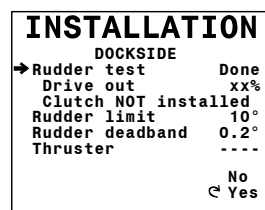
Activate the automatic **Rudder test** by turning the course knob clockwise.

The AP50 will, after a few seconds, issue a series of PORT and STBD rudder commands, automatically verify correct rudder direction, detects minimum voltage for running, and reduce the rudder speed (reversing pumpset or proportional valves) if it exceeds the maximum acceptable speed for autopilot operation.



The **Rudder test** is verified by the display showing ‘Motor OK’, ‘Proportional OK’, ‘Solenoids OK’, or ‘Failed’. If ‘Failed’ is given, check for correct electrical connection and also make sure that the steering engine is selected for autopilot control (ref. to ‘System select’ on page 18).

When test is finished the display will read:




or

The **Drive out** (displayed in percentage) is the amount of maximum available voltage needed to achieve correct rudder speed when automatic steering (Maximum speed is used in NFU steering).

It will be indicated on the screen whether a clutch is installed or not.

If the Automatic rudder test fails, refer to "Warnings" in the Operator Manual.

Proceed to the next menu item by pressing the  (STBD) button.

### **Rudder Limit**

<b>INSTALLATION</b>		
DOCKSIDE		
Rudder test	Done	
Solenoid drive		
Clutch NOT installed		
→ Rudder limit	10°	
Rudder deadband	0.2°	
Thruster	----	

**Rudder Limit** determines the maximum rudder movement in degrees from the "used" midship position that the autopilot can command the rudder in the automatic modes.

"Used" midship position is the rudder angle required to maintain a straight course.


The **Rudder limit** setting is only active during autosteering on straight courses, NOT during course changes. This **Rudder limit** does not affect WORK, Non-Follow-up or Follow Up steering. In WORK, Non-Follow-up or Follow Up steering, only the max. rudder limit applies.

**Note !**

*The max. rudder limit was set automatically to physical stop minus 2° when the rudder feedback calibration was performed.*

Range: 5° to max. rudder limit in 1° steps.

Default: 10°

Proceed to the next menu item by pressing the  (STBD) button.

### Rudder Deadband

(Not applicable for analog drives)


INSTALLATION	
DOCKSIDE	
Rudder test	Done
Solenoid drive	
Clutch	NOT installed
Rudder limit	10°
→ Rudder deadband	0.2°
Thruster	----

Necessary deadband to avoid the rudder from hunting is calculated and set automatically during the rudder test. Therefore this parameter should normally not be adjusted. If the auto-setting does not perform properly (rudder commands due to vibration of the rudder when under way), it can be adjusted manually. A narrow deadband may cause the rudder to hunt and a wide deadband will create inaccurate steering.

Adjust the **Rudder deadband** by rotating the course knob. Find the lowest possible value that will prevent the rudder from hunting. It is recommended to check rudder stability and accuracy in FU-mode.

Range: Auto, 0.1° to 4.0° in 0.1° increments.

Default: Auto.

Proceed to the next menu item by pressing the  (STBD) button.


### Thruster

INSTALLATION	
DOCKSIDE	
Rudder test	Done
Solenoid drive	
Clutch	NOT installed
Rudder limit	10°
→ Rudder deadband	0.2°
→ Thruster	----
	<input type="radio"/> ---- <input type="radio"/> Danfoss <input type="radio"/> Continuous <input type="radio"/> On/Off

Select the type of thruster connected to the autopilot system.

Select between: ---- (no thruster connected), **Danfoss** (Danfoss PVEM valve), **Continuous** (analog: ±10V internal, 4-20 mA or external ref. voltage) or **On/Off** (On/Off solenoid).

“Continuous” must also be selected for Proportional Directional control (ref. TI51 Instruction Manual).

Proceed to the next menu item by pressing the  (STBD) button.

Note !

*Before use of the thruster, the Thruster sea-trial set-up has to be performed to set the **Thruster direction** and the **Maximum thrust**.*

### Interface Set-up

The AP50 system provides a flexible approach to the input of data from heading sensors and other external equipment. Identification of the type of equipment connected to the AP50 system is performed in the Interface Menu.

To be able to display all the information on the instrument screens (see section “Instrument Screens and Menu” in the Operator Manual), refer to the table in section 6.18 on page 110 for the required NMEA sentences.

When your system includes connection of external equipment to the NMEA0183 data ports in the junction unit or the NI300X NMEA Interface, or if the GI51 Gyro Interface is installed with optional compass units, they must be configured in the Interface Menu. This procedure allows you to assign an abbreviated name to identify the type of equipment that is connected to each of the available hardware ports in the AP50 system.

**Caution !**

*The ECS1 and ECS2 set-up items are intended for connection to professional navigators where the radius for the course change is preset in the chart system. This turn radius will allow the ship to turn before the waypoint is reached and enables the AP50 to follow a route seamlessly.*

**Note !**

*Confirmation for course change by the user will not be required. Users navigating in this mode must show extra caution!*

When connecting a GPS or a Chartplotter, use the GPS1 or GPS2 set-up item.

Abbreviated name	Equipment / Usage	NOTES
GPS1	Primary GPS/Chart Plotter	Can be used as either Nav. source or Speed source
GPS2	Backup GPS/Chart Plotter	
ECS1 *	Primary Electronic Chart System	
ECS2 *	Backup Electronic Chart System	
GYRO1	Any primary gyro	NMEA, syncho or step signal input
GYRO2	Backup gyro for GYRO1	
THD1	Transmitting Heading Device	NMEA input
THD2	Transmitting Heading Device	
MAGN1	Magnetic compass with course detector (CD100A)	1) CD100A + CDI35 connected to J50
MAGN2	Magnetic compass with course detector (CD100A)	2) CD100A directly connected to CI300X
FLUX1	For use with fluxgate compasses	Robnet, NMEA, sine/cosine or J50 Heading Sensor (HS) input
FLUX2	For use with fluxgate compasses	
WIND	For wind sensor	NMEA input
DEPTH	For depth sensor	
LOG	For speed sensor	NMEA or pulse log
Output INSTR	NMEA output of compass heading or VDR data	HDG or HDT output increased from 1 to 5 times/sec. on TX1 port. HDT and RSA 5x/sec.
Output RADAR	Clock/data heading output to radars	May select Simrad, Furuno, or Special** (for both J50 and NI300X)

\* Automatic course change at waypoint will now occur during navigation in NAV mode.

\*\* For future use.

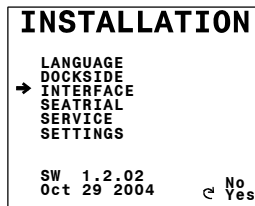
**Table 3-1 Interface Menu**

Output signal	Output terminal	Output sentence
Continuous output of 10 Hz NMEA compass heading	Junction unit, Power PCB, NMEA2, TX2+, TX2-	HDT or HDG (input dependent)

**Table 3-2 Permanent NMEA Output on Port 2**

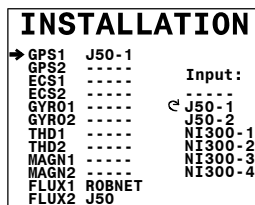
The Interface Set-up Menu presents names so that they can be assigned to the hardware input or output port (see Table 3-1 on page 56. Each abbreviated name is then presented in the appropriate locations of the User Set-up Menu (see Operator Manual) to provide the user with choices of data sources.

Upon completion of the Interface Set-up, it is recommended that the configuration be recorded in the Interface Set-up Table on page 58.



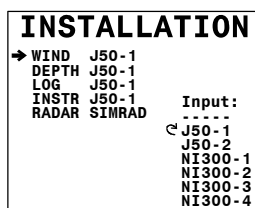
To begin Interface set-up, proceed to the Interface Set-up menu under the Installation Menu.

To access the Interface Set-up items, turn the course knob clockwise.



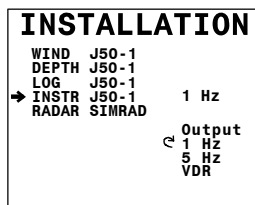
The display now shows the first name on the list. Select the hardware port where that device is connected by turning the course knob until the appropriate hardware port is displayed.

Proceed to the names on the list that should be assigned by pressing the (STBD) button. Assign the appropriate hardware ports by turning the course knob, or exit from the menu by progressing through the list of names by pushing the (STBD) button.



**Note !**

*Upon completion of the Interface Set-up, the names of items to which you have assigned hardware ports will be available as sources of data for compass, navigation, and speed in the User Set-up Menu. It is recommended that you access the User Set-up Menu directly after completing the Interface Set-up to select the desired data. Refer to the Operator Manual for details on changing the items in the User Set-up Menu.*



The standard NMEA output rate is 1 Hz. If INSTR J50-1, is set to 5 Hz, the output port, TX1, will have an output rate of 5 Hz for HDG or HDT (heading) messages. NMEA OUTPUT 2 on the J50 has a constant output rate of 10 Hz for HDG or HDT (see Table 3-2 on page 56. Both port 1 and 2 are still sending HDM at 1 Hz. HDM is an obsolete sentence, but some older equipment may still use it (see table on page 110).

If INSTR is set to VDR, rudder command, response and heading data as defined in IEC61996, is provided at 5 Hz in the HTD and RSA sentences.

**Interface Set-up - Input Signal**

Set-up item (abbrev. name)	Equipment connected (name)	Connected to terminal (use one available from list)	Assign hardware port to set-up item (* = default setting)
GPS1		Not connected	-----
		J50, Main PCB NMEA I/P RX1+,RX1-	J50-1*
		J50, Power PCB NMEA I/P RX2+,RX2-	J50-2
		NI300X, NMEA port #1	NI300-1
		NI300X, NMEA port #2	NI300-2
		NI300X, NMEA port #3	NI300-3
		NI300X, NMEA port #4	NI300-4
GPS2		Not connected	-----*
		J50, Main PCB NMEA I/P RX1+,RX1-	J50-1
		J50, Power PCB NMEA I/P RX2+,RX2-	J50-2
		NI300X, NMEA port #1	NI300-1
		NI300X, NMEA port #2	NI300-2
		NI300X, NMEA port #3	NI300-3
		NI300X, NMEA port #4	NI300-4
ECS1		Not connected	-----*
		J50, Main PCB NMEA I/P RX1+,RX1-	J50-1
		J50, Power PCB NMEA I/P RX2+,RX2-	J50-2
		NI300X, NMEA port #1	NI300-1
		NI300X, NMEA port #2	NI300-2
		NI300X, NMEA port #3	NI300-3
		NI300X, NMEA port #4	NI300-4
ECS2		Not connected	-----*
		J50, Main PCB NMEA I/P RX1+,RX1-	J50-1
		J50, Power PCB NMEA I/P RX2+,RX2-	J50-2
		NI300X, NMEA port #1	NI300-1
		NI300X, NMEA port #2	NI300-2
		NI300X, NMEA port #3	NI300-3
		NI300X, NMEA port #4	NI300-4
GYRO1		Not connected	-----*
		Connection to Robnet	ROBNET**
		J50, Power PCB NMEA I/P RX2+,RX2-	J50-2
		NI300X, NMEA port #1	NI300-1
		NI300X, NMEA port #2	NI300-2
		NI300X, NMEA port #3	NI300-3
		NI300X, NMEA port #4	NI300-4
		GI51, Gyro terminal	GI-sync
		GI51, Gyro terminal	GI-step
		GI51, Gyro terminal	GI-0183
		GI51, Gyro terminal	GI-prop

Set-up item (abbrev. name)	Equipment connected (name)	Connected to terminal (use one available from list)	Assign hardware port to set-up item (* = default setting)
GYRO2		Not connected	-----*
		Connection to Robnet	ROBNET**
		J50, Power PCB NMEA I/P RX2+,RX2-	J50-2
		NI300X, NMEA port #1	NI300-1
		NI300X, NMEA port #2	NI300-2
		NI300X, NMEA port #3	NI300-3
		NI300X, NMEA port #4	NI300-4
		GI51, Gyro terminal	GI-sync
		GI51, Gyro terminal	GI-step
		GI51, Gyro terminal	GI-0183
	GI51, Gyro terminal	GI-prop	
THD1		Not connected	-----*
		Connection to Robnet	ROBNET**
		J50, Power PCB NMEA I/P RX2+,RX2-	J50-2
		NI300X, NMEA port #1	NI300-1
		NI300X, NMEA port #2	NI300-2
		NI300X, NMEA port #3	NI300-3
		NI300X, NMEA port #4	NI300-4
THD2		Not connected	-----*
		Connection to Robnet	ROBNET**
		J50, Power PCB NMEA I/P RX2+,RX2-	J50-2
		NI300X, NMEA port #1	NI300-1
		NI300X, NMEA port #2	NI300-2
		NI300X, NMEA port #3	NI300-3
		NI300X, NMEA port #4	NI300-4
MAGN1		Not connected	-----*
	CD100A + CDI35	Junction unit: HS+, HS-	J50-HS
		J50, Power PCB NMEA I/P RX2+,RX2-	J50-2
		NI300X, NMEA port #1	NI300-1
		NI300X, NMEA port #2	NI300-2
		NI300X, NMEA port #3	NI300-3
		NI300X, NMEA port #4	NI300-4
	CD100A	CI300X Magnetic Compass terminal	CI300X
MAGN2		Not connected	-----*
	CD100A + CDI35	Junction unit: HS+, HS-	J50-HS
		J50, Power PCB NMEA I/P RX2+,RX2-	J50-2
		NI300X, NMEA port #1	NI300-1
		NI300X, NMEA port #2	NI300-2
		NI300X, NMEA port #3	NI300-3
		NI300X, NMEA port #4	NI300-4
	CD100A	CI300X Magnetic Compass terminal	CI300X

Set-up item (abbrev. name)	Equipment connected (name)	Connected to terminal (use one available from list)	Assign hardware port to set-up item (* = default setting)
FLUX1		Not connected	----
	RC25	Connection to Robnet	ROBNET*
		Junction unit: HS+, HS-	J50-HS
		J50, Power PCB NMEA I/P RX2+,RX2-	J50-2
		NI300X, NMEA port #1	NI300-1
		NI300X, NMEA port #2	NI300-2
		NI300X, NMEA port #3	NI300-3
		NI300X, NMEA port #4	NI300-4
		CI300X, Analog terminal	CI300X
FLUX2		Not connected	----*
	RC25	Connection to Robnet	ROBNET
		Junction unit: HS+, HS-	J50-HS
		J50, Power PCB NMEA I/P RX2+,RX2-	J50-2
		NI300X, NMEA port #1	NI300-1
		NI300X, NMEA port #2	NI300-2
		NI300X, NMEA port #3	NI300-3
		NI300X, NMEA port #4	NI300-4
		CI300X, Analog terminal	CI300X
WIND		Not connected	----*
		J50, Main PCB NMEA I/P RX1+,RX1-	J50-1
		J50, Power PCB NMEA I/P RX2+,RX2-	J50-2
		NI300X, NMEA port #1	NI300-1
		NI300X, NMEA port #2	NI300-2
		NI300X, NMEA port #3	NI300-3
		NI300X, NMEA port #4	NI300-4
DEPTH		Not connected	----*
		J50, Main PCB NMEA I/P RX1+,RX1-	J50-1
		J50, Power PCB NMEA I/P RX2+,RX2-	J50-2
		NI300X, NMEA port #1	NI300-1
		NI300X, NMEA port #2	NI300-2
		NI300X, NMEA port #3	NI300-3
		NI300X, NMEA port #4	NI300-4
LOG		Not connected	----*
		J50, Main PCB NMEA I/P RX1+,RX1-	J50-1
		J50, Power PCB NMEA I/P RX2+,RX2-	J50-2
		NI300X, NMEA port #1	NI300-1
		NI300X, NMEA port #2	NI300-2
		NI300X, NMEA port #3	NI300-3
		NI300X, NMEA port #4	NI300-4
	GI51 Pulse log terminal	GI-LOG	

J50 = All junction unit models

Set-up item	Equipment connected	Connected to terminal	Assignment
INSTR	Instrument system Instrument system Voyage Data Recorder	J50, Main PCB	1 Hz* 5 Hz VDR
RADAR	Radar Radar Future option	J50, Power PCB, TB9	Simrad* Furuno Special **

\* Default setting

\*\* For future use.

**Table 3-3 Interface Set-up - Output Signal Port 1**

## Sea Trial

### Caution !

*The Sea Trial must always be performed in open waters at a safe distance from other traffic.*

A sea-trial can only be performed if the Dockside Settings are completed and confirmed. It is also important that the Interface Set-up be performed prior to adjusting sea trial settings.

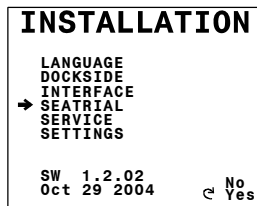
The following sea trial settings must be set:

- Compass calibration (to automatically compensate for onboard magnetic deviation)
- Compass Offset (to offset the final compass heading readout)
- Max/Minimum thrust, thrust direction and levels (only if thruster is selected)
- Set cruising speed (in the AP50)
- Set rudder zero (to indicate the precise midships position of the rudder)
- Set rate of turn at cruising speed (to select your preferred turn rate). **It is essential that this setting is carried out.**

If the boat steers satisfactorily, there is no need to perform the Manual or Automatic tuning.

The following sea trial settings may be used as optional settings:

- Manual tuning (Steering parameters: Rudder, Counter Rudder)
- Automatic tuning (an optional method of determining the steering parameters)
- Speed response (to tell how the rudder gain shall be adjusted automatically by vessel speed)



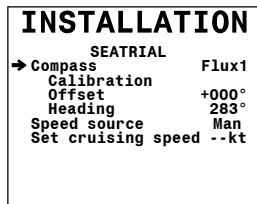
The Sea Trial menu is selected by rotating the course knob clockwise.

### Compass Calibration

This function will activate the automatic compass calibration procedure (for Simrad compasses connected through Robnet and through J50 Junction Unit Heading Sensor (HS) terminal, and compasses connected through GI51).

Note !

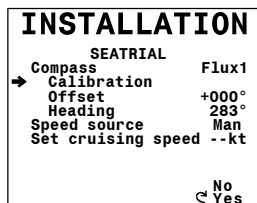
*If an optional magnetic compass is installed and connected to J50 or GI51, or if a gyrocompass, or other manufacturer's fluxgate is connected to a GI51, it is still required to perform the automatic compass calibration in order to calibrate the heading/input signal. Not applicable for stepper and geared synchro signals.*




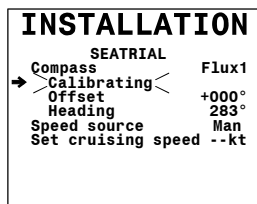
Select the compass to be calibrated.

Before you begin the compass calibration procedure, make sure you have enough open water around you to make a full turn with the boat.

The calibration should be done in calm sea conditions with minimal wind to obtain good results.



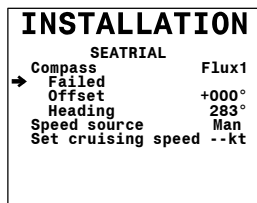
Press the  (STBD) button to select the **Calibration** function.



1. Begin turning the boat (port or starboard) and establish your turning rate.



2. Start compass calibration by turning the course knob clockwise. The display will flash **“Calibrating”**.

When calibration is completed (after having completed approximately 1 1/4 turns), it will be verified by the display reading **“Confirmed”**.



If the compass is too close to magnetic objects, the compass calibration may fail and the display will show **“Failed”**.

In that case, move the compass to a more suitable location and re-calibrate.

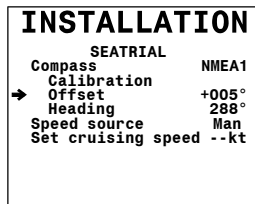
After calibration, check the compass readout against a known reference, compensated compass, or leading line. If the reading is correct ( $\pm 3^\circ$  for magnetic compass,  $\pm 0.5^\circ$  for gyrocompass) except for a fixed offset, proceed to the next menu item by pressing the  (STBD) button or return to STANDBY mode by pressing the  (STBY) button.

Note !

*If an optional NMEA compass from Simrad or another manufacturer is installed, refer to the optional compass' manual regarding calibration.*

### Compass Offset

The compass **Offset** feature allows you to correct for a constant compass heading offset. This offset may be present as a result of the compass being installed with a lubber line offset or if a fixed offset remains after the calibration procedure has been completed. The value of compass offset is specific to the heading sensor that is selected at the time the offset is entered. This means that you can have individual offsets for each compass installed.



Select the amount of correction by turning the course knob to offset the heading to agree with the known, accurate heading. The **Offset** value can be either positive or negative.



Note !

*If an Offset still exists after having accounted for it, one of the following problems may still exist:*

- The heading reference to which you are comparing the compass is not accurate.
- The automatic calibration obtained by the compass is not correct. This may be due to a large magnetic influence near the compass (relocation may be required) or to excessive wave condition during calibration.

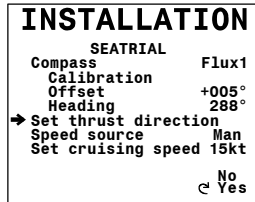
Note !

*Do not compare with GPS' COG, since your GPS is showing course, rather than heading.*

Proceed to the next menu item by pressing the  (STBD) button or return to Standby mode by pressing the  (STBY) button.

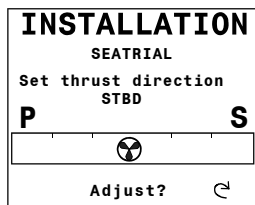
### Set Thrust Direction, On/Off Thruster

(ONLY IF ON/OFF THRUSTER IS SELECTED, proceed to page 65 if continuous thruster or Danfoss thruster is selected)



Rotate the course knob clockwise to activate the **Set thrust direction** setting.

Rotate the course knob to starboard and verify that the vessel turns to starboard. The thruster stops after 10 seconds, or when the (STBD) button is pressed.



If the boat turns to port when the course knob is turned to starboard, rotate the knob to port to ensure a starboard turn.

This tells the autopilot which direction to turn the thruster.

For ON/OFF thrusters, a change in direction command will always be delayed 1 second to prevent thruster breakage.

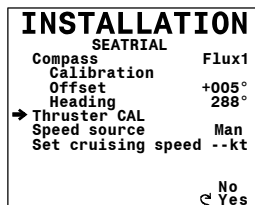
#### Note !

If advanced set-up of the thruster is required, refer to the **SETTINGS** menu on page 86.

Proceed to the “**Speed source**” item on page 66 by pressing the (STBD) button or return to STANDBY mode by pressing the (STBY) button.

### Thruster Calibration, Analog Thruster

(ONLY IF CONTINUOUS THRUSTER OR DANFOSS THRUSTER IS SELECTED)



Rotate the course knob clockwise to select the **Thruster CAL** display.

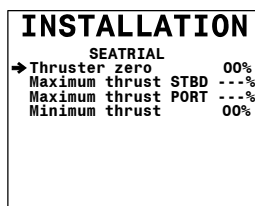
#### Thruster zero

Rotate the course knob until you have no output effect from the thruster. The Thruster zero offset is now set.

Range: -50% to +50% in step of 1%.

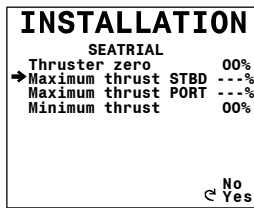
Default: 0%.

Proceed to the **Maximum thrust STBD** item by pressing the (STBD) button.



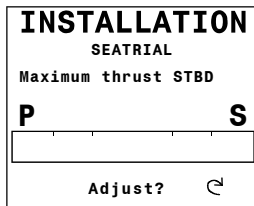
### **Direction and Maximum Thrust STBD, Analog Thruster**

*(ONLY IF CONTINUOUS THRUSTER OR DANFOSS THRUSTER IS SELECTED)*

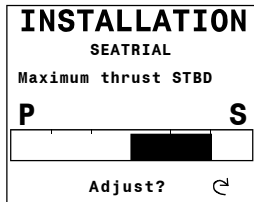


Rotate the course knob clockwise to activate the **Maximum thrust STBD** setting.

Rotate the course knob to starboard and verify that the boat turns to starboard. Adjust the bargraph until maximum thrust is obtained. The thruster will run for 10 seconds after last adjustment has been carried out.



If the boat turns to port when the course knob is turned to starboard, rotate the knob to port to ensure a starboard turn. Adjust the bargraph until maximum thrust is obtained.



This tells the autopilot which direction to turn the thruster.


Proceed to the **Maximum thrust PORT** item by pressing the  (STBD) button.

### **Direction and Maximum Thrust PORT, Analog Thruster**

*(ONLY IF CONTINUOUS THRUSTER OR DANFOSS THRUSTER IS SELECTED)*

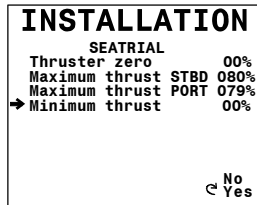
Rotate the course knob clockwise to activate the **Maximum thrust PORT** setting. Adjust the bargraph until you get maximum thrust in port direction.

This tells the autopilot which direction to turn the thruster.

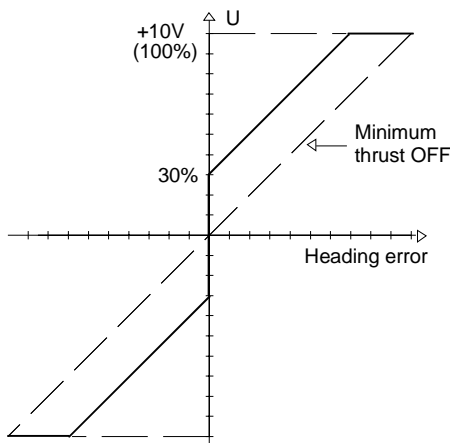
Proceed to the **Minimum thrust** item by pressing the  (STBD) button.

### Minimum Thrust, Analog Thruster

(ONLY IF CONTINUOUS THRUSTER OR DANFOSS THRUSTER IS SELECTED)



The **Minimum thrust** determines the amount of power (in % of the maximum control signal) that is applied as the "first command signal".

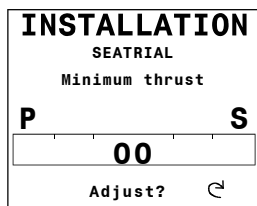


The example shows 30% of the control signal applied as **Minimum thrust**.

The dotted line shows the output signal for **Minimum thrust** set to 0.

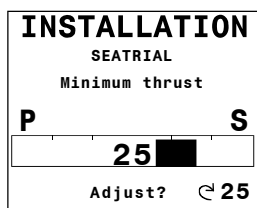
Range: 0-50% in step of 1%.

Default: 0%.



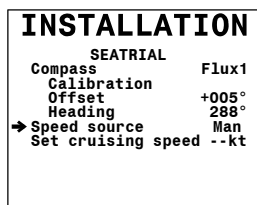
Rotate the course knob clockwise to activate the **Minimum thrust** setting.

Rotate the course knob to port or starboard to find the minimum amount of thrust you must apply as "first command signal".

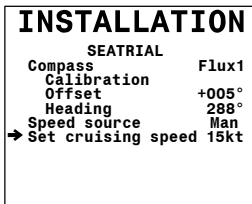


Proceed to the **Speed source** item by pressing the (STBD) button or return to STANDBY mode by pressing the (STBY) button.

### Speed source





Select the **Speed source** setting. Refer to Interface Set-up table on page 58. If no speed source is available, set the **Speed source** to **Man** and proceed to the **Set cruising speed** item by pressing the (STBD) button or return to STANDBY mode by pressing the (STBY) button.



### Set Cruising Speed

Steer the boat at cruising speed. The speed is shown at the **Set cruising speed** line. Rotate the course knob clockwise to confirm the cruising speed.

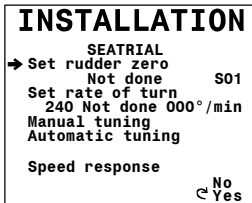
If **Speed source** is set to **Man**, adjust for actual cruising speed by the course knob.

Proceed to the **Set rudder zero** item by pressing the  (STBD) button or return to STANDBY mode by pressing the  (STBY) button.


### Set Rudder Zero

(Not applicable for analog drive)

This adjustment should be made in calm sea with little side forces from wind or current.



- Bring the boat up to cruising speed and head directly into the wind.
- If the boat has twin engines, synchronize the engines' RPM's.
- Set the trim tabs and stabilizers to have no effect on the boat's heading.
- Steer the boat manually on a steady course.
- Confirm the rudder zero position by rotating the course knob clockwise.

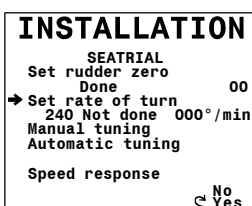
Proceed to the **Set rate of turn** function by pressing the  (STBD) button or return to STANDBY mode by pressing the STBY button.

### Set Rate of Turn

(Not applicable for analog drives)

The setting determines both the **Rate of turn** and the **Turn gain** (ref. Settings Menu, page 85) used for course changes in automatic steering modes. It is essential that this setting is carried out at sea when the boat is turning. To avoid setting at dockside it is blocked for rate of turn less than 5°/min.

Before this setting, the display shows '**Not done**' with default rate of turn to the left. Afterwards the display reads '**Done**' with set value to the left. The present rate of turn is always shown to the right.




At cruising speed, make a manual, constant turn. When you have an acceptable turn and the **Rate of turn** reading is stable, rotate the course knob clockwise to confirm the setting. Verify that the rate value and '**Confirmed**' is displayed.

The **Rate of turn** may be readjusted at any time while in

automatic modes (Ref. User Set-up in the Operator Manual). The **Turn gain** may also be readjusted (Refer to Turn Gain on page 85).

**Note !**

*The **Set rate of turn** function is only activated when using the course knob, NOT the Port and STBD buttons.*


Proceed to the next function by pressing the  (STBD) button.


**Adjust rudder angle/Set rate of turn**

(For analog drives only)

The **Adjust rudder angle** adjustment is part of the **Set rate of turn setting** when analog rudders are used for steering.

The setting determines both the **Rate of turn** and the **Turn gain** command when turning. It is used at course changes in automatic steering modes. It is essential that this setting is carried out.

At cruising speed, make a constant turn by turning the course knob. When you have an acceptable turn and the rate of turn reading is stable, press the  (STBD) button to select **Set rate of turn**. Rotate the course knob clockwise to confirm the setting. Verify that the rate value and **'Confirmed'** is displayed.

Proceed to the next function by pressing the  (STBD) button.

<p><b>INSTALLATION</b></p> <p>SEATRIAL</p> <p>→ Adjust rudder angle</p> <p>Manual tuning</p> <p>Automatic tuning</p> <p>Speed response</p>
---

<p><b>INSTALLATION</b></p> <p>SEATRIAL</p> <p>Adjust rudder angle S10</p> <p>→ Set rate of turn</p> <p>240 Not done 180°/min</p> <p>Manual tuning</p> <p>Automatic tuning</p> <p>Speed response</p>
---

### Manual Tuning



If the boat steers satisfactorily, there is no need to perform the **Manual** or **Automatic** tuning.

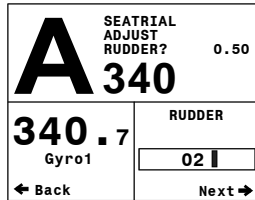
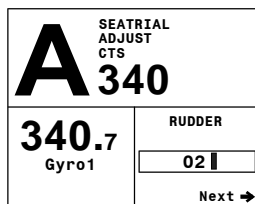
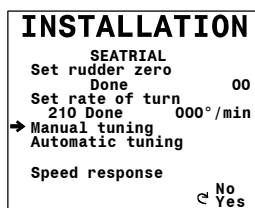
The two most important parameters that determine the performance of the automatic steering are **Rudder** and **Counter Rudder**.

These parameters have already been automatically set in the Installation Dockside menu as scaling factors of the boat type and boat length.

These settings may also be accessed at any time in the User Set-up menu (see Operator Manual) under the automatic modes.

Run the boat at cruising speed. Rotate the course knob clockwise to activate the Manual Tuning. The AP50 will now control the steering of the boat. If another course is desired, rotate the course knob until the desired course is obtained. After the course has stabilized, observe the steering performance.

If you need to change the steering parameters to improve the performance and are familiar with manual adjustment, press the  (STBD) button and adjust the values according to the description below. Otherwise proceed to Automatic tuning by pressing the  (STBD) button several times.



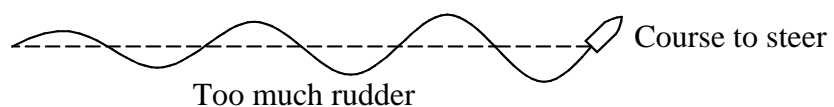
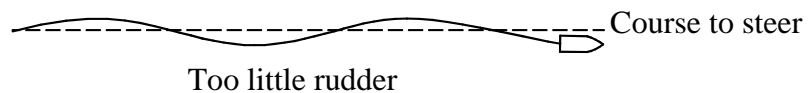
### Rudder

**Rudder** sets the rudder gain, which is the ratio between the commanded angle and the heading error (p-factor).

Range: 0.05 to 4.00.

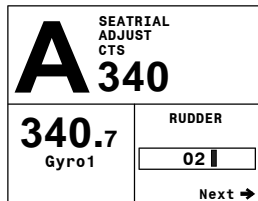
- Too little **Rudder** and the autopilot fails to keep a steady course.
- Too much **Rudder** gives unstable steering (hunting) and reduces speed.


Low speed requires more rudder than high speed (see **Speed Response**, page 72).




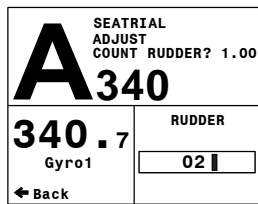
While at cruising speed, adjust the **Rudder** value by turning the course knob until the autopilot keeps the boat on a steady course.

### Counter Rudder



Press the  (STBD) button to display the set course. Make a 90° course change (CTS) by rotating the course knob and observe the transition to the new set course.

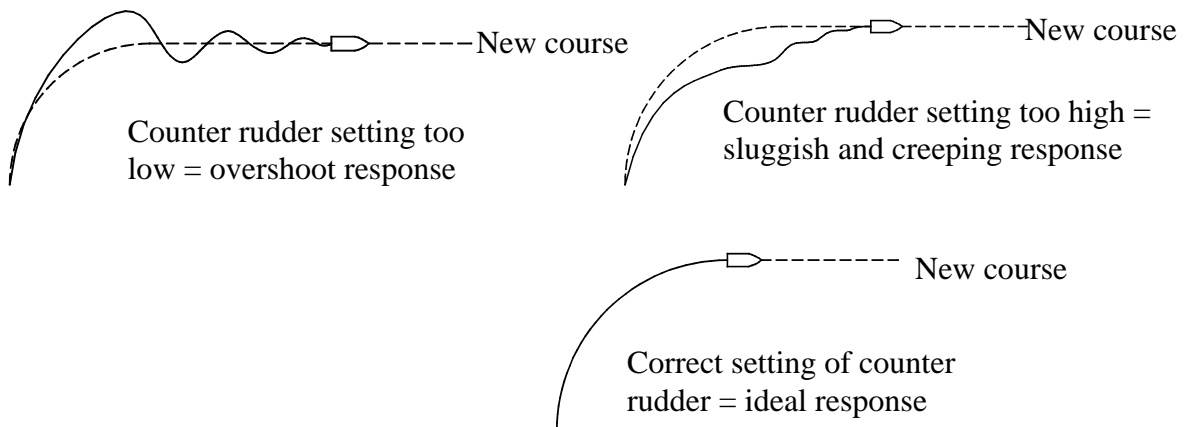
Press the  (STBD) button again to adjust the **Counter rudder** value, if necessary, according to the following:







**Counter rudder** is the parameter that counteracts the effect of the boat's turn rate and inertia. It is superimposed on the normal rudder response as provided by the rudder parameter. It may sometimes appear as if the autopilot tends to make the rudder move in the opposite direction of the turn (counter rudder).

The figures illustrate the effects of various **Counter rudder** settings.

Range: 0.05 to 8.00.



Go back to previous screen by pressing the  (PORT) button, make a new 90° course change by rotating the course knob and observe the transition to the new set course. Press  (STBD) button again to adjust the **Counter rudder** value if necessary

Proceed to **Speed Response** by pressing the  (STBD) button or return to STANDBY mode by pressing the  (STBY) button.

### Automatic tuning

If the boat steers satisfactorily, there is no need to perform the **Automatic** tuning.

Automatic tuning is a feature that automatically sets the two main steering parameters (**Rudder** and **Counter Rudder**) by taking the boat through a number of S-turns.

Selecting the boat type and length has set default values for these parameters (Installation Dockside menu). Before doing any parameter tuning, check if the boat steers satisfactory with the default setting (can be checked as described under Manual Tuning or by normal Auto steering).

Recommended speed during Automatic tuning varies with the type of boat, but it should not exceed 10 knots.


Note !

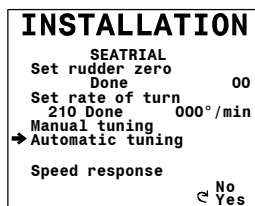
**Automatic tuning should not be performed at planing speed!**

For displacement boats, use a speed that is approximately half the normal cruising speed (i.e. if cruising speed is 10 knots, do the **Automatic tuning** at about 5 knots).

If possible, perform the **Automatic tuning** steering East or West, as this will yield the best-balanced parameters.

**WARNING !**

**The Automatic tuning function will take control of the boat and perform a number of S-turns. It must always be performed in open waters at a safe distance from other traffic. The Automatic tuning function may take from 1 to 2 minutes to complete. To stop the Automatic tuning, press the  (STBY) button.**



Activate **Automatic tuning** by rotating the course knob clockwise.

After the **Automatic tuning** has been completed, the autopilot will return to STANDBY mode and the rudder must be controlled manually.

When the **Automatic tuning** has been completed, there should be no need for further adjustments to the **Rudder** and **Counter Rudder**, but the speed response must be set. However, on certain installations, you may want to "fine tune" the parameters after the **Automatic tuning** due to special steering characteristics of the specific boat. One may view or change the **Automatic tuning** parameters in the User Set-up menu (see Operator Manual).

### Speed Response

To make this adjustment you need speed input from either SOG or Log.

The **Speed response** adjusts the relationship between speed and amount of rudder, with lower speed requiring more rudder.

This adjustment should be done at slow speed as follows:

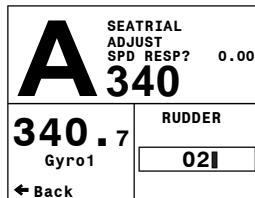
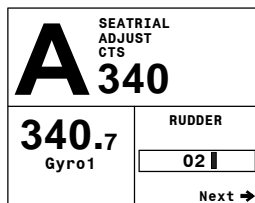
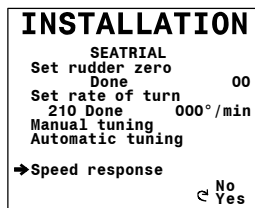
For displacement and planing boats, steer at minimum operating speed.


If there is a big difference in steering performance for a planing boat before and after planing, refer to **Transition speed** on page 83.

For water jet, steer at a speed that begins giving reasonable response from the main steering.



From the Sea trial menu, select **Speed response** by rotating the course knob clockwise. The AP50 will now take control over the steering of the boat.

If another course is desired (CTS), rotate the course knob until the desired course is obtained.



Proceed to the **Speed response** adjust screen by pressing the  (STBD) button. Rotate the course knob to set the **Speed response** parameter to the level at which the vessel steers satisfactorily at slow speed. Change of speed will now automatically adjust the rudder gain in an adaptive manner between slow speed and cruising speed.

Range: 0.00 – 2.00

Exit the Seatrial Settings menu by pushing the  (STBD) button to proceed to the System Data menu, or press the  (STBY) to return to normal AP50 operation.

### 3.3 Final Test

After having completed all the settings in the Installation Menu, take the boat out and perform a final sea trial in open waters at a safe distance from other traffic.

- Steer the boat on all cardinal headings in AUTO mode.
- Start with low and medium speeds to get familiar with the response from the AP50.
- Try the DODGE, U-turn, and C-turn functions.

- If a Non-Follow Up lever (or handheld remote) is connected, test change of modes and verify port and starboard steering commands of the lever.
- Set waypoints into each navigator connected to the system, and verify that the AP50 steers in NAV mode for each Nav. source.
- Provide user training.

### 3.4 Providing User Training


The user should be instructed in the "basic" operational functions, such as:

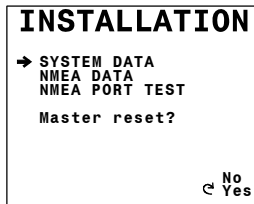
- Turning the system on and off.
- Changing modes. Explain briefly what takes place in the different modes.
- Regaining manual control from any mode. Point out in what modes the helm is engaged by the autopilot.
- Taking command at an "inactive" station, if applicable.
- Using the lock mode, how to lock/unlock, and how to shut the system down from a locked control unit, if applicable.
- Use of the Non-Follow-up and Follow-up steering modes and learning the difference between the two.
- Use of a Non-Follow-up and Follow-up controller, if connected.
- Changing course by rotary knob and buttons.
- Moving through the User Set-up Menu in STANDBY, AUTO, NAV, and WORK modes learning how to (and why to) change the settings.
- Knowing the difference between normal parameters and WORK parameters also including Nav. source and Compass sensor selection, if applicable.
- Locating any compasses and knowing to keep all magnetic items away.
- Locating the Mains circuit breaker.
- Knowing the different uses of thruster (Follow-up, Non-Follow-up, and WORK modes).

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## 4 ADVANCED SETTINGS

### 4.1 Service Menu

Select STANDBY mode and then enter the Installation Menu by pressing and holding the NAV/SETUP button for 5 seconds. Select "SERVICE" by pressing the  (STBD) button and confirm by rotating the course knob clockwise.

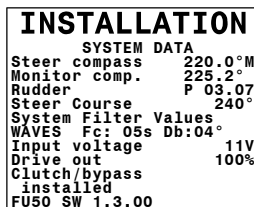


“SYSTEM DATA” and “NMEA DATA” are test functions to analyze data processed by the AP50.

To exit the menu, press any mode key (STBY, AUTO or NAV).

#### System Data

Select "SYSTEM DATA" by rotating the course knob clockwise. This menu provides you with additional system data that can be useful when testing or trouble shooting the system.



#### Steer compass

Steering Compass readout, M=Magnetic, T = True.

#### Monitor comp.

Monitor Compass readout.

#### Rudder

Rudder angle. Normally between 0 and 45°.

#### Steer Course

Current steered course in AUTO and NAV modes.

#### System Filter Values

Values set by the automatic sea state filter (in AUTO and NAV modes).

Fc = Wave filter time constant in seconds.

Db = Deadband in degrees to each side of the set course. The boat has to be outside the deadband before the autopilot responds.

#### Input voltage

Mains voltage on input terminals.

#### Drive out

Power needed to drive the unit (in percent of full [100%]) to get satisfactory rudder speed. (Refer to page 81 for adjustment).

### Clutch/bypass

Verifies if a clutch or bypass valve has been activated when performing the rudder test.


### FU50 SW

Shows the software version for a connected FU50 Steering Lever

### NMEA Data

```

INSTALLATION
  NMEA DATA
--- XTE                ---NM
OK  BRG                270°
INV BRG POS-WP        ---°
OK  POS/LAT  N 58°33.222'
OK  POS/LON  E 10°50.013'
OK  COG                270°
INV SOG              ---kt
OK  WIND              R 45.3°
FRM SPEED            ---kt
INV DEPTH            ---m
    
```

Select the "NMEA DATA" by pressing the  (STBD) button and confirm this by rotating the course knob clockwise.

The menu provides you with status information about the different NMEA messages used by the system.

### Decoding

The incoming signals are decoded according to a built-in priority table in the AP50. Cross Track Error and bearing information is taken from the NMEA messages with highest priority.

For all data items, one of the following codes will be displayed:

- No data or no NMEA sentence containing the data needed at the input port.
- OK Valid data found
- INV A message with invalid information.
- FRM Message has a format failure such as:
  - a) Incorrect check sum
  - b) Wrong contents in the datafield(s)

If data are missing or invalid, perform the following:

- Check the NMEA signal monitor (see below).
- Check the interface setup in the Installation Menu (see page 54).
- Check the navigator set-up and make sure it is transmitting appropriate NMEA data.
- Perform a NMEA Port Test (hardware) (see below).

### Note !

*The "WIND" reading is the apparent wind from the left (L) or right (R). The "SPEED" reading is the speed through water.*

### NMEA Signal Monitor

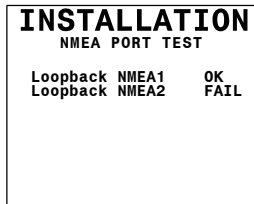
Near the NMEA terminals in the junction unit you will find a green monitor LED (Refer to Junction Unit Terminals, page 18). A flickering LED indicates that a NMEA signal is received. It does not, however, qualify the contents of the message.


Note !

*Do not confuse this “RX” LED with the LED marked “TX”. The “TX” LED will always be lit/flickering when the autopilot is on.*

### NMEA Port Test (J50 hardware)

Disconnect the cables on the Main PCB in the junction unit and connect TX1+ to RX1+ and TX1- to RX1-. Similarly, on the Power PCB, connect the NMEA ports the same way: TX2+ to RX2+ and TX2- to RX2-.



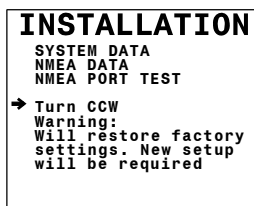
Under SERVICE in the Installation Menu, select "NMEA PORT TEST" by pressing the  (STBD) button and confirm this by rotating the course knob clockwise.

Verify that the hardware is OK. If not, replace the corresponding PCB('s).


### Master Reset

Note !

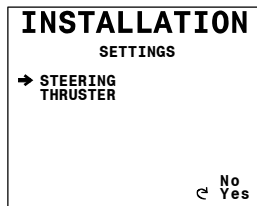
*A Master Reset will reset the memories to factory settings. Unless you need to clear all stored values during the installation set-up procedure, you should not perform a Master Reset. A Master reset will not clear the stored compass calibration and offset values in RC25, RFC35, J50 and GI51.*




The Master Reset needs a double confirmation to prevent an accidental reset. To perform a Master Reset, rotate the course knob clockwise and then rotate the course knob counter-clockwise.

Exit the Installation Menu by pressing the  (STBY) button to return to normal AP50 operation.

## 4.2 Settings Menu





Select SETTINGS in the Installation Menu by pressing the  (STBD) button and confirm this by rotating the course knob clockwise.


Two groups of settings are available; **Steering** and **Thruster** (only when thruster is installed).

Note !

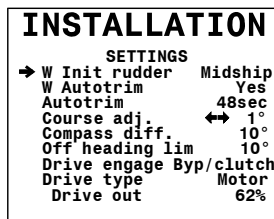
*If a thruster is not installed, the Steering menu appears when entering the Settings menu.*

Use the  (PORT) or  (STBD) buttons to move through the menu items. Turn the course knob clockwise or counter clockwise to adjust the values.

### Steering

Select STEERING by pressing the  (STBD) button and confirm this by rotating the course knob.

#### *W Init rudder*



Select between Midship or Actual rudder position in Work mode.

When “Midship” is selected, the autopilot will use zero degrees as the midship reference. Hence, the rudder will always move to midship when switching from STANDBY or DODGE mode to AUTO-WORK or NAV-WORK mode.

When “Actual” is selected, the autopilot will use the current rudder position as the midship reference (bumpless transfer) when switching from STANDBY or DODGE mode to AUTO-WORK, or NAV-WORK.

Note !

*“Midship” will always be used when switching to AUTO or NAV from STBY/NFU/FU.*

#### *W Autotrim*

Rotate the course knob to turn the **Autotrim** function off or on in the AUTO-WORK and NAV-WORK modes.

#### *Autotrim*

When the vessel has a constant heading error due to external forces such as wind and current, the **Autotrim** function corrects for this by building up a constant rudder offset.



The value for the **Autotrim** parameter is the time it is allowed to calculate the rudder offset.



The **Autotrim** value can be adjusted from 10 seconds to 400 seconds with the course knob. The default value depends on the boat length.

The **Autotrim** parameter is reset every time the AUTO mode is entered or when a course change greater than approximately 20° is made by the course knob.

**Autotrim** is automatically disabled during a turn.

### ***Course Adjust***

When using the  (PORT) or  (STBD) buttons in AUTO mode, you are changing the set course in 1° increments. If you prefer the increments to be 5° or 10° each press, proceed as follows:

Select **Course adjust** using the  (PORT) or  (STBD) button. Turn the rotary knob to display the setting. The default value is 1°, which is the preferred setting. Select 5° or 10° if you want to make major course changes in 5° or 10° increments with the buttons and fine-tune the set course with the course knob.

### ***Compass difference***

When two compasses are used (main compass and monitor compass), there is virtually always a difference between the readings of the two. If the difference in reading exceeds the set limit for **Compass diff.**, an alarm is given.

Range: 5 to 35°.

Default: 10°.

Note !

*The difference between the two compass readings may vary with the vessel's heading and from one area to another where a vessel is in transit. The difference between the two compass readings is automatically reset when the **Compass diff.** alarm is given and then reset.*

### ***Off Heading lim***

This sets the limit for the 'Vessel off course' alarm. This alarm occurs when the actual heading deviates from the set heading by more than the selected limit.

Range: 3 to 35°.

Default: 10°.

### ***Drive engage***

This determines the use of the J50 Drive Engage port. The port voltage is the same as the selected Drive Unit voltage. Drive engage has the following different settings:

Bypass/clutch:

This port will activate (go high), in all modes except for STANDBY and DODGE hand-steering.

It is typically used to engage a bypass valve for a hydraulic linear drive. It may be used to start a hydraulic pump when entering Follow-up, Non-Follow-up, AUTO and NAV. modes.

Auto:

The port will activate (go high) in AUTO and NAV modes.

"Auto On" is typically used to switch the pump speed when different rudder speeds are needed in automatic and Follow-up/Non-Follow-up steering. The switch is normally off.

Handshake 1:

This setting is specially made for interfacing with KaMeWa's CanMan standardized system but can also be used for similar installations. Manual steering is performed from a joystick. On top of the joystick, there is an override button for manual takeover from the autopilot. The Drive Engage and Remote port (regardless which one) of J50 is used as handshake signals between autopilot and manual steering system as follows:

If AUTO, NAV or FU is selected, the Drive Engage port will go high causing the autopilot to take control. When STBY is pushed on the autopilot, Drive Engage will go low and the manual steering system will take control. If the override button is activated in AUTO or NAV, the pilot will go into STBY but Drive Engage remains high, and the boat can be steered manually by the joystick. When the override button is released, the autopilot will take control again under new current heading (AUTO) or ongoing track (NAV). Pushing the override button in FU-mode will be identical to pushing the STBY button, i.e. Drive Engage goes low and pilot remains in STBY.

NFU and Dodge from autopilot will not be possible when Handshake 1 is set.

### **Drive type**

This indicates the type of drive installed. The display will show “Motor”, “Solenoid”, “Proportional” or “Analog”, respectively.

The reading is obtained from the Automatic rudder test under the Dockside menu. The set value may be changed here.

### **Drive out**

Not applicable for “Analog” drives.

Shows the amount of power needed to achieve the correct rudder speed. The reading is obtained from the Automatic rudder test under the Dockside menu. The set value may be increased or decreased here.

Range: 4-100%

Default: 50%, updated during Rudder Test.

### **Prop. gain**

Applicable only for “Proportional” drive.

This parameter is set automatically when the Rudder Test is done in the Dockside menu. It influences the start/stop slope of the rudder. The value could be increased if rudder response to a start/stop command feels too slow. The value could be decreased if start/stop feels too quick and causes rudder angle overshoot or hydraulic shock when stopping.

Range: 1-20

Default: 13, updated during Rudder Test.

### **Seastate**

Seastate determines the number of degrees the vessel may fall off the set course before any response is given to the rudder.

OFF: Provides precise steering but increases rudder activity.

AUTO: Automatically reduces the rudder activity and sensitivity of the autopilot in rough weather.

MANUAL: Sets yaw band manually (MAN 1-MAN 10, 10 ≈ ±6°).

Default: AUTO

Refer to the Operator Manual/*User Set-Up Menu/Auto Mode*.

<b>INSTALLATION</b>		
SETTINGS		
→ Seastate		AUTO
Rudder		0.50
Count rudder		1.40
W Seastate		AUTO
W Rudder		0.50
W Count Rudder		1.40
W Rudder Limit		10°
Cruising speed		15kt
Speed response		0.00
Transition speed		OFF

### ***Rudder***

**Rudder** sets the rudder gain, which is the ratio between the commanded angle and the heading error. Default value depends on boat length.

Range: 0.05 to 4.00.

### ***Counter rudder***

**Counter Rudder** is the parameter that counteracts for the effect of the boats turn rate and inertia. The default value depends on boat length.

Range: 0.05 to 8.00.

### ***W Seastate***

As for **Seastate** above but applies for the Work-modes.

### ***W Rudder***

As for **Rudder** above but applies for the Work-modes.

### ***W Count rudder***

As for **Counter rudder** above but applies for the Work-modes.

### ***W Rudder limit***

This determines the maximum rudder movement, in degrees from the “used” midship position, that the autopilot can command the rudder in the WORK modes.

Default: 10°.

**The W Rudder limit setting is only active during AUTO-WORK and NAV-WORK steering on straight courses, NOT on course changes, but a Rudder Limit warning will be shown during course changes.**

### ***Cruising speed***

If the **Cruising speed** was not set during sea trial or needs to be changed, it can be set manually here. Refer to page 67.

Range: 3 – 70 knots

Default: 15 knots

### ***Speed response***

This adjusts the value for the **Speed response** (see page 72).

Range: 0.00 – 2.00

Default: 0.00

### Transition Speed

(Only appears in the Settings menu when “Planing” or “Waterjet” is selected as the “Boat type”.

To make this adjustment you need speed input from either SOG or Log.

Planing boats may often have very different steering characteristics before and after planing. The same may apply for water jet driven boats at low and high speed. AP50 offers the possibility of using the Auto-Work mode values for Rudder and Counter Rudder at low speed. By setting the **Transition Speed** to a value different from the default = 0, the Work parameters for Rudder, Counter Rudder and RateOfTurn/Radius will automatically be used for speed below the set value.

**Note !**

*Other special work functions (thruster control, disabling of special alarms etc.) do not apply without the Work mode being manually selected.*

For a planing boat it is recommended to set the **Transition Speed** to the value that represents the speed where the hull begins to plane. For a water jet boat it should be set to a value that represents the speed where it begins giving good response from the main steering.

Range: OFF - 40

Default: OFF

### Nav Gain

INSTALLATION	
SETTINGS	
→ Nav gain	3.5
Minimum rudder	0.0°
Turn mode	ROT
RateOfTurn	240°/min
W RateOfTurn	033°/min
Added stop time	0s
Init NAV	Firm
Turn Gain	1.0
W Turn Gain	10.0
Rate sensitivity	15

The **Nav Gain** determines how many degrees the autopilot must change the vessel’s heading in order to bring the vessel back on track, using the Cross Track Error and the vessel’s speed (refer also to the Operator Manual/*User Set-Up Menu/Nav Mode*).

Range: 0.5 to 7.

Default: Depends on the boat length.

### Minimum rudder

Some vessels may have a tendency of not responding to small rudder deflection around “used” midship position because of a possible rudder deadband or whirls/disturbance of the water-stream passing the rudder.

By setting the Minimum Rudder to a certain value, the autopilot will add this value to any given rudder command.

The amount of rudder command is determined by adding the minimum rudder value and the rudder deadband value to the p-factor value.

Minimum Rudder 0.1°  
 Rudder deadband 0.3°  
 P-factor/Counter Rudder 1.0°  
 Total rudder amount 5.3°

Range: 0 to 10° in 0.1° increments

Default: OFF

### **Turn mode**

This allows for the selection of Rate of Turn (ROT) steering or Radius (RAD) steering.

When ROT steering is selected, **Rate of Turn** and **W Rate of Turn** are shown in the Settings menu.

If RAD steering is selected, **Radius** and **W Radius** are shown.

Default: ROT

### **Rate of Turn**

The **Rate of Turn** sets the turning speed of the vessel used by the autopilot during large turns.

Range: 5°/minute to 720°/minute.

Default: Dependent on boat length.

### **W Rate of Turn**

As for **Rate of Turn** above but applies for the Work-modes.

### **Radius**

This sets the size of the turning circle for the vessel used by the autopilot during large turns.

Range: 0.01 to 0.99 nautical mile.

Default: Calculated from default Rate of Turn

INSTALLATION	
SETTINGS	
Nav gain	3.5
Minimum rudder	0.0°
Turn mode	RAD
→ Radius	0.06NM
W Radius	0.28NM
Added stop time	0s
Init NAV	Firm
Turn Gain	1.0
W Turn Gain	10.0
Rate sensitivity	15

### **W Radius**

As for **Radius** above but applies for the Work-modes.

### **Added stop time**

On larger vessels (typically above 300') or quickly turning small boats, the counter rudder may be insufficient to avoid overshooting large turns. The **Added stop time** parameter is used to stop a turn earlier to avoid overshoot.

Range: 0 to 60 seconds

Default: 0 seconds.

### ***Init NAV***

Sets a firm or soft approach to the rhumb line when entering the NAV mode at the first leg. The approach angle is dependant (adaptive) on the distance (XTE) from the rhumb line and the boat speed.

Range: Soft - Firm

Default: Firm

### ***Turn Gain***

**Turn gain** determines the initial rudder command when turning in AUTO and NAV modes.

Increase this value if the amount of rudder is too small when starting a turn.

Range: 1-320

Default value is set according to **Boat length** and **Set rate of turn** in the Installation Seatrial Menu.

### ***W Turn Gain***

**W Turn gain** determines the initial rudder command when turning in WORK modes.

Increase this value if the amount of rudder is too small when starting a turn.

Range: 1-320

Default value is set according to **Boat length** and **Set Rate of Turn** in the Installation Seatrial Menu.

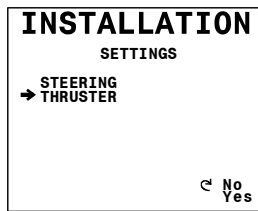
### ***Rate Sensitivity***

This parameter determines how sensitive the **Rate of turn** calculation is for changes in the heading signal. The default setting will fit most vessels. For vessels that can turn quickly and have a stable heading compass (high performance compass), the setting should be reduced if the vessel tends to overshoot, even with a high setting of counter rudder. For a slowly turning vessel with noisy compass and unstable **Rate of turn**, the value could be increased.

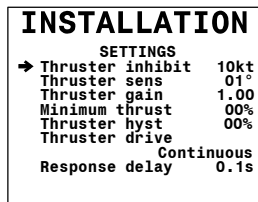
Range: 5 - 25.

Default: 15.

## Thruster



Select Thruster in the Settings menu by pressing the (STBD) button and confirm this by rotating the course knob clockwise (only available when Thruster is selected for steering).



### *Thruster inhibit*

**Thruster inhibit** is a feature that will block the thruster from running above a set inhibit speed of the boat. It is a safety feature to prevent, especially electrical on/off thrusters, from overheating if out of water on for instance a planning boat or in rough weather. **“No thruster response”** alarm will be given when passing the set limit.

Thruster inhibit will not apply when Man speed source is selected, only Log or SOG.

Range: 1 – 99 knots.

Default: 10 knots.

### *Thruster sensitivity*

The **Thruster sens** determines how many degrees the vessel must deviate from the set course before a thruster command is given. As the vessel deviates from its heading, the thruster will push the vessel back. A higher value will reduce the thruster activity and extend the lifetime, especially for on/off thrusters.

If the thruster commands are hunting from side to side, the set value for **Thruster sens** may be too low.

If a low value for **Thruster sens** is needed, consider reducing **Thruster gain** (ref. page 86) to avoid hunting.

Range: Continuous thrusters 0° to 30° in 1° increments  
On/off thrusters 3° to 30° in 1° increments.

Default: 1° for continuous thrusters, 5° for on/off thrusters.

### *Thruster gain*

(Only applicable for Continuous and Danfoss thrusters)

Since a continuous type thruster can be operated both in **“Continuous”** and **“Adaptive on/off”** mode (ref. Thruster Drive setting, page 88) the **Thruster gain** parameter is dual. The parameter associated to the thruster drive mode setting will be the one displayed and adjusted.

When operating in “**Continuous**” mode, the thruster gain setting determines the power from the thruster versus heading error. For higher values, the power increases with the same error signal. If the vessel tends to oscillate around set heading, the value should be decreased. If the vessel has a slow approach to set heading, the value should be increased.

When operating in “**Adaptive on/off**” mode, the setting determines the fixed power from the thruster. Higher value gives more power. Some thrusters may be so powerful that even the shortest command makes the vessel to overshoot, especially at low setting of **Thruster sens**. If so the **Thruster gain** must be reduced. If the power is too low for the vessel to regain heading within reasonable time, the setting should be increased.

Range: 0.05 to 2.00

Default: 1 for Continuous thrusters

2 for Adaptive on/off operation

(Ref. Thruster Drive Setting, page 88)

### ***Minimum thrust***

(Only applicable for Continuous and Danfoss thrusters)

The **Minimum thrust** determines the amount of power (in % of maximum control signal) that is applied as "first command signal". (Refer to page 66)

Range: 0 to 50% in 1% increments.

Default: 0%.

### ***Thruster hyst***

(Only applicable for Continuous and Danfoss thrusters)

When applying a command signal to a proportional valve, a certain amount of deadband may occur, dependant on the directional change of the command. Therefore, a certain “extra” menu-adjustable command signal is generated and either added or subtracted to the command signal in order to compensate for the deadband. Hence the command signal gives the required power without the “loss of deadband signal”.

Range: 0 to 10% in 1% increments.

Default: 0%.

### ***Thruster Drive***

(Only applicable for Continuous and Danfoss thrusters)

For On/Off thrusters, it is important to keep thruster activity to a minimum. TI51 therefore has a feature that adaptively adjusts the length of each thruster command to bring the vessel back on heading without over- or undershoot.

When setting **Thruster drive** to “Adaptive on/off”, this feature will also apply for continuously type thrusters in all Work modes (not Follow Up). For operations where the **Thruster sens** can be of some degrees, on/off adaptively will reduce activity also for continuous type thrusters.

Refer also to the **Thruster gain** setting for optional performance.

Default: Continuous

### ***Response delay***

(Only applicable for Continuous and Danfoss thrusters)

This parameter determines the slope-time of the start/stop signal to the thruster. Increased value will give softer start/stop and less wear of the thruster. Big powerful thrusters normally need a longer start time than small rapid thrusters.

Range: 0-2 seconds

Default: 1 second

**SETTINGS**

Displayed parameter	Boat type (Default settings)			Own boat	
	Displacement	Planing	Waterjet	Autotune	Manual
<i>Dockside Menu</i>					
Master Operation	No	No	No		
Boat length	0-50 feet	0-50 feet	0-50 feet		
Drive unit voltage	12V	12V	12V		
Rudder limit	10°	10°	10°		
Rudder deadband	AUTO	AUTO	AUTO		
Thruster	----	----	----		
<i>Settings Menu</i>					
W Init rudder	Actual	Actual	Actual		
W Autotrim	Yes	Yes	Yes		
Autotrim	48 sec	40 sec	40 sec		
Course adj.	1°	1°	1°		
Compass diff.	10°	10°	10°		
Off heading lim	10°	10°	10°		
Drive engage	Bypass/clutch				
Drive type	----	----	----		
Drive out	50%	50%	50%		
Prop. gain	13	13	13		
Seastate	AUTO	AUTO	AUTO		
Rudder	0.50	0.30	0.30		
Counter rudder	0.90	0.90	0.90		
W Seastate	AUTO	AUTO	AUTO		
W Rudder	0.75	0.45	0.45		
W Count Rudder	1.40	1.40	1.40		
W Rudder limit	10°	10°	10°		
Cruising speed	15kt	15kt	15kt		
Speed response	0.00	0.00	0.00		
Transition speed	OFF	OFF	OFF		
Nav gain	3.5	3.5	3.5		
Minimum rudder	0.0°	0.0°	0.0°		
Turn mode	ROT	ROT	ROT		
Rate Of Turn	240°/min	240°/min	240°/min		
W Rate Of Turn	240°/min	240°/min	240°/min		
Added stop time	0s	0s	0s		
Init NAV	Firm	Firm	Firm		
Turn gain	38	38	38		
W Turn gain	38	38	38		
Rate sensitivity	15	15	15		
Thruster inhibit	10 kt	10 kt	10 kt		
Thruster sens	1°/5°	1°/5°	1°/5°		
Thruster gain	Continuous	1.0	1.0	1.0	
	Adaptive on/ off	2.0	2.0	2.0	
Minimum thrust	00	00	00		
Thruster hyst	00	00	00		
Thruster drive	Continuous	Continuous	Continuous		
Response delay	1.0 sec	1.0 sec	1.0 sec		

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## 5 SPARE PARTS LIST

### AP50 Control Unit

20214045	AP50 Control Unit with accessories
20212247	Installation Accessories
20212130	Mounting Bracket ass'y
20211819	Protection Cover
20212213	AP50 Front Housing Ass'y
20211868	AP50 Board Ass'y
20212189	PROM (programmed) V..R..

### AP51 Remote Control

20214052	AP51 Remote Control with accessories
22086276	Mounting Kit
20212015	AP51 Front Housing Ass'y
22086383	Cable with Gasket
20212031	AP51 Board Ass'y
20212007	AP51 PROM (programmed) V..R..

### JP21 Jack Point

22086433	JP21 Jack Point
22086557	JP21 Cover Ass'y & o-ring

### Junction Units

20214011	J50 Junction Unit with accessories
20214029	J50-40 Junction Unit with accessories
20212528	J50 Power PCB Ass'y
20212916	J50-40 Power PCB Ass'y
20211918	J50 Main PCB Ass'y (Both models)
20212544	J50 Filter PCB Ass'y
20211934	PROM for all junction units
22081350	Main Cover
22089924	Plug-In Terminal Kit
22081368	Terminal Cover

### RF300 Rudder Feedback Unit

20193744	RF300 Rudder Feedback
20193678	RF300 Transmission Lever Ass'y
20193454	RF300 Transmission Link Ass'y
20193624	RF300 Ball Joint Ass'y

**RF45X Rudder Feedback Unit**

22011415	RF45X Rudder Feedback Unit
22011217	Mounting Kit
22011258	RF45X PCB Ass'y with Potentiometer
22011183	RF45 Transmission Link Ass'y
22011431	RF45X Ball Joint Ass'y
22504039	Transmission Lever

**RF14XU Rudder Feedback Unit**

22506950	RF14XU Rudder Feedback Unit
22501605	Electronic XU Module
44118388	Potentiometer 5 Kohm

**RF Standard Transmission Link**

22504005	RF Standard Transmission Link complete
22504021	Transmission Lever (Ø12mm)
44132306	Ball Joint 8mm, Stainless Steel

**RFC35 Electronic Fluxgate Compass**

22086995	RFC35 Fluxgate Compass with accessories
22081178	RFC35 PCB Ass'y

**RC25 Rate compass**

22084438	RC25 Rate Compass with accessories
22084370	RC25 PCB Ass'y

**CD100A Course Detector**

20106688	CD100A Course Detector
20106696	Cable, 7m

**CD109 Course Detector**

20121257	CD109 Course Detector with Tripod Holder
20120721	CD109 Course Detector
22331997	Tripod Holder
20120853	AMP Connector with bracket

**CDI35 Course Detector Interface**

22087001	CDI35 Course Detector Interface w/accessories
22081152	CDI35 PCB Ass'y

**NI300X NMEA Interface**

22089536	NI300X NMEA Interface
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22081913	NI300X PCB Ass'y
	<b>S35 NFU Steering Lever</b>
23241227	S35 NFU Steering Lever
23241144	S35 PCB Ass'y
44125599	Micro Switch
23240096	Spring
44190114	Gasket
44140796	Cable Gland
	<b>S9 Steering Lever</b>
23601800	S9 Non Follow Up steering lever
23601859	Lever with actuator shaft
23602089	S9 Service Kit (Springs and Grease)
	<b>R3000X Remote Control</b>
22022446	R3000X Remote Control
20184552	Mounting Kit
20184545	PCB Ass'y
20184578	Cable
20184586	Front Housing
22022396	Front Panel
	<b>Robnet cables and connectors</b>
22081145	Robnet Cable 15 m (49') with one male connector
20191607	Robnet Cable 7m (23') with Male Connectors
20191615	Robnet Cable 15m (49') with Male Connectors
20192266	Robnet Extension Cable 10m (33') with Male and Female Connector
44138048	Robnet Cable (bulk)
22082697	Male Connector Ass'y
22082705	Female Connector Ass'y
	<b>Tools</b>
44139707	Key for Lock Ring on Robnet Receptacles
44139806	PROM Extraction Tool
44161792	Robnet Pin Extraction Tool (for crimp type connectors)

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## 6 TECHNICAL SPECIFICATIONS

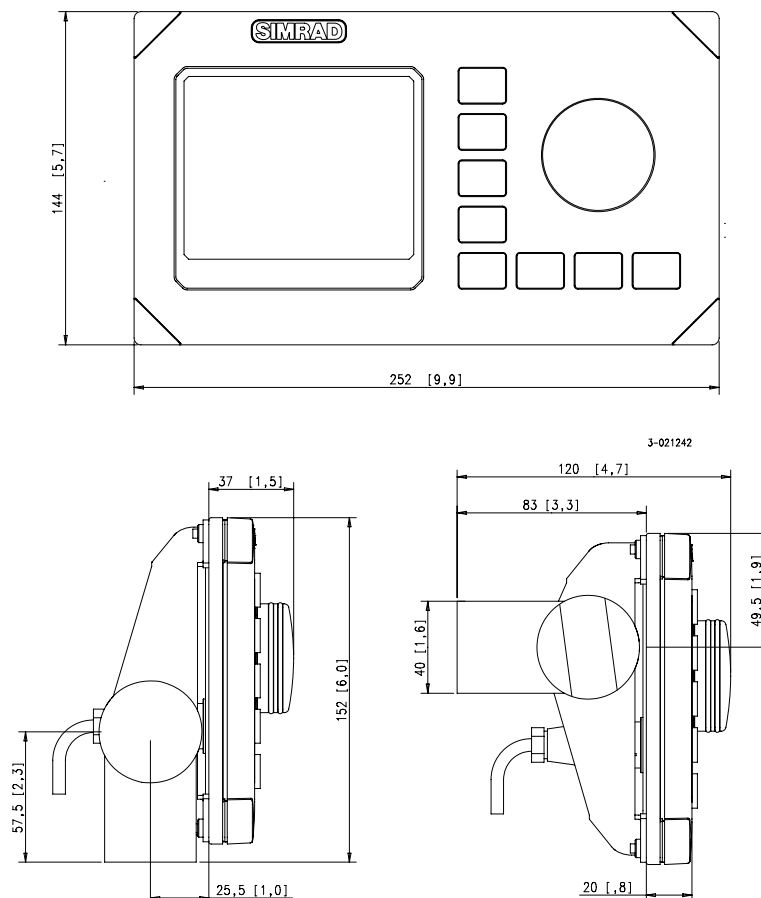
### 6.1 AP50 Autopilot System

Boat type:.....	Power
Steering system types: .....	Hydraulic, mechanical, solenoids
Inter-unit connection: .....	Robnet network or two-wire supply/data
Number of Robnet units in a system: .....	Refer to page 26 and 27
System ON/OFF: .....	From control units/master unit
Supply voltage: .....	12-32 VDC -10%/+30%
Power consumption: .....	Dependent on system configuration (See 6.4 Junction Unit)
EMC protection: .....	EN60945: 1996-11
Performance:....	IMO A.822(19), ISO/CD16329.2, IMO MSC(64)67, ISO 11674:2000(E)
Rate of turn: .....	Within $\pm 10\%$ of preset value or $3^\circ/\text{min}$ . (Ref. ISO 11674: 4.3.7)
Heading indication error: .....	$<0.5^\circ$ (Ref. ISO 11674: 4.3.5)
Heading stability: .....	Within $\pm 1^\circ$ (Ref. ISO 11674: 4.3.13)
Automatic Steering control:	
Rudder Drive: .....	Proportional pump, solenoid on/off, proportional valve, analog
Parameter selection: .....	Automatic with manual override
Sea state control: .....	Adaptive sea state filter
Language selection:	English, German, French, Spanish, Italian, Dutch, Swedish, Norwegian.
Electronic Interface:	
Navigation interface: .....	Standard (NMEA 0183)
NMEA input/output ports:	Max. 6 (see Junction units and NI300X specifications)
Refer to NMEA Sentences table	page 110 for data.
Heading output: .....	Anritsu and Furuno radar display (clock/data)
Heading sensors:.....	Gyrocompass, Fluxgate compass, Magnetic compass NMEA Compasses, Transmitting Heading Device (THD)
Course selection:.....	Rotary course knob and buttons
Alarms: .....	Audible and visual, external optional
Alarm modes: .....	Compass difference, off heading, system failures, overload
Steering modes: .....	STANDBY, Non-follow-up, Follow-up, AUTO, AUTO-WORK, NAV, NAV-WORK
Special turn modes: .....	DODGE, U-Turn, C-Turn ( $5-720^\circ/\text{min}$ .)
System selector autopilot/main steering system: .....	Potential free contact

## 6.2 AP50 Control Unit



Dimensions: ..... See Figure 6-1  
 Weight: ..... 0.9 kg (2.0 lbs.)  
 Material: ..... Epoxy coated aluminum  
 Supply: ..... 12-32 VDC  $-10\%/+30\%$  via Robnet  
 Power consumption: ..... 3 W  
 Environmental Protection: ..... IP56 (when panel-mounted)  
 Safe distance to compass: ..... 0.35 m (1.0 ft.)  
 Color: ..... Black  
 Temperature:  
     Operating: .....  $-25$  to  $+55^{\circ}\text{C}$  ( $-13$  to  $+130^{\circ}\text{F}$ )  
     Storage: .....  $-30$  to  $+70^{\circ}\text{C}$  ( $-22$  to  $+158^{\circ}\text{F}$ )  
 Display:  
     Type: ..... Backlit LCD matrix  
     Resolution: ..... 160 x 128 pixels  
 Illumination: ..... Adjustable in 10 grades  
 Mounting: ..... Panel mount or bracket mount (optional)  
 Cable: ..... Robnet cable 15 m (49 ft.) with one male connector

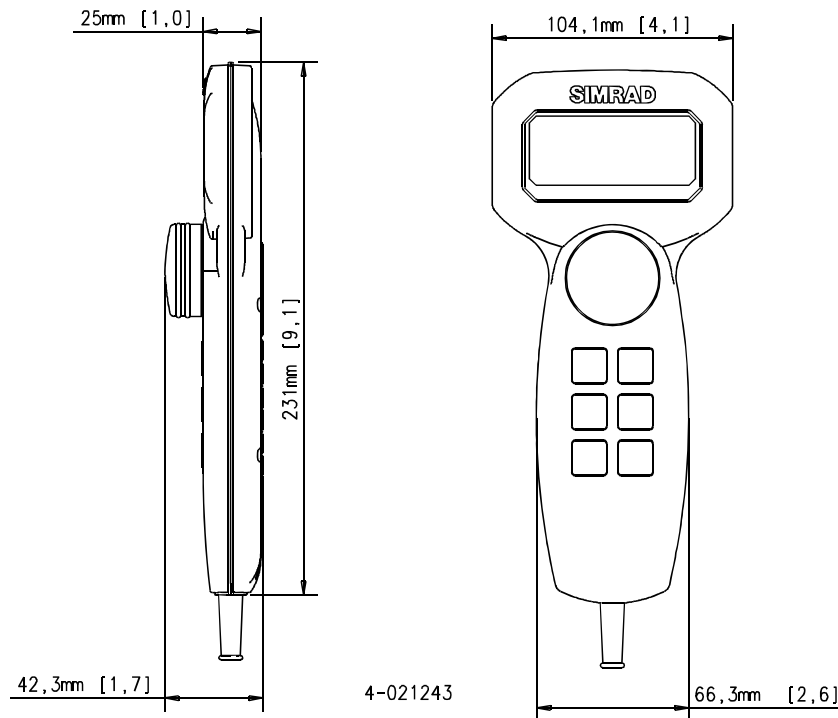


**Figure 6-1 AP50 Control Unit Dimensions**

### 6.3 AP51 Remote Control




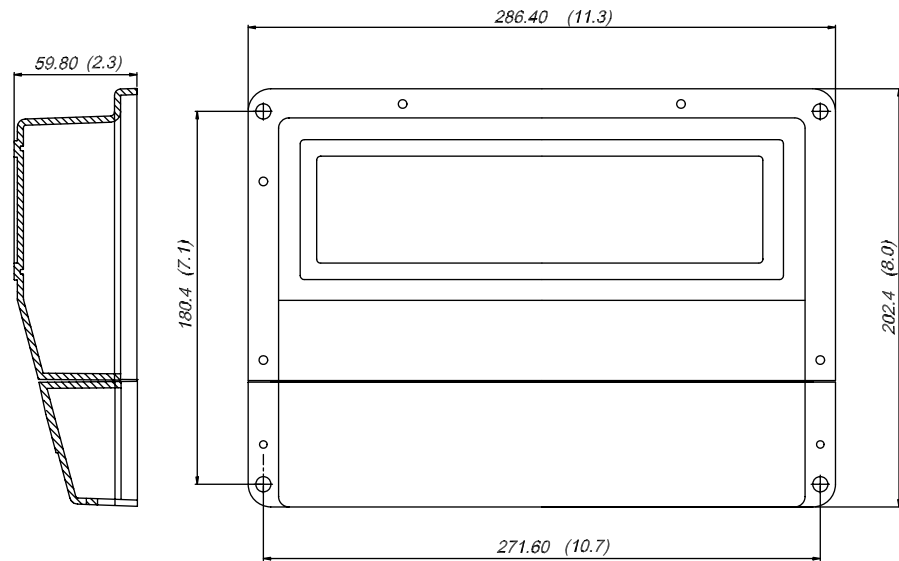
Dimensions: ..... See Figure 6-2  
 Weight: ..... 0.57 kg (1.25 lbs.)  
 Material: ..... PC-ABS  
 Supply ..... 12-32 VDC -10%/+30% via Robnet  
 Power consumption ..... 3 W  
 Environmental Protection: ..... IP56  
 Safe distance to compass: ..... 0.35 m (1.0 ft.)  
 Color: ..... Black  
 Temperature:  
     Operating: ..... -25 to +55°C (-13 to +130°F)  
     Storage: ..... -30 to +70°C (-22 to +158°F)  
 Display:  
     Type: ..... Backlit LCD matrix  
     Resolution: ..... 80 x 32 pixels  
 Illumination: ..... Adjustable in 10 grades  
 Mounting: ..... Handheld or placed in a fixed, bracket-mount  
 Cable: ..... 7m (23 ft.) Robnet cable with air tube and one male connector



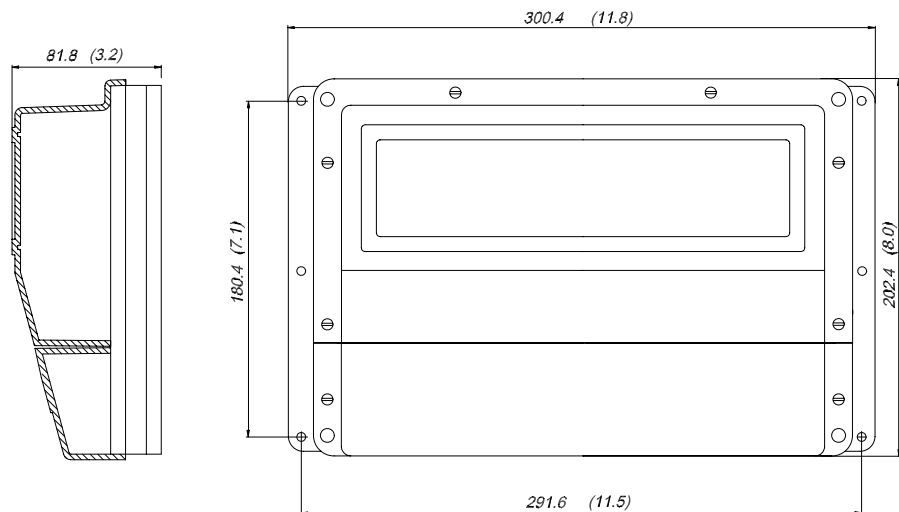
**Figure 6-2 AP51 Remote Control Dimensions**

## 6.4 Junction Units

Dimensions:	.....	See Figure 6-3 and Figure 6-4
Weight:		
J50.....		1.6 kg (3.5 lbs.)
J50-40 .....		2.8 kg (6.2 lbs.)
Material:	.....	Anodized aluminum and black ABS cover
Supply voltage:	.....	12-32 VDC -10%/+30%
Reverse voltage protection	.....	Yes (not J50-40)
Environmental Protection:	.....	IP22
Power consumption:	.....	5 Watt (electronics only)
Robnet Supply:	.....	2.5A (automatic fused)
Drive engage (Bypass/Clutch, Auto, Handshake):	.....	Max 1.5 A
Solenoids, externally supplied	.....	J50: Maximum 3 A
Motor/solenoid drive:	.....	J50: 10 A continuous, 20 A for 5 seconds J50-40: 20 A continuous, 40 A for 5 seconds
Vbat output:	.....	2.5 A (automatic fused)
Safe distance to compass:	.....	0.5 m (1.6 ft.)
Temperature range:		
Operation:	.....	-25 to +55°C (-13 to +130°F)
Storage:	.....	-30 to +70°C (-22 to +158°F)
Heading Sensor input:	.....	Composite pulse width modulated
Rudder feedback input:	.....	Frequency signal, 3400 Hz, 20 Hz/degree
Rudder feedback units:	.....	RF300, RF300S, RF45X or RF14XU
FU/NFU control input	.....	Yes
NMEA input/output ports:	.....	Two
External Alarm:	.....	Open collector 0.75A (automatic fused)
Mounting:	.....	Bulkhead-mount
System selector Autopilot/Main steering system	.....	Potential free contact
Heading output:	..	Simrad and Furuno radar display (clock/data; 0-5V, 10mA, 50 msec.)



**Figure 6-3 J50 Junction Unit - Dimensions**

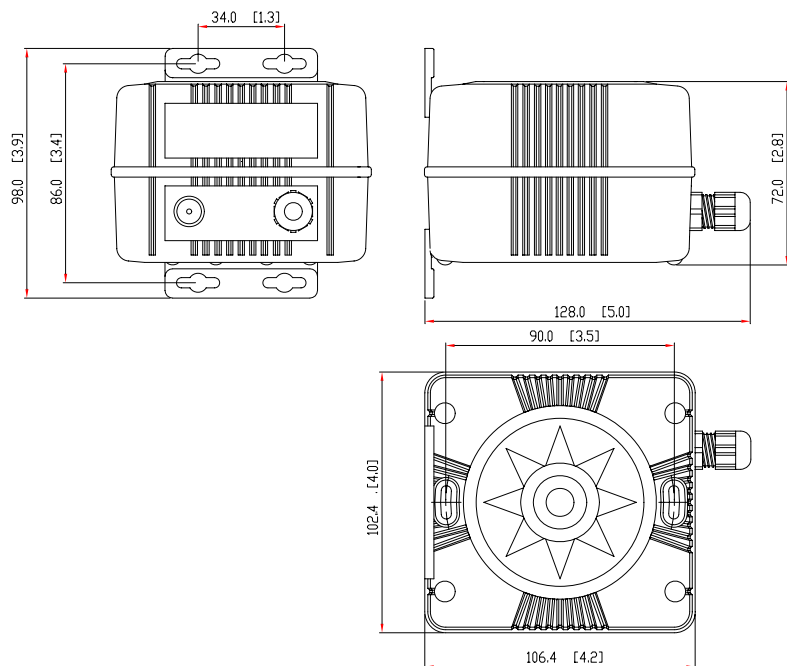


**Figure 6-4 J50-40 Junction Unit Dimensions**

## 6.5 RC25 Rate Compass

- Dimensions: ..... See Figure 6-5
- Weight: ..... 0.9 kg (2.0 lbs.)
- Power consumption: ..... 0.9 watts
- Supply and interface: ..... Robnet
- Environmental Protection: ..... IP56
- Material: ..... White ABS
- Temperature range:
  - Operation: ..... 0 to +55°C (+32 to + 130°F)
  - Storage: ..... -30 to +70°C (-22 to +158°F)

Mounting: ..... Deck-mount or bulkhead-mount  
 Cable: ..... 15 m (49 ft.) Robnet cable with connector  
 Automatic Performance:  
     Calibration: ..... Automatically activated by control head  
 Rate sensor stabilized heading output  
     Accuracy: ..... <1.25° rms (after calibration)  
     Repeatability: ..... <0.2° rms  
     Roll/Pitch: ..... ± 35°



**Figure 6-5 RC25 Rate Compass and CDI35 Course Detector Interface Dimensions**

## 6.6 CDI 35 Course Detector Interface

Dimensions: ..... See Figure 6-5  
 Weight: ..... 0.9 kg including cable (2.0 lbs.)  
 Power consumption: ..... 0.9 W  
 Supply and output: ..... Polarity-independent 2-wire supply with superimposed pulse width modulation  
 Environmental Protection: ..... IP56  
 Safe distance to compass: ..... 0.1 m (0.3 ft.)  
 Material: ..... Black ABS  
 Temperature range:  
     Operation: ..... -25 to +55°C (-13 to + 130°F)  
     Storage: ..... -30 to +70°C (-22 to +158°F)  
 Mounting: ..... Deck-mount or bulkhead-mount

Cable:..... 15 m (49 ft.) single twisted pair, shielded  
 Automatic Performance:  
     Calibration: ..... Automatically activated by control head  
     Repeatability: .....  $\pm 0.5^\circ$   
     Accuracy: .....  $\pm 1,0^\circ$  after calibration (not including errors from course detector)

### 6.7 CD100A Course Detector

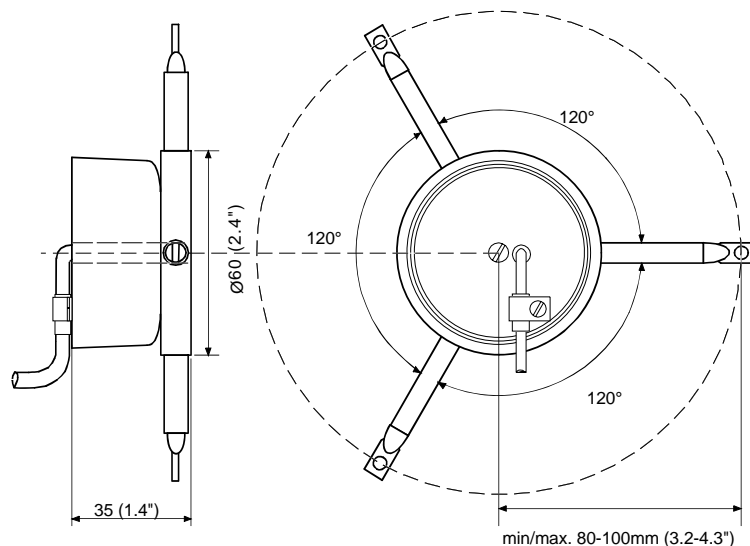


Dimensions: ..... See Figure 6-6  
 Weight: ..... 0.3 kg (0.7 lbs.) including cable  
 Environmental Protection: ..... IP56  
 Temperature range:  
     Operation: .....  $-25$  to  $+55^\circ\text{C}$  ( $-13$  to  $+130^\circ\text{F}$ )  
     Storage: .....  $-30$  to  $+70^\circ\text{C}$  ( $-22$  to  $+158^\circ\text{F}$ )  
 Mounting: ..... Attached to compass by screw or by tripod holder  
 Cable length: ..... 7 m (23 ft.), no plug included

### 6.8 CD109 Course Detector



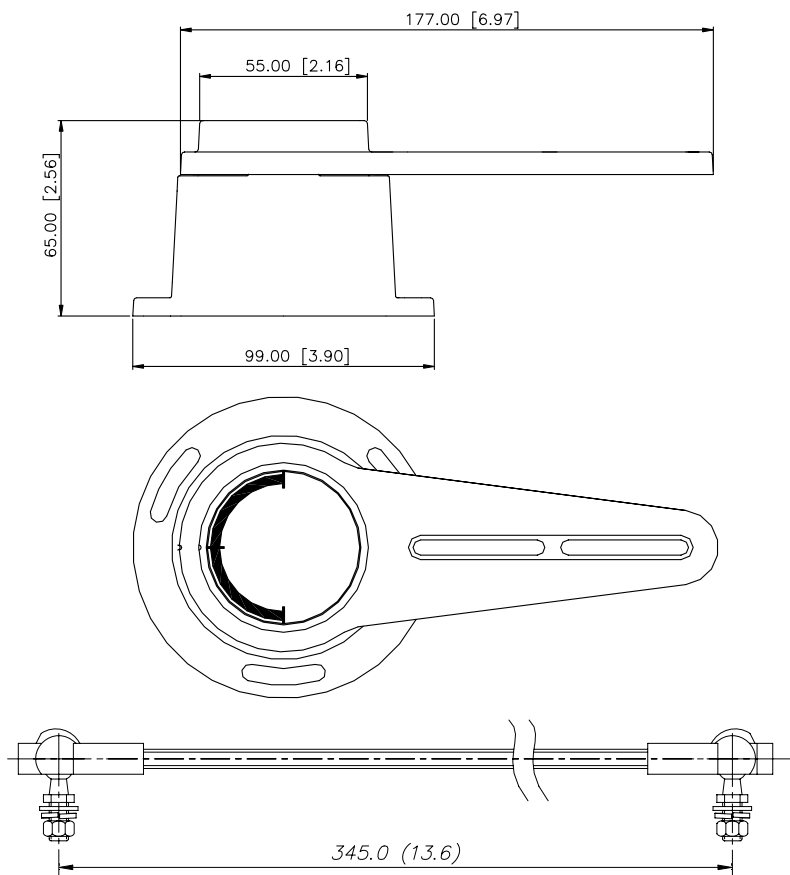
Dimensions: ..... See Figure 6-6  
 Weight: ..... 0.3 kg (0.7 lbs.) including cable  
 Environmental Protection: ..... IP56  
 Temperature range:  
     Operation: .....  $-25$  to  $+55^\circ\text{C}$  ( $-13$  to  $+130^\circ\text{F}$ )  
     Storage: .....  $-30$  to  $+70^\circ\text{C}$  ( $-22$  to  $+158^\circ\text{F}$ )  
 Mounting: ..... Attached to compass by screw or by tripod holder  
 Cable length: ..... 1 m (3 ft.) with AMP plug



**Figure 6-6 CD100A/CD109 Course Detector Dimensions**

## 6.9 RF300 Rudder Feedback Unit

- Dimensions: ..... See Figure 6-7 and Figure 2-2  
 Weight: ..... 0.5 kg (1.1 lbs.)  
 Material: ..... Arnite T06 200 PBT  
 Environmental Protection: ..... IP56  
 Temperature range:  
     Operation: ..... -25 to +55°C (-13 to +130°F)  
     Storage: ..... -30 to +70°C (-22 to + 158°F)  
 Mounting: ..... Horizontal, vertical, or upside down  
 Cable: ..... 10 m (33 ft.) single twisted-pair, shielded  
 Rudder angle: ..... ± 90°  
 Supply and output: ..... Polarity independent two wire frequency signal  
     Frequency resolution: ..... Center: 3400 Hz, 20 Hz/degree of change  
     Linearity: ..... ± 3° up to 45° of rudder  
 Transmission link: ..... Stainless 350mm (13.8 in.) with 2 ball joints.  
     Ball joint stud for rudder arm requires 4.2mm diameter hole and 5mm tap.



**Figure 6-7 RF300 Rudder Feedback Unit Dimensions**

## 6.10 RF45X Rudder Feedback Unit

Dimensions: ..... See Figure 6-8, Figure 6-10 and Figure 2-4  
 Weight: ..... 1,0 kg (2,2 lbs.)  
 Material: ..... Polyacetal (POM)  
 Supply voltage: ..... 12-24 VDC  $-10\%/+30\%$ , system supplied  
 Environmental Protection: ..... IP56  
 Temperature range:  
     Operation: .....  $-25$  to  $+55^{\circ}\text{C}$  ( $-13$  to  $+130^{\circ}\text{F}$ )  
     Storage: .....  $-30$  to  $+70^{\circ}\text{C}$  ( $-22$  to  $+158^{\circ}\text{F}$ )  
 Cable: ..... 2 m (6 ft.)  
 Rudder angle: .....  $\pm 45^{\circ}$   
 Output signal: ..... Polarity-independent frequency signal  
     Frequency resolution: ..... Center: 3400 Hz, 20 Hz/degree of change  
     Linearity: .....  $\pm 3^{\circ}$  up to  $45^{\circ}$  of rudder  
 Current output for rudder angle indicator (only for stand-alone system).. 0.1mA - 1.1mA  
 Number of indicators (only for stand-alone system): ..... 5 in series

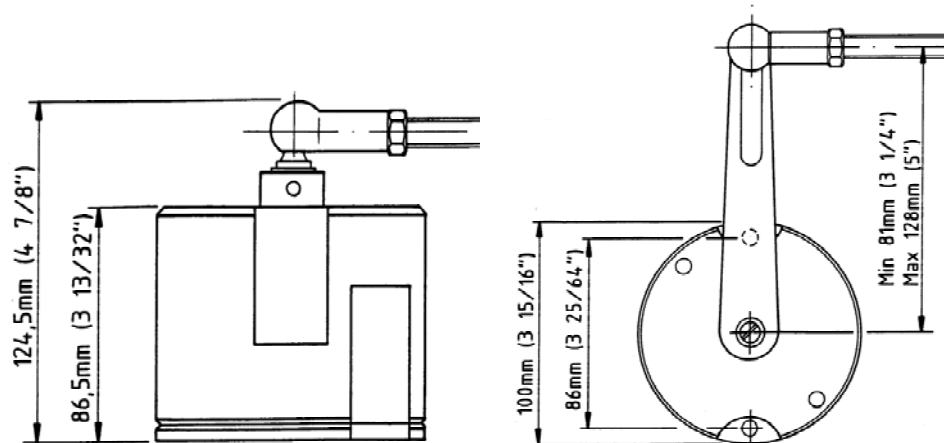
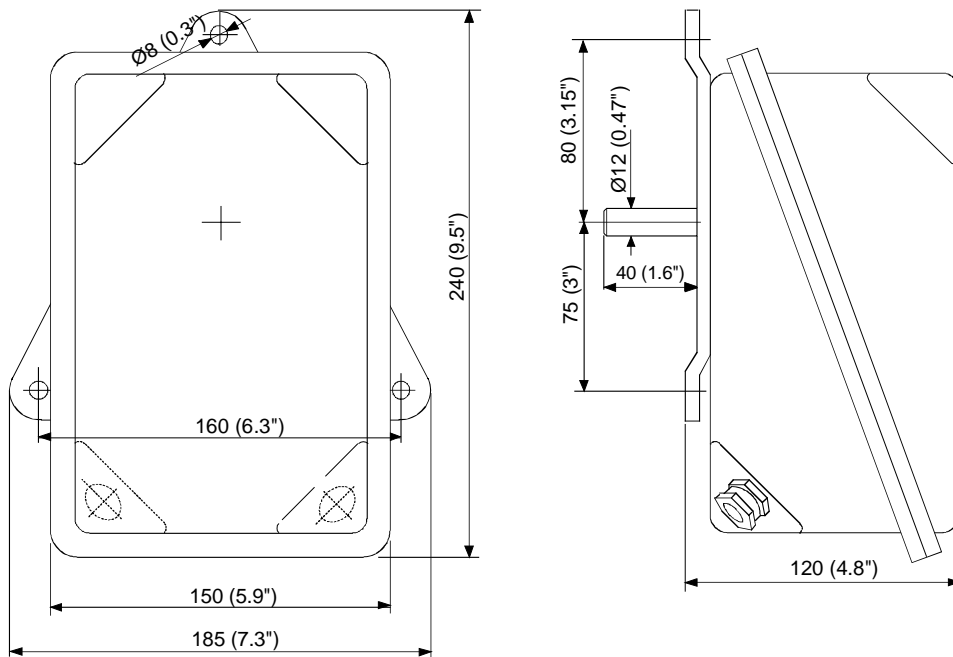


Figure 6-8 RF45X Rudder Feedback Unit Dimensions

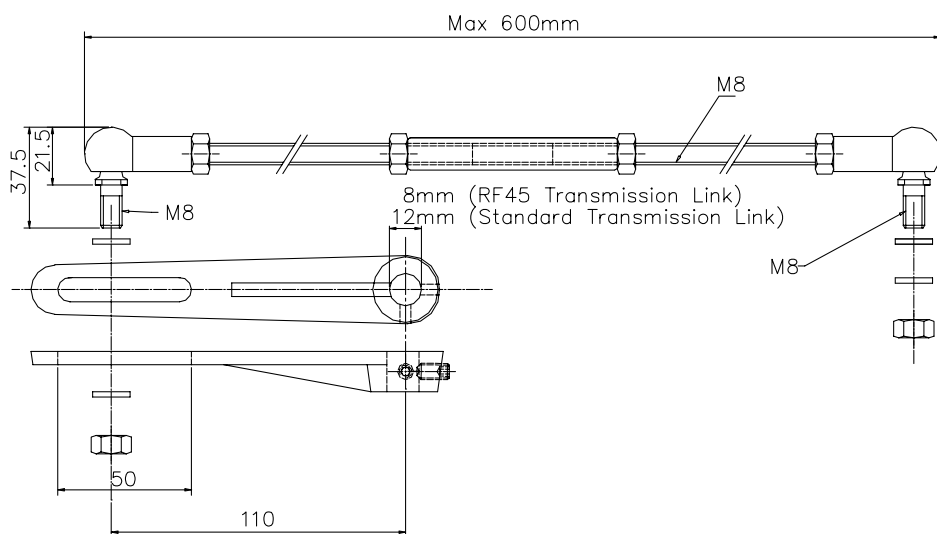
## 6.11 RF14XU Rudder Feedback Unit

Dimensions: ..... See Figure 6-9  
 Weight: ..... 2,8 kg (4,9 lbs.)  
 Material: ..... Reinforced glass fibre polyester  
 Environmental Protection: ..... IP56  
 Ambient temperature:  
     Operation: .....  $-15$  -  $+55^{\circ}\text{C}$  ( $+5$  to  $+130^{\circ}\text{F}$ )  
     Storage: .....  $-30$  to  $+70^{\circ}\text{C}$  ( $-22$  to  $+158^{\circ}\text{F}$ )  
 Supply voltage: ..... 24VDC  $-10\%/+30\%$

Voltage output: .....Operating voltage/2 ±9V  
 Frequency output: ..... 3400Hz (midships reference)  
 Port: +20Hz/degree, Stbd: -20Hz/degree  
 Capacity: .....5 indicators in parallel  
 Rudder angle: ..... ±45 ° (Changeable to 60, 70 or 90°)  
 Limit switches: ..... Two sets, individual adjustable from ±5 to ±160°



**Figure 6-9 RF14XU Rudder Feedback Unit Dimensions**



**Figure 6-10 RF Standard Transmission Link - dimensions**

## 6.12 NI 300X NMEA Interface



Dimensions: ..... See Figure 6-11  
 Weight: ..... 0.9 kg (2.0 lbs.)  
 Material:.....Epoxy coated aluminum  
 Environmental Protection: ..... IP44  
 Supply and interface: .....Robnet, 2 connectors  
 Power consumption: ..... 3 W  
 Safe distance to magnetic compass: ..... 0.3 m (1 ft.)  
 Temperature range:  
     Operation: ..... -25 to +55°C (-13 to +130°F)  
     Storage: ..... -30 to +70°C (-22 to +158°F)  
 Mounting: ..... Bulkhead mount  
 Cable inlets: .....Rubber glands for cable diameter 10-14 mm  
 NMEA183 input/output:.....4 ports, max. output load 20 mA  
 Heading output: .... Simrad (Anritsu) and Furuno radar display (clock/data; 0-5V, 10mA, 50 msec.)  
 NMEA instrument supply:..... 12 VDC, max 0.25A  
 External alarm: .....Potential free contact

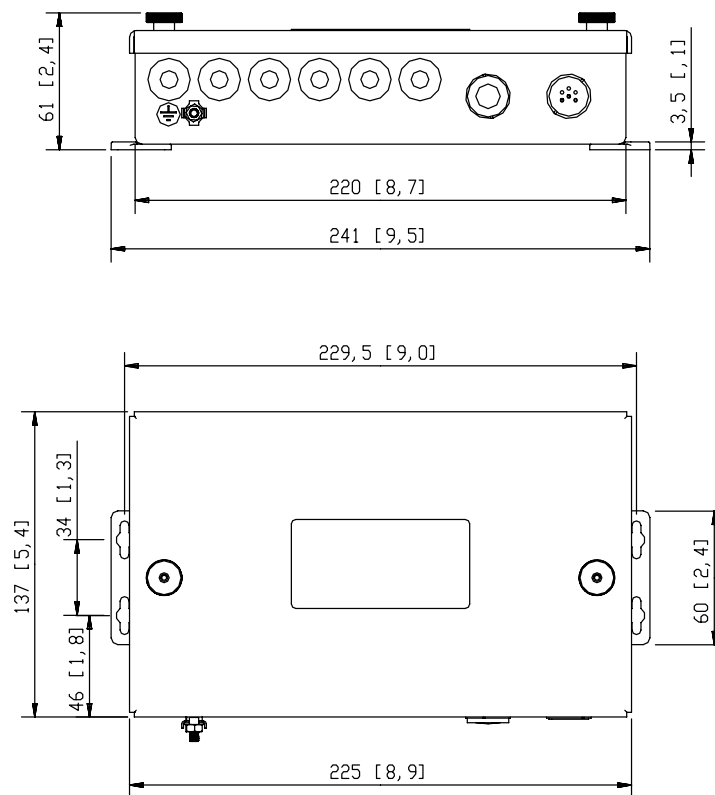


Figure 6-11 GI51, TI51, AD50 and NI300X Dimensions





## 6.16 S9 Steering Lever

Dimensions: ..... See Figure 6-13

Weight: ..... 2.8 kg (6.2 lbs)

Environmental Protection: ..... IP56

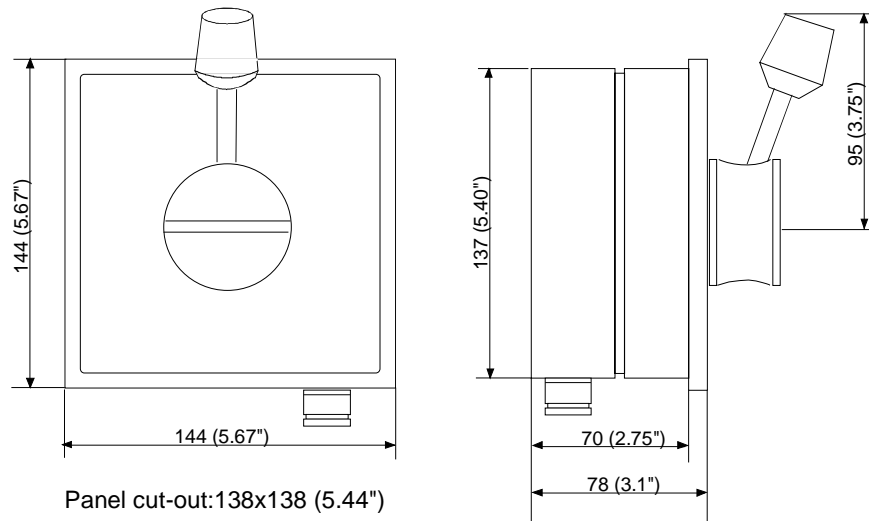
Temperature range:

Operation: ..... -25 - +55°C (-13 to +130°F)

Storage: ..... -30 to +70°C (-22 to +158°F)

Safe distance to compass: ..... 0.15 m (0.5')

Max. inductive load: ..... 4A/24V DC, 0.6A/110V DC, 0.3A/220V DC, 10A/AC



**Figure 6-13 S9 Steering Lever - Dimensions**

## 6.17 Environmental Protection

Each part of a Simrad autopilot system has a two-digit IP protection code.

The IP rating is a method to classify the degree of protection against solid objects, water ingress, and impact afforded by electrical equipment and enclosures. The system is recognized in most European countries and is set out in a number of British and European standards.

The first code number describes the protection against solid objects and the second number describes the protection against liquids.

<b>FIRST NUMBER</b> Protection against solid objects		<b>SECOND NUMBER</b> Protection against liquids	
<b>IP</b>	<b>TESTS</b>	<b>IP</b>	<b>TESTS</b>
0	No protection	0	No protection
1	Protection against solid objects up to 50 mm, e.g. accidental touch by hands.	1	Protected against vertically falling drops of water (e.g. condensation).
2	Protection against solid objects up to 12 mm, e.g. fingers.	2	Protected against direct sprays of water up to 15° from the vertical.
3	Protection against solid objects over 2.5 mm (tools + wires)	3	Protected against sprays to 60° from the vertical.
4	Protection against solid objects over 1 mm (tools + wires + small wires)	4	Protected against water sprayed from any direction - limited ingress permitted.
5	Protection against dust - limited ingress (no harmful deposit)	5	Protected against low-pressure jets of water from all directions - limited ingress permitted.
6	Totally protected against dust	6	Protected against strong jets of water, e.g. for use on ship decks - limited ingress permitted.
		7	Protected against the effects of immersion between 15 cm and 1 m.
		8	Protected against long periods of immersion under pressure.

## 6.18 NMEA Sentences

See table next page.

AP50 system, NMEA 183 messages (applies for J50 and NI300X sw release V1R2 onwards)		Missing data timeout (s)																															
Sentence Formatter mnemonic code		(APA)	APB	BOD	BWW	BWC	BWR	RMB	XTE	XTR	CGA	GLL	RMA	RMC	VTG	VBW	VHW	(DBK)	DBT	DPT	MW	(MWR)	HDT	HOG	ROT	(HDM)	ASA	HSC	HTD	Remarks:	TX stop	Alarm	New mess. priority
Bold = recommended navigator/instr. output for autopilot /italic = IMO designated ( ) = not for new designs		N	N	N	N	N	N	N	N	N	N	N	N	N	N	I	I	I	I	I	I	I	C	C	I,A	C	A	A	A				
Data source: (A=autop., C=comp., I=instr. sensor, N=navigator)		n	n	n	n	n*	n*	n	n	n	n	p	p	p	p	p*																	
Accept. condition: No nav/pos (n/p) flag warning		n	n																														
Status flag		n	n																														
Nav Data																																	
Destination wp position						2	1	3																									
Destination wp ident.		6	7	5	1	3	2	4																									
Origin wp ident.				3	1			2																									
Bearing wp-wp, T		3	4	2	1																												
Bearing wp-wp, M		3	4	2	1																												
Bearing pos-wp, T		4				2	1	3																									
Bearing pos-wp, M			3			2	1																										
Distance pos-wp						2	1	3																									
XTE		4	5					2	3	1																							
Position Data											4	1	2	3																			
Present position Lat, Long																																	
COG, T													1	2	3																		
COG, M															1																		
Magnetic variation				3	2								5	6	4									1*									
Speed Data																																	
Speed over ground (SOG)													1	2	3																		
Speed through water (LOG)																2*	1																
Depth Data																																	
Depth relative to transducer																			1	2	3												
Wind Data																																	
Apparent wind angle																							2	1									
Apparent wind speed																							2	1									
Heading Data																																	
Compass heading, T																								3	2*								
Compass heading, M																									3		2						
Rate of turn*																																	
Rudder Data																																	
Rudder angle																																	
Rudder command																																	
Rudder angle limit																																	
Rudder status																																	
Steering control																																	
Commanded heading T/M																																	
Commanded ROT/radius																																	
Selected steering mode																																	
Off heading limit																																	
Off heading status																																	
RX: J50-1, NI300X		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x*	x	x	x	x	x	x										
J50-2		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	
GI51																	x*	x*							x	x							
TX: J50-1, 1Hz Installation setup						.1	.1	.5	.2		.5	.5	.5											1*	1*	1	1	.1					
J50-1, 5Hz Installation setup						.1	.1	.5	.2		.5	.5	.5											5*	5*	1	5	.1					
J50-1, VDR Installation setup																											5	5					
J50-2																									10*	10*	1	5	.1				
NI300X						.1	.1	.5	.2		.5	.5	.5											1*	1*	1	1	.1					
GI51																																	
GI50																																	
Normal sentence length (bytes)		46	66	45	45	78	78	82	29	23	78	46	67	72	43	47	41	36	36	28	30	40	19	32	18	19	27	27	82				
Max sentence transmission rate (Hz)		10	7	11	11	6	6	6	17	21	6	10	7	7	11	10	12	13	13	17	16	12	25	15	27	25	18	18	6				

## 7 INDEX

- A**
- Actual rudder, 78
  - Added stop time, 84
  - Adjust rudder angle, 68
  - Alarm
    - external, 19
  - Analog Heading Repeater, 41
  - Analog rudder, 51, 68
  - Analog thruster, 64, 65
  - AUTO/STANDBY
    - Toggling, 19
  - Autotrim, 78
  - Autotrim in work modes, 78
- B**
- Boat length, 49
  - Boat type, 49
- C**
- COG, 63
  - Compass
    - Calibration, 62
    - difference, 79
    - Offset, 63
  - Configuration, 4
  - Continuous thrusters, 54, 65, 86
  - Control unit
    - Bracket mounting, 25
    - Installation, 25
    - Panel mounting, 25
  - Control Unit
    - Specifications, 96
  - Counter Rudder, 70, 82, 84
  - Course adjust, 79
  - Course detector
    - Installation, 43
    - Specifications, 101
  - Course detector interface
    - Installation, 44
    - Specifications, 100
  - Cruising speed, 67, 82
- D**
- Digital Heading Repeater, 41
  - Dockside settings, 47
  - Drive engage, 80
  - Drive out, 53, 75, 81
  - Drive type, 81
  - Drive unit
    - Installation, 20
    - Voltage selection, 49
- E**
- Electronic Chart System, 56
  - Environmental Protection, 109
  - External alarm, 19
- F**
- Feedback unit
    - Installation, 6
    - Specifications, 102
- G**
- GPS, 63
  - Gyro interface
    - Installation, 41
- H**
- Handshake 1, 80
  - Hydraulic pumps, 21

**I**

IMO MSC(64)67, 95

Init NAV, 85

Input voltage, 75

Installation

Index, 3

Menu, 46

Set-up, 45

Interface Menu, 56

Interface Set-up, 54

IP Protection Code, 109

ISM Code, 1

ISO 11674, 95

**J**

Jack point, 29

Junction unit

Installation, 16

Specifications, 98

**L**

Language selection, 47

**M**

Manual tuning, 69

Marine Equipment

Directive, 1

Master operation, 49

Master Reset, 77

Maximum rudder limit, 53

Maximum thrust, 65

Midship rudder, 53, 78

Minimum rudder, 83

Minimum thrust, 66, 87

Monitor compass, 75

**N**

Nav gain, 83

NMEA Compass in, 40

NMEA data, 76

NMEA input/output

Double, 39

Single, 39

NMEA interface

installation, 42

NMEA PORT test, 77

NMEA sentences, 109

NMEA Signal Monitor, 77

**O**

Off heading limit, 79

On/off thrusters, 54, 64, 86

**P**

P-factor, 69, 82, 84

Physical stop, 50, 53

Prop. gain, 81

Proportional drive, 50, 52,  
81

Proportional valve, 52, 87

**R**

RAD, 84

Radar Clock/Data, 40

Radio Frequency Interface,  
17

Radius steering, 84

Rate Compass

Installation, 30

Specifications, 99

Rate of turn, 67, 84

Rate sensitivity, 85

Remote Control

Connection, 29

Specifications, 97

Response delay, 88

Reversible Pump, 22

Rhumb line, 85

- Robnet, 17, 26, 93
- ROT, 84
- Rudder, 69, 75, 82
  - rudder angle scaling, 13
  - Rudder cal, 51
  - Rudder calibration, 51
  - Rudder deadband, 54, 84
  - rudder feedback
    - installation, 12
    - specifications, 103
  - Rudder feedback
    - Calibration, 50
  - Rudder limit, 53
  - Rudder test, 52, 81
  - Rudder zero, 67
- S**
- Sea Trial, 61
- Seastate, 81, 82
- Service Menu, 75
- Settings, 89
- Solenoid Valves, 24
- Solenoids
  - Externally powered, 23, 24
  - Not externally powered, 24
- Speed response, 72, 82
- Speed source, 66
- Steered course, 75
- Steering compass, 75
- Stepper gyro
  - Connection, 41
- Synchro gyro
  - Connection, 41
- System data, 75
- System Filter Values, 75
- System select, 18
- System Select, 47
- T**
- Thrust direction, 64
- Thruster calibration, 64
- Thruster drive, 88
- Thruster gain, 86
- Thruster hyst, 87
- Thruster inhibit, 86
- Thruster sensitivity, 86
- Thruster settings, 86
- Thruster type, 54
- Thruster zero, 64
- Transition speed, 83
- Transmitted Heading Device, 56
- Turn gain, 67
- Turn Gain, 85
- Turn mode, 84
- U**
- Used midship position, 53, 82
- V**
- VDR, 56
- W**
- W Autotrim, 78
- W Count rudder, 82
- W Initial rudder, 78
- W Radius, 84
- W Rate of Turn, 84
- W Rudder, 82
- W Rudder limit, 82
- W Seastate, 82
- W Turn Gain, 85
- Waterjet, 83
- Wheelmark, 20, 29, 49

Work Turn Gain, 85

## 8 APPROVALS

### 8.1 Product compliance schemes

Electronic navigation equipment on boats and ships within the **European Common marked** (EC) are regulated by two main directives:

- Directive 89/336/EEC Electromagnetic Compatibility, "EMC directive"
  - This directive is applicable to more or less all boats, including leisure boats. Refer **CE mark** section below
- Council Directive 96/98/EC of 20 December 1996 on marine equipment, "Marine directive" or "MED"
  - This directive is valid for ships that come under international conventions such as LL66, Colreg, Marpol, and Solas. Refer to the **Wheelmark** section below

The **Marine directive** requirements include the requirements of the **EMC directive**, and a product which comply with the **Marine directive** is therefore automatically also in compliance with **EMC directive**.

#### **CE mark**

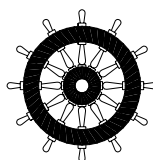


The **CE mark** is placed on a product as the manufacturer's visual identifier that the product meets the requirements of relevant European Directives. The CE mark is mandatory for a wide range of products sold within or exported to the European market, and applies to all Electric- and Electronic equipment.

When the equipment is tested according to the requirements in the Directive 89/336/EEC, the CE marking is applied to the units to symbolize Simrad's Declaration of Conformity with the directive.

The CE declaration for any CE marked unit can be obtained from your Simrad distributor.

#### **Wheelmark**



0575/05

The **Wheelmark symbol** (Mark of Conformity) is an accreditation that is required for equipment placed on board ships for which safety certificates are issued by, or on behalf of, Member States of the European Union.

Before a wheelmark can be affixed to a product, an independent organization appointed by a European national authority (a Notified body) has to undertake conformity assessment, and test reports and a MED-B certificate have to be issued. These test reports and certificates have to be kept by the manufacturer.

The manufacturer is allowed to affix the Wheelmark symbol and issue a declaration of conformity only if the manufacturer also holds a relevant QA certificate (MED-D).

The wheelmark shall be followed by:

- the identification number of the notified body (Det Norske Veritas = 0575) which has performed the conformity assessment procedure and the last two digits of the year in which the mark is affixed.

**Note !**

*When a complete system (e.g. an autopilot system) is wheelmark approved, only the main unit(s) in the system wears the wheelmark symbol. This to avoid the misunderstanding that all standard and optional units in a system retain their wheelmark approval if they are installed in a not approved system. The type examination certificate (MED-B) for the wheelmarked system lists all optional equipment that is part of the wheelmark approval. The EC Declaration of Conformity do also show which units that are part of the approval.*

EU's official database (MarED Product Database) contains information about wheelmarked equipment. This database is found on:

<http://www.mared.org/>

## 8.2 Certificates

The certificates and CE declarations for any wheel marked equipment can be obtained from your Simrad distributor.