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Instruction Manual

This manual is intended as a reference guide for operating and correctly installing the AP21 and AP22 autopilots.

Great care has been paid to simplify operation and set-up of the autopilots. However, an autopilot is a complex electronic system. It is affected by sea conditions, speed of the vessel, hull shape and size.

Please take time to read this manual to get a thorough understanding of the operation and system components and their relationship to a complete autopilot system.

Other documentation material that is included in this manual is a warranty card. This must be filled out by the authorized dealer that performed the installation and mailed in to activate the warranty.
Document revisions

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Document history

Rev. –   First edition
Rev. A   Drawings for panel mounting the control unit included. Changed note, page 118. Spare parts list: Changed description of part no. 22085872 from Optional mounting kit to Optional mounting bracket.
Rev. D   LFI3000 Mk2 included.
Rev. E   Minor modifications in text. New art. no. on Robnet connectors, page 123. Distributor list updated.
Rev. F   IS11 instruments replaced by IS15. Added RPU300, 24V to the table on page 58. CD100A included. Minor corrections to text.
Rev. G   Updated according to software versions AP21&AP22 V1R3 and J300X V1R8.
Rev. H   Correction of misprint: Manual Rev. G was updated according to software version AP21&AP22 V1R2, not V1R3. Corrected on page 17 and 75.
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1 INTRODUCTION

1.1 General

Congratulations on the purchase of your new Simrad autopilot system and thank you for selecting what we feel is the most advanced autopilot system available on the market today.

Today Simrad manufacture a complete range of autopilots for all types of vessels, from leisure boats up to advanced steering systems for merchant marine vessels. Our factory for these products is located in Egersund on the south/west coast of Norway. The company's involvement in autopilots began in 1953 with equipment for the North Sea fishing fleet. Professional mariners around the world acknowledge that the Simrad name is synonymous with the absolute best in autopilot technology.

The Simrad AP21 and AP22 autopilots represents yet another step forward in autopilot technology with the intent to provide leisure boats between 30 and 80 foot with a host of new features. The system can be expanded and enhanced with a selection of options and accessories.

The brain in the autopilot system is the single "intelligent" junction unit that communicates with all other system modules on the ROBNET network. The ROBNET has been developed to establish a reliable digital communication and power distribution network between the units in the system. The ROBNET simplifies installation and enables the autopilot system to be easily expanded at any time.

1.2 How to use this manual

This manual is intended as a reference guide for operating, installing and maintaining the Simrad AP21 and AP22 autopilots. Great care has been paid to simplify operation and set-up, however, an autopilot is a complex electronic system. It is affected by sea conditions, speed of the vessel, hull shape and size.

Please take time to read this manual to get a thorough understanding of the operation and system components and their relationship to a complete autopilot system.
Other documentation material provided with your system includes a warranty card. This must be filled out by the authorized dealer that performed the installation and mailed in to activate the warranty.

1.3 System components

A basic autopilot system consists of the following units (refer to Figure 1-1 and Figure 1-2):

- AP22 Control Unit or AP21 Control Unit
- Heading sensor (compass)
- Rudder Feedback Unit with transmission link
- Junction Unit
- Drive unit

The basic system can be expanded with remote control unit, hand held remote and steering lever.

![Figure 1-1 AP22 Basic system](image)
1.4 **AP22 Control Unit**

A compact autopilot control for panel, bulkhead or overhead mounting. It has a multifunction LCD display for readout of autopilot data, dedicated keys and rotary course knob. Two Robnet connectors are provided for system interconnection and expansion.

1.5 **AP21 Control Unit**

A portable control unit with 7 m (20 ft.) of cable. It has the same autopilot functions as AP22 and can be used as a hand held autopilot or be mounted in a fixed, bracket mount.

1.6 **Junction units**

The junction unit is the heart in the autopilot system. It contains the steering computer, interface circuits to all system components and drive circuits for the drive unit motor and clutch. Three models, J300X, J300X-40 and J3000X are available.
Junction unit comparison chart:

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<td>10-28 V</td>
<td>10-40 V</td>
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<tr>
<td>Motor current</td>
<td>6/10 A</td>
<td>10/20A (20/40A)</td>
</tr>
<tr>
<td>(continuous/peak)</td>
<td></td>
<td></td>
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<tr>
<td>Clutch/bypass current</td>
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<td>1.5 A</td>
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<td>Number of Robnet units</td>
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<td>Input for NFU control</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>External alarm</td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>Radar clock/data interface</td>
<td></td>
<td>x</td>
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1.7 **Rudder Feedback unit**

**RF300 Rudder Feedback unit**
Rudder feedback unit with transmission link and 10 m (30 feet) of cable. Transforms the angular travel of the rudder to a digital signal read by the autopilot steering computer.

**LF3000 Linear Feedback**
Linear feedback unit for boats with outboard engine. Transforms the linear movement to an analogue signal. Supplied with 8.5 m cable and mounting clamps.

**LFI3000 Mk2 Linear Feedback Interface**
Interface unit for LF3000 Linear Feedback. Converts the analogue LF3000 signal to the standard digital feedback signal for the autopilot steering computer.
1.8 Heading Sensors

The AP21 and AP22 autopilots can be used with the following combinations of heading sensors:

**RFC35 Electronic Fluxgate Compass**

A compact heading sensor from Simrad with 15 m (45 feet) of cable. The direction of the earth's magnetic field is sensed by a floating ring core in a fluxgate coil and transformed to a digital signal read by the autopilot steering computer.

**RFC35R Rate compass**

Fluxgate compass with integrated rate sensor. Provides a dramatic improvement to the dynamic performance of both the autopilot and a stabilized radar display when connected to the autopilot system. Same dimensions as RFC35.

**CDI35 Course Detector Interface and CD100A Course Detector**

Interface and sensor unit to connect AP21 and AP22 to a magnetic compass. The autopilot provides excitation current for CD100A and converts the analogue sin/cos signal to digital two wire format for the autopilot steering computer.

*Note! You can not connect both an RFC35 and a CDI35 at the same time.*

**NMEA compass**

(Appplies for AP21&AP22 V1R3/J300X V1R8)

Any NMEA 0183 compass with HDT, HDG or HDM messages can be connected directly to the J300X/J300-40X junction units.

**Other fluxgate compass models**

The optional CI300X can interface AP21 and AP22 to fluxgate compasses with heading signal on a sine/cosine format.

**Simrad RGC10 and RGC50 gyrocompasses**

The optional CI300X unit is needed to interface these two gyrocompass models. Other gyrocompass models with synchro 1:1 (max 110V) can also be interfaced.
1.9 Optional equipment

A series of options are available for the basic AP21 and AP22 systems.

**R3000X Remote Control**

A small handheld remote control with two push buttons for power steering or course selection (port and starboard), and one push button with built-in lighted indicator for limited mode change.

**S35 NFU Lever**

S35 is designed for indoor and outdoor bulkhead mount. The lever has spring loaded return to mid-position. A push button with light indicator is used for limited mode change.

**FU35 Follow-Up Steering Lever**

The FU35 Follow-up steering lever features a dial (scale) with 10° markings. The rudder will move and stop at the commanded angle as read on the dial. FU35 has a mid-position detent, push buttons for (limited) mode selection and mode indicators (STBY, FU, AUTO and NAV). It is designed for indoor and outdoor bulkhead or panel mount. See separate manual for FU35.

**NI300X NMEA Interface Unit**

Unit with 4 NMEA I/O ports for communication to other systems, and a selectable heading output for radars (Anritsu or Furuno). Includes two Robnet connectors for connection to the autopilot system.

**CI300X Compass Interface**

Unit for interface to non-Simrad fluxgate compasses and windvane systems with analogue output, and NFU levers. Input for Simrad RGC50 and RGC10 gyro compasses.

**Mounting Bracket**

Optional bracket for bulkhead or overhead mount of AP22. See Figure 4-8 on page 65.
2 OPERATION OF THE AUTOPILOT

WARNING! An autopilot is a very useful navigational aid, but DOES NOT under any circumstance replace a human navigator.

Do not use automatic steering when:
• In heavy traffic areas or in narrow waters
• In poor visibility or extreme sea conditions
• When in areas where use of autopilot is prohibited by law

When using an autopilot:
• Do not leave the helm unattended
• Do not place any magnetic material or equipment near heading sensor used in the autopilot system
• Verify at regular intervals course and position of vessel
• Always switch to Standby mode and reduce speed in due time to avoid hazardous situations

2.1 Overview

Figure 2-1 AP22 Front Panel
The control unit can operate as a stand alone unit in an autopilot system or combined in a multistation system. In a multistation system the command can easily be transferred from one unit to another. Units not in control will display "Inactive".

The autopilot system is capable of the following primary steering modes: STBY (manual steering), AUTO, NAV or WIND, each mode having a dedicated push button.

Each of the mode push buttons is clearly identified with the primary function in large text, and a secondary function listed in smaller text. Each button provides you with access to a primary display and a secondary.

A group of user adjustable settings and selections are provided in the USER SETUP MENU (page 33). Adjustment of display visibility, selection of heading sensors, navigation sources are among the menu items.

Alarms are presented in plain text to alert you in the event of system or external data failure conditions. Alarms include both audible and visual presentations. The alarm listing is on page 113.

### 2.2 ON/OFF - Standby mode

A single press on the STBY button switches the system ON and the following status displays are shown:
SW and HW revisions shown are examples only.  
After approx. 5 seconds the system is operative and the unit that was turned on will show the STBY mode display. Other units in a multistation system will display "Inactive". Control can be available at any unit by pressing the STBY button.

A long press (2-3 sec.) on the STBY button switches the system OFF.

**Note!**

*In an emergency it is possible on a multistation system to turn OFF the system at any control unit by pressing down the STBY button for 2-3 seconds.*

STBY mode is also the mode that is used when steering the boat at the helm.
2.3 **AP21 and AP22 with MSD50 Stern Drive unit**

**Note!** The information in this paragraph only applies if your autopilot is driving a Simrad MSD50 Stern Drive.

The MSD50 Stern drive unit has a relative feedback signal which needs a zero point setting after the autopilot has been turned on. Refer to paragraph 1.1 of the MSD50 manual for further information.

### Zero point setting

**Note!** If you not need a rudder angle display when leaving the dock, just steer the boat manually on a straight course and press the AUTO button. The zero point is then set automatically.

If you prefer to use the rudder angle display when leaving the dock, proceed as follows:

After turn on the rudder angle display will alternate between 10° port and 10° starboard to indicate that the "rudder" zero point need be set.

Use the wheel to bring the "rudder" to midship position. Turn the wheel from lock to lock (H.O. to H.O.) and count the exact number of turns. Then start from one lock position and turn the half number of turns.

Press AUTO and then STBY. The zero point is now set and the display will show:
Operation

Follow the operating instructions on the following pages. There is no further need for zero point setting until next time you turn the autopilot on.

2.4 Follow-Up steering (FU)

When both the PORT and STBD push buttons are pressed simultaneously the autopilot is set to Follow-Up mode and rudder commands can be set by the course knob. One revolution of the knob equals 44° rudder command. The commanded rudder angle is shown on the display and the rudder will move to the commanded angle and stop.

Note! The maximum rudder angle is limited to the LO rudder limit setting. Refer to paragraph “View parameters” on page 104.

WARNING! While in Follow-Up mode, you cannot take manual control of the wheel.

2.5 Non-Follow-Up steering (NFU)

When PORT or STBD push button is pressed in STBY mode the NFU display is presented. The rudder will move as long as the button is pressed and the actual rudder angle is shown on the display.
2.6 R3000X Remote Control

In the STBY mode the rudder will move as long as the Port or Stbd button is pressed.

In AUTO mode, the set course will change 1° each press.

Note!

If you keep the button pressed, it will automatically change the course at a rate of 3°/second.

Operation of mode button cycles the pilot as follows:

AUTO → STBY → AUTO
NAV → STBY → AUTO *

* NAV mode can only be entered from the Control unit

2.7 S35 Steering lever

The principle is similar to that of R3000X Remote Control (see above). The rudder will move as long as the lever is offset to Port or Starboard.

Note!

When a NFU steering lever or remote control is operated, the control unit(s) become "Inactive".

2.8 Automatic Steering

The AUTO mode is used to make the autopilot steer the boat automatically on a set course. AUTO is always available from any mode or function within the autopilot by a single press on the AUTO button. When changing from STBY to AUTO mode, the autopilot uses the current boat heading as the set course and the simultaneous rudder angle. This gives a bumpless transfer at the mode change.
In AUTO, the autopilot is issuing rudder commands to keep the boat on the set course. Heading input is provided by the compass for course keeping.

The autopilot will keep the boat on the set course until a new mode is selected or a new course is set with either the course knob or the PORT or STBD buttons. One revolution of the course knob equals 44° course change.

Once the course is changed to a new set course, the boat will automatically turn to the new heading and continue to steer the new set course.

### 2.9 Automatic Speed selection

The autopilot provides two different sets of steering parameters to control the response of the boat at different speeds (HI or LO) while in AUTO and NAV modes.

The autopilot always selects the HI speed steering parameters when first switched on. This is a safety feature. After initial turn
on, selection of the steering parameters may be accomplished automatically, based on the availability of input data from either an external speed log or an external navigator, or manually.

The autopilot automatically selects the HI or LO parameter set. The speed at which the autopilot changes from HI to LO (or opposite) is determined by the "Transition Speed" set in the Installation Setup Menu.

**Note!**

*It is not recommended to use automatic speed switching if input is from Loran.*

![Example of Transition speeds with AUTOMATIC Speed parameter selection](image)

**2.10 Manual speed selection**

Select AUTO mode. To toggle between HI and LO speed parameters, press the "AUTO" button two times quickly.

If you change boat speed it is recommended that you select HI or LO parameters correspondingly.

![Quick double press to toggle between HI and LO speed parameters](image)

**Note!**

*The manually selected speed setting (HI or LO) will override the automatic speed selection and remain in effect until you re-enter AUTO mode.*
2.11 Navigating with the AP21 or AP22

The autopilot has the capability to use steering information from an external navigator (GPS/Chart Plotter) to direct the boat to a specific waypoint location, or through a route of waypoints. In NAV mode, the autopilot uses the heading sensor as it's reference for course keeping. The steering information received from the external navigator alters the set course to direct the autopilot to the destination waypoint.

The autopilot is designed to steer in mixed mode operation. This combines the straight steering capability of cross track error (XTE) steering in conjunction with the turning capability of bearing mode steering.

To obtain satisfactory navigation steering, the following points must be fulfilled prior to entering the NAV mode:

- The autopilot autosteering must be tested and found satisfactory.
- The navigation receiver must be operating and the navigation system (GPS/Chart Plotter) must be in full operating mode with adequate signal characteristics for valid position and steering data.
- At least one waypoint must be entered and selected as the current waypoint in the navigation receiver.
- The navigation source in the AUTOPILOT USER SETUP menu must be set for the navigator that contains the current waypoint.

Note! Navigational steering must only be used in open waters. The process of having an external navigation receiver direct an autopilot can be a slow acting process. By selecting the NAV mode, the autopilot is set for automatic steering on the current set course and then waits for the user to accept the course change to the destination waypoint.
Simrad AP21 and AP22 Autopilots

Press

again to activate NAV mode

* CTS (course to steer) is the course set internally in the autopilot to steer the boat on to the track.

When operating the autopilot in NAV mode to automatically steer through a route of waypoints, the autopilot will steer to the first waypoint in the route after you accept the first waypoint as the location to steer to. When you arrive at the waypoint, the autopilot will give an audible warning and display the proposed new course information. If the required course change is more than 10° you will need to verify that the upcoming course change is acceptable. Verification is performed by pressing the NAV button after the prompt screen is displayed. If no verification is received, the autopilot will continue on the current set course in AUTO mode.

Verify course change greater than 10° by pressing

At the arrival of each new waypoint in a route:

Name of new waypoint. Bearing to new waypoint. Required course change.

Regain manual steering at any time by pressing:
2.12 Selecting a different Navigator

If you have more than one navigation source connected to the autopilot, you will be able to choose any for navigation. Refer to the User Set-up menu for details on selecting a different navigator.

Note !

*If the autopilot is connected to a navigation receiver that does not transmit a message with bearing to next waypoint, it will pick a XTE message and steer on Cross Track Error only. In that case you have to revert to AUTO mode at each waypoint and manually change set course to equal bearing to next waypoint and then select NAV mode again.*
2.13 Dodging

Dodging is useful in situations where you need to quickly take control of the helm to steer around an obstruction, and then wish to return to the previous set heading after performing the evasive manoeuvre. Dodging is activated by a quick press on the DODGE button.

When in DODGE mode the displayed set course is the last one set prior to activating the dodge function. When DODGE is displayed, the autopilot is in STBY mode and is no longer in control of the steering. You must either manually steer the boat by the helm or take control using Non Follow Up or Follow Up steering. The autopilot will remain in DODGE mode until you exit DODGE by a second press on the TURN/DODGE button or select another mode.

![Diagram of Autopilot Controls]

- **Perform dodge using:**
  - Wheel
  - Non Follow Up
  - Follow Up

- **Press both**
- **Next press**
  - DODGE: Selects AUTO mode at the last set course
  - AUTO: Selects AUTO mode with current heading as set course

**Note!** Using NFU or FU modes while dodging will make “NFU” or “FU” flash instead of “DODGE”.
2.14 Dodge in NAV

Press to activate DODGE mode

Cross track error: 0.02 nm to starboard

Perform dodge using:
- Wheel
  - or Non Follow Up
- Follow Up
  - Press both

To return from Dodge mode press one of the following buttons:
- NAV<br>  Selects NAV mode at present position with new bearing to waypoint
- AUTO<br>  Selects AUTO mode with current heading as set course
- DODGE<br>  Returns to NAV mode at the current track (not recommended as it may result in a big course change)
2.15 **TURN-mode**

The autopilot provides a special U-turn feature when in AUTO mode. This feature is very useful in a man overboard situation.

U-Turn changes the current set course to be 180 degrees in the opposite direction. The user may decide if the U-Turn should be made to Port or Starboard to bring the boat on the new course. U-Turn is activated by a quick double press on the DODGE button. The autopilot will continue on the set course until you press either the PORT or STBD button to select the direction to make the U-Turn. If you do not press PORT or STBD within 1 minute, the autopilot will return to the AUTO mode and stay on course.

![Quick double press to enter TURN mode]

2.16 **Tacking in Auto mode**

When the autopilot is installed on a sailboat, a fixed tack of 100 degrees can be made in AUTO mode.

The use of this function should be carefully considered based on the boat’s characteristics and the weather conditions. The tack function should only be used into the wind and must be tried out in good weather conditions with light wind to find out how it works on your boat. Due to wide range in boat characteristics (from cruising to racing boats) the performance of the tack function may vary from boat to boat. Except for the course change of 100° the procedure is similar to that of the U-Turn described above.

![Boat makes STBD U-turn]
2.17 Wind vane steering

Prior to entering WIND mode the autopilot system should be operating in AUTO, with valid input from the selected wind transducer. The WIND mode is an alternative function to the NAV mode and it is only available if the system has been set up for SAIL-boat in the Installation Menu, and NAV/WIND source is set to WIND under the USER SETUP menu. (Ref. to page 33).

WIND function can only operate when reaching as it is necessary to have a stable apparent wind. The sails should be trimmed so that the autopilot can easily steer the boat in AUTO mode and the wind transducer must give a stable signal.

Enter the WIND mode by pressing the NAV/SETUP button.

The pilot will read the apparent wind angle at the moment the WIND function is selected and enter it as the set apparent wind angle. From that point the pilot will change the course to maintain this apparent wind angle as the wind direction may change.

Note!

If the cumulative shift of the apparent wind exceeds 15° from the value at the time the WIND mode was selected, a WIND SHIFT alarm will sound.

The display will show the set apparent wind angle. Adjustments to this set angle can be done by using PORT or STBD button or the rotary course knob.

When pressing the NAV/SETUP button a second time the display presents current heading and rudder angle.
Dodging while in WIND mode is very similar to dodging in AUTO or NAV modes. Refer to DODGE mode operation in the AUTO mode section on page 26.

Regain manual steering by pressing:

2.18 Tacking in Wind mode

In WIND mode on sailboats there is also a tacking aid function. This function may only be used when the boat is reaching and will when activated take the boat from the course you are steering to the computed course that gives you the same apparent wind on the other side.

This tacking function as compared to tacking in AUTO mode can only be used when you are sailing with the apparent wind as the reference (WIND mode), and with apparent wind angle less than 80-90 deg.

A quick double press on DODGE will activate the tack function which will prompt you for which way the tack should be performed. Press PORT or STBD to select the tack.
2.19 Multiple station system

In normal operation of multiple control units, control is accessible from every control unit connected to the autopilot system. One control unit is "active" and provides the user with access to all functions and enables the user to change modes and set the course for automatic course keeping. All remaining control units are "inactive" and have no effect on course changes. A single press on any of the mode buttons on an "inactive" control unit will allow transfer of command and make it "active".

2.20 Lock function

The "LOCK" function is a safety feature included in the autopilot system when you have more than one control unit installed. It will disable all control units except for a single, user selected control unit location.

When the "lock" function is in use, no transfer of command may take place; only the "active" control unit stays in command.

To enable the "lock" function, make a quick double press on the STBY button.

The display on the "active" control unit will first show a "female" icon and then the icon will alternate with the mode index.

The "locked" control units in the system will show:
The “Lock function is disengaged by the following actions:

- The “active” control unit unlocks by another double press on the STBY button.
- The system is switched OFF by any control unit (press STBY for 2-3 seconds).

After having "unlocked" the other control stations, the "active" control unit will show the above symbol before the display returns to normal. All other control units will return to the "inactive" state.
2.21 User Set-up Menu

Quick double press to enter User Setup Menu

Scrolls through menu selections or sets value on menu items

Sequences FWD in MENU

Sequences BACK in MENU

The Nav/Wind selection only appears if the autopilot is configured for sailboat. (See Dockside settings, page 89). Determines whether the NAV mode button will activate NAVigation mode or WIND mode steering.

Adjust backlight of display and pushbuttons (10 steps, 10 = brightest). Setting is stored when system is turned off, and resets to stored level at turn on. Adjustment is local to the control head you adjust.

Adjust contrast of displays (10 steps). Setting is stored when system is turned off, and resets to stored level at turn on. Adjustment is local.
Select the source for NAV mode steering. Refer to interface setup table on page 98.

Select value for Sea State Filter.

OFF: Provides precise steering but increases rudder activity.

AUTO: Reduces rudder activity and reduces sensitivity of autopilot in rough weather automatically.

MANUAL: Sets yaw band manually (1-10, 10 = +/-6°).

Select the source of speed over ground (SOG). This option will only appear if there is more than one GPS receiver connected to the system.

Select the compass to be used for AUTO steering if more than one compass is connected. Refer to the interface setup table on page 97.

RFC = Simrad RFC35 Fluxgate compass or Simrad RFC35R Rate compass (See Note)
MAGN = Magnetic compass (or Simrad RFC35 Fluxgate Compass. (See Note)
FLUXG = Non-Simrad fluxgate compass
GYRO = Simrad gyrocompass
NMEA = NMEA compass

Note !

It is necessary to select the correct compass and Nav. source to make the autopilot operate.

When using the PORT or STBD buttons in automatic mode you are changing the set course in 1° increments. If you prefer the increments to be 10° each press, proceed as per below:

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 10° if you want to make major course changes in 10° steps with the buttons and fine tune the set course with the rotary knob.

System data and NMEA data found in this menu are test functions to analyse data processed by the autopilot. (See Trouble shooting page 113).

Except when NMEA data or System data is displayed, the menu will disappear after 30 seconds if no key is pressed. It will disappear immediately if any mode key (STBY, AUTO or NAV/WIND) is pressed.
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3 TECHNOLOGICAL SPECIFICATIONS

3.1 AP21 and AP22 Autopilot System

Boat size and type: Up to 80 feet, Power, Displacement, Sail
Steering system types: Hydraulic, Mechanical
Inter-unit connection: ROBNET network or two-wire supply/data
System ON/OFF: From control units
Supply voltage: See junction units
Power consumption: Dependent on system configuration

Environmental Protection:
- AP21 Control Unit: IP56.
- AP22 Control Unit: IP56 from front, IP43 from back.
- RFC35, RFC35R, CDI35: IP56
- RF300: IP56
- J300X: IP44
- NI300X, CI300X: IP44


Automatic Steering control:
- Rudder Drive: Proportional rate or solenoid on/off
- Parameter selection: Automatic with manual override
- Sea state control: Adaptive sea state filter or manual

Language selection: English, Norwegian, French, Spanish, German, Italian, Dutch, Swedish.

Electronic Interface:
- Navigation interface: NMEA 0183
- NMEA inp./outp. ports: Max. 6 (see junction units and NI300X specifications)
- NMEA input sentences: APA, APB, BOD, BWC, BWR, BWW, DBK, DBT, DPT, GGA, GLL, MTW, MWV, RMA, RMB, RMC, VHW, VLW, VTG, VWR, XTE, XTR, ZTG, ZDA, (PSTOE, PSTOI).
- NMEA output sentences: BWC, BWW, GGA, HDG, HDM, HDT, HSC, RMB, RMC, RSA, VTG, XTE.
Simrad AP21 and AP22 Autopilots

Optional output: ............... Anritsu and Furuno radar display (clock/data)

Heading sensors:
Standard: ......................... RFC35 Electronic Fluxgate compass
Options: ......................... Magnetic compass
RFC35R Rate compass
NMEA compass (Not J3000X)
Simrad RGC50/RGC10 gyrocompasses *
Analogue fluxgate compass (sin/cos)*
Analogue wind vane (sin/cos)*
* By CI300X

Course Selection: .................. Rotary course dial and push button
Alarms: ............................. Audible and visual, optional external
Alarm modes: ........................ Off course, system failures, overload
Steering modes: .................... Standby, Non-follow up, Follow-up, Auto, Nav, Wind
Special Turn modes: ............... Dodging, Tacking, U-Turn

3.2 AP22 Control Unit
Dimensions: ....................... See Figure 3-1
Weight: .......................... 0,5 kg (1.1 lbs)
Power consumption .............. 3 W
Display:
    Type: .......................... Backlit LCD matrix display
    Resolution: .................. 80 x 32 pixels
Colour: ............................ Black
Illumination: ........................ Adjustible in 10 steps
Environmental Protection: ...... IP56 from front, IP43 from back.
Safe distance to compass: ....... 0.3 m (1’)
Temperature:
    Operating: ...................... 0 to +55 °C (+32 to +130 °F)
    Storage: ......................... –30 to +80 °C (–22 to +176 °F)
Mounting: ........................ Panel by four screws
Optional bracket for bulkhead and overhead mount.
Figure 3-1 AP22 Control Unit - dimensions
(Mounting bracket is optional equipment)
(D3-208503)
3.3 AP21 Control Unit

Dimensions: See Figure 3-2

Weight: 0.57 kg (1.25 lbs)

Power consumption: 3 W

Display:
- Type: Backlit LCD matrix display
- Resolution: 80 x 32 pixels
- Colour: Black
- Illumination: Adjustable in 10 steps
- Environmental Protection: IP56.

Safe distance to compass: 0.3 m (1')

Temperature:
- Operating: 0 to +55 °C (+32 to +130 °F)
- Storage: −30 to +80 °C (−22 to +176 °F)

Mounting: Handheld or mounted in a fixed, bracket mount.

Cable: 7m (23') special Robnet cable with air tube.

Figure 3-2 AP21 Control Unit - dimensions
3.4 Junction units

Dimensions: See Figure 3-3 and Figure 3-4

Weight:
- J300X/J3000X: 1.3 kg (2.9 lbs.)
- J300X-40: 2.8 kg (6.2 lbs)

Supply voltage:
- J3000X: 10-28V DC
- J300X/J300X-40: 10-40V DC

Reverse voltage protection: Yes (not J300X-40)

Power consumption: 5 Watt (electronics)

Motor / solenoid drive:
- J3000X: 6 A continuous, 10 A for 5 sec.
- J300X: 10 A continuous, 20 A for 5 sec.
- J300X-40: 20 A continuous, 40 A for 5 sec.

Heading Sensor input: Composite pulse width modulated

Rudder feedback input: Frequency signal, 3400 Hz., 20 Hz/deg.

Rudder feedback units: RF300, LF3000

NMEA input/output ports:
- J3000X: 1
- J300X, J300X-40: 2

External Alarm: Open collector

Temperature range:
- Operation: 0 to +55 °C (+32 to +130 °F)
- Storage: −30 to +80 °C (−22 to +176 °F)

Mounting: Bulkhead mount

Material: Anodized aluminium and black ABS cover
Figure 3-3  J300X/J3000X Junction Unit - Dimensions

Figure 3-4  J300X-40 Junction Unit - Dimensions
3.5 RFC35 Fluxgate compass

Dimensions: ...................... See Figure 3-5
Weight: ............................. 0.9 kg (2.0 lbs)

Supply and output: ............... Polarity independent 2-wire supply with
superimposed pulse width modulation

Automatic Performance:
  Calibration: ......................... Automatically activated by control head
  Gain compensation: ............ Automatically adjusted continuously

Repeatability: ...................... ± 0.5 degrees
Roll/Pitch: ............................ ± 35 degrees

Accuracy: ............................ ± 3 degrees after calibration

Cable supplied: .................... 15 m TP shielded cable

Temperature range:
  Operation: ......................... 0 to +55 °C (+32 to + 130 °F)
  Storage: ............................. −30 to +80 °C (−22 to +176 °F)

Environmental Protection: ....... IP56

Mounting: ............................ Deck or bulkhead

Material: ............................. Black ABS

Figure 3-5 RFC35 Fluxgate Compass - Dimensions
3.6 RFC35R Rate compass

Dimensions: See Figure 3-5
Weight: 0.9 kg (2.0 lbs)
Supply and interface: Robnet
Power consumption: 0.9 watts

Automatic Performance:
- Calibration: Automatically activated by control head
- Gain compensation: Automatically adjusted continuously
- Rate sensor stabilised heading output

Accuracy: <1.25° (rms)
Repeatability: <0.2° (rms)
Roll/Pitch: ±35 degrees
Cable supplied: 15 m TP shielded cable

Temperature range:
- Operation: 0 to +55 °C (+32 to +130 °F)
- Storage: −30 to +80 °C (−22 to +176 °F)

Environmental Protection: IP56
Mounting: Deck or bulkhead
Material: Black ABS

3.7 CDI35 Course Detector Interface

Dimensions: See Figure 3-6
Weight: 0.9 kg (2.0 lbs)
Supply and output: Polarity independent 2-wire supply with superimposed pulse width modulation

Automatic Performance:
- Calibration: Automatically activated by control head
- Gain compensation: Automatically adjusted continuously

Repeatability: ±0.5 degrees
Accuracy: ±0.5° (not including errors from course detector)
Cable supplied: 15 m TP shielded cable
Weight: ................................. 0,9 kg including cable (2,0 lbs.)
Power consumption: .................... 0,9 watts
Temperature range:
   Operation: ...................... 0 to +55 °C (+32 to + 130 °F)
   Storage: ......................... –30 to +80 °C (–22 to +176 °F)
Environmental Protection:........... IP56
Mounting: ............................. Deck or bulkhead
Material: ............................. Black ABS

![Figure 3-6 CDI35 Course Detector Interface - Dimensions](image)

3.8 RF300 Rudder Feedback

Dimensions: ............................. See [Figure 3-7] and [Figure 3-8]
Weight: ................................. 0,5 kg (1,1 lbs)
Rudder angle: .......................... ± 90 degrees
Output signal: .......................... Polarity independent frequency signal
   Frequency resolution:........... Centre: 3400 Hz, 20 Hz/degree of change
   Linearity: ............................ ± 3 degrees up to 45 degrees of rudder
Cable supplied: .......................... 10 m twisted pair shielded cable
Mounting: ............................ Horizontal, vertical, upside down
Material: ............................ Polyacetal (POM)
Environmental Protection: .......... IP56
Simrad AP21 and AP22 Autopilots

Temperature range:
- Operation: –10 to +55 °C (+14 to +130 °F)
- Storage: –30 to +80 °C (–22 to +176 °F)

Transmission link: Stainless 350mm (13.8”) with 2 ball joints. Ball joint stud for rudder arm requires 4.2mm dia hole and 5mm tap.

3.9 CI300X Compass Interface

Dimensions: See Figure 3-9
Weight: 0,9 kg (2,0 lbs)
Power consumption: 2 W
Technical specifications

Gyro compass input: Synchro 1:1 (RGC10/RGC50 gyrocompasses)
Heading or windvane input: Sin/cos max 12V DC
NFU steering lever input: Port/stbd potential free contact
Robnet network interface: 2 network connectors
Cable inlets: Rubber glands for cable diam. 10-14 mm
Mounting: Bulkhead mount
Material: Epoxy coated aluminium
Environmental Protection: IP44
Temperature range:
  Operation: 0 to +55 °C (+32 to +130 °F)
  Storage: –30 to +80 °C (–22 to +176 °F)

Figure 3-9  CI300X  and NI300X - Dimensions

3.10  NI300X NMEA Interface

Dimensions: See Figure 3-9
Weight: 0,9 kg (2,0 lbs)
Power consumption: 3 W
NMEA183 input/output: 4 ports, max output load 20 mA
Heading output: Anritsu and Furuno radar display (clock/data)
NMEA instrument supply: 12V DC, max 0.25A
Robnet network interface: 2 network connectors
Cable inlets: Rubber glands for cable diam 10-14 mm
Mounting: Bulkhead mount
Simrad AP21 and AP22 Autopilots

Material: Epoxy coated aluminium
Environmental Protection: IP44
Temperature range:
  Operation: 0 to +55 °C (+32 to +130 °F)
  Storage: –30 to +80 °C (–22 to +176 °F)

3.11 R3000X Remote

Dimensions: See Figure 3-10
Weight: 0.4 kg (0.9 lbs)
Protection: IP56
Cable length: 7 m, shielded
Material: Epoxy coated aluminium

Figure 3-10 R3000X - Dimensions

3.12 S35 NFU Steering Lever

Dimensions: See Figure 3-11
Weight: 1.4 kg (3.1 lbs)
  incl. 10 m cable
Protection: IP56
Power consumption: 6 mA
Max. inductive load: 4A/12-24VDC
  60mA/110VAC,
  25mA/220VAC

Figure 3-11 S35 - Dimensions
3.13  **LF3000 Linear Feedback**

Stroke: ...................... 300 mm

Operating principle: ...... Variable differential transformer, excitation and signal
conversion by separate LFI3000 Mk2 Interface unit

Power: ......................... Supplied by LFI3000 Mk2

Dimensions: .................... 465 mm (18,3") x 22 (0,86") dia.

Mounting: ...................... Clamped to hydraulic ram

Material: ....................... Rod: Stainless

                             Tube: Epoxy coated seawater resistant aluminium

Environmental protection:  IP67

3.14  **LFI3000 Mk2 Linear Feedback Interface**

Supply: ......................... From Junction Unit

Output signal............... Polarity independent variable frequency

Frequency resolution .... Centre 3400Hz, ±10Hz/degree equal to 1,7 mm travel

Linearity:...................... ±3 degrees up to 45 degrees of rudder

Cable supplied: ............. 1,5 m TP shielded cable

Weight: ......................... 0,7 kg including cable (1,6 lbs.)

Power consumption: ...... 0,9 watts

Temperature range:

  Operation:.... 0 to +70°C (+32 to + 158°F)
  Storage: ....... -30 to +80°C (-22 to +176°F)

Environmental Protection: . IP56

Mounting: ...................... Deck or bulkhead

Material: ....................... Black ABS

Dimensions: .................... See Figure 3-6.
## 3.15 NMEA sentences

| NMEA messages and data overview for IS15, AP11, AP20, AP35, AP300X, AP3000(X) and J3xx V1R8 |
|---|---|---|---|---|---|---|---|---|
| **Message ident.** | HDG (HDM) | HDT | RSA | MMV | VWR | DBK | BPT | MTW | VHW | VLW | GGA | GLL | RMA | DG | VTG | ZDA | (APA) |
| **Data source:** (n/p/h=nav/pos/heading source, c=calculated): | h | h | h | c | p | p | p | p | p | p | n | n | n |  |  |  |  |  |
| **Accept. cond.** (N=no nav. flg warning, P= no pos. flg warning): Status flag |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Compass_Data | Compass heading, M | 2 | 1 | X |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Compass heading, T | 2 | 3 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Rudder_Data | Rudder angle | 1 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Wind_Data | Apparent wind angle | 2 | 1 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Apparent wind speed | 2 | 1 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Depth_Data | Depth ref transducer | 1 | 3 | 2 | X |  |  |  |  |  |  |  |  |  |  |  |  |
| Transducer-Keel Offset |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Depth range |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Speed_Temp_Data | Speed through water | 1 |  | 1 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Log distance and trip |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Water temperature |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Gps_Data | Present position Lat, Long | 4 | 1 | 2 | 3 | 1 | 2 | 3 | 1 |  |  |  |  |  |  |  |  |
| COG, T |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| COG, M |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Universal Time Coordinated (UTC) | 3 | 1 | 2 | 4 |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Magnetic variation | X |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| SOG | 4 | 5 |  | 1 | 2 | 3 |  |  |  |  |  |  |  |  |  |  |  |
| Nav_Data | To-wp position | 6 | 7 | 5 | 3 |  |  |  |  |  |  |  |  |  |  |  |  |
| To-wp ident. |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| From-wp ident. |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Bearing wp-wp, T | 6 | 5 |  | 4 |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Bearing wp-wp, M | 5 | 6 | 4 |  | 3 |  |  |  |  |  |  |  |  |  |  |  |  |
| Bearing pos-wp, T |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Bearing pos-wp, M |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Distance pos-wp |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Time to go to dest. Wp |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| XTE |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Waypoint closure velocity, VMG | 4 | 5 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Steering_contrl | Heading steering cmd, T / M |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Light_Cmd | IS11 illumination |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| IS15 RX: | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x |
| IS15 TX: | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x |
| J3xx RX: | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x |
| J3xx TX: | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| J3xx V1R7 onwards Channel2 TX: | .1* | .1* | .1* | 1 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

**Note!**

1. **APB sentence may read in true or magnetic bearing wp-wp and bearing pos-wp. These fields are sent as magnetic bearings from IS15.**

2. **IS15. Magnetic variation from the HDG sentence is only used to calculate true heading from the data in the same Hdg sentence, and is not read in to the system.**
Technical specifications

<table>
<thead>
<tr>
<th>Proprietary sentences in/out IS15:</th>
</tr>
</thead>
<tbody>
<tr>
<td>In to IS15 $PSTOK,a&lt;CR&gt;&lt;LF&gt; Status of compass calibration: a = I:init, R:running, F:failed, C:calibrated.</td>
</tr>
<tr>
<td>Out from IS15: $PSTOK,,,x.x,*XX&lt;CR&gt;&lt;LF&gt; Set compass offset. x.x is offset angle, 0 to 360 degrees.</td>
</tr>
<tr>
<td>Out from IS15: $PSTOC,*77&lt;CR&gt;&lt;LF&gt; Sent start calibration of compass.</td>
</tr>
</tbody>
</table>
3.16 IP 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 recognised 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.

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

4.1 General

This section provides detailed information required to successfully installing the AP21 and AP22 Autopilot systems.

The autopilot system includes several modules that need to be mounted in different locations on the boat, and also 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 on board (NMEA interfacing)

In addition, the advanced capabilities of the autopilot require the installer to perform a series of settings and tests to verify proper operation of the system, refer to the check list below.

4.2 Installation checklist

1. Determine system configuration you are installing (Page 54)
2. Perform the hardware installation (Page 55)
3. Connect external NMEA devices (inputs and outputs, page 74)
4. Set Language (Page 88)
5. Dockside settings (Page 89)
   a) Boat type selection.
   b) Drive unit selection.
   c) Rudder feedback calibration.
   d) Automatic rudder test.
   e) Transition Speed
6. Interface setup for Junction Unit and NI300X/CI300X if installed (Page 94)
7. Perform settings in User Setup Menu page 33 for NAV source, POS source and Compass source
8. Dockside Autopilot tests (refer to Operating Instructions, page 15)
   a) Test all stations (if applicable) - lock/unlock - active/inactive
   b) Test Non-Follow Up mode
   c) Test Follow-Up mode
   d) Test AUTO mode
e) Test NAV mode and input interfaces (if connected) including optional heading sensors
f) Test interface outputs to external equipment (if connected)

9. Seatrial settings (Page 100)
   a) Set rudder zero
   b) Compass calibration
   c) Compass Offset adjustment
   d) Automatic tuning (if required)
   e) Viewing parameters

10. Testing Autopilot Operation at Sea (refer to Sea Trial instructions, pages 100, 107)

11. Provide the user with training (Page 108)

### 4.3 Unpacking and handling

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

A standard autopilot system will include:

- Control unit with standard installation accessories.
- Junction unit (J300X, J300X-40, J3000X) and one 15 m (49') Robnet cable.
- RFC35 Fluxgate Compass with 15 m (49') cable attached.
- RF300 Feedback unit with 10 m (33') cable attached and transmission rod.
- Appropriate drive unit for the installation (unless the autopilot is going to operate an existing drive unit or solenoids).
- Optional equipment that may have been ordered for the installation.

### 4.4 Determine the system configuration

It is important to become familiar with the configuration of the system prior to beginning the installation. The autopilot system layout with options is shown in Figure 4-1

Pay particular attention to the junction unit/drive unit combinations on page 60 and the chart on page 11.
As many of the units are communicating on a common network (ROBNET), with identical connectors, the installation is simplified. Try to mount the units within the standard cable length supplied with each unit, if possible. ROBNET Extension Cable (10m) is available from your distributor.

### 4.5 Autopilot System Layout

![Autopilot system layout with options](image)

**Figure 4-1 Autopilot system layout with options**

### 4.6 RF300 Rudder feedback installation

The RF300 Rudder feedback unit mounts close to the rudder, and is mechanically linked to the rudder tiller arm or rudder quadrant.

Refer to **Figure 4-2** 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 need no further adjustment at installation than 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 4-2). 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 wheel to set the rudder tiller arm to approximate centre position.

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

**Note!**

*Carefully observe the alignment marks. A rudder feedback alarm may be the result if the alignment instructions as per Figure 4-2 are neglected.*

Attach the transmitter rod to the RF300. Set the RF300 mounting location to be in accordance with Figure 4-2. The centre of the RF300 should be in line with the centre of the rudder post. 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.

**Note!**

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

Tighten the mounting screws for both the RF300 feedback unit and the transmitter rod ball joint.
Observe the RF300 while someone turns the helm wheel through the complete travel from full port to full stbd. rudder to verify that the mechanical linkage to the RF300 is not obstructed.

![RF300 connection diagram](image)

**Figure 4-3 RF300 connection**

### 4.7 Junction unit installation

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

**Note!** The junction units (J3000X, J300X and J300X-40) are not weather proof and should be mounted vertically as shown in a dry place between the control unit and the drive unit.

![J3XX mounting diagram](image)

**Figure 4-4 J3XX mounting**
4.8 **Cable connections**

Use only shielded cables. This includes Mains input, drive units and if necessary for the extension of the RF300 Rudder Feedback cable. The clutch/bypass cable and the solenoid cable should be 1.5 mm² (AWG14). Signal cables should be 0.5 mm² (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.

<table>
<thead>
<tr>
<th>Cable length Description</th>
<th>Drive Unit Voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Breaker panel to Junction Unit.</td>
<td>12V</td>
</tr>
<tr>
<td>2. Junction Unit to Drive Unit motor (Length refers to each of the two cables)</td>
<td>AWG</td>
</tr>
<tr>
<td>Up to 3 m (10 ft.)</td>
<td>12</td>
</tr>
<tr>
<td>Up to 6 m (20 ft.)</td>
<td>10</td>
</tr>
<tr>
<td>Up to 10 m (32 ft.)</td>
<td>8</td>
</tr>
<tr>
<td>Up to 16 m (52 ft.)</td>
<td>6</td>
</tr>
</tbody>
</table>

4.9 **Grounding and RFI**

The autopilot system has excellent RFI protection and all units use the Junction Unit as a common ground/shield connection. The Junction Unit should therefore have a proper ground connection to the hull/bonding system.

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

Remove the bottom cover to get access to the plug-in terminals. Strip about 1 cm (0.4") 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 has good contact.

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

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

The Mains input is not polarity protected on J3000X-40.

Power Board terminals

TB9 and TB10 are not on the J3000X Power Board

Main Board terminals
4.10 Drive unit installation

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

Refer to the connecting diagram for the different drive units on page 62 onwards.

Installation instruction for the drive units are found in the manual for the individual units.

The maximum drive current capability of the J3000X, J300X and J300X-40 junction units are different. Use the table below as reference and observe the notes on next page.

### HYDRAULIC PUMPS

<table>
<thead>
<tr>
<th>MODEL</th>
<th>MOTOR VOLTS</th>
<th>JUNCTION UNIT</th>
<th>RAM CAPACITY MIN cm³ (cu. in.)</th>
<th>RAM CAPACITY MAX cm³ (cu. in.)</th>
<th>FLOW RATE AT 10 bar cm³/min (cu. in/min)</th>
<th>MAX PRESSURE bar</th>
<th>PWR. CONSUMPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>RPU80</td>
<td>12V</td>
<td>J3000X</td>
<td>80 (4,9)</td>
<td>250 (15,2)</td>
<td>800 (49)</td>
<td>50</td>
<td>2.5-6 A</td>
</tr>
<tr>
<td>RPU160</td>
<td>12V</td>
<td>J300X</td>
<td>160 (9,8)</td>
<td>550 (33,5)</td>
<td>1600 (98)</td>
<td>60</td>
<td>3-10 A</td>
</tr>
<tr>
<td>RPU200</td>
<td>24V</td>
<td>J300X</td>
<td>190 (11,6)</td>
<td>670 (40,8)</td>
<td>2000 (122)</td>
<td>80</td>
<td>3-10 A</td>
</tr>
<tr>
<td>RPU300</td>
<td>12V</td>
<td>J300X-40</td>
<td>290 (17,7)</td>
<td>960 (58,5)</td>
<td>3000 (183)</td>
<td>60</td>
<td>5-25 A</td>
</tr>
<tr>
<td>RPU300</td>
<td>24V</td>
<td>J300X</td>
<td>290 (17,7)</td>
<td>960 (58,5)</td>
<td>3000 (183)</td>
<td>60</td>
<td>2.5-12 A</td>
</tr>
<tr>
<td>RPU3</td>
<td>24V</td>
<td>J3000X</td>
<td>370 (22,4)</td>
<td>1700 (103)</td>
<td>3800/5000 (232/305)</td>
<td>40</td>
<td>7-22 A</td>
</tr>
<tr>
<td>RPU1</td>
<td>12V</td>
<td>J3000X</td>
<td>140 (8,5)</td>
<td>600 (36,6)</td>
<td>1400/2000 (120/185)</td>
<td>40</td>
<td>7-22 A</td>
</tr>
</tbody>
</table>

Steering gear interface: Hydraulic plumbing
## LINEAR DRIVE UNITS

<table>
<thead>
<tr>
<th>MODEL</th>
<th>MOTOR VOLTS</th>
<th>JUNCTION UNIT</th>
<th>MAX STROKE mm (in.)</th>
<th>PEAK THRUST kg (lb.)</th>
<th>MAX RUDDER TORQUE Nm (lb.in.)</th>
<th>HARD-OVER TIME sec. (30% load)</th>
<th>PWR. CON-SUMP.</th>
<th>TILLER ARM mm (in.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MLD200</td>
<td>12V</td>
<td>J3000X</td>
<td>300 (11.8)</td>
<td>200 (440)</td>
<td>490 (4350)</td>
<td>15</td>
<td>1.5-6 A</td>
<td>263 (10.4)</td>
</tr>
<tr>
<td>HLD350</td>
<td>12V</td>
<td>J3000X</td>
<td>200 (7.9)</td>
<td>350 (770)</td>
<td>610 (5400)</td>
<td>12</td>
<td>2.5-8 A</td>
<td>175 (6.9)</td>
</tr>
<tr>
<td>HLD2000L</td>
<td>12V</td>
<td>J300X</td>
<td>340 (13.4)</td>
<td>500 (1100)</td>
<td>1460 (12850)</td>
<td>19</td>
<td>3-10 A</td>
<td>298 (11.7)</td>
</tr>
<tr>
<td>HLD2000D</td>
<td>24V</td>
<td>J300X</td>
<td>200 (7.9)</td>
<td>1050 (2310)</td>
<td>1800 (15900)</td>
<td>11</td>
<td>3-10 A</td>
<td>175 (6.9)</td>
</tr>
<tr>
<td>HLD2000LD</td>
<td>24V</td>
<td>J300X</td>
<td>340 (13.4)</td>
<td>1050 (2310)</td>
<td>3180 (28000)</td>
<td>19</td>
<td>3-10 A</td>
<td>298 (11.7)</td>
</tr>
<tr>
<td>MSD50*</td>
<td>12V</td>
<td>J3000X</td>
<td>190 (7.5)</td>
<td>60 (132)</td>
<td>–</td>
<td>15</td>
<td>0.8-2 A</td>
<td>–</td>
</tr>
</tbody>
</table>

Steering gear interface: Connects to quadrant or tiller.

* For stern drive power assisted steering only.

1. The motor voltage is stepped down by the junction unit when operating from 24V or 32V mains (except for RPU1 and RPU3).

2. The specified junction unit is necessary to achieve max drive unit capacity.

3. Recommended operational thrust or torque is 70% of listed value.

4. Typical average power consumption is 40% of listed maximum value.
<table>
<thead>
<tr>
<th>Model</th>
<th>Motor voltage</th>
<th>Junction unit</th>
<th>Drive output</th>
<th>Interface to steering gear</th>
</tr>
</thead>
<tbody>
<tr>
<td>RPU100, RPU150, (Reversible hydraulic pump)</td>
<td>12V</td>
<td>J300X</td>
<td>Proportional rate</td>
<td>Hydraulic plumbing</td>
</tr>
<tr>
<td>MRD100 (Reversible mechanical drive)</td>
<td>12V 24V</td>
<td>J300X</td>
<td>12V to clutch 24V to clutch Proportional rate to motor</td>
<td>Chain/ sprockets</td>
</tr>
<tr>
<td>MRD150</td>
<td>12V 32V</td>
<td>J300X</td>
<td>12V to clutch 32V to clutch Proportional rate to motor</td>
<td>Chain/ sprockets</td>
</tr>
</tbody>
</table>

**Note!**

When selecting **DRIVE UNIT** voltage in the Installation setup, the clutch/bypass voltage is always set equal to the motor voltage. If a retrofit installation where e.g. a HLD2000 has a 12V motor and a 24V bypass valve, the bypass valve solenoid has to be changed back to standard 12V version.

**Connecting a reversible pump**

![Connecting a reversible pump](image)

*Figure 4-5  Connecting a reversible pump*
Connecting a hydraulic linear drive

![Diagram of hydraulic linear drive connection]

Figure 4-6   Connecting a hydraulic linear drive

Connecting a solenoid valve

![Diagram of solenoid valve connection]

Figure 4-7   Connecting a solenoid valve
4.11 Control unit installation

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 white protection cover when not used.

Panel mounting of AP22

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

- Drill the 4 mounting holes and make a panel cut-out according to supplied template.
- Place one of the three supplied gaskets between the panel and the unit with the interlocking feature correctly orientated (see figure).
- Use the supplied screws to fasten the control unit to the panel. Do not overtighten the mounting screws!
- Apply the front panel corners.
- Connect the Robnet cable(s) to the control unit connector(s) (See note on page 66).

Alternative panel mounting of AP22

Note!

This way of mounting is simpler, but will lift the unit from the panel surface. When installed adjacent to Simrad MarineLine equipment there will be a difference in height between the autopilot and the instruments.

- Use the template and drill hole(s) only for the connectors.
- Place all three gaskets between panel and unit with the interlocking feature correctly orientated (see figure).
- Follow above panel mounting instructions.
Do not overtighten the mounting screws!
Optional bracket mounting of AP22

- Locate the cradle on the mounting site and mark the 4 holes for the fixing screws on the mounting surface.
- Drill the 4 mounting 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 to best viewing angle.
- Connect the Robnet cable(s) to the control unit connector(s) (See note on page 66).

![Figure 4-8 AP22 Bracket mounting (D2-208570)](image)

4.12 ROBNET network cables

As Robnet units have two Robnet connectors they can be used as "jack points" 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 length and provided with 6 pin male connector at one or both ends. The 15 m cable to the junction unit has connector only at the control unit end.

Optional extension cable (10 m) is available and has a male and a female connector.
When installing a system, try to minimize total Robnet cable length by connecting all Robnet units to the nearest available Robnet connector.

Total length of Robnet cable installed in a system should not exceed 50 m (165”).

Examples of interconnecting Robnet units:

![Interconnecting Robnet units diagram](image)

**Figure 4-9 Interconnecting Robnet units**

All connectors are crimp type. These can be easily disassembled, if desired for easy of installation.

See table for pin configuration and colour code of the network cable. DO NOT MIX THE PINS AND THE CABLE COLORS!

**Note!**

*Apply a thin layer of pure Vaseline on the connector threads and make sure the connectors are properly secured to the receptacle by the coupling ring. The connectors are weather proof according to IP56, when properly installed. All unused Robnet plugs must be fitted with the plastic cap to keep the connector free from dirt and moisture. A separate screw cap for the Control unit comes as part of the installation kit.*

<table>
<thead>
<tr>
<th>Cable pairs</th>
<th>Color code</th>
<th>Pin</th>
<th>Signal</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. pair</td>
<td>Pink</td>
<td>5</td>
<td>V SYSTEM+</td>
</tr>
<tr>
<td></td>
<td>Grey</td>
<td>4</td>
<td>V SYSTEM–</td>
</tr>
<tr>
<td>2. pair</td>
<td>Brown</td>
<td>1</td>
<td>Bus–</td>
</tr>
<tr>
<td></td>
<td>White</td>
<td>2</td>
<td>Bus+</td>
</tr>
<tr>
<td>3. pair</td>
<td>Yellow</td>
<td>3</td>
<td>On - Off</td>
</tr>
<tr>
<td></td>
<td>Green</td>
<td>6</td>
<td>ALARM</td>
</tr>
</tbody>
</table>

**VIEWED FROM CABLE SIDE**
HOW TO REMOVE PINS:

Extraction tool

Insert tool in slot

Pull the wire

Note! For installations that require special cable length, contact your Simrad distributor for information.

4.13 Control unit connection

AP22 connection

AP21 connection

If the AP21 control unit is part of the system, use the Robnet connector in a free receptacle (see Figure 4-9). Alternatively cut the connector from the cable and connect the wires in parallel with the cable shown on Figure 4-10 using the same colour code.
Note! The AP21 cable contains an air-breathing tube. Check that the tube is open after you have cut the cable.

**JP21 Jack Point installation**

The JP21 can be used in conjunction with the AP21 control units. It provides a quick and simple means of connection/disconnection of the AP21 at different locations on the boat.

The JP21 includes a watertight connector cover which must be installed as shown. A 32 mm (1.26” dia.) hole needs to 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. Also apply a thin layer of Vaseline on the O-ring seal.

![JP21 Mounting Diagram](image)

*Figure 4-11 JP21 mounting*
4.14 RFC35 Fluxgate Compass installation

Figure 4-12
RFC35 mounting

The heading sensor is the most important part of the autopilot system and great care should be taken when deciding the mounting location. As the heading is displayed on the Control Unit, the heading sensor can be mounted at a remote location.

Note!
An autopilot fluxgate compass or magnetic compass should not be installed on the fly bridge or in the mast.

The RFC35 compass can be mounted on deck or bulkhead, athwartship or alongship. The heading offset feature in the autopilot will compensate for the mechanical offsets that may be a result of the selected location and orientation of the RFC35.

If the RFC35 is deck or bulkhead mounted athwartship with the cable gland pointing aft, little if any offset correction is required. With the cable gland pointing forward a 180° correction is required.

When mounting RFC35 on a bulkhead alongship, a +90° or –90° correction is needed dependent on whether it is port or starboard bulkhead.

Note!
Offset correction is performed after the calibration (see paragraph 4.33).

Find a location that provides a solid mounting place free from vibration, and as close to the vessel's centre 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 (min. 2 meters), engine ignition cables, other large metal objects and particularly the drive unit.
Use the supplied mounting kit and drill the holes through the centre of the slots in the sensor or the mounting brackets.

**Note !**

_The compass face plate on the RFC35 is the TOP. Never mount it upside down! Level the sensor as close to horizontal as possible._

![Diagram of RFC35 connection](image)

* RFC35 FLUXGATE COMPASS

* JUNCTION UNIT

* MAIN PCB

* NON POLARIZED

* COLOR INDEPENDENT

**Figure 4-13 RFC35 connection**

- Select RFC = J300X in the Installation Interface Set-up
- Select RFC as compass in the User Set-up menu

### 4.15 RFC35R Rate Compass installation

The RFC35R Rate Compass also contains a magnetic fluxgate sensor, which means you have to take the same precautions at installation as for the standard RFC35 (see previous page). On steel hull boats, however, it should be installed 0.75-1 meter (2.5-3 feet) above the steel deck to obtain optimum performance.

- Connect the Robnet connector to the AP22 Control Unit (or CI300X or NI300X if installed).

![Diagram of RFC35R connection to autopilot control unit](image)

* RFC35R RATE COMPASS

* AP20 (AP22, AP35, AP300X)

**Figure 4-14 RFC35R connection to autopilot control unit**
• 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 wire, but secure them from connection to the terminal or chassis.

![Diagram of connection](image)

*Figure 4-15 Alternative connection to J3XX Robnet terminal*

• Select RFC = ROBNET in the Interface Menu.
• Select RFC as compass in the User Setup Menu.
• Perform the compass calibration as described on page 101

**Note!** After turn on the compass will stabilize in less than 30 seconds, but it will need another 10 minutes to get the full effect of the rate sensor.

Refer to page 102 to compensate for any permanent off-set after the calibration is completed.

RFC35R calibration and offset data is stored in the compass and will not be deleted by a Master Reset in the autopilot.
4.16  **R3000X Remote Control installation**

R3000X should be mounted in the supplied bracket that can be fixed by four mounting screws. The unit is weather proof and can be mounted outdoor.

![R3000X connection diagram](image-url)
4.17 S35 NFU Lever installation

The unit is mounted to bulkhead or panel by two screws from the front. The cable is connected to the junction unit according to Figure 4-17. Interchange the port and stbd wires to the screw terminals in the junction unit if necessary to make the direction of the lever movement coincide with the direction of the rudder movement.

The unit 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.

Figure 4-17 S35 connection
4.18 Interfacing

With the autopilot system there are several possibilities to connect to other equipment for data exchange:

1. J3000X includes a single NMEA input/output port.
2. J300X includes two NMEA input/output ports and Clock Data interface to Anritsu and Furuno radars.
3. The optional NI300X NMEA Interface (expansion) Unit with 4 additional NMEA input/output ports.

The NMEA output may also drive IS15 instruments directly.

The different connecting diagrams below illustrate the interface possibilities.

Note! See also Interface Settings, page 94.

4.19 Single NMEA input/output

![Diagram of Single NMEA Connection]

*Figure 4-18 Single NMEA connection*
4.20 Double NMEA input/output

![Diagram showing Double NMEA connection]

Figure 4-19 Double NMEA connection

4.21 Additional NMEA output on Port 2

(Applies for AP21&AP22 V1R2/J300X V1R8 onwards)

<table>
<thead>
<tr>
<th>Output signal</th>
<th>Output terminal</th>
<th>Output sentence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Continuous output of compass heading on 10 Hz (10x/sec.) NMEA format</td>
<td>Junction unit, Power PCB, NMEA2, TX2+, TX2−</td>
<td>HDT (True) or HDG (Magn.) depending on heading source.</td>
</tr>
</tbody>
</table>

4.22 NMEA Compass in

(Applies for AP21&AP22 V1R2/J300X V1R8 onwards)

![Diagram showing NMEA compass connection]

Figure 4-20 NMEA compass connection
4.23 **Radar Clock/Data**

![Diagram of Radar Clock/Data connection]

**Figure 4-21 Radar Clock/Data connection**

4.24 **IS15 Instrument installation**

For installation and operation of the IS15 instruments refer to separate manuals.

**NMEA In**

This connection will provide speed, depth and temperature input to the autopilot. If an IS15 Wind Transducer is connected to the system, wind information will also be transferred to the autopilot.

The connection is made by a Roblink cable from the instrument NMEA socket (4) to the J3xx Junction Unit Main Board, Terminal RX1+ and RX1-. See **Figure 4-22**.

**NMEA Out**

This will provide the instrument system with heading data.

The connection is made by a Roblink cable from J3xx Junction Unit Main Board, terminal TX1+ and TX1– to the instrument NMEA socket (4). See **Figure 4-22**.

You will need a minimum of two instrument heads to make the system both ‘listen’ and ‘talk’ (I/O).

If IS15 Expander is used in the instrument system, the NMEA connections are made to this unit. See **Figure 4-23**.
Figure 4-22  IS15 Instruments / J3XX Connection

Figure 4-23  IS15 Expander / J3XX Connection
4.25 External Alarm

The external alarm circuit has an open collector output for an external alarm relay or buzzer. The operating voltage for the circuit is the main supply voltage. Max. load on external alarm output is 0.9 Amp.

![External alarm connection diagram]

Figure 4-24 External alarm connection

4.26 NI300X NMEA Interface Unit

The NI300X is normally installed inside a console or locker close to Nav receivers, radar and instruments to keep 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, 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 a location that provides ambient 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!

The NI300X NMEA Interface (expansion) Unit is designed to handle installations where more NMEA lines have to be tied into the system. Four NMEA ports are available. An additional output data-port with DATA/CLOCK signal is capable of generating heading data in the format used by some radar displays made by Anritsu and Furuno. This feature is thus added to the system if a
J3000X Junction Unit is installed (J3000X has no radar Clock/Data output as compared to J300X and J300X-40).

Configuration for Anritsu or Furuno is selected in the Installation Menu.

12V out can drive max. 2 IS15 instruments (max 250mA load), e.g. “Rudder” and “Compass”.

Figure 4-25 NI300X connection

The NMEA 1-4 ports are identical in HW and SW and can be connected as desired.
4.27 CI300X Analogue Interface Unit

The CI300X analogue interface unit is an optional module, designed to enable a variety of different equipment to connect into the autopilot systems. The CI300X converts the analogue inputs into Robnet compatible signals for use by autopilot system components. The CI300X adds the following capabilities to the autopilot system, and allows connection of each of the following simultaneously:

- Magnetic compass connection with CD100A course detector.
- Gyrocompass connection for Simrad RGC50, RGC10
- Analogue input of SIN/COS for either one of the following:
  - Fluxgate compass connection (for other manufacturers SIN/COS fluxgate compasses)
  - Analogue windvane (SIN/COS)

For detailed information, see separate CI300X Manual

**Note!**

*If an analogue wind vane is connected to the system via CI300X, the Interface setup must be set accordingly (see page 98). Furthermore a calibration must be performed. Access to the calibration display is automatic and follows the compass calibration (see page 101). The calibration procedure is similar to the compass calibration, but will normally take 3 full turns.*
4.28 LF3000 Linear Feedback

The rod of the LF3000 is not locked in place in the cylinder. If caution is not exercised it may slip out of its housing and end up over the side, so be careful!

The LF3000 is a waterproof feedback unit. It has a 300 mm (11.8") stroke and comes with a special mounting bracket which secures the LF3000 to the cylinder of the existing outboard drive unit.

The 8.5 m (28') cable is terminated in the LFI3000 Mk2 Linear Feedback Interface according to the wiring diagram.
Center the drives. Loosely secure the LF3000 to the supplied mounting bracket, across the center of the drive unit cylinder. Either cylinder may be used if there is a dual set up. You may mount the feedback in either direction, i.e. the shaft of LF3000 may point to port or starboard.

Loosen the end bolt (a) used to secure the cylinder to the drive unit mount. Insert the rod retaining assembly (b) (end plate) and retighten this bolt. Secure the feedback rod to the end plate using the two washers and cap nut provided. Adjust the location of the LF3000 Linear Feedback to allow full travel of the hydraulic cylinder without causing the endplate of the LF3000 hitting the end of the cylinder. Check that the outboard motor can be tilted freely. Tighten all nuts and the mounting bracket.

Turn the helm slowly by hand to the stops on either side, making sure that the rod does not bind up in any direction. Also, clamp cable to allow full engine movement to port and starboard. The mounting hardware provided with this system is meant to interface with Teleflex HC5340 cylinders and Hynautic K7 and K10 Cylinders. If you are attempting to interface to another system the hardware enclosed may not be appropriate!

Figure 4-27 LF3000 mounting
Note! The previous LFI3000 had no centre block terminal for screen termination.

4.29 CD100A Course Detector

On some installations the owner may prefer to use the boats own compass. The compass must be fully gimballed and have a flat surface underneath to fit the CD100A. Make hole for a 6 mm screw in the bottom of the compass and mount the CD100A as shown on the drawing. Secure the 6 mm screw through the centre hole of the CD100A. Make sure the cable does not prevent the compass from moving freely in the gimbals.

Note! Lock nut on mounting screw (pos. 1) for transportation only. To be removed before mounting.

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Screw M6x25mm, non magnetic</td>
</tr>
<tr>
<td>2</td>
<td>Washer, non magnetic</td>
</tr>
<tr>
<td>3</td>
<td>Course detector</td>
</tr>
<tr>
<td>4</td>
<td>Cable clamp, nylon</td>
</tr>
<tr>
<td>5</td>
<td>Washer, non magnetic</td>
</tr>
<tr>
<td>6</td>
<td>Screw M3x10mm, non magnetic</td>
</tr>
</tbody>
</table>
4.30 CDI35 Interface

Locate the CDI35 as close to the compass as possible so that there will be no problem finding it in the event of a service.

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

Cut the course detector cable to make a suitable length and connect both cables as shown on the diagram below.

![CDI35 Interface Diagram](image)

**Note:**
CD100 has a connector that has to be cut off the cable.
4.31 Software Setup Procedure

Description of Installation Settings

The design of the autopilot includes advanced features that have simplified the installation and setup of an autopilot. The principle advantage is that manual adjustments that needed to be done on previous models are no longer necessary with the AP21 and AP22.

Note!

*The installation settings must be performed as part of the installation of the autopilot system. Failure to correctly set the values in the installation settings may prohibit the autopilot from functioning properly!*

The Installation Settings are grouped into the following functional categories:

- **Language:** Selects language used for display information
- **Dockside Settings:** Items to be set prior to seatrials
- **Interface Setup:** Sets the identification of navigation and optional equipment connected to the autopilot system
- **Seatrial Settings:** Determines automatic calibrations and steering parameters
- **Parameters**
  - Permits viewing, setting or changing of steering parameters
- **NMEA test**
  - Loopback test menu to verify that the hardware is OK.
- **Master reset**
  - Master reset of memories.

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

Some important points regarding the installation settings values:

- When the autopilot is delivered new from the factory, (AND ANY TIME AFTER A MASTER RESET OF MEMORIES HAS BEEN PERFORMED) the Installation Settings are all reset to preset (default) values. The warning message "INSTALLATION SETUP REQUIRED" will appear at turn
on and if an attempt is made to access the AUTO or NAV modes prior to completion of setup.

- The Dockside, Interface and Seatrial settings can only be accessed when the system is in STBY mode.

- The values that are selected (also referred to as "PARAMETERS") from within the Installation Settings Menu, are stored in the memory of the autopilot system. No specific action is required to "SAVE" the selected values. Once the value is changed, it is stored until the next time the menu item is selected and changed.

- The Installation Settings except for the language are considered global, enabling values to be available to all control units in the system.

- The values in the Seatrial Settings are dependent on successful completion of the Dockside Settings.

Before attempting to turn on the autopilot and perform an Installation Setup, the hardware installation and electrical installation must be completed in accordance with the installation instructions.

**Installation Menu**

The Installation Menu (IM) is presented on the autopilot display by pressing and holding the NAV/SETUP push-button for 5 seconds. The below screen is the first display to be presented when the IM is accessed.

```
INSTALLATION
Language
English
```

*Note!*  The INSTALLATION MENU is different from the USER SETUP MENU. Refer to flow diagram on the next page for a pictorial view of the Installation Menu.
Figure 4-31 Installation menu
There are several actions that you can do once you have accessed
the IM:

- Answer YES to the question by rotating the course knob
clockwise.

- Change the highlighted item by rotating the course knob.

- Proceed to the next item in the menu by pressing the STBD
push-button. (Proceeding to the next item when presented with
a question is the same as answering NO to the question.)

- Proceed back to the previous item in the menu by pressing the
PORT button.

- Leave the Installation Menu by selecting STBY, AUTO, or
NAV.

On new installations, and whenever a control unit, junction unit,
or software is replaced in the autopilot system, it is
recommended that a MASTER RESET be performed as
described in the IM prior to proceeding with the setup procedure.

When using the Installation Menu refer to the "Installation
Menu" diagram on previous page.

**Language selection**

The autopilot can present the display in eight different languages:

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

To access the language selection in the IM:

1. Select Language by pressing and holding the NAV/SETUP
push-button for 5 seconds.

2. Turn the course knob to select the language you wish to use.

3. Leave the Installation Menu by a press on the STBY button, or
continue to next item in the menu by pressing STBD button.
4.32 **Dockside settings**

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

- Boat type
- Drive Unit voltage
- Rudder Feedback calibration
- Automatic Rudder test
- Transition Speed

In addition the Dockside Menu display will show:

- Drive output
- Clutch/bypass verification

Select STBY mode and enter the IM as previously described. Select "Dockside" by pressing STBD [>] button.

```
INSTALLATION
Dockside
```

Confirm by rotating the course knob.

```
Boat type
Planing
Drive unit
voltage
```

Actual boat type is selected by turning the course knob. The options are: Displacement, Planing, Sail.

Type of boat will affect the steering parameters, and the functions available in the autopilot system. Select appropriate boat type and press STBD [>] button.
Drive unit voltage selection

This menu option requires the installer to set the drive unit voltage to the correct level. The selections are 12V, 24V or 32V (32V only with J300X/J300X-40) and should be set to the voltage specified for your drive unit.

Note! Selection of 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.

Refer to the drive unit table on page 60 for information. It is not possible to select a higher voltage than the input voltage. The CLUTCH/BYPASS voltage is automatically set to the same as the drive unit voltage. In Rudder Test, the autopilot system will automatically detect whether the drive unit is a reversible motor or solenoid operated.

<table>
<thead>
<tr>
<th>Boat type</th>
<th>Planing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drive unit voltage</td>
<td>---</td>
</tr>
</tbody>
</table>

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 next menu item by pressing STBD [>] button.

Rudder Feedback Calibration

Make sure the RF300 is installed and aligned as pr. instruction in section 4.6 (or eventually section 4.28 for LF3000). This function enables you to compensate for any non-linearity in the transmission between the rudder and the rudder feedback.

Rudder feedbk calibration

Confirm by rotating the course knob clockwise.
The display will show with the rudder in mid position:

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

The value shown on the display is the value read by the rudder feedback unit before any adjustment is made. If the actual rudder angle is different from that of the display, correct the reading on the display by turning the course knob clockwise to increase the value or counter clockwise to decrease the value.

**Note !** If the rudder feedback unit is mounted upside down, the displayed rudder angle will be to the opposite side before you start the adjustment.

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.

**Note !** If you are not making any adjustment to the display readout (i.e. not turning the course knob), the AP20 will set a (default) value of 45° to each side in order to get full deflection on the display. If the real rudder deflection is less than ±20°, make sure the Rudder Limit (which default is 20°) is set 2°-3° less to avoid the rudder hit the end stops.

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

**Note !** Rudder zero may still not be accurate but will be adjusted later during sea trial.
Proceed to next menu item by pressing STBD [>] button.

**Automatic Rudder Test**

Note!

*Bring the rudder manually to midship position before starting the test. It is important also that if the boat uses power assisted steering, that the engine or electric motor used to enable the power assist steering be 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 autopilot will after a couple of seconds issue a series of PORT and STBD rudder commands and automatically verify correct motor direction, and reduce the rudder speed if it exceeds the maximum acceptable speed for autopilot operation.

When test is finished the display will read:

<table>
<thead>
<tr>
<th>Motor OK</th>
<th>Rudder test</th>
</tr>
</thead>
<tbody>
<tr>
<td>P 00 S</td>
<td></td>
</tr>
</tbody>
</table>

If the drive unit has a clutch or bypass, “NOT” will be excluded.

**Test of LF3000/LFI3000 Mk2 feedback**

1. Align engines to centre position; “zero rudder”.

2. Rev engines to 3-4000 rev/min and observe the rudder angle indicator on the autopilot, a 2° change in the reading should be accepted.

3. If the rudder angle exceeds 2°, connect the screen on the TB1 cable to the centre block terminal and repeat item 2 (See
Proceed to next menu item by pressing STBD [>] button.

**Transition Speed**

The transition speed is the speed where the autopilot will automatically change the steering parameter set from HI speed to LO speed parameters, or vice versa.

The default setting of transition speed is zero, which requires that steering parameter selection be done manually. If a GPS, Loran, or external speed log input from the instrument system is connected the transition speed must be set to a value greater than 0, to enable the automatic speed selection feature in the autopilot.

It is recommended that you set the transition speed to a speed that represents the speed where the hull begins to plane, or where you would manually change the parameters from HI to LO.

The speed used for the automatic transition is obtained as follows:

1. Data from the source set for the INSTR channel in the interface setup. If this is a valid source of VHW (speed through the water) data, then this data is used to change the HI-LO parameter sets.

2. If VHW data is not available from the INSTR channel or if the INSTR channel is not selected as source, the autopilot will use the speed data obtained from the VTG (speed over ground) sentence received from the currently selected POS source.

If no speed data is available, manual speed selection is required. The autopilot will always default to the HI speed steering parameters when the system is first turned on, or if there is a speed data failure.

If manual speed selection is used, the manual setting will override the automatic until the AUTO mode is re-selected.
Rotate the course dial clockwise until the transition speed is set to the desired value in knots.

Proceed to next menu item by pressing STBD [>] button.

**Interface Settings**

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

When your system includes connection of external equipment to the NMEA0183 data ports in Junction Unit or NI300X, or if the CI300X is installed with optional compass units or an optional analogue wind vane unit, they must be configured under 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 autopilot system.
<table>
<thead>
<tr>
<th>Abbreviated name</th>
<th>Equipment / Usage</th>
<th>NOTES</th>
</tr>
</thead>
<tbody>
<tr>
<td>GPS1</td>
<td>Primary GPS</td>
<td>Can be used as either NAV source or POS source. Also for VTG data for automatic.</td>
</tr>
<tr>
<td>GPS2</td>
<td>Backup GPS</td>
<td>AUTO HI/LO speed selection</td>
</tr>
<tr>
<td>LC 1</td>
<td>Primary Loran</td>
<td></td>
</tr>
<tr>
<td>LC 2</td>
<td>Backup Loran</td>
<td></td>
</tr>
<tr>
<td>NAV1</td>
<td>Chart plotter</td>
<td></td>
</tr>
<tr>
<td>NAV2</td>
<td>Other Nav source</td>
<td></td>
</tr>
<tr>
<td>INSTR</td>
<td>Source of data for instrument screens and automatic HI/LO parameter selection</td>
<td>Log input (VHW) for speed data has priority to SOG from GPS navigator.</td>
</tr>
<tr>
<td>RFC</td>
<td>For use when selecting between Simrad fluxgate compasses</td>
<td>RFC35 fluxgate compass is connected to junction unit. RFC35R rate compass is connected to Robnet.</td>
</tr>
<tr>
<td>MAGN</td>
<td>Magnetic compass with course detector (CD100A)</td>
<td>CDI35 +CD100A is connected to junction unit. CD100A only must be connected to CI300X.</td>
</tr>
<tr>
<td>FLUXG</td>
<td>For use with non-Simrad fluxgate compasses that output SIN/COS</td>
<td>Optional CI300X item.</td>
</tr>
<tr>
<td>GYRO</td>
<td>For use with Simrad RGC50, RGC10 gyro (1:1 synchro output)</td>
<td>Optional CI300X item. True data displayed for heading, COG and bearing to waypoint</td>
</tr>
<tr>
<td>NMEA</td>
<td>For use with NMEA compasses</td>
<td>Gyro, THD or other</td>
</tr>
<tr>
<td></td>
<td>(Applies for AP21&amp;AP22 V1R3/J300X V1R8 onwards)</td>
<td></td>
</tr>
<tr>
<td>Output INSTR</td>
<td>For high speed NMEA output of compass heading</td>
<td>HDM or HDT output increased from 1 to 5 times/sec. on TX1 port</td>
</tr>
<tr>
<td>Output RADAR</td>
<td>Clock/data heading output to radars</td>
<td>Selectable between Anritsu and Furuno. (On both J300X and NI300X)</td>
</tr>
</tbody>
</table>

Note! If using J300X, TX2 outputs HDT or HDG at 10 Hz.
**Interface setup - input signal**

<table>
<thead>
<tr>
<th>Setup item (abbrev. name)</th>
<th>Equipment connected</th>
<th>Hardware port terminal (use one available from list)</th>
<th>Hardware port to be assigned (* = default setting)</th>
</tr>
</thead>
<tbody>
<tr>
<td>GPS1</td>
<td>Not connected</td>
<td>J3XX, Main PCB NMEA I/P RX1+,RX1–</td>
<td>J300X-1 * (on J3000X)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>J300X, Power PCB NMEA I/P RX2+,RX2–</td>
<td>J300X-2 * (on J300X and J300X-40)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NI300X, NMEA port #1</td>
<td>NI300-1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NI300X, NMEA port #2</td>
<td>NI300-2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NI300X, NMEA port #3</td>
<td>NI300-3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NI300X, NMEA port #4</td>
<td>NI300-4</td>
</tr>
<tr>
<td>GPS2</td>
<td>Not connected</td>
<td>J300X, Main PCB NMEA I/P RX1+,RX1–</td>
<td>J300X-1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>J300X, Power PCB NMEA I/P RX2+,RX2–</td>
<td>J300X-2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NI300X, NMEA port #1</td>
<td>NI300-1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NI300X, NMEA port #2</td>
<td>NI300-2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NI300X, NMEA port #3</td>
<td>NI300-3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NI300X, NMEA port #4</td>
<td>NI300-4</td>
</tr>
<tr>
<td>LC1</td>
<td>Not connected</td>
<td>J3XX, Main PCB NMEA I/P RX1+,RX1–</td>
<td>J300X-1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>J300X, Power PCB NMEA I/P RX2+,RX2–</td>
<td>J300X-2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NI300X, NMEA port #1</td>
<td>NI300-1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NI300X, NMEA port #2</td>
<td>NI300-2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NI300X, NMEA port #3</td>
<td>NI300-3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NI300X, NMEA port #4</td>
<td>NI300-4</td>
</tr>
<tr>
<td>LC2</td>
<td>Not connected</td>
<td>J300X, Main PCB NMEA I/P RX1+,RX1–</td>
<td>J300X-1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>J300X, Power PCB NMEA I/P RX2+,RX2–</td>
<td>J300X-2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NI300X, NMEA port #1</td>
<td>NI300-1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NI300X, NMEA port #2</td>
<td>NI300-2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NI300X, NMEA port #3</td>
<td>NI300-3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NI300X, NMEA port #4</td>
<td>NI300-4</td>
</tr>
<tr>
<td>NAV1</td>
<td>Not connected</td>
<td>J3XX, Main PCB NMEA I/P RX1+,RX1–</td>
<td>J300X-1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>J300X, Power PCB NMEA I/P RX2+,RX2–</td>
<td>J300X-2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NI300X, NMEA port #1</td>
<td>NI300-1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NI300X, NMEA port #2</td>
<td>NI300-2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NI300X, NMEA port #3</td>
<td>NI300-3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NI300X, NMEA port #4</td>
<td>NI300-4</td>
</tr>
</tbody>
</table>

J3XX = All junction unit models
J300X also includes J300X-40
## Installation

<table>
<thead>
<tr>
<th>Setup item (abbrev. name)</th>
<th>Equipment connected</th>
<th>Hardware port terminal (use one available from list)</th>
<th>Hardware port to be assigned (* = default setting)</th>
</tr>
</thead>
<tbody>
<tr>
<td>NAV2</td>
<td>Not connected</td>
<td>J300X, Main PCB NMEA I/P RX1+, RX1–</td>
<td>J300X-1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>J300X, Power PCB NMEA I/P RX2+, RX2–</td>
<td>J300X-2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NI300X, NMEA port #1</td>
<td>NI300-1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NI300X, NMEA port #2</td>
<td>NI300-2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NI300X, NMEA port #3</td>
<td>NI300-3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NI300X, NMEA port #4</td>
<td>NI300-4</td>
</tr>
<tr>
<td>INSTR</td>
<td>Not connected</td>
<td>J3XX, Main PCB NMEA I/P RX1+, RX1–</td>
<td>J300X-1*</td>
</tr>
<tr>
<td>WIND</td>
<td></td>
<td>J300X, Power PCB NMEA I/P RX2+, RX2–</td>
<td>J300X-2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NI300X, NMEA port #1</td>
<td>NI300-1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NI300X, NMEA port #2</td>
<td>NI300-2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NI300X, NMEA port #3</td>
<td>NI300-3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NI300X, NMEA port #4</td>
<td>NI300-4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CI300X, sin/cos/Gnd</td>
<td>CI300X</td>
</tr>
<tr>
<td>RFC</td>
<td>Not connected</td>
<td>RFC35 Junction unit: HS+, HS–</td>
<td>J300X</td>
</tr>
<tr>
<td></td>
<td></td>
<td>RFC35R Connection to ROBNET</td>
<td>ROBNET * (V1R3/V1R8 Onwards)</td>
</tr>
<tr>
<td>MAGN</td>
<td>Not connected</td>
<td>CDI35+CD100A Junction unit: HS+, HS–</td>
<td>J300X</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CD100A CI300X Magn. Comp. terminal</td>
<td>CI300X</td>
</tr>
<tr>
<td>FLUXG</td>
<td>Not connected</td>
<td>CDI300X Analogue terminal</td>
<td>CI300X</td>
</tr>
<tr>
<td>GYRO</td>
<td>Not connected</td>
<td>RGC50, RGC10 CI300X Gyro terminal</td>
<td>CI300X</td>
</tr>
<tr>
<td>NMEA</td>
<td>NMEA compass</td>
<td>J300X, Power PCB, NMEA I/P RX2+, RX2–</td>
<td>J300X-2</td>
</tr>
</tbody>
</table>

**J3XX = All junction unit models**

### Interface setup - Output signal

<table>
<thead>
<tr>
<th>Setup item</th>
<th>Output signal</th>
<th>Output terminal</th>
<th>Select output (* = default setting)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output INSTR</td>
<td>High speed NMEA output of compass heading</td>
<td>Junction unit Main PCB, NMEA, TX1+, TX1–</td>
<td>J300X-1 * 5x/second – 1x/second</td>
</tr>
<tr>
<td>Output RADAR</td>
<td>Clock/data heading output to radars</td>
<td>J300X Power PCB, TB9</td>
<td>Anritsu * Furuno</td>
</tr>
</tbody>
</table>

**Note 1** The standard NMEA output rate is 1x/second. When Output INSTR is set to J300X-1 (default), the output port, TX1, will have an output rate of 5x/sec. for HDG or HDT (heading) messages. The RSA (rudder angle) message is always 5x/sec.
Note 2

NMEA OUTPUT 2 on J300X has a constant output rate of 10x/sec. for HDG or HDT. 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.

The Interface Menu presents these names so that they can be assigned to a hardware input or output port. Each abbreviated name is then presented in appropriate locations of the USER SETUP MENU to provide the user with choices of data sources, or identified to the autopilot where to look for various types of data.

When you assign a hardware port to an abbreviated name, you are simply telling the autopilot system that when the user chooses an abbreviated name as a data source it should look to the hardware port assigned to the abbreviated name for data.

• Step to the Interface part of the Installation Menu.

The following display will be presented:

```
INSTALLATION
Interface
```

To access the Interface Setup items, turn the course knob clockwise.

The display will show:

```
Input
GPS1    -------
GPS2    -------
LC 1    -------
```

Abbreviated name       Assigned HW port

Assign a hardware port to the name by turning the course knob until the hardware port is displayed along with the name.

Proceed to the names on the list that shall be assigned by pressing STBD [>] button. Select appropriate hardware ports by turning the course knob, or exit from menu by stepping through the list of names by pushing STBD [>] button.
Installation

Note!
At the completion of the Interface Setup, the names of items that you have assigned hardware ports to will be available as sources of data for NAV (navigation), POS (position) and COMPASS in the USER SETUP MENU. It is recommended that you access the User Setup Menu directly after completing the Interface Setup to select the desired data. Refer to page 33 for details on changing the items in the User Setup Menu.

Output

INSTR J300X-1
5/sec
Radar -------

Abbreviated name
Assigned HW port

Note!
The standard NMEA output rate is 1/second. However, in this autopilot the RSA (rudder angle) sentence is always 5/sec. When Output INSTR is set to J300X-1 (default), the TX1 (output) port, will increase the output rate to 5/sec. for the HDM or HDT (heading) sentences and no other sentences but RSA will be transmitted from the TX1 port. The output rate may be changed to 1/second by rotating the course knob. In that case there is no limitation to the sentences transmitted from TX1.
4.33 Sea Trial

The Sea-trial menu can only be accessed if the Dockside Settings are done and confirmed. It is also recommended that the Interface Setup be performed prior to Seatrial settings.

The following are the seatrial settings:

- Rudder zero adjust (To tell the autopilot the precise midships position of the rudder)
- Compass calibration (To automatically compensate for onboard magnetic Deviation)
- Compass Offset (To offset the final compass heading readout)
- Automatic tuning (An optional method of determining the steering parameters)

Advance through the IM until the following display is presented:

![INSTALLATION Seatrial]

Confirm by rotating the course dial Clockwise.

Rudder zero adjust

![Set rudder zero P02]

The adjustment should be made in calm sea and side forces from wind or current should be avoided.

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

The display will then show:

```
Set rudder zero
Confirmed 00
```

Press STBD [>] to proceed to next menu item.

**Compass calibration**

This function will activate the automatic compass calibration procedure.

*Note!* If an optional magnetic compass is installed and connected to a CI300X, or if a GYRO compass, or other manufacturers fluxgate is connected to a CI300X, it is still required to perform the automatic compass calibration in order to calibrate the CI300X Interface/input signal.

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

The calibration should be done in calm sea conditions and with minimal wind to obtain good results. Use about 45-60 seconds to make a full circle.

```
RFC compass calibration
```

1. Begin turning the boat to starboard (can also turn to port).
2. Start compass calibration by turning the course knob clockwise. The display will flash “calibrating”.
3. When the calibration is completed, (after having completed approximately 1 1/4 turns), it will be confirmed by the display reading “confirmed”.

If the compass is close to disturbing magnetic objects, the compass calibration may fail, and the display will show:

![RFC compass Failed]

Try a second calibration. If it still fails, move the compass to a better location and re-calibrate.

After calibration, check the compass readout against a known reference, other compass or leading line. If the reading is correct (±3°) except for a fixed offset, proceed to next menu item by pressing STBD [>] button.

**Compass Offset**

*Note! Offset correction is always performed after the calibration.*

The compass OFFSET feature allows you to correct for a constant compass heading offset that may be present as a result of the compass being installed with a lubber line offset or 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. (For multiple heading sensor offset procedure, refer to separate CI300X manual).

The following display is presented when accessing the COMPASS OFFSET screen:

![Compass Offset 000° Heading 345°]

Dial in the correction by turning the course knob to offset the compass heading to agree with a known heading or bearing. The offset value can be either positive or negative.

*Note! If an OFFSET still exists after having accounted for the mechanical offset, one of the following problems may still exist:*

- The heading reference that you are comparing the compass is not accurate.
• The automatic calibration obtained by the compass is not correct, and may be due to a large magnetic influence near the compass (a relocation may be needed) or too much waves during calibration.

Proceed to the AUTOTUNE function by pressing the STBD [>] button, or return to STBY mode.

**Automatic tuning**

AUTOTUNE is a dynamic function that enables the autopilot system to automatically set up the two main steering parameters (Rudder, Counter Rudder) for the boat. The scaling factors of the parameters are also set automatically as a function of the boat type selection performed in the Dockside menu.

**Note !**

*Autotune is an optional procedure that is not required for the autopilot to function. The autopilot is preset with steering parameters that should steer most boats in the 30 - 80 foot range and Autotune is not needed if the preset parameters steer your boat satisfactory.*

Recommended speed during Autotune varies with the type of boat, but should not exceed 10 knots. *Autotune 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 Autotune at about 5 knots).

The parameter values calculated during Autotune becomes the LO speed parameters. The HI speed parameters are automatically set to 66% of the LO.

If possible it is recommended to perform the Autotune steering East or West, as this will yield the best balanced parameters.

**WARNING !**

*The Autotune function will take control of the boat and perform a number of S-turns. It must always be performed in open waters with sufficient safe distance to other traffic. The Autotune function may take from 1 to 2 minutes to complete.*
Activate the AUTOTUNE, by rotating the course knob clockwise. The display will flash “Automatic tuning”.

After the Autotune has been completed the rudder must be controlled manually, as the mode is returned to STBY.

When the Autotune has been completed, there should normally be no need for further adjustments. On certain installations, however, you may want to "fine tune" the parameters after the Autotune due to the special steering characteristic of a specific boat. Viewing or changing the Autotune parameters are done from within the VIEW PARAMETERS menu item.

Exit the Seatrial menu by pushing STBD [>] button to proceed to the Parameters menu, or press STBY to return to normal autopilot operation.

**View parameters**

A boats steering parameters found by Autotune can be looked at and if needed changed under this menu item. The steering parameters can also be set manually instead of performing an Autotune. The parameters are divided into two sets:

- LO = Steering parameters for automatic steering at LO speed
- HI = Steering parameters for automatic steering at HI speed
Manual parameter adjust

<table>
<thead>
<tr>
<th>Displayed parameter</th>
<th>Boat type:</th>
<th>Own boat</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Displacement &amp; Sail</td>
<td>Planing</td>
</tr>
<tr>
<td>LOw speed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rudder LO</td>
<td>0.50</td>
<td>0.30</td>
</tr>
<tr>
<td>Cont Rudder LO</td>
<td>1.40</td>
<td>1.40</td>
</tr>
<tr>
<td>Autotrim LO</td>
<td>40 sec.</td>
<td>40 sec.</td>
</tr>
<tr>
<td>Rudder lim LO</td>
<td>20°</td>
<td>20°</td>
</tr>
<tr>
<td>High speed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rudder HI</td>
<td>0.35</td>
<td>0.20</td>
</tr>
<tr>
<td>Cont Rudder HI</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Autotrim HI</td>
<td>40 sec.</td>
<td>40 sec.</td>
</tr>
<tr>
<td>Rudder lim HI</td>
<td>20°</td>
<td>20°</td>
</tr>
</tbody>
</table>

Note!

The values in the table are factory set (default) and listed for information only. After having performed the Autotune, the values may differ from those listed in the table. It is recommended that you write down the parameters "learned" by the Autotune prior to making any adjustments.

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

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

- Too little rudder

- Too much rudder

- Too little Rudder and the autopilot fails to keep a steady course.
- Too much Rudder gives unstable steering and reduces speed.
- Low speed requires more rudder than high speed.

**Counter Rudder** is the parameter that counteracts the effect of the boat's turn rate and inertia. For a short time period it is superimposed on the normal rudder response as provided by the Rudder parameter. It may sometimes appear as if it tends to make the rudder move to the wrong side (counter rudder).

The best way of checking the value of the Counter Rudder setting is when making turns. The figures illustrate the effects of various Counter Rudder settings.

**Autotrim** standard value is 40 sec. which should work well on most boats.

**Rudder Limit** should be kept at 20 degrees unless there is a need for more rudder when performing dockside manoeuvres.

**Note!**

*In no event should the Rudder Limit be set to a value higher than the actual maximum rudder angle.*

Exit the Parameter menu by pressing STBD [>] button to proceed to the Display Units menu, or press STBY to return to normal autopilot operation.
**NMEA Test**

This menu item is for trouble shooting only. Do not pay attention to the readings on the display if the system interface is OK.

Proceed to the Master Reset menu by pressing the STBD [>] button, or press STBY to return to normal operation.

**Master Reset**

![Master Reset of memories]

**Note!**

A Master Reset is part of the final test at factory and will reset the memories to factory settings. Unless you need to clear all stored data during the installation setup procedure, you should not perform a Master Reset. Master reset will also clear the stored compass calibration data, except for the RFC35R Rate compass where data are stored in the compass.

The Master Reset needs a double confirmation to prevent an unwanted reset. To perform a Master Reset, rotate the course knob clockwise and observe the display; then rotate the course knob counter clockwise.

Exit the Installation Menu by pressing STBY to return to normal autopilot operation.

**Final sea trial**

After having completed all settings in the Installation Menu, take the boat out and perform a final sea trial in open waters with sufficient distance to 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 autopilot.
- Try the effect of LO and HI speed settings.
- If the hardware for automatic HI/LO speed selection is connected and configured, verify that the HI/LO transition is occurring, and the HI/LO parameters are changing after the
transition speed is crossed (by more than 1 Knot higher or lower speed).

- Try the Dodge function and the U-turn.
- If a Non-Follow Up lever (or handheld remote) is connected, test the mode switching and verify Port and Stbd steering commands of the lever.
- Set waypoints into each navigator connected to the system, and verify that the autopilot steers in NAV mode for each NAV source.
- If the boat is a sailboat use the WIND mode and try the autopilot at different settings of the apparent wind angle.
- Provide the owner with user training.

**Providing user training**

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

- Turning the system on and off
- Explain how to change 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 (bypass/clutch).
- How to take command at an "inactive" station if applicable.
- Lock mode and how to lock/unlock and how to shut the system down from a locked control unit if applicable.
- Show NFU and FU steering and explain the difference.
- Review how to use a NFU controller if connected.
- Course change by rotary knob and buttons.
- Go through the user SETUP menu and show how to (and why) change the settings.
- Also include Nav. source, Pos. source and Compass sensor selection if applicable.
- Show the owner where the compass (or compasses) is mounted and instruct him to keep magnetic items away.
- Show where the Mains circuit breaker is.
5 MAINTENANCE

5.1 Control unit

The AP21 and AP22 Control Units will under normal use require little maintenance.

If the unit requires any form of cleaning, use fresh water and a mild soap solution (not a detergent). It is important to avoid using chemical cleaners and hydrocarbons such as diesel, petrol etc.

Make sure that all open ROBNET connectors are fitted with a protection cap.

It is advisable at the start of each season to check all connections to the control unit head and cover with Vaseline or WD40. If the Control unit is not removed from the boat, it should be covered with the white protection cover.

5.2 Junction Unit

No special maintenance is required. It is advisable, however, at the start of each season to make a visual inspection of the internal and check all connections.

5.3 Rudder Feedback

Make a visual inspection at 2-3 month intervals and at the start of each season. Apply some grease at the ball joints when required (RF300)

5.4 Compass

If the compass is exposed to the weather, make a visual inspection at 2-3 months intervals, and at the start of each season.

5.5 Drive unit

Refer to the drive unit manual for maintenance instructions.
5.6 Exchange of software programme

Figure 5-1  J3000X/J300X/J300X-40 Main PC-Board

Figure 5-2  AP22 PCB, component layout
• Remove the PROM from the socket by means of the special extraction tool (p/n 44139806).

• Insert the tool by pressing the two grip pins down into the two slots in the corners of the socket.

• Squeeze the tool and pull out the PROM.

• When inserting new PROMS, make sure the cut-off corner matches with the one in the socket. Press it gently into the socket.
• The identification tag indicates:
  - Name of unit
  - Part number
  - Software version

**WARNING !** Make sure that the right PROM is mounted in the actual unit.

PROM for AP21 and AP22 Control Unit:
P/N 22085823

PROM for J300X, J300X-40 and J3000X Junction units: P/N 22081640

• After change of PROM, perform a master reset as described on page 107
6 TROUBLE SHOOTING

An autopilot is a complex system and the performance is dependent of a proper installation and a successful sea trial.

In the event of a failure, you will be helped by the autopilot software which contains several test features that will assist you in isolating a probable fault.

Audible and visual alarms are given in the event a fault is detected.

The audible alarm is reset by pressing any button (e.g. by changing mode from AUTO to STBY). The visual alarm will remain and alternate with the operating display until the fault has been rectified. Refer to the table below for hints and try to solve the problem yourself, or consult your nearest Simrad dealer for assistance.

Perform the repair action in the listed order.

6.1 Alarms

<table>
<thead>
<tr>
<th>Display readout</th>
<th>Probable fault</th>
<th>Recommended action</th>
</tr>
</thead>
<tbody>
<tr>
<td>System failure</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rudder feedback</td>
<td>Rudder feedback signal missing or erratic</td>
<td>1. Check all connections.</td>
</tr>
<tr>
<td>feedback failure (autopilot operates on simulated feedback)</td>
<td></td>
<td>2. Check the alignment as per the installation instructions</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3. Replace rudder feedback unit.</td>
</tr>
<tr>
<td>Rudder response failure</td>
<td>No response to rudder command.</td>
<td>1. Check all connections.</td>
</tr>
<tr>
<td>Rudder test too slow</td>
<td>Excessive load on steering gear. Air in hydraulic system. Insufficient drive unit capacity.</td>
<td>1. Look for mechanical obstructions at the rudder/tiller/quadrant. Check the back drive force.</td>
</tr>
<tr>
<td>Display readout</td>
<td>Probable fault</td>
<td>Recommended action</td>
</tr>
<tr>
<td>-----------------</td>
<td>--------------------------------------------------------------------------------</td>
<td>----------------------------------------------------------------------------------</td>
</tr>
</tbody>
</table>
| Rudder test failed | Following conditions may exist:  
  a) Rudder feedback failure  
  b) J3XX current overload  
  c) Bypass/clutch overload | Refer to recommended actions for the specific probable faults.                     |
| Rudder moves in one direction only  
  Poor connection to one of the solenoids (continuously running pump)  
  Faulty Power PCB in junction unit | a) Check connections  
  b) Replace PCB |                                                                    |
| Rudder test failed (cont’d)  
  Rudder test not completed within 2 min.  
  a) Poor connections to drive unit  
  b) Faulty Main PCB in junction unit  
  c) Faulty Power PCB in junction unit | a) Check connections  
  b) Replace PCB  
  c) Check PCB for traces of burnt transistors. – Change PCB. | Replace PCB |
| Rudder moves at full speed to one side.  
  a) Faulty Power PCB in junction unit | Replace PCB |
<table>
<thead>
<tr>
<th>Display readout</th>
<th>Probable fault</th>
<th>Recommended action</th>
</tr>
</thead>
</table>
| Compass data missing | No data from selected compass. | 1. If more that one compass is connected to the system, refer to the USER SETUP menu to select a different compass.  
2. Check connections/Interface menu.  
3. Replace compass PCB or interface PCB *(Note: Do not cut cables. The PCB contains screw terminals).* |
| Comm. failure active autopilot | Active control unit goes silent. | 1. Press STBY button on "Inactive" unit to reset.  
2. Check/repair Robnet cable.  
3. Replace control unit PCB. |
| J3XX current overload | Drive unit shut down due to excessive load or short circuit. | 1. Check Drive unit/Drive unit installation/Manual steering/Rudder  
2. Disconnect Drive unit. If fault is still present, replace junction unit Power PCB. |
| Low 15 volt | Internal 15 Volt supply in Junction Unit below limit. | 1. Replace junction unit Main PCB  
2. Replace junction unit Power PCB if Mains voltage is 12V. |
| Bypass/clutch overload | Clutch/bypass current exceeds 2.5 Amps (overload or short circuit). | 1. Check actual current  
2. Check voltage marking on coil  
3. Check coil resistance (through connecting wires) |
| Bypass/clutch disengaged | Poor connection or open circuit in bypass/clutch coil | 1. Check connections  
2. Replace bypass/clutch if open.  
3. Perform new "Rudder test". |
| J3XX high temp. | Excessive temperature in Junction Unit (>75°C), possible long term overload. | 1. Switch off autopilot  
2. Check for backload in Drive unit/steering system.  
3. Check that Junction unit specifications matches Drive unit. |
<table>
<thead>
<tr>
<th>Display readout</th>
<th>Probable fault</th>
<th>Recommended action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data failure J3XX</td>
<td>Wrong checksum on memory parameters or variables. Junction unit will use default values.</td>
<td>Perform a &quot;Master reset&quot; and make a new &quot;Dockside set-up&quot;. Switch off and on again. If the alarm is repeated, replace Junction unit Main PCB.</td>
</tr>
<tr>
<td>Com. failure with J3XX</td>
<td>Junction Unit faulty or possible poor connections in Robnet cable from same.</td>
<td>1. Check Robnet connectors and cable. 2. Replace Junction unit Main PCB.</td>
</tr>
<tr>
<td>Low supply voltage</td>
<td>Mains voltage less than 9 Volts</td>
<td>1. Verify by System Data Menu 2. Switch autopilot off, charge batteries 3. Check/repair battery charger</td>
</tr>
</tbody>
</table>
### Alarms in AUTO and NAV:

| The boat is off course | Extreme weather conditions, too slow speed. Boats heading is outside fixed off course limit of 20 deg. (Automatic reset when inside limit.) | 1. Check steering parameters (Rudder, Autotrim, Seastate-filter). 2. Increase Rudder value 3. Increase boat speed, if possible, or steer by hand. |

### Alarms in NAV

| NAV. data failure | Missing or invalid NAV data. | 1. Use NMEA Test Menu 2. Check Nav. receiver setup. |

### 6.2 System Data Menu

The menu is accessed from the User Set up Menu (page 33). It provides you with additional system data that can be useful when testing or trouble shooting the system.

To access the system data items, turn the course knob clockwise.
Compass heading readout
Rudder angle. Normally between zero and 45 degrees.

Steered course in Auto and Nav. mode.
Verifies if clutch or bypass valve has been activated when performing the rudder test.

Power to drive unit in percent of full (100%)
Supply voltage on input terminals.

Values set by the automatic seastate filter.
FC=Filter time constant in seconds.
Db=Deadband in degrees to each side of set course. Boat has to be outside db before autopilot responds.

6.3 NMEA Data Menu
The NMEA data menu is accessed from the User Set Up Menu the same way as for the System Data Menu (above). It provides
you with status information of the different NMEA sentences used in the system.

Decoding
The incoming signals are decoded according to a built in priority table.

Cross track and bearing information are taken from the NMEA sentences with highest priority.

One of the following codes will be displayed:

--- No data or no NMEA sentence containing the data needed is available at the input port.
OK Valid data found
INV Sentence with invalid information.
FRM Sentence has format failure such as
   a) Incorrect check sum
   b) Wrong contents in 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 (page 98)
• Check the navigator setup and make sure it is transmitting appropriate NMEA data.
• Perform a NMEA (hardware) test as per below.
NMEA signal monitor

Close to the NMEA terminals in the junction unit you will find a green LED marked “RX”. A flickering LED indicates that an NMEA signal is received. It does not, however, qualify the contents of the message.

**Note!**

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

NMEA (hardware) test

Access the NMEA Test from the INSTALLATION Menu (see page 86).

<table>
<thead>
<tr>
<th>INSTALLATION Loopback</th>
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</thead>
<tbody>
<tr>
<td>NMEA 1    FAIL</td>
</tr>
<tr>
<td>NMEA 2    OK</td>
</tr>
</tbody>
</table>

On the Main PCB in the junction unit disconnect the cables and connect TX1+ to RX1+ and TX1- to RX1-. Similar on the Power PCB connect the NMEA ports the same way; TX2+ to RX2+ and TX2– to RX2– (not available on J3000X).

Select the NMEA test menu and verify that the hardware is OK. If not, replace the corresponding PCB(s) to rectify.

**Note!**

*With J3XX software version V1R5 the display readout will not automatically reset to FAILED when you remove the TX/RX straps. You will have to turn the equipment off and back on again to reset.*
7 SPARE PARTS LIST

AP21 Control Unit
22086268 AP21 Control Unit
22086276 Mounting kit
22086169 AP21 Board Ass’y
22085823 PROM (programmed) V..R..
22086193 Back cover
22086250 AP21 Front Housing Ass’y
22086383 Cable with gasket

AP22 Control Unit
22085849 AP22 Control Unit
22085831 Standard mounting kit consisting of:
   22084529 Cabinet corners
   44162840 Cover for plug
   22085807 Gasket
   44165181 Screw 3.5x19
   44165645 Screw 3.5x32
22085872 Optional mounting bracket consisting of:
   44148906 Screw M4x12
   22084776 Right bracket
   22084784 Left bracket
   22084859 Locking knob
   22085880 Cradle
   44163145 Locking washer for left and right bracket
   44163160 Locking washer for cradle
22085765 AP22 Front Housing Ass’y
22085963 Back cover with gasket
22085682 AP22 Board Ass’y
22085799 Protection Cover
22085823 PROM (programmed) V..R..

Junction Units
22081830 J300X Junction unit
22081822 J3000X Junction unit
22081954 J300X-40 Junction unit
Simrad AP21 and AP22 Autopilots

22081707  J300X Installation accessories
22081855  J3000X Installation accessories
22081962  J300X-40 Installation accessories
22081251  J300X Power PCB Ass'y
22081715  J3000X Power PCB Ass'y
22081947  J300X-40 Power PCB Ass'y
22081285  J300X Main PCB Ass'y (All models)
22081640  PROM for all junction units
22081434  J300X/J3000X Base plate
22082036  J300X-40 Base plate
22081350  Main cover
22081368  Terminal cover

**RFC35 Electronic Fluxgate Compass**
22081459  RFC35 Fluxgate Compass
22081442  Installation accessories consisting of:
  20104972  Mounting plate (2)
  44140762  Screw 3.5x25 (2)
  44140770  Screw 30x9 (4)
  22081376  Plug (2)
22081178  RFC35 PCB Ass'y

**RFC35R Rate compass**
22082382  RFC35R Rate Compass
22081442  Installation accessories consisting of:
  20104972  Mounting plate (2)
  44140762  Screw 3.5x25 (2)
  44140770  Screw 30x9 (4)
  22081376  Plug (2)
22081178  RFC35 PCB Ass'y
22082374  RFC35R PCB Ass'y
22082440  Cable, 15 m with plug

**RF300 Rudder Feedback Unit**
20193462  RF300 Rudder Feedback
20193470  RF300 transmission lever
20193454  RF300 transmission link
  44133122  Transmission rod M5x325mm
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<th>Part Number</th>
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<td>RF300 Ball joint Ass'y (2)</td>
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<td>Compass Interface</td>
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<td>CI300X Compass Interface</td>
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<td>Cover nutknobs</td>
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<td>20191607</td>
<td>Robnet Cable 7m</td>
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<td>NI300X</td>
<td>NMEA Interface</td>
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<td>NI300X NMEA Interface</td>
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<td>Robnet cable 15 m (49&quot;) with one male connector</td>
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<td>Robnet cable 7m (23') with male connectors</td>
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<td>Robnet cable 15m (49') with male connectors</td>
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<tr>
<td>20192266</td>
<td>Robnet extension cable 10m (33') with male and female connector</td>
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<td>Robnet cable (bulk)</td>
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<td>22082697</td>
<td>Male connector - crimp type</td>
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<tr>
<td>22082705</td>
<td>Female connector - crimp type (for extension cable only)</td>
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<tr>
<td>Tools</td>
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<tr>
<td>44139707</td>
<td>Key for Lock ring on Robnet receptacles</td>
</tr>
<tr>
<td>44139806</td>
<td>Extraction tool for PROM</td>
</tr>
<tr>
<td>44161792</td>
<td>Robnet pin extraction tool (for crimp type connectors)</td>
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<tr>
<td>22086433</td>
<td>JP21 Jack Point</td>
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<tr>
<td>22086441</td>
<td>Connector cover</td>
</tr>
</tbody>
</table>
8 GLOSSARY

NMEA 0183 - A format (language) designed to permit communication between various types of marine electronic equipment. In essence this is a two-wire shielded, serial data link, permitting one device to talk while other devices listen. Numerous different sentences are available, permitting communication between various different devices.

GPS - Global Positioning System - This system consists of 18 satellites plus 3 spares in fixed orbits, circling the earth at an altitude of approximately 20,200 km. The system will provide the user with 24 hour a day all weather position coverage, with an accuracy of 15 to 100 meters.

Loran C - A complex radio navigation network developed by the US coast guard, to assist a navigator in determining his precise location. The acronym, Loran C, stands for Long Range Navigation. It is an all weather 24 hour a day electronic system of shore based radio transmitters.

Waypoint - A discrete point, stored in a navigator, located on the surface of the earth. Normally this point will be identified by Lat/Lon coordinates although in some systems it may be shown by T.D.’s. The AP300DLX has the capability of storing 98 waypoints.

Route - A stored sequence of waypoints. These waypoints will be listed in the order in which you desire to follow them. The AP300DLX permits the storage of up to 20 routes.

XTE - Cross Track Error - Used to identify a vessel’s position relative to a straight line drawn between two waypoints. The amount the vessel is off to the left or to the right of this line is known as the track. It is normally displayed in hundredths of a nautical mile, equal to 60 ft or 18.5 m.

BWW – Bearing waypoint to waypoint - Bearing angle of the line between the “TO” and the “FROM” waypoint, calculated at the “FROM” waypoint for any two arbitrary waypoints.
**BRG POS - WP** – Bearing to a specified waypoint from present position.

**SOG** - Speed over ground is the actual speed of the vessel relative to the ocean floor.

**COG - Course Over Ground** - The actual direction of progress of a vessel, between two points, with respect to the surface of the earth. The vessels heading may differ from the course over ground due to the effects of wind, tide, currents.

**Magnetic variation** - A magnetic compass points to the magnetic north pole. The difference between this direction and true north is the magnetic variation. The amount and direction of this variation is dependent upon where on the earth you are located.
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The above companies represent only main importers. Each country is in addition served by a network of local service outlets.

Some importers represent only specific market segments according to the following codes:
Professional: Coastal and Fishery market
Recreational: Leisure market

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