Yacht Devices

User Manual

NMEA 2000 Autopilot YDAP-04

Firmware version 1.04
Hardware version
1.00

2023

Contents

Package Contents

Device	1 pc.
This Manual	1 pc.

Introduction

YDAP-04 is a course computer that allows you to automatically steer a rudder-equipped vessel of up to 12 tons displacement (depending on the type of steering gear) equipped with a rudder. YDAP-04 requires data about the external environment, navigation and tracking data from the NMEA2000 network for normal operation. The boat must have a rudder drive unit with a clutch. Autopilot system diagram is shown in Appendix B.

Unlike autopilots from other manufacturers, YDAP-04 provides maximum compatibility with third-party equipment. It can be controlled using chartplotters from major manufacturers such as Raymarine, Simrad, B&G, Lowrance. In addition, the YDAP-04 can be used even if you don't have a chartplotter at all – by using the button control panel. Also, if you have any of our IP-based NMEA2000-to-PC gateways, such as YDWG-02, YDNR-02 or YDEN-02, you can control the autopilot directly from your PC, tablet or smartphone using the ready-to-use autopilot control panel in Web Gauges (virtual dashboard in your browser). You can also control the YDAP-04 using various navigation applications such as OpenCPN, iNavX, Expedition etc.

YDAP-04 can be used in Auto, Track and Wind modes. In Wind mode, you can easily change the tack with one click. The device supports leeway compensation, so you don't have to worry about drift breaking your course.

However, it should be noted that autopilot usage does not relieve you of your watch keeping responsibility. Like any other equipment, such as a radar, echo sounder or a chart plotter, autopilot is auxiliary equipment, facilitating the task of keeping watch, and not completely replacing a person.

YDAP-04 should be installed, calibrated and configured in accordance with "**Installation and commissioning**" manual.

Warranty and Technical Support

1. Device warranty is valid for two years from the purchase date. If the Device was purchased in a retail store, the sales receipt may be requested when applying for a warranty claim.

2. The Device warranty is terminated in case of violation of the instructions in this Manual, case integrity breach, or repair or modification of the Device without the manufacturer's written permission.

3. If a warranty request is accepted, the defective Device must be sent to the manufacturer.

4. The warranty liabilities include repair and/or replacement of the Device and do not include the cost of equipment installation and configuration nor shipping the defective Device to the manufacturer.

5. Responsibility of the manufacturer in case of any damage as a consequence of the Device operation or installation is limited to the Device cost.

6. The manufacturer is not responsible for any errors and inaccuracies in guides and instructions of other companies.

7. The Device requires no maintenance. The Device's case is non-dismountable.

8. In case of a fault or incorrect operation, please first refer to Appendix A before contacting technical support.

9. The manufacturer accepts applications under warranty and provides technical support only via e-mail or from authorized dealers.

10. Manufacturer's contact details and the list of authorized dealers are published on the website: http://www.yachtd.com/.

I. Product Specification

Table 1

Device parameter	Value	Unit
NMEA 2000 interface		
Supply voltage (via NMEA 2000 network)	7..16	V
Max. current consumption from NMEA2000 network	20	mA
Load equivalency number	1	LEN
Reverse polarity protection	YES	-
Galvanic isolation between NMEA 2000 and all other interfaces	2500	V_{RMS}
Drive / Clutch circuit		
Drive / Clutch circuit input voltage range — between BATTERY "+" and "– " (V bat)	7..29	V
MOTOR output max. allowed current (constant / peak)	10/16	A
CLUTCH output max. allowed current	10	A
BATTERY input current at STANDBY (no drive operation / clutch not engaged), not higher than	100	mA
Reverse polarity protection — BATTERY input	YES	-
Overcurrent protection	NO (use ext. fuse !)	-
User control interface circuits		
Button type / environment protection rating	Pushbutton with no latch / IP56..IP67	
Button output max. allowed voltage range (pushed/ not pushed) — LVTTL	0 / 3.3	V
External LED voltage / built-in current limiting resistor	3.3 / 200	V / Ohm
External alarm or buzzer supplied voltage / max. allowed current	Equal to V bat / 1	V / A

Screw hole Ø 4mm

Single-color status LEDs

Bi-color status LEDs

87 mm

57 mm

73 mm

38 mm
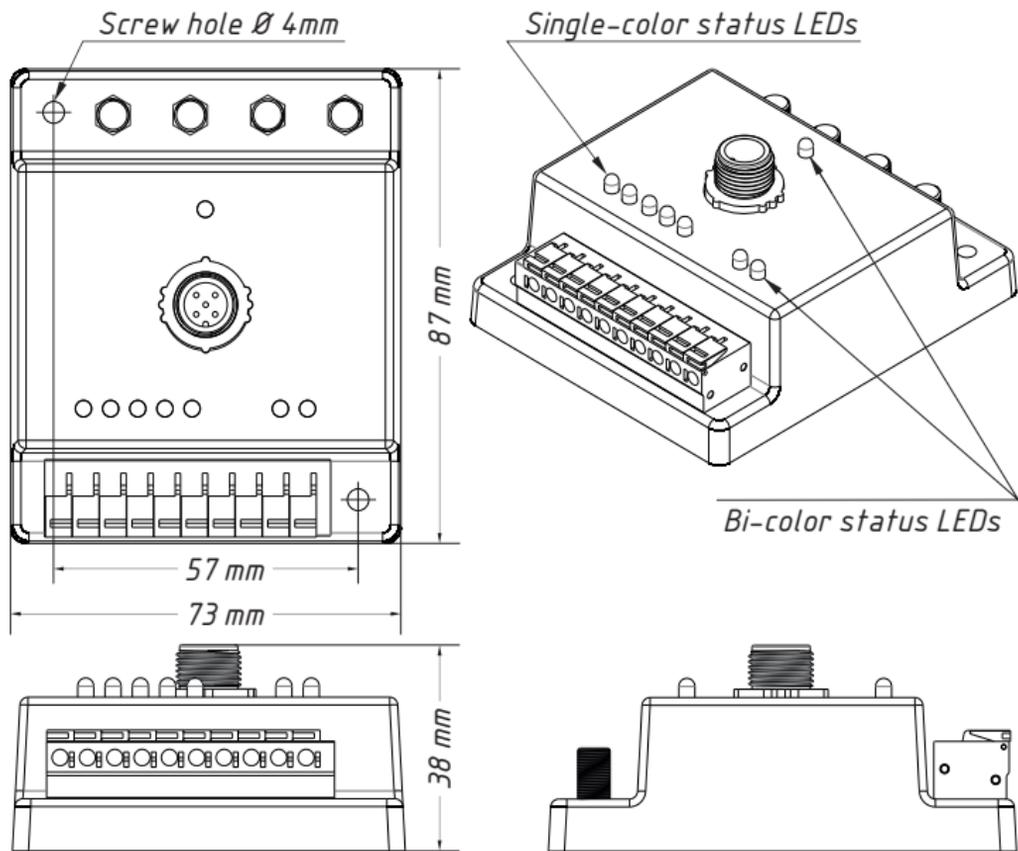
Figure 1. Drawing of YDAP-04 case with dimensions

II. Control Panel

Buttons

YDAP-04 has an external control panel (not supplied) with 5 function buttons, LED indicator and buzzer.

Table 2

Button	Functionality
STANDBY	Press to stop YDAP-04 operation and enter **STANDBY** mode. Hold "**STANDBY**" for 5 seconds in STANDBY mode to enter into the calibration menu.
AUTO	Press to put YDAP-04 into **AUTO** mode. Hold "AUTO" for 1 second to put the YDAP-04 into **WIND** mode; Pressing "AUTO" while holding "X10" will put the YDAP-04 into **TRACK** mode.
-1	Press to change the target course or wind angle by 1 degree counterclockwise. Pressing "-1" while holding "X10" will change the target heading/wind angle by 10 degrees. When pressed for 5 seconds, activates 90-degree counterclockwise turn (angle value can be changed using command YD:SHARP_TURN).
+1	Press to change the target course or wind angle by 1 degree clockwise. Pressing "+1" while holding "X10" will change the target heading/wind angle by 10 degrees. When pressed for 5 seconds, activates 90-degree clockwise turn (angle value can be changed using command YD:SHARP_TURN).
X10	Used in combination with other buttons. When pressed alone, resets the audible warning of a critical error. Single short press cancels active alarm.
+1 and -1	Hold "+1" and "-1" for 1 second to change tack in WIND mode.

External LED indicator

The External LED is the Autopilot mode indicator. It indicates the Device's current mode and is synchronized with the built-in "MODE" LED:

MODE	Sequence
STANDBY	One short (250msec) blink with very long pause
MENU	Long (500 msec) blink with long (500 msec) pause
AUTO	Series of two short (250 msec) blinks
TRACK	Series of one short (250 msec) and two very short blinks (100 msec)
WIND	Series of one (250 msec) short and one very short (100 msec) blinks
CALIBRATION	Very long (1 sec) blink with very long (1 sec) pause

External buzzer

Device should be equipped with external sounder (not supplied) to inform about alerts, mode changes and other events. Refer to Appendix A.

III. Indication

LED signals

Device has 8 integrated LEDs (5 single-color status/menu LEDs, and 3 bi-color LEDs), and one external LED can be connected.

5 single-color LEDs indicate when the connected buttons are pressed. They are also used for error status indication and menu navigation (refer to Appendix A).

3 bi-color LEDs show "NMEA2000", "MODE" and "DATA" status:

Table 4. NMEA2000LED indication

NMEA2000 LED	GREEN	RED
Flash #1	No errors on CAN bus	CAN bus error
Flash #2	"**AUTO**" mode can be activated	Not enough data for "AUTO" mode
Flash #3	"**WIND**" mode can be activated	Not enough data for "WIND" mode
Flash #4	"**TRACK**" mode can be activated	Not enough data for "TRACK" mode

"MODE" LED indication is synchronized with the external LED indicator, refer to Table 2.

Table 5. DATA LED indication

DATA LED	GREEN	RED
Flash #1	RUDDER received	No RUDDER
Flash #2	HEADING received	No HEADING
Flash #3	Magnetic variation received	No VARIATION
Flash #4	Speed through water received	No STW
Flash #5	COG & SOG received	No COG & SOG
Flash #6	WIND received	No WIND
Flash #7	WAYPOINT received	No WAYPOINT

Sound signals

In addition to LED indication, an external piezoelectric buzzer can be connected to the Device to inform about changes in the operating mode and critical errors. The table below lists the possible signals and its meaning. Error/Hazard alerts are described in Appendix A.

Table 6

Action		Signal
Manual target Heading change in AUTO mode Manual target Wind angle change in WIND mode Next waypoint confirmation in TRACK mode	SET SET CONFIRMED	● One short (100 ms) beep
Manual MODE change Automatic MODE change	CHANGED CHANGED	● ● Two short (50 ms) beeps
Manual target Heading change in AUTO mode Manual target Wind angle change in WIND mode MODE change	CAN NOT BE SET CAN NOT BE SET CAN NOT CHANGE MODE	— One long (300 ms) beep

Errors/alerts indication

Device allows compatibility for alerts messages with Raymarine MFDs via PGN 65288 "Seatalk: Alarm"and PGN 65361 "Seatalk: Silence Alarm".

When an alert is triggered by YDAP, MFD will display an alarm message, and YDAP will send audio and LED signals for 10 seconds (this duration can be changed using **YD:DURATION** command). The last active error/alert can be viewed with the **YD:ERR** command.

To mute the audible alarm, press the "X10" button, or close the alarm message on Raymarine MFD. To cancel this alert, press "Standby" (Autopilot will be switched to Standby mode).

IV. Operating Modes

You can select the operation mode using external control buttons.

Standby mode

In Standby mode Autopilot is disengaged and not control behavior of your vessel. This mode is used when you steer the boat at the helm.

To enter this mode, press "STANDBY" button shortly.

Auto mode

In Auto mode, Device sends commands to steer your vessel at a given course.

AUTO mode requires, as minimum, rudder angle and heading data. When the mode is activated, the current azimuth is set as the target and Device will take all necessary actions to maintain it.

To engage Autopilot, turn vessel to desired azimuth, and press the "AUTO" button briefly. Device will take control and maintain current heading. With COG&SOG data available, the autopilot will maintain COG (if **Leeway Compensation** is enabled).

If you want to turn left, say 15^0, press "-1" five times, then press and hold "X10" button, and press "-1" one more time. To turn right, use "+1" button instead "-1". To disable autopilot, press "STANDBY".

Press and hold for 5 seconds "+1"or "-1" button to execute "SHARP TURN" (sharp turn angle can be changed via setting YD:SHARP_TURN, default 90°)

Wind mode

Hold "AUTO" button for 1 second to enable "WIND" mode.

Wind Direction Assist (WIND) mode can be enabled only if rudder angle, heading, magnetic variation, and wind speed and direction are present in NMEA2000. In addition to this minimal data set, water speed or COG&SOG data can also be used to calculate the theoretical (true) wind vector and then average it. Theoretical wind vector averaging is necessary to minimize Device steering activity during short-term

changes in wind direction. If water speed and COG&SOG data are not available, the value specified in **"YD:SPEED_AVG"** is used to calculate the theoretical wind.

In this mode, "+1" and "-1" buttons can be used to change the target wind angle by 1 degree counterclockwise and clockwise respectively. By holding X10, the target wind angle will be changed by 10 degrees.

Hold for 1 sec "-1" and "+1" buttons simultaneously to turn to the opposite tack, while the target wind direction will be set similar to the previous tack. It is not possible to perform a turn into "Running", "into the wind" and "Beam reach" positions. When the ship is in the close-hauled position, the turn will be carried out through the "Into the wind" position, if the ship is in the "Broad reach" position, then the turn will be carried out through the "Running" position (see Figure 2). Press and hold "+1" or "-1" for 5 sec to perform tack in desired direction.

To tack to port or starboard in Wind mode, press and hold "-1" or "+1" for 5 seconds (refer to Figure 3). The autopilot will make an additional small angle turn (default 20 degrees, can be changed with the YD:OVERSHOOT command) and then return to the target angle.
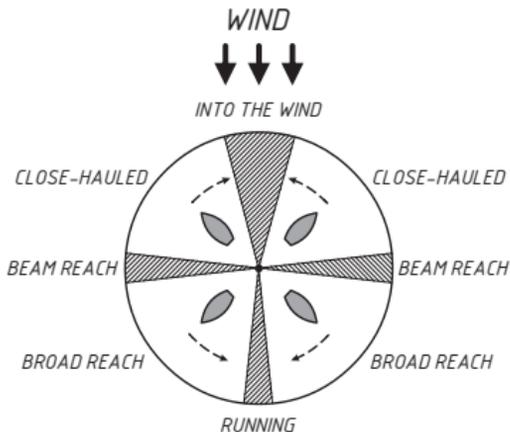
Figure 2. Tacking direction and restricted tacking/jibing angles.

Table 7

Position/course	Wind angle
Into the wind	$0° ± 11.25°$
Running downwind	$180° ± 5.625°$
Beam reach	$90° ± 5.625°$ or $270° ± 5.625°$

WIND

↓ ↓ ↓

Press "+1" and "-1"

To change tack
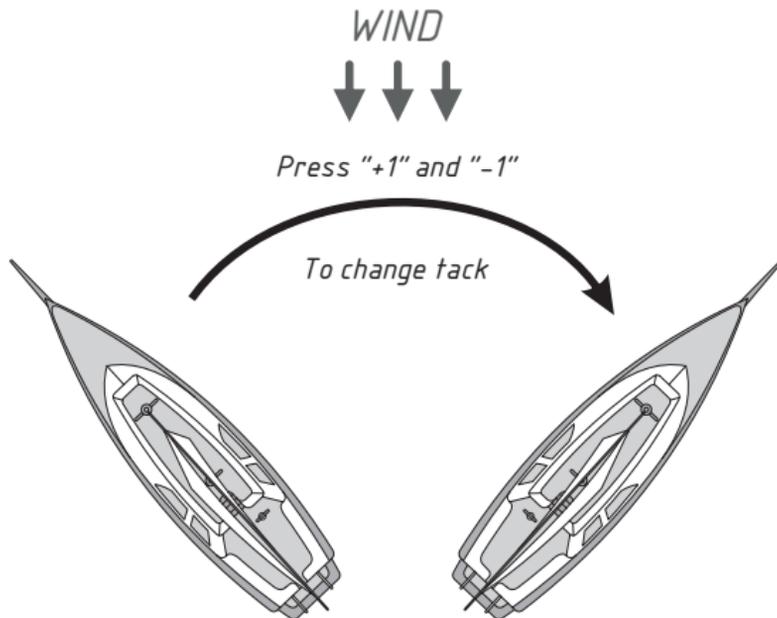
Figure 3. Tack change.

Track mode

Press and hold "x10" and then press "AUTO" to enable "Track" mode.

To use this mode, Autopilot should be connected to an external source of navigation information – such as a chart plotter, or a Navigation program running on a PC.

Rudder angle, magnetic variation, heading, COG&SOG, and current track data (Navigation Data and Cross Track Error) are minimally required to enable TRACK mode.

On the plotter screen, you need to create a route as a series of waypoints.

When the autopilot is on, it will steer the boat to or slightly ahead of the nearest waypoint to smooth out the boat's path.

To avoid sharp turns, line up your boat with the desired track before entering tracking mode. The "lookahead" distance can be changed with the "**YD:TRACK_MULT**" command to set smoother or sharper turns.

When a waypoint is reached, the Navigation System sends Autopilot the next set of navigation information – for the next waypoint – and Device then turns the boat to head to the next waypoint.

As Autopilot will turn automatically – without action from the user – at each waypoint, when planning the trip, it is crucial that the user verify that there will be sufficient room to execute the turn at each waypoint.

After the last waypoint will be reached, Device will be switched to AUTO mode, and Sound notification "Mode Change" will be activated.

Calibration mode

Calibration mode is intended to adjust your autopilot for optimal performance of your vessel. This includes rudder extreme positions calibration, automatic steering gear calibration, automatic calibration of vessel steering coefficients, and automatic compass deviation correction.

To enter calibration mode, press and hold "STANDBY" button for 5 seconds. To turn off calibration mode, press "STANDBY" or wait 10 seconds.

Leeway compensation

If your boat encounters a crosswind, and/or a tidal current, at some angle to the desired heading, it will be constantly moved away from that heading, in the direction of the wind or current. So, the autopilot will constantly be making course corrections as shown in Figure 4.

Leeway Compensation function uses the vessel's derived or calculated Set & Drift vector to adjust the target heading to minimize the effect of water current and wind gusts on the current course (COG). Drift compensation works in AUTO and TRACK modes. Leeway compensation can be enabled/disabled with the **"YD:LEEWAY"** command.

Heading, water speed and COG&SOG data are necessary for leeway compensation calculation.

If STW data is lost when autopilot is in AUTO or TRACK mode, leeway compensation calculation will be impossible. Autopilot will indicate a "SPEED LOST" error and switch to STANDBY mode to prevent abrupt manoeuvres.
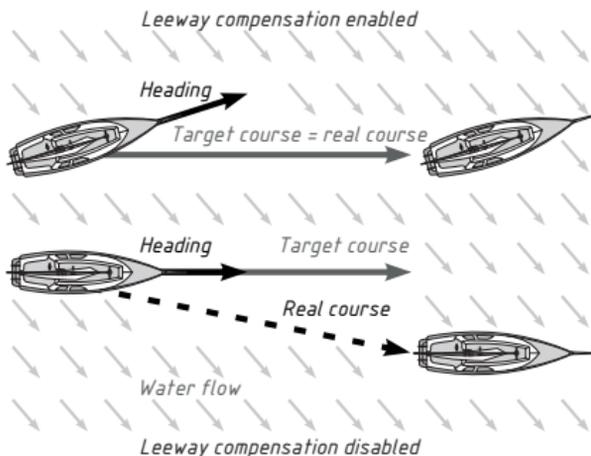
Figure 4. Leeway compensation.

V. Typical Usage Scenarios

Control via physical buttons
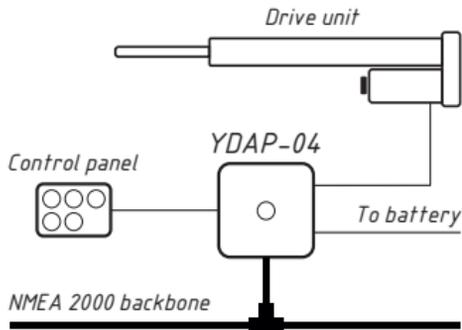
Figure 5. Autopilot control with physical buttons
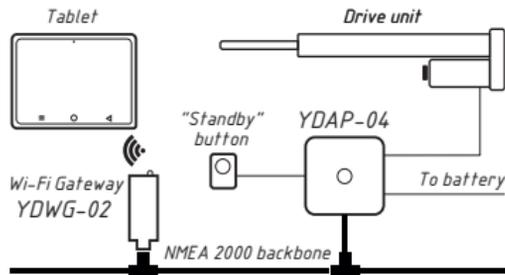
Figure 6. Autopilot control with Web Gauges

You can install the autopilot control panel with physical buttons directly connected to the autopilot as shown in Figure 5.

This method is suitable when the chartplotter does not allow autopilot control or it is not installed at all.

In this case, it is recommended to use YDAP-04 LED and audible indication.

Control via Web Gauges

Since Web Gauges provide more convenient autopilot control, you may install only the "**Standby**" physical button (refer to Figure 6). In this case, you need any IP-based gateway from Yacht Devices. A smartphone, tablet or PC must be connected to this gateway via a TCP/UDP connection. Then you can open in your browser **Web Gauges** page with a preconfigured page for autopilot control.

Autopilot calibration in this case can be done using YD gateway web interface, or via special command in the installation string with a third-party NMEA2000 gateway (for example, NGT-1).

Attention! Wireless autopilot control in heavy shipping areas is not recommended as the gateway signal may be jammed by more powerful WiFi devices. In this case, it is recommended to use physical buttons or a chartplotter.

Control via Raymarine or Simrad (Navico) MFD
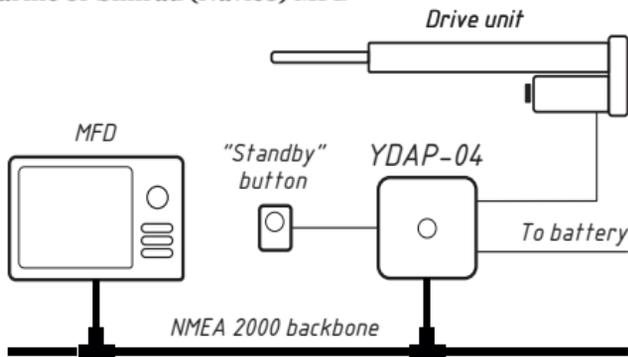
Figure 7. Autopilot control with MFD

YDAP-04 has an experimental integration mode with Raymarine and Simrad chartplotters, which allows you not only to control the autopilot, but also display notifications directly on the plotter screen.

In this case, it is also possible to install only a physical "**Standby**" button (refer to Figure 7). However, to calibrate YDAP-04, you will need to connect all buttons at least temporarily, or use any NMEA2000-to-PC gateway.

Raymarine AXIOM chart plotters with Lighthouse 3 or Lighthouse 4 can be used in TRACK, AUTO and WIND modes. To enable Raymarine support in YDAP configuration, enter "**YD:RAYMARINE ON**" into YDAP installation string.

Navico chart plotters (Simrad, B&G, Lowrance brands) can be used in AUTO, WIND, TRACK modes. To enable Navico support, enter "**YD:SIMRAD ON**" into the YDAP installation string.

AP control in this case is similar to that of the Raymarine/Simrad autopilot. Refer to the user manual for your chartplotter for the details.

All three methods can be combined. — 19 —

VI. Digital Switching and CZone Support

Digital Switching

YDAP-04 can be controlled over NMEA2000 using PGNs 127501" Binary Status Report" and 127502 "Switch Bank Control".

Autopilot uses 12 channels (switches) in one bank. The bank number can be set with the command **YD: BANK [1].**

Table 8

Channel number	Channel name	Description
1	STANDBY	Enable STANDBY mode
2	AUTO	Enable AUTO mode
3	WIND	Enable WIND mode
4	TRACK	Enable TRACK mode
5	-1	Change target heading/wind angle by 1 degree counterclockwise
6	+1	Change target heading/wind angle by 1 degree clockwise
7	-10	Change target heading/wind angle by 10 degrees counterclockwise
8	+10	Change target heading/wind angle by 10 degrees clockwise
9	TACK	Tack change in WIND mode
10	DISMISS ALARM	Audible alarm muting
11	TACK PORT	Attempt to change tack on port side
12	TACK STARBOARD	Attempt to change tack on starboard side

It is prohibited to use the autopilot with other Digital Switching devices with the same bank number.

CZone support

You can control autopilot from most modern chart plotters with CZone support. This includes Simrad, Lowrance, B&G chart plotters and recent Raymarine MFD with Lighthouse 3 and newer.

You need to do the following:

1. Visit the product's page on our website and follow the link to related article.

2. Fill the forms on this page and download a personalized configuration file for your MFD.

3. Import the configuration file to the MFD (usually, from MicroSD card).

VII. Integration with Marine Applications

YDAP-04 can be controlled via various navigation applications. Most of such applications use serial or IP connection (TCP or UDP) for data transfer, and NMEA0183 protocol, so you will need NMEA2000-to-PC gateway with NMEA0183 protocol support.

To control autopilot over NMEA0183 protocol, the app should at least send APB, RMB and XTE sentences. Please check that your application can do this.

Figure 8. Autopilot control page in Web Gauges

Note that with this control method, only TRACK and GO TO WAYPOINT modes will be available.

To get around this limitation, we have added autopilot support to the built-in Web gauges in our IP-based NMEA2000-to-PC gateways - YDEN-02, YDWG-02, and YDNR-02. Autopilot support is available since 1.70 FW version.

Web Gauges allow full support for YDAP-04 - it can be used in TRACK, WIND, AUTO modes.

You can make your own custom page to make autopilot control more convenient.

Appendix A. Error/Hazard Alerts
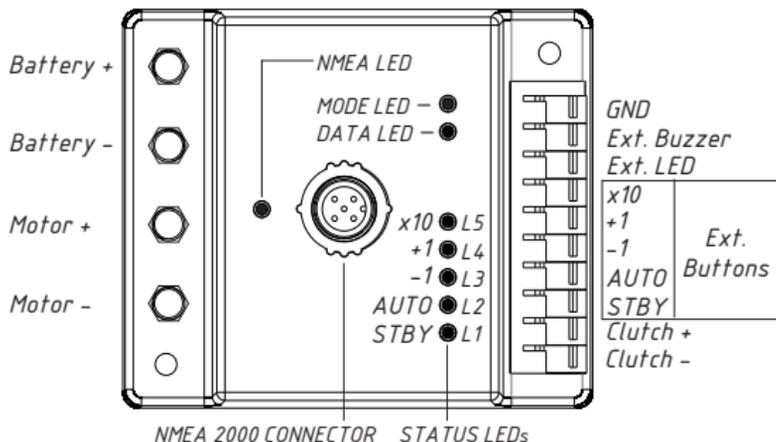
Figure 9. YDAP-04 Inputs / Outputs and signal LEDs diagram

Table 1

Name	Sound indication	Mode switched to	Seatalk Alarm ID	Status LEDs indication					Description
				L1	L2	L3	L4	L5	
Rudder lost	●	STANDBY	61	●	○	○	○	○	Rudder angle data lost during autopilot operation.
Rudder wrong direction	— ●	STANDBY	40	○	●	○	○	○	Incorrect rudder polarity.

— 23 —

Name	Sound indication	Mode switched to	Seatalk Alarm ID	Status LEDs indication					Description
				L1	L2	L3	L4	L5	
Rudder stall	● ●	STANDBY	30	●	●	○	○	○	Rudder does not move.
Overcurrent	— — ●	STANDBY	72	○	○	●	○	○	Steering current too high.
Battery low	● — ●	STANDBY	22	●	○	●	○	○	Low battery voltage (< 11V).
Compass lost	— ●●	STANDBY	46	○	●	●	○	○	Lost heading data.
Wind lost	● ● ●	AUTO	51	—	—	—	—	—	Lost wind data.
Track lost	— — — ●	AUTO	58	—	—	—	—	—	Lost track data.
Too slow	No signal	No mode change	45	●	○	○	●	○	Vessel speed too low.

Name	Sound indication	Mode switched to	Seatalk Alarm ID	L1	L2	L3	L4	L5	Description
Speed lost	— • — •	STANDBY	52	○	●	○	●	○	Lost water speed data.
COG or SOG lost	•• — •	STANDBY	43	●	●	○	●	○	Lost course over ground or speed over ground.
Large XTE	— — — — •	No mode change	70	—	—	—	—	—	Distance to track exceeds specified value more than 20 seconds. Ignored when moving to waypoint.
Off-heading	• — — — •	No mode change	69	—	—	—	—	—	Current vessel azimuth differs from the target by more the specified angle for more than 20 seconds.
Shallow water	— • — •	No mode change		—	—	—	—	—	Current water depth under transducer less than specified value more than 3 seconds.
"Learn Stops" failed	•••••	STANDBY	62	○	○	●	●	○	Failed to calibrate rudder blade extreme positions. Try again.
"Learn Rudder" failed	•••••	STANDBY	63	●	○	●	●	○	Rudder auto calibration failed. Try again.

Name	Sound indication	Mode switched to	Seatalk Alarm ID	Status LEDs indication					Description
				L1	L2	L3	L4	L5	
"Learn Vessel" failed	● ● ● ● ●	STANDBY	64	○	●	●	●	○	Failed to automatically calibrate the ship control coefficients. Try again.
"Learn Compass" failed	● ● ● ● ●	STANDBY	65	●	●	●	●	○	Failed to automatically calculate the compass deviation relative to the ship's centerline. Try again.
"Wind shift"	● ● — — ●	No mode change	71	—	—	—	—	—	Current wind angle differs from the target by more than the specified in settings angle within 3 seconds.
Unknown	—	STANDBY	—	●	●	●	●	●	Unknown internal error.

Appendix B. System Diagram

YDAP-04 unit is powered from a DC power distribution panel via Battery input, controlled by DIY Control Panel via control panel interface connected by a shielded cable and from a NMEA 2000 ECDIS solution that provides GNSS and TRACK data. Device outputs DC voltage on Motor interface that drives Rudder Drive mechanism. Rudder Drive is connected via mechanical linkage to the Rudder and DC-controlled Clutch mechanism that decouples Drive from Rudder to allow manual Rudder control. YDAP-04 gets Rudder position form NMEA 2000 Rudder angle sensor, Heading (HDG) data from NMEA 2000 Compass or Gyro, Speed Through Water (STW) from NMEA 2000 water speed transducer.
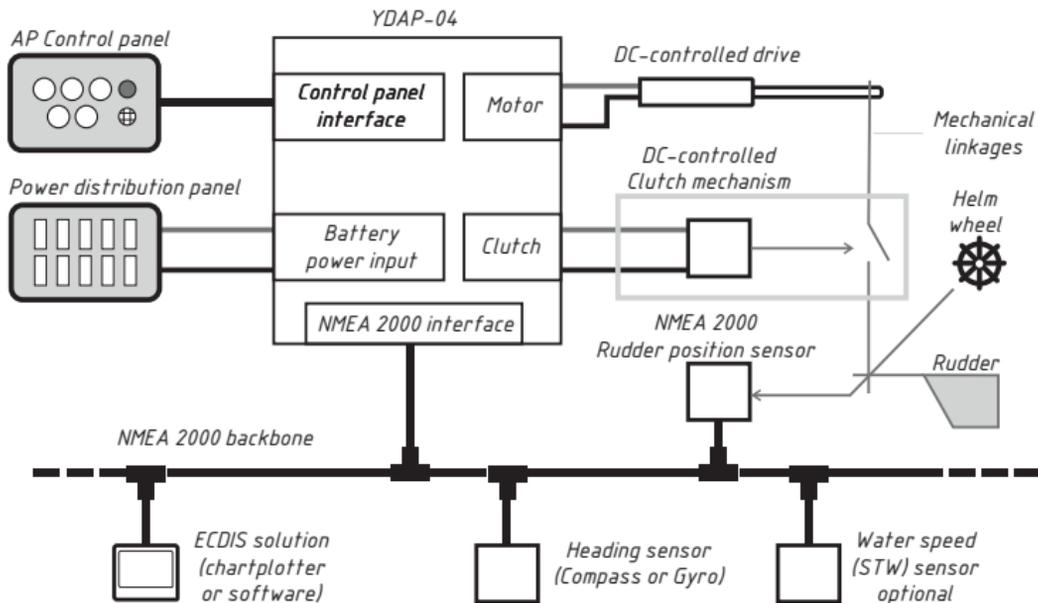
Figure 10. Autopilot System diagram