Yacht Devices

Installation and Commissioning Manual

NMEA 2000 Autopilot YDAP-04

Firmware version 1.04

Hardware revision 1.00

2023

Package Contents

Device (YDAP-04 Autopilot Computer unit with integrated high-power DC Motor output)	1 pc.
This Manual	1 pc.
Control Panel and buttons	Not supplied (needs DIY Control Panel)
External alarm/buzzer and LED	Not supplied
NMEA 2000 cable	Not supplied
External Drive unit	Not supplied (needs third-party Drive unit to be installed on the boat first)
External Rudder Feedback unit	Not supplied (needs our YDRA-01 unit or third-party NMEA 2000 Rudder Feedback unit to be installed)

Yacht Devices Autopilot YDAP-04 is certified by the National Marine Electronics Association.

Contents

Important information

Warning: **Autopilot installation**

Autopilot steering is crucial for safety, therefore, it is highly recommended to have a certified NMEA 2000 installer handle the installation and commissioning of the Device.

Warning: **Maintain permanent watch**

Always maintain a permanent watch during Autopilot operation. Failure to do so poses a serious risk to you, your vessel, and other passengers and crew on board.

Warning: **Ensure safe navigation**

Autopilot is intended solely as a navigation aid and cannot replace the skills of a human operator.
Use current official government charts and notices to mariners (NOTAMs) to ensure safety.
Ensure the crew receives adequate training and is familiar with the proper operation of the whole Autopilot system.
Follow Standard Operating Procedures (SOPs) and Quick Reference Handbook (QRH) promptly and accurately.

Warning: **Potential ignition source**

Device is not approved for use in flammable atmospheres.
Do not install the Device in areas such as the engine room or near fuel tanks.

Disclaimer

Yacht Devices Ltd makes no guarantee that the Device is without errors or that it will be fully compatible with third-party products.

Yacht Devices Ltd is not liable for any damages or injuries resulting from your use (or inability to use) of the Device, including instances where Device malfunction is caused by interaction with other NMEA 2000 equipment.

Conformity

Yacht Devices Ltd attests that this product fulfills the indispensable stipulations of EMC directive 2004/108/EC.
Yacht Devices Autopilot YDAP-04 is certified by the National Marine Electronics Association.

IMO and SOLAS

Device is designed for use on recreational marine vessels and workboats that are not subject to International Maritime Organization (IMO) and Safety of Life at Sea (SOLAS) Carriage Regulations.

Disposal

Dispose of this product in compliance with the WEEE Directive or local regulations. Do not dispose of it with household or industrial waste.

Supplementary Documentation

This manual provides instructions for installation, commissioning, maintenance, and troubleshooting of YDAP-04 unit.

The Device's User Manual is a separate document that covers basic Device operation.

The Device's Standard Operating Procedures (SOP) and Quick Reference Handbook (QRH) are separate, editable documents you should use as a template and adapt for your particular installation.

You can download latest version of all those documents at:

https://www.yachtd.com/downloads/

You should modify the SOP and QRH to suit the specific boat construction and handling details, current Device Control Panel implementation, installed equipment, and local maritime laws and regulations.

Produce sufficient copies of the SOP and distribute them to each crew member authorized and trained to operate the Autopilot. Ensure there is a hard copy of the SOP on board for the crew to refer to at all times.

Laminate and print a copy of the Quick Reference Handbook (QRH) and ensure it is readily available to the autopilot operator for swift and appropriate action.

Maintain SOP and QRH well.

Ensure that both physical copies consistently reflect the current Device Control Panel construction, Device firmware and hardware version, and adhere to all applicable maritime and local laws and restrictions.

Any alterations made to the system must also be reflected in updated SOP and QRH hard-copies.

Introduction

This manual provides instructions for installing, commissioning, configuring, and operating the Yacht Devices NMEA 2000 Autopilot YDAP-04 (also referred to as the Device or Autopilot).

The Device is a single-box NMEA 2000 Autopilot Computer with a built-in high-power (12...24 Volt 16 Amperes) full-bridge DC output and is equipped with a digital Control Panel input/output interface.

The Device is intended for use on pleasure craft with a displacement of between 0.3 and 12 metric tons.

Please note that the Device may experience instability in close proximity to Earth's geodesic and magnetic poles.

Device can perform:

- GOTO and TRACK navigation in TRACK mode, guided by a generic NMEA 2000 ECDIS/EIS solution. This may be achieved with a chartplotter, MFD, or software ECS/ECDIS solution that sends standard NMEA 2000 AP control PGNs 129284 "Navigation Data" and 129283 "Cross Track Error".
- Steering at constant Heading or COG (AUTO mode) or Wind angle (WIND mode).

To steer the boat's Rudder, the Device needs to use an external DC Motor or Drive that is linked mechanically to the Rudder. The Drive unit should incorporate Clutch mechanisms to connect and disconnect the Drive from the Rudder using DC current signal.

The Device does not have an internal compass and should receive Heading information from the NMEA 2000 sensor. Additionally, the Device lacks analog Rudder Feedback input and should receive Rudder angle information from the NMEA 2000 sensor. For WIND mode, the Device must receive Wind data from the NMEA 2000 sensors.

Device has five external button inputs, one external LED output, and one Buzzer alarm output. A simple DIY Control Panel matching the vessel design must be created and integrated. The Control Panel schematic is straightforward and requires only easily available materials and components, providing ultimate customization capability.

Thank you for choosing our Autopilot, and we wish you bon voyage!

Warranty and Technical Support

1. The Device's warranty is valid for two years from the date of purchase. If the Device was bought at a retail store, you may need to provide the sales receipt when filing a warranty claim.

2. The warranty on the unit is void if the instructions in this manual are not followed, if the unit's enclosure is compromised, or if the unit is repaired or modified without the written consent of the manufacturer.

3. If a warranty claim is approved, the faulty Device must be shipped to the manufacturer.

4. Our warranty covers the cost of repairing or replacing your Device, but does not include expenses related to equipment installation, Device configuration, or shipping the defective product to the manufacturer.

5. The manufacturer's responsibility in the event of any damage resulting from the operation or installation of the Device is limited to the cost of the Device.

6. The manufacturer assumes no responsibility for errors or inaccuracies in guides and instructions provided by other companies.

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

8. Please refer to Appendix A before calling for Technical Support in the event of a malfunction or incorrect operation of the Device.

9. The manufacturer provides technical support for warranty claims only via e-mail or through authorized dealers.

10. The manufacturer's contact information and a list of authorized dealers can be found on the web site: https://www.yachtd.com/

I. Product Specifications

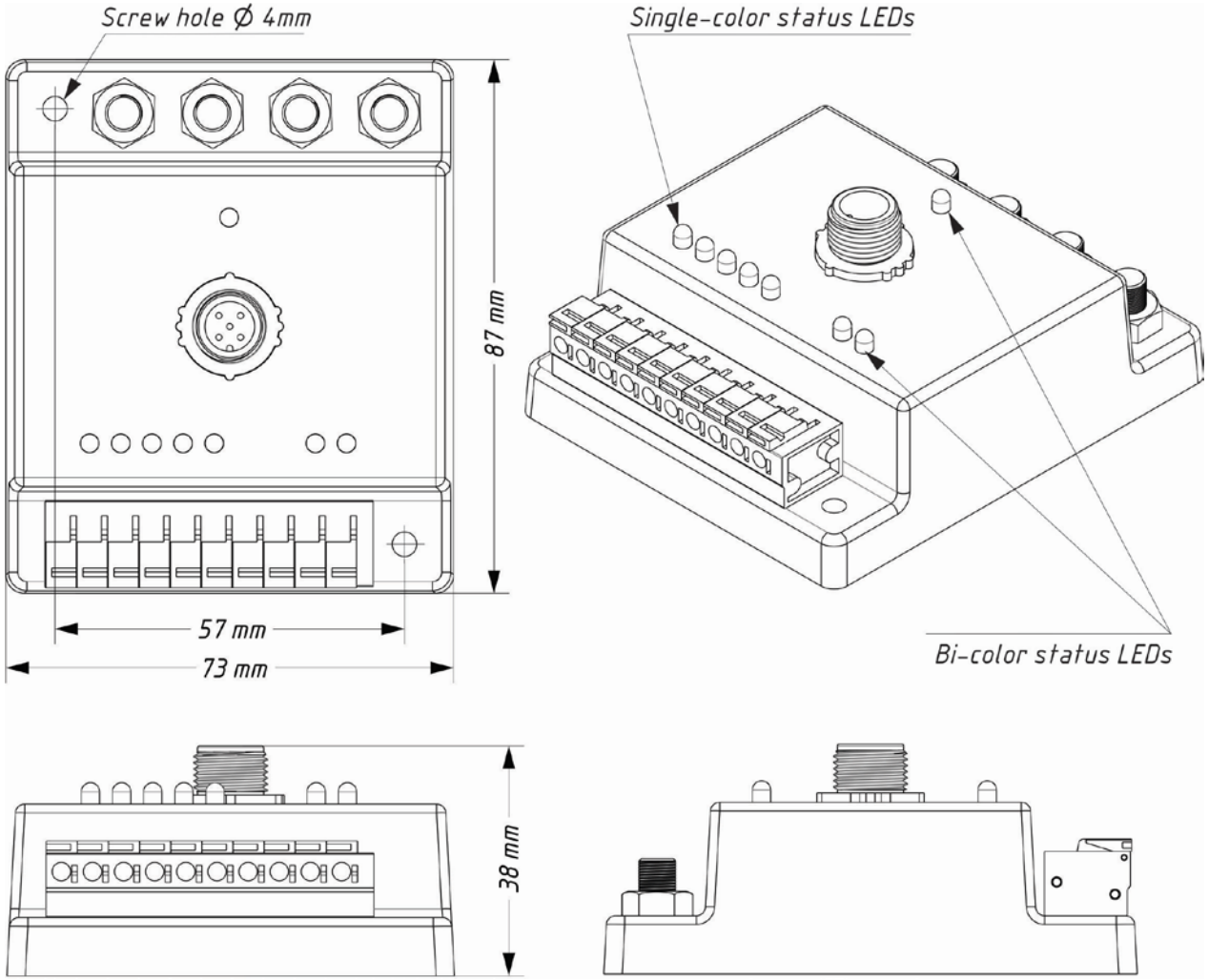


Figure 1. YDAP-04 unit enclosure with dimensions.

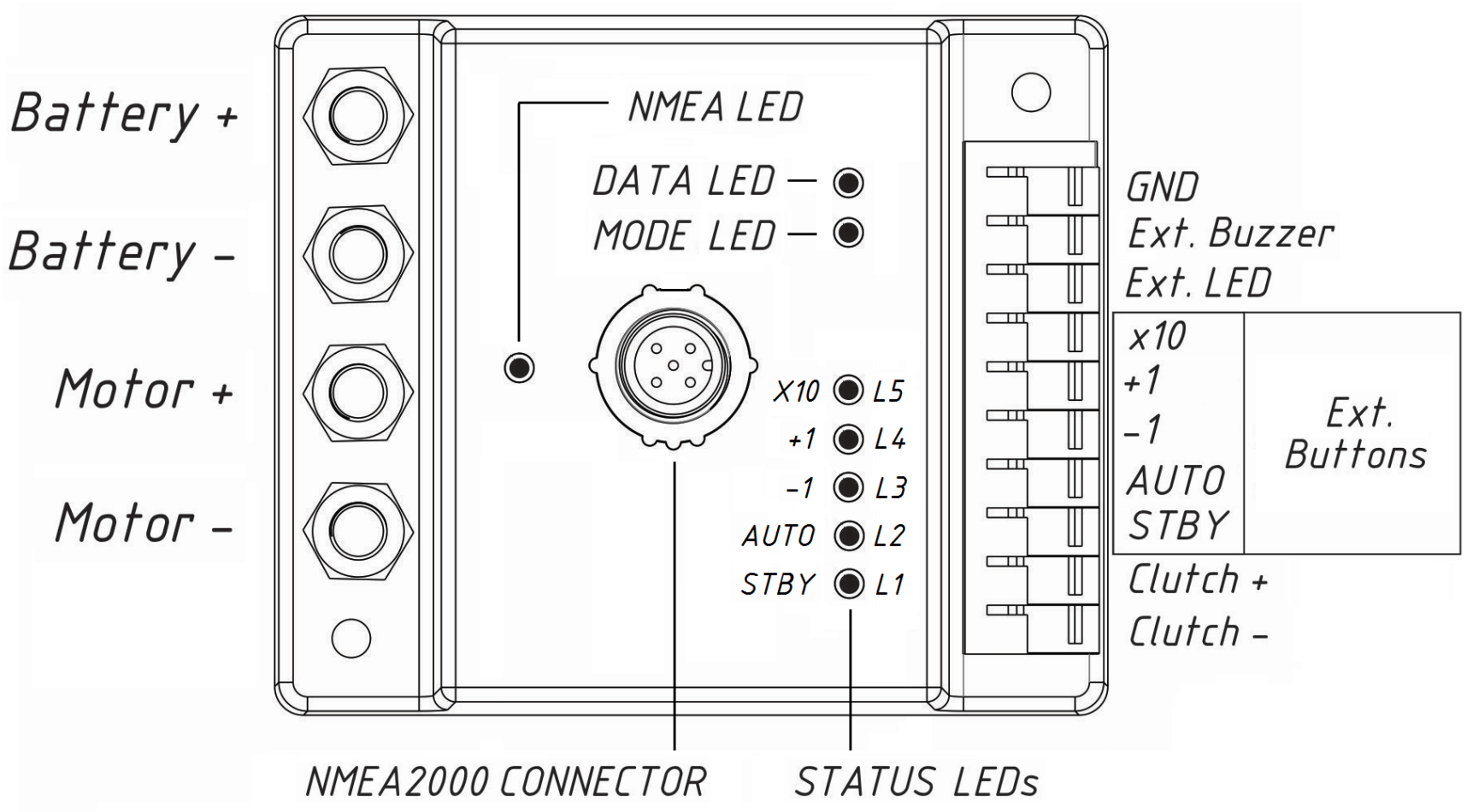


Figure 2. YDAP-04 terminals and signal LEDs locations.

Device parameter	Value	Unit
NMEA 2000 interface		
Allowed NMEA 2000 power supply voltage range	7...16	V
Consumption current, @ 12.0 Volts NMEA 2000 supply voltage, max.	20	mA
Load Equivalency Number (LEN)	1	LEN
Reverse polarity protection	YES	-
Galvanic isolation between NMEA 2000 and all other interfaces	2500	V_{RMS}
Power / Drive / Clutch circuit		
Allowed power supply voltage range — between BATTERY "+" and "−" (V bat)	7...29	V
Total max. current draw from DC supply (constant / peak) @ V bat = 12 V	20 / 26	A
MOTOR output max. allowed current draw (constant / peak)	10 / 16	A
CLUTCH output max. allowed current draw (constant, limited by terminal)	10	A
Total current draw from DC supply (no Drive operation / clutch not engaged / no sound), not higher than	100	mA
Reverse polarity protection on BATTERY input	YES	-
Overcurrent protection	NO (Note1)	-
DIY Control Panel components requirements		
Button type / environment protection rating	Pushbutton with no latch, N.O. / IP56...IP67	
Button input max. allowed voltage range (pushed/ not pushed) — LVTTL	0 / 3.3	V
External LED terminals output voltage — LVTTL output buffer with resistor in series	3.3	V
External LED terminals output built-in current limiting resistor	200	Ohm
External buzzer supplied voltage (BATTERY + terminal)	equal to V bat	V
External buzzer maximal allowed current @ maximal V bat	1.0	A

Mechanical and Thermal		
Weight, net	210	g
Dimensions	87 x 73 x 38	mm
Operating temperature range	–20...+55	ºC
BATTERY and MOTOR contacts material	Brass	-
BATTERY and MOTOR contacts nut thread	M6	-
BATTERY and MOTOR contacts max. allowed torque for top nut	5	N·m

Note 1: Usage of external fuse is mandatory! Refer Section III. 2 "Power input connection".

II. System Overview

The YDAP-04 unit receives power from a DC power distribution panel through a BATTERY power input. The Device is controlled via a DIY Control Panel connected by a shielded cable, and also receives GNSS and TRACK navigation data from an NMEA 2000 ECDIS/ECS solution. The Device outputs DC voltage on the MOTOR interface which drives the Rudder Drive mechanism. The Rudder Drive is linked mechanically to the Rudder and the DC-controlled Clutch mechanism couples/decouples the Drive from the Rudder to allow for automatic/manual Rudder control. YDAP-04 receives Rudder position data from an NMEA 2000 Rudder angle sensor, heading (HDG) data from an NMEA 2000 compass or gyro, and speed through water (STW) data from an NMEA 2000 water speed transducer.

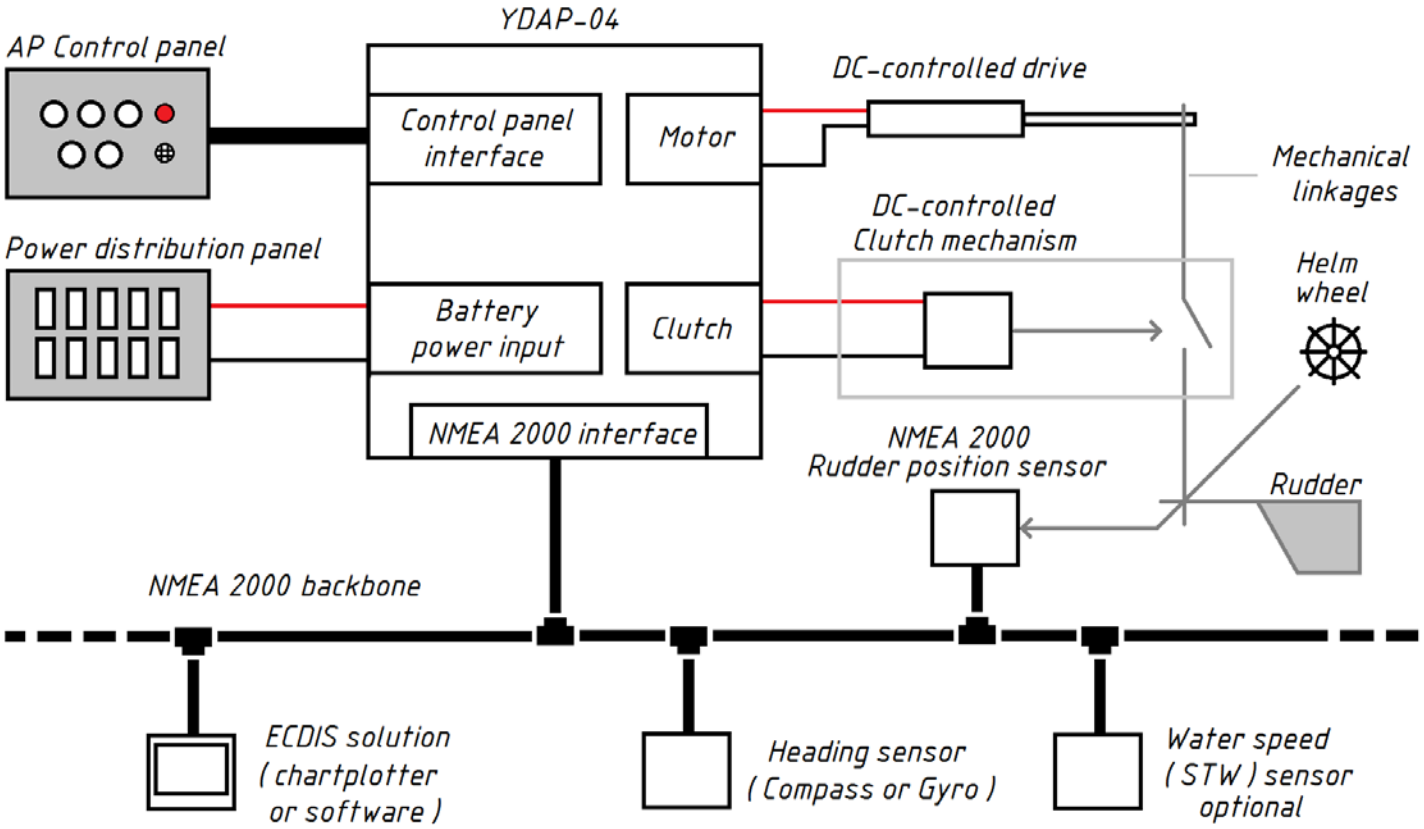


Figure 3. Autopilot System Diagram.

III. Extra Components Required

The Device requires the following external equipment in order to function:

1. Rudder Drive system equipped with a Clutch mechanism

This system drives your Rudder. It should be supplied by a third party and installed and tested first.

Such a system should be electrically controlled — it should have only one pair of high current wires controlling the Rudder rotation: it should rotate the Rudder in one direction when 12...24 Volt DC power is applied to this pair of wires in the "forward" direction, and rotate the Rudder in the opposite direction when 12...24 Volts DC power is applied in the "reverse" direction and stop rotation when 0 Volts are applied.

The Drive system should also be equipped with an electrically controlled Clutch mechanism — it should have only one pair of high current wires controlling the mechanical coupling between the Rudder and the Drive. The Clutch mechanism should mechanically connect the Rudder to the Drive unit when 12...24 Volts DC power are applied to this pair of wires, and mechanically disconnect the Rudder from the Drive unit when 0 Volts are applied.

Before installing the Device, verify that your Drive unit and Clutch mechanism meet these requirements.

Tip: test the system by applying 12...24 volts DC to the appropriate wires and confirm that the Rudder and Clutch operate as desired. Also note which DC polarity rotates the Rudder clockwise (CW) and which rotates it counterclockwise (CCW).

2. NMEA 2000 Rudder position sensor

The Device receives Rudder position data from NMEA 2000 network. Therefore you need a NMEA 2000 Rudder Position Sensor, like our Rudder adapter YDRA-01 or similar. The main requirement for such a Rudder Position Sensor is that it should send standard PGN 127245 "Rudder" with default update rate of 100 ms. Any valid "Rudder Instance" is supported, you can select which "Rudder Instance" to use in the Device setting.

The Rudder sensor should be well zeroed and calibrated, it should also report the Rudder angle direction correctly (positive values are starboard and negative values are port), and there should be no large mechanical play in the mechanical coupling between Rudder and Rudder Position Sensor.

Note on multiple Rudder position data sources:

Make sure there is no Rudder data conflict — if you have multiple data sources sending PGN 127245 "Rudder", the one used for Device Rudder feedback should have a unique "Rudder Instance" data field.

By default, upon power up the Device locks onto any first detected PGN 127245 "Rudder" source, so on vessels with multiple Rudders you will need to either:

- use different "Rudder Instances" for each Rudder data source and force Device to "lock onto" a source with particular PGN 127245 "Rudder Instance"
- force Device to "lock onto" a to particular Rudder data source Device by its NMEA 2000 "NAME" (64-bit unique Device ID).

3. NMEA 2000 Heading source

The Device receives Heading from NMEA 2000. Therefore, you need a NMEA 2000 Heading source (magnetic compass or RTK/AHRS Heading solution). The main requirement for such Heading source is that it should send standard PGN 127250 "Vessel Heading" with default update rate of 100 ms.

The Device supports PGN 127250 "Vessel Heading" with either True or Magnetic "Heading Sensor Reference".

Magnetic Heading sensor should be compensated for deviation ("compass rotated") according to manufacturer's instructions prior to Device integration.

Note on multiple Heading sources:

By default, upon power up the Device locks onto any first detected PGN 127250 "Vessel Heading" source, so on vessels with multiple Heading sources you will need to force the Device to "lock onto" a to particular Heading data source equipment by its NMEA 2000 "Device Address".

Note that if the NMEA 2000 network layout is changed (e.g., new devices are added) and the Heading source equipment receives a new NMEA 2000 "Device Address", you do not need to reconfigure the Device and set a new Heading source "Device Address" because the "locking" mechanism will remember and use the NMEA 2000 "NAME" (64-bit unique Device ID) for Heading source identification (not the address per se).

4. NMEA 2000 ECDIS or ECS solution (chartplotter, MFD or software)

To work in TRACK mode, the Device must receive PGN 129284 "Navigation Data" from NMEA 2000 ECDIS/ECS solution (chartplotter/MFD) or software (e.g. OpenCPN connected to NMEA 2000 via gateway).

The main requirement for such ECDIS/ECS solution is that it should send standard NMEA 2000 PGN 129284 "Navigation Data" with default update rate of 1000 ms. when TRACK or GOTO navigation mode is activated.

5. NMEA 2000 COG & SOG data source (GNSS)

Leeway Compensation feature requires PGN 129026 "COG & SOG, Rapid Update" with default update rate of 250 ms. COG & SOG data is typically provided by GNSS solutions, such as NMEA 2000 GPS receivers.

Note on multiple COG & SOG sources:

By default, upon power up the Device locks onto any first detected PGN 129026 "COG & SOG, Rapid Update" source, so on vessels with multiple COG & SOG sources you will need to force Device to "lock onto" a to particular COG & SOG data source equipment by its NMEA 2000 "Device Address".

Note that if the NMEA 2000 network layout is changed (e.g., new devices are added) and the COG & SOG source equipment receives a new NMEA 2000 "Device Address", you do not need to reconfigure the Device and set a new COG & SOG source "Device Address" because the "locking" mechanism will remember and use the NMEA 2000 "NAME" (64-bit unique Device ID) for COG & SOG source identification (not the address per se).

6. NMEA 2000 Magnetic Variation data source

If your Heading source only sends Magnetic "Heading Sensor Reference", the Device also requires a Magnetic Variation data source to calculate the True Heading. The main requirement for such a source is that it should send standard PGN 127258 "Magnetic Variation" with default update rate of 1000 ms. Variation data is typically provided by the Heading source device itself or the ECDIS/ECS solution (chartplotter/MFD).

Note on multiple Magnetic Variation sources:

By default, upon power up the Device locks onto any first detected PGN 127258 "Magnetic Variation" source, so on vessels with multiple Variation sources you will need to force the Device to "lock onto" a to particular Variation data source equipment by its NMEA 2000 "Device Address".

Note that if the NMEA 2000 network layout is changed (e.g., new devices are added) and the Variation source equipment receives a new NMEA 2000 "Device Address", you do not need to reconfigure the Device and set a new Variation source "Device Address" because the "locking" mechanism will remember and use the NMEA 2000 "NAME" (64-bit unique Device ID) for Variation source identification (not the address per se).

7. NMEA 2000 Wind data source (optional)

To work in TRACK mode, the Device must receive Wind sensor data (speed and angle). The main requirement for Wind sensor solution is that it should send standard NMEA 2000 PGN 130306 "Wind Data" with default update rate of 100 ms.

Device supports PGN 130306 "Wind Data" with any "Wind Reference" (either "Apparent" or one of four NMEA 2000 "Theoretical" wind types).

Wind sensor should be calibrated and correctly oriented in respect to vessel centerline.

Note on multiple Wind sources:

By default, upon power up the Device locks onto any first detected PGN 130306 "Wind Data" source, so on vessels with multiple Wind sources you will need to force the Device to "lock onto" a to particular Wind data source equipment by its NMEA 2000 "Device Address".

Note that if the NMEA 2000 network layout is changed (e.g., new devices are added) and the Wind source equipment receives a new NMEA 2000 "Device Address", you do not need to reconfigure the Device and set a new Wind source "Device Address" because the "locking" mechanism will remember and use the NMEA 2000 "NAME" (64-bit unique Device ID) for Wind source identification (not the address per se).

8. NMEA 2000 Speed Through Water (STW) source (optional)

To augment the performance on waters with high current, Device can use Speed Through Water (STW) data from NMEA 2000. Therefore, you need a NMEA 2000 STW data source. The main requirement for such STW data source is that it should send standard PGN 128259 "Speed, Water Referenced" with default update rate of 1000 ms.

Device supports PGN 128259 with any "Speed Water Referenced Type".

STW sensor should be calibrated and should report valid STW value via PGN 128259 "Speed, Water Referenced" payload.

Leeway Compensation feature

If your boat is hit by a crosswind or tidal current at an angle to the desired Heading, it will deviate from that Heading in the direction of the wind or current. The Device can compensate for this effect if it receives sufficient supplementary data — STW, COG and SOG.

The Leeway Compensation function utilizes the "Set & Drift" vector of the vessel, either derived or calculated, to adjust the target Heading and minimize the impact of wind gusts and water currents on the current course (COG). Drift compensation operates in both AUTO and TRACK modes and can be enabled/disabled via "YD:LEEWAY" command.

If SOG data becomes unavailable when the autopilot is in either AUTO or TRACK mode, leeway compensation calculation will not be possible. An "SPEED LOST" error will be displayed, and the autopilot will switch to STANDBY mode to prevent sudden erratic maneuvers.

Note on multiple STW sources:

By default, upon power up the Device locks onto any first detected PGN 128259 "Speed, Water Referenced" source, so on vessels with multiple STW sources you will need to force the Device to "lock onto" a to particular STW data source equipment by its NMEA 2000 "Device Address".

Note that if the NMEA 2000 network layout is changed (e.g., new devices are added) and the STW source equipment receives a new NMEA 2000 "Device Address", you do not need to reconfigure the Device and set a new STW source "Device Address" because the "locking" mechanism will remember and use the NMEA 2000 "NAME" (64-bit unique Device ID) for STW source identification (not the address per se).

9. NMEA 2000 Depth source (optional)

The Device can monitor water Depth and sound an alarm if it falls below a predetermined threshold. To obtain Depth data, the Device requires a NMEA 2000 Depth data source that sends the standard PGN 128267 "Water Depth" with a default update rate of 1000ms.

The Device disregards the "Transducer Offset" data field in PGN 128267 and measures depth relative to the transducer's location. Set the alarm threshold accordingly.

Multiple Depth sources:

By default, upon power up the Device locks onto any first detected PGN 128267 "Water Depth" source, so on vessels with multiple Depth sources you will need to force the Device to "lock onto" a to particular STW data source equipment by its NMEA 2000 "Device Address" or use a TAC COS solution which automatically selects and forwards data from one of the Depth sensors depending on vessel's attitude.

Note that if the NMEA 2000 network layout is changed (e.g., new devices are added) and the Depth source equipment receives a new NMEA 2000 "Device Address", you do not need to reconfigure the Device and set a new Depth source "Device Address" because the "locking" mechanism will remember and use the NMEA 2000 "NAME" (64-bit unique Device ID) for Depth source identification (not the address per se).

10. DIY Control Panel

Buttons

Device primary control method is via pushbutton panel connected to Device "Ext. Buttons" digital inputs. Device has a built-in weak 3.3 Volt pull-up (LVTTL "logic 1" level) on those inputs. When corresponding input is connected to GND terminal, Device registers a button push, when released, device registers a button pull. It is recommended to use industry or marine grade waterproof panel mount pushbuttons and a total of 5 buttons are needed.

Mode indicator LED

The Device indicates its operation mode and state using a single LED which connects to the "Ext. LED" output. This LED should be integrated onto the Control Panel. To power this LED, the Device applies 3.3V through a built-in current-limiting resistor with a resistance of 200 Ohms.

To ensure high luminosity and water resistance, we recommend using an industry or marine grade 3.3 Volt single LED panel mount indicator. Alternatively, you can use STANDBY button with an integrated LED.

Alarm/Buzzer

The Device can activate an external Alarm Unit or Buzzer. The Alarm Unit should be of the simplest type and should emit a continuous sound when powered, such as a Buzzer.

To activate alarm, Device connects the "Ext. Buzzer" terminal to GND/Battery "−" via a built-in open-drain MOSFET. Please note that this input is not internally fused, and the maximum allowed input current is 1000 mA @ 24 Volts.

It is highly recommended to add an extra fuse, such as an industry or marine grade waterproof panel mount 1000...750 mA fuse in series to the BATTERY "+" output to guard the Buzzer. Always keep a sufficient quantity of spare fuses easily accessible.

Main DC power switch

Connect the Device power to the main DC power source using the ON/OFF single pole Switch on positive rail. Switch must be rated for a minimum of 20 Amperes of DC constant current and 26 amperes peak. Whenever possible, it is recommended that a switch be installed on the control panel. In this scenario, it's recommended to use an industrial or marine-grade waterproof panel mount switch. It's preferable to utilize a flip switch that includes a switch guard for extra protection.

Main DC power fuse or circuit breaker

Protect the main positive DC input power rail of the Device with a 15...20 Ampere, slow-blow fuse or an automatic circuit breaker located on the ship's main power distribution panel or on the local power distribution panel. The fuse or circuit breaker must be easily accessible so operators can reset it if it trips.

Extra main DC power indicator (optional)

It is highly recommended to add an additional MAIN POWER LED to the Control Panel for indicating the presence of DC power voltage on Device's BATTERY terminals. Use a high-intensity, waterproof panel-mounted LED indicator with a built-in current-limiting resistor that matches Device DC power voltage and meets industrial or marine standards.

Panel cable and connectors

Use industry or marine grade **shielded** signal cables with distinct wire color coding.

Use separate cables for input circuits (buttons) and output circuits (MODE LED and Alarm/Buzzer).

It is highly recommended to connect the control panel to signal cables via waterproof connectors designed for automotive or marine use. The connector on the panel side should be male (with pins).

Panel front plate

Make a front panel using a galvanically-compatible material such as metal or plastic sheet. Determine locations and labels for all chosen control elements, and produce a drawing.

Select an appropriate labeling method. All controls must be clearly marked with durable labels.

Plan the location of the panel at a control station and develop a method for securing the panel that allows for easy removal without compromising the control station's water ingress protection.

To ensure the panel fits your control station and can be mounted easily, create a mockup panel using inexpensive materials such as plywood or plastic. Once you have assessed the overall view and usability, cut the plate to the desired size, drill all mounting holes according to the drawing, paint the plate, and mark control elements for clarity.

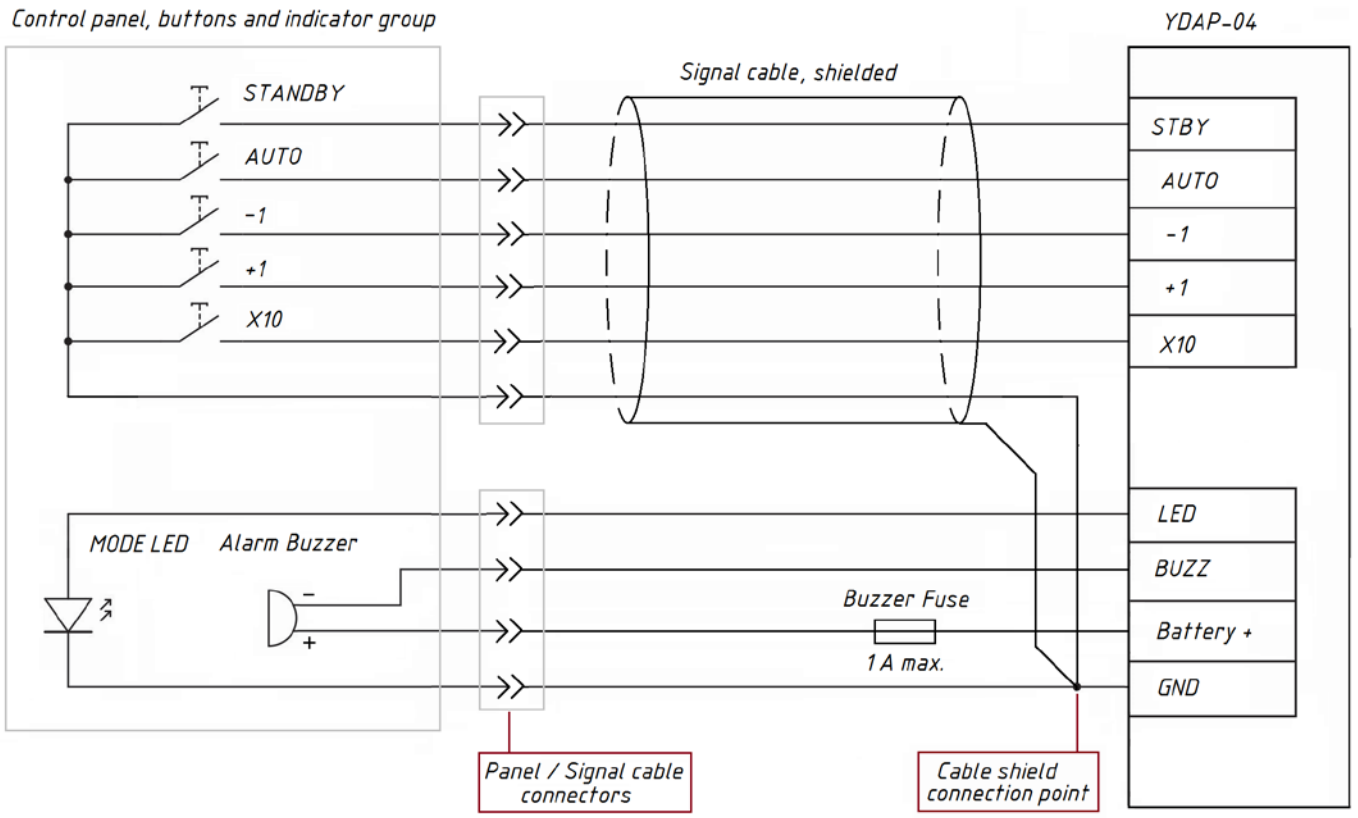


Figure 4. Connecting Device to DIY Control Panel.

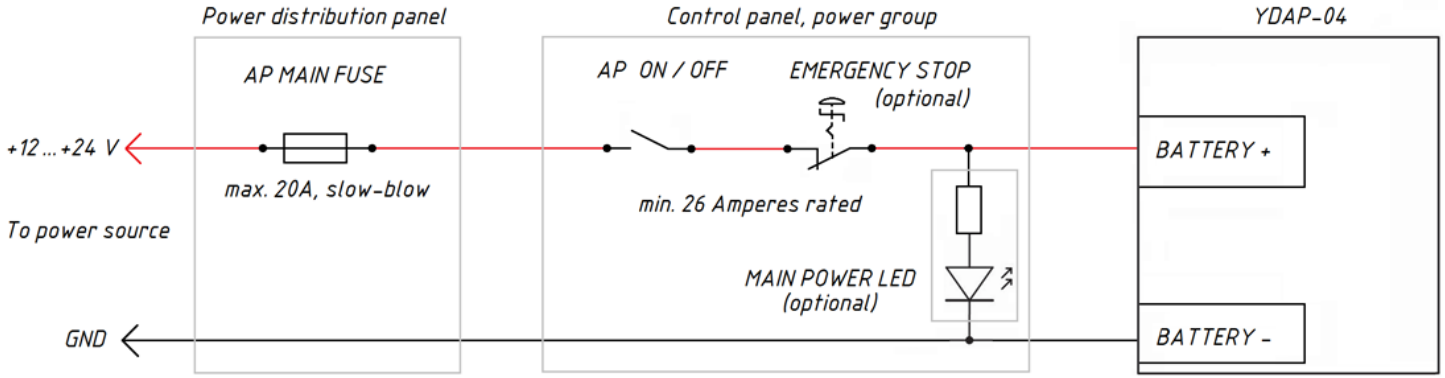


Figure 5. Connecting Device to Power Source.

IV. System Installation and Connection

The Device does not need regular maintenance. Although the Device case is waterproof, its wire terminals are open, and seawater can cause a short circuit. Avoid installing the Device in a location that may be flooded or sprayed by water, or get wet in the rain. To decrease any potential water damage, protect the Device with an IP55...67 box.

Warning: **power OFF all equipment!**

All connections should be performed only when all when associated equipment is NOT powered!

Failure to do so will damage the equipment and may lead to serious injury.

Installation workflow:

- Plan the system beforehand by creating an installation layout and comprehensive schematic diagrams. These diagrams should incorporate part numbers for all components, installation locations, connector types, and cable lengths.
- Procure all necessary tools and additional components such as buttons, alarm units, signal cables, ring terminals, cable end lugs, and a protection box.
- Create a DIY autopilot control panel.
- Install and securely attach all components and cables.
- Connect all system components using cables.
- Conduct preliminary tests.
- Verify and calibrate the system.
- Conduct a sea trial and adjust Device settings for optimal performance.

Device location:

Determine the optimal location for the Device based on your vessel's specific construction details.

Install the Device in a dry vessel compartment that is completely protected from water intrusion or install the Device in an IP55...67 electrical distribution box.

When utilizing an electrical distribution box, route all cables into it using waterproof fittings. Suggestion: employ "detachable cable glands" for cables with pre-installed connectors like NMEA 2000 cables.

Do not place the Device and route Control Panel cables near strong sources of electromagnetic interference (EMI), such as high-power cables, DC motors, engines, generators, VHF antennas, and feeders.

Cable routing:

- Refer ABYC E-11 Standard on DC circuitries.
- Use marine-grade power and signal cables.
- Control Panel button cable should be shielded.
- Avoid excessive bending of the cables and maintain a minimum bend radius of 100 mm whenever possible, with a recommended 200 mm radius.
- Protect the cables from physical damage and heat exposure by using trunking or cable conduits whenever possible.
- Secure the cables with zip-ties, spiral cable wrap, or lacing twine
- Use watertight feed-through fittings when running cables through a bulkhead.
- Avoid routing signal cables near strong EMI sources, such as high-power cables, DC motors, engines and gensets, VHF antennae, and feeders.
- Ensure that cable strain relief is sufficient and do not over-tighten.
- Cables connected to the Device should not be tightened to prevent them from being pulled out under extreme sea conditions.

1. DIY Control Panel assembly

Test all control element components before installation using a multimeter and a 12...24 Volt power supply.

Mount all control components onto the Control Panel plate, confirming their firm placement. Make sure that all the control elements are properly sealed in place and that they do not compromise the water resistance of the Control Panel.

Connect all of the control elements according to the schematic diagram shown in Figures 4 and 5.

Do not use solder to connect controls, terminals and wires (as per ABYC E-11 requirements).

Instead, use appropriate mating terminals (such as blade terminals) that are **crimped** directly onto wires.

Insulate all exposed parts with shrink tubes.

Create your **final control panel schematic diagram**. Attach a hard copy to the Autopilot documentation package.

Ensure accurate labeling of Control Panel signal cable pinouts.

After assembly, test all Control Panel circuits with a multimeter and a 12...24 Volt power supply.

2. Power input connection

The Device features a dedicated high-current power circuit for Drive and Clutch that necessitates a separately fused power supply. Opt for an appropriate power cable of suitable type and length, and calculate the necessary wire gauge based on cable length and maximum combined Device peak current (26 Amperes). All ABYC E-11 requirements for DC power circuits should be met.

The Device does not have an internal Drive and Clutch input and output short protection.
15...20 Ampere FUSE on power supply rail is mandatory!
It is recommended to use a resettable circuit breaker located on or near DIY Control Panel so you can:

- power down autopilot in emergency
- restart autopilot if circuit breaker tripped during excessive Drive load.

The Device's BATTERY and MOTOR M6 terminals are made of brass.
To avoid corrosion use **only brass, copper or tinned copper** ring terminals.
Brass ring terminals offer best corrosion resistance.

The Device's M6 terminals have two nuts. **Avoid loosening the lower nut**!

Route the DC power cable from the power source to the main circuit breaker of the Device, and then connect it to the Device as shown in Figure 5. Only use M6 ring terminals made of brass, copper, or tinned copper. Crimp the M6 ring terminals onto the power cable and use terminals that match the appropriate cable gauge. Use a crimp tool that matches the diameter of the ring terminals. Verify that the wires are correctly crimped and the crimped connection can withstand a nominal pull load of 4 kg for 60 seconds. Add an additional heat-shrink tube to insulate the crimped connection and exposed ring terminal parts.

Unscrew one nut from each BATTERY terminal, leaving the second nut in place. Connect the positive power cable rail to the Device BATTERY "+" terminal and the negative rail to the BATTERY "–" terminal. Then, tighten the nut using a dynamometric torque wrench. The maximum allowed torque is 5 N·m.

Verify that each of the terminal connections is secure and that the ring contact does not rotate when rotational force is applied.

Secure all wires to the vessel/protective box structure. Provide additional insulation to prevent ring terminals from touching each other, which may lead to a short circuit even when the nut is loosened due to vibration.

3. Drive and clutch connection

Calculate the necessary Drive and Clutch cable wire gauge based on cable length and maximal Drive current (20 Amperes) and Clutch current (6 Amperes).

Drive:

Route the Drive DC control cable (2 wires) from the Drive unit to the Device. Only use M6 ring terminals made of brass, copper, or tinned copper. Crimp the M6 ring terminals onto the Drive unit cable and use terminals that match the appropriate cable gauge. Use a crimp tool that matches the diameter of the ring terminals. Verify that the wires are correctly crimped and the crimped connection can withstand a nominal pull load of 4 kg for 60 seconds. Add an additional heat-shrink tube to insulate the crimped connection and exposed ring terminal parts.

Unscrew one nut from each MOTOR terminal, leaving the second nut in place. Connect the positive power cable rail to Device MOTOR "+" terminal, negative rail to MOTOR "–" terminal, then, tighten the nut using a dynamometric torque wrench. The maximum allowed torque is 5 N·m.

Verify that each of the terminal connections is secure and that the ring contact does not rotate when rotational force is applied.

Secure all wires to the vessel/protective box structure. Provide additional insulation to prevent ring terminals from touching each other, which may lead to a short circuit even when the nut is loosened due to vibration.

Clutch:

Route the Clutch DC control cable (2 wires) from the Clutch unit to the Device. Crimp lug terminals or pin terminals onto both ends of the Clutch cable using appropriate terminals matching the cable gauge. Use a crimp tool that matches the diameter of the terminals. Verify that the wires are correctly crimped and the crimped connection can withstand a nominal pull load of 4 kg for 60 seconds. Add an additional heat-shrink tube to insulate the crimped connection and exposed terminal parts.

Plug the positive Clutch wire into the CLUTCH "+" terminal and the negative Clutch wire into the CLUTCH "–" terminal.

Check that all terminal connections are secure and do not detach when moderate pulling force is applied. Secure all wires to the vessel/protective box structure.

4. NMEA 2000 connection

Connect the Device to the NMEA 2000 network using a standard DeviceNet NMEA 2000 drop cable. Do not connect the Device directly to the T-piece. Before connecting the Device, turn OFF the NMEA 2000 network power supply. Ensure connection reliability by tightening/closing all locks on the NMEA 2000 connectors.

Please refer to the following documents for any questions about the use of connecting cables, terminators, or connectors:

- Technical Reference for Garmin NMEA 2000 Products (190-00891-00) for standard NMEA 2000 network;
- SeaTalk NG Reference Manual (81300-1) for Raymarine SeaTalk NG network.

5. DIY Control Panel connection

Route Control Panel cables between the Control Panel and the Device, giving sufficient cable strain relief. Allow for 20 to 40 centimeters of extra length for future servicing needs. Secure the cable to the vessel's cable-carrying structure to prevent vibrational damage.

Crimp cable end lugs or pins onto the Device side cable wires ends. Crimp panel connectors on panel side cable wires. Use an appropriate crimp tool which matches lugs and pins diameter. Double-check that the wires are crimped properly and that the crimp connection can handle a nominal pull load of 4 kg for 60 seconds.

Plug all cable end lugs/pins into the terminals of the Device. Connect cable shields to the Device's GND terminal at only one point, as shown in Figure 4.

Secure all cables to prevent vibration damage to both cables and connectors, or loosening of connections due to vibration.

Plug all connectors into the Control Panel and make sure the connectors have been securely fastened and latched.

Once you've completed initial testing, securely attach all signal/panel cables and Control Panel connectors to the vessel structure to prevent damage from connector and cable vibration.

V. Initial Tests

Acceptance:

Check the Device case and connectors for damage. If damage is present, do not power up the Device and immediately contact technical support.

Before tests:

Double-check that all Device wiring and connections matches your **actual** wiring diagram.

Verify that all necessary NMEA 2000 equipment is installed and functioning properly.

Record all steps and actions taken in the boat's Technical Log.

First power-up:

Initial condition: vessel's 12...24 Volt power supply bus connected to Device is OFF.

- Check the Power distribution panel AP MAIN FUSE / circuit breaker is intact / engaged to ON.
- Put Device main ON/OFF switch to OFF
- Power up vessel's 12...24 Volt power supply bus. Power up vessel NMEA 2000 bus.
- Flip Device Main ON/OFF switch to ON.

Device immediately should produce:

- single short Buzzer/Alarm beep
- single short GREEN flash on NMEA LED that indicates correct hardware initialization
- single short GREEN flash on both built-in MODE and Control Panel MODE LED immediately follows.

After powering up, the Device enters STANDBY mode. The MODE LED on the Control Panel should flash a single short (250 ms) pulse every 3 seconds (indicating the Device is in STANDBY mode).

Confirm the beep and correct LED sequences have been observed and then proceed to the next test.

Button tests:

Press and release each button one-by-one. While the button is pressed, the corresponding STATUS LED (STBY, AUTO, −1, +1, X10) will remain illuminated. Once the button is released, that LED should turn off.

The AUTO button is an exception, a short press will enter AUTO mode, holding for 1 second will enter WIND mode. The STANDBY button is also an exception, if pressed for 5 seconds it will enter CALIBRATION mode — but we do not need to calibrate now.

Confirm that all button labels correspond to their respective LEDs and that all buttons operate as expected, without bad or intermittent contacts that may cause LED flickering.

Turn on and operate all high-power and VHF equipment to ensure there are no EMI issues and that no false button activations occur.

Verify correct button operation and LED indication before moving to the next test.

NMEA 2000 tests:

Turn Device power ON, NMEA 2000 power ON, boot MFD/chartplotter.

Verify that the Device is visible in the NMEA 2000 Device list on the MFD/chartplotter, and check the Device's firmware version, serial number, and other extended information. Ensure that all information is accurate, with no "garbage" symbols present. It is also highly recommended to update the Device firmware to latest version, see Section XII. "Firmware Update".

Check all available NMEA 2000 Heading, COG/SOG, and Wind sources using a NMEA 2000-to-PC gateway. Choose the desired data sources and record the corresponding NMEA 2000 addresses and NAMEs (64-bit UIDs) in the Device Integration Sheet (Appendix D) and boat's Technical Log.

Verify that the NMEA 2000 Rudder Position Sensor is present on the bus. Manually move the Rudder to check if the Rudder Position Sensor reacts correctly and displays the accurate Rudder deflection angles. Record the NMEA 2000 address, NAME (64-bit UID) of the Rudder feedback Device and its current PGN 127245 "Rudder Instance" in the Device Integration Sheet (Appendix D) and boat's Technical Log.

Drive/Clutch tests:

The purpose of this test is to verify that the Drive and Clutch outputs of the Device are functional and that the electromechanical system of the Drive, Clutch and Rudder Position Sensor is operating as intended, and to check the polarity of the Drive connections, and to check if Rudder angle is displayed correctly.

Warning!

Device applies full power to MOTOR output in this test, do not move Drive to extreme positions or you may damage Drive and/or its mechanical linkage.

Note that this procedure require special commands to be sent to the Device via "Installation Description String 2" using an NMEA 2000-to-PC gateway or compatible display device; see Section X and Appendix B for details.

- Put the Device into STANDBY mode by either power cycling or pressing the STANDBY button once.
- Verify that the Clutch is disengaged.
- Put the Rudder in a central position manually.
- Send YD:AP FACTORY_TEST_2 command to Device, confirm DONE command response and two short beeps.
- Verify that the Clutch is engaged.
- Press the "+1" button several times to confirm that the Rudder moves to STARBOARD (Rudder rotates counter-clockwise, with the displayed Rudder angle reading increasing).
- Press the "−1" button several times to confirm that the Rudder moves to PORT (Rudder rotates clockwise, with the displayed Rudder angle reading decreasing).
- Verify that the MFD/Chartplotter's Rudder Position Indicator moves in the correct direction and accurately displays the Rudder deflection angle and movement direction.
- Hold STANDBY button for 5 seconds to exit Drive/Clutch Test Mode or issue command YD:AP STANDBY to return to STANDBY mode. Two short beeps indicate successful exit.
- Verify that the Clutch is disengaged upon return to STANDBY mode.

VI. Calibration and Data Sources Selection

Device should be calibrated before use. The following items should be calibrated:

- Rudder extreme positions and Rudder deflection limits
- Drive unit dynamics
- Vessel rotation dynamics
- Compass response dynamics (optional)

Note that some advanced calibration procedures, such as source selection, require special commands to be sent to the Device via "Installation Description String 2" using an NMEA 2000-to-PC gateway or compatible display Device; see Section X and Appendix B for details.

You can also calibrate your Device using our free CAN Log Viewer software, which is compatible with NMEA 2000-to-PC gateways such as the YDWG-02 Wi-Fi gateway, YDNR-02 Wi-Fi router, YDNU-02 USB gateway, and YDEN-02 Ethernet gateway. The software is available on Microsoft Windows, Mac OS X, and Linux.

https://www.yachtd.com/products/can_view.html

You can download the calibration and data source selection procedure for CAN Log Viewer as a separate Application Note from our website at

https://www.yachtd.com/downloads/

Calibration menu

Put the Device in STANDBY mode by either power cycling or pressing the STANDBY button once.

Press and hold the STANDBY button for 5 seconds until the unit emits two short beeps and the control panel mode LED begins to flash at 1 second intervals.

Press "+1" button to go to next menu option, "−1" button to go to previous menu option, "X10" button to enter menu option, STANDBY button to exit menu. Or do not press the button and wait 30 seconds to exit the menu.

Current menu item is shown by STATUS LEDs on the Device:

STATUS LED indication					**Calibration menu item**
STBY	**AUTO**	**−1**	**+1,**	**X10**	
☀					Rudder extreme positions and Rudder deflection limits
	☀				Drive unit dynamics
		☀			Vessel rotation dynamics
			☀		Compass response dynamics

1) Rudder extreme positions and Rudder deflection limits calibration

Before calibration:

- Verify that the desired NMEA 2000 Rudder Feedback unit is operational and is transmitting the NMEA 2000 "Rudder" PGN 127245 with the correct interval of 100 ms or less.

If you got multiple PGN 127245 "Rudder" sources:

- Select one:
  - by NMEA 2000 "Rudder Instance", send commands YD:SRC RUDDER AUTO, then YD:RUDDER *instance_number*
    or
  - by NMEA 2000 "Device Address", send command YD:SRC_FIND RUDDER *Device_address*

Note that *instance_number* and *Device_address* are decimal numbers.

- Record the Rudder source device model, NMEA 2000 "Device Address", NAME (64-bit UID) and its current PGN 127245 "Rudder Instance" in the Device Integration Sheet (Appendix D) and boat's Technical Log.

- Manually move the Rudder to extreme positions and confirm that the Rudder position is displayed correctly on the MFD/chartplotter/instrument display or in PC software:

  - move to PORT position (Rudder rotates clockwise, Rudder angle readings decreasing and go down to negative values);
  - move to STARBOARD (Rudder rotates counter-clockwise, Rudder angle readings increasing and go up to positive values).

Calibration procedure:

- Verify that the Device is receiving valid Rudder angle data — first flash of the DATA LED is GREEN.
- Manually set Rudder to center position.
- Start "Rudder extreme positions and Rudder deflection limits" calibration either:
  - via buttons (hold STANDBY for 5 seconds until two short beeps then release, press and release "X10");
    or
  - by sending "YD:LEARN_STOPS" command to the Device;
  - by pressing "Run" button in CAN Log Viewer "YDAP-04" window, "Rudder Limits calibrated" section.

  The Device will emit two **short beeps** to indicate that the calibration procedure has begun.

- Immediately turn the Rudder manually to extreme PORT position (Rudder rotates clockwise, the Rudder angle indicator decreases and should reach minimum negative value) and wait 2 seconds until the Device emits **one short beep**.
- Immediately turn the Rudder manually to extreme STARBOARD position (Rudder rotates counterclockwise, Rudder angle indicator increases and should reach maximum positive value) and wait 2 seconds for another **two short beeps**.

If calibration is not successful, the Device will indicate the cause of the error with an appropriate sequence of beeps and flashes of the STATUS LED, see Section IX.

If the calibration is successful, the Device will enter STANDBY mode. If the calibration is performed through the CAN Log Viewer, the "Rudder Limits calibrated" check box will be checked.

After calibration:

- Cross-check the Rudder limits — send the YD:RUDDER_MAX command and confirm that both returned values accurately reflect the actual angles of the extreme Rudder positions that were used during the calibration.
- Record obtained values to Device Integration Sheet (Appendix D) and boat's Technical Log.

On success, proceed to next step:

2) Drive unit dynamics calibration

This calibration procedure can be done with the vessel stationary, but the best results are obtained with the vessel moving at an STW of approximately 2...3 knots.

Before calibration:

- Perform Drive/Clutch tests from Section V.

Calibration procedure:

- Verify that the Device is receiving valid Rudder angle data — first flash of the DATA LED is GREEN.
- Manually set Rudder to center position.
- Start "Drive parameters automatic" calibration either:
  - via buttons (hold STANDBY for 5 seconds until two short beeps then release, press and release "+1" **once**, then "X10");
    or
  - by sending "YD:LEARN_RUDDER" command to the Device;
  - by pressing "Run" button in CAN Log Viewer "YDAP-04" window, "Drive Unit calibrated" section.

  The Device will emit two **short beeps** to indicate that the calibration procedure has begun.

The Device should deflect the Rudder performing 3 cycles of two turns:

- to full STARBOARD position (Rudder rotates counter-clockwise, Rudder angle reading should increase and reach **maximum positive value**)
  then
- to full PORT position (Rudder rotates counter-clockwise, Rudder angle reading should increase and reach **maximum positive value**).

The Device should then return the Rudder to the center position, emit two short beeps, and enter STANDBY mode.

Tip: If the Device generates a "Rudder Wrong Direction" alarm immediately after starting calibration, your Drive is connected with the wrong polarity. In this case, you can either:

- reverse the polarity of the wires connecting the Drive unit to the Device's MOTOR terminals (recommended);
  or
- send the "YD:POLARITY REVERSE" command to the Device to reverse the polarity of the MOTOR output circuitry via software.

After calibration:

- Check the Drive parameters — send commands:

YD:DRIVE_GAIN

YD:DRIVE_FRICTION

YD:DRIVE_OFFSET

YD:DRIVE_MIN

YD:DRIVE_SPEED

YD:DRIVE_COUNTER

and record obtained values to Device Integration Sheet (Appendix D) and boat's Technical Log.

Optional Drive mechanical system play test:

- Put Device into STANDBY mode
- Manually move Rudder to extreme PORT or STBD position
- Send the "YD:AP HOME" command to the Device, it should:
  - engage the Clutch;
  - move Rudder to center position;
  - disengage the Clutch;
  - enter STANDBY mode.

On success, proceed to next step:

3) Vessel rotation dynamics calibration

This test should be carried out on the water.

Device will perform several test maneuvers, make sure you have adequate clearance from other vessels and obstacles.

Before calibration:

- Perform Drive unit dynamics (2) calibration;
- Verify that the desired NMEA 2000 Heading source is operational and is transmitting the NMEA 2000 "Vessel Heading" PGN 127250 with the correct interval of 100 ms or less.

If you got multiple PGN 127250 "Vessel Heading" sources:

- Select one
  - by NMEA 2000 ""Device Address"", send command: YD:SRC_FIND HEADING *Device_address;*
    or
  - by NMEA 2000 Device NAME (64-bit UID), send command: YD:SRC HEADING *Device_NAME*

Note that *Device_address* is a decimal number and *Device_NAME* is a NMEA 2000 Device NAME (64-bit UID) written in hexits.

- Record the Heading source Device model, NMEA 2000 address, NAME (64-bit UID) in the Device Integration Sheet (Appendix D) and boat's Technical Log.

If you got Speed Through Water (STW) source:

The calibration procedure will be more accurate because the unit will account for water currents.

Note that STW source should provide calibrated data via 2000 PGN 128259. PGN payload should provide already calibrated "Speed Water Referenced" data (STW calibration performed on display Devices may not affect actual PGN payload and are limited to view only).

- Verify that the desired NMEA 2000 STW source is operational and is transmitting the NMEA 2000 "Speed, Water Referenced" PGN 128259 with the correct interval of 100 ms or less.

If you got multiple PGN 128259 "Speed, Water Referenced" sources:

- Select one
  - by NMEA 2000 ""Device Address"", send command: YD:SRC_FIND STW *Device_address;*
    or
  - by NMEA 2000 Device NAME (64-bit UID), send command: YD:SRC STW *Device_NAME*

Note that *Device_address* is a decimal number and *Device_NAME* is a NMEA 2000 Device NAME (64-bit UID) written in hexits.

- Record the STW source Device model, NMEA 2000 address, NAME (64-bit UID) in the Device Integration Sheet (Appendix D) and boat's Technical Log.

Calibration procedure:

- Navigate the boat to the marina test area, ideally with little or no current. The sea state should be calm, otherwise the calibration may fail.
- Check that Device receives valid
  - Rudder data — DATA LED first flash is GREEN
  - Heading data — DATA LED second flash is GREEN
  - STW data (optional) — DATA LED 4-th flash is GREEN
- Manually set Rudder to center position.
- Engage vessel propulsion and go ahead at approximately4...5 knots STW
- Start "Vessel rotation dynamics calibration either:
  - via buttons (hold STANDBY for 5 seconds until two short beeps then release, press and release "+1" **twice**, then press "X10"); or
  - by sending "YD:LEARN_VESSEL" command to the Device;
  - by pressing "Run" button in CAN Log Viewer "YDAP-04" window, "Vessel Coefficients calibrated" section.

  The Device will emit two **short beeps** to indicate that the calibration procedure has begun.

Device will start a series of ±15° zig-zag turns, deflecting Rudder to fixed ±7 ° angle. First turn will be right turn (vessel Heading rotates clockwise, Rudder rotates counter-clockwise).

Total 6 turns will be performed, Device will produce one short beep after each turn. After all turns completed Device will issue two short beeps and enter AUTO mode.

- Check the Drive parameters — send commands:

YD:RUDDER_TRIM YD:RUDDER_GAIN

YD:RUDDER_COUNTER YD:RUDDER_DELAY

YD:MAX_ROT

and record obtained values to Device Integration Sheet (Appendix D) and boat's Technical Log.

On success, proceed to next step:

4) Compass calibration

This test should be carried out on the water.

Allows to assess and learn the effects of vessel inertia on the dynamics of COG/SOG vs. Heading vector differences on vessel rotation.

STW correction is also applied if STW source is present and selected.

Device will perform several test maneuvers, make sure you have adequate clearance from other vessels and obstacles.

Before calibration:

- Perform Drive unit dynamics (2) and Vessel rotation dynamics (3) calibration.
- Verify that the desired NMEA 2000 Heading source is operational and is transmitting the NMEA 2000 "Vessel Heading" PGN 127250 with the correct interval of 100 ms or less and is selected as Heading data source on the Device.
- Verify that the desired NMEA 2000 COG/SOG source is operational and is transmitting the NMEA 2000 "COG/SOG" PGN 129026 with the correct interval of 250 ms or less.

If you got multiple PGN 129026 COG/SOG sources:

- Select one
  - by NMEA 2000 ""Device Address"", send command: YD:SRC_FIND COG_SOG *Device_address*
    or
  - by NMEA 2000 Device NAME (64-bit UID), send command: YD:SRC COG_SOG *Device_NAME*.

Note that *Device_address* is a decimal number and *Device_NAME* is a NMEA 2000 Device NAME (64-bit UID) written in hexits.

- Record the Cog/SOG source Device model, NMEA 2000 address, NAME (64-bit UID) in the Device Integration Sheet (Appendix D) and boat's Technical Log.

Calibration procedure:

- Navigate the boat to the marina test area, ideally with little or no current. The sea state should be calm, otherwise the calibration may fail.
- Check that Device receives valid:
  - Rudder data — DATA LED first flash is GREEN.
  - Heading data — DATA LED second flash is GREEN.
  - COG/SOG data — DATA LED 5-th flash is GREEN.
  - STW data (optional) — DATA LED 4-th flash is GREEN.

- Manually set Rudder to center position.
- Engage vessel propulsion and go ahead at approximately 3...4 knots STW
- Start "Compass" calibration either:
  - via buttons (hold STANDBY for 5 seconds until two short beeps then release, press and release "+1" **3 times**, press "X10");
    or
  - by sending "YD:LEARN_COMPASS" command to the Device;
  - by pressing "Run" button in CAN Log Viewer "YDAP-04" window, "Compass Alignment calibrated" section.

The Device will emit two **short beeps** to indicate that the calibration procedure has begun.

Device will move Rudder to – 7° = RUDDER_TRIM value position and will wait until vessel performs 360 ° clockwise turn. When clockwise turn is completed, Device will issue **one short beep**.

After that, Device will move Rudder to +7° = RUDDER_TRIM value position and will wait until vessel performs 360 ° counter-clockwise turn. When counter-clockwise turn is completed, Device will issue two beeps and enter AUTO mode.

- Check the Drive parameters — send commands:

YD:HEADING_TRIM

YD:ROT_BANK

and record obtained values to Device Integration Sheet (Appendix D) and boat's Technical Log.

On success, calibration is considered complete.

VII. Button Actions

- **STANDBY** — stops current operation:
  - single short press will disengage Autopilot and put it into STANDBY mode;
  - press and hold for 5 seconds to enter the CALIBRATION menu (from STANDBY mode only).

- **AUTO** — selects operation mode:
  - single short press will engage Autopilot in AUTO mode — steer to keep current Heading (if no STW available) or COG (if STW not available);
  - press and hold for 1 second to engage AP in WIND mode (steer at constant wind angle);
  - press simultaneously with X10 button to engage TRACK mode (steer under control of ECDIS/ECS solution).

- **"+1" and "–1"**:
  - in **AUTO** mode:
    - if STW source is available — changes target COG by 1°;
    - if no STW source is available — changes target Heading by 1°;
    - press simultaneously with "X10" to change by 10°;
    - press and hold for 5 seconds to execute SHARP TURN (Sharp Turn angle can be changed via setting YD:SHARP_TURN, default 90°).“–1” turns vessel to STARBOARD, “+1” to PORT.

  - in **WIND** mode:
    - if only Apparent Wind is available — changes target AWA ("+1" decreases target AWA, "–1" increases target AWA by 1°);
    - if any Theoretical Wind (type 0, 1, 3 or 4) is available or Device has enough data to calculate Theoretical Wind from AWA — changes target TWA ("+1" decreases target TWA,"–1" increases target TWA);
    - press simultaneously with "X10" to change by 10°;
    - press and hold both "+1" and "-1" simultaneously for 1 second to execute AUTOMATIC TACK maneuver;
    - hold for 5 seconds to execute MANUAL TACK maneuver ("+1" tacks to STARBOARD, "–1" tacks to PORT, behavior depends on current AWA/TWA, see Device's User Manual for detailed behavior).

  - used in the CALIBRATION menu to select next or previous menu items.

- **"X10"**:
  - single short press cancels active alarm;
  - used in combination with other buttons to activate alternative functions;
  - used in the CALIBRATION menu to start selected calibration procedure.

VIII. LED and Sound Signals

Device has 3 bi-color (NMEA, DATA and MODE) LEDs (see Section I, Figure 2):

1) NMEA LED — indicates NMEA 2000 connection status and which modes can be activated based on available data.

Every 8 seconds this LED produces a series of 4 consecutive flashes:

Flash #	GREEN	RED
1	NMEA 2000 CAN bus communication is OK	NMEA 2000 CAN bus communication ERROR
2	AUTO mode can be engaged	AUTO mode can NOT be engaged
3	WIND mode can be engaged	WIND mode can NOT be engaged
4	TRACK mode can be engaged	TRACK mode can NOT be engaged

Note that RED flashes 2, 3, and 4 indicate that the required data is missing or not valid on the NMEA 2000 bus.

2) DATA LED — indicates NMEA 2000 data items availability and validity.

Every 8 seconds this LED produces a series of 7 consecutive flashes:

Flash #	Data	GREEN	RED
1	Rudder feedback	available	NOT available
2	Magnetic Heading		
3	Magnetic Variation		
4	Speed Through Water (STW)		
5	COG / SOG		
6	Wind speed and angle		
7	Track waypoints data from ECS/ECDIS solution (MFD/chartplotter/software)		

3) MODE LED — indicates current operation mode. This LED shows the same indication as Control Panel MODE LED:

Current AP MODE active	**MODE LED signal**
STANDBY	ON (250 ms) then OFF, repeats each 3 seconds
AUTO	ON (250 ms) OFF (250 ms)
WIND	ON (250 ms) OFF (250 ms) ON (100 ms) OFF (400 ms)
TRACK	ON (250 ms) OFF (250 ms) ON (100 ms) OFF (250 ms) ON (100 ms) OFF (400 ms)
MENU	ON (500 ms) OFF (500 ms)
CALIBRATION in progress or in DEBUG mode	ON (1 s) OFF (1 s)

Device also has 5 single-color **STATUS LEDs** (see Section I, Figure 2).

STATUS LEDs are used:

- To indicate if corresponding Control Panel button is pressed (see Section V, subsection "Button tests").
- To indicate error condition (see Section IX).
- As a calibration menu indication (see VI, subsection "Calibration menu").

Sound signals during normal operation:

Action		**Signal**
Manual target Heading / COG change in AUTO mode Manual target Wind angle change in WIND mode Next waypoint confirmation in TRACK mode	SET OK SET OK WAYPOINT 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

IX. Alarms and Error Conditions

The Device can trigger an alarm in case of errors or when it detects dangerous conditions or when an operator action is required.

There are several levels of alarms implemented:

- CRITICAL — Device cannot operate in the selected mode and has returned to the STANDBY mode.
- ERROR — Device cannot operate in the selected mode and has returned to the AUTO mode.
- WARNING — one of the set warning conditions reached, Device still operates in selected mode.
- SILENT — minor issue, no sound alarm, only LED indication, Device still operates in selected mode.
- CALIB — used only in CALIBRATION mode, indicates that the selected calibration procedure failed.

When the Device detects an error condition, it will:

- Play sound via buzzer, see list of sound sequences in Table 1 on the next page. The default behavior is a looping alarm/buzzer activation. The maximum loop duration can be modified with the YD:DURATION command.
- Show a combination of constantly flashing STATUS LEDs (STBY, AUTO, −1, +1, X10), see list of LED combinations in Table 1 on the next page. Note that pressing any Control Panel button overrides the STATUS LED error indication — while button is pressed, the STATUS LEDs indicate which button is pressed.
- Send Raymarine proprietary PGN 65288 "SeaTalk: Alarm" with corresponding "alarm ID code", that alarm can be observed on Raymarine Axiom MFDs. You can silence the alarm via Axiom MFDs — they can send PGN 65361 "SeaTalk: Silence Alarm" to cancel active alarms.

To cancel alarm either:

- press and release "X10" Control Panel button;

  or

- switch AP to another mode;

  or

- cancel alarm on Raymarine Axiom MFD.

Table 1. List of Device alarms and errors with corresponding LED and sound indications.

Name	**ID**	**Type**	**Description**	**STATUS LEDs**					**Buzzer signal**
				STBY	AUTO	–1	+1	X10	
Rudder lost	61	CRITICAL	NMEA 2000 Rudder data lost	☀					●
Rudder wrong direction	40	CRITICAL	Rudder feedback signal is inverted		☀				— ●
Rudder stall	30	CRITICAL	Rudder stuck and cannot be moved or Rudder feedback sensor failure	☀	☀				● ●
Overcurrent	72	CRITICAL	Drive unit consumes too much current			☀			— — ●
Battery Low	22	CRITICAL	Voltage on BATTERY input is lower than set threshold (default 11.0 Volts)	☀		☀			● — ●
Compass lost	46	CRITICAL	NMEA 2000 Heading data lost		☀	☀			— — ●
Wind lost	51	ERROR	NMEA 2000 Wind data lost						● ● ●
Track lost	58	ERROR	NMEA 2000 Navigation data lost						— — — ●
Too slow	45	SILENT	Vessel speed too slow	☀			☀		No (SILENT)
Speed lost	52	CRITICAL	NMEA 2000 STW data lost		☀		☀		— ● — ●
COG or SOG lost	43	CRITICAL	NMEA 2000 COG or SOG data lost	☀	☀		☀		● ● — ●
Large XTE	70	WARNING	XTE is larger than limit set via YD:ALARM_XTE						— — — — ●
OFF Heading	69	WARNING	HDG error is larger than limit set via YD:ALARM_HDG						● — — — ●
Depth alarm		WARNING	Depth value is smaller than limit set via YD:ALARM_DEPTH						— ● — — ●

Wind shift	71	WARNING	Wind angle is larger than limit set via YD:ALARM_WIND						● ● — — ●
Learn Stops Failed	62	CALIB	Rudder limits calibration failed. Check Rudder/Drive/Clutch mechanism and recalibrate			☀	☀		● ● ● ● ●
Learn Rudder Failed	63	CALIB	Rudder/Drive calibration failed. Check Rudder/Drive/Clutch mechanism and recalibrate	☀		☀	☀		● ● ● ● ●
Learn Vessel Failed	64	CALIB	Vessel dynamics calibration failed. Retry calibration.		☀	☀	☀		● ● ● ● ●
Learn Compass failed	65	CALIB	Compass calibration failed. Retry calibration	☀	☀	☀	☀		● ● ● ● ●
Internal failure		CRITICAL	Internal failure	☀	☀	☀	☀	☀	—

X. Device Configuration and Settings

The Device should be configured by sending special "YD commands" via Device NMEA 2000 "Installation Description String 2".

In practice, NMEA 2000 installers use Installation Description Strings to specify Device location, leave text notes or contact information. To set an installation description string, use a hardware NMEA 2000-to-PC gateway and corresponding software. Some MFDs also allow editing of installation description strings. Please refer to your software / MFD documentation for details on how to set NMEA 2000 "Installation Description" strings.

To connect your PC to the NMEA 2000 network, use a suitable gateway and software capable of editing Devices "Installation Description String 2".

We recommend the following Yacht Devices products: NMEA 2000 Wi-Fi Gateway YDWG-02, NMEA 2000 USB Gateway YDNU-02, and NMEA 2000 Ethernet Gateway YDEN-02 and our free CAN Log Viewer software. You can download this multi-platform application (Microsoft Windows, Mac OS X and Linux) from http://www.yachtd.com/downloads/

CAN Log Viewer software also has a more convenient GUI interface for setting up the Device.

To program the Device, open the "Device Properties" window and enter a command string starting with YD: characters into the installation description field #2. For example, YD:DEV 1 will change the NMEA 2000 Device Instance of the Device to 1 (refer Figure 6 below).

If a command is accepted, Device will add DONE to the entered string, for our example, YD:DEV 1 DONE message will appear in the "Installation Description 2" field. If a command is NOT accepted, Device will add FAIL to the entered string.

If a command is entered without the argument(s), Device returns the current value of that argument(s).

The complete set of commands is listed in Table 2 below. Use UPPER CASE letters for all commands and arguments.

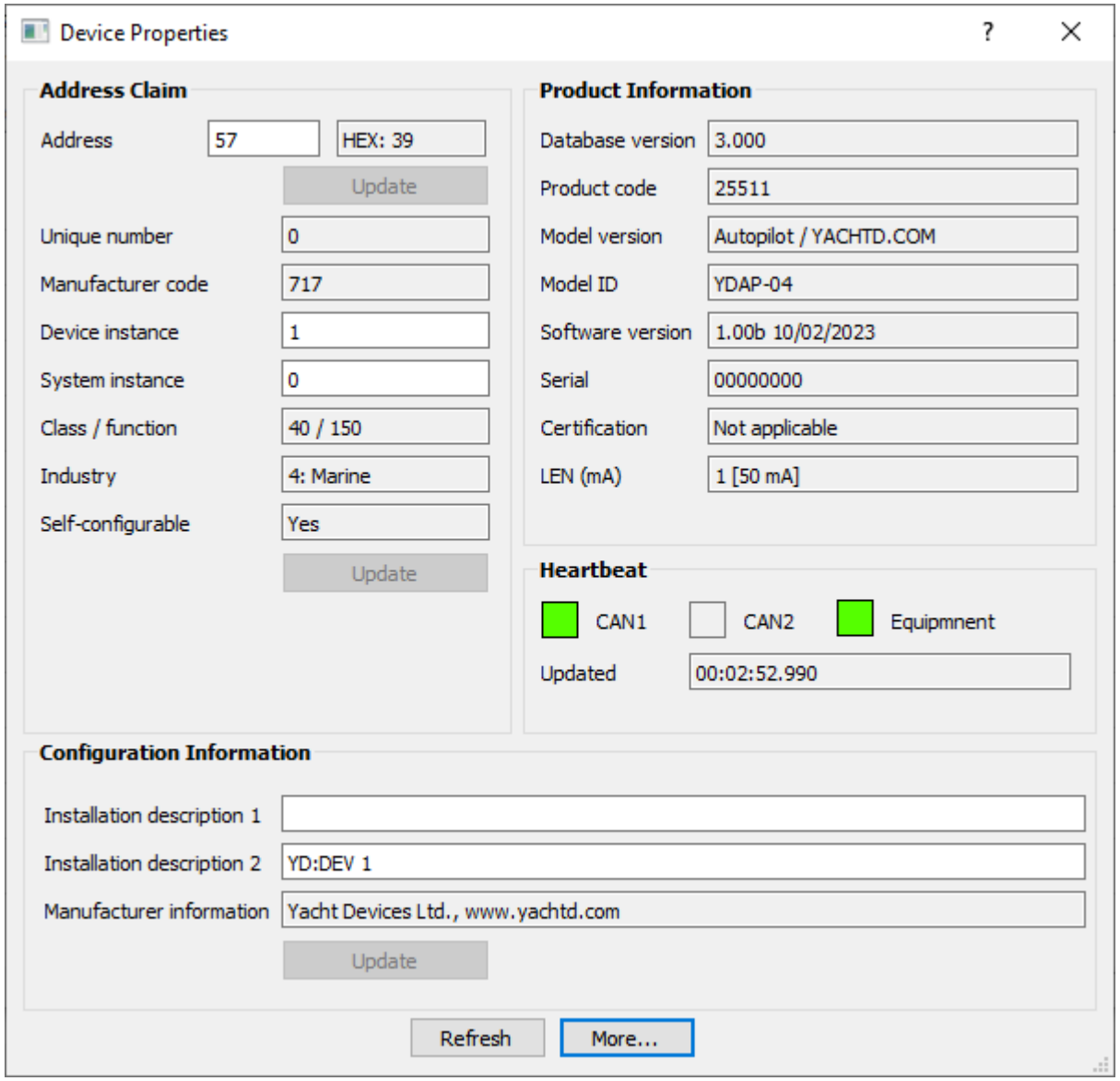


Figure 6. Programming with CAN Log Viewer.
Enter the command into "Installation description 2" input field and click "Update".

Table 2. Supported "YD commands"

Syntax	Examples	Description
YD:RESET	YD:RESET	Resets settings to factory defaults, preserving calibration data
YD:RESET ALL	YD:RESET ALL	Resets settings to factory defaults and clears calibration data
YD:RESTART	YD:RESTART	Performs Device software reset (soft restart)
YD:DEV <number>	YD:DEV 0	Sets NMEA 2000 "Device Instance"
YD:SYS <number>	YD:SYS 0	Sets NMEA 2000 "System Instance"
Data sources selection		
YD:SRC <type> [<associated_source_type> | AUTO | Device_NAME]		Selects and groups data sources. Refer Appendix B. "Data types, sources and timeouts"
YD:SRC_FIND <type> <Device_address>		Selects data source by NMEA 2000 "Device Address" Refer Appendix B. "Data types, sources and timeouts"
YD:SRC_LOCK <type>		Hard-locks onto selected data source (by Device NAME)
YD:SRC RESET	YD:SRC RESET	Resets all data sources and their grouping to factory defaults
YD:TIMEOUT <type> [<milliseconds>]		Selects data source timeout in milliseconds. Refer Appendix B. "Data types, sources and timeouts"
YD:TIMEOUT RESET	YD:TIMEOUT RESET	Resets all data sources timeouts to factory default.
YD:RUDDER [AUTO | <0...252>]	YD:RUDDER AUTO YD:RUDDER 1	Selects which "Rudder Instance" to use. Should match Rudder source address if it was also set via YD:SRC RUDDER Default: AUTO
YD:ROT_TYPE [GET | CALC | AUTO]	YD:ROT GET YD:ROT CALC YD:ROT AUTO	Selects Rate of Turn (RoT) processing mode: GET – use external source PGN 127251 "Rate of Turn" and do not generate and send PGN 127251 "Rate of Turn"

		CALC – calculate RoT based on available PGN 127250 "Vessel Heading" data, then generate and send PGN 127251 "Rate of Turn" AUTO – if no external source of PGN 127251 "Rate of Turn" source detected — activate CALC mode Default: AUTO
YD:SPEED_REF [AUTO | STW | SOG | FIXED]	YD:SPEED_REF AUTO YD:SPEED_REF STW YD:SPEED_REF SOG YD:SPEED_REF FIXED	Selects primary vessel speed source: AUTO – use best available vessel speed source: If STW is available, use STW; else use SOG. If SOG is not available use constant value set via YD:SPEED_AVG STW – forces to use STW; If no STW available use fixed value set via YD:SPEED_AVG SOG – forces to use SOG from GNSS solution; If no SOG available use fixed value set via YD:SPEED_AVG FIXED – forces to use fixed value set via YD:SPEED_AVG Default: AUTO
YD:SPEED_AVG [1.00..50.00]	YD:SPEED_AVG 9.4	Sets average cruising speed in knots. Use when no speed source available. Default: 3
YD:VARIATION [-180.00..180.00]	YD:VARIATION -12.32	Sets default Magnetic Variation in degrees. Use when no Variation source is available. Positive values are Easterly and negative values are Westerly. Default: 0
YD:LEEWAY [OFF | CALC | GET | AUTO]	YD:LEEWAY AUTO	Selects Leeway Compensation algorithm (refer Section XXX): OFF – disabled CALC – calculate based on available data using internal model GET – use value from external source — PGN 129291 "Set & Drift, Rapid Update" AUTO – .use PGN 129291; if not available use CALC algorithm Default: AUTO

YD:DAMP_LEEWAY [OFF | 1..120]	YD:DAMP_LEEWAY 50	Sets Leeway vector averaging window in seconds Default: 50
YD:DAMP_WIND [OFF | 1..120]	YD:DAMP_WIND 50	Sets Theoretical Wind vector averaging window in seconds Default: 50
YD:TRANSMIT <ROT | SET_DRIFT> [OFF | ON]	YD:TRANSMIT ROT ON YD:TRANSMIT ROT OFF YD:TRANSMIT SET_DRIFT ON YD:TRANSMIT SET_DRIFT OFF	Enables/disables transmission of data calculated by internal Device model. ROT — send calculated ROT via PGN 127251 "Rate of Turn" SET_DRIFT — send PGN 129291 "Set & Drift, Rapid Update" with calculated "Set" and "Drift" values and "Set Reference" = 0 (True) OFF – do not send ON – send but only if there is no corresponding PGN on the bus or this PGN is present but has "not available" data fields. If data can not be calculated, Device will not send corresponding PGNs Default: both ROT and SET_DRIFT enabled (set to ON)
Digital Switching		
YD:BANK [OFF | 0..252]	YD:BANK OFF YD:BANK 69	Sets NMEA 2000 Digital Switching (DS) bank for control and monitoring via NMEA 2000 DS PGNs 127501 "Binary Status Report" and 127502 "Switch Bank Control". See section XI. OFF disables DS control and status report Default: 5
CZone extension		
YD:CZONE [ON | OFF | AUTO]	YD:CZONE AUTO	Eanbles / disables AP control via CZone protocol extension. AUTO value will read configuration from the bus.
YD:DIPSWITCH [8 bit binary, MSB first]	YD:DIPSWITCH 11001100	Sets YDAP-04 unit CZone DIPSWITCH value.
YD:CZONE_CLAIM [AUTO | MANUAL]	YD:CZONE_CLAIM AUTO	Sets CZone configuration reception method. AUTO — get CZone configuration from the bus MANUAL — do not request CZone configuration from the bus

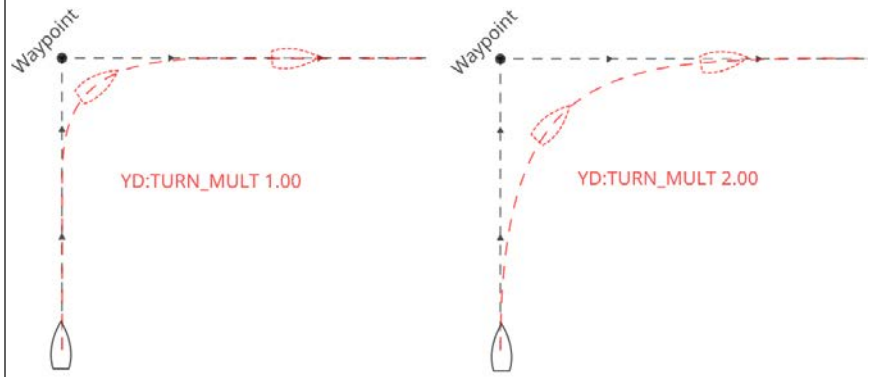
YD:DOWNLOAD	YD:DOWNLOAD	Forces Device to send request and get CZone configuration file form the bus.
YD:CZONE_VER [4-byte value in hexits]	YD:CZONE_VER 000DB13B	Gets/sets CZone configuration file version.
YD:CIRCUIT <1-12> [0-255]	YD:CIRCUIT 1 25 YD:CIRCUIT 2 26 YD:CIRCUIT 3 27 YD:CIRCUIT 4 28 YD:CIRCUIT 5 29 YD:CIRCUIT 6 30 YD:CIRCUIT 7 31 YD:CIRCUIT 8 32 YD:CIRCUIT 9 33 YD:CIRCUIT 10 34 YD:CIRCUIT 11 35 YD:CIRCUIT 12 3	Sets CZone circuit number (first argument) for CZone channel number (second argument).
YD:DSWITCH <1-12> <1-12>	YD:DSWITCH 1 1 YD:DSWITCH 2 2 YD:DSWITCH 3 3 YD:DSWITCH 4 4 YD:DSWITCH 5 5 YD:DSWITCH 6 6 YD:DSWITCH 7 7 YD:DSWITCH 8 8 YD:DSWITCH 9 9 YD:DSWITCH 10 10 YD:DSWITCH 11 11 YD:DSWITCH 12 12	Ties standard DS channel number (first argument) to CZone channel number (second argument).

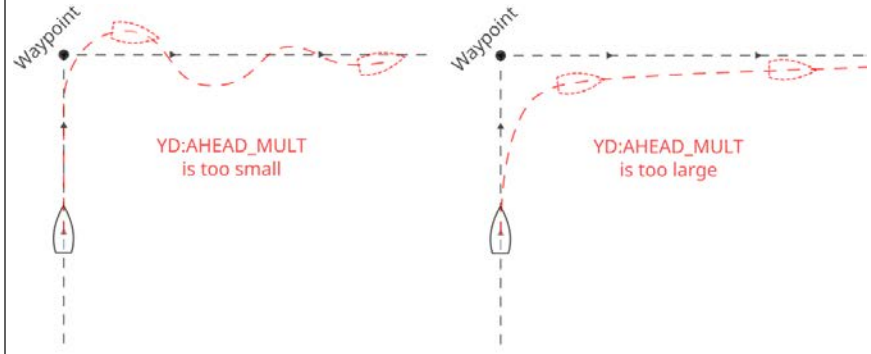
Rudder and Drive		
YD:LEARN_STOPS	YD:LEARN_STOPS	Run test to determine Rudder extreme PORT and STBD positions
YD:LEARN_RUDDER	YD:LEARN_RUDDER	Run test to determine Drive parameters
YD:POLARITY [FORWARD | REVERSE]	YD:POLARITY FORWARD YD:POLARITY REVERSE	Changes Drive unit signal polarity. Use if Drive rotates Rudder in wrong direction. Default: FORWARD
YD:RUDDER_MAX [[-45..-10] <10..45>]	YD:RUDDER_MAX 15 YD:RUDDER_MAX -40 30	Sets maximal allowed Rudder angle deflection in degrees. If only one argument is given — sets PORT and STARBOARD maximal angle to same value. If two arguments are given, first argument (negative) sets max. PORT deflection angle, second argument (positive) sets max. STARBOARD deflection angle Default: from -15 to 15
YD:DRIVE_GAIN [0.1..10.0]	YD:DRIVE_GAIN 1.0 YD:DRIVE_GAIN 5.4	Adjusts Drive PWM duty cycle. Higher values yield higher Rudder rotation speeds. If this setting is entered manually, DRIVE_COUNTER setting will be reset to 0 Default: 1.0
YD:DRIVE_FRICTION [0.0..100.0]	YD:DRIVE_FRICTION 0	Adjusts for Drive friction using a second-order polynomial. Use non-zero values with caution! Default: 0
YD:DRIVE_OFFSET [0.1..5.0]	YD:DRIVE_OFFSET 0.1	Sets min. Drive PWM threshold value @ which Ruder can be rotated by Drive Default: not defined (calibrate Drive first, then read and adjust)
YD:DRIVE_MIN [0.5..6.0]	YD:DRIVE_MIN 1.0	Sets min. Drive PWM threshold value @ which Ruder can NOT be rotated by Drive Default: not defined (calibrate Drive first, then read and adjust)

YD:DRIVE_SPEED [1.0..45.00]	YD:DRIVE_SPEED 15.0	Sets maximal allowed Rudder rotation speed in degrees/second. Higher values yield faster rotation speed. **Adjust with caution!** Default: 15.0.
YD:DRIVE_COUNTER [1.0..45.0]	YD:DRIVE_COUNTER 15.0	Sets max allowed Rudder rotation acceleration in degrees/second per second. Higher values yield faster rotation acceleration. Default: not defined (calibrate Drive first, then read and adjust)
YD:RUDDER_TRIM [-10.0..10.0]	YD:RUDDER_TRIM 0	Sets Rudder relative (automatic) trim angle in degrees (in respect to vessel's centerline). Positive value deflects Rudder towards the PORT. Default: 0
YD:RUDDER_GAIN [-1.0..10..0]	YD:RUDDER_GAIN 0.67	Sets target ROT vs current Rudder angle dependency. Higher values yield more aggressive vessel turn. *ROT ≈ RUDDER_GAIN * current_Rudder_angle* Default: not defined (perform vessel hull response calibration first, then read and adjust)
YD:RUDDER_COUNTER [-5.0..20.0]	YD:RUDDER_COUNTER 1.27	Sets how fast current ROT feedbacks on Rudder position changes. Dimensionless coefficient. Higher values yield faster Rudder movement. Default: not defined (perform vessel hull response calibration first, then read and adjust)
YD:RUDDER_DELAY	YD:RUDDER_DELAY	Read only, reserved for debug purposes. Currently not used in AP Math Model. **Do not change**!
YD:MAX_ROT [50.0..900.0]	YD:MAX_ROT 250	Sets maximal allowed vessel ROT in degrees/minute. Default: 250
YD:SHARP_TURN [20.00..180.00]	YD:SHARP_TURN 90	Sets "Sharp Turn" maneuver angle in degrees.
YD:OVERSHOOT [0.00..45.00]	YD:OVERSHOOT 20	Set "Sharp Turn" maneuver extra angle in degrees for WIND mode. If "Sharp Turn" maneuver is activated in WIND mode, vessel will initially turn to YD:SHARP_TURN + YD:OVERSHOOT angle, then turn back to YD:SHARP_TURN angle.

Autopilot setup and control		
YD:LEARN_VESSEL	YD:LEARN_VESSEL	Starts vessel hull response calibration algorithm
YD:LEARN_COMPASS	YD:LEARN_COMPASS	Starts Compass rotation procedure. Also learns differences between COG and HDG at different ROTs (this improves Leeway Correction model)
YD:AUTO_ADJUST [OFF | ON]	YD:AUTO_ADJUST ON YD:AUTO_ADJUST OFF	Automatically adjust vessel hull response parameters to match current measured vessel speeds. Recommended: ON Default: ON
YD:STANDBY or YD:STOP	YD:STANDBY YD:STOP	Enters STANDBY Operation Mode
YD:AP [STANDBY | AUTO | WIND | TRACK | MANUAL]	YD:AP STANDBY YD:AP AUTO YD:AP WIND YD:AP TRACK YD:AP MANUAL	Enters corresponding operation mode
YD:TURN <-360..360>	YD:TURN 12 YD:TURN -270	Performs vessel turn. Positive value turns vessel to STBD Positive value turns vessel to PORT AUTO mode: turns in respect to current HDG (no STW source) or COG (with STW source). WIND mode: changes target wind angle. Allowed range [-120..120] TRACK mode: switches mode to AUTO then turns to a set target angle in respect to current HDG (no STW source) or COG (with STW source).

YD:HEADING_TRIM [-90.00..90.00]	YD:HEADING_TRIM 0	Sets residue True HDG source correction (for possible compass installation offset error): Used AP HDG = Source True HDG - HEADING_TRIM Default: 0
YD:WIND_TYPE [AWA | TWA]	YD:WIND_TYPE AWA YD:WIND_TYPE TWA	For WIND mode only: selects which Wind Reference to use. AWA: Use PGN 130306 with Wind Reference = 2 TWA: Use PGN 130306 with Wind Reference = 3 or 4 and if they are not available calculate TWA.
Autopilot control from third-party MFDs (experimental)		
YD:RAYMARINE [OFF | ON]	YD:RAYMARINE OFF	Enables/disables integration of Raymarine LightHouse 3 and 4 based MFDs native AP control page. Should enable Autopilot setup page in MFD main settings and allows mode switching to STANDBY, AUTO and TRACK from MFD native AP control page. WIND mode can also be switched on latest LightHouse 4 software.
YD:SIMRAD [OFF | ON]	YD:SIMRAD OFF	Enables/disables Navico (Simrad, B&G) MFD native AP control page integration. When enabled, new virtual NMEA 2000 Device faking Navico AC12 autopilot computer should appear on the bus. Should enable AP mode switching to STANDBY, AUTO, WIND and TRACK from MFD native AP control page.

<table>
<tr><th colspan="3">Manually set coefficients</th></tr>
<tr><td>YD:RESPONSE [0.1..10.0]</td><td>YD:RESPONSE 1.00</td><td rowspan="2">Sets how fast AP moves Rudder in response to Heading/COG change. Recommended range 0.5...3.0. Use higher values for calm sea states. Too low value will yield too small Rudder angle changes that can lead to vessel "snaking". If the value is too high, the Rudder angle will change too much, resulting in a "jerky" Rudder.</td></tr>
<tr><td colspan="2"> 
</td></tr>
<tr><td>YD:TURN_MULT</td><td>YD:TURN_MULT 1.00</td><td rowspan="2">Sets target vessel turn radius multiplier.
Recommended range 1...2. Higher values yield lower ROT and thus larger turn radius.</td></tr>
<tr><td colspan="2"> 
</td></tr>
<tr><td>YD:AHEAD_MULT</td><td>YD:AHEAD_MULT 1.00</td><td rowspan="2">Sets turn start and turn end timing thresholds.
Recommended range 1...3.

Adjust if ROT and turn radius performance are already satisfactory, but autopilot starts and stops turn too early or too late (e.g. last 5...15 degrees @ 90 degree test turn take too long). Lower values yield start and stop of turn to be performed faster.</td></tr>
<tr><td colspan="2"> 
</td></tr>
</table>

Alarms		
YD:ALARM_XTE [OFF | 20.0..500.0]	YD:ALARM_XTE OFF YD:ALARM_XTE 128	XTE alarm threshold in meters. Enables alarm to trigger when XTE exceeds set threshold for more than 20 seconds. Default: OFF
YD:ALARM_HDG [OFF | 5.0..25.0]	YD:ALARM_HDG OFF YD:ALARM_HDG 7.5	Heading mismatch alarm threshold in degrees. Enables alarm to trigger when target vs actual COG/Heading difference exceeds set threshold for more than 20 seconds. Default: OFF
YD:ALARM_DEPTH [OFF | 0.1..10.0]	YD:ALARM_DEPTH OFF YD:ALARM_DEPTH 3.9	Depth alarm threshold in meters. Enables alarm to trigger when selected transducer reports "Depth Below Transducer" below set threshold for 3 seconds. Default: OFF
YD:ALARM_WIND [OFF | 5.0..40.0]	YD:ALARM_ WIND OFF YD:ALARM_ WIND 15.5	Wind Shift angle threshold in degrees. Generate Wind Shift alarm if difference between current AWA and averaged (filtered) AWA stays above the threshold for more than 5 seconds. Default: OFF
YD:DURATION [OFF | 0 | 3..60]	YD:DURATION 10 YD:DURATION OFF	Sets Alarm signal duration in seconds. OFF to disable alarms. Default: OFF
YD:MIN_VOLTAGE [9.00..14.00]	YD:MIN_VOLTAGE 10.25	Sets BATTERY "input voltage low" alarm threshold in Volts. Default: 11.0 Volt. Tip: Mostly used to monitor the battery and drop along the power input wires. Set according to your battery specified minimal allowed discharged voltage, give 1...2 Volt headroom to get an early warning.
YD:ERR	YD:ERR	Query last error / Alarm condition

XI. NMEA 2000 Digital Switching and CZone Support

Device supports NMEA 2000 digital switching (DS) control and status reporting via NMEA 2000 Standard PGNs.

Device default "Switch Bank Instance" is set to 5, you can change bank or disable DS control feature with YD BANK command.

When DS control is enabled, the Device will send PGN 127501 "Binary Status Report" reporting the Device status, with "Switch Bank Instance" matching the selected bank number.

PGN 127501 will be sent once every 10 seconds and also will be sent once — immediately after a status change. Channels 1...4 will indicate current operation mode and can be toggled to switch mode. Channels 5...8 are used to send "+1", "−1", "+10", "−10" control commands.

To control the Device, send PGN 127502 "Switch Bank Control" with matching "Switch Bank Instance". Only one of the first 12 Switches available on the Device should be set to 1 (turn ON command), all others should be set to 3 (NO action).

Device will immediately send one single PGN 127501 "Binary Status Report" in response, with target Switch set to 1 (ON). Then the Device will try to switch mode or execute the command, upon completion or inability to switch mode PGN 127501 "Binary Status Report" target Switch will be reset to 0 (OFF).

Table 3. NMEA 2000 Digital Switching channels layout.

DS Switch number (channel number)	**Switch mode**: **send PGN 127502** and set Switch status = 1 (ON) to:	**Get current mode**: **read PGN 127501** Switch status = 1 (ON) indicates:
1	Switch mode to STANDBY	Current mode is STANDBY
2	Switch mode to AUTO	Current mode is AUTO
3	Switch mode to WIND	Current mode is WIND
4	Switch mode to TRACK	Current mode is TRACK
10	Dismiss current alarm	Alarm condition is active
9	Change to opposite tack in WIND mode	Tack maneuver is in progress, will change to OFF when finished

DS Switch number (channel number)	**Command**: **send PGN 127502** and set Switch status = 1 (ON) to:	**Command execution status**: **read PGN 127501** immediate reply
5	Emulate "+1" button press	Switch status 1 (ON) indicates command accepted. Switch status 0 (OFF) indicates command rejected. Switch status 1 (ON) followed by next PGN with Switch status 0 (OFF) indicates command accepted (ON) and executed (OFF).
6	Emulate "−1" button press	
7	Emulate "+10" button press	
8	Emulate "−10" button press	
11	Change to PORT tack in WIND mode	
12	Change to STBD tack in WIND mode	

CZone support.

You can control the Device via the CZone digital switching interfaces from most of modern chart plotters with CZone support. This includes Simrad, Lowrance, B&G chartplotters and recent Raymarine MFD with Lighthouse 3 and newer.

You need to do the following:

- Visit the product page on our website and follow the link to the related article.
- Fill out the CZone Configurator form on this page and download a personalized configuration file for your MFD.
- Import the configuration file into the MFD (usually using a MicroSD card).

XII. Firmware Update

Firmware updates can be performed using our free CAN Log Viewer software running on Microsoft Windows, Mac OS X and Linux:

http://www.yachtd.com/products/can_view.html

The program must be connected to the NMEA 2000 network via our NMEA 2000 Wi-Fi Gateway YDWG-02, NMEA 2000 USB Gateway YDNU-02, or NMEA 2000 Ethernet Gateway YDEN-02.

Download the latest YDAP-04 firmware version from our website at:

http://www.yachtd.com/downloads/

Open the downloaded .ZIP archive, extract and copy the YDAP.BIN file to a location on your disk where you can easily find it later. Also check the README.TXT file included in the archive as it may contain additional important information for this update.

Update procedure:

- Run Can Log Viewer and connect it to NMEA 2000.
- Click the "NMEA 2000 Devices" item in the "View" menu.
- Click "Refresh" button (see Figure 10 on the next page) in the opened window and wait for the Device to appear in the list
- Select the Device and click "Firmware Update" button.
- Locate and select the YDAP.BIN file previously saved on the disk.
- Wait until the firmware upload is complete (refer figure 10 below).

During the firmware upload, Device NMEA LED will flash RED fast. After each firmware page successfully received, it will also give a single GREEN flash.

If the update is successful, Device NMEA LED will flash GREEN-RED 5 times and CAN Log Viewer will also inform you that the update is successful.

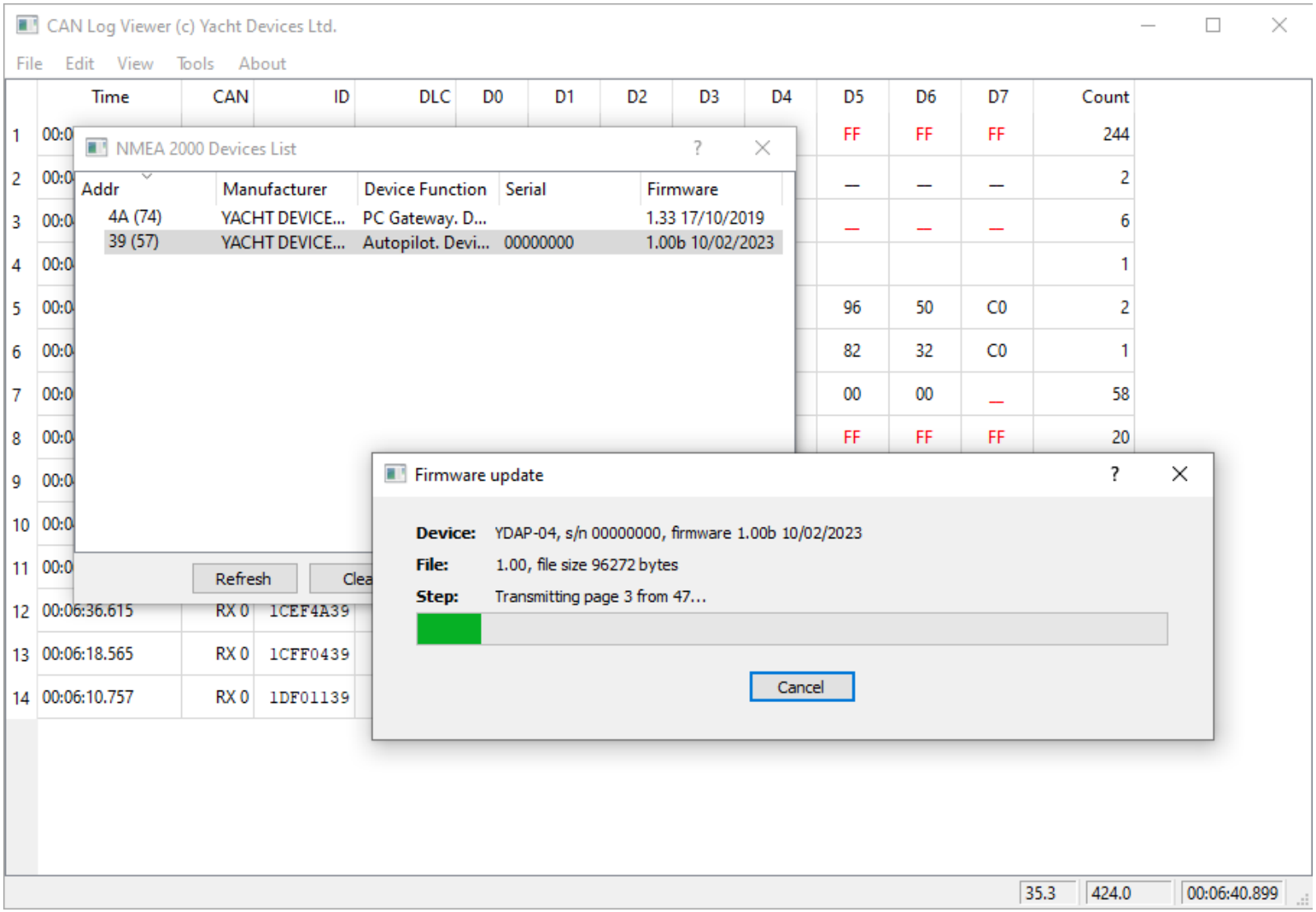


Figure 10. Firmware update via CAN Log Viewer.

Appendix A. Troubleshooting

Table 4. Typical issues and solutions.

Issue	**Possible causes and solutions**
No LED indication on Device after the BATTERY interface is powered ON.	**No power supply on the BATTERY input.** Check if the DC bus main power is supplied to the Device BATTERY input. Check the MAIN AP FUSE, AP ON/OFF main power switch, EMERGENCY STOP button (if installed)
NMEA LED flash #1 RED and/or Device is not visible in NMEA 2000 Device List on NMEA 2000 MFD/Chartplotter or in NMEA 2000 software.	**NMEA 2000 network connection issue.** a) Loose connection in Device's NMEA 2000 connector. Inspect and treat the unit's connector with an electrical contact cleaning spray if necessary. Connect the Device to another "known good" NMEA 2000 drop cable and check again if visible in the Device list. If not, Device CAN interface may be faulty, contact Technical Support. b) The Device network segment is not powered. Power up NMEA 2000 and check +12 DC voltage presence directly on the drop cable that is used to connect the Device to NMEA 2000. c) The Device network segment is not connected to the chart plotter (e.g. bad cable or connector on the backbone or drop cable). Power down NMEA 2000 and perform NMEA 2000 CAN bus continuity checks, also measure termination resistance (should be 60 Ohms, not 120 or 40). Plug another Device into the selected connector and make sure it appears in the list of Devices on the chart plotter.
NMEA LED flash #2 RED.	**AUTO mode cannot be engaged.** Check that all required data sources are operational. Check if you got all required data for AUTO mode (check DATA LED indication). Check data source selection.

NMEA LED flash #3 RED.	**WIND mode cannot be engaged**. Check if you got all required data for WIND mode (check DATA LED indication). Check that all required data sources are operational. Check data sources selection.
NMEA LED flash #4 RED.	**TRACK mode cannot be engaged**. Check that all required data sources are operational. Check if you got all required data for TRACK mode (check DATA LED indication). Check data source selection.
DATA LED flash #1 RED.	**No Rudder data received from NMEA 2000**. Check that Rudder Feedback Sensor unit is operational. Check if you got PGN 127245 "Rudder" present on the bus with valid "Position" data field value. Check Rudder data source selection.

DATA LED flash #2 RED.	**No Heading data received from NMEA 2000**. Check if you got PGN 127250 "Vessel Heading" present on the bus with valid "Heading Sensor Reading" data field value. Check that Heading data source unit is operational. Check Heading data source selection.
DATA LED flash #3 RED.	**No Variation data received from NMEA 2000**. If "manual Variation" was selected via YD:VARIATION, ignore. If selected/single Heading solution provides True Heading, ignore. If selected/default Heading solution provides Magnetic Heading: • check if you get PGN 127250 "Vessel Heading" present on the bus with valid "Variation" data field value or • you get PGN 127258 "Variation" present on the bus with valid "Variation" data Check that Variation data source unit is operational. Check Variation data source selection.
DATA LED flash #4 RED.	**No STW data received (not critical)**. Check that STW data source unit is operational. Check if you get PGN 128259 "Speed, Water Referenced" present on the bus with valid "Speed Water Referenced" data field value. Check STW data source selection.
DATA LED flash #5 RED.	**No COG/SOG data received**. Check that COG/SOG data source unit is operational. Check if you get PGN 129026 "COG & SOG, Rapid Update" present on the bus with valid "Course Over Ground" and "Speed Over Ground" data field values. Check COG/SOG data source selection.

DATA LED flash #6 RED.	**No Wind data received (required for WIND mode)**. Check that Wind data source unit is operational. Check if you get PGN 130306 "Wind Data" present on the bus with valid "Wind Speed" and "Wind Direction" data, with any valid "Wind Reference" value (supported values are 0...4). Check Wind data source selection.
DATA LED flash #7 RED.	**No Track data received (required for TRACK mode)**. Check that ECDIS/EIS solution is engaged in TRACK or GOTO navigation mode and PGN 129284 "Navigation Data" is present on the bus with valid data field values of: • "Distance to Destination Waypoint" • "Course/Bearing Ref." • "Bearing, Origin To Destination Waypoint" • "Bearing, Position To Destination Waypoint"
Buzzer/Alarm sounds and some STATUS LEDs are FLASHING when buttons are NOT pressed.	**Alarm/Error condition.** Refer Section VIII.
Rudder moves in opposite direction while performing Drive/Clutch test or "Rudder wrong direction" Alarm/Error when performing "Drive unit dynamics" calibration (step 2).	**Incorrect MOTOR connection polarity** Swap MOTOR wires polarity, either • physically swap wires connected to Device MOTOR terminals or • physically swap wires connected to Drive unit terminals or • swap polarity via software by using YD:POLARITY REVERSE setting.
Cannot engage certain modes.	**Not all required data present** Check DATA LED, see this table DATA LED #1...7 RED for details.

Device exits selected mode.	**Some data items become missing**. Check DATA LED, see this table DATA LED #1...7 RED for details. **Incorrect data source PGN repeat intervals**. Check if some DATA LED becomes RED occasionally, see this table DATA LED flash #X RED for details. Check corresponding PGN repeat intervals (recommended software is Actisense NMEA Reader) and check/set up bad data source Device. Refer Appendix B for data sources selection. You can increase data timeouts for certain items with YD:TIMEOUT command (inferior solution). **NMEA 2000 bus load too high**. Confirm by Actisense NMEA Reader "bus load %" metric or via Navico (Simrad, B&G, Lowrance) MFD "bus load" metric in NMEA 2000 diagnostics section. If bus load is indeed too high, decrease NMEA 2000 bus load by disconnecting Devices which produce high bus load (consider dividing NMEA 2000 network into smaller segments and adding our YDNB-07 bridge to pass only required data between segments).

Appendix B. Data Types, Data Sources and Timeouts; Data Sources Selection

Table 5. Data sources, types and timeouts, corresponding PGNs.

Data item	**Source PGN**	**YD:SRC datatype**	**YD:SRC default value**	**YD:TIMEOUT default, ms**	**YD:TIMEOUT max allowed, ms**
Rudder angle	127245	RUDDER	AUTO	1 000	1 500
Heading	127250	HEADING	AUTO	1 000	1 500
Rate of Turn	127251	ROT	HEADING	1 000	1 500
Magnetic variation	127258	VARIATION	AUTO	10 000	60 000
Speed Through Water	128259	STW	AUTO	3 000	10 000
Depth below transducer	128267	DEPTH	AUTO	3 000	10 000
Course over Ground / Speed over Ground	129025	COG_SOG	AUTO	5 000	30 000
Wind	130306	WIND	AUTO	10 000	30 000
Cross Track Error	129283	XTE	NAV_DATA	5 000	10 000
Track/GoTo navigation	129284	NAV_DATA	AUTO	5 000	10 000
Leeway Set and Drift	129291	SET_DRIFT	AUTO	5 000	10 000

To allow automatic data source selection issue command

YD:SRC *type* AUTO

where *type* is one of the "YD:SRC datatype" in Table 5 above. AUTO allows Device to "lock onto" any data source that sends the corresponding PGN.

After power up, when Device's NMEA 2000 interface goes online, Device will attempt to randomly "lock onto" valid data sources. Data source is selected by the first PGN with valid data received. The Device will be "locked onto" this source by NMEA 2000 Device "NAME". If data source "Device Address" changes, the Device will still be locked onto that particular data source.

If that data source goes offline during STANDBY mode, Device will silently "lock onto" another data source that also sends the corresponding PGN. If no such data sources remains available, the DATA LED will indicate this with a corresponding RED flash in a 7-flash sequence.

If this data source goes offline during any other operation mode that requires the source data, Device will trigger an Error/Alarm. Put Device into STANDBY mode to "re-lock onto" another data source that sends the corresponding PGN. If no such data source remains available, the DATA LED will indicate this with a corresponding RED flash in a 7-flash sequence.

Use AUTO sources selection only when you got:

- single data source per entire NMEA 2000 network (safe);
- multiple data sources providing absolutely identical data (e.g. COG/SOG).

Example 1:

You have only one Wind source per entire NMEA 2000 network, so it is safe to allow Device to automatically select it. Issue command:

YD:WIND AUTO

Example 2:

You have two GNSS receivers for the RTK solution and NMEA 2000 data analysis reveals that both devices provide not only very accurate but also very similar COG/SOG readings, so it is safe to allow Device to automatically select the COG/SOG source. Issue command:

YD:COG_SOG AUTO

Automatic data source selection will be performed again after Device power cycle. If such behavior is not appropriate, you can force Device to "lock on" to certain sources, see below.

To permanently lock onto already found data sources issue command:

YD:SRC_LOCK *type*

Where *type* is one of the "YD:SRC datatype" in Table 5 above.

Example 3:

You have a COG/SOG source (mast GNSS unit) and you have added an MFD with a built-in GNSS receiver. You also have the default Device setting for automatic COG/SOG selection — YD:COG_SOG AUTO. You want Device to use only the mast GNSS unit data.

Power up the Device and mast GNSS unit but do not power up MFD. Wait for Device to find COG/SOG source (corresponding DATA LED flash #5 is GREEN). Issue command:

YD:SRC_LOCK COG_SOG

On success, the Device will append "DONE" to the command response. Device will remain "locked onto" mast GNSS unit as the COG/SOG source and will remain "locked onto" it between power cycles. Now you can power up the MFD first — Device will not attempt to perform a COG/SOG source search, so it will not "lock onto" the MFD as a COG/SOG source.

On failure, device will add "FAIL" to the command response. This may happen if data source is offline or returns invalid data during this command execution, check if corresponding Device DATA LED flash is GREEN.

You can avoid automatic data sources selection altogether and perform manual data sources selection.

To select the data source by NMEA 2000 "Device Address" issue command:

YD:SRC_FIND *type Device_address*

Where *type* is one of the "YD:SRC datatype" from the Table 5 above and *Device_address* is the data source NMEA 2000 "Device Address", decimal.

Example 4a:

You have two Magnetic Variation sources, with NMEA 2000 "Device Addresses" 01 and 56 (decimal). NMEA 2000 data analysis reveals that Device 56 provides PGN 127258 "Magnetic Variation" with "Variation Source" of WMM year 2015 (outdated) but Device 01 provides "Variation Source" of WMM year 2020 (actual).

You want to use Magnetic Variation from Device with address 01. Issue command:

YD:SRC_FIND VARIATION 01

Note that it is highly recommended to select RUDDER source by "Rudder instance" instead, via YD:RUDDER command.

To explicitly select the data source by NMEA 2000 Device "NAME" issue command:

YD:SRC *type Device_NAME*

Where *type* is one of the "YD:SRC datatype" from the Table 5 above and *Device_ NAME* is the data source NMEA 2000 device "NAME" (unique 64-bit Device ID) written as 16 hexits.

Example 4b:

You have two Magnetic Variation sources, with NMEA 2000 NAMEs 0x 0123 4567 89AB CDEF and 0x FEDC BA89 7654 3210.

You want to use Magnetic Variation from Device with NAME 0x FEDC BA89 7654 3210. Issue command:

YD:SRC VARIATION FEDCBA8976543210

To allow data sources grouping issue command:

YD:SRC *type associated_source_type*

Where both *type* and *associated_source_type* are one of the "YD:SRC datatype" from the Table 5 above.

This command forces the Device to use *type* data from the same NMEA 2000 device as *associated_source_type.*

Example 5:

You have two Heading + ROT sources, one primary, based on the RTK solution and another, backup, based on the AHRS GYRO solution. NMEA 2000 data analysis reveals that both Heading + ROT sources provide valid data but AHRS GYRO Heading and ROT changes slightly slower than RTK.

Sea trials with manual Heading and ROT selection show similar performance for both AHRS and RTK colutions.

You want to use automatic Heading selection via YD:SRC HEADING AUTO (e.g. if primary Heading + ROT source fails, you can immediately switch to backup). However, it turns out that you need to get ROT from the same Device as Heading to improve Device performance. Issue command:

YD:SRC ROT HEADING

As a result, when Device "re-locks" to a new Heading source, the associated ROT source is automatically "re-locked" to the same source Device that has become a new Heading source.

Timeouts

If selected data source PGN will not present on the NMEA 2000 bus for more than YD:TIMEOUT milliseconds, Device will indicate data source lost on DATA LED.

If Device was engaged in TRACK or WIND mode, loss of some data items may cause exit from current mode to STANDBY or AUTO.

If Device was engaged in AUTO mode, loss of some data items may cause exit from current mode to STANDBY.

Refer to Section VIII. "Alarms and Error Conditions" for details.

Appendix C. Supported NMEA 2000 Messages

Table 6. Standard NMEA 2000 PGNs

PGN	Name	Receive	Transmit
59392	ISO Acknowledge	Yes	Yes
59904	ISO Request	Yes	Yes
60928	Address Claim	Yes	Yes
126208	NMEA - Group Function	No	Yes
126464	PGN List	No	Yes
126993	Heartbeat	No	Yes
126996	Product Information	No	Yes
126998	Configuration Information	No	Yes
127237	Heading/Track Control	No	Yes (2)
127245	Rudder	Yes	No
127250	Vessel Heading	Yes	No
127251	Rate of Turn	Yes	Yes (1)
127258	Magnetic Variation	Yes	No
127501	Binary Status Report	Yes	Yes
127502	Switch Bank Control	Yes	Yes
128259	Speed, Water Referenced	Yes	No
128267	Water Depth	Yes	No
129026	COG & SOG, Rapid Update	Yes	No
129283	Cross Track Error	Yes	No

129284	Navigation Data	Yes	No
129285	Navigation - Route/WP information	Yes	No
129291	Set & Drift, Rapid Update	Yes	Yes (1)
130306	Wind Data	Yes	No

Note 1: can be enabled/disabled via YD:TRANSMIT command.

Note 2: used for debug purposes.

Table 7. Yacht Devices proprietary PGNs

PGN	Name	Receive	Transmit
65380	Proprietary, "YD: AP Calibration State"	Yes	Yes
131048	Proprietary, Fast Packet, "YD: AP Debug"	No	Yes (1)
130832	Proprietary, Fast Packet, "YD: AP Data Sources setup" Read/Write	No	Yes (2)
130833	Proprietary, Fast Packet, "YD: AP Current Settings Dump" Read only	No	Yes (1)
131048	Proprietary, Fast Packet, "YD: Live AP Internal Model State Data"	No	Yes (1)

Note 1: used for debug purposes.

Note 2: used for data sources selection via CAN Log Viewer software.

Appendix D. Device Integration Sheet

Device Integration Sheet must be filled out by the Device Installer.

Device Integration Sheet must be accepted and signed by vessel's maintainer and owner.

If Device Integration Sheet is not filled out completely or filled incorrectly:

- vessel's maintainer and owner should NOT accept Device installation work;
- Yacht Devices Technical Support may not be able to provide adequate technical support.

Vessel details	
Vessel name and register number	
Vessel type	
Vessel hull displacement, metric tons	
Installation details	
YDAP-04 serial number and firmware version	
YDAP-04 unit location	
YDAP-04 installation date/time	
YDAP-04 assigned NMEA 2000 "System Instance" (or factory default 0)	
YDAP-04 assigned NMEA 2000 "Device Instance" (or factory default 0)	
YDAP-04 installed by: (company name, installers/technicians names, contact phones)	

Drive, Clutch and Rudder details	
Drive unit manufacturer and model, serial number	
Clutch unit manufacturer and model, serial number	
Rudder angle limits, PORT/STBD (actual/displayed by NMEA 2000)	
Set value of YD:POLARITY (or factory default FORWARD)	
Drive/Clutch/Rudder mechanical system details	
Main DC power system	
YDAP-04 BATTERY bus power voltage, Volts DC	
YDAP-04 BATTERY connected bus name/designation, (if applicable, e.g. for vessels with multiple DC buses)	
YDAP-04 BATTERY bus wiring details	
YDAP-04 BATTERY MAIN POWER fuse rating and location	
YDAP-04 BATTERY MAIN POWER bus switch location and designation	
Set YD:MIN_VOLTAGE value (or factory default 11.0 Volts)	
NMEA 2000 equipment details	
Rudder Feedback Sensor unit	
Manufacturer, model, serial number	
NMEA 2000 "NAME"	
PGN "Rudder" payload has "Rudder Instance" =	

Total number of PGN "Rudder" sources in current NMEA 2000 setup	
Rudder source selection method (default=auto or by "Device Address" or by NMEA 2000 "NAME" or by "Rudder Instance")	
Heading source unit	
Manufacturer, model, serial number	
NMEA 2000 "NAME"	
Total number of PGN "Vessel Heading" sources in current NMEA 2000 setup	
Heading source selection method (default=auto, by "Device Address" or NMEA 2000 "NAME")	
Wind data source unit	
Manufacturer, model, serial number	
NMEA 2000 "NAME"	
Total number of PGN "Wind Data" sources in current NMEA 2000 setup	
Wind source selection method (default=auto, by "Device Address" or NMEA 2000 "NAME")	
Speed Through Water (STW) unit (optional)	
Manufacturer, model, serial number	
NMEA 2000 "NAME"	
Total number of PGN "Water Speed" sources in current NMEA 2000 setup	
STW source selection method (default=auto, by "Device Address" or NMEA 2000 "NAME")	
COG/SOG data source unit	
Manufacturer, model, serial number	
NMEA 2000 "NAME"	
Total number of PGN "COG & SOG" sources in current NMEA 2000 setup	
COG/SOG source selection method (default=auto, by "Device Address" or NMEA 2000 "NAME")	
Depth source (optional)	

Manufacturer, model, serial number	
NMEA 2000 "NAME"	
Total number of PGN "Depth" sources in current NMEA 2000 setup	
Depth source selection method (default=auto, by "Device Address" or NMEA 2000 "NAME")	
Set Depth Below Transducer Alarm limit YD:ALARM_DEPTH, meters (or factory default OFF, Depth Alarm disabled).	
ECS/ECDIS system details	
List all system units on which Autopilot control is approved and tested with positive results. Type (MFD/Chartplotter/software) Manufacturer, exact full model	
ECS/ECDIS special notes (noteworthy implementation details, known limitations, quirks)	

Calibration	
1) Rudder extreme positions and Rudder deflection limits calibration	
Calibration date/time	
Values obtained after calibration	
YD:RUDDER_MAX	
2) Drive unit dynamics calibration	
Calibration date/time	
Values obtained after calibration	
YD:POLARITY	
YD:DRIVE_GAIN	
YD:DRIVE_FRICTION	
YD:DRIVE_OFFSET	
YD:DRIVE_MIN	
YD:DRIVE_SPEED	
YD:DRIVE_COUNTER	
3) Vessel rotation dynamics calibration	
Calibration date/time	
Values obtained after calibration	
YD:RUDDER_TRIM	
YD:RUDDER_GAIN	
YD:RUDDER_COUNTER	
YD:RUDDER_DELAY	
YD:MAX_ROT	
4) Compass calibration	
Calibration date/time	
Values obtained after calibration	
YD:HEADING_TRIM	
YD:ROT_BANK	

Digital switching	
Via standard NMEA 2000 PGNs	
Set YD:BANK (of factory default 5)	
Via CZone protocol extension	
Set YD:DIPSWITCH	
Set values of all YD:CIRCUIT (that differs from factory default)	
Set values of all YD:DSWITCH (that differs from factory default)	

Miscellaneous settings, fill out if any settings were set to non-factory default values	
YD:SHARP_TURN	
YD:OVERSHOOT	
YD:RAYMARINE	
YD:SIMRAD	
YD:RESPONSE	
YD:TURN_MULT	
YD:AHEAD_MULT	
YD:ALARM_XTE	
YD:ALARM_HDG	
YD:ALARM_WIND	
YD:DURATION	
YD:ROT_TYPE	
YD:SPEED_REF	
YD:WIND_TYPE	
YD:DAMP_WIND	
YD:LEEWAY	
YD:DAMP_LEEWAY	
YD:VARIATION	
YD:SPEED_AVG	
YD:AUTO_ADJUST	
YD:TRANSMIT ROT	
YD:TRANSMIT SET_DRIFT	
YD:TIMEOUT (for all timeouts that differs from factory default)	

Extra notes