Yacht Devices

User Manual

Rudder Angle Adapter

also covers models
YDRA-01R, YDRA-01N

Firmware version
1.02

2019

Contents

Package Contents

Device	1 pc.
This Manual	1 pc.
Blade «FASTON» receptacles	4 pcs.
Stickers for MicroSD slot sealing	6 pcs.
MicroSD card	not supplied
NMEA 2000 drop cable	not supplied

Note: Device can be connected to the network backbone directly, without an NMEA 2000 drop cable.

Introduction

The NMEA 2000 Rudder Angle Adapter YDRA-01 (hereinafter Adapter or Device) allows you to connect an existing resistive type rudder angle sensor installed on a rudder and supply NMEA 2000 autopilots, chart plotters and other devices with the rudder angle data.

The Device can be used with resistive rudder angle sensors with maximal resistance less than 400 Ohm. Most commonly used resistive sensors are of rheostat type and have only two terminals or wires.

The Device also supports potentiometer type sensors (with 3 terminals) up to 5 kOhms with an external power supply (see 1.1.2).

The Device can also be used with angular position transducers, equipped with voltage output, proportional to the angle value, in any range from 0 to 16 Volts.

The Device can provide different types of NMEA 2000 data: Rudder angle, Trim Tab position or Garmin «Custom Channel» angular value.

The Adapter can be installed as a standalone measuring unit, or together with compatible digital gauges, or in parallel with most types of 12V analog gauges (2-coil and 1-coil gauges are supported).

Rudder angle readings can be calibrated with up to 7 calibration points to compensate for non-linearity of the sensor's resistance value vs rudder angle, and to avoid making mechanical adjustments during installation. Parasitic resistance of the sensor wires can also be compensated in the settings.

The Device is equipped with a MicroSD card slot intended for configuration, calibration, firmware updates, diagnostics and data logging. No special software is required to update or configure the Device. You only need a laptop or smartphone with a MicroSD card reader and a simple text editor.

The Device is powered from the NMEA 2000 network and provides high voltage galvanic isolation between NMEA 2000 and sensor inputs.

We thank you for purchasing our Devices and wish you happy voyages!

Warranty and Technical Support

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

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

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

4. The warranty liabilities include repair and replacement of the goods and do not include the cost of equipment installation and configuration, as well as shipping of the defective Device to the manufacturer.

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

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

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

8. In the event of a failure, please refer to Appendix A before contacting technical support.

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

10. The contact details of the manufacturer and a list of the authorized dealers are published on our website: http://www.yachtd.com/

I. Product Specification

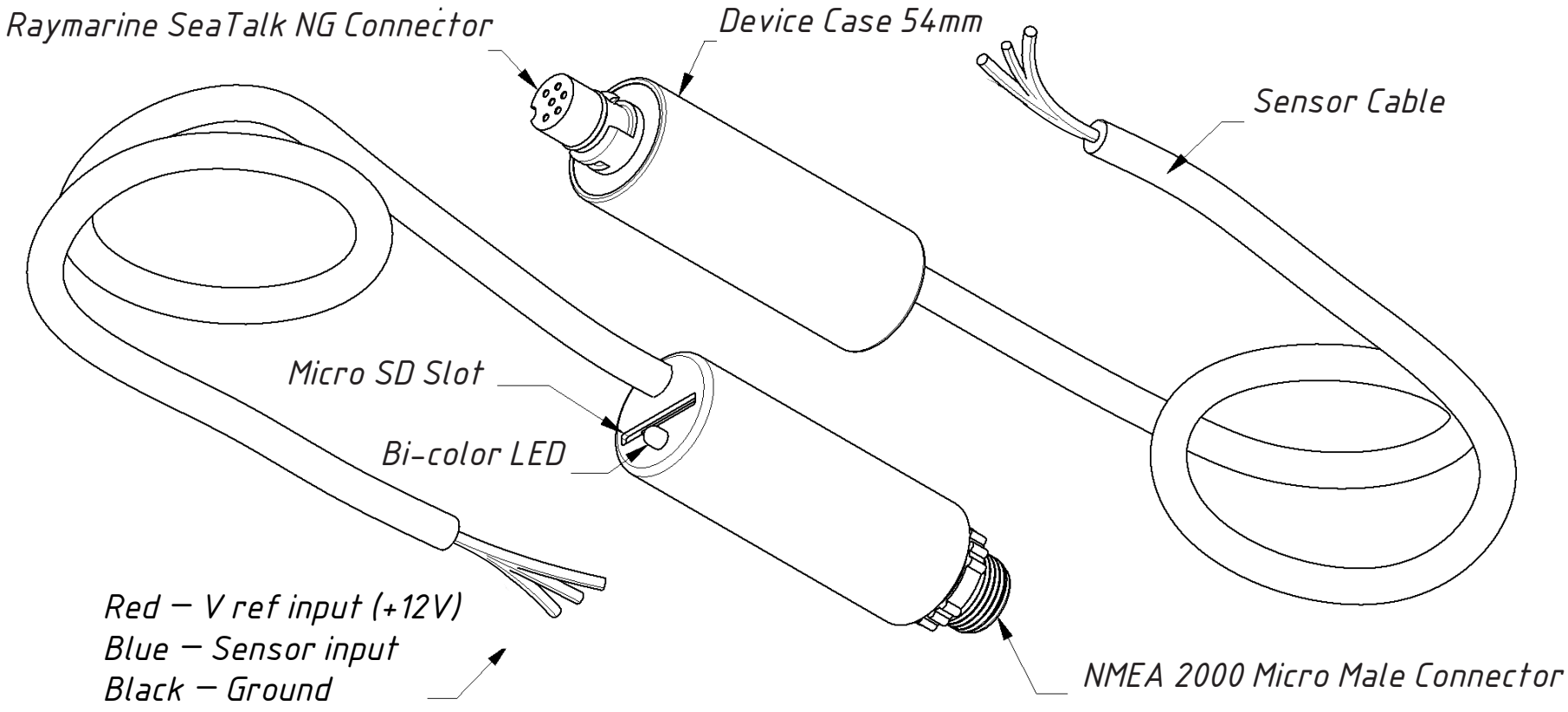


Figure 1. Drawing of YDRA-01R and YDRA-01N models of the Adapter

Our Devices are supplied with different types of NMEA 2000 connectors. Models containing R in the suffix of model name are equipped with NMEA 2000 connectors and are compatible with Raymarine SeaTalk NG. Models containing N in the suffix are equipped with NMEA 2000 Micro Male connectors.

Device parameter	Value	Unit
Supply voltage (from NMEA 2000 network)	7 — 16	V
Average current consumption (from NMEA 2000 network)	45	mA
Load Equivalency Number	2	LEN
Galvanic isolation between NMEA 2000 interface and sensor input	2500	V_{RMS}
Maximum voltage on sensor and gauge reference voltage inputs	16	V
Rudder angle sensor resistance range	0 — 400	Ohm
Analog gauge coils resistance range	0 — 10 000	Ohm
Sensor resistance measurement accuracy	±1	%
Device cable length	800	mm
Device case length	54	mm
Weight (without MicroSD card)	50	g
Operating temperature range	-20..55	°C

CE Yacht Devices Ltd declares that this product is compliant with the essential requirements of EMC directive 2004/108/EC.

Dispose of this product in accordance with the WEEE Directive. Do not dispose of electronic refuse with domestic or industrial waste.

II. MicroSD Slot and Card Compatibility

The Device has a slot for a MicroSD card that allows you to configure and calibrate the Device (refer to Section VI), update the firmware (refer to Section IX) and log the rudder angle in a file (refer to Section VIII).

If the MicroSD card is not permanently installed for logging, we recommend sealing the card slot with a sticker that is supplied with the Device or with a piece of tape to prevent water from entering the Device through the slot.

> *The Device slot has a «push-push» mechanism that works on a spring and ensures proper card fixation. Improper loading or unloading (withdrawing your finger to quickly or not waiting for the click) can result in the card being propelled out of the Device up to 5 meters. To avoid possible eye injury, loss of or damage to the card and other hazards, insert and remove the card with caution.*

The Device supports MicroSD memory cards of all sizes and classes. The MicroSD card must be formatted on a personal computer before it can be used in the Device. The Device supports the following file systems: FAT (FAT12, FAT16, MS-DOS) and FAT32. It does not support exFAT, NTFS or any other file systems.

Be careful when inserting the MicroSD card into the Device. The card is inserted with the label side toward the LED and with the pin side toward the sensor cable.

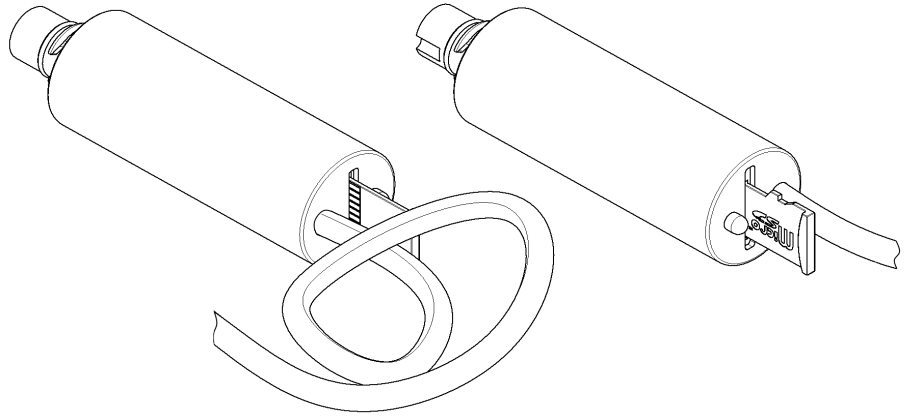


Figure 1. Device with MicroSD card (pin side visible at left, label side at right)

III. Installation and Connection of Device

All connections should be made when the power is cut off at the circuit breaker. This will protect against accidental short circuits during installation

The Device requires no maintenance. When deciding where to install the Device, choose a dry mounting location. Avoid places where the Device can be flooded with water, this can damage it.

1. Rudder angle sensor connection

The device has three wires for connection to a rudder angle sensor.

Table 1. Device wire colors and functions

Wire color	**Signal**
Red	Vref, sensor or analog gauge reference voltage
Blue	Sensor +
Black	Sensor – (ground)

The wires should be connected by crimping in sleeves or by twisting rather than soldering. Soldered connections can quickly break down in the marine environment and require insulation from moist air with paint or lacquer.

1.1 Standalone sensor connection

This connection method is suitable if you do not have a gauge connected to your rudder angle sensor. Two connection methods are supported: for rheostat type sensors (most common, with two terminals) and for potentiometer type sensors with voltage output (this type has three terminals and a voltage source is connected to it).

1.1.1 Rheostat type sensors

Rheostat type sensors have only two terminals, usually marked as «+» or «Signal» and «–» or «Ground». Most popular resistive sensors are of rheostat type and have only two wires or terminals. Before connecting the Device, you should check the sensor and measure its resistance values with the rudder in «full port» and «full starboard» positions. For this sensor you should connect only two wires of the Device: the Blue wire to the sensor «Signal» or «+» terminal and Black wire to sensor «Ground» or «–» terminal. The Red wire should be left unconnected and its terminal should be insulated.

You should configure the Device and set the CONNECTION setting to RESISTIVE and also set the measured values of your sensor to the OHMS_PORT and OHMS_STBD settings (refer to Section VI). Note that YDRA-01 supports rheostat type sensors up to 400 Ohms only.

1.1.2 Potentiometer type sensor

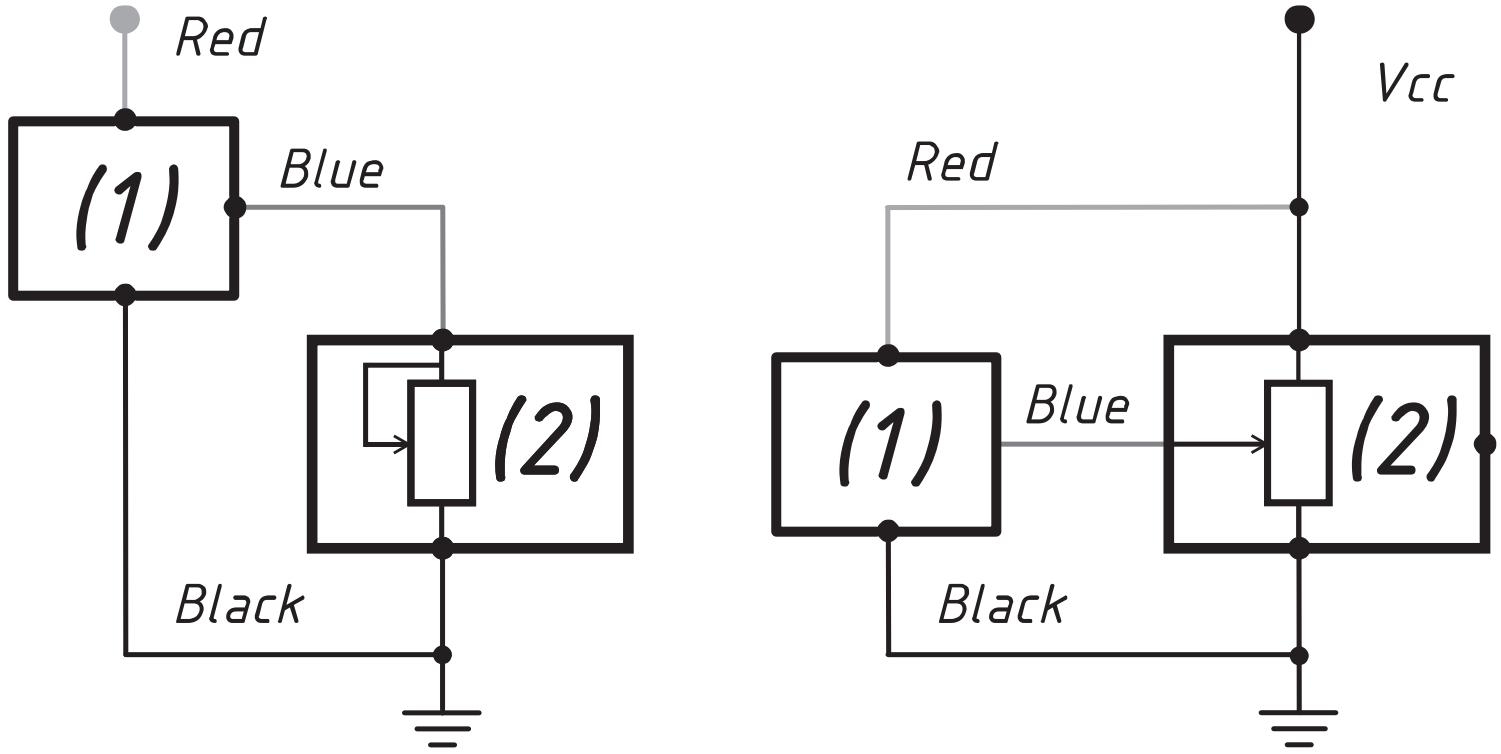
Potentiometer type sensor has three terminals, usually marked as «+» or «Vcc», «Signal» or «Out» and «–» or «Ground». YDRA-01 supports this type of sensor with maximal resistance up to 5 kOhms. The sensor should be connected to a voltage source (up to +16 Volt). You should connect the Blue wire to the «Signal» or «Out» terminal, the Black wire to the «Ground» or «–» terminal, and the Red wire to the «+» or «Vcc» terminal (refer to Figure 1 for connection scheme).

You should configure the Device and set the CONNECTION setting to VOLTAGE. After the sensor is connected, you should measure the voltage between the Black and Blue wires with the rudder in «full port» and «full starboard» positions and set the measured values in the VOLTS_PORT and VOLTS_STBD settings, measure the voltage between the Black and Red wires and set the measured value to REFERENCE setting (refer to Section VI).

1.1.3 Angular position transducers

Angular position transducers are supported only if they are equipped with voltage-output circuitry, capable of producing a voltage level proportional to the angular value. The Device supports voltage levels from 0 to +16 Volt. You should connect the Blue wire to the analog voltage signal output terminal and the Black wire to the «Ground» terminal of the sensor. The Red wire should be left unconnected and its terminal should be insulated.

You should configure the Device and set the CONNECTION setting to VOLTAGE. You should also measure the voltage between the Black and Blue wires with the rudder in «full port» and «full starboard» positions and set the measured values to VOLTS_PORT and VOLTS_STBD settings (refer to Section VI).



(1) — YDRA, (2) — Rudder Angle Sensor

Figure 1. Standalone sensor connection

1.2 Connection in parallel with an existing analog gauge

The analog gauge connected to the rudder angle sensor can be of two types: having a single measuring coil (this type of gauge has only two terminals) or having two measuring coils (three terminals).

You may have «combined» gauge equipped with several buttons (see Figure 2), one of which activates the measurement of the rudder angle. The Device detects whether the button is pressed or not and this does not affect the measurement results.

1.2.1 Connection to a 1-coil gauge

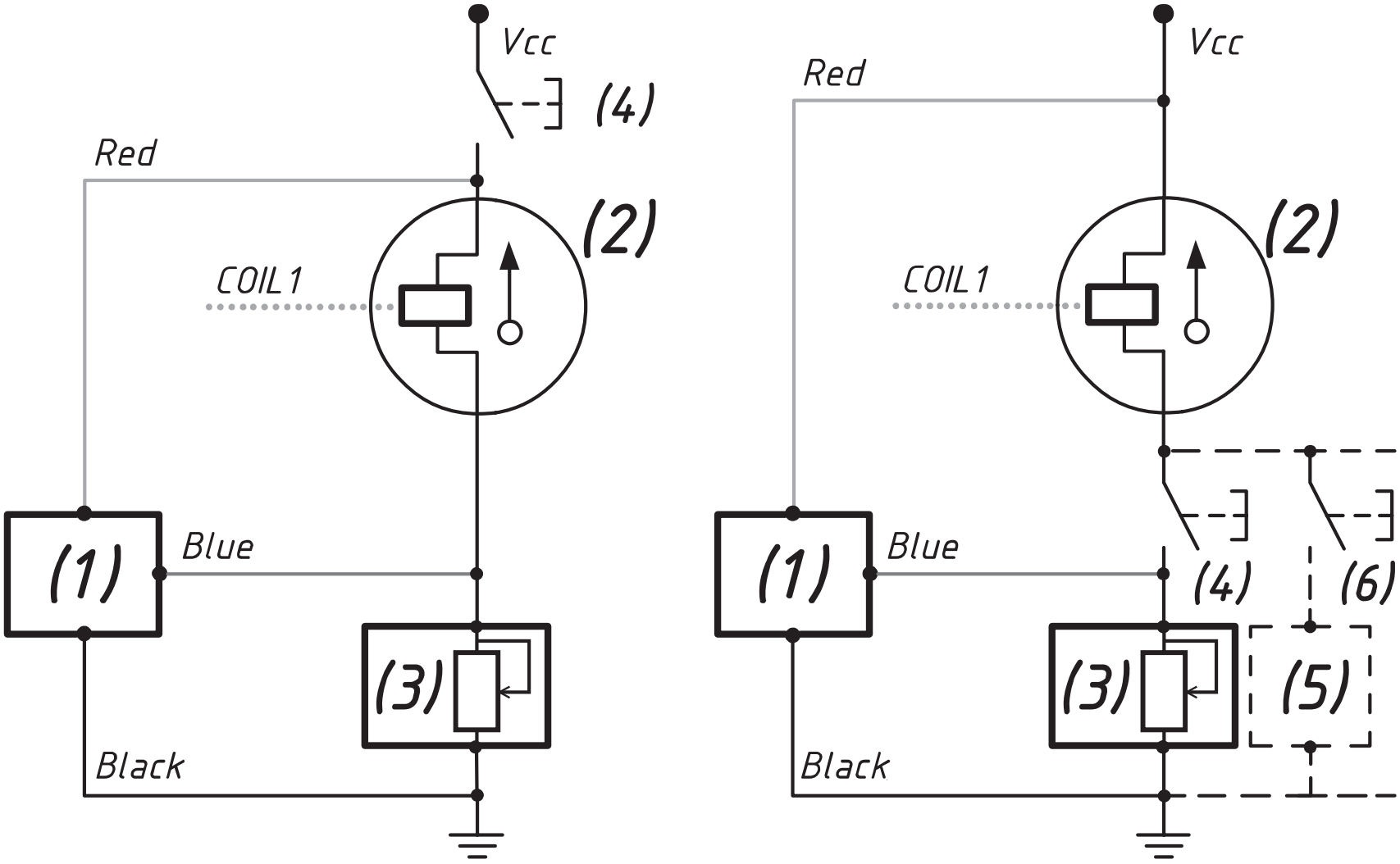
If the gauge has one coil, the Red wire should be connected to the gauge's power terminal (up to 16 Volts), the Blue wire to the gauge's «Signal» input (or to the rudder angle sensor's «Signal» wire after the measurement activation button — refer to Fig. 2), and the Black wire to the rudder angle sensor «Ground» terminal.

You should also configure the Device and set the CONNECTION setting to 1COIL (refer to Section VI).

1.2.2 Connection to a 2-coil gauge

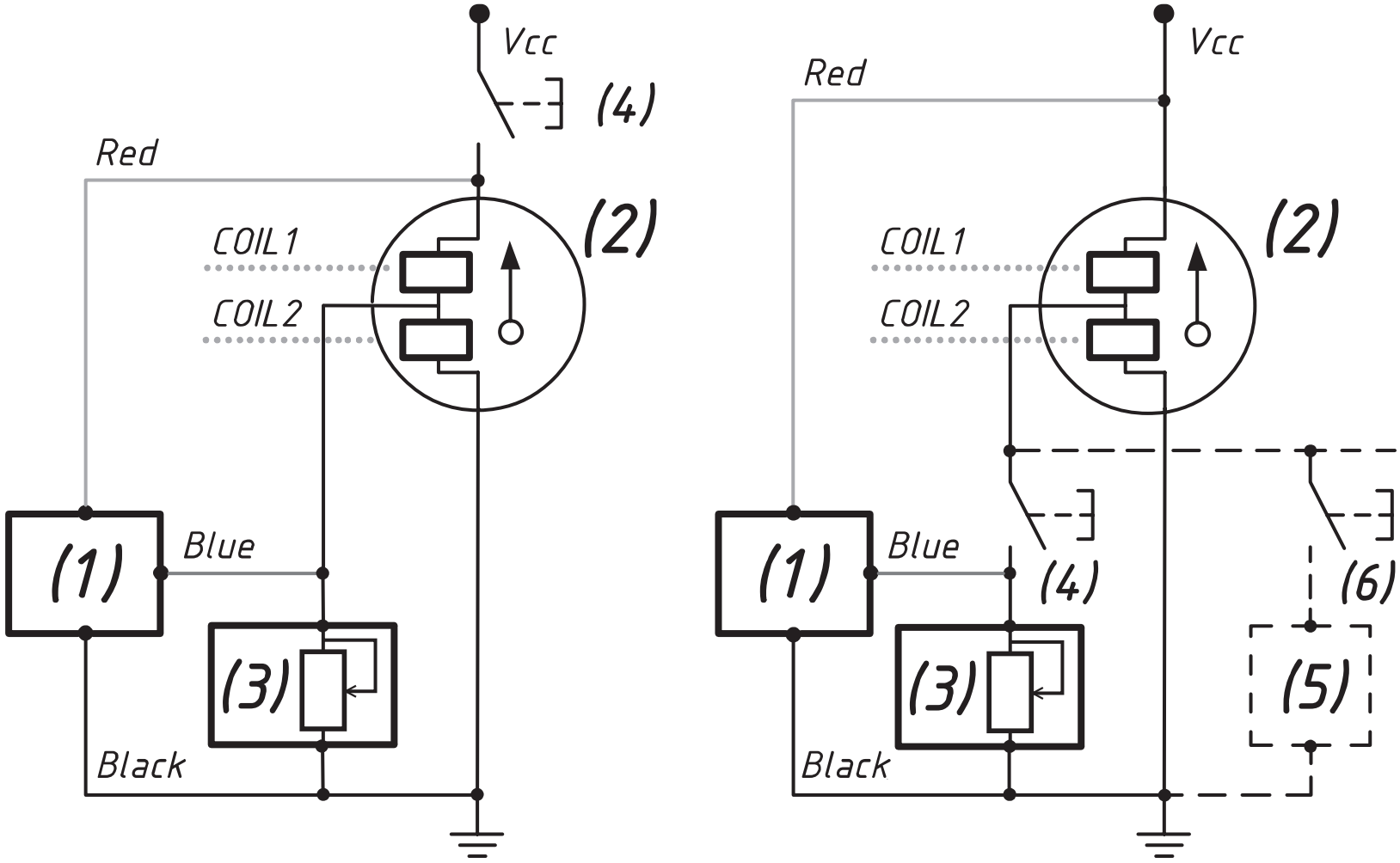
If the gauge has two coils, the Red wire should be connected to the gauge's power terminal (up to 16 Volts), the Blue wire to the gauge's «Signal» input (or to the rudder angle sensor's «Signal» wire after the measurement activation button — refer to Fig. 3), and the Black wire to the gauge's «Ground» terminal.

You should also configure the Device and set the CONNECTION setting to 2COIL_VCC for the connection scheme shown on the left of Fig. 3 and to COIL2 for the connection scheme shown on the right of Fig. 3. (refer to Section VI).



(1) — YDRA, (2) — Gauge, (3) — Rudder Angle Sensor, (4) — Optional Button, (5) and (6) — Parallel Sensors and their Buttons (optional)

Figure 2. Connection in parallel with an existing 1-coil analog gauge



1) — YDRA, (2) — Gauge, (3) — Rudder Angle Sensor, (4) — Optional Button, (5) and (6) — Parallel Sensors and their Buttons (optional)

Figure 3. Connection in parallel with an existing 2-coil analog gauge

When using a Device with an existing gauge, you will need to measure its coil resistance values with an ohmmeter or multimeter and set the measured values to the configuration parameters OHMS_COIL_1 and OHMS_COIL_2 (refer to Section VI).

To make an accurate measurement, you will need to warm up your gauge: turn it on and let it operate

for approx. 15 minutes. When you are ready, promptly disconnect the gauge and measure the COIL 1 resistance — between the gauge reference voltage source (+12V) input and sensor «Signal» input. For a two-coil gauge, you should also measure the COIL 2 resistance — between the gauge «Signal» input and gauge the «Ground» input. To increase accuracy, make several measurements and take the average value.

1.3 Parasitic sensor wire resistance compensation

It is recommended to keep the length of the wires connecting the rudder angle sensor to the gauge and the Device as short as possible. Long and thin wires have enough resistance to cause a persistent measurement error.

You can measure the wire's resistance and compensate for it in the Device's settings.

If the total sensor wire length is greater than 5 meters, it is recommended to measure the resistance with an ohmmeter or multimeter and set the measured value in the configuration parameter OHMS_WIRES (refer to Section VI).

To make an accurate measurement you should short the wires connecting the rudder angle sensor (firmly connect both wires at the sensor side) and measure the resistance between those wires on the Device side. To increase accuracy, make several measurements and take the average value. A value below 10 Ohms is acceptable; otherwise consider replacing the sensor cable.

2. Connection to NMEA 2000

The Device is directly connected to the network backbone without a drop cable. Before connecting the Device, turn off the bus power supply. Refer to the manufacturer's documentation if you have any questions regarding the use of connectors:

- SeaTalk NG Reference Manual (81300-1) for Raymarine networks
- Technical Reference for Garmin NMEA 2000 Products (190-00891-00) for Garmin networks

After connecting the Device, close the NMEA 2000 connector lock to ensure water resistance and reliability.

The Device is powered from the NMEA 2000 network and has an LED which flashes red or green. After the NMEA 2000 network power is turned on, the Device LED should produce one long and three short green flashes. If this does not happen, refer to Appendix A.

You can also check the NMEA 2000 connection and firmware version from a chart plotter. Please refer to Section IX for details.

IV. LED Signals

The Device is equipped with a two-color red/green LED that indicates the Device's state.

1. Signals during power-on sequence

The Device produces one long (half second) GREEN flash after powering on, indicating that the Device is successfully initialized.

After initialization the Device produces three short (quarter of second) LED flashes indicating that is has successfully connected to the NMEA 2000 network.

2. Signals during normal operation

When data logging to the MicroSD card is disabled (factory settings, see the Section VIII), the Device produces a single short GREEN flash. Device produces one LED flash for each tenth «Rudder» PGN sent to the NMEA 2000 network. Default interval between flashes is 1 second which corresponds to ten «Rudder» PGNs sent with a default interval of 0.1 second.

A short RED flash indicates an issue with the rudder angle sensor (rudder angle sensor has an internal fault, its wires are damaged, it is connected incorrectly, its position is out of range or the Device sensor connection settings and resistance settings are incorrect).

If data logging to the MicroSD card is enabled and a MicroSD card is inserted, the Device produces a series of two short LED flashes instead of one. The meaning of the first flash is the same as described above. The second LED flash indicates the MicroSD card log status: GREEN indicates that the last log file write operation was successful, RED indicates a log file writing error (there is no free space left on the MicroSD card, the file with the last available filename is full or there is an error in the file system).

3. Signals during the configuration using MicroSD card

After the MicroSD card is inserted, the Device produces three flashes:

- **GREEN, GREEN, GREEN:** the YDRA.TXT file has been read and changes has been applied to the current Device settings. The YDRASAVE.TXT file with an updated configuration has been saved on the card.
- **GREEN, RED, RED:** the YDRA.TXT file has been read from the card, but the current configuration of the Device has not been changed (either the configuration file does not differ from the current settings or there are no settings in the file). The YDRASAVE.TXT file with the current configuration has been saved on the card.
- **RED, RED, RED**: the YDRA.TXT was not found on the MicroSD card or the file system is not supported.

You can safely remove the MicroSD card when the flash sequence is finished.

4. Signals during firmware update

LED signals during firmware updates are described in Section IX.

V. Device Configuration and Settings

Configuration of the Device should not be performed at sea.

The Device can be configured by two different methods:

1. With the configuration file on a MicroSD card.
2. With a special set of commands which can be entered into the installation description field of the Device using PC software like CAN Log Viewer developed by our company, ActiSense NMEA Reader or Maretron N2KAnayzer. This method is very simple and may be supported in some chart plotter models.

Table 1. Applicability of the configuration methods

Number	Setting or action	Method	
		[1]	[2]
(1)	Reset device settings to a factory defaults	Yes	Yes
(2)	NMEA 2000 device instance	No	Yes
(3)	NMEA 2000 system instance	No	Yes
(4)	NMEA 2000 rudder instance (rudder number)	Yes	Yes
(5)	Transmission interval for PGN 127245 (Rudder), PGN 130576 (Trim Tabs), PGN 126720 (Garmin Custom Data)	No	Yes
(6)	Sensor type (Resistive or Voltage output)	Yes	Yes
(7)	Set maximum rudder deflection angle	Yes	Yes
(8)	Set sensor resistance standard values (USA and European)	Note (1)	Yes
(9)	Sensor resistance value at full starboard position	Yes	Yes
(10)	Sensor resistance value at full port position	Yes	Yes
(11)	Sensor/gauge connection method	Yes	Yes
(12)	Sensor gauge coils resistance values	Yes	Yes
(13)	Sensor wires parasitic resistance value	Yes	Yes
(14)	Add/remove calibration points	Yes	No
(15)	Enable logging to MicroSD card and set log interval	Yes	No
(16)	Switch to «Rudder», «Trim Tabs» or «Garmin Custom Data channel» data source mode	Yes	Yes

Note 1: Standard sensor resistance values can be programmed in this method by setting the sensor resistance value at full starboard position (9) and at full port position (9).

NMEA 2000 device (2) and system (4) instances should not be modified by the user, these fields are used by installers in complex NMEA 2000 networks.

VI. Device Configuration with a MicroSD Card

To configure the Device, a configuration text file YDRA.TXT should be created in the root folder of the MicroSD card. A sample of the configuration file is in Appendix D. The file contents must conform to these rules:

- parameters and their values must be entered in UPPER CASE;
- each parameter must be on a separate line;
- commentary lines must start with the # symbol.

Insert the card with the configuration file into the Device and in a few seconds you will see three LED signals (refer to Section IV.3) indicating that the configuration file has been processed. A YDRASAVE.TXT file with the current configuration of the Device will be created in the root folder of the memory card.

After the three LED signals, you can remove the card and check the new YDRASAVE.TXT file to be sure that the configuration file has been properly interpreted. You can also load an empty YDRA.TXT file into the Device to get the YDRASAVE.TXT file with the full configuration of the Device and then use it as a template to configure the Device.

A vertical line in the list of parameters below means that the setting may have one of these values.

1. *CFGRESET*

Resets Device settings to the default values. If this setting is present in the configuration file, all other settings will be ignored.

2. *RUDDER=x*

x — integer from 0 to 252, NMEA 2000 Rudder Instance (rudder number)
Factory setting: 0

A rudder number should be configured when multiple Devices are installed. For example, if there are two rudders installed on the vessel, you should configure port rudder Device with RUDDER=0 and starboard rudder Device with RUDDER=1.

3. *CONNECTION=RESISTIVE|1COIL|2COIL|2COIL_VCC|VOLTAGE*

Factory setting: RESISTIVE

Rudder angle sensor type. RESISTIVE — standalone connection, 1COIL — in parallel with 1-coil gauge, 2COIL and 2COIL_VCC — in parallel with 2-coil gauge, VOLTAGE — connection to a voltage-output sensor. Refer to Section III.1.

Note: Starting with firmware version 1.02, the CONNECTION setting replaces the old SENSOR_TYPE and GAUGE_TYPE settings.

4. *MAX_ANGLE=x*

x — integer from 10 to 90
Factory setting: 45

Rudder maximum deflection angle from the central position.

5. *OHMS_PORT=x*

x — number from 0.00 to 400.00
Factory setting: 10.0

Rudder angle sensor resistance value when the rudder is at full port position. Use this setting only with the connection to a resistive rheostat-type sensor type and set CONNECTION=RESISTIVE (refer to Section VI.3).

6. *OHMS_STBD=x*

x — number from 0.00 to 400.00
Factory setting: 180.0

Rudder angle sensor resistance value when the rudder is at full starboard position. Use this setting only

with the connection to a resistive rheostat-type sensor type and set CONNECTION=RESISTIVE (refer to Section VI.3).

7. OHMS_COIL_1=x

x — number from 0.00 to 10000.00
Factory setting: 200.0

Coil 1 resistance in Ohms for 2COIL connection or single coil resistance in Ohms for 1COIL connection. Refer to Section III.1.3. Use this setting only with the resistive type sensor connected to a single-coil gauge and set CONNECTION=1COIL (refer to Section VI.3).

8. OHMS_COIL_2=x

x — number from 0.00 to 10000.00
Factory setting: 200.0

Coil 2 resistance in Ohms for 2COIL connection. Refer to Section III.1.3. Use this setting only with the resistive type sensor connected to a dual-coil gauge and set CONNECTION=2COIL or 2COIL_VCC (refer to Section VI.3).

9. OHMS_WIRES=x

x — number from 0.00 to 100.00
Factory setting: 0.0

Sensor wire's parasitic resistance in Ohms. Used for compensation of the sensor wire resistance. Refer to Section III.1.4.

10. VOLTS_PORT=x

x — number from 0.00 to 16.00
Factory setting: 0.0

Voltage-output type sensor output voltage when the rudder is at full port position. Use this setting only with the connection to a voltage-output type sensor type and set CONNECTION=VOLTAGE (refer to Section VI.3).

11. *VOLTS_STBD=x*

x — number from 0.00 to 16.00
Factory setting: 5.0

Voltage-output type sensor output voltage when the rudder is at full starboard position. Use this setting only with the connection to a voltage-output type sensor type and set CONNECTION=VOLTAGE (refer to Section VI.3).

12. *REFERENCE=x*

x — number from 0.00 to 16.00
Factory setting: 5.0

Voltage-output type sensor reference output voltage. Use this setting only with the connection to a voltage-output type sensor type and set CONNECTION=VOLTAGE (refer to Section VI.3). If the red wire of the Device is not connected to a reference voltage source, this setting is ignored.

13. *CALIBRATION=a, b|OFF*

Factory setting: OFF
a — rudder position angle, degrees, integer from -90 to 90. Positive values are for starboard and negative values are for port deflections relative to the zero position.
b — transmitted rudder position angle, degrees, number from -90.00 to 90.00

Rudder angle sensors can have a nonlinear dependence on the resistance value vs the rudder position. This setting defines up to 7 calibration points, for which you can specify the «real» position of the rudder and the corresponding transmitted value.

Each calibration point should be added with its own CALIBRATION setting.

For example, the maximum rudder deflection angle on a vessel is ±24 degrees. For 7 calibration points, you need to split the whole range into equidistant angle intervals, in our example this corresponds to 0, ±8, ±16, and ±24 angle values.

The recommended calibration procedure is to configure maximum deflection angle and to reset all previous calibration values by loading a configuration file with two lines:

MAX_ANGLE=24
CALIBRATION=OFF

then read the angle values reported by the Device on a chart plotter or instrumental display for several (up to 7) known rudder positions and add all calibration values at once.

Suppose you got the following values:

Rudder angle position	**Angle value, reported by Device**
-24	-22.60
-16	-15.54
-8	-8.65
0	-1.49
8	4.17
16	12.27
24	21.15

Then you will need to add the following calibration settings:

CALIBRATION=-24,-22.60
CALIBRATION=-16,-15.54
CALIBRATION=-8,-8.65
CALIBRATION=0,-1.49
CALIBRATION=8,4.17
CALIBRATION=16,12.27
CALIBRATION=24,21.15

14. *ADD_POINT=a*

a — current rudder position angle, degrees, integer from -90 to 90. Positive values are for starboard and negative values are for port deflections relative to the central position.

Adds a calibration point for the current rudder position. This is an alternative way to calibrate the device.

For example, the maximum rudder deflection angle on a vessel is ±40 degrees. You can set the rudder to its central position and load the configuration file from MicroSD card with the single line:

MAX_ANGLE=40
ADD_POINT=0

to add a first calibration point. Then, you can set the rudder to its full starboard position and load ADD_POINT=40 to add the full starboard position calibration point, then do the same for port position with ADD_POINT=-40.

Calibration values entered via ADD_POINT are saved as a set of CALIBRATION parameters in the YDRASAVE.TXT file.

You can add only 7 points. If you try to add more than 7 points, they will be ignored. To remove or edit points created with the ADD_POINT command, save the current configuration to YDRASAVE.TXT file, edit the set of CALIBRATION settings and apply this new configuration via YDRA.TXT file.

15. *LOG=OFF|ON*

Factory setting: OFF

Disables/enables logging of rudder angle data to a file on the MicroSD card. Refer to chapter VIII.

16. *INTERVAL=x*

x — integer from 1 to 180, log interval in seconds.
Factory setting: 1

Set the log interval. Refer to chapter VIII.

17. *TRIM_TABS=OFF|PORT|STBD|MASTER|SLAVE|BOTH*

Factory setting: OFF

This setting allows the Device to be used as a trim tab sensor. In this mode, the Device stops transmitting «Rudder» PGN 127245 and starts transmitting «Trim Tab Status» PGN 130576 instead.

PORT — use measured angle value and transmit PGN 130576 with data for the port trim tab;
STBD — with data for the starboard trim tab;
BOTH — with data set the same for both port and starboard trim tabs;

If you have two Devices, one connected to a port trim tab and other connected to the starboard trim tab, you will need to use the port Device as MASTER, and the starboard Device as SLAVE.

The SLAVE setting instructs the Device to transmit measured value in our proprietary PGN 65328 instead of PGN 130576.

The MASTER setting instructs the Device to intercept our proprietary PGN 65328 and treat its data value as a starboard trim tab data value. The Master device will combine its own measured value (port trim tab data) and the intercepted value from the SLAVE device (starboard trim tab data) and then will send PGN «Trim Tab Status» 130576 with both port and starboard trim tab data.

OFF value turns off «Trim Tab Status» PGN transmission.

18. *CUSTOM_DATA=OFF|x*

x — integer from 1 to 9, Garmin «Custom Channel» number.
Factory setting: OFF

Disables/enables Garmin «Custom Channels» mode. In this mode, the Device stops transmitting «Rudder» PGN 127245 and starts transmitting the measured value as an angular data type value (with name YDRA) for the specified «Custom Channel» number. This mode can be used only with compatible Garmin NMEA 2000 equipment.

19. *CUSTOM_DATA_INTERVAL=x*

x — integer from 100 to 60000, transmission interval for Garmin «Custom Channel» data in milliseconds.
Factory setting: 500

Set the Garmin «Custom Channel» data transmission interval.

VII. Device Configuration with an Installation Description String

Installation description strings are stored in the Device's memory and are usually written by installers to specify the device location or to leave notes or contact information. They can be set with a PC software and a hardware gateway to the NMEA 2000 network. Some models of chart plotters also allow editing of installation description strings. Please refer to your software or chart plotter documentation for details.

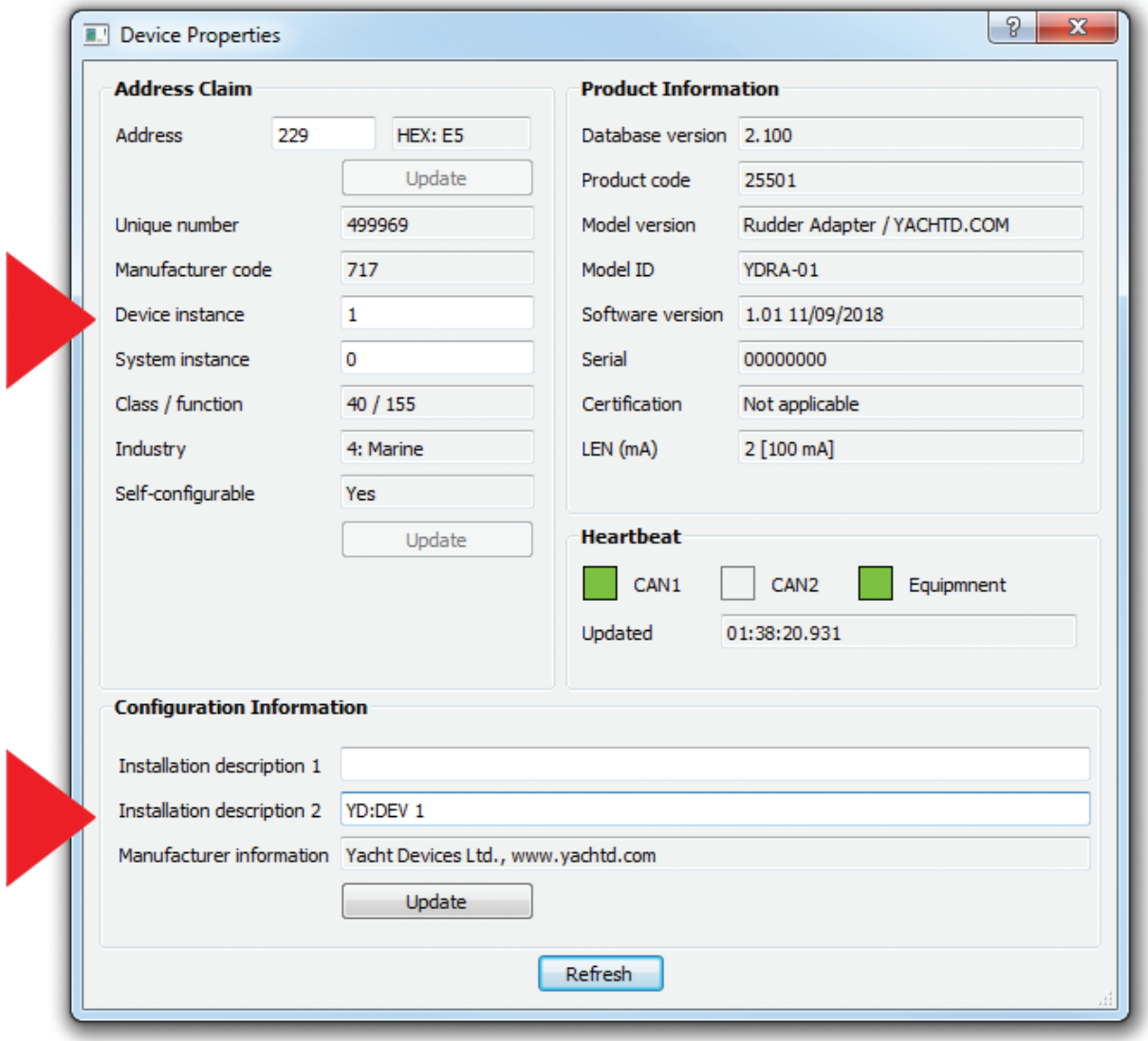


Figure 1. Programming with CAN Log Viewer

To program the Device, enter a special string starting with «YD:» to the installation description field 2 in the Device properties. For example, «YD:DEV 1» (without quotes) will change the NMEA 2000 device instance of the Device to 1. If the command is accepted by the Device, it will add «DONE» to the entered text and «YD:DEV 1 DONE» will be displayed in this installation description field. If a command is entered without the last parameter, the device replies with the current value of the parameter.

In Figure 1 on the previous page, you can see the process of programming the Device with free CAN Log Viewer software (to open this window, select the item «NMEA 2000 Devices» in the «View» menu, refresh the list of devices, and select the device and click «Properties» button). You can download this program (runs on Microsoft Windows, Mac OS X and Linux) at http://www.yachtd.com/downloads/. Yacht Devices NMEA 2000 Wi-Fi Gateway or Yacht Devices NMEA 2000 USB Gateway are required to connect the PC to the NMEA 2000 network.

CAN Log Viewer also allows you to modify the NMEA 2000 device instance by entering a value in the dedicated field (see «Address Claim» group on the screenshot).

After entering the command as shown in Figure 1 (click the «Update» button to apply changes), the value in the «Device Instance» field will be changed to 1, and «Installation Details 2» field will be changed to «YD:DEV 1 DONE».

Table 1. Installation description strings

Command string format	**Example**	**Description**
YD:RESET	YD:RESET	Reset device settings to the default values.
YD:DEV <number>	YD:DEV 1	Set NMEA 2000 device instance value (0–255). (Note 1)
YD:SYS <number>	YD:SYS 3	Set NMEA 2000 system instance value (0–15). (Note 1)

Table 1 continued

Command string format	Example	Description
YD:RUDDER <number>	YD:RUDDER 1	Set NMEA 2000 rudder instance value (0–252). This setting allows you to assign a Devices' rudder number, used it if the vessel has more than one NMEA 2000 rudder sensor. (Note 1)
YD:CONNECTION <type>	YD:CONNECTION RESISTIVE YD:CONNECTION 1COIL YD:CONNECTION 2COIL YD:CONNECTION 2COIL_VCC YD:CONNECTION VOLTAGE	Sensor connection method. RESISTIVE: standalone connection to rheostat type sensor, 1COIL: in parallel with 1-coil gauge; 2COIL: in parallel with a 2-coil gauge with permanently connected power source; 2COIL_VCC: in parallel with a 2-coil gauge with power source controlled by a button; VOLTAGE: to potentiometer or voltage-output type sensor. Refer to Section III.1. (Note 1)
YD:MAX_ANGLE<angle>	YD:MAX_ANGLE 30 YD:MAX_ANGLE 40	Rudder maximum deflection angle from the central position. Integer values from 10 to 90 are allowed. In this programming method, this command also REMOVE ALL calibration points. (Note 1)
YD:ADD_POINT <angle>	YD:ADD_POINT 0 YD:ADD_POINT-40	Add a calibration point for current rudder position. Integer values from -90 to 90 are allowed. Refer to Section VI.13

Table 1 continued

Command string format	Example	Description
YD:REMOVE <angle>	YD:REMOVE 0 YD:REMOVE -40	Remove a previously created calibration point for specified rudder position. Integer values from -90 to 90 are allowed.
YD:REMOVE ALL	YD:REMOVE ALL	Remove all previously added calibration points.
YD:PGN <pgn> <interval>	YD:PGN 127245 60000 YD:PGN 130576 50 YD:PGN 126720 100	Set transmitting interval for PGNs 127245 (Rudder) 130576 (Trim Tab Status) or 126720 (Garmin Custom Channel) in milliseconds. Allowed values: PGNs 127245 and 126720 — from 50 to 60 000; PGN 126720 — from 100 to 60 000. (Note 2)
YD:SENSOR <type>	YD:SENSOR EUR YD:SENSOR USA	Set the default standard sensor resistance values for full port and full starboard rudder positions. EUR: 10–180, USA: 240–33 Ohms. (Note 1)
YD:OHMS_PORT <ohms>	YD:OHMS_PORT 11.42	Set the sensor resistance value for the full port position, in Ohms. Range: from 0.00 to 400.00 Ohms. (Note 1)
YD:OHMS_STBD <ohms>	YD:OHMS_STBD 160.6	The same as above, but for a full starboard position.

Table 1 continued

Command string format	Example	Description
YD:COIL_1 <ohms>	YD:COIL_1 330.65	Coil 1 resistance in Ohms for 2COIL connection or single coil resistance in Ohms for 1COIL connection. Range: from 0.00 to 10000.00. (Note 1)
YD:COIL_2 <ohms>	YD:COIL_2 240.5	Coil 2 resistance in Ohms for 2COIL connection. Range: from 0.00 to 10000.00. (Note 1)
YD:WIRES <ohms>	YD:WIRES 0.48	Sensor wires parasitic resistance in Ohms Range: from 0.00 to 100.00. (Note 1)
YD:VOLTS_PORT <Volts>	YD:VOLTS_PORT 1.0	Set the sensor voltage value for the full port position, in Volts. Range: from 0.00 to 16.00 Volts. (Note 1)
YD:VOLTS_STBD <Volts>	YD:VOLTS_STBD 4.5	The same as above, but for a full starboard position. (Note 1)
YD:TRIM_TABS <mode>	YD:TRIM_TABS <mode> YD:TRIM_TABS OFF YD:TRIM_TABS PORT YD:TRIM_TABS STBD YD:TRIM_TABS BOTH YD:TRIM_TABS MASTER YD:TRIM_TABS SLAVE	Enable/disable «Trim Tabs» data source mode. Refer to section VI. 17. (Note 1)

Table 1 continued

Command string format	Example	Description
YD:CUSTOM_DATA <OFF|number>	YD: CUSTOM_DATA OFF YD: CUSTOM_DATA 8	Enable/disable Garmin «Custom Channel» data source mode. Integer values from 1 to 9 are allowed. OFF value turns off Garmin «Custom Channel» data source mode. Refer to sections VI. 17–19. (Note 1)

Note 1: If the parameter is omitted, the device will return the current parameter setting.

For example, if you enter YD:RUDDER, the reply will be YD: RUDDER 0, where 0 is the current Device's NMEA 2000 rudder instance value (rudder number).

Note 2: If the interval parameter is omitted, the device will return the current interval.

VIII. Recording a Log File

The Device allows recording measured sensor data values to the MicroSD card at regular intervals. These log files can be used as an archive of voyage rudder angle positions historical data.

Create a file called YDRA.TXT with the following lines included:

```
LOG=ON
INTERVAL=1
```

where 1 is the time interval between the log records in seconds.

Insert the MicroSD card into the Device. The Device will produce three green LED flashes (refer to Section IV.3) indicating that the configuration file has been processed.

The YDRAxxxx.TXT file (where xxxx – is a file number from 0001 to 9999) will be created in the root folder of the MicroSD card. The Device will append a new data record to the file according to the configured interval until the maximum file size is reached, in this case the next file will be created. After powering on, the Device will seek for a file with the greatest file number and will continue to append data to it. When the file with the last available file name (YDRA9999.TXT) is completely filled up with data, the logging stops.

The log file size is 16 clusters; with a 32 KB cluster size (can be specified during the card formatting) it will contain 12483 records. With a 1-second logging interval, one day of sailing will take up to 7 files, in other words, the Device can store a total of 3,9 years of sailing data given the MicroSD card of appropriate volume.

You can eject the MicroSD card from the Device at any time, you don’t need power off the Device.

Note that the logging configuration settings are saved in the non-volatile memory of the Device and will be active even after the card is removed or when the NMEA 2000 network is powered off. Logging will restart automatically when a MicroSD card is inserted allowing you to change a card on-the-fly.

Log files are ASCII-encoded text files with fixed line length. Each record contains 5 data fields with fixed

length divided by an ASCII «Space» character. Record example:

```
14.09.2018 22:04:46 OK #001 Angle -26.5°
```

where

1. *14.09.2018 — local date in DD.MM.YYYY format.*
2. *22:04:46 — local time in hh:mm:ss format.*
3. *OK — status code. Can be one of the following:*
   OK — no error

   NA — Device could not get NMEA 2000 address. This can happen if there are more than 252 NMEA devices in the NMEA 2000 network.

   IS — Invalid state. The Device is connected improperly. Refer to Sections III.1, VI.3 and VI.7.

   Invalid data. Rudder sensor resistance measurement is greater than 400 Ohm. Usually indicates sensor or wiring fault or incompatible sensor type.
4. *#001 — Rudder number (NMEA 2000 Rudder Instance). Refer to Section VI.2.*
5. *Angle -26.5° — Measured angle (with calibration applied). Note the leading space(s) and negative sign.*

IX. Firmware Updates

Download a current version of the firmware file from our site: http://www.yachtd.com/downloads/

Extract the AUPDATE.BIN file which contains the firmware update of the Device from the archive.

Prepare a MicroSD card with FAT or FAT32 file system, and copy AUPDATE.BIN file to the root folder. Insert the card into the Device and turn on the NMEA 2000 network power.

From 5–10 seconds after powering on, the LED will produce 5 green LED flashes. This indicates that the firmware update is successfully completed.

If the Device is already using the given version of the firmware or if the Device cannot open the file or the file is corrupted, the bootloader immediately transfers control to the main program. This is done without visual cues.

The Device information including the firmware version is displayed in the list of NMEA 2000 devices (SeaTalk NG, SimNet, Furuno CAN) or in the common list of external devices on the chart plotter (check the third line in Figure 1 on the next page). Usually, access to this list is in the «Diagnostics», «External Interfaces» or «External devices» menu entry of the chart plotter.

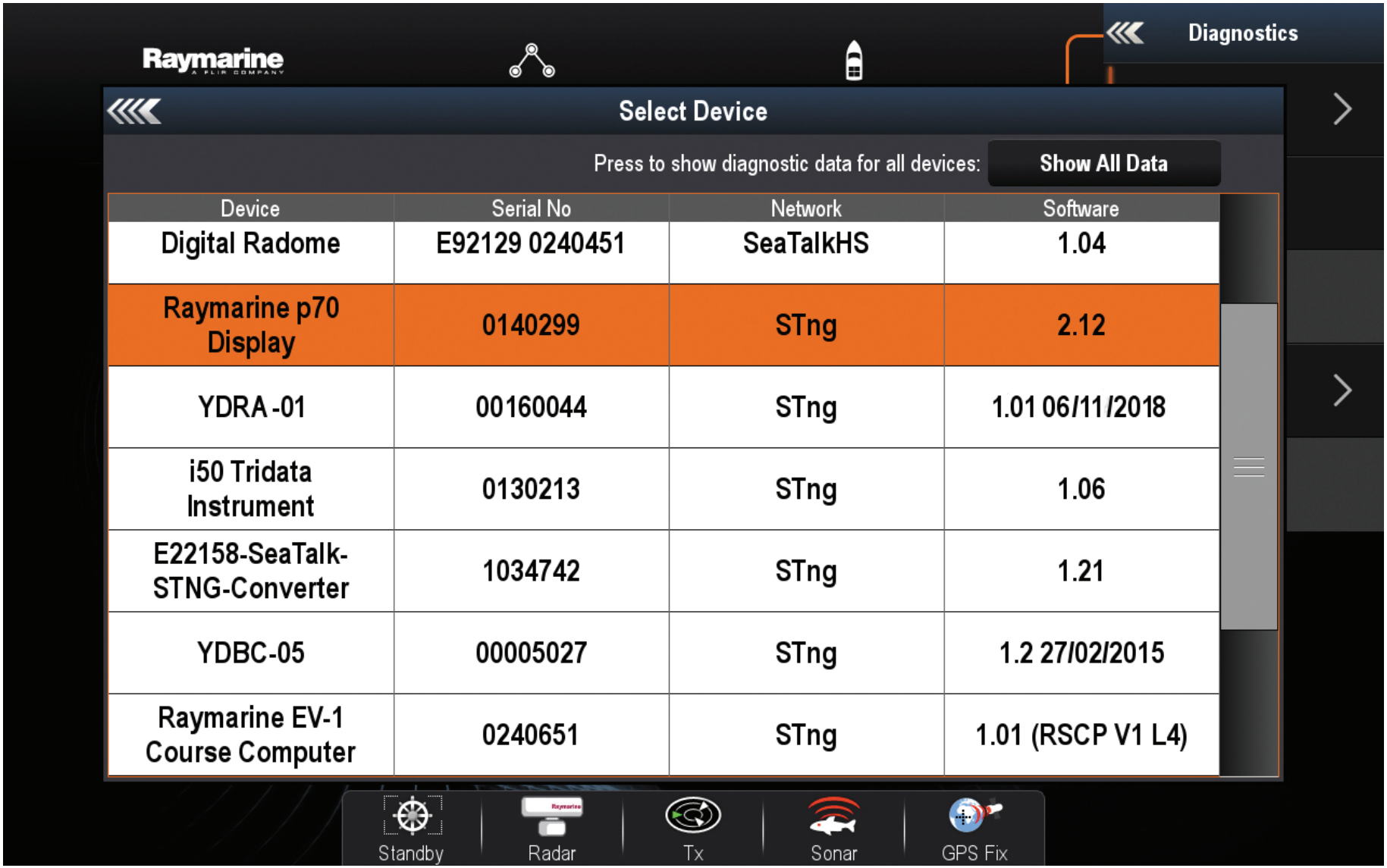


Figure 1. Raymarine c125 MFD devices list with Adapter (YDRA-01)

Appendix A. Troubleshooting

Situation	Possible cause and required actions
No LED indication after the NMEA 2000 network is powered on	**1. No power supply on the bus.** Check if the bus power is supplied (NMEA 2000 network requires a separate power connection and cannot be powered by a chart plotter or another device connected to the network). **2. Loose connection in the power supply circuit.** Treat the Device connector with a cleaning spray for electrical contacts. Plug the Device into another NMEA 2000 connector.
The Device produces long (1 second) red LED flashes continuously.	**1. Device cannot get NMEA 2000 device address.** There are more than 252 NMEA devices already in the NMEA 2000 network. Consider using our NMEA 2000 Bridge YDNB-07 to divide your network into separate segments.
The Device produces short green LED flashes corresponding to the configured PGN transmit interval, but is not displayed in the list of external devices on the chart plotter, data do not appear	**1. There is a NMEA 2000 network connection issue.** Loose connection in the data circuit. Treat the Device connector with a spray for cleaning electrical contacts. Plug the Device into another NMEA 2000 connector. **2. Connectivity issue in the NMEA 2000 network.** The network segment is not connected to the chart plotter or there are missing terminators in the network. Plug another device into the selected connector and make sure it appears in the list of devices on the chart plotter.
The Device is displayed in the list of devices on the chart plotter, but rudder angle data does not appear on the screen, Device first LED flash is RED	**1. Rudder angle sensor connection issue.** Check if the rudder angle sensor is connected according to the instructions given in Section III.1. Check the rudder angle sensor and its wires for shorts and failed connectivity. **2. Incorrect Device settings** (wrong connection method, sensor resistance range or coil resistances are set in the device configuration). Reconfigure the Device (refer to Section VI).

Table continued

Situation	**Possible cause and required actions**
The Device is displayed in the list of devices on the chart plotter, but rudder angle data does not appear on the screen, Device first LED flash is GREEN	**1. Incompatible equipment.** Make sure that your hardware supports reception of the «Rudder» 127245 PGN. Update the firmware of your equipment if necessary. **2. Rudder gauge is not enabled in the chart plotter settings.** Check the «data pages customization» section of the chart plotter manual and enable the gauge. **3. Wrong operation mode selected.** Check the device data source mode and configure your chartplotter accordingly. Refer to Section VI. 17–19
Device is configured to log rudder angle data to the MicroSD card, but the second LED flash is RED	**1. MicroSD card issue.** Check if the card has a supported file system (refer to Section II). Check the card file system for errors. Replace the card if the issue persists. **2. There is no space left on the card.** **3. The file with the last available filename YDRA9999.TXT is full.** Backup and delete log files.
Incorrect rudder angle readings	**1. Rudder angle sensor connection issue.** Check if the rudder angle sensor is connected according to the instructions given in Section III.1. Check the rudder angle sensor and its wires for shorts and failed connectivity. **2. Incorrect Device settings** (wrong connection method, sensor resistance range or coil resistances are set in the device configuration). Reconfigure the Device (refer to Section VI). **3. Sensor wires are too long.** Compensation of the parasitic sensor wire resistance is recommended (refer to Section VI.9). **4. Device needs to be calibrated.** Perform calibration as described in Sections VI.13 or VII.

Appendix B. Device Connectors

V+, V- – Battery 12V; CAN H, CAN L – NMEA 2000 data;
SCREEN – Not connected in the Device.

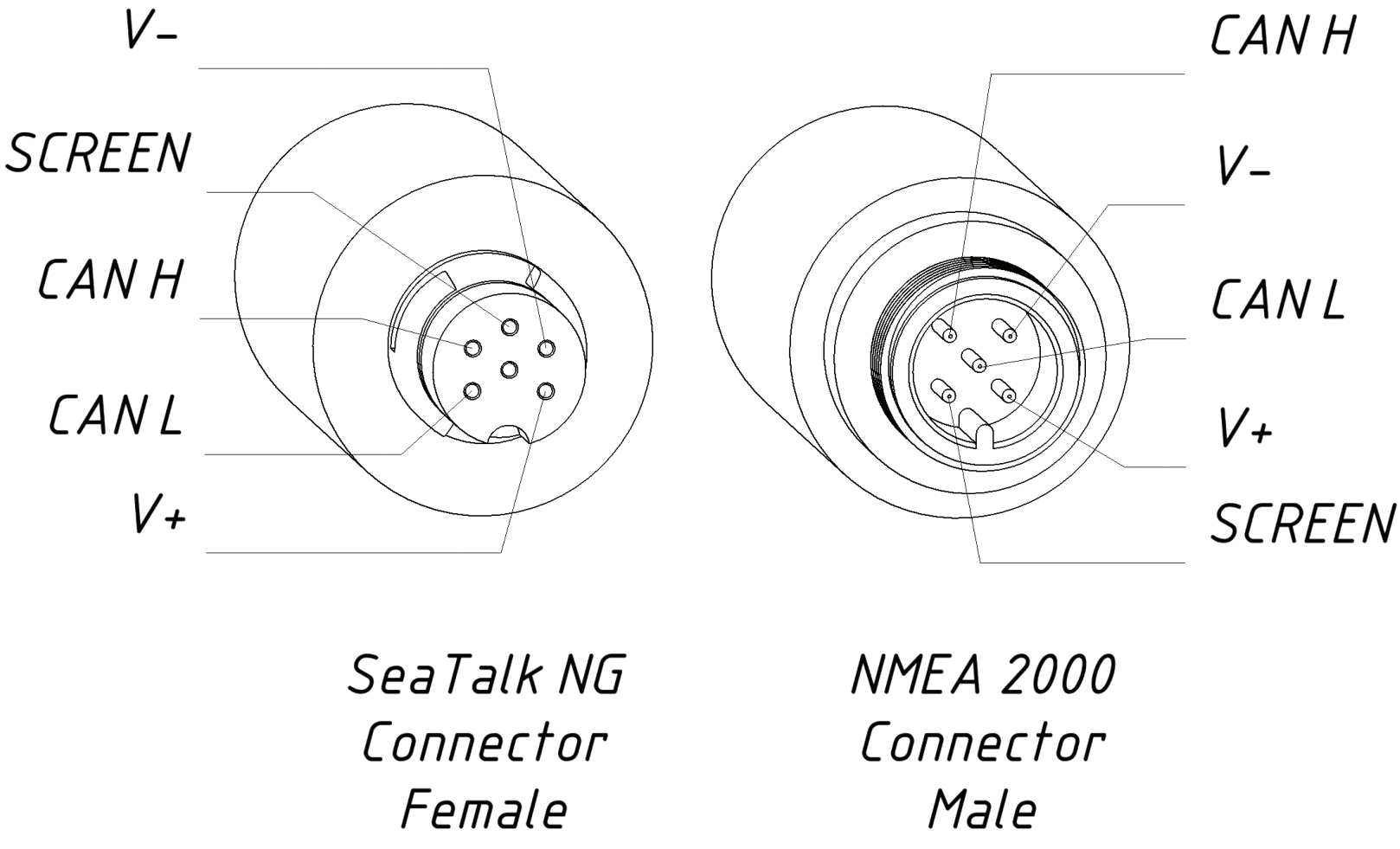


Figure 1. NMEA 2000 connectors of the YDRA-01R (left), and connectors of the YDRA-01N (right) models

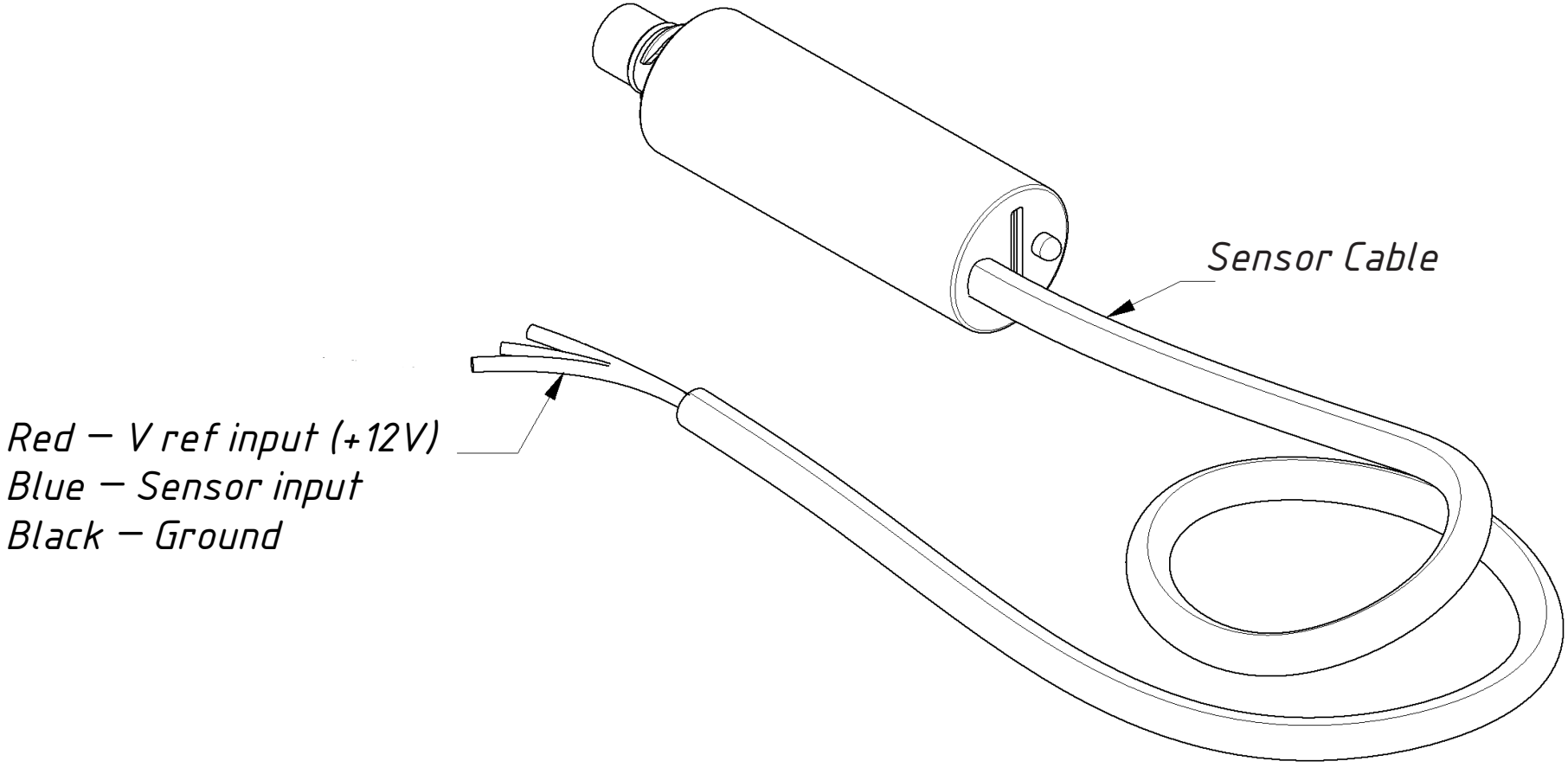


Figure 2. Device wire colors

Appendix C. NMEA 2000 Messages Supported by Device

Message	Receive	Transmit
ISO Acknowledgment, PGN 59392 (0xE800)	Yes	Yes
ISO Request, PGN 59904 (0xEA00)	Yes	No
ISO Transport Protocol (DT), PGN 60160 (0xEB00)	Yes	No
ISO Transport Protocol (CM), PGN 60416 (0xEC00)	Yes	No
ISO Address Claim, PGN 60928 (0xEE00)	Yes	Yes
ISO Commanded Address, PGN 65240 (0xFED8)	Yes	No
NMEA Group Function, PGN 126208 (0x1ED00)	Yes	Yes
PGN List Group Function, PGN 126464 (0x1EE00)	No	Yes
System Time, PGN 126992 (0x1F010)	Yes	No
Heartbeat, PGN 126993 (0x1F011)	No	Yes
Product Information, PGN 126996 (0x1F014)	No	Yes
Configuration Information, PGN 126998 (0x1F016)	No	Yes
Rudder, PGN 127245 (0x1F10D)	No	Yes (1)
Trim Tab Status, PGN 130576 (0x1FE10)	No	Yes (2)
Yacht Devices Proprietary (Trim Tab Slave Device Data), PGN 65328 (0xFF30)	No	Yes (2,3)
Garmin Proprietary «Custom Channel» PGN 126720 (0x1EF00)	No	Yes (4)
GNSS Position Data, PGN 129029 (0x1F805)	Yes	No
Local Time Offset, PGN 129033 (0x1F809)	Yes	No

Note 1 : Sent only if «Trim Tabs» or Garmin «Custom Channel» data source modes are disabled (refer to Section VI. 14–16). Sent every 0.1 seconds by default, interval can be changed in the Adapter's settings (refer to Section VII).

Note 2: Sent only if «Trim Tabs» data source mode is enabled in PORT, STBD, MASTER or BOTH mode (refer to Section VI. 14). Sent every 0.2 seconds by default, interval can be changed in the Adapter's settings (refer to Section VII).

Note 3: Sent only if «Trim Tabs» data source mode is enabled in SLAVE mode (refer to Section VI. 14). Sent every 0.2 seconds by default, interval can be changed in the Adapter's settings (refer to Section VII).

Note 4: Garmin «Custom channel» PGNs are sent only if Garmin «Custom Channels» data source mode is enabled (refer to Section VI. 15–16). Sent every 0.5 seconds by default, interval can be changed in the Adapter's settings (refer to Section VII).

Note 5: NMEA 2000 Device Instance, System Instance, Installation Description Field 1 and Installation Description Field 2 can be changed with PGN 126208 (professional NMEA 2000 installer software and hardware may be required).

Appendix D. Example of Configuration File

Contents listed below corresponds to the factory settings.

```
# Current configuration of Yacht Devices Rudder Adapter
# Firmware version: 1.02 04/09/2019

# NMEA 2000 SETTINGS
RUDDER=0

# CONNECTION AND SENSOR TYPE
CONNECTION=RESISTIVE
MAX_ANGLE=45

# RESISTIVE SENSOR SETTINGS (EUROPE: 10..180, USA: 240..33, JAPAN: 0..310)
OHMS_PORT=10.0
OHMS_STBD=180.0

# VOLTAGE SENSOR SETTINGS
VOLTS_PORT=0.0
VOLTS_STBD=5.0
REFERENCE=5.0

# ANALOG GAUGE SETTINGS
OHMS_COIL_1=200.0
OHMS_COIL_2=200.0
OHMS_WIRES=0.0

# RUDDER ANGLE TRANSMITTER CALIBRATION
CALIBRATION=OFF
```

```
# SENSOR DATA RECORDING
LOG=OFF
INTERVAL=1

# SWITCH TO TRIM TABS MESSAGES
TRIM_TABS=OFF

# ENABLE GARMIN CUSTOM DATA PROTOCOL (disables rudder info)
CUSTOM_DATA=OFF
CUSTOM_DATA_INTERVAL=500

# End of file
```