Yacht Devices

User Manual

Digital Thermometer YDTC-13

Digital Barometer YDBC-05

also covers models

YDTC-13R, YDTC-13RT, YDTC-13N, YDTC-13NT

YDBC-05R, YDBC-05RT, YDBC-05N, YDBC-05NT

Software version

1.50

2018

Digital Thermometer and Digital Barometer are certified by the National Marine Electronics Association.

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Contents

Package Contents

Device	1 pc.
This Manual	1 pc.

Introduction

This Manual contains information on how to install, configure and operate YDTC-13 digital thermometers (hereinafter Thermometer) and YDBC-05 digital barometers (hereinafter Barometer) intended for use on pleasure crafts.

The Thermometer and Barometer (hereinafter, where the differences are not critical, Devices) have one digital sensor. Up to 50 devices may be used on a vessel simultaneously; this limitation is set by the network specification. Data from the Devices can be displayed on chartplotters, digital navigation instruments, as well as used by other digital equipment of the vessel.

The Thermometer performs measurements within the range from -55 to +125 °C (-67..+257 °F), the sensor is placed outside the case on a flexible 95cm-long wire in a sealed stainless steel sleeve and can be used to measure the temperature of gases and liquids. The wire, if necessary, can be elongated up to 100 meters. The Thermometer can be configured to display its data as «Air temperature», «Sea temperature», «Temperature in the refrigerator», «Temperature in the engine room», etc.

The Barometer is intended for measuring atmospheric pressure within the range from 300 to 1100 hPa (mbar). The sensor is located inside the device case. The Barometer identifier can be configured so that data from several Barometers will be simultaneously displayed on a chartplotter.

These Devices can be configured to turn on or off specified channels of digital switching equipment. For example, the Thermometer can automatically turn on the sea water pump when the temperature in the live well is too high, and also turn it off when the temperature returns to normal. The Barometer can trigger an alarm when atmospheric pressure drops too fast. See Section VIII for details.

The measurements of the last 48 hours are stored in the Device's RAM and can be retrieved by compatible software (CAN Log Viewer) or hardware (NMEA 2000 Wi-Fi Gateway) to provide the user with historical data. The protocol is described in the Appendix C. We will be happy to help developers add support of this feature to their products.

The Devices are designed for operating in an NMEA 2000 network and are compatible with a wide range of equipment supporting this protocol. Raymarine SeaTalk NG, Simrad SimNet, Furuno CAN networks are branded versions of NMEA 2000 and differ only in the type of connectors. In its devices, Garmin uses the NMEA 2000 Micro connector which is compatible with the DeviceNet Micro connector. Our Devices are supplied with different types of connectors, making it possible to connect them to networks of different manufacturers without any adapters. The Device model is shown on the case.

Device model	**Type of the connector, compatibility (see Appendix B)**
YDBC-05R, YDTC-13R	Raymarine SeaTalk NG Female
YDBC-05RT, YDTC-13RT	Raymarine SeaTalk NG Female Terminator
YDBC-05N, YDTC-13N, YDBC-05NT, YDTC-13NT	NMEA 2000 Micro Male, DeviceNet Micro Male, Garmin NMEA 2000 Male

To connect to other types of NMEA 2000 networks, a cable adapter is required (it is not supplied with the Device and must be purchased separately).

According to the specification, an NMEA 2000 network has two terminators (120-Ohm resistors) connected to the NMEA 2000 bus ends. Device models with the T index at the end of their names contain a built-in terminator and should be connected to the network instead of the terminator. This allows a zero-cost connection of the Devices to existing networks with no free connectors. Please note that according to the specification, you can not use more than two devices with the T index on one NMEA 2000 bus.

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, when applying under a warranty case, the sale receipt may be requested.
2. The Device warranty is terminated in case of violating the instructions of this Manual, case integrity breach, repair or modification of the Device without manufacturer's written permission.
3. Modification of the Thermometer sensor cable is performed by the user at his own risk, the warranty does not cover the Device failure in this case.
4. If a warranty request is accepted, the defective Device must be sent to the manufacturer.
5. 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 the defective Device to the manufacturer.
6. Responsibility of the manufacturer in case of any damage as a consequence of the Device operation or installation is limited to the Device cost.
7. The manufacturer is not responsible for any errors and inaccuracies in guides and instructions of other companies.
8. The Device requires no maintenance. Device's case is non-dismountable. If the event of a failure, please refer to Appendix A before contacting the technical support.
9. The manufacturer accepts applications under the warranty and provides technical support only via e-mail or from authorized dealers.
10. Contact details of the manufacturer and a list of the authorized dealers are published on the website: http://www.yachtd.com/.

I. Product Specification

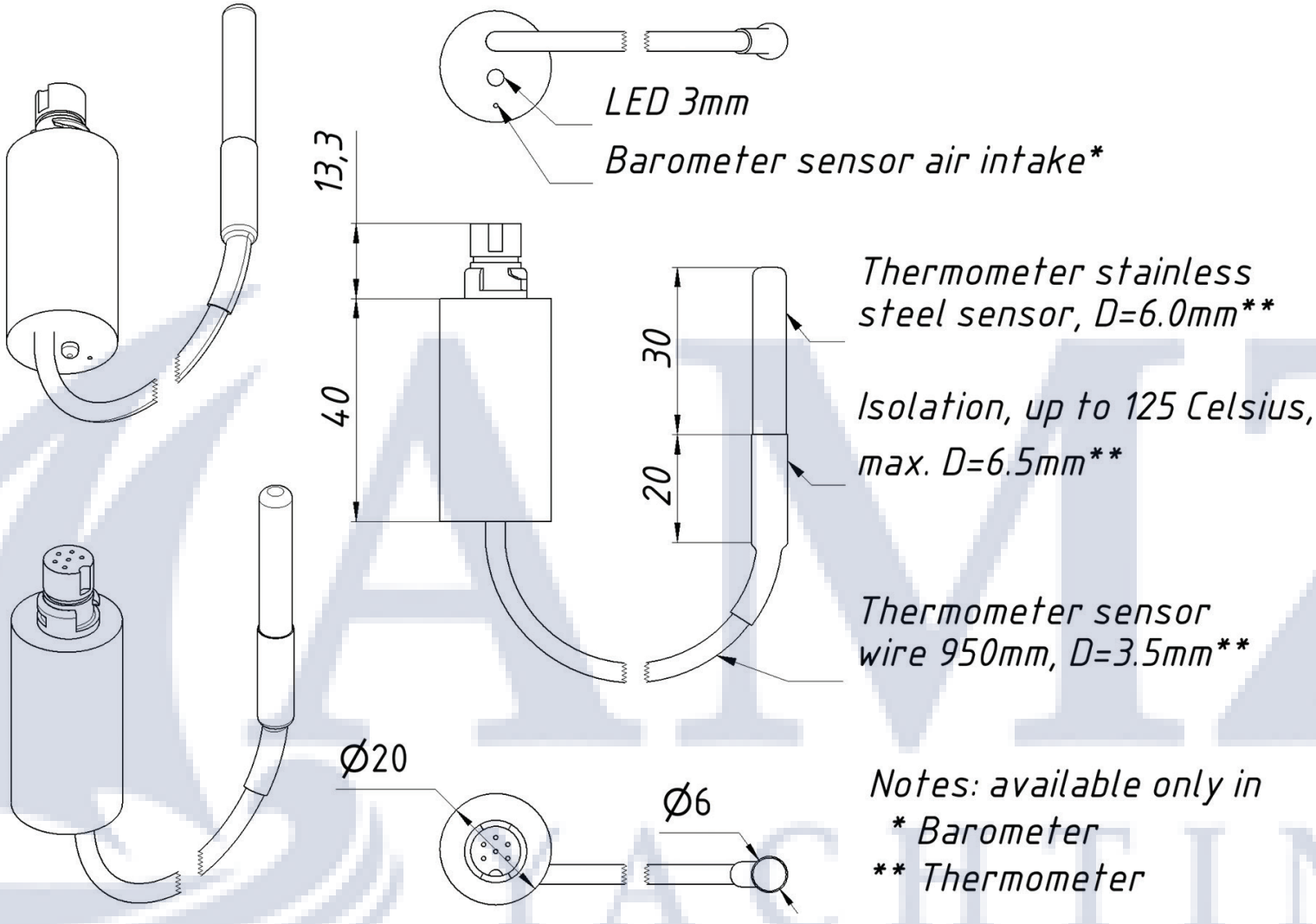

Figure 1. Combined drawing of the Thermometer and Barometer

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 mix electronic disposal with domestic or industrial refuse.

Device parameter	Value	Unit
Operating voltage (from an NMEA 2000 network)	7..16	V
Protection against reverse polarity	Yes	—
Consumption current of the Thermometer / Barometer	24 / 24	mA
Load Equivalency Number	1	LEN
Operating temperature range (except the Thermometer sensor)	-40..+80	°C
Weight of the Thermometer / Barometer	31 / 11	g
NMEA 2000 data output resolution	0.01	°C / hPa
Parameters of the Barometer		
Measurement range	300..1100	hPa
Relative measurement accuracy	± 0.12	hPa
Absolute measurement accuracy, at 0..+65 °C	± 1	hPa
Absolute measurement accuracy in the rest of the range	± 2.5	hPa
Parameters of the Thermometer		
Measurement range	-55..+125	°C
Error of the thermometer within the range of -10..+85°C, max	± 0.5	°C
Error of the thermometer within the rest of the range, max	± 2	°C

II. Device Connection and Testing

The Device requires no maintenance; calibration of the digital sensors has been performed by the manufacturer. Therefore, you can set an offset from -10.0 to +10.0 (Celsius for Thermometer or hPa for Barometer) for the sensor readings to align with readings from other ship equipment (see Section III).

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. The Thermometer sensor has a waterproof case made of stainless steel and is not intended for permanent location in hostile environments such as sea water. To prevent corrosion, when installing outdoors protect the sensor case with the help of a coating of paint.

Read the model number on the Device case. If the model name has the T index at the end (for example, YDBC-05NT), then the device has a built-in terminator (with resistance of 120 Ohm) and must be connected to the bus instead of an existing terminator. Different connectors for terminators (blue) and devices (white) are used in the SeaTalk NG network, which eliminates the chance to err. In networks with the NMEA 2000 Micro connectors (DeviceNet Micro, Garmin NMEA 2000), devices are connected to the Female connector on the bus, while terminators are connected to both Male and Female connectors.

The Device is directly connected to the bus 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 connecting cables, terminators and 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 lock on the connection to ensure its water resistance and reliability.

Figure 1. SeaTalk NG bus with the YDBC-05RT, YDTC-13R and YDBC-05R (left to right)

After turning on the bus power supply, the Device LED will produce one or two short

signals every second (see LED signals in Section VI).

If the Device is connected to a network having a chartplotter or any other device transmitting a PGN 0x1F814 (129044) message with chart datum configuration or PGN 0x1F11A (127258) with data on magnetic variation, the Device will produce six LED signals with a period of 0.5 seconds when such message is received for the first time after power is on. This usually happens within 15 seconds after the Device is turned on. The signal series confirms the Device is properly connected to the NMEA 2000 network and the chartplotter is able to receive data from the Device.

The Device information should be displayed in the list of NMEA 2000 devices (SeaTalk NG, SimNet, Furuno CAN) or in the common list of external devices on the chartplotter (see Figure 2). Usually, access to this list is in the «Diagnostics», «External Interfaces» or «External devices» menu.

Data from the Device are available to all the equipment connected to the network and can be displayed simultaneously on several chartplotters and digital navigation instruments.

Under the factory settings, the Thermometer shows measured data as air temperature. The Barometer always shows the measured data as atmospheric pressure, regardless of the user's settings.

Switch to the chartplotter screen, which provides information about the atmospheric pressure (for the Barometer) and air temperature (for the Thermometer) or add this indicator to the screen using instructions supplied with your equipment. Data in the indicator should begin to appear no later than 5 seconds after turning the Device on. Data is updated at an interval of 500 milliseconds.

Many chartplotters and digital navigation instruments are able to display data

on pressure and temperature in the form of graphs; this allows tracking of trends in the weather. The digital indicator can also contain a trend pointer (see Figure 3).

The Thermometer can be reprogrammed by the user to display data in other indicators, such as «Sea temperature», «Temperature in the engine room», «Temperature in the refrigerator» (see Section III).

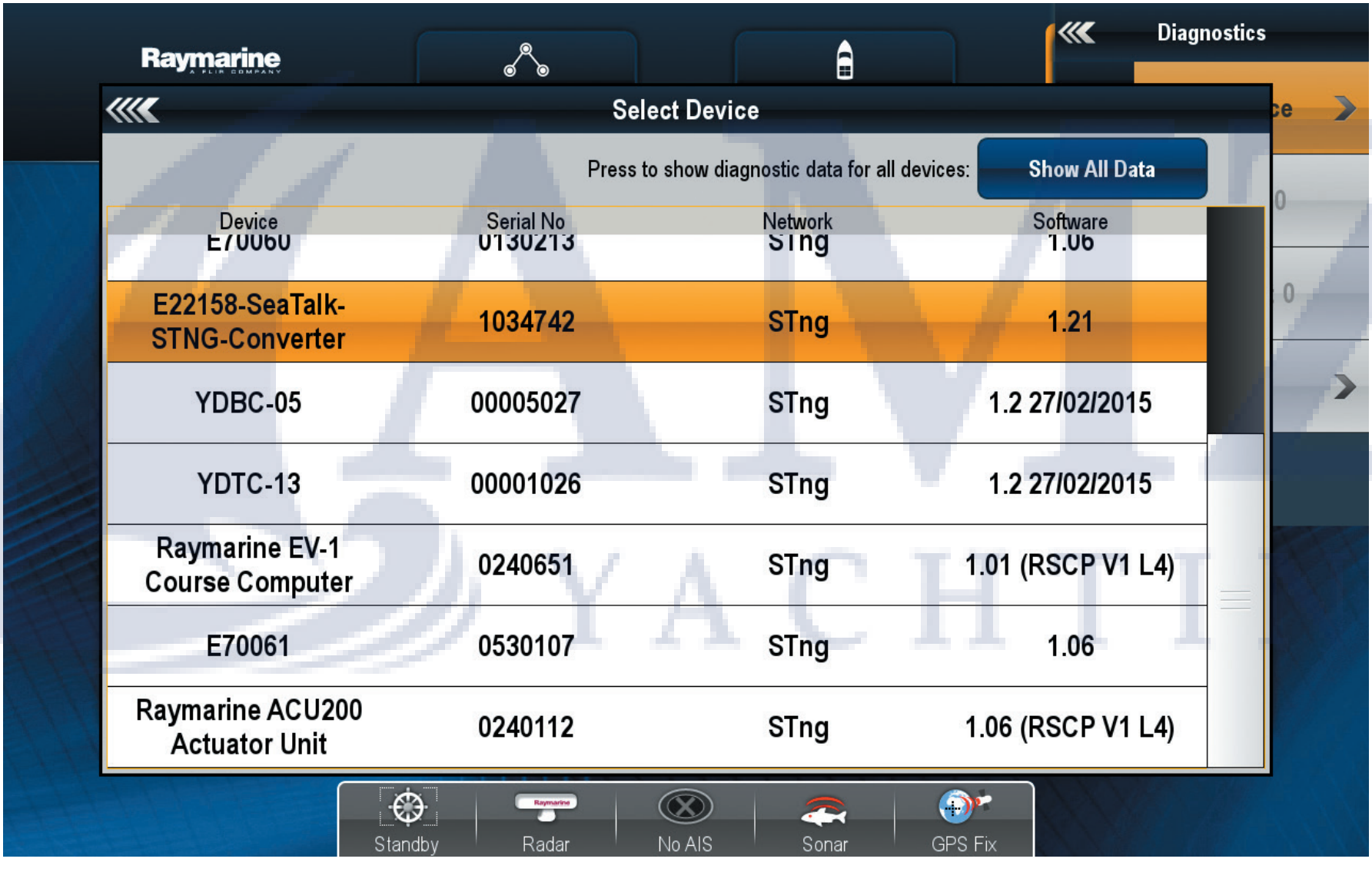

Figure 2. Raymarine c125 MFD devices list with Barometer and Thermometer

Figure 3. Garmin GPSmap 721 display with the connected Barometer and two Thermometers

The Thermometer sensor cable can be elongated up to 100 m by the user himself (note that the warranty for the modified Device is not maintained). To do this, turn the Device off, cut the cable in the middle (see Appendix B) and extend it with a three-conductor wire and properly insulate the joints. The wires are recommended to be connected by crimping in sleeves rather than soldering. Soldered connections can quickly break down in the marine environment.

The core section of the connection cable must not be less than 0.2 sq. mm, with the diameter of 0.5 mm. Cables of UTP 3, UTP 5, UTP 5e categories with the AWG-24 and AWG-22 labelling used for telephone lines and computer networks are suitable for the role of a connection cable. When routing the cable, avoid powerful sources of electromagnetic interference: motors, compressors, generators, electric pumps and transmitting antennas.

If after the cable extension the Thermometer's LED shines for two seconds with small interruptions, this indicates absence of communication with the digital sensor (see. Appendix A. Troubleshooting). In this case, check the connection cable and joints. Note that in previous firmware versions (1.2x and 1.3x), Thermometer shows a temperature of 290 °C in case of communication error; this behavior was modified.

III. Device Programming and Settings

Programming of the Device should not be performed at sea.

The Device can be programmed by three methods. Table 1 on the next page shows the applicability of the methods for different settings. The following methods are supported:

1. By a special sequence of datum or variation settings on a chart plotter (column [1] at Table 1). This method is tricky, but it only requires a chart plotter and it can be performed on legacy chart plotters. Tested with Garmin and Raymarine chart plotters. See Section V for details.
2. With a special installation description string which can be entered for the Device in PC software like CAN Log Viewer from our company, ActiSense NMEA Reader or Maretron N2KAnayzer. This method is very simple and may be supported in some models of chart plotters. Described in the next Section.
3. Using special PC software, including professional NMEA 2000 installer software. The Device supports «Request Message», «Command Message» and «Write Fields» functions of PGN 126208, which allows changing of the Device settings.

Table 1. Applicability of the programming methods

Number	Setting or action	Method		
		[1]	[2]	[3]
(1)	NMEA 2000 device instance and system instance	Yes	Yes	Yes
(2)	NMEA 2000 data instance	Yes	Yes	Yes
(3)	Type of a measured data (Thermometer only)	Yes	Yes	Yes
(4)	Transmission interval for periodic messages	Note 1	Yes	Yes
(5)	Sensor reading offset	No	Yes	Note 3
(6)	Installation description	No	Yes	Yes
(7)	Reset all settings to factory values	Yes	Yes	Note 3
(8)	NMEA 2000 message priority	No	No	Note 2
(9)	Digital switching settings	No	Yes	No

Note (1): Only turning on with default transmission interval and off are allowed with this method.

Note (2): Setting is not stored in non-volatile memory and acts only while Device is powered.

Note (3): Not allowed with «Command Message» and «Write Fields» of PGN 126208, use method 2.

NMEA 2000 device and system instances (1) should not be modified by a user, these fields are used by installers in complex NMEA 2000 networks. Message priority (8) can be dynamically managed on the network by devices and is not intended to be managed by a user.

NMEA 2000 data instance (2) may be used when multiple Devices are installed. For example, data on the refrigerator temperature with instance 3 can be displayed as «Temperature in refrigerator № 3». Chart plotters with factory settings are usually able to show only one value with data instance 0, but manufacturers may supply dealers and professional installers by internal instruments to customize chart plotter screens. Please refer to your chart plotter manual before changing this setting.

You can choose one of the 14 types of data types (3) for the Thermometer. Note that, for example, data on the engine room temperature (value 3 in Table 2) cannot be send in the PGN 130310. Refer to your chart plotter or instrument display manual what PGNs and temperature types are supported.

The data transmission interval (4) setting allows changing of the interval of periodical (data transmitting) messages with methods [2] or [3] and individually turning on/off message transmission with all three methods. Intervals from 50 milliseconds (value 50) to 1 hour (value 3600000) are allowed, a value of 0 turns off the transmission (but data can be received by request). «Restore default Interval» value is also supported in method [3] (see Appendix C). In case of method [1], the user can only turn on and off transmission of messages.

The Device sensor is calibrated at the factory. Therefore, you can set an offset (5) from -10.0 to +10.0 (Celsius for Thermometer, hPa for Barometer) for the sensor readings to align with readings from other ship equipment.

Installation description (6) are two text fields (see the next Section), which can be filled in by installer to specify the Device's location or leave notes and contact data. Special strings starting with «YD:» in the second field are used for Device programming in method [2].

Resetting of settings (7) returns a Device to the factory state.

To learn about digital switching settings (9), see Sections IV and VIII.

The next two Sections describe the details of Device programming with methods [2] and [1]. Regarding method [3], please refer to your software manual and the NMEA 2000 Standard.

Table 2. Setting type of a measured data for the Thermometer

Type setting	**Description**	**NMEA 2000 messages, PGN**			
		130310	**130311**	**130312**	**130316**
0	Sea Temperature	Yes	Yes	Yes	Yes
1*	Outside Temperature	Yes	Yes	Yes	Yes
2	Inside Temperature	—	Yes	Yes	Yes
3	Engine Room Temperature	—	Yes	Yes	Yes
4	Main Cabin Temperature	—	Yes	Yes	Yes
5	Live Well Temperature	—	—	Yes	Yes
6	Bait Well Temperature	—	—	Yes	Yes
7	Refrigeration Temperature	—	—	Yes	Yes
8	Heating System Temperature	—	—	Yes	Yes
9	Dew Point Temperature	—	—	Yes	Yes
10	Wind Chill Temperature, Apparent	—	—	Yes	Yes
11	Wind Chill Temperature, Theoretical	—	—	Yes	Yes
12	Heat Index Temperature	—	—	Yes	Yes
13	Freezer Temperature	—	—	Yes	Yes

* — *Factory setting*

IV. Programming with Installation Description String

> ⚠ *This method is not available for Devices with the firmware version below 1.40.*

Installation description strings are usually written by installers to specify the device location or to leave notes or contact information. This can be done with professional PC software (with a hardware connector to NMEA 2000 network) and it may be supported by some models of chart plotters. Please refer to your software or chart plotter documentation for details.

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 the case of our example. Note that the Device always accepts correct strings regardless of the current settings, etc.

In Figure 1 on the next 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, 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 is required to connect the PC with NMEA 2000 network.

In the software you can also 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 «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».

After entering the command as shown in Figure 1 (click «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».

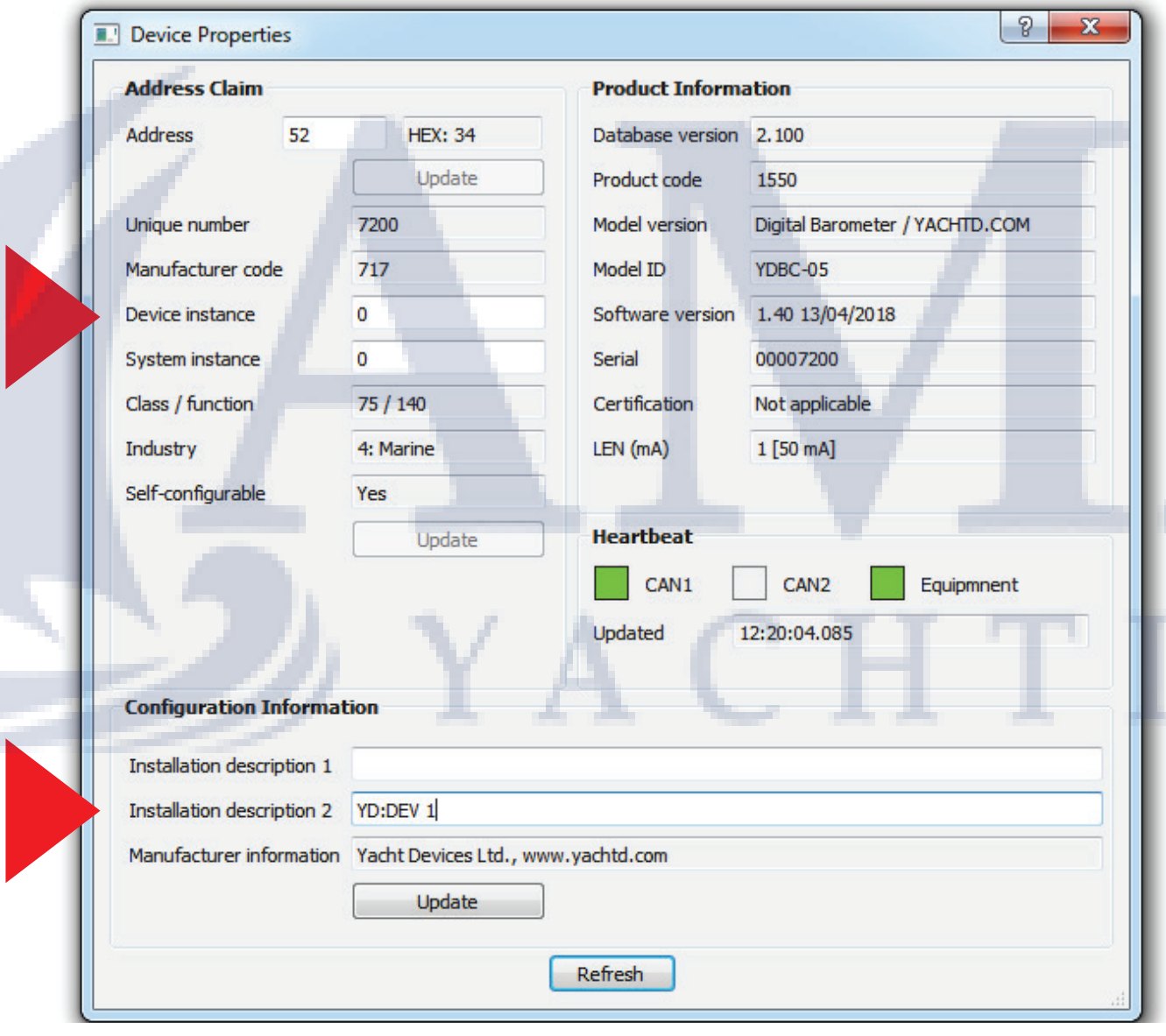

Figure 1. Programming with CAN Log Viewer

Table 1. Special strings

String format	Examples	Description
YD:DEV <number>	YD:DEV 1	Set NMEA 2000 device instance value (0..255). Factory setting 0.
YD:SYS <number>	YD:SYS 1	Set NMEA 2000 system instance value (0..15). Factory setting 0.
YD:DAT <number>	YD:DAT 1	Set NMEA 2000 data instance value (0..252). Factory setting 0.
YD:TYPE <number>	YD:TYPE 3	Thermometer only. Range 0..13, factory setting 1. Switches transmitted type of measured data (see Table 2 in the previous Section).
YD:TEMPERATURE <d> YD:PRESSURE <d>	YD:TEMPERATURE 3 YD:PRESSURE -1.5	Set positive or negative offset in °C or hPa. Values from -10.0 to 10.0 are allowed.

Table 1 continued

String format	Examples	Description
YD:PGN <pgn> <interval>	YD:PGN 130310 0 YD:PGN 130311 500	Set transmitted interval for specified message (130310, 130311, 130312 and 130316 for Thermometer; 130310, 130311 and 130314 for Barometer) in milliseconds. Values from 50 to 3600000 (1 hour) are allowed, value 0 turns transmission of specified PGN off.
YD:SW1 (parameters) YD:SW2 (parameters) YD:SW3 (parameters)	See Section VIII	Thermometer only. Turn on or off the channel of digital switching equipment depending on actual temperature.
YD:SBP (parameters) YD:S30 (parameters) YD:S1H (parameters)	See Section VIII	The Barometer only. Turn on or off the channel of digital switching equipment depending on actual pressure, or on the rise/fall of pressure over the last 30 minutes or 1 hour.
YD:RESET	YD:RESET	Reset all settings to factory values.

V. Programming with Datum or Variation

This method suitable for Devices with any firmware version. To program the Device with this method, you must connect it to a network with a chart plotter. This method of programming is tricky, but is compatible with virtually all NMEA 2000 chart plotters.

Figure 1. Setting the chart datum and magnetic variation on Raymarine c125

If one network includes several chart plotters, turn off all of them except the one from which you will program the Device. If multiple Devices are connected to the network, they will be programmed at the same time.

The Device confirms commands received from the chart plotter by lighting LEDs for 3 seconds once or repeatedly. If you are not able to see the Device LED when sitting behind the chart plotter, you may need an assistant.

Programming the Device is performed either by a sequential change of chart datum settings, or sequential change of the magnetic variation settings on the chart plotter. Older models of Raymarine plotters do not send notifications when changing the magnetic variation (NMEA 2000 message with PGN 127258) and only the first method is available for them. Garmin plotters do not send notifications when the chart datum is changed (NMEA 2000 message with PGN 129044) and only the second method is available for them.

To select a programming method, refer to the documentation of your chart plotter. In some cases you may need to update the plotter firmware.

STEP 1. Putting the Device into standby mode

The Device enters standby mode if, when it is switched on, the chart datum is set on the plotter as follows:

- to «Australian Geodetic 1966» for the Thermometer
- to «European 1950 (Mean, European Datum)» for the Barometer

Or if the magnetic variation on the plotter is set to a user-defined value with the following parameter:

- 28°W for the Thermometer
- 29°E for the Barometer

Usually the plotter sends notifications on settings every 20 seconds. When changing the setting on the plotter as mentioned above, do not forget to remember the initial configuration of the plotter. Cycle the Device power. Within a minute after the Device is turned on, it will produce a confirmation signal (LED will light up for 3 seconds). This means that the Device is put into standby mode. If the Device power is turned off along with the plotter power, the wait time for the signal will be increased by the plotter loading time.

If after some time the setting on the plotter automatically returns to the previous value, it means that there is another device in the network sending notifications. It may be an NMEA0183-NMEA2000 converter, another plotter, or a computer connected to the NMEA 2000 network. Turn off the power of this device or disconnect it from the NMEA2000 bus at the time of programming. It is recommended to disconnect any such device from the bus when the bus power is off.

STEP 2. Putting the Device into programming mode

If the Device was put into standby mode by setting the chart datum (magnetic variation), all the subsequent steps should be carried out with the setting of chart datum (magnetic variation).

In the standby mode, without turning the Device power off, change the chart datum setting on the plotter

- to «European 1950 (Mean, European Datum)» for the Thermometer
- to «Australian Geodetic 1966» for the Barometer

Or change the magnetic variation setting to:

- 29°E for the Thermometer
- 28°W for the Barometer

The Device will produce one confirmation signal and enter programming mode.

The programming mode ends automatically 10 minutes after the Device power is turned on. Four confirmation signals are produced at the same time. After that, the Device returns to normal operation mode. The settings are not saved into non-volatile memory and if the Device settings were changed at the time of programming, they will be kept only until the Device power is turned off.

STEP 3. Programming the Device

When programming, you can customize the list of NMEA 2000 messages containing data sent by the Device, as well as the type of the transmitted data (for the Thermometer only, the Barometer always has the «atmospheric pressure» data type).

Unlike the programming method described in the previous Section, this method does not allow setting the interval for messages with periodic transmission. This method allows turning on and off message transmission only. When transmission is turned on, the interval specified in NMEA 2000 Standard for this message is applied (see Appendix C).

Table 1. Setting NMEA 2000 messages for the Barometer and Thermometer

Messages setting	**Description**
0 (factory setting)	Maximum compatibility mode. Transfer of the measured value with instance data instance 0 in the following messages (PGN): • Barometer: 130310, 130311, 130314; • Thermometer: 130310, 130311, 130312, 130316.
1	Transfer of the measured value only in PGN 130310 message.
2	Transfer of the measured value only in PGN 130311 messages.
3..15	Transfer of the measured value only in PGN 130314 (Barometer) and PGNs 130312 and 130316 (Thermometer) messages with data instance 0..12.

We recommend using the maximum compatibility mode (value 0 in Table 1) and not changing the factory settings of messages unnecessarily. If you change the message setting to the value of 1 (see Table 1) and allow only PGN 130310 when the Thermometer is configured to send measured data as engine room temperature (see Table 2 in Section III), the Thermometer will stop transmitting temperature data as engine room temperature cannot be sent in this message. When configuring messages setting with the value of 0 and data type with the value of 13 (Freezer temperature, see Table 2 in Section III), only messages with PGNs 130312 and 130316 will be transmitted, because these data cannot be transferred in other messages.

Regardless of settings, the Device receives and transmits NMEA 2000 service messages (see Appendix C) and is displayed in the list of NMEA 2000 devices (SeaTalk NG, SimNet, Furuno CAN).

Table 3. Device actions in response to setting changes

Chart datum	Magnetic variation	Result
Bermuda 1957	20°E	Incrementing the message setting by one. Upon reaching 16, the setting value is set to zero.
Bogota Observatory (Colombia)	21°E	Incrementing the message setting by one. Upon reaching 16, the setting value is set to zero.
ARC 1950 (Africa)	22°E	Incrementing the message setting by 5. Upon reaching or exceeding 16, the setting value is set to zero.
Campo Inchauspe (Argentina)	23°E	Reset the message setting to zero (resetting to factory setting). Two confirmation signals.
Guam 1963 (Pacific Ocean)	24°E	For Thermometer only. Incrementing the data type setting by one. Upon reaching 14, the setting value is set to zero.
Hjorsey 1955 (Ireland)	25°E	For Thermometer only. Incrementing the data type setting by one. Upon reaching 14, the setting value is set to zero.
Ireland 1965	26°E	For Thermometer only. Incrementing the data type setting by 5. Upon reaching or exceeding 14, the setting is reset to zero.
Liberia 1964 (Africa)	27°E	For Thermometer only. Reset the data type setting to zero. Two confirmation signals.

Programming the Device is performed by changing the chart datum or magnetic variation setting on the plotter. The Device confirms the command by producing a single signal (unless shown otherwise in Table 3). The Device must be previously put into programming mode (STEP 2).

Please note that changing the Device settings occurs only when changing the plotter configuration. To increase the value of the message setting by 3, first change the setting to the first value from Table 3, then to the second, and then back to the first one. After each change, wait for the Device confirming signal (lighting of LEDs for 3 seconds). Usually, when changing the setting, the plotter sends notification immediately and the Device signals just after the setting value is changed.

STEP 4. Saving the settings in the non-volatile memory

Without turning the Device power off, change the chart datum setting on the plotter to «WGS 1984», or magnetic variation setting to 27°W. The Device will save the settings in the non-volatile memory, produce three confirming signals, and return to normal operation mode. If you do not save the settings into the non-volatile memory, they will be kept only until the power is turned off (see STEP 2). Do not forget to return the initial chart plotter settings after programming.

VI. LED Signals

Signal	Meaning
Short single flash after powering on	Indicating that the Device is functioning.
Six half-second signals, once after power on	Chart plotter presence indicator. This sentence is produced on first receiving of «Datum» (PGN 129044) or «Magnetic Variation» (PGN 127258) messages. Usually it happens within 20 seconds after chart plotter loading.
Repeated very short (25 milliseconds) signals	Normal operation. It is indicator of periodical messages sending (see Table 2 in Section III). Interval between flashes is 500 milliseconds by default, but can be changed by user.
Three second signal, once or repeatedly	Programming signals. See Section V for details.
Two second signal, once or repeatedly	Digital sensor communication problem (in case of permanent failure, two second signals with a small intervals).
One second signal with six second interval	Network problem. No messages was actually sent or received during the last seven seconds.

Signals during firmware update are described in the next Section.

VII. Firmware Updates

> ⚠ *Firmware updates are supported in the firmware version 1.40 and later.*

Firmware updates can be done with 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 an NMEA 2000 network with USB Gateway YDNU-02 or a Wi-Fi Gateway YDWG-02.

You should download the latest firmware version from our website:

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

Open the downloaded .ZIP archive with the update and copy the YDTC13.BIN file (for Thermometer) or YDBC05.BIN file (for Barometer) to the disk. The README.TXT file inside the archive can contain important information regarding the update.

1. Click the «NMEA 2000 Devices» item in the «View» menu.
2. Click the «Refresh» button (see Figure 1 at the next page) in the opened window and wait for the Device to appear in the list.
3. Select the Device and click the «Firmware Update» button.
4. Locate and select the update file with the .BIN extension on the disk.
5. Wait while the firmware is uploading.

If in doubt, watch the video with the update procedure on our web site. During

the firmware upload, the Device's LED flashes very fast. When the firmware is updated, Devices produce five half-second signals and the CAN Log Viewer also informs you that the update is successfully done.

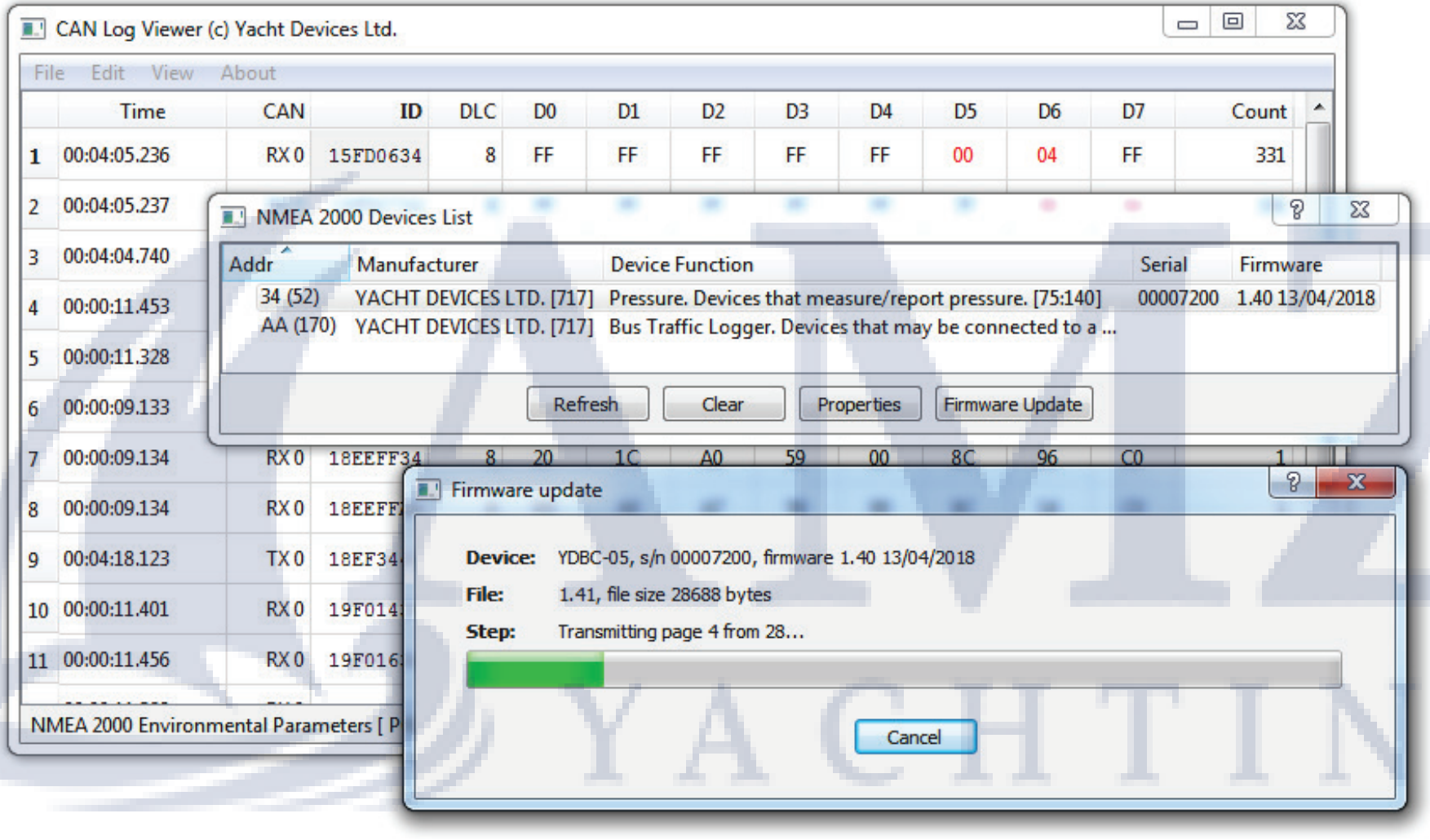

Figure 1. Firmware update of Barometer

VIII. Digital Switching Support

The Devices (with the firmware 1.50 or later) can turn on or off channels of NMEA 2000 digital switching which support the PGN 127502 «Switch Bank Control». A list of compatible equipment can be obtained on our web site. Configuration can be performed with the method described in Section IV.

1. Configuration of the Thermometer

You can configure 3 different rules to turn on and 3 rules to turn off the channels depending on the actual temperature value (six conditions in total). Here is an example command:

```
YD:SW1 ON <-0.5 60 0 1
```

This command programs the 1st rule to turn ON channel 1 (values 1 – 28 are allowed, channel numbers start from 1) of Switching Bank 0 (values 0 – 252 are allowed, zero based) if the temperature is below -0.5 Celsius (allowed values are from -273.15 to 2000 Celsius) in the last 60 seconds (intervals from 0 to 65534 seconds are allowed).

The command:

```
YD:SW1 OFF >5 10 0 1
```

Programs the 1st rule to turn OFF this channel if the temperature exceeded 5 Celsius in the last 10 seconds. The bank number and the channel in the ON and OFF conditions of the same rule can be different.

To check the programmed rule, run the following command without parameters:

```
YD:SW1
```

The answer in the «Installation Description 2» field will be:

```
SW1 ON <-0.50 60 0 1, OFF >5.00 10 0 1 DONE
```

To disable the ON condition, type:

```
YD:SW1 ON NEVER
```

To configure rules 2 and 3, use commands `YD:SW2` and `YD:SW3`.

When the condition becomes true (and remains true for a specified time interval), the Device sends the command to the network. If no response (PGN 127501 «Binary Status Report») is received in 200 milliseconds or the status of the channel in the answer does not match, the Device re-sends the command one time.

After sending the command, the condition becomes inactive. It will be active again when it remains false for the specified time interval. Therefore, it is not recommended to use a zero time interval, since this can cause sending of multiple messages if the temperature is not stable (or have no noticeable trend). Also, if the interval is too big, the fact that returning to the original state will take as much time as the triggered action may lead to undesirable results.

For example, you need to program the sea water pump (bank 0, channel 1) to run if the temperature in the live well is above 15 degrees (the normal temperature is below 13 degrees). In case someone accidentally turns off the pump, you can add an additional rule to turn the pump on when the temperature is above 20 degrees. And in case the pump is broken, you can turn on the sound alarm (bank 0, channel 2) if the temperature reaches above 23 degrees. To configure the Thermometer in this way, enter the following commands (one by one, and wait for confirmation with «DONE» after the each command):

```
YD:SW1 ON >15 30 0 1
YD:SW2 ON >20 15 0 1
YD:SW3 ON >23 10 0 2
YD:SW1 OFF <13 10 0 1
```

The configuration above guarantees the protection of your catch.

2. Configuration of the Barometer

Unlike the Thermometer, commands begin with YD:SBP, YD:S30 and YD:S1H. Other syntax is the same.

The command YD:SBP allows setting the rule based on the actual atmospheric pressure (specified in millibars or hPa, allowed range from 0 to 3000 mb). For example, to turn on Channel 1 of Bank 0 when the pressure has exceeded 1022.5 mb in the last 10 minutes (600 seconds), type:

```
YD:SBP ON >1022.5 600 0 1
```

This rule is practically unusable if you have no «sunny weather» indicator connected to the digital switching equipment.

Commands YD:S30 and YD:S1H operates by the difference (from -3000 to 3000 millibar or hPa) between the actual pressure and the pressure 30 minutes and 1 hours ago respectively. It allows a warn to be set about the rise or fall of pressure and upcoming weather changes.

For example, to turn on the sound alarm (Bank 1, Channel 5), when the atmospheric pressure has fallen more than on 1.5 mb in comparison with the reading from one hour beforehand and this trend has been going on for 20 minutes, type the following command:

```
YD:S1H ON <-1.5 1200 1 5
```

The conditions of the rule YD:SBP becomes inactive and recovers in the same way as the Thermometer's rules (see VIII.1). The conditions of YD:S30 and YD:S1H are also recovered 30 minutes after the action. For the example above this means that if the atmospheric pressure continues to fall at the same rate, you'll get the next alarm after 50 minutes (30 minutes for condition recovery and 20 minutes for the specified interval). If the pressure rises, the condition recover in 20 minutes, in the same way as the YD:SBP rule and rules of the Thermometer.

Appendix A. Troubleshooting

Fault	Possible reasons and solution
The LED does not signal after the Device is turned on	**1. No power supply on the bus**. Check if the bus power is supplied (NMEA 2000 network requires a separate power connection and can not be powered by a plotter or another Device connected to the network). **2. Loose connection in the power supply circuit**. Treat the Device connector with a spray for cleaning eletrical contacts. Plug the Device into another connector.
Device is not displayed in the list of external devices on the plotter, data do not appear, LED lights up full second every seven seconds	**1. Loose connection in the data circuit.** Treat the Device connector with a spray for cleaning electrical contacts. Plug the Device into another connector. **2. There are problems in the NMEA 2000 network.** The network segment is not connected to the 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 plotter.
The Device is displayed in the list of Devices, but data do not appear on the screen	**1. Incorrect Device settings.** Reset Device's settings it to the factory settings (see Section III). **2. Incompatible equipment.** Make sure that your hardware supports messages sent by the Device. Update the firmware of your equipment if necessary.

Table continued

Fault	**Possible reasons and solution**
Two second signal, once or repeatedly	Digital sensor communication problem (in case of permanent failure, two second signals with a small intervals). In case of the Thermometer, check the sensor cable.
Cannot update the firmware or program the Device with installation description string	Check the firmware version (see Figure 2 in the Section 2), these features are available in the firmware version 1.40 or later.

Appendix B. Description of Connectors and Joints

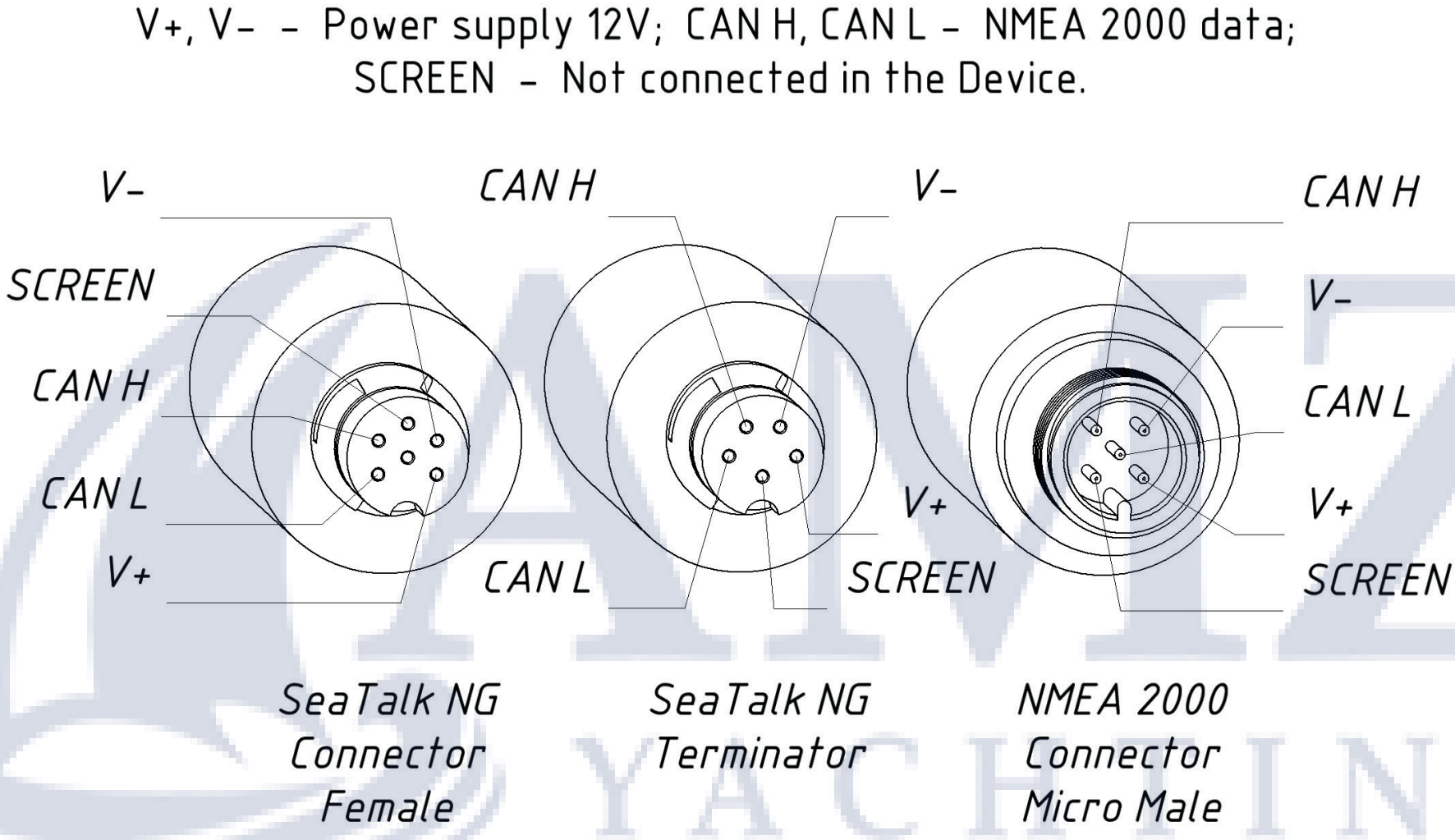

Figure 1. Connectors of the Devices with indices R (left), RT (center), N and NT (right) in the end of model name

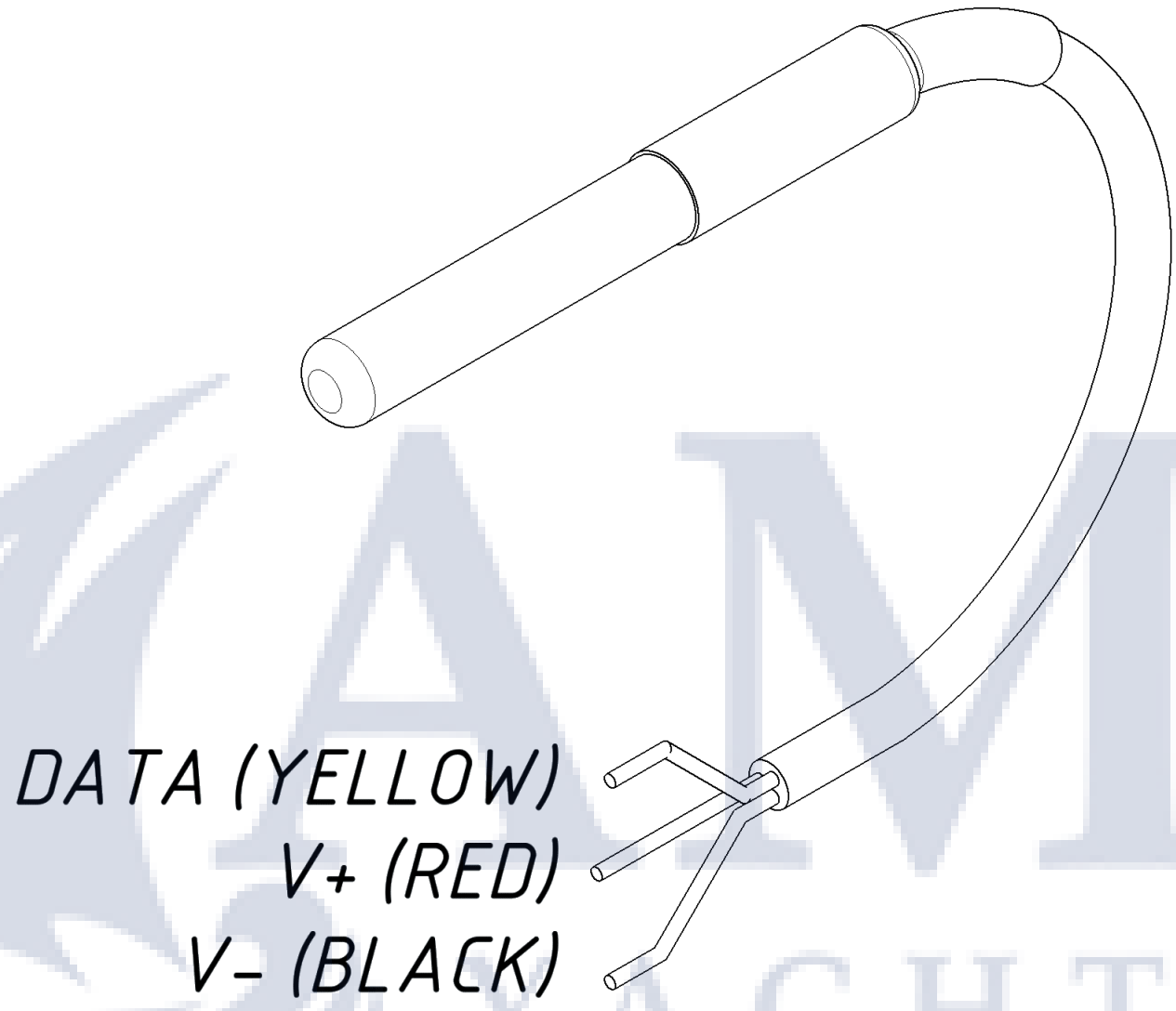

Figure 2. Digital sensor of the Thermometer

Appendix C. NMEA 2000 Messages

Table 1. NMEA 2000 Messages

Message	Receive	Transmit	Period, sec	Note
PGN 59392 ISO Acknowledgment	Yes	Yes	—	
PGN 59904 ISO Request	Yes	—	—	
PGN 60160 ISO Transport Protocol (DT)	Yes	—	—	
PGN 60416 ISO Transport Protocol (CM)	Yes	—	—	
PGN 60928 ISO Address Claim	Yes	Yes	—	
PGN 61184 Proprietary: History Request	Yes	—	—	Table 2
PGN 65240 ISO Commanded Address	Yes	—	—	
PGN 126208 NMEA Group Function	Yes	Yes	—	1
PGN 126464 PGN List (Received / Transmitted)	—	Yes	—	
PGN 126993 Heartbeat	—	Yes	60	
PGN 126996 Product Information	—	Yes	—	6
PGN 126998 Configuration Information	—	Yes	—	
PGN 127258 Magnetic Variation	Yes	—	—	2
PGN 127501 Binary Status Report	Yes	—	—	Section VIII

Table 1 continued

Message	Receive	Transmit	Period, sec	Note
PGN 127502 Switch Bank Control	—	Yes	—	Section VIII
PGN 129044 Datum	Yes	—	—	2
PGN 130310 Environmental Parameters	—	Yes	0.5	3
PGN 130311 Environmental Parameters	—	Yes	0.5	3
PGN 130312 Temperature	—	Yes	2	3, 4
PGN 130314 Actual Pressure	—	Yes	2	3, 5
PGN 130316 Temperature, Extended Range	—	Yes	2	3, 4
PGN 130816 Proprietary: History Data	—	Yes	—	Table 3

Note (1): Request Message, Command Message and Write Fields are supported.

Note (2): Used in Device programming (see Section V).

Note (3): User can change the period or turn off transmission of this message (see Section IV).

Note (4): The Thermometer only.

Note (5): The Barometer only.

Note (6): Periodic transmission was performed in the previous firmware versions (1.1x, 1.2x).

Table 2. PGN 61184 «Proprietary: History Request»

Single Frame:	*Yes*	Priority:	*3-6*	Frequency:	*N/A*
Destination:	*Address*	Query Support:	*Prohibited*	Direction:	*Receive*

Field #	Name	DD	DF	Width [bits]	Value [decimal]	Remark
1	Manufacturer Code	172	52	11	717	Yacht Devices Code
2	Reserved Bits	1	52	2	3	All bits set to «1»
3	Industry Group	168	52	3	4	«Marine Industry»
4	1st Point Offset	6	52	13	0..8291	0 to get the latest data
5	Data Instance	201	52	3	• 0: Temperature (0.1 Kelvin/bit, zero offset) • 1: Humidity (0.01 %/bit, -300% offset) • 2: Pressure (10 Pa/bit, zero offset) • Other values: Reserved	Type of requested data. Thermometer: 0 only. Barometer: 2 only. Messages with other instances are ignored.

Table 2 continued

Single Frame:	*Yes*	Priority:	*3-6*	Frequency:	*N/A*
Destination:	*Address*	Query Support:	*Prohibited*	Direction:	*Receive*

Field #	**Name**	**DD**	**DF**	**Width [bits]**	**Value [decimal]**	**Remark**
6	Points Interval	383	116	16	2..58 with step 2, 60..65520 with step 60	Interval between points in seconds
7	Number of Points	6	53	8	1..107	0 – 107 points can be returned
8	Reserved	1	52	8	255	All bits set to «1»

Table 3. PGN 130816 «Proprietary: History Data»

Single Frame:	*No*	Priority:	*6*	Frequency:	*N/A*
Destination:	*Global*	Query Support:	*Prohibited*	Direction:	*Answer*

Field #	**Name**	**DD**	**DF**	**Width [bits]**	**Value [decimal]**	**Remark**
1	Manufacturer Code	172	52	11	717	Yacht Devices Code
2	Reserved Bits	1	52	2	3	All bits set to «1»
3	Industry Group	168	52	3	4	«Marine Industry»
4	1st Point Offset	6	52	13	As in the request	See Table 2
5	Data Instance	201	52	3	As in the request	See Table 2
6	Points Interval	210	80	16	As in the request	See Table 2
7	Data Age	383	116	16	0..65532	Age of the point with zero offset, in milliseconds
(8..115)	Data (variable number of fields, from 0 to 112)	0	54	16	65535 means «sensor error» or «no data»	Value depends on field #5, see Table 2

Note (1): *The Device stores measurements of the last 4 minutes with 2-second intervals (120 points) and measurements of the last 48 hours with 1-minute intervals (2880 points) in the RAM. Depending on Field #6 of the request, the Device will return data from the short (when the interval is below 60 seconds) or long array.*

The Device ignores incorrect requests. For correct requests, if no data is available, the Device returns only 7 fields in the answer. To obtain the number of returned points, subtract 8 bytes (width of fields #1-#7) from the message payload size and divide the result by 2 (width of the data field in bytes).

The requesting device should compare fields #1 - #6 of the answer against the request sent, to be sure that the answer is addressed to it. In case of a mismatch, it should re-send the request.

Note that field #7 in the request is the age of the point with zero offset in the Device's memory. Age of the first returned point in milliseconds can be calculated as:

```
(field #4)*(field #6)*1000 + (field #7)
```

Example: *A request of the last 107 measurements with 2-second intervals from the Thermometer (data type is zero) with the network address 0x34 (hexadecimal):*

```
18EF340B CD 9A 00 00 02 00 6B FF
```

The answer's payload size is 24 bytes (0x18 hexadecimal), 8 points are returned, age of the 1st returned point is 332 milliseconds (0x14C hexadecimal):

```
19EF0034 00 18 CD 9A 00 00 02 00
19EF0034 01 4C 01 94 0B 94 0B 96
19EF0034 02 0B 8C 0B 8A 0B 94 0B
19EF0034 03 82 0B 8C 0B
```

The latest temperature value is 296.4 Kelvin (0x0B94 hexadecimal, 23.25 Celsius or 73.85 Fahrenheit). The oldest value, measured 16 seconds and 332 milliseconds ago (when the Thermometer was turned on, because the number of returned points [8] is less than the storage size [120] and less than requested [107]), is 295.6 Kelvin (0x0B8C hexadecimal).

The CAN Log Viewer software (version 1.20 and above) can display historical data from all our sensors and display sent and received CAN messages. This free program is the best way to test and learn the protocol.