User manual

ADA-4040PC6

NMEA0183 to MODBUS-RTU Protocol Converter

Contents

1. GENERAL INFORMATION

Thank you for your purchase of **CEL-MAR Company** product. This product has been completely tested and is covered by a two year warranty on parts and operation from date of sale.
If any questions or problems arise during installation or use of this product, please do not hesitate to contact Technical Support at +48 41 362-12-46 or e-mail support@cel-mar.pl.

1.1. WARRANTED INFORMATION

ADA-4040PC6 converter is covered by a two year warranty from date of sale. In case of being damaged it will be repair or the damaged component will be replace. The warranty does not cover damage caused from improper use, materials consumption or any unauthorized changes. If the product does not function (is damaged), or not operate in accordance with the instructions, will be repaired or replaced.
All warranty and no warranty repairs must be returned with paid transport and insuring to the **CEL-MAR Company.**
CEL-MAR Company under no circumstances won't be responsible for ensuing damage from improper using the product or as a result of random causes: the lightning discharge, the flood, the fire and the like.
CEL-MAR Company is not be held responsible for damages and loss including: loss of profits, loss of data, pecuniary losses ensuing from using or the impossibility of using this product.
In specific cases **CEL-MAR Company** discontinue all warranties and in particular do not follow the user manual and do not accept terms of warranty by the user.

1.2. GENERAL CONDITIONS FOR SAFE USE

The device should be installed in a safe and stable places (eg, electroinstallation cabinet), the powering cable should be arranged so as not to be exposed to trampling, attaching, or pulling out of the circuit.
Do not put device on the wet surface.
Do not connect devices for nondescript powering sources,
Do not damage or crush powering wires.
Do not make connection with wet hands.
Do not adapt, open or make holes in casings of the device!
Do not immerse device in water or no other liquid.
Do not put the fire opened on device sources: candles, an oil lamps and the like.
Complete disable from the supply network is only after disconnecting the power supply circuit voltage.
Do not carry out the assembly or disassembly of the device if it is enabled. This may result to short circuit and damage the device.
The device can not be used for applications that determine human life and health (eg. Medical).

1.3. CE LABEL

CE

The CE symbol on the device CEL-MAR means compatibility with electromagnetic compatibility Electromagnetic Compatibility Directive **EMC 2014/30/WE.**
The declaration of conformity is delivered with purchased device.

1.4. ENVIRONMENTAL PRESERVATION

This sign on the device inform about putting expended device with other waste materials. Device should send to the recycling. (In accordance with the act about the Electronic Appliance Expended from day 29 of July 2005)

1.5. SERVICE AND MAINTENANCE

Converter ADA-4040PC6 does not require the servicing and maintenance.
Technical support is available at number +48 41 362-12-46 in 8.00-16.00, from Monday to Friday or e-mail support@cel-mar.pl.

1.6. PACK CONTENTS

ADA-4040PC6 converter; User Manual; CE declaration; Line terminators 120Ω; CD with ADAConfig software.

2. PRODUCT INFORMATION

2.1. PROPERTIES

- Protocol conversion NMEA0183 to MODBUS-RTU and inversely,
- Baud rate and data format conversion between NMEA0183 and MODBUS-RTU ports,
- Operating on 2 or 4 wire buses in RS485/RS422 standard,
- Baud rate setted on RS485/RS422 interfaces (bps): 300, 600, 1200, 1800, 2400, 4800, 7200, 9600, 14400, 19200, 28800, 38400, 57600, 76800, 115200, 230400,
- Data format setted on RS485/RS422 interfaces: Data bit: 5, 6, 7, 8; Parity: None, Odd, Even; Number of stop bits: 1, 2,
- Power supply 10 - 30 VDC stable min. 2W,
- ~3kV= optoisolation in signal channel between RS485/RS422 (MODBUS-RTU) and RS485/RS422 (NMEA0183),
- 1kV= or 3kV= galvanic isolation between RS485/RS422 (MODBUS-RTU), RS485/RS422 (NMEA0183) interfaces and power supply (depend on version),
- Connection RS485/RS422 network and power supply via screw terminal block 2.5 mm^2.
- Implemented short circuit protection and over-voltage protection on RS485 / RS422 network,
- Implemented protection against power supply reverse connection,
- Cover compatible with DIN 43880 standard– mounting in typical electro-installation unit,
- Cover adapt to rail mounting according to DIN35 / TS35 standard,
- Cover dimensions (W x D x H) 53mm x 62mm x 90mm,

2.2. DESCRIPTION

NMEA0183 to MODBUS-RTU protocol converter ADA-4040PC6 solves a problem of connection devices with NMEA0183 protocol to multipoint RS-485 bus, to which are connected devices with MODBUS-RTU protocol.
Simultaneously, the device can convert baud rate and format of transmitted data between the port of NMEA0183 protocol and the port of MODBUS-RTU protocol. Depending on configurations, can be set baud rate, data bits, parity, number of stop bits. The setting can be different for NMEA0183 port and MODBUS-RTU port. Additionally, ADA-4040PC6 separates NMEA0183 devices from RS485 bus. Galvanic isolation of ADA-4040PC6, protect the system structured on RS422/485 bus and increases its reliability.
ADA-4040PC6 supports the asynchronous baud rate up to 230.4 kbps through four or two pairs of twisted-pair cables connected to screw terminals. The converter use RX+, RX-, TX+/A, TX-/B lines for functioning. It is possible to connect 32 devises to RS485/RS422 network constructed on base of ADA-4040PC6, working at the half duplex or full duplex mode. Over-voltage protection on each RS485/RS422 line was made on base of 600W over-voltage led and fuses.

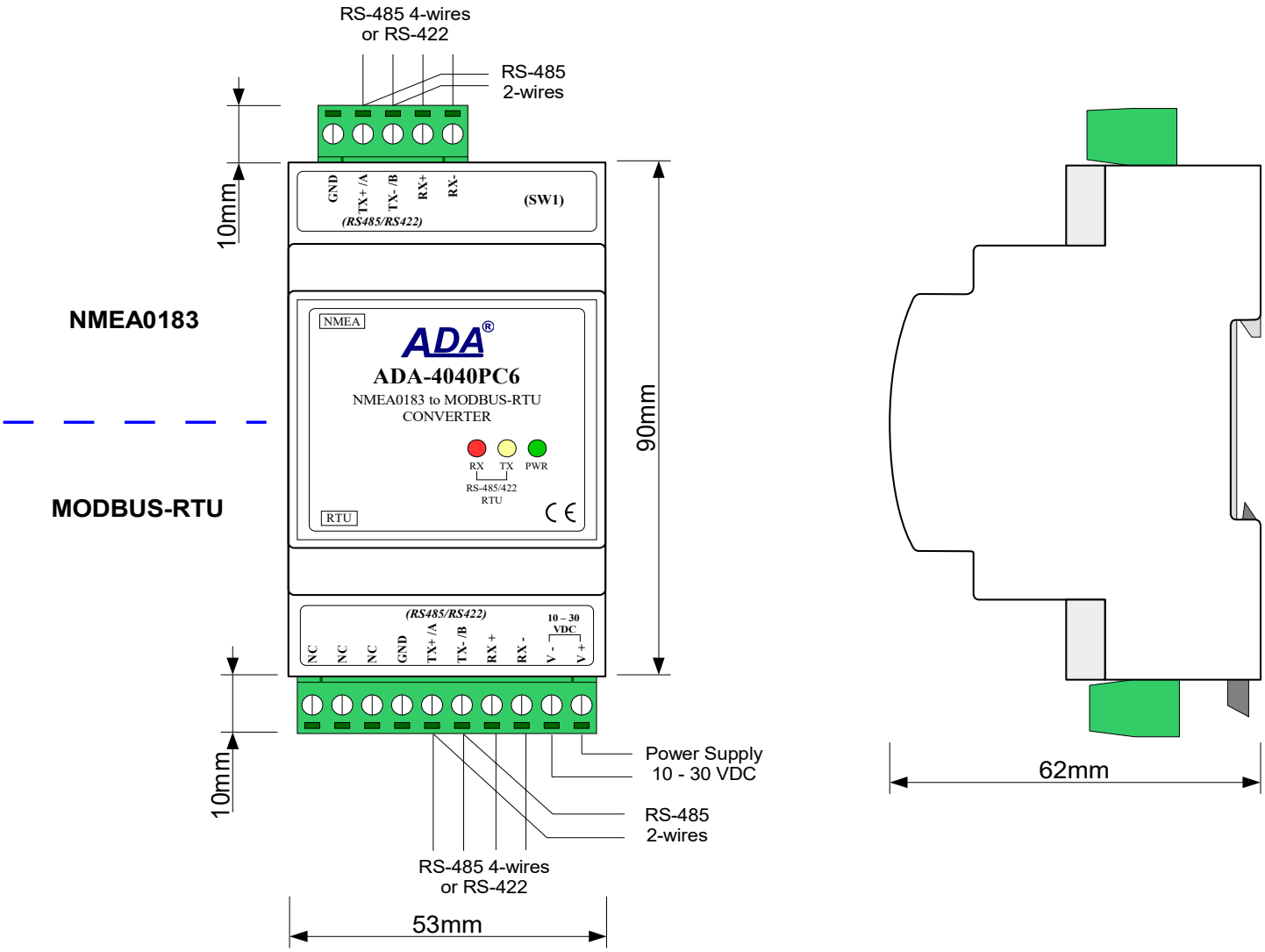

Fig 1. ADA-4040PC6 view and location of SW1

2.3. NMEA0183 PROTOCOL COMMANDS IMPLEMENTATION.

ADA-4040PC6 (firmware v0.18) converter supports follow sentences of NMEA 0183 protocol:
a) standard commands of NMEA0183 protocol: ZDA, GLL, VTG, VBW, VLW, MWV, XDR, DBT, DBK, DBS, DPT, HDT, HDM.
b) proprietary NMEA0183 protocol sentence: TSX5 – sentence for TSX-5 device of SeaTechniK Ltd company.

2.4. ISOLATION

ADA-4040PC6 converter has 3-way galvanic isolation on the levels 1kV= or 3kV=, depend on version described in section VERSIONS.

3-WAY ISOLATION

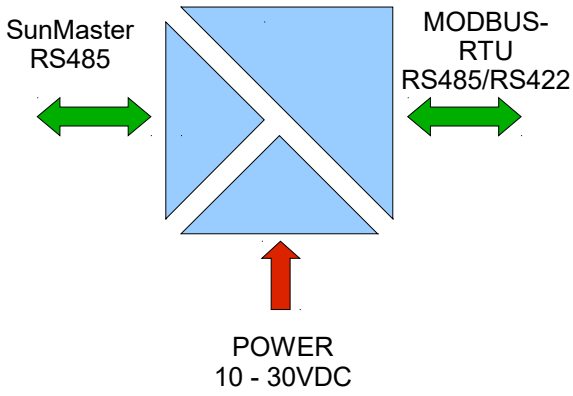

Fig 2. Isolation structure

3. INSTALLATION

This chapter will show how to use and connect ADA-4040PC6 to RS485, RS422 network and power supply.
In the purpose of minimization of disruptions from environment is being recommended to:
- apply multipair type shielded cables, which shield can be connected to the earthing on one end of the cable,
- arrange signal cables in the distance not shorter than 25 cm from powering cables.
- apply cable of adequate cross-section due to voltage drops for converter powering,
- use suppression filters for powering converters that are installed within a single object.
- not supply converter from power circuit device that generates large impulse interference such as transmitters, contactors.

3.1. ASSEMBLING

The cover of ADA-4040PC6 is adapted to assembly on TS-35 (DIN35) rail. To install the converter, should be mounted on the rail upper part of the cover then press bottom part to hear characteristic „Click” sound.

3.2. COMPUTER CONNECTION

To connect ADA-4040PC6 to computer is needed additional converter e.g. ADA-I9141 USB to RS485/RS422 converter; connected to NMEA (5-pin connector) port of the converter.
Typical connections of ADA- 4040PC6 to PC are shown bellow.

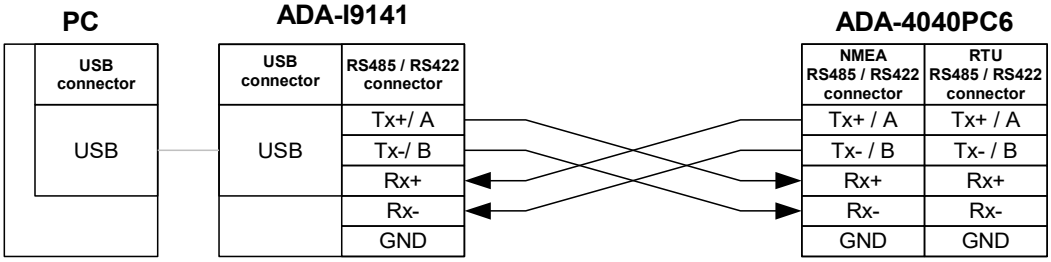

Fig 3. 4-Wires connection of ADA-4040PC6 to PC by the use of ADA-I9141 – USB to RS485/RS422 converter.

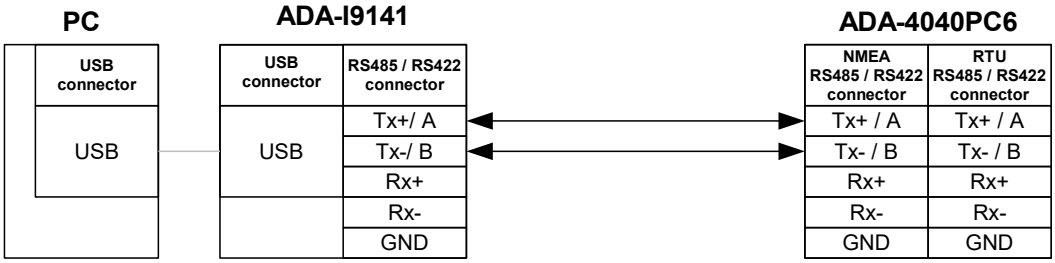

Fig 4. 2-Wires connection of ADA-4040PC6 to PC by the use of ADA-I9141 – USB to RS485/RS422 converter.

3.3. RS485 NETWORK CONNECTION

RS485/RS422 interface in ADA-4040PC6 converter is available on terminal block, described as: Tx+/A, Tx-/B, Rx+, Rx-, and connection to RS485(4W) and RS485(2W) bus are shown bellow.
ADA-4040PC6 connect to eg. FURUNO GP-150 by the use of signal cable NMEA0183 7-pin 5 m (MJ-A7SPF0003-050C), according to below specification.

3.3.1. NMEA0183 DEVICE CONNECTION TO RS485(4W) MODBUS-RTU BUS.

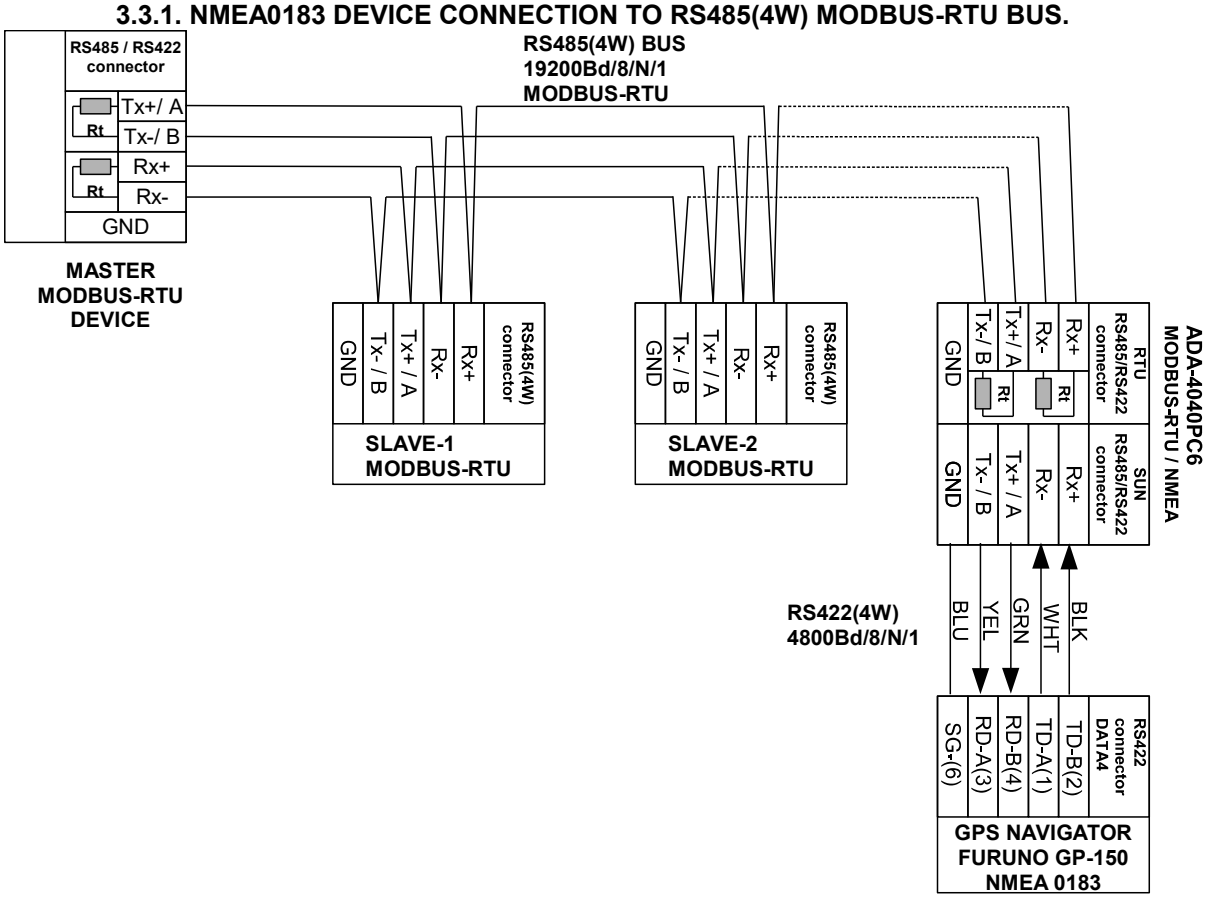

Fig 5. Example connection of ADA-4040PC6 to RS485(4W) 4-wire bus and FURUNO* GP-150 (NMEA0183).

3.3.2. NMEA0183 DEVICE CONNECTION TO RS485(2W) MODBUS-RTU BUS.

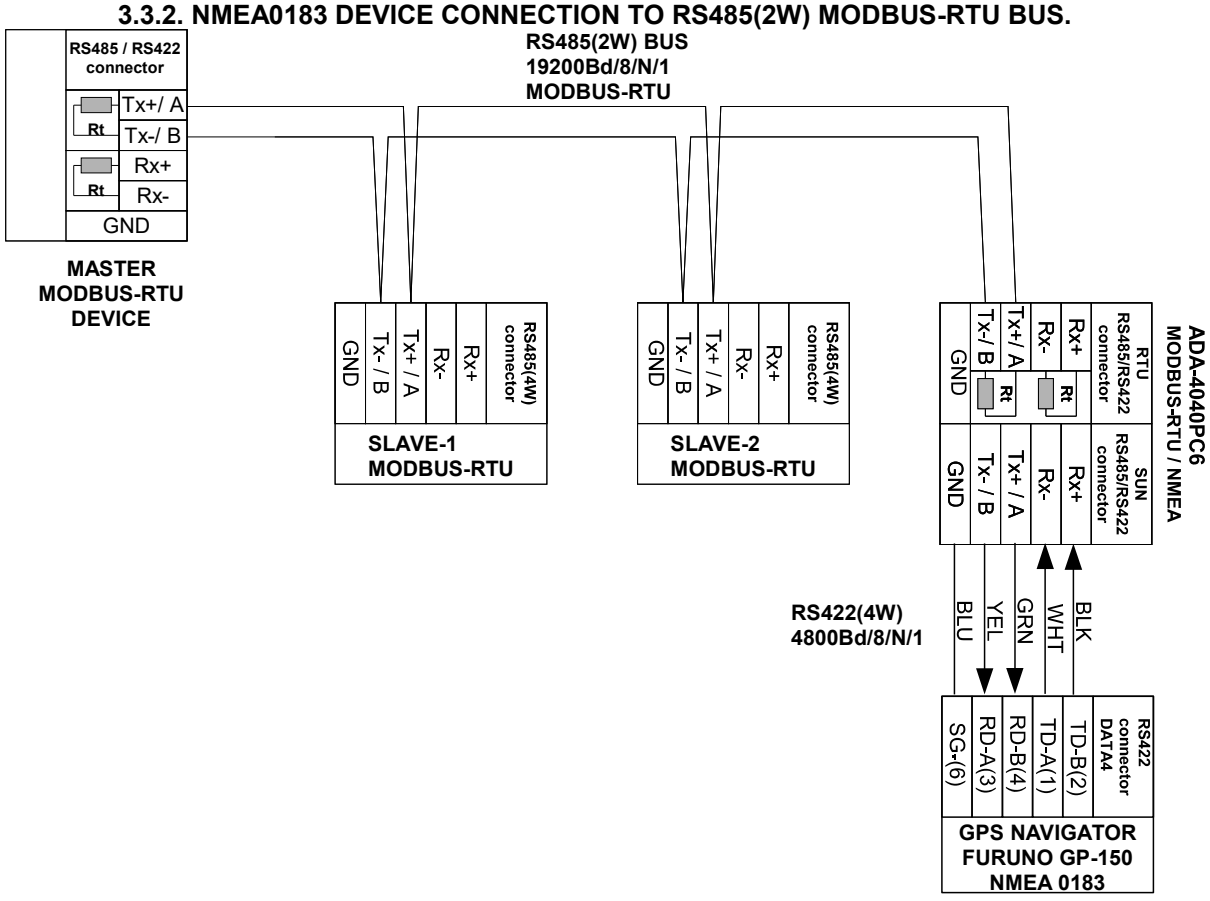

Fig 6. Example connection of ADA-4040PC6 to RS485(2W) 2-wire bus and FURUNO* GP-150 (NMEA0183).

3.3.3. LINE TERMINATION Rt

The application of Line Termination (terminator) Rt = 120 ohms will reduce electrical reflection in data line at high baud rate. It is not needed below 9600Bd. Should be used the Line Termination resistor if the distance is over 1000m @ 9600Bd or 700m @ 19200Bd, and if the disturbance in transmission will appear.
Example connection of Rt are shown on Fig. 6 & 7. Four Rt=120 Ω , 5%, 0,25W are delivered with the converters.

3.4. POWER SUPPLY CONNECTION

To connect power supply to the converter, should have DC power supplies (regulated) output voltage from 10 V= to 30V=, min. nominal power 2W, e.g. HDR-15-24. Power cable from DC power supplies to device can not be longer than 3m. Should connect positive (+) end of DC power supplies to V+ device terminal and negative (-) end to V- on terminal block. ADA-4040PC6 has protection against power supply reverse connection.

4. ACTIVATION

The converter can be power on after properly connection according to section above.
If after connection power supply on front panel will not light green led PWR, check correctness of power supply connecting (polarization). When data is present the LEDs Tx and Rx should blink

ATTENTION!
AT BAUD RATE ABOVE 38.4 KBPS THE LED'S TX, RX WILL LIGHT WEAKLY DURING DATA TRANSMISSION

4.1. DESCRIPTION OF SIGNALLING LEDS

LED	*Description*
PWR	Signalling of Power Supply
RX	Signalling of data receiving through ADA-4040PC6 from RTU RS485/RS422 port.
TX	Signalling of data transmitting from ADA-4040PC6 through RTU RS485/RS422 port.
Yellow LED by SW1	Not light – signalling of normal operating mode (RUN)
	Blinking at frequency 1 Hz – signalling of configuration mode or data flow of software to the converter.
	Blinking at frequency 2 Hz – signalling of factory default mode
	Lit continuously – signalling of emergency firmware update

4.2. TROUBLESHOOTING

Problem	Solutions
PWR LED is not light	Check polarization and parameters of connected power supply.
Rx LED lights continuously	RS485(4W) /422 network. Wrong polarization on terminals: Rx+, Rx- RTU port; change polarization.
No transmission Tx LED is blinking	RS485(4W) / RS422 network. Check correctness of connection to terminals Tx, Rx; according to point 3 and the converter configuration.

5. CONFIGURATION

5.1. OPERATION MODE

ADA-4040PC6 converter can operates in a few modes:
- RUN,
- configuration,
- factory default,
- emergency firmware update mode,

Those modes can be set by use SW1 located by screw terminal block NMEA0183 port. To set the switch section, should remove terminal cover marked as SW1 and make the appropriate settings by the use a small, flat screwdriver. Figure 1 present the location of two-position SW1 micro-switch.
All available adjusting the SW1 switch are shown in table below.

Converter operation modes

SW1- 1	*SW1- 2*	*Mode*
OFF	OFF	Run
ON	OFF	Configuration
OFF	ON	Factory default
ON	ON	Emergency firmware update

5.2. CONFIGURATION BY USING ADACONFIG

The configuration of ADA-4040PC6 converter can be made by the use of *ADAConfig* Software - selling with converter. To make the configuration, connect converter to computer (see pt. 3.2) and power supply. If after power, on the front panel is not lit green LED PWR, check the power connection (polarity). If the PWR LED lights, set the section of SW1 switch to configuration mode as in table below.

SW1-1	SW1-2
ON	OFF

In the configuration mode the yellow LED located by SW1 micro-switch will blink with frequency 1 Hz. Start the ADAConfig Software and make the configuration of transmission parameters for each converter interfaces. First should be set the number of **[COM port] [1]** for communication with the converter, then readout the configuration from ADA-4040PC6 memory, using the button ***[Read configuration]*** **[2]** and make the proper changes of each interfaces setting, as below.

[3] setting converter address from side RS485 MODBUS-RTU bus,

In the section **[Converter Address]** select the field **[Enable]** and in the field **[Address]** enter the address of MODBUS-RTU converter, from the scope 1-247.

[4] setting of transmission parameters for the **NMEA0183** port,

– baud rate (kbps) : 0.3, 0.6, 1.2, 1.8, 2.4, 4.8, 7.2, 9.6, 14.4, 19.2, 28.8, 38.4, 57.6, 76.8, 115.2, 230.4,
– number of data bites: 5, 6, 7, 8,
– control parity: no control, parity control, control of none parity,
– number of stop bits : 1, 2,
– frame spacing – range from 1 to 255 (time silence as frame's end),

[5] setting transmission parameters for the MODBUS-RTU port:

– baud rate (kbps) : 0.3, 0.6, 1.2, 1.8, 2.4, 4.8, 7.2, 9.6, 14.4, 19.2, 28.8, 38.4, 57.6, 76.8, 115.2, 230.4,
– number of data bites: 5, 6, 7, 8,
– control parity: no control, parity control, control of none parity,
– number of stop bits : 1, 2,
– frame spacing – range from 1 to 255 (time silence as frame's end),

After configuration, the setting should be saved on converter memory by using button ***[Write configuration]*** **[6]**. Return to work in run mode is made by using SW1 switch as below.

SW1-1	SW1-2
OFF	OFF

The yellow LED (located near the SW1) will turn off in the RUN mode.

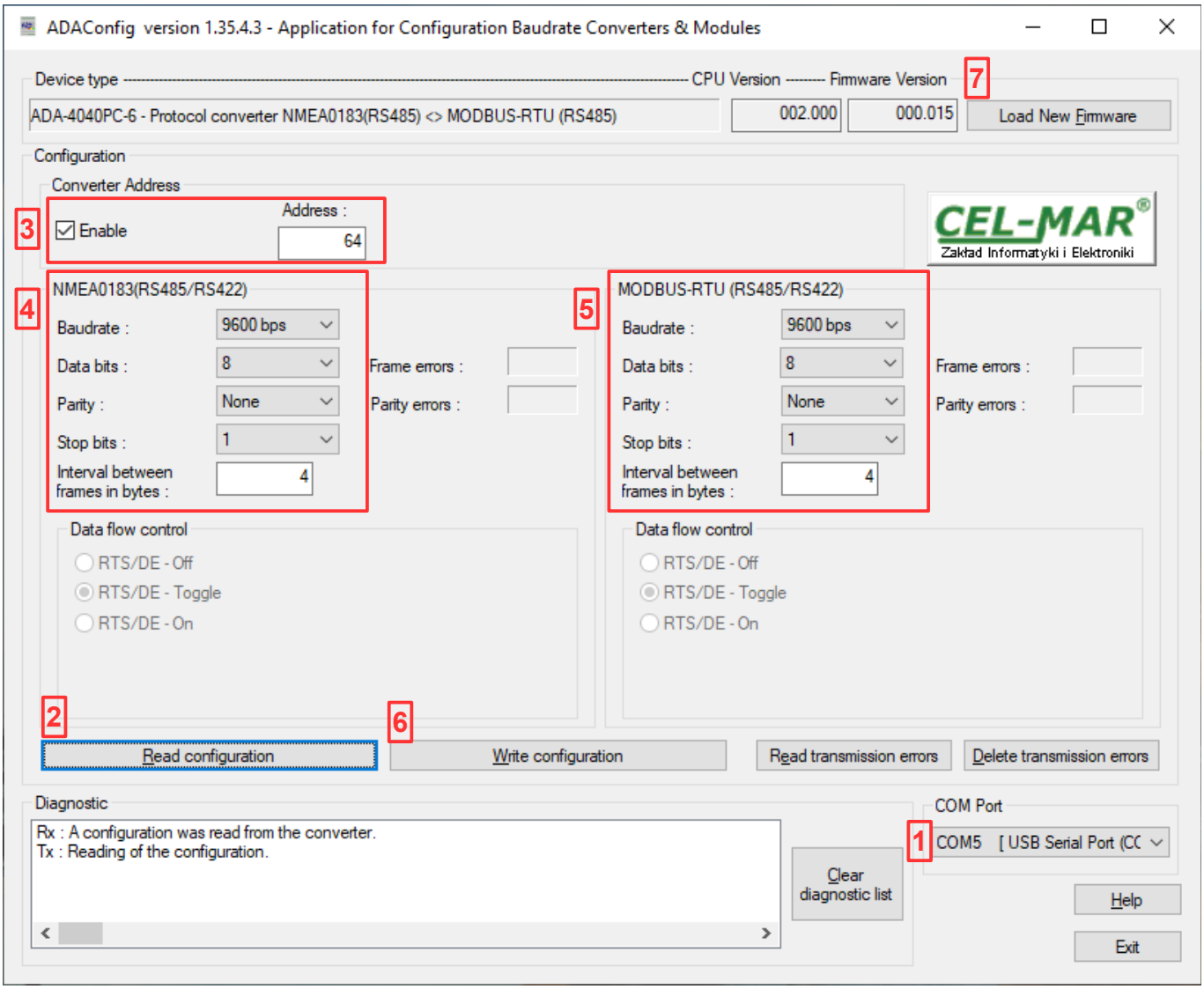

Fig.7. View of ADAConfig software interface

5.3. FACTORY DEFAULT

In case of faulty functioning ADA-4040PC6, can be restored the factory default setting of the converter internal registers.
Set SW1 microswitch mode as in the table below.

SW1-1	SW1-2
OFF	ON

Disconnect the power and after while **connect** again the power. After that, will be loaded the factory default setting to the converter internal registers.
After this operation, the converter parameters should be set again for operating in the application.
Set micro switch SW1 to run mode as shown in the table below.

SW1-1	SW1-2
OFF	OFF

The yellow LED (located near the SW1) will turn off in the RUN mode.

5.4. FIRMWARE UPDATE

Set SW1 micro switch to configuration mode as in table below.

SW1-1	SW1-2
ON	OFF

In the configuration mode the yellow LED will blink with frequency 1Hz. Press a button ***[Load New Firmware]*** **[7]** to change the software delivered by manufacturer. The Select File window will open (fig. below) and select the *.bin file then click ***[Open]*** - software will be load to *ADAConfig* buffer storage and will be checked. If the *ADAConfig* not detect errors in loaded file, change converter software. Process of updating is visualized by *ADAConfig* in use Progress Window and after proper changing confirmed by correct message.

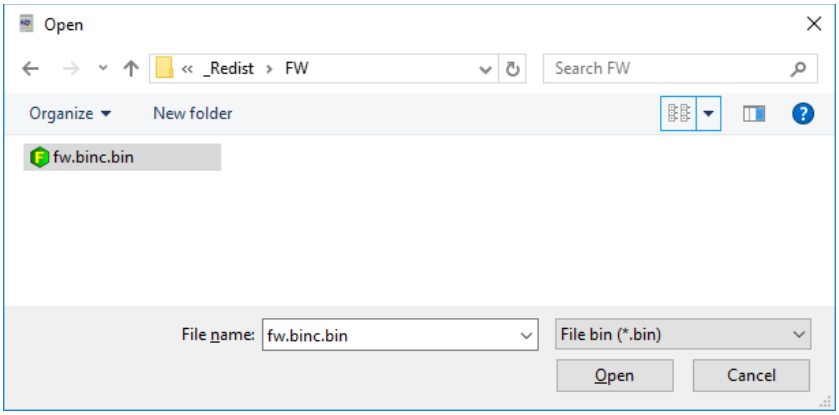

Fig.8. Selection of firmware file

During loading software the yellow LED located beside SW1 micro-switch will blink, showing data flow to the converter. If the software was loaded correctly yellow LED will be blink with frequency 1 Hz.
After that, set microswitch SW1 to run mode as shown in the table below.

SW1-1	SW1-2
OFF	OFF

The yellow LED (located near the SW1) will turn off in the RUN mode.

5.5. EMERGENCY FIRMWARE UPDATE

In case of the unsuccessful update of the converter software, try again according to description in the above point. If the update is still incorrect use emergency firmware update. Set SW1 microswitch mode as in the table below.

SW1-1	SW1-2
ON	ON

After microswitch setting, should be restarted ADA-4040PC6, by turning OFF and then ON the power supply. The yellow LED will light continuously and the converter will be in Emergency Firmware Update mode. Now follow the description in the above point.
After successful software update, set microswitch SW1 to the run mode as shown in the table below.

SW1-1	SW1-2
OFF	OFF

The yellow LED (located near the SW1) will turn off in the RUN mode.

6. DATA TRANSMISSION DIAGNOSTICS

To readout diagnostics, the SW1 microswitch should be set to the configuration mode.

SW1-1	SW1-2
ON	OFF

In the configuration mode the yellow LED will blink with frequency 1Hz..

Correctness of transmission proceed on NMEA (RS485) and RTU (RS485) interfaces can be checked by readout the errors list by *ADAConfig* Software from the converter memory. Frames error counter will be increased, in case of: improper speed set compared to real speed of data transmission. Parity error counter will be count the errors which can arise in case of misrepresent bytes in transmitted sign. This counter will not work in case of disable control parity.
To check those counters press the button ***[Read transmission errors]***, *and to delete (zeroing of counters in the memory of the converter) press* ***[Delete transmission errors]*** In case of parity errors or frame errors, should be checked the ADA-4040PC6 converter's configuration and correctness connection of RS485 bus to RTU and NMEA converter ports.
After finishing the diagnostics, the SW1 microswitch should be set to the run mode as shown in the table below.

SW1-1	SW1-2
OFF	OFF

The yellow LED (located near the SW1) will turn off in the RUN mode.

7. OPERATION

ADA-4040PC6 is bidirectional protocol converter of NMEA0183 to MODBUS-RTU protocols, with possibility of conversion a baud rate, a data format (number of data bits, parity bit, stop bits) and interface type RS485 to RS422. Additionally, is a separator of NMEA0183 port from MODBUS-RTU port
ADA-4040PC6 reads data from NMEA0183 device, and properly processed write them to registers of MODBUS-RTU protocol (described in pt. IMPLEMENTATION OF MODBUS-RTU PROTOCOL).
Frames of MODBUS protocol having the errors CRC are rejected by the converter.
Frames of NMEA0183 having the checksum errors are also rejected by the converter.
In case of no respond from NMEA0183 device, ADA-4040PC6 converter responds exception MODBUS protocol (described in pt. EXCEPTIONS OF MODBUS-RTU PROTOCOL)

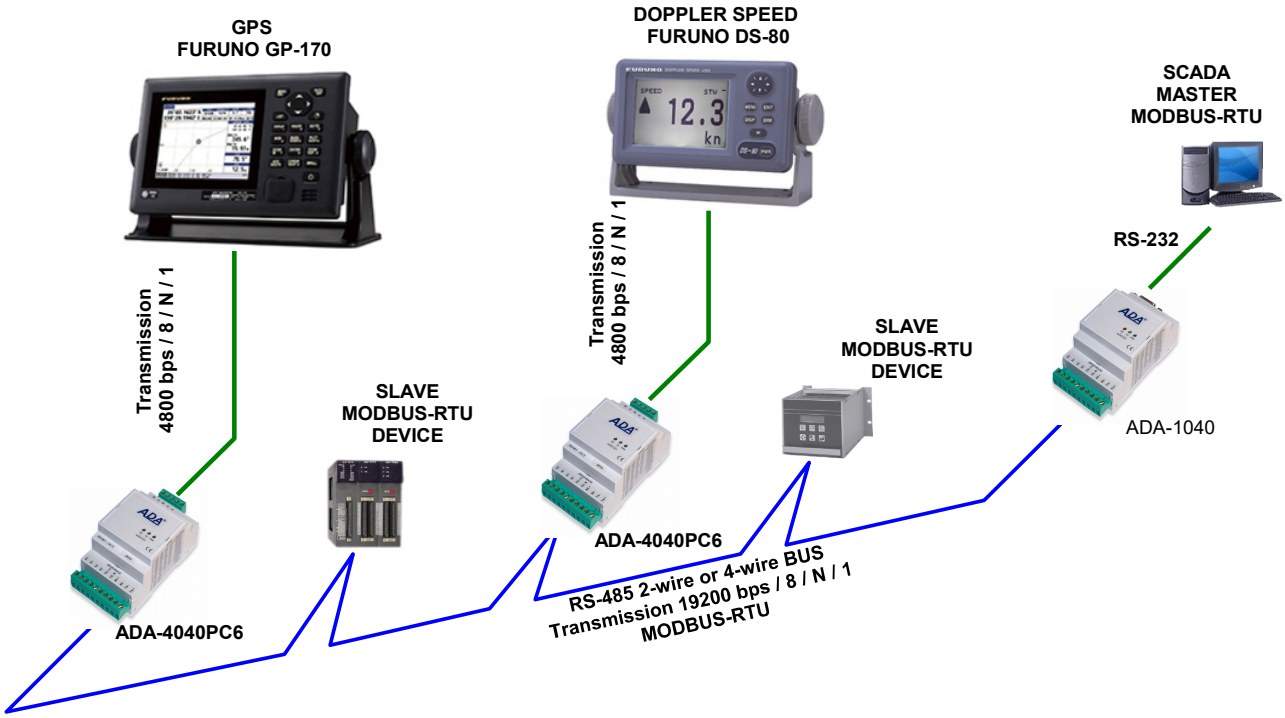

Fig.9. Connection of device with NMEA0183 protocol to RS485 MODBUS-RTU bus.

8. IMPLEMENTATION OF MODBUS-RTU PROTOCOL

ADA-4040PC6 protocol converter allows connecting devices with NMEA0183 protocol as SLAVE to RS485 MODBUS-RTU bus. The length of RS485 bus can be extended (another 1200m) by the use of ADA-4040 repeaters or ADA-4044H HUBs RS485.
The MODBUS-RTU protocol used for communication between ADA-4040PC6 converters and SCADA system or PLC controller enable easy integration of devices with NMEA0183 in existing automation systems.

8.1. MODBUS REGISTERS TABLE OF STANDARD NMEA0183 SENTENCE

8.1.1. CONVERTER MODBUS REGISTERS TABLE IN - READOUT BY FUNCTION 04 (3X – REFERENCES) INPUT REGISTERS

Address 3X	Registers Address	Registers description	Attribute	Value
30001	0	**TALKER ID** = GP BYTE HI = 0x47 = 71 (ASCII – G) BYTE LO = 0x50 = 80 (ASCII – P)	R	16-bit register U16
30002	1	**ZDA - Time & Date** ZDA | UTC HHMM:**1436**40.00 BYTE HI = HH = 0x0E = 14 - hours BYTE LO = MM = 0x24 = 36 - minutes	R	16-bit register U16

Address 3X	Registers Address	Registers description	Attribute	Value
30003	2	ZDA | UTC SS.SS:1436**40.00** BYTE HI = SS = 0x28 = 40 - seconds BYTE LO =.SS= 0x00 = 0– hundredths of a second	R	16-bit register U16
30004	3	ZDA | UTC DDMM: **10,05**,2019, BYTE HI = DD = 0x0A = 10 - day BYTE LO = .MM = 0x05 = 05 - month	R	16-bit register U16
30005	4	ZDA | UTC YYY: 10,05,**2019**, BYTE HI = YYHI = 0x07 = 7 - year BYTE LO = YYLO = 0xE3 = 227 - year	R	16-bit register U16
30006	5	ZDA | UTC LZ HHMM: **-02,00*** Local time BYTE HI = LZHH = 0xFE = 254 – (-2) hours, Local zone hours BYTE LO = LZMM = 0x00 = 0 – (0) minutes, Local zone minutes	R	16-bit register U16
30007	6	**GLL - Geographic Position - Latitude/Longitude** GLL LANTITUDE: 5129.61670,N, GLL | LANTITUDE DWORD = 512961670 = 0x1E 93 2C 86 WORD LO = 0x2C86; BYTE HI = 0x2C; BYTE LO = 0x86	R	16-bit register U32 LO DW=10000
30008	7	GLL | LANTITUDE DWORD = 512961670 = 0x1E 93 2C 86 WORD HI = 0x1E 93; BYTE HI = 0x1E; BYTE LO = 0x93	R	16-bit register U32 HI DW=10000
30009	8	GLL | LANTITUDE UNITS DESIGNATOR: 5129.6167,**N**, (N/S) WORD = 0x004E; BYTE HI = 0x00; BYTE LO = 0x4E = N (ASCII)	R	16-bit register CH[2]
30010	9	GLL | LONGITUDE: 00636.58680,W GLL | LONGITUDE DWORD = 63658680 = 0x03 CB 5A B8 WORD LO = 0x5AB8; BYTE HI = 0x5A; BYTE LO = 0xB8	R	16-bit register U32 LO DW=10000
30011	10	GLL | LONGITUDE DWORD = 63658680 = 0x03 CB 5A B8 WORD HI = 0x03CB; BYTE HI = 0x03; BYTE LO = 0xCB	R	16-bit register U32 HI DW=10000
30012	11	GLL | LONGITUDE UNITS DESIGNATOR : 00636.58680,**W** (W/E) WORD = 0x0057; BYTE HI=0x00; BYTE LO = 0x57 = W (ASCII)	R	16-bit register CH[2]
30013	12	GLL | UTC TIME HHMM: **1351**07.00 BYTE HI = HH = 0x0D = 13 - hours BYTE LO = MM = 0x33 = 51 - minutes	R	16-bit register U16
30014	13	GLL | UTC TIME SS.SS: 1351**07.00** BYTE HI = SS = 0x07 = 7 - seconds BYTE LO = .SS= 0x00 = 0 - hundredths of a second	R	16-bit register U16
30015	14	GLL | STATUS, MODE INDICATOR: **V,N** BYTE HI = STATUS = 0x56 = 86 (ASCII – V) BYTE LO = .MODE = 0x4E = 78 (ASCII – N)	R	16-bit register CH[2]
30016	15	**VTG - Course Over Ground and Ground Speed** VTG | COURSE TRUE NORTH :**309.620**,T, VTG | COURSE TRUE NORTH DWORD = 309620 = 0x00 04 B9 74 WORD LO = 0xB974; BYTE HI = 0xB9; BYTE LO = 0x74	R	16-bit register U32 LO DW=1000
30017	16	VTG | COURSE TRUE NORTH DWORD = 309620 = 0x00 04 B9 74 WORD HI = 0x004; BYTE HI = 0x00; BYTE LO = 0x04	R	16-bit register U32 HI DW=1000
30018	17	VTG | COURSE MAGNETIC NORTH: ,,M VTG | COURSE MAGNETIC NORTH = 0 = 0x00 00 00 00 WORD LO = 0x0000; BYTE HI = 0x00; BYTE LO = 0x00	R	16-bit register U32 LO DW=1000
30019	18	VTG | COURSE MAGNETIC NORTH = 0 = 0x00 00 00 00 WORD HI = 0x0000; BYTE HI = 0x00; BYTE LO = 0x00	R	16-bit register U32 HI DW=1000
30020	19	VTG | COURSE REFERENCE: 309.62,**T**, ,**M**, VTG | COURSE REFERENCE WORD: 0x544D BYTE HI = 0x54 = 84 (ASCII – T) - TRUE NORTH BYTE LO = 0x4D = 77 (ASCII – M) - MAGNETIC NORTH	R	16-bit register CH[2]
30021	20	VTG | KNOTS: **0.131**,N, VTG | KNOTS DWORD = 131 = 0x00 00 00 83 WORD LO = 0x0083; BYTE HI = 0x00; BYTE LO = 0x83	R	16-bit register U32 LO DW=1000

Address 3X	Registers Address	Registers description	Attribute	Value
30022	21	VTG | KNOTS DWORD = 131 = 0x00 00 00 83 WORD HI = 0x0000; BYTE HI = 0x00; BYTE LO = 0x00	R	16-bit register U32 HI DW=1000
30023	22	VTG | KM: **0.212**,K VTG | KM DWORD = 212 = 0x00 00 00 D4 WORD LO = 0x00D4; BYTE HI = 0x00; BYTE LO = 0xD4	R	16-bit register U32 LO DW=1000
30024	23	VTG | KM DWORD = 212 = 0x00 00 00 D4 WORD HI = 0x0000; BYTE HI = 0x00; BYTE LO = 0x00	R	16-bit register U32 HI DW=1000
30025	24	VTG | SPEED UNIT: 0.131,**N**,0.212,**K** VTG | SPEED UNIT WORD = 0x554B BYTE HI = 0x4E = 78 (ASCII – N) - KNOTS BYTE LO = 0x4B = 75 (ASCII – K) - KM	R	16-bit register U16
30026	25	VTG | GPS STATUS INDICATOR: **A** BYTE HI = GPS STATUSHI = 0x00 = 00 BYTE LO = GPS STATUSLO = 0x41 = 65 (ASCII – A) - GPS STATUS A = Autonomous mode D = Differential mode E = Estimated (dead reckoning) mode M = Manual input mode S = Simulator mode N = Data not valid The positioning system Mode Indicator shall not be a null field	R	16-bit register CH[2]
30027	26	**VBW - Dual Ground/Water Speed** VBW | LONGITUDINAL WATER SPEED: -998.1, VBW | LONGITUDINAL WATER SPEED WORD: -9981 = 0xD903 BYTE HI = 0xD9, BYTE LO = 0x03	R	16-bit register I16 DW=10
30028	27	VBW | TRANSVERSE WATER SPEED: 1000.2, VBW | TRANSVERSE WATER SPEED WORD: 10002 = 0x2712 BYTE HI = 0x27, BYTE LO = 0x12	R	16-bit register I16 DW=10
30029	28	VBW | LONGITUDINAL GROUND SPEED: -978.2, VBW | LONGITUDINAL GROUND SPEED WORD = -9782 = 0xD9CA BYTE HI = 0xD9, BYTE LO = 0xCA	R	16-bit register I16 DW=10
30030	29	VBW | TRANSVERSE GROUND SPEED: 1000.0, VBW | TRANSVERSE GROUND SPEED WORD: 10000 = 0x2710 BYTE HI = 0x27, BYTE LO = 0x10	R	16-bit register I16 DW=10
30031	30	VBW | STATUS, WATER / GROUND SPEED: AA VBW | STATUS, WATER / GROUND SPEED WORD = 0x4141 BYTE HI = 0x41 = A (ASCII) STATUS, WATER SPEED BYTE LO = 0x41 = A (ASCII) STATUS, GROUND SPEED A = VALID DATA , V = INVALID DATA	R	16-bit register U16 CH[2]
30032	31	VBW | STERN TRANSVERSE WATER SPEED: -1000.0, VBW | STERN TRANSVERSE WATER SPEED WORD: -10000= 0xD9CA BYTE HI = 0xD9, BYTE LO = 0xCA	R	16-bit register I16 DW=10
30033	32	VBW | STERN TRANSVERSE GROUND SPEED: 980.4 VBW | STERN TRANSVERSE GROUND SPEED WORD: 9804 = 0x2710 BYTE HI = 0x27, BYTE LO = 0x10	R	16-bit register I16 DW=10
30034	33	VBW | STATUS, STERN WATER/GROUND SPEED: AA VBW | STATUS, STERN WATER/GROUND SPEED WORD = 0x4141 BYTE HI = 0x41 = A (ASCII) STATUS, WATER SPEED BYTE LO = 0x41 = A (ASCII) STATUS, GROUND SPEED A = VALID DATA, V = INVALID DATA	R	16-bit register U16 CH[2]
30035	34	**VLW - Distance Traveled through Water** VLW | TOTAL CUMULATIVE WATER DISTANCE: 100007.048,N, VLW | TOTAL CUMULATIVE WATER DISTANCE DWORD = 0x05F5 FC88 WORD LO = FC88; BYTE HI = 0xFC; BYTE LO = 0x88	R	16-bit register U32 LO DW=1000
30036	35	VLW | TOTAL CUMULATIVE WATER DISTANCE DWORD = 0x05F5 FC88 WORD HI = 0x05F5; BYTE HI = 0x05; BYTE LO = 0xF5	R	16-bit register U32 HI DW=1000
30037	36	VLW | DISTANCE SINCE RESET: 100007.048,N VLW | DISTANCE SINCE RESET DWORD = 0x05F5 FC88	R	16-bit register U32 LO

Address 3X	Registers Address	Registers description	Attribute	Value
		WORD LO = FC88; BYTE HI = 0xFC; BYTE LO = 0x88		
30038	37	VLW | DISTANCE SINCE RESET DWORD = 0x05F5 FC88 WORD HI = 0x05F5; BYTE HI = 0x05; BYTE LO = 0xF5	R	16-bit register U32 HI
30039	38	VLW | NAUTICAL MILES: NN VLW | NAUTICAL MILES WORD = 0x4E4E BYTE HI = 0x4E = N(ASCII) CUMULATIVE DISTANCE, NAUTICAL MILES BYTE LO = 0x4E = N(ASCII) DISTANCE SINCE RESET, NAUTICAL MILES	R	16-bit register U16 CH[2]
30040	39	**MWV - Wind Speed and Angle** MWV | WIND ANGLE	R	16-bit register U16 DW=10
30041	40	MWV | WIND ANGLE REFERENCE : R = Relative, T = Theoretical BYTE HI = 0x00 BYTE LO = 0x52 (ASCII: R) lub 0x54 (ASCII: T)	R	16-bit register U16 CH[2]
30042	41	MWV | WIND SPEED	R	16-bit register U16 DW=10
30043	42	MWV | WIND SPEED UNIT & DATA STATUS BYTE HI = K – km/h, M – m/s, N – knots (ASCII) | SPEED UNIT BYTE LO = A - Data Valid, V - Data invalid (ASCII) | DATA STATUS	R	16-bit register U16 CH[2]
30044	43	**XDR - Transducer Measurements** XDR | SENSOR1 – VALUE CD AB INT32 : CD	R	32-bit register I32 DW=1000
30045	44	XDR | SENSOR1 – VALUE CD AB INT32 : AB	R	32-bit register I32 DW=1000
30046	45	XDR | SENSOR1 – VALUE TYPE, VALUE UNIT BYTE HI = C–Temperature, H–Humidity, U–Voltage (ASCII) | VALUE TYPE BYTE LO = C–°C, H–%RH, V–Volts (ASCII) | VALUE UNIT	R	16-bit register U16 CH[2]
30047	46	XDR | SENSOR1 – IDENTIFIER BYTE HI = A (ASCII) | ID CHAR1 BYTE LO = 1 (ASCII) | ID CHAR2	R	16-bit register U16 CH[2]
30048	47	XDR | SENSOR2 – VALUE CD AB INT32 : CD	R	32-bit register I32 DW=1000
30049	48	XDR | SENSOR2 – VALUE CD AB INT32 : AB	R	32-bit register I32 DW=1000
30050	49	XDR | SENSOR2 – VALUE TYPE, VALUE UNIT BYTE HI = C–Temperature, H–Humidity, U–Voltage (ASCII) | VALUE TYPE BYTE LO = C–°C, H–%RH, V–Volts (ASCII) | VALUE UNIT	R	16-bit register U16 CH[2]
30051	50	XDR | SENSOR2 – IDENTIFIER BYTE HI = A (ASCII) | ID CHAR1 BYTE LO = 2 (ASCII) | ID CHAR2	R	16-bit register U16 CH[2]
30052	51	XDR | SENSOR3 – VALUE CD AB INT32 : CD	R	32-bit register I32 DW=1000
30053	52	XDR | SENSOR3 – VALUE CD AB INT32 : AB	R	32-bit register I32 DW=1000
30054	53	XDR | SENSOR3 – VALUE TYPE, VALUE UNIT BYTE HI = C–Temperature, H–Humidity, U–Voltage (ASCII) | VALUE TYPE BYTE LO = C–°C, H–%RH, V–Volts (ASCII) | VALUE UNIT	R	16-bit register U16 CH[2]
30055	54	XDR | SENSOR3 – IDENTIFIER BYTE HI = A (ASCII) | ID CHAR1 BYTE LO = 3 (ASCII) | ID CHAR2	R	16-bit register U16 CH[2]
30056	55	XDR | SENSOR4 – VALUE CD AB INT32 : CD	R	32-bit register I32 DW=1000

Address 3X	Registers Address	Registers description	Attribute	Value
30057	56	XDR | SENSOR4 – VALUE CD AB INT32 : AB	R	32-bit register I32 DW=1000
30058	57	XDR | SENSOR4 – VALUE TYPE, VALUE UNIT BYTE HI = C–Temperature, H–Humidity, U–Voltage (ASCII) | VALUE TYPE BYTE LO = C–°C, H–%RH, V–Volts (ASCII) | VALUE UNIT	R	16-bit register U16 CH[2]
30059	58	XDR | SENSOR4 – IDENTIFIER BYTE HI = A (ASCII) | ID CHAR1 BYTE LO = 4 (ASCII) | ID CHAR2	R	16-bit register U16 CH[2]
30060	59	**DBT - Depth Below Transducer** DBT | Depth below transducer in feet	R	16-bit register U16 DW=10
30061	60	DBT | Depth below transducer in meters	R	16-bit register U16 DW=10
30062	61	DBT | Depth below transducer in fathoms	R	16-bit register U16 DW=10
30063	62	DBT | UNIT ID BYTE HI = f (ASCII) | ID CHAR1 - Feet BYTE LO = M (ASCII) | ID CHAR2 - Meters	R	16-bit register U16 CH[2]
30064	63	DBT | UNIT ID BYTE HI = F (ASCII) | ID CHAR1 - Fathoms BYTE LO = 0x00 (ASCII) | ID CHAR2 – Not use	R	16-bit register U16 CH[2]
30065	64	**DPT - Depth** DPT | Water depth relative to the transducer, meters	R	16-bit register U16 DW=10
30066	65	DPT | Offset from transducer *, meters Notes: *1) "positive" = distance from transducer to water-line, "-" = distance from transducer to keel *2) For IEC applications the offset shall always be applied so as to provide depth relative to the keel.	R	16-bit register I16 DW=10
30067	66	DPT | Maximum range scale in use	R	16-bit register U16 DW=10
30068	67	**DBK - Depth Below Keel** DBK | Depth below Keel in feet	R	16-bit register U16 DW=10
30069	68	DBK | Depth below Keel in meters	R	16-bit register U16 DW=10
30070	69	DBK | Depth below Keel in fathoms	R	16-bit register U16 DW=10
30071	70	DBK | UNIT ID BYTE HI = f (ASCII) | ID CHAR1 - Feet BYTE LO = M (ASCII) | ID CHAR2 - Meters	R	16-bit register U16 CH[2]
30072	71	DBK | UNIT ID BYTE HI = F (ASCII) | ID CHAR1 - Fathoms BYTE LO = 0x00 (ASCII) | ID CHAR2 – Not use	R	16-bit register U16 CH[2]
30073	72	**DBS - Depth Below Surface** DBS | Depth below Surface in feet	R	16-bit register U16 DW=10
30074	73	DBS | Depth below Surface in meters	R	16-bit register U16 DW=10
30075	74	DBS | Depth below Surface in fathoms	R	16-bit register U16 DW=10

Address 3X	Registers Address	Registers description	Attribute	Value
30076	75	DBS | UNIT ID BYTE HI = f (ASCII) | ID CHAR1 - Feet BYTE LO = M (ASCII) | ID CHAR2 - Meters	R	16-bit register U16 CH[2]
30077	76	DBS | UNIT ID BYTE HI = F (ASCII) | ID CHAR1 - Fathoms BYTE LO = 0x00 (ASCII) | ID CHAR2 – Not use	R	16-bit register U16 CH[2]
30078	77	**HDT - Heading True, Vessel heading in degrees true** HDT | VESSEL HEADING TRUE IN DEGREES: 359.200,T HDT | VESSEL HEADING TRUE IN DEGREES DWORD = 0x00057B20 WORD LO = 0x7B20; BYTE HI = 0x7B; BYTE LO = 0x20	R	16-bitowy rejestr U32 LO DW=1000
30079	78	HDT | VESSEL HEADING IN DEGREES TRUE DWORD = 0x00057B20 WORD HI = 0x0005; BYTE HI = 0x00; BYTE LO = 0x05	R	16-bit register U32 HI DW=1000
30080	79	**HDM - Heading Magnetic, Vessel heading in degrees with respect to magnetic north** HDM |VESSEL HEADING MAGNETIC IN DEGREES: 359.200,T HDM |VESSEL HEADING MAGNETIC IN DEGREES DWORD= 0x00057B20 WORD LO = 0x7B20; BYTE HI = 0x7B; BYTE LO = 0x20	R	16-bit register U32 LO DW=1000
30081	80	HDM |VESSEL HEADING MAGNETIC IN DEGREES DWORD= 0x00057B20 WORD HI = 0x0005; BYTE HI = 0x00; BYTE LO = 0x05	R	16-bit register U32 HI DW=1000
30082	81	HDT & HDM | ID BYTE HI = T (ASCII) | ID CHAR1 - TRUE BYTE LO = M (ASCII) | ID CHAR2 – MAGNETIC	R	16-bit register U16 CH[2]

8.1.2. CONVERTER MODBUS REGISTERS TABLE IN - READOUT BY FUNCTION 03 (4X – REFERENCES) HOLDING REGISTERS

Address 4X	Registers Address	Registers description	Attribute	Value DW
40001	0	**TALKER ID** = GP BYTE HI = 0x47 = 71 (ASCII – G) BYTE LO = 0x50 = 80 (ASCII – P)	R	16-bit register U16
40002	1	**ZDA - Time & Date** ZDA | UTC HHMM:**1436**40.00 BYTE HI = HH = 0x0E = 14 - hours BYTE LO = MM = 0x24 = 36 - minutes	R	16-bit register U16
40003	2	ZDA | UTC SS.SS:1436**40.00** BYTE HI = SS = 0x28 = 40 - seconds BYTE LO =.SS= 0x00 = 0– hundredths of a second	R	16-bit register U16
40004	3	ZDA | UTC DDMM: **10,05**,2019, BYTE HI = DD = 0x0A = 10 - day BYTE LO = .MM = 0x05 = 05 - month	R	16-bit register U16
40005	4	ZDA | UTC YYY: 10,05,**2019**, BYTE HI = YYHI = 0x07 = 7 - year BYTE LO = YYLO = 0xE3 = 227 - year	R	16-bit register U16
40006	5	ZDA | UTC LZ HHMM: **-02,00*** Local time BYTE HI = LZHH = 0xFE = 254 – (-2) hours, Local zone hours BYTE LO = LZMM = 0x00 = 0 – (0) minutes, Local zone minutes	R	16-bit register U16
40007	6	**GLL - Geographic Position - Latitude/Longitude** GLL LANTITUDE: 5129.61670,N, GLL | LANTITUDE DWORD = 512961670 = 0x1E 93 2C 86 WORD LO = 0x2C86; BYTE HI = 0x2C; BYTE LO = 0x86	R	16-bit register U32 LO DW=10000
40008	7	GLL | LANTITUDE DWORD = 512961670 = 0x1E 93 2C 86 WORD HI = 0x1E 93; BYTE HI = 0x1E; BYTE LO = 0x93	R	16-bit register U32 HI DW=10000
40009	8	GLL | LANTITUDE UNITS DESIGNATOR: 5129.6167,**N**, (N/S) WORD = 0x004E; BYTE HI = 0x00; BYTE LO = 0x4E = N (ASCII)	R	16-bit register CH[2]

Address 4X	Registers Address	Registers description	Attribute	Value DW
40010	9	GLL | LONGITUDE: 00636.58680,W GLL | LONGITUDE DWORD = 63658680 = 0x03 CB 5A B8 WORD LO = 0x5AB8; BYTE HI = 0x5A; BYTE LO = 0xB8	R	16-bit register U32 LO DW=10000
40011	10	GLL | LONGITUDE DWORD = 63658680 = 0x03 CB 5A B8 WORD HI = 0x03CB; BYTE HI = 0x03; BYTE LO = 0xCB	R	16-bit register U32 HI DW=10000
40012	11	GLL | LONGITUDE UNITS DESIGNATOR : 00636.58680,**W** (W/E) WORD = 0x0057; BYTE HI=0x00; BYTE LO = 0x57 = W (ASCII)	R	16-bit register CH[2]
40013	12	GLL | UTC TIME HHMM: **1351**07.00 BYTE HI = HH = 0x0D = 13 - hours BYTE LO = MM = 0x33 = 51 - minutes	R	16-bit register U16
40014	13	GLL | UTC TIME SS.SS: 1351**07.00** BYTE HI = SS = 0x07 = 7 - seconds BYTE LO = .SS= 0x00 = 0 - hundredths of a second	R	16-bit register U16
40015	14	GLL | STATUS, MODE INDICATOR: **V,N** BYTE HI = STATUS = 0x56 = 86 (ASCII – V) BYTE LO = .MODE = 0x4E = 78 (ASCII – N)	R	16-bit register CH[2]
40016	15	**VTG - Course Over Ground and Ground Speed** VTG | COURSE TRUE NORTH :**309.620**,T, VTG | COURSE TRUE NORTH DWORD = 309620 = 0x00 04 B9 74 WORD LO = 0xB974; BYTE HI = 0xB9; BYTE LO = 0x74	R	16-bit register U32 LO DW=1000
40017	16	VTG | COURSE TRUE NORTH DWORD = 309620 = 0x00 04 B9 74 WORD HI = 0x004; BYTE HI = 0x00; BYTE LO = 0x04	R	16-bit register U32 HI DW=1000
40018	17	VTG | COURSE MAGNETIC NORTH: ,,M VTG | COURSE MAGNETIC NORTH = 0 = 0x00 00 00 00 WORD LO = 0x0000; BYTE HI = 0x00; BYTE LO = 0x00	R	16-bit register U32 LO DW=1000
40019	18	VTG | COURSE MAGNETIC NORTH = 0 = 0x00 00 00 00 WORD HI = 0x0000; BYTE HI = 0x00; BYTE LO = 0x00	R	16-bit register U32 HI DW=1000
40020	19	VTG | COURSE REFERENCE: 309.62,**T**, ,**M**, VTG | COURSE REFERENCE WORD: 0x544D BYTE HI = 0x54 = 84 (ASCII – T) - TRUE NORTH BYTE LO = 0x4D = 77 (ASCII – M) - MAGNETIC NORTH	R	16-bit register CH[2]
40021	20	VTG | KNOTS: **0.131**,N, VTG | KNOTS DWORD = 131 = 0x00 00 00 83 WORD LO = 0x0083; BYTE HI = 0x00; BYTE LO = 0x83	R	16-bit register U32 LO DW=1000
40022	21	VTG | KNOTS DWORD = 131 = 0x00 00 00 83 WORD HI = 0x0000; BYTE HI = 0x00; BYTE LO = 0x00	R	16-bit register U32 HI DW=1000
40023	22	VTG | KM: **0.212**,K VTG | KM DWORD = 212 = 0x00 00 00 D4 WORD LO = 0x00D4; BYTE HI = 0x00; BYTE LO = 0xD4	R	16-bit register U32 LO DW=1000
40024	23	VTG | KM DWORD = 212 = 0x00 00 00 D4 WORD HI = 0x0000; BYTE HI = 0x00; BYTE LO = 0x00	R	16-bit register U32 HI DW=1000
40025	24	VTG | SPEED UNIT: 0.131,**N**,0.212,**K** VTG | SPEED UNIT WORD = 0x554B BYTE HI = 0x4E = 78 (ASCII – N) - KNOTS BYTE LO = 0x4B = 75 (ASCII – K) - KM	R	16-bit register U16
40026	25	VTG | GPS STATUS INDICATOR: **A** BYTE HI = GPS STATUSHI = 0x00 = 00 BYTE LO = GPS STATUSLO = 0x41 = 65 (ASCII – A) - GPS STATUS A = Autonomous mode D = Differential mode E = Estimated (dead reckoning) mode M = Manual input mode S = Simulator mode N = Data not valid The positioning system Mode Indicator shall not be a null field	R	16-bit register CH[2]

Address 4X	Registers Address	Registers description	Attribute	Value DW
40027	26	**VBW - Dual Ground/Water Speed** VBW | LONGITUDINAL WATER SPEED: -998.1, VBW | LONGITUDINAL WATER SPEED WORD: -9981 = 0xD903 BYTE HI = 0xD9, BYTE LO = 0x03	R	16-bit register I16 DW=10
40028	27	VBW | TRANSVERSE WATER SPEED: 1000.2, VBW | TRANSVERSE WATER SPEED WORD: 10002 = 0x2712 BYTE HI = 0x27, BYTE LO = 0x12	R	16-bit register I16 DW=10
40029	28	VBW | LONGITUDINAL GROUND SPEED: -978.2, VBW | LONGITUDINAL GROUND SPEED WORD = -9782 = 0xD9CA BYTE HI = 0xD9, BYTE LO = 0xCA	R	16-bit register I16 DW=10
40030	29	VBW | TRANSVERSE GROUND SPEED: 1000.0, VBW | TRANSVERSE GROUND SPEED WORD: 10000 = 0x2710 BYTE HI = 0x27, BYTE LO = 0x10	R	16-bit register I16 DW=10
40031	30	VBW | STATUS, WATER / GROUND SPEED: AA VBW | STATUS, WATER / GROUND SPEED WORD = 0x4141 BYTE HI = 0x41 = A (ASCII) STATUS, WATER SPEED BYTE LO = 0x41 = A (ASCII) STATUS, GROUND SPEED A = VALID DATA , V = INVALID DATA	R	16-bit register U16 CH[2]
40032	31	VBW | STERN TRANSVERSE WATER SPEED: -1000.0, VBW | STERN TRANSVERSE WATER SPEED WORD: -10000= 0xD9CA BYTE HI = 0xD9, BYTE LO = 0xCA	R	16-bit register I16 DW=10
40033	32	VBW | STERN TRANSVERSE GROUND SPEED: 980.4 VBW | STERN TRANSVERSE GROUND SPEED WORD: 9804 = 0x2710 BYTE HI = 0x27, BYTE LO = 0x10	R	16-bit register I16 DW=10
40034	33	VBW | STATUS, STERN WATER/GROUND SPEED: AA VBW | STATUS, STERN WATER/GROUND SPEED WORD = 0x4141 BYTE HI = 0x41 = A (ASCII) STATUS, WATER SPEED BYTE LO = 0x41 = A (ASCII) STATUS, GROUND SPEED A = VALID DATA, V = INVALID DATA	R	16-bit register U16 CH[2]
40035	34	**VLW - Distance Traveled through Water** VLW | TOTAL CUMULATIVE WATER DISTANCE: 100007.048,N, VLW | TOTAL CUMULATIVE WATER DISTANCE DWORD = 0x05F5 FC88 WORD LO = FC88; BYTE HI = 0xFC; BYTE LO = 0x88	R	16-bit register U32 LO DW=1000
40036	35	VLW | TOTAL CUMULATIVE WATER DISTANCE DWORD = 0x05F5 FC88 WORD HI = 0x05F5; BYTE HI = 0x05; BYTE LO = 0xF5	R	16-bit register U32 HI DW=1000
40037	36	VLW | DISTANCE SINCE RESET: 100007.048,N VLW | DISTANCE SINCE RESET DWORD = 0x05F5 FC88 WORD LO = FC88; BYTE HI = 0xFC; BYTE LO = 0x88	R	16-bit register U32 LO
40038	37	VLW | DISTANCE SINCE RESET DWORD = 0x05F5 FC88 WORD HI = 0x05F5; BYTE HI = 0x05; BYTE LO = 0xF5	R	16-bit register U32 HI
40039	38	VLW | NAUTICAL MILES: NN VLW | NAUTICAL MILES WORD = 0x4E4E BYTE HI = 0x4E = N(ASCII) CUMULATIVE DISTANCE, NAUTICAL MILES BYTE LO = 0x4E = N(ASCII) DISTANCE SINCE RESET, NAUTICAL MILES	R	16-bit register U16 CH[2]
40040	39	**MWV - Wind Speed and Angle** MWV | WIND ANGLE	R	16-bit register U16 DW=10
40041	40	MWV | WIND ANGLE REFERENCE : R = Relative, T = Theoretical BYTE HI = 0x00 BYTE LO = 0x52 (ASCII: R) lub 0x54 (ASCII: T)	R	16-bit register U16 CH[2]
40042	41	MWV | WIND SPEED	R	16-bit register U16 DW=10
40043	42	MWV | WIND SPEED UNIT & DATA STATUS BYTE HI = K – km/h, M – m/s, N – knots (ASCII) | SPEED UNIT BYTE LO = A - Data Valid, V - Data invalid (ASCII) | DATA STATUS	R	16-bit register U16 CH[2]
40044	43	**XDR - Transducer Measurements** XDR | SENSOR1 – VALUE CD AB	R	32-bit register I32 DW=1000

Address 4X	Registers Address	Registers description	Attribute	Value DW
		INT32 : CD		
40045	44	XDR | SENSOR1 – VALUE CD AB INT32 : AB	R	32-bit register I32 DW=1000
40046	45	XDR | SENSOR1 – VALUE TYPE, VALUE UNIT BYTE HI = C–Temperature, H–Humidity, U–Voltage (ASCII) | VALUE TYPE BYTE LO = C–°C, H–%RH, V–Volts (ASCII) | VALUE UNIT	R	16-bit register U16 CH[2]
40047	46	XDR | SENSOR1 – IDENTIFIER BYTE HI = A (ASCII) | ID CHAR1 BYTE LO = 1 (ASCII) | ID CHAR2	R	16-bit register U16 CH[2]
40048	47	XDR | SENSOR2 – VALUE CD AB INT32 : CD	R	32-bit register I32 DW=1000
40049	48	XDR | SENSOR2 – VALUE CD AB INT32 : AB	R	32-bit register I32 DW=1000
40050	49	XDR | SENSOR2 – VALUE TYPE, VALUE UNIT BYTE HI = C–Temperature, H–Humidity, U–Voltage (ASCII) | VALUE TYPE BYTE LO = C–°C, H–%RH, V–Volts (ASCII) | VALUE UNIT	R	16-bit register U16 CH[2]
40051	50	XDR | SENSOR2 – IDENTIFIER BYTE HI = A (ASCII) | ID CHAR1 BYTE LO = 2 (ASCII) | ID CHAR2	R	16-bit register U16 CH[2]
40052	51	XDR | SENSOR3 – VALUE CD AB INT32 : CD	R	32-bit register I32 DW=1000
40053	52	XDR | SENSOR3 – VALUE CD AB INT32 : AB	R	32-bit register I32 DW=1000
40054	53	XDR | SENSOR3 – VALUE TYPE, VALUE UNIT BYTE HI = C–Temperature, H–Humidity, U–Voltage (ASCII) | VALUE TYPE BYTE LO = C–°C, H–%RH, V–Volts (ASCII) | VALUE UNIT	R	16-bit register U16 CH[2]
40055	54	XDR | SENSOR3 – IDENTIFIER BYTE HI = A (ASCII) | ID CHAR1 BYTE LO = 3 (ASCII) | ID CHAR2	R	16-bit register U16 CH[2]
40056	55	XDR | SENSOR4 – VALUE CD AB INT32 : CD	R	32-bit register I32 DW=1000
40057	56	XDR | SENSOR4 – VALUE CD AB INT32 : AB	R	32-bit register I32 DW=1000
40058	57	XDR | SENSOR4 – VALUE TYPE, VALUE UNIT BYTE HI = C–Temperature, H–Humidity, U–Voltage (ASCII) | VALUE TYPE BYTE LO = C–°C, H–%RH, V–Volts (ASCII) | VALUE UNIT	R	16-bit register U16 CH[2]
40059	58	XDR | SENSOR4 – IDENTIFIER BYTE HI = A (ASCII) | ID CHAR1 BYTE LO = 4 (ASCII) | ID CHAR2	R	16-bit register U16 CH[2]
40060	59	**DBT - Depth Below Transducer** DBT | Depth below transducer in feet	R	16-bit register U16 DW=10
40061	60	DBT | Depth below transducer in meters	R	16-bit register U16 DW=10
40062	61	DBT | Depth below transducer in fathoms	R	16-bit register U16 DW=10
40063	62	DBT | UNIT ID BYTE HI = f (ASCII) | ID CHAR1 - Feet BYTE LO = M (ASCII) | ID CHAR2 - Meters	R	16-bit register U16 CH[2]

Address 4X	Registers Address	Registers description	Attribute	Value DW
40064	63	DBT | UNIT ID BYTE HI = F (ASCII) | ID CHAR1 - Fathoms BYTE LO = 0x00 (ASCII) | ID CHAR2 – Not use	R	16-bit register U16 CH[2]
40065	64	**DPT - Depth** DPT | Water depth relative to the transducer, meters	R	16-bit register U16 DW=10
40066	65	DPT | Offset from transducer *, meters Notes: *1) "positive" = distance from transducer to water-line, "-" = distance from transducer to keel *2) For IEC applications the offset shall always be applied so as to provide depth relative to the keel.	R	16-bit register I16 DW=10
40067	66	DPT | Maximum range scale in use	R	16-bit register U16 DW=10
40068	67	**DBK - Depth Below Keel** DBK | Depth below Keel in feet	R	16-bit register U16 DW=10
40069	68	DBK | Depth below Keel in meters	R	16-bit register U16 DW=10
40070	69	DBK | Depth below Keel in fathoms	R	16-bit register U16 DW=10
40071	70	DBK | UNIT ID BYTE HI = f (ASCII) | ID CHAR1 - Feet BYTE LO = M (ASCII) | ID CHAR2 - Meters	R	16-bit register U16 CH[2]
40072	71	DBK | UNIT ID BYTE HI = F (ASCII) | ID CHAR1 - Fathoms BYTE LO = 0x00 (ASCII) | ID CHAR2 – Not use	R	16-bit register U16 CH[2]
40073	72	**DBS - Depth Below Surface** DBS | Depth below Surface in feet	R	16-bit register U16 DW=10
40074	73	DBS | Depth below Surface in meters	R	16-bit register U16 DW=10
40075	74	DBS | Depth below Surface in fathoms	R	16-bit register U16 DW=10
40076	75	DBS | UNIT ID BYTE HI = f (ASCII) | ID CHAR1 - Feet BYTE LO = M (ASCII) | ID CHAR2 - Meters	R	16-bit register U16 CH[2]
40077	76	DBS | UNIT ID BYTE HI = F (ASCII) | ID CHAR1 - Fathoms BYTE LO = 0x00 (ASCII) | ID CHAR2 – Not use	R	16-bit register U16 CH[2]
40078	77	**HDT - Heading True, Vessel heading in degrees true** HDT | VESSEL HEADING TRUE IN DEGREES: 359.200,T HDT | VESSEL HEADING TRUE IN DEGREES DWORD = 0x00057B20 WORD LO = 0x7B20; BYTE HI = 0x7B; BYTE LO = 0x20	R	16-bit register U32 LO DW=1000
40079	78	HDT | VESSEL HEADING IN DEGREES TRUE DWORD = 0x00057B20 WORD HI = 0x0005; BYTE HI = 0x00; BYTE LO = 0x05	R	16-bit register U32 HI DW=1000
40080	79	**HDM - Heading Magnetic, Vessel heading in degrees with respect to magnetic north** HDM |VESSEL HEADING MAGNETIC IN DEGREES: 359.200,T HDM |VESSEL HEADING MAGNETIC IN DEGREES DWORD= 0x00057B20 WORD LO = 0x7B20; BYTE HI = 0x7B; BYTE LO = 0x20	R	16-bit register U32 LO DW=1000
40081	80	HDM |VESSEL HEADING MAGNETIC IN DEGREES DWORD= 0x00057B20 WORD HI = 0x0005; BYTE HI = 0x00; BYTE LO = 0x05	R	16-bit register U32 HI DW=1000

Address 4X	Registers Address	Registers description	Attribute	Value DW
40082	81	HDT & HDM | ID BYTE HI = T (ASCII) | ID CHAR1 - TRUE BYTE LO = M (ASCII) | ID CHAR2 – MAGNETIC	R	16-bit register U16 CH[2]

8.2. MODBUS REGISTERS TABLE OF PROPRIETARY NMEA0183 SENTENCE MANUFACTURERS

8.2.1. CONVERTER MODBUS REGISTERS TABLE IN - READOUT BY FUNCTION 04 (3X – REFERENCES) INPUT REGISTERS

Address 3X	Registers Address	Registers description	Attribute	Value DW
31001	1000	**TSX5 – sentence for TSX-5 device of SeaTechniK Ltd company** **TSX5** | ROTATION SPEED [rev/min] – VALUE LO: CD UINT32 : CD	R	16-bit register U32LO DW=10
31002	1001	**TSX5** | ROTATION SPEED [rev/min] – VALUE HI: AB UINT32 : AB	R	16-bit register U32HI DW=10
31003	1002	**TSX5** | TORQUE [kNm] – VALUE: AB UINT16 : AB	R	16-bit register U16 DW=1
31004	1003	**TSX5** | THRUST [kNm] – VALUE: AB UINT16 : AB	R	16-bit register U16 DW=1
31005	1004	**TSX5** | POWER [kW] – VALUE LO: CD UINT32 : CD AB	R	16-bit register U32LO DW=1
31006	1005	**TSX5** | POWER [kW] – VALUE HI: AB UINT32 : CD AB	R	16-bit register U32HI DW=1

8.2.2. CONVERTER MODBUS REGISTERS TABLE IN - READOUT BY FUNCTION 03 (4X – REFERENCES) HOLDING REGISTERS

Address 4X	Registers Address	Registers description	Attribute	Value DW
41001	1000	**TSX5 – sentence for TSX-5 device of SeaTechniK Ltd company** **TSX5** | ROTATION SPEED [rev/min] – VALUE LO: CD UINT32 : CD	R	16-bit register U32LO DW=10
41002	1001	**TSX5** | ROTATION SPEED [rev/min] – VALUE HI: AB UINT32 : AB	R	16-bit register U32HI DW=10
41003	1002	**TSX5** | TORQUE [kNm] – VALUE: AB UINT16 : AB	R	16-bit register U16 DW=1
41004	1003	**TSX5** | THRUST [kNm] – VALUE: AB UINT16 : AB	R	16-bit register U16 DW=1
41005	1004	**TSX5** | POWER [kW] – VALUE LO: CD UINT32 : CD AB	R	16-bit register U32LO DW=1
41006	1005	**TSX5** | POWER [kW] – VALUE HI: AB UINT32 : CD AB	R	16-bit register U32HI DW=1

8.3. FRAME STRUCTURE OF MODBUS-RTU PROTOCOL

Device address (1-byte)	*Function (1-byte)*	*Dane (n-bytes)*	*CRC-16Lo (1-byte)*	*CRC-16Hi (1-byte)*

8.4. USED FUNCTIONS OF MODBUS-RTU PROTOCOL

Function code	Description
03 (0x03)	Values readout from MODBUS-RTU registers
04 (0x04)	Values readout from MODBUS-RTU registers

8.4.1. FUNCTION 0x03 / 0x04 – READOUT MODBUS REGISTERS VALUE FROM CONVERTER

8.4.1.1. READOUT OF CURRENT MEASURED VALUE STORED IN 16-BIT REGISTER [4X / 3X-REFERENCES]

Function 0x03 / 0x04 are used for readout of status and parameter values from the converter.
Parameter values readout form MODBUS-RTU register is presented by a 16-bit register.
The registers have parameter values in format:
- integer: signed 16-bit - **I16** (in C/C++ type short int),
- integer: 16-bit without sign - **U16** (in C/C++ type short unsigned int),
- integer: signed 32-bit - **I32** (in C/C++ type int),
- integer: unsigned 32-bit - **U32** (in C/C++ type unsigned int),
- signed array – **CH[ ]** (in C/C++ type char[ ]);

The actual measurement value is obtained from the read register using the following algorithms, using the appropriate factor value **DW** (see table below), if it has been specified.

Algorithm 1. Readout register is saved to regular type variable (float) and then divide it by the factor **DW**.

```
// The fragment of code in C language (VS6.0) presenting above algorithm
short int siMeasurementReg;
float       fMeasurmentValue
.....
fMeasurmentValue = (float)siMeasurementRegister;
fMeasurmentValue = fMeasurmentValue / DW;
```

Algorithm 2.Readout register is saved to regular type variable 16-bit (short int) and then divide by the factor **DW**, received change of the dividing it is a number of the hundredth parts of the measurement value.

```
// The fragment of code in C language (VS6.0) presenting above algorithm
short int siMeasurementReg;
div_t     div_MeasurmentValue;
.....
div_MeasurmentValue= div((int)siMeasurementRegister, DW)
printf( "Total measurement value =  %d\n, Hundredths of measured values= %d\n",
          div_MeasurmentValue.quot, div_MeasurmentValue .rem );
```

8.4.1.2. READOUT TALKER ID FROM 16-BIT REGISTER [4X / 3X-REFERENCES]

0x03 / 0x04 Function are used for readout of converter registers value.
Example query MODBUS-RTU about TALKER ID from NMEA0183 protocol is shown below.

Query about TALKER ID register

Byte no	Designation	Size	Value [hex]
00	Converter address	1 Byte	**11 [11 do F7]**
01	Function code	1 Byte	**03 / 04**
02	Registry address Hi	1 Byte	**00**
03	Registry address Lo	1 Byte	**00**
04	Registry number Hi	1 Byte	**00**
05	Registry number Lo	1 Byte	**01**
06	CRC-Lo	1 Byte	**---**
07	CRC-Hi	1 Byte	**---**

Example. Query TALKER ID from registry address 40001 / address 30001

11-03-00-00-00-01-CRCLo-CRCHi
11-04-00-00-00-01-CRCLo-CRCHi

Response with TALKER ID value

Byte no	Designation	Size	Value [hex]
00	Converter address	1-Byte	**11 [11 do F7]**
01	Function code	1-Byte	**03 / 04**
02	Data bytes number	N-Byte	**02**
03	Dane1-Hi	1-Byte	**47**
04	Dane1-Lo	1-Byte	**50**
05	CRC-Lo	1-Byte	**---**
06	CRC-Hi	1-Byte	**---**

Example. Readout TALKER ID from register address 40001 / address 30001

11-03-02-47-50-CRCLo-CRCHi
11-04-02-47-50-CRCLo-CRCHi

In respond TALKER ID is presented as 2-byte with values (Hex): 0x47, 0x50 (ASCII : G, P) .

Response – in case or error

Byte no	Designation	Size	Value [hex]
00	Converter address	1-Byte	**11 [11 to F7]**
01	Function code	1-Byte	**83 / 84**
02	Error code	1-Byte	**01 – unknown function** **02 – unknown data address** **03 – unknown data value** **04 – NMEA0183 device not respond or is faulty**
03	CRC-Lo	1-Byte	
04	CRC-Hi	1-Byte	

8.4.1.3. READOUT UTC TIME FROM ZDA SENTENCE WITH 16-BIT REGISTER [4X / 3X-REFERENCES]

0x03 / 0x04 function are used for readout of converter registers value.
Example queries MODBUS-RTU about UTC time hours and minutes from ZDA sentence are shown below.

Query about UTC TIME register with ZDA sentence

Byte no	Designation	Size	Value [hex]
00	Converter address	1 Byte	**11 [11 to F7]**
01	Function code	1 Byte	**03 / 04**
02	Register address Hi	1 Byte	**00**
03	Register address Lo	1 Byte	**01**
04	Registry number Hi	1 Byte	**00**
05	Registry number Lo	1 Byte	**01**
06	CRC-Lo	1 Byte	**---**
07	CRC-Hi	1 Byte	**---**

Example. Query of UTC time from ZDA sentence from register address 40002 / address 30002

11-03-00-01-00-01-CRCLo-CRCHi
11-04-00-01-00-01-CRCLo-CRCHi

Response with register value UTC TIME from ZDA sentence

Byte no	Designation	Size	Value [hex]
00	Converter address	1-Byte	**11 [11 to F7]**

Byte no	Designation	Size	Value [hex]
01	Function code	1-Byte	**03 / 04**
02	Error code	N-Byte	**02**
03	Dane1-Hi	1-Byte	**0E**
04	Dane1-Lo	1-Byte	**24**
05	CRC-Lo	1-Byte	**---**
06	CRC-Hi	1-Byte	**---**

Example. Readout of UTC time from ZDA sentence from register address 40009 / address 30009

11-03-02-0E-24-CRCLo-CRCHi
11-04-02-0E-24-CRCLo-CRCHi

In respond UTC time, hours and minutes from ZDA sentence is presented as 2-byte with values:
UTC HHMM = 0x0E24 => Hour=0x0E=14, minutes=0x24=36

Response – in case of error

Byte no	Designation	Size	Value [hex]
00	Converter address	1-Byte	**11 [11 to F7]**
01	Function code	1-Byte	**83 / 84**
02	Error code	1-Byte	**01 – unknown function** **02 – unknown data address** **03 – unknown data value** **04 – NMEA0183 device not respond or is faulty**
03	CRC-Lo	1-Byte	
04	CRC-Hi	1-Byte	

8.5. EXCEPTIONS OF THE MODBUS-RTU PROTOCOL

ADA-4040PC6 in case of received MODBUS-RTU frame, includes:
- unsupported function,
- unknown data address,
- unknown data value
- NMEA0183 device not respond on inquiries,

returns to MASTER type device the frame containing the appropriate exception – described below.

Response – in case of error

Byte no	Designation	Size	Value [hex]
00	Converter address	1-Byte	**11 [11 to F7]**
01	Function code	1-Byte	**83 / 84**
02	Error code	1-Byte	**01 – unknown function** **02 – unknown data address** **03 – unknown data value** **04 – NMEA0183 device not respond or is faulty**
03	CRC-Lo	1-Byte	
04	CRC-Hi	1-Byte	

9. VERSIONS

ADA-4040PC6 - [ ] - [ ]

Version:	
Standard	**1**
3-way galvanic isolation:	
1kV=	**23**
3kV=	**33**

Order example:
Product Symbol: **ADA-4040PC6-1-23**
1 – standard version,
23 – 1kV=, 3-way galvanic isolation,

10. SPECIFICATION

TECHNICAL DATA		
Transition Parameters		
Interface	**RS-485/RS-422 (NMEA0183)**	**RS-485/RS-422 (RTU)**
Connector	Screw terminal, wire max. Ø 2,5mm^2	Screw terminal, wire max. Ø 2,5mm^2
Line length	1200m (depends on baud rate)	1200m (depends on baud rate)
Max. number of connected device	Up to 32 devices	
Baud rates (bps)	300, 600, 1200, 1800, 2400, 4800, 7200, 9600, 14400, 19200, 28800, 38400, 57600, 76800, 115200, 230400,	
Data formats	Data bits 5, 6, 7, 8, Parity: None, Parity, Odd, Number of stop bits: 1, 2,	
Transmission line	Twisted cable 1-pair or 2-pair, UTP Nx2x0,5 (24AWG), shield inside large interferences STP Nx2x0,5(24AWG).	
Transmission type	Asynchronism full duplex, half duplex.	
Standards	EIA-485, CCITT V.11	
Protocol	**NMEA0183**	**Modbus-RTU**
Optical signalisation	• PWR – green LED power supply, • RX - red LED data receiving from RTU port – RS485/RS422, • TX - yellow LED data transmission through RTU port – RS485/RS422.	
Electrical Parameters		
Power requirements	10 - 24 – 30 V DC	
Power Cable	Recommended length of power cable – up to 3m.	
Power	<2W	
Protection from reverse power polarization	YES	
Galvanic Isolation	1kVDC or 3kVDC between power circuit and RS-485/RS-422 NMEA and RTU signal lines – depend on version.	
Optoisolation	~3kV - between signal line RS-485/RS-422 (NMEA0183) and RS-485/RS-422 (RTU)	
Electromagnetic compatibility	Resistance to disruptions according to the standard PN-EN 55024. Emission of disruptions according to the standard PN-EN 55022.	
Safety requiring	According to the PN-EN60950 norm.	
Environment	Commercial and light industrial.	
Environmental Parameters		
Operating temperature	- 30°C ÷ 60°C	
Humidity	5 ÷ 95% - non-condensing	
Storage temperature	-40 ÷ 70 °C	
Casing		
Dimensions	53 x 90 x 62 mm	
Material	PC/ABS	
Degree of casing protection	IP40	
Degree of terminal protection	IP20	
Weight	0,10 kg	
According to standard	DIN EN50022, DIN EN43880	
Location during work	Free	
Mounting method	On the rail compliant with DIN35 / TS35 standard.	

* - Names of companies and logotypes have been used only for informational purposes.

Dear Customer,

Thank you for purchasing **CEL-MAR Company** products.

We hope that this user manual helped connect and start up the **ADA-4040PC6 converter**. We also wish to inform you that we are a manufacturer of the widest selections of data communications products in the world such as: data transmission converters with interface RS232, RS485, RS422, USB, Current Loop, Fibre-Optic Converters and Ethernet or Wi-Fi.
Please contact us to tell how you like our products and how we can satisfy you present and future expectation.

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