Elseta
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V1.0

ELSETA

IOMOD T

User manual

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DECLARATION OF CONFORMITY

(in accordance with ISO / IEC Guide 22 and EN Section 45014)
Manufacturer: UAB Aedilis
Address of the manufacturer L. Zamenhofo st. 5 LT Vilnius, Lithuania

We claim that:
The device IOMOD T

Conforms to the following standards:

EMC:
Radiation EN 55022 (Class A)
1 emitted radiation (30-1000 MHz)
Second radiation conductors (0.15-30 MHz)
EN 50082-1 immunity test
1 IEC 801-3: Radio-frequency electromagnetic field
2 IEC 801-2: Electrostatic discharge.
3 IEC 801-4: Quick periodic electrostatic discharges

Additional information:
The device complies with the Low Voltage Directive 73/23 / EEC and EMC Directive 89/336 / EEC.
Device assembly complies with the RoHS Directive.

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SAFETY REQUIREMENTS

This equipment's operating notes, which must be met for your personal safety, as well as to avoid damage to the equipment, are marked with a warning triangle symbol and the various degrees of risk of falling within signs. All work related to electronic systems design, installation, commissioning, adjustment and maintenance should be carried out in accordance with the safety requirements.

EQUIPMENT MANUAL - USED SYMBOLS

Danger - important notice which may affect the safety of the user or device.

Attention - notice on possible problems that may arise in individual cases.

Information Notice - the information that is useful advice or special places.

Warning of the danger. The work may be performed only by a qualified professional. Equipment installation, commissioning and maintenance may only be performed by a qualified professional. If the safety notes in this manual, the term refers to persons qualified specialists authorized to perform commissioning, grounding and labeling devices, systems and circuits. The person must: Be aware of occupational safety in the workplace. Need to understand the equipment components. Electrical equipment. Have the knowledge and skills to identify a component beneath the voltage.

To maintain the equipment necessary to always turn off the power supply before installing or dismantling works. It must be in mind that even though alone equipment, but can have a common ground connection. Always before connecting the power supply, cables and interconnect components must be inspected.

This product can not be implemented, or resold to install in areas that are high-security as nuclear power plants, aircraft navigation, military equipment, transport traffic in management. In areas where equipment failure can result in of nature and human injury.

Do not operate the equipment in extreme weather conditions, as they may affect the operation of the equipment.

TABLE OF CONTENTS

1. Introduction

IOMOD T is used for temperature data monitoring over Modbus or IEC-60870-103 using resistance temperature detector (RTD) platinum sensor and negative temperature coefficient (NTC) thermistors. Device is also capable of reading up to count pulses of three bidirectional digital inputs up to ±24 volts.

2. Features

- Temperature sense with ±0.5 °C accuracy over all operating conditions;
- Three bidirectional digital inputs - 12-24 VDC, 2 kV isolation voltage;
- Selectable PT100 ar PT1000 temperature sensor (2, 3 or 4 wire);
- Possibility to connect NTC resistor to system;
- Configurable temperature and sensors' fault detection;
- Temperature sensing range from -200 up to 800 °C when using platinum RTD sensors, from -40 up to 200 °C when using NTC thermistors;
- Configurable Modbus or IEC-60870-103 settings: Slave ID, baud rate, parity and stop bits, RS485 terminating resistor, etc.
- Firmware upgrade over USB;
- Two connectors for RS485, for easier device connection on one line.

3. Device operational information

IOMOD uses Modbus (RTU) or IEC-60870-103 protocols over RS485 connection. Default Modbus and IEC-60870-103 settings are: 9600 bauds/s baudrate, 8N1, Slave (Link) address - 1.

To read temperature using Modbus (RTU) protocol user can use device with default settings without configuring it. To read temperature from RTD sensor, send 04 Modbus command (Read Input Registers) with resolution of first (0) and second (1) registers. To read temperature from NTC sensor, send 04 Modbus command (Read Input Registers) with resolution of third (2) and fourth (3) registers. Two words read by Modbus represent a float type variable.

To read temperature from any of aforementioned sensors using IEC-60870-103 protocol user should first configure it over USB. To send RTD or NTC sensor temperature it should first be enabled in RTD parameters menu. Only RTD sensor temperature sending is enabled by default. After enabling transmission from any of the two sensors data will be available as cyclically read values. These values are represented as 12 bit integers in a range from -200°C to 200°C - temperature value is therefore multiplied by 10 to have resolution of 0.1 °C unless full range of RTD (from -200°C to 800°C) is selected - then 1 °C resolution is achieved and temperature is not multiplied by any number. Thermistor temperature with 0.1 °C fits into 12-bit measurand, so there is no range selection for NTC sensors and temperature can be measured from from -40°C to 200°C.

For further information regarding setting temperature parameters, reading digital inputs, their counter values and configurable options please refer to table shown below, also supported MODBUS and IEC-60870-103 functions described in paragraphs described below.

CONFIGURABLE OPTIONS	OVER USB	OVER MODBUS	OVER IEC-60870-103
Slave Address	Yes	No	No
Baudrate	Yes	No	No
Data, Stop and Parity bits	Yes	No	No
RS485 Terminating Resistor	Yes	No	No
Input pull-up	Yes	No	No
Input filter-time	Yes	No	No
RTD parameters	Yes	No	No
Default settings	Yes	No	No
Setting temperature limits	Yes	Yes	No
Fault configuration and clearing	Yes	Yes	No
Defining pulse counter values	Yes	Yes	No*

* Counters/Timers are not implemented in IEC-60870-103 firmware version

Supported MODBUS functions

01 (0x01) Read Coil Status

Used to read fault flag. Fault is logical high if any configured fault has occurred, zero otherwise. Fault flag should be cleared manually.

02 (0x02) Read Input Status

Reads status of digital inputs (OFF or ON states). IOMOD T has 3 digital inputs which values are kept on addresses 0 to 2. For further register explanation please check *Modbus register mapping table*.

03 (0x03) Read Holding Registers

May be used to read holding registers containing temperature limits defined by user in degrees Celsius, fault mask register, pulse count, on time registers for any of three digital inputs.

Temperature limits are defined as a 16-bit integer values. Values that are below or above the predefined limits are ignored. These limits are described in *Modbus register mapping table* below. If upper limit value is lower than lower limit value, these values are switched between them.

Fault mask register contains information about fault bits that would be lifted in fault register if any particular fault has occurred. Its value is kept at holding register at address 11.

Fifteen registers from 20 to 34 are used to hold values of calculated pulse counts and on times for digital inputs. Pulse count is held as 16-bit wide value, on time in milliseconds and seconds is held as 32-bit wide values. To get actual on time, user should sum on time in milliseconds and seconds. Values are held most significant word first.

04 (0x04) Read Input Registers

May be used to read current temperature values and faults.

As temperature is kept as a 4-byte wide float value, two neighboring register are used to keep it. RTD values are kept at addresses 0 and 1, NTC values are kept at addresses 2 and 3. Value read can be easily converted using any converter capable of converting floats based of IEEE-754 standard.

Fault register value is read as a one 16-bit input register at address 10. Meanings of individual bits are explained below, in subsection *Fault registers*.

05 (0x05) Force Single Coil

Used to clear flag condition. Writing zero clears the flag, writing one does nothing. Flag should be cleared manually if fault condition has occurred.

06 (0x06) Preset Single Register

Used to set holding registers one by one described when explaining 03 Modbus function. That means that arbitrary value may be written to pulse count, on time registers, etc. It is advised to set most significant word first.

16 (0x10) Preset Multiple Registers

Used to set multiple registers by one instruction. Registers that can be changed are: pulse count, on time in both seconds and milliseconds. This may be useful when in need to clear all input values instantly without any transmission delays.

Modbus register mapping table

Register	Description	Value range
Read coil status (01)		
00010	Reading fault flag	0-1
Read discrete inputs (02)		
00000-0002	Reading digital inputs DI1-DI3	0-7
Read holding register (03)		
00000	Get lower RTD temperature limit	-200-800
00001	Get upper RTD temperature limit	-200-800
00002	Get lower NTC temperature limit	-40-200
00003	Get upper NTC temperature limit	-40-200
00011	Fault Mask register	0-57836
00020-00022	Pulse count for DI1-DI3	0-65535
00023-00028	On time, in seconds, for DI1-DI3, MSB first	0-65535
00029-00034	On time, in milliseconds, for DI1-DI3, MSB first	0-65535
Read input registers (04)		

00000	Temperature from RTD Sensor, MSB	0-65535
00001	Temperature from RTD Sensor, LSB	0-65535
00002	Temperature from NTC Sensor, MSB	0-65535
00003	Temperature from NTC Sensor, LSB	0-65535
00010	Fault register	0-57836
Force single coil (05)		
00010	Clearing fault flag (0 to clear)	0-1
Preset Single Register (06)		
00000	Set lower RTD temperature limit*	-200-800
00001	Set upper RTD temperature limit*	-200-800
00002	Set lower NTC temperature limit*	-40-200
00003	Set upper NTC temperature limit*	-40-200
00011	Set Fault Mask register	0-65535
00020-00022	Set pulse count register for DI1-DI3	0-65535
00023-00028	Set On Time register of seconds for DI1-DI3, MSB first**	0-65535
00029-00034	Set On Time register of milliseconds for DI1-DI3, MSB first**	0-65535
Preset Multiple Registers (16)		
00020-00022	Set pulse count register for DI1-DI3	0-65535
00023-00028	Set On Time register of seconds for DI1-DI3**	0-65535
00029-00034	Set On Time register of milliseconds for DI1-DI3**	0-65535

*if lower limit is set higher that upper limit, limits will be switched in order. Temperature is encoded as signed integer.
**It is advised to set most significant word of counter/timer first or preset multiple registers (Modbus operation 16)

Fault registers

Fault register (Modbus address - 40010) is read-only. It represent faults that occurred during operation of device. To enable showing desired fault user should set appropriate bits in Fault mask register (Modbus address - 30011). Default values are shown in brackets below.

Fault register[15:12] show flags that are lifted in temperature limits are exceeded. Fault register[10] informs if NTC is not connected. Bits[7:5,3:2] inform about faults that were detected by RTD reading chip. These faults are usually lifted if unsuitable software or jumper settings are set or RTD is faulty or not connected.

Fault register

15 (R-0)	14 (R-0)	13 (R-0)	12 (R-0)	11 (R-0)	10 (R-0)	9 (R-0)	8 (R-0)
RTD Temperature Hi Threshold	RTD Temperature Lo Threshold	NTC Temperature Hi Threshold	NTC Temperature Lo Threshold	-	NTC Not connected	-	-
7 (R-0)	**6 (R-0)**	**5 (R-0)**	**4 (R-0)**	**3 (R-0)**	**2 (R-0)**	**1 (R-0)**	**0 (R-0)**
RTD Code Hi Threshold	RTD Code Lo Threshold	RTD REFIN- > 0.85 x VBIAS	-	RTD FORCE - Open	RTD Overvoltage/ Undervoltage	-	-

Fault mask register

15 (R/W-0)	14 (R/W-0)	13 (R/W-0)	12 (R/W-0)	11 (R/W-0)	10 (R/W-0)	9 (R/W-0)	8 (R/W-0)
RTD Temperature Hi Threshold Fault Enable	RTD Temperature Lo Threshold Fault Enable	NTC Temperature Hi Threshold Fault Enable	NTC Temperature Lo Threshold Fault Enable	-	NTC Not connected Fault Enable	-	-
7 (R/W-1)	**6 (R/W-1)**	**5 (R/W-1)**	**4 (R/W-0)**	**3 (R/W-1)**	**2 (R/W-1)**	**1 (R/W-0)**	**0 (R/W-0)**
RTD Code Hi Threshold Fault Enable	RTD Code Lo Threshold Fault Enable	RTD REFIN- > 0.85 x VBIAS Fault Enable	-	RTD FORCE-Open Fault Enable	RTD Overvoltage/ Undervoltage Fault Enable	-	-

IEC-60870-103 operation

IEC 60870-5-103 is a standard for power system control and associated communications. It defines a companion standard that enables interoperability between protection equipment and devices of a control system in a substation. The device complying with this standard can send the information using two methods for data transfer - either using the explicitly specified application service data units (ASDU) or using generic services for transmission of all the possible information. The standard supports some specific protection functions and provides the vendor a facility to incorporate its own protective functions on private data ranges.

IOmod T device might act as a IEC-60870-103 slave if appropriate firmware is uploaded. For more information about firmware upload check chapter *Firmware upgrade over USB*.

IEC-60870-103 operation differs from Modbus operation in a way that Modbus messages are not time-tagged. IEC-60870-103 contains timestamp information therefore counter/timer information for digital inputs is considered redundant and therefore is not configurable to be sent. Master may read (if configured) temperature from RTD sensor, temperature from NTC thermistor, three digital inputs and data from user-configured fault register. Fault is not cleared and fault register is not reset automatically, therefore user should first eliminate the source of fault and then reset the device. Fault mask reset register is also not set via IEC-60870-103, user should predefine it first via USB communication.

Fault register value is read as a standard-defined 12-bit measurand. Meanings of individual bits are explained below, in subsection *Fault registers*.

User can define RTD and thermistor (NTC) temperature upper and lower limit values so that when any limit is exceeded, overflow flag will be lifted according to IEC-60870-103 standard rules for measurands. Note that limit values are set globally so if narrower range is selected limit values won't be able to be higher than defined by standard even if limits are explicitly defined as higher values. That is, if narrow range is selected for RTD but higher temperature limit is above 200°C, reading temperatures above 200°C will be considered as an overflow condition. Temperature limit flag bits are defined as Fault Register[11:8].

Fault registers

Fault register is read-only. It represent faults that occurred during operation of device. To enable showing desired fault user should set appropriate bits in Fault mask register via USB. Default values are shown in brackets below.

Fault register[11:18] show flags that are lifted if temperature limits are exceeded. Fault register[1] informs if NTC thermistor is not connected. Bits[7:5,3:2] inform about faults that were detected by RTD reading chip. These faults flag are usually set if unsuitable software or jumper settings are set or RTD is faulty or not connected. Note that fault bits are set if they are configured to be set in *Fault Mask register*.

Fault register

15 (R-0)	14 (R-0)	13 (R-0)	12 (R-0)	11 (R-0)	10 (R-0)	9 (R-0)	8 (R-0)
-	-	-	-	RTD Temperature Hi Threshold	RTD Temperature Lo Threshold	NTC Temperature Hi Threshold	NTC Temperature Lo Threshold
7	**6**	**5**	**4**	**3**	**2**	**1**	**0**

(R-0)	(R-0)	(R-0)	(R-0)	(R-0)	(R-0)	(R-0)	(R-0)
RTD Code Hi Threshold	RTD Code Lo Threshold	RTD REFIN- > 0.85 x VBIAS	-	RTD FORCE-Open	RTD Overvoltage/ Undervoltage	-	NTC Not connected

Fault mask register

15 (R/W-0)	14 (R/W-0)	13 (R/W-0)	12 (R/W-0)	11 (R/W-0)	10 (R/W-0)	9 (R/W-0)	8 (R/W-0)
-	-	-	-	RTD Temperature Hi Threshold Fault Enable	RTD Temperature Lo Threshold Fault Enable	NTC Temperature Hi Threshold Fault Enable	NTC Temperature Lo Threshold Fault Enable
7 (R/W-1)	**6 (R/W-1)**	**5 (R/W-1)**	**4 (R/W-0)**	**3 (R/W-1)**	**2 (R/W-1)**	**1 (R/W-0)**	**0 (R/W-0)**
RTD Code Hi Threshold Fault Enable	RTD Code Lo Threshold Fault Enable	RTD REFIN- > 0.85 x VBIAS Fault Enable	-	RTD FORCE-Open Fault Enable	RTD Overvoltage/ Undervoltage Fault Enable	-	NTC Not connected Fault Enable

4. Technical information

System		
1.	Dimensions	54 (H) x 78 (W) x 118 (L), mm
2.	Case	ABS, gray, transparent top, IP65
3.	Working environment	Indoors
4.	Working temperature	-35 ÷ +80°C
5.	Recommended operating conditions	5 – 60°C and 20 – 80% RH;
6.	Configuration	USB
7.	Firmware upgrade	USB – mass storage device
Electrical Characteristics		
8.	Termination Resistor	Selectable, 120Ω
9.	Power supply	12-24VDC, 0.3W (nominal); 5-33VDC (full range)
10.	Inputs	12-24 VDC, 2 kV isolation, bidirectional

5. Device Connection

Power connection

IOmod T can be powered through main power connector (see Fig. 5.1) or through USB. Apply +12/24VDC to V_{IN+} and 0 V to V_{IN-}. The device has a built-in reverse voltage polarity, overcurrent and overvoltage protection.

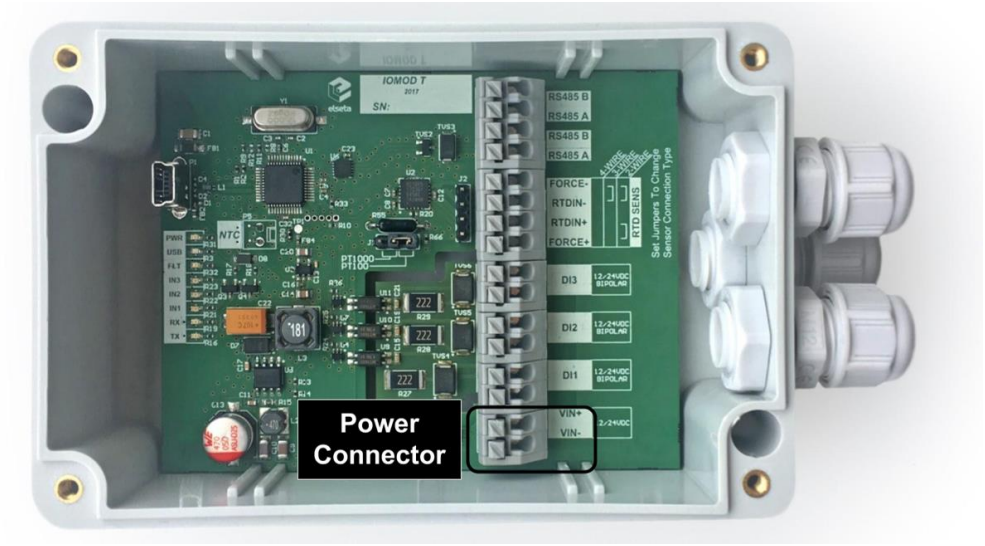

Fig. 5.1. Power connector

RS485 serial interface

IOmod T has dual RS485 spring type connector (see Fig. 5.2). Connect RS485 cable to the one pair of ***RS485 A*** and ***RS485 B*** marked contacts. A second pair of ***RS485 A*** and ***RS485 B*** contacts can be used for easy RS485 bus extension with a minimum possible cable stub.

Fig. 5.2. RS485 interface connector

IOMOD T has integrated 120Ω termination resistor which can be enabled or disabled over USB configuration. It is recommended to use termination at each end of the RS485 cable. See typical connection diagram on Fig. 5.3.

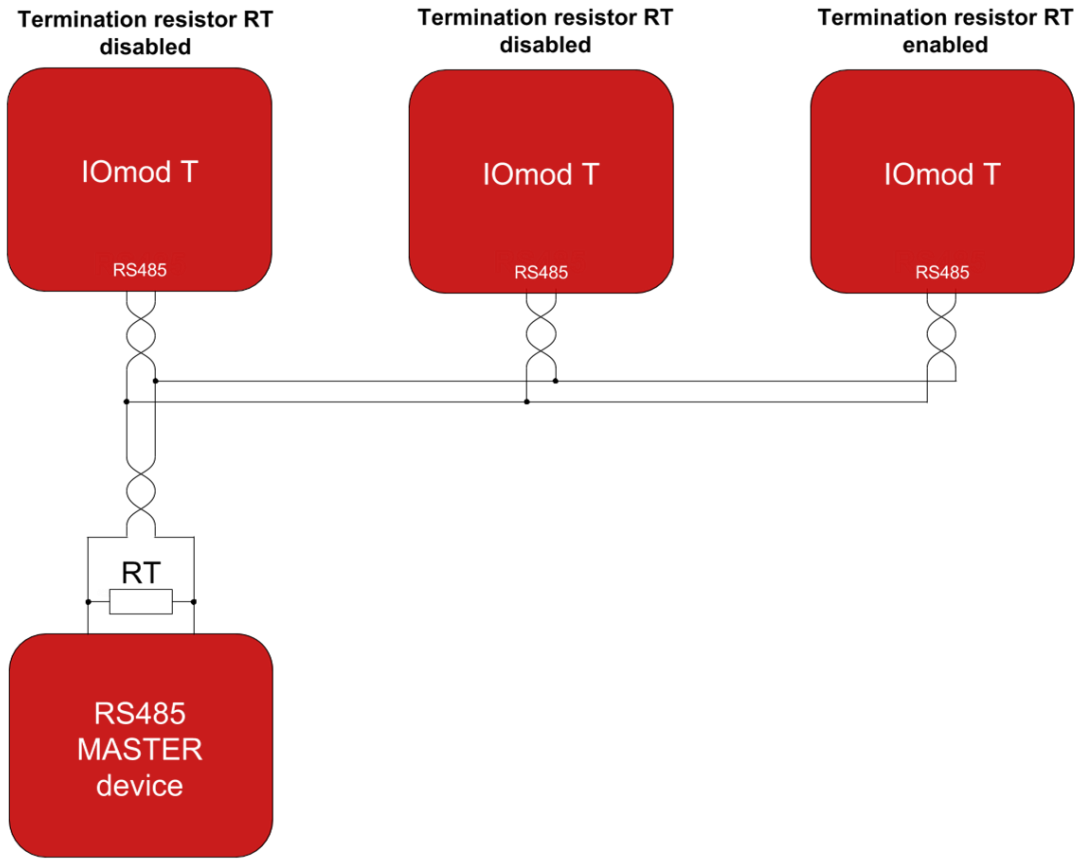

Fig. 5.3. Bus configuration example diagram

IOMOD T has 1/8 Unit load receiver which allows to have up to 256 units on line (compared to standard 32 units). To reduce reflections, keep the stubs (cable distance from main RS485 bus line) as short as possible when connecting device.

RTD sensor connection

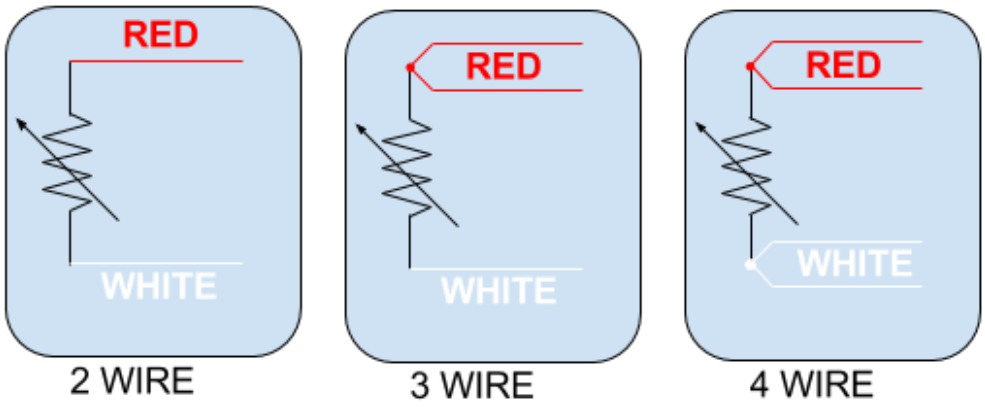

Fig. 5.4. RTD sensor colour codes

IOmod T accepts 2-wire, 3-wire or 4-wire connection types of RTD sensors (PT100, PT1000). Firstly, select a sensor type (PT100 or PT1000) using a jumper (Fig. 5.6). Secondly, use the following instructions depending on the number of wires of a selected RTD sensor.

2-wire RTD sensor: connect red wire to ***RTDIN+*** and white wire (or black) to ***RTDIN-*** contacts. The jumpers between ***RTDIN+*** and ***FORCE+***, ***RTDIN-*** and ***FORCE-*** must be set.

3-wire RTD sensor: connect one red wire to ***RTDIN+***, second red wire (compensating lead wire) to ***FORCE+*** and white (or black) wire to ***RTDIN-***. The jumper between ***RTDIN-*** and ***FORCE-*** must be set.

4-wire RTD sensor: connect red wires to ***RTDIN+*** and ***FORCE+*** contacts, white (or black) wires to ***RTDIN-*** and ***FORCE-*** contacts. NO jumpers must be set.

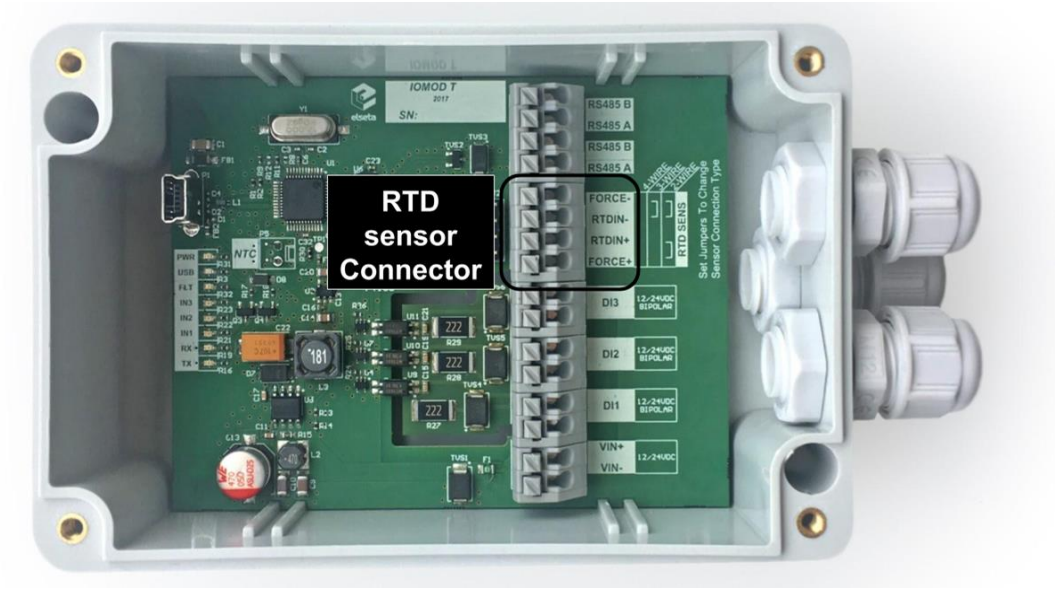

Fig. 5.5. RTD sensor connector

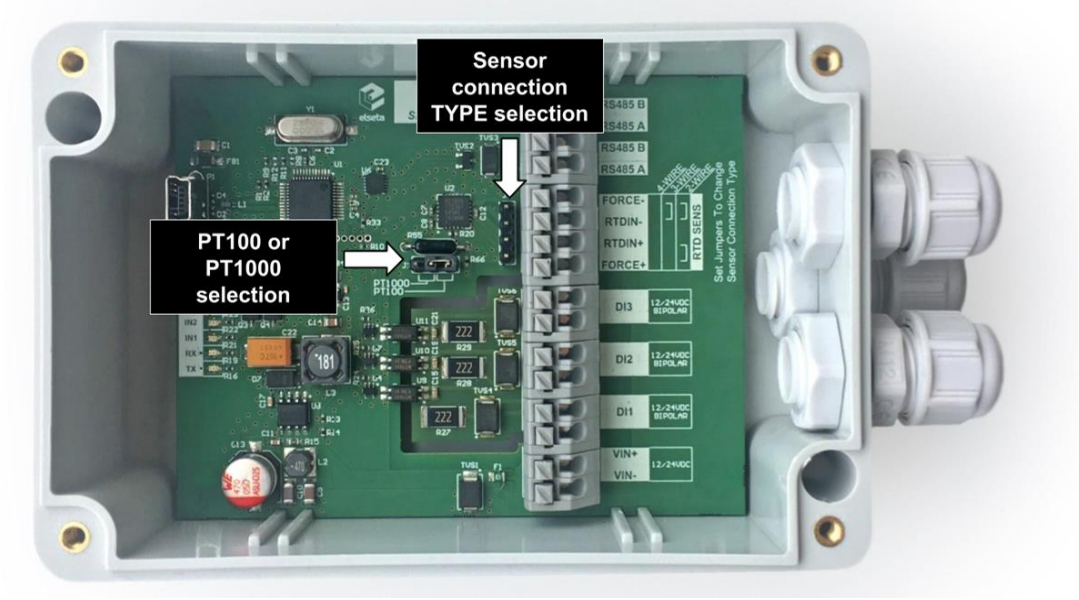

Fig. 5.6. IOmod T Jumpers

Digital input connection

IOmod T has 3 bidirectional digital inputs. Nominal voltage range for inputs is 12-24 VDC. Inputs are galvanically isolated (2 kV_{RMS}) through optocouplers. Since inputs are bidirectional, any input voltage polarity is accepted.

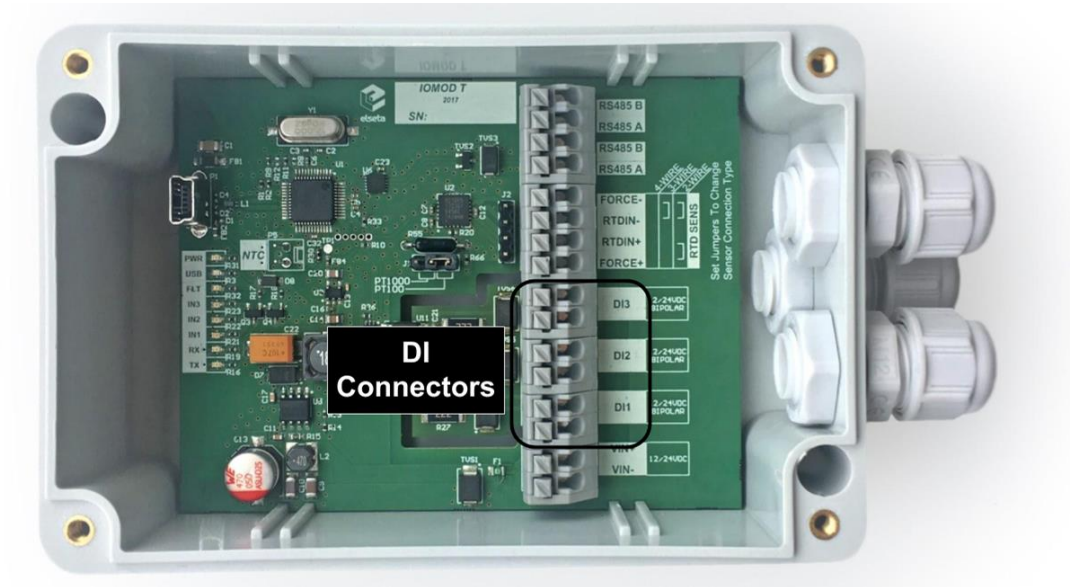

Fig. 5.7. IOmod DI Connectors

USB interface

IOmod T USB interface is used for configuration, diagnostics and firmware updates. IOmod T is powered through USB when connected, no extra power connection needed for operation. Use a USB mini B cable for connection.

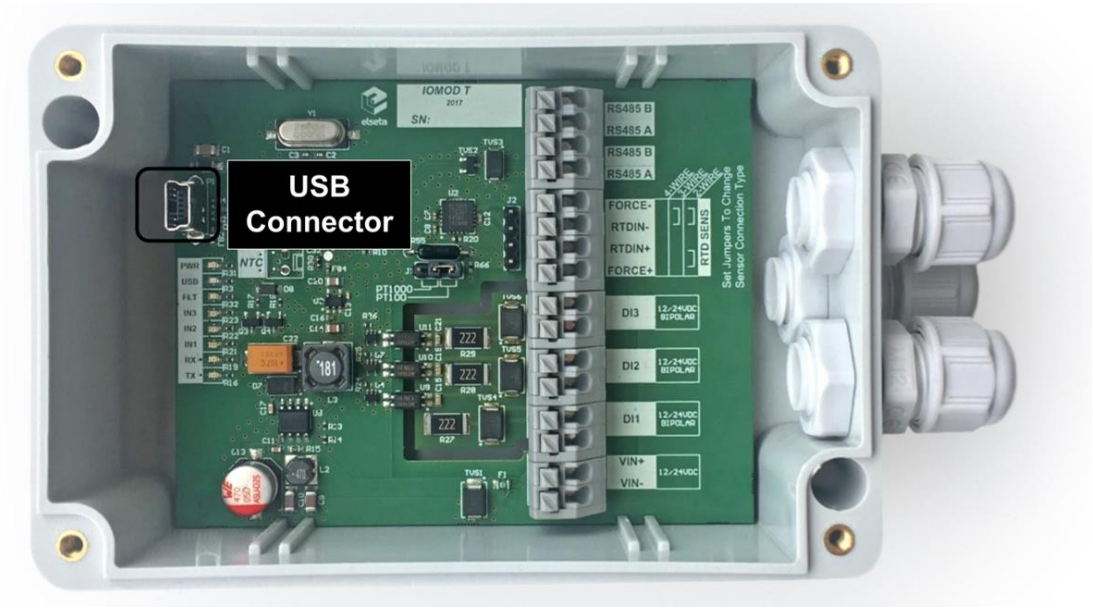

Fig. 5.7. IOmod USB Connector

6. Configuration over USB

a. Driver installation

Device requires USB drivers to work as a Virtual COM port. First-time connection between device and computer could result in “Device driver software was not successfully installed” error such as one shown in Fig.6.1.

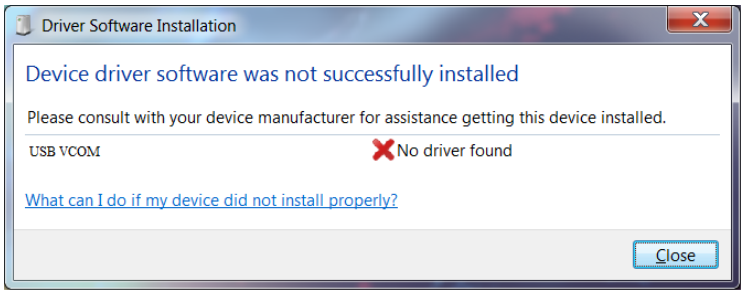

Fig. 6.1. Possible installation error

User then should manually install drivers by selecting downloaded driver folder:
Go to Control Panel -> Device Manager;
Select failed device;
Press “Update driver software”; following screen should appear:

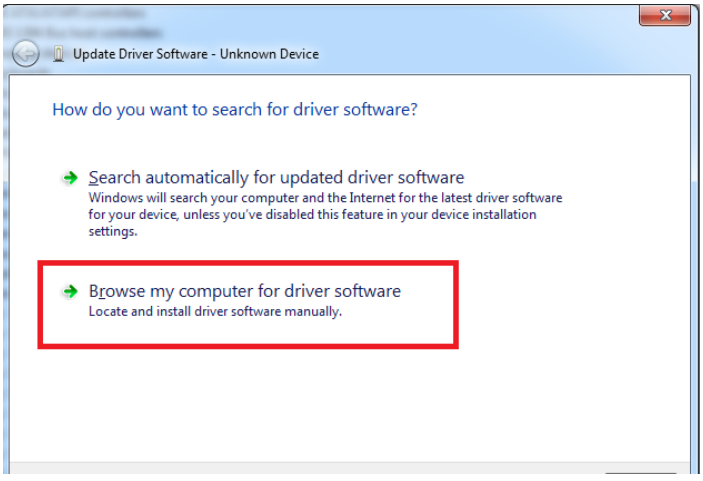

Fig. 6.2. Driver update screen

Select “x86” driver for 32bit machine, or x64 for 64bit machine. If not sure, select root folder (folder in which x64 and x86 lays inside).

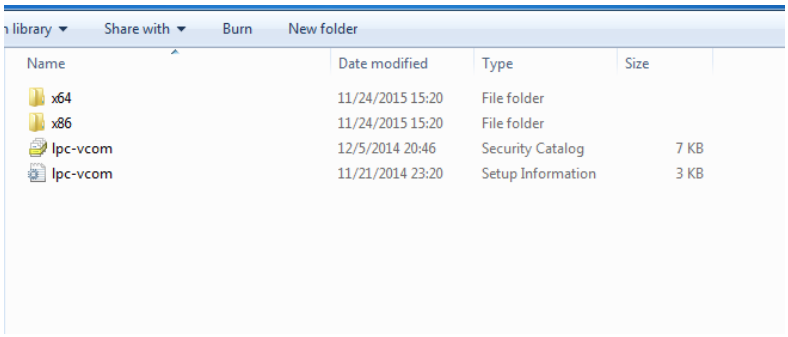

Fig. 6.3. Contents of folder used to install drivers

b. IOMOD T configuration with PuTTY terminal

Configuration of IOMOD device is done through CLI (Command Line Interface) on virtual COM port. Drivers needed for MS Windows to install VCOM will be provided. To open up CLI simply connect to specific VCOM port with terminal software (it is advised to use PuTTY terminal software. If other software is being used, user might need to send <return> symbol after each command). When connected user should immediately see main screen similar to one in Fig.6.4.

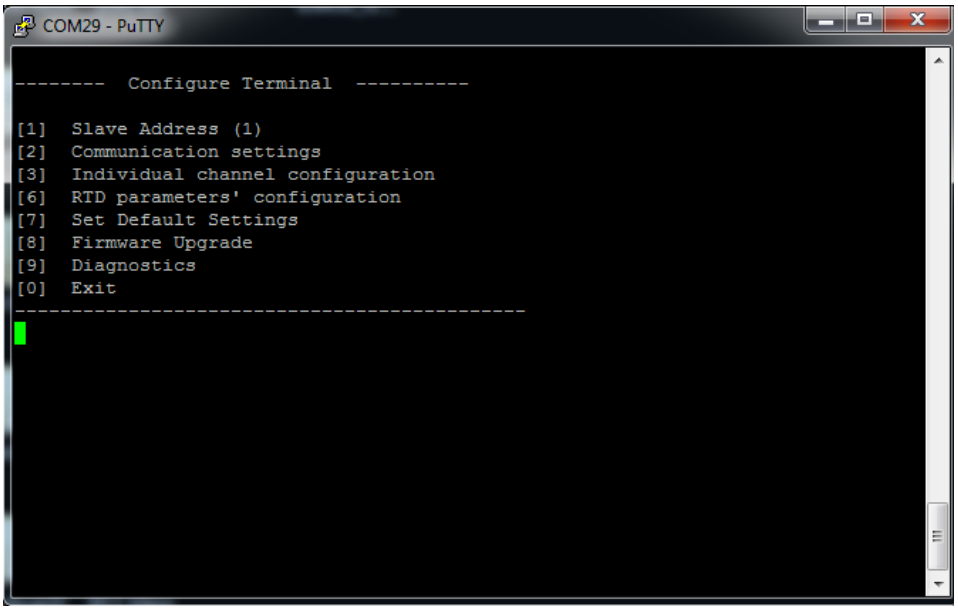

Fig. 6.4. Main configuration menu example

Navigation is performed by pressing number connected to its function. User then should proceed by following further on-screen instructions. For example, to set desired slave address, press [1] to enter Slave Address screen; enter new configuration; press [RETURN] to save, or [ESC] to cancel changes. When done, press [0] (exit) before disconnecting device. Default values are set by pressing [7] on main screen, and later confirming these changes by pressing [1].

If terminal window is accidentally closed, user can connect to terminal again, and press any key on keyboard to show up main menu once again.

Configuration of device is not possible when USB Simulation Mode is entered. To access configuration menu again user should reset device and then try again.

c. Main Menu

Modbus

	Menu Name	Function	Values	Default Values
1.	Slave Address	Modbus Slave address / ID	1-247	(default: 1)
2.	Communication settings	Modbus baud rate; data, stop, parity bits; terminating resistor		(default: 9600, 8N1, 1 (Enabled))
3.	Individual channel configuration	Input state polarity, pull-up enable, filter time, timer/counter configuration	Described when particular menu option is chosen	
6.	RTD parameters' configuration*	Configuring Callendar-Van Dusen, Steinhart-Hart coefficients; RTD wire count, type, etc.		PT100, 2 wires, coefficients according to IEC-751
7.	Set Default Settings	Sets Default Settings	(1 to confirm, 0 to cancel)	-
8.	Firmware Upgrade	Mass Storage Device Firmware Upgrade	(1 to confirm, 0 to cancel)	-
9.	Diagnostics	Entering diagnostics mode	-	-
0.	Exit	Exit and disconnect	-	-

*When configuring RTD or NTC coefficients A, B and C, write values without their respective exponents (e.g. A=3.9083)

IEC-60870-103

	Menu Name	Function	Values	Default Values
1.	Link Address	Link Slave address	1-247	(default: 1)
2.	Baudrate & bits	Modbus baud rate; data, stop, parity bits		(default: 9600, 8N1)
3.	Data addressing config	Configuring input address function type	1-255	8
4.	RS485 Terminating Resistor	Enabling or disabling terminating resistor	Enabled/ Disabled	Enabled

5.	Input configure	Input state polarity, pull-up enable, filter time	Described when particular menu option is chosen	
6.	RTD parameters' configuration*	Configuring Callendar-Van Dusen, Steinhart-Hart coefficients; RTD wire count, type, etc.		PT100, 2 wires, coefficients according to IEC-751
7.	Set Default Settings	Sets Default Settings	(1 to confirm, 0 to cancel)	-
8.	Firmware Upgrade	Mass Storage Device Firmware Upgrade	(1 to confirm, 0 to cancel)	-
9.	Diagnostics	Entering diagnostics mode	-	-
0.	Exit	Exit and disconnect	-	-

*When configuring RTD or NTC coefficients A, B and C, write values without their respective exponents (e.g. A=3.9083)

d. Firmware upgrade over USB

To update device firmware user must enter main configuration menu.
Enter Firmware update screen by pressing [4];
Confirm update by pressing [1];
Device now enters Firmware Upgrade mode.

It is recommended to close terminal window after entering firmware upgrade mode.

Device reconnects as a mass storage device:

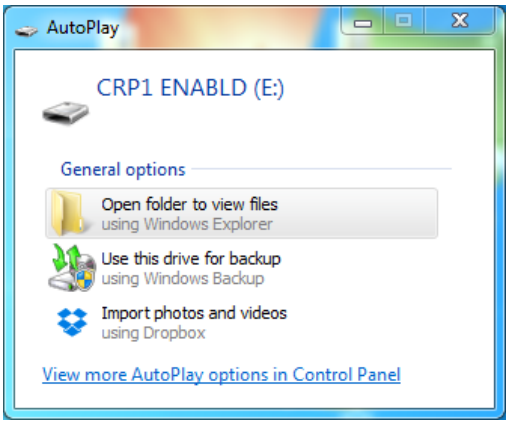

Fig. 6.5. Mass storage device window

User then should delete existing file “firmware.bin” and simply upload new firmware .bin file by dragging and dropping.

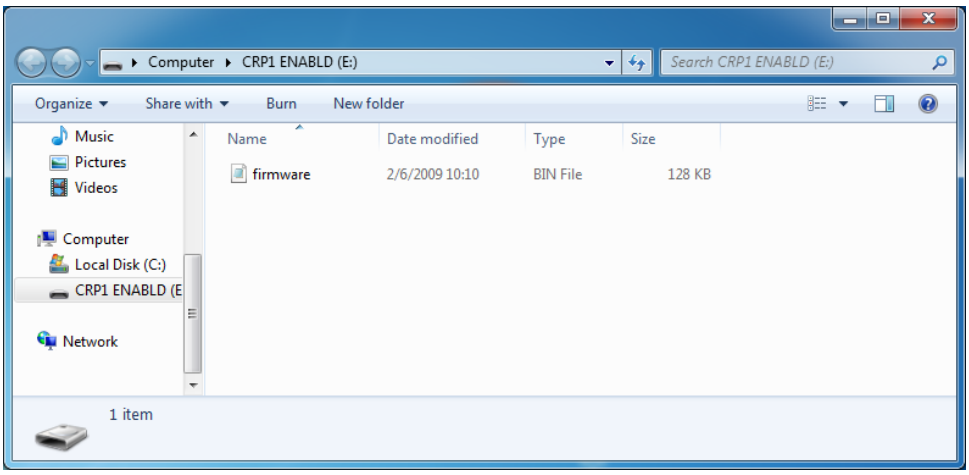

Fig. 6.6. Folder into which new firmware has to be uploaded

Reconnect device and check firmware version. It should now show that you upgraded your device.

e. Testing With “THE VINCI” software

To test IOMOD T with default settings, user can connect device through RS485 to Modbus or IEC-60870 (depending on firmware) master or using USB Simulation Mode. Example will show “The Vinci Expert” as serial interface converter and adapter to PC with “The Vinci” software. Default settings – 9600 baud; 8 data, no parity, 1 stop bit. When opening “The Vinci” software, choose Modbus serial – Master mode. In Settings tab, choose station number (default – 1); configure tags (as described in section 2. Device operational information); press Start and go to Statistic tab:

Station	Function	Address	Value	Count	Name
1	Read Holding Registers (04)	3	27709	46	NTC Temperatur...
1	Read Holding Registers (04)	0	16844	46	PTC Temperatur...
1	Read Input Registers (03)	20	0	46	Pulse counters
1	Read Input Registers (03)	21	0	46	-
1	Read Input Registers (03)	22	0	46	-
1	Read Holding Registers (04)	1	27225	45	PTC Temperatur...
1	Read Holding Registers (04)	10	0	45	Read Fault reg...
1	Read Discrete Inputs (02)	0	OFF[0]	45	Digital inputs
1	Read Discrete Inputs (02)	1	OFF[0]	45	-
1	Read Discrete Inputs (02)	2	OFF[0]	45	-
1	Read Input Registers (03)	11	236	45	Read Fault mas...
1	Read Holding Registers (04)	2	16855	45	NTC Temperatur...
1	Read Input Registers (03)	23	0	45	On time, seconds
1	Read Input Registers (03)	24	0	45	-
1	Read Input Registers (03)	25	0	45	-
1	Read Input Registers (03)	26	0	45	-
1	Read Input Registers (03)	27	0	45	-
1	Read Input Registers (03)	28	0	45	-
1	Read Input Registers (03)	0	-200	45	Get lower PTC ...
1	Read Input Registers (03)	1	800	45	Get upper PTC ...
1	Read Input Registers (03)	2	-40	45	Get lower NTC ...
1	Read Input Registers (03)	3	200	45	Get upper NTC ...
1	Read Input Registers (03)	29	0	45	On time, milli...
1	Read Input Registers (03)	30	0	45	-
1	Read Input Registers (03)	31	0	45	-
1	Read Input Registers (03)	32	0	45	-
1	Read Input Registers (03)	33	0	45	-
1	Read Input Registers (03)	34	0	45	-

Fig. 6.7. Example of results of Modbus testing

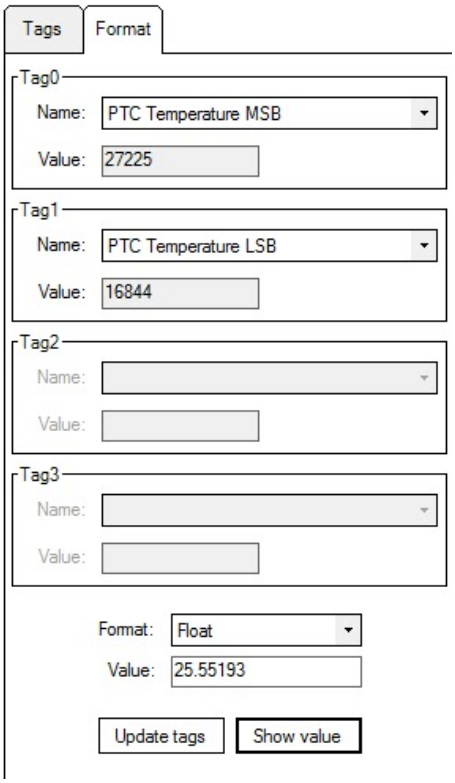

Fig.6.8. Representing temperature as float when using Modbus

TI	Couse	ASDU	FUN	INF	Value	Status	TimeTag	Count
(TI=005)	Start/restart	1	255	1 (0)	2	ASC=IOMODT F...	-	0
(TI=003)	cyclic	1	255	24 (0)	00253(006.1768%)	OV=0 IV=0	-	1111
(TI=003)	cyclic	1	255	24 (1)	00271(006.6162%)	OV=0 IV=0	-	1111
(TI=008)	End of g. int	1	255	0 (0)	SCAN:2	-	-	3
(TI=001)	General inter	1	24	1 (0)	OFF[01]	SIN=0	[W]2017/08/07 14:56:30.112	0
(TI=001)	General inter	1	24	2 (0)	OFF[01]	SIN=1	[W]2017/08/07 14:56:30.215	0
(TI=001)	General inter	1	24	3 (0)	OFF[01]	SIN=2	[W]2017/08/07 14:56:30.318	0

Fig. 6.9. Example of results of IEC-60870-103 testing

Fig. 6.8. represents how “The Vinci” software should be configured to represent temperature in IEEE-754 standard float type when using Modbus communication.

Fig.6.9 represent show example of results of IEC-60870-103 testing. Temperatures are shown and updated cyclically if they are configured to be shown via USB. To show inputs and outputs, send General Interrogation.

7. Information of the equipment manufacturer

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