IOMOD 4RTD User Manual IEC 60870-5-103

Introduction

IOMOD 4RTD is used for temperature data monitoring over Modbus or IEC-60870-103 using resistance temperature detector (RTD) platinum sensors. Up to 4 RTD temperature sensors can be connected at once.

Features

● Temperature sense with ±0.5 °C accuracy over all operating conditions;
● Selectable PT100 or PT1000 RTD temperature sensor for every channel (2, 3 or 4 wire);
● 2.5kV(rms) isolated RTD inputs;
● Configurable temperature and sensors' fault detection for every channel;
● Temperature sensing range from -200 up to 800 °C when using platinum RTD sensors;
● Configurable Modbus or IEC-60870-103 settings: Slave ID, baud rate, parity and stop bits, RS485 terminating resistor, etc.
● Firmware upgrade over USB.

Operational Information

IOMOD uses Modbus (RTU) or IEC-60870-103 protocols over RS485 connection, which can be used for cable lengths up to 1500 meters and connect up to 30 devices on one line. Default Modbus and IEC-60870-103 settings are: 9600 bauds/s baudrate, 8N1, Slave (Link) address - 1.

To read temperature from any of aforementioned sensors using IEC-60870-103 protocol user should first configure it over USB. To send temperature values from desired RTD sensors it should first be enabled in RTD parameters menu. All temperature values are by default sent cyclically. 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 values are not multiplied by any multiplier.

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

CONFIGURABLE OPTIONS	OVER USB	OVER IEC-60870-103
Slave Address	Yes	No
Baudrate	Yes	No
Data, Stop and Parity bits	Yes	No
RS485 Terminating Resistor	Yes	No
RTD parameters	Yes	No
Default settings	Yes	No
Setting temperature limits	Yes	No
Fault configuration	Yes	No

Status LED

Status LED can be in 2 colors :

Blue - Device connected to USB.

Green - Normal operation.

Rx/Tx LED

The RX/TX LED on the IOMod flashes when data is either being transmitted or received via the RS485 port.

FLT1, FLT2, FLT3, FLT4 LEDs

Input fault LEDs can be in 2 states :

Off - Normal operation.

Red - Input fault or faults occurred during operation of device.

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 4RTD 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.

Master may read (if configured) temperature values from RTD sensors and data from user-configured fault registers. Fault is cleared and fault register is cleared automatically whenever fault condition disappears, therefore user could easily eliminate the source of fault without a need of hard reset. Fault mask reset register is also not set via IEC-60870-103, user should predefine it first via USB communication.

Fault register values are read as standard-defined 12-bit measurands. Meaning of individual bits is explained below, in subsection Fault registers.

User can define temperature upper and lower limit values for every RTD 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[11:10].

Technical information

System	
Dimensions	17.5 (H) x 101 (W) x 119 (L), mm
Case	ABS, black
Working environment	Indoor
Working temperature	-40 | +80°C
Recommended operating conditions	5 – 60°C and 20 – 80% RH;
Configuration	USB
Firmware upgrade	USB – mass storage device
Electrical characteristics	
Termination resistor	Selectable, 120Ω
Power	

Power Supply	9-33 VDC
Current consumption	40mA @ 12VDC, 20mA @ 24VDC

Device Connection

Power connection

IOmod 4RTD can be powered through main power connector +12/24 VDC or through USB. Apply +12/24VDC to V+ and 0 V to V-. The device has a built-in reverse voltage polarity, overcurrent and overvoltage protection.

RS485 serial interface

IOMod 4RTD has one RS485 connector. Connect RS485 cable pair to contacts marked RS485/A and RS485/B. Connections should be made with minimum possible cable stub.

IOMOD 4RTD 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. 5.1.

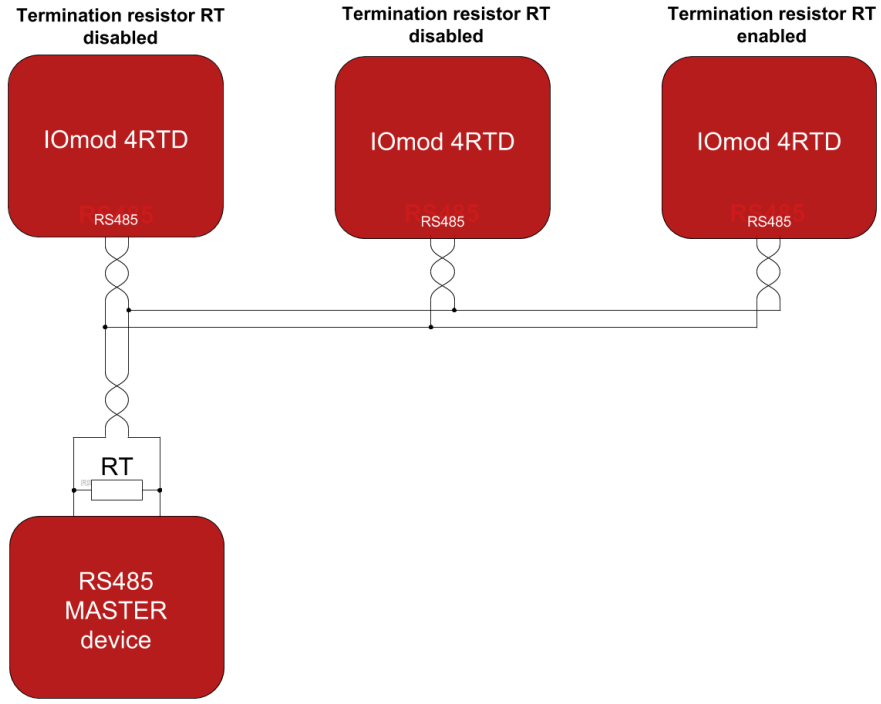

Fig. 5.1. Typical IOMod connection diagram

IOMOD 4RTD 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.

Status indication

IOMOD 4RTD devices has indications that help user easily debug possible problems. Light emitting diodes can show if RTD fault has happened on any of four RTD measuring channels (FLT1-FLT4). STAT LED indicates if proper power connection is made - this LED is always on if device has a power connection. Blue light means device is only powered via USB, green light indicates proper power connection is made and there is no fault condition on printed circuit board , red light indicates there is something wrong with either power connection or RTD channels. RX/TX status LED indicates if RS- 485 transmission is happening at a moment.

RTD sensor connection

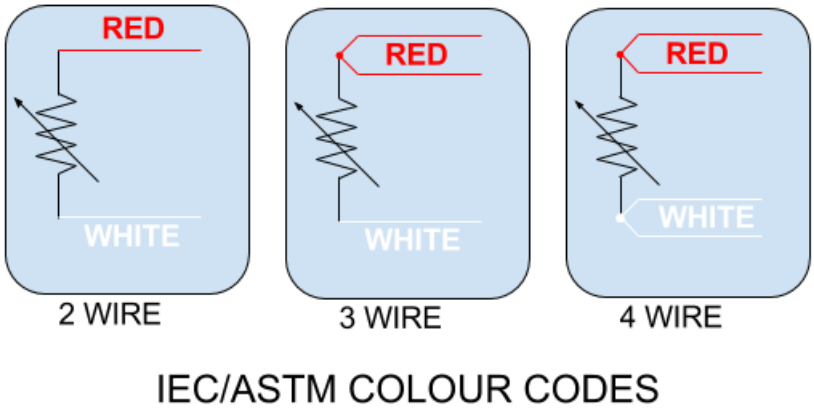

Fig. 5.3. RTD sensor colour codes

IOmod 4RTD 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 USB terminal. Secondly, use the following instructions depending on the number of wires of a selected RTD sensor.

2-wire RTD sensor: connect red wire to RTD+ and white wire (or black) to RTD- contacts. The connection between RTD+ and F+, RTD- and F- must be shorted.

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

4-wire RTD sensor: connect red wires to RTD+ and F+ contacts, white (or black) wires to RTD- and F- contacts. No contacts shall be shorted.

USB interface

IOmod 4RTD USB interface is used for configuration, diagnostics and firmware updates. IOmod 4RTD is powered through USB when connected, no extra power connection needed for operation. Use a USB mini B cable for connection.

Configuration over USB

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.

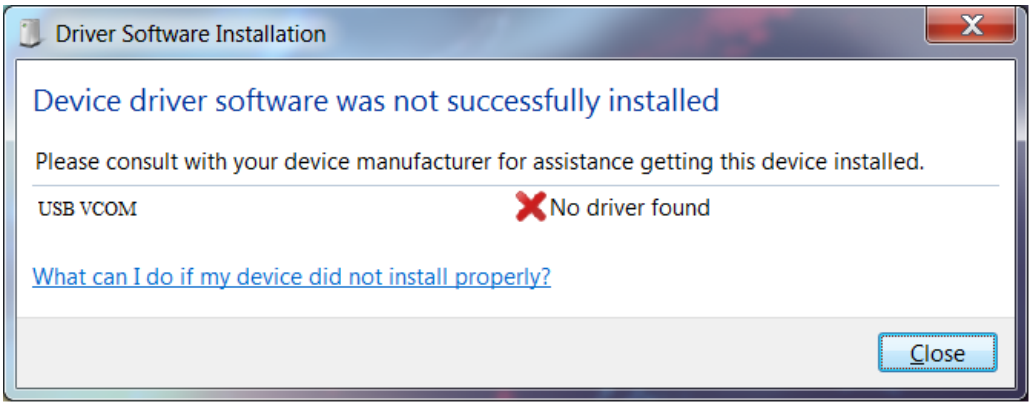

Fig. 6.1. Unsuccessful device software installation error

A user then should manually install drivers by selecting a downloaded driver folder:

- Go to Control Panel -> Device Manager;
- Select a failing device;
- Press “Update driver software”; screen as in Fig. 6.2. should appear:

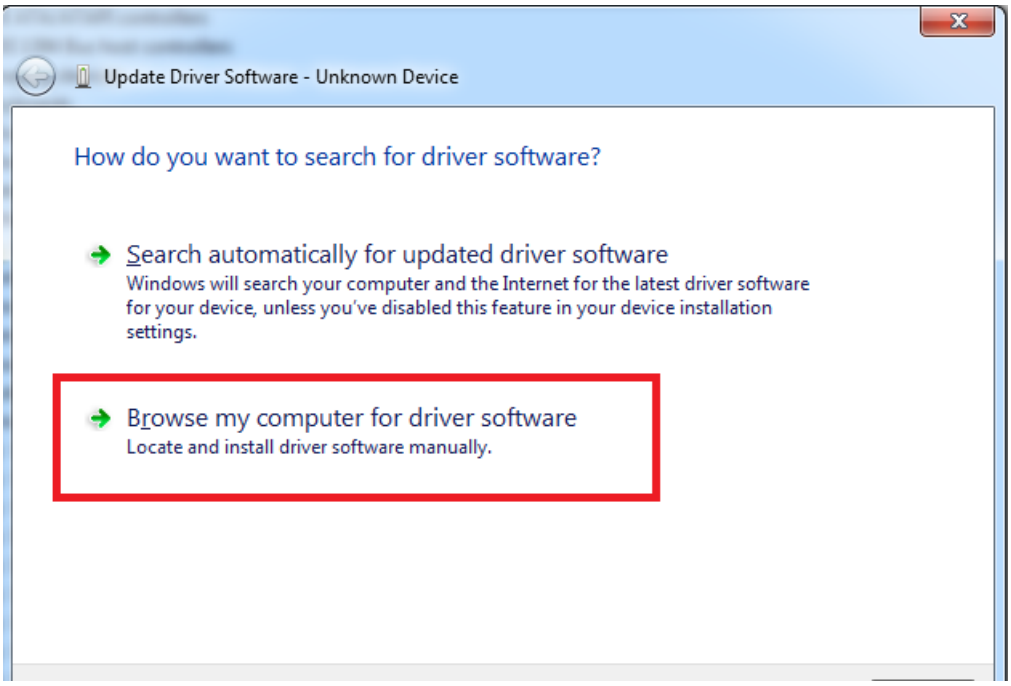

Fig. 6.2. Device driver software update message

- Select “x86” driver for a 32-bit machine or x64 for a 64-bit machine. If not sure, select a root folder (folder in which x64 and x86 lay inside, as in Fig. 6.3).

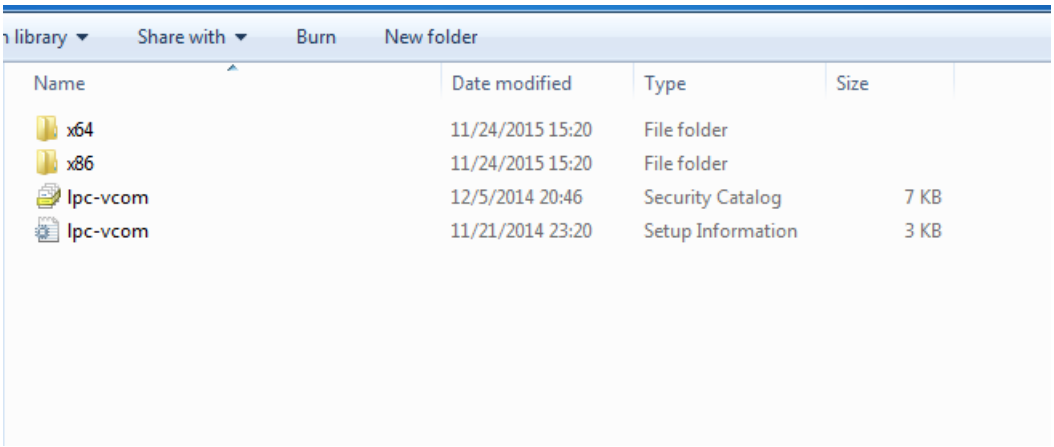

Fig. 6.3. Device driver folder content

IOMod 4RTD configuration via 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.

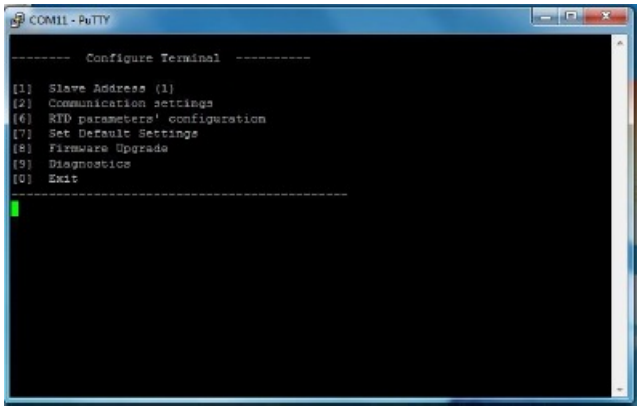

Fig. 6.4. The main menu for IOMod 4RTD

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 without exiting, 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.

IEC-60870-103 Main menu

	Menu Name	**Function**	**Values**	**Default Values**
1.	Link Address	Link Slave address	1-247	1
2.	Baudrate & bits	[1] Baud rate, [2] Data, Stop and Parity Bits, [3] RS485 Terminating resistor	[1] 100 - 256000, [2] 8 Data bits + 1/2 Stop bits, Even/None/Odd Parity [3] Enabled/Disabled	[1] 9600, [2] 8N1, [3] Enabled
3.	Data addressing config	Configuring input address function type	1-255	160
4.	RS485 Terminating resistor	Enabling or disabling terminating resistor	Enabled/Disabled	Enabled
6.	RTD parameters' configuration*	Configuring Callendar-Van Dusen 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	Input / Output states	-	-
0.	Exit	Exit and disconnect	-	-

Firmware upgrade over USB

To update device firmware user must enter main configuration menu.
Enter Firmware update screen by pressing [8];
Confirm update by pressing [1];
Device now enters Firmware Upgrade mode. Device reconnects as mass storage device (Fig 6.10.).


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

Fig. 6.10. Mass storage device warning

User then must delete existing file “firmware.bin”, and simply upload new firmware file by drag and drop. (Fig 6.11.)

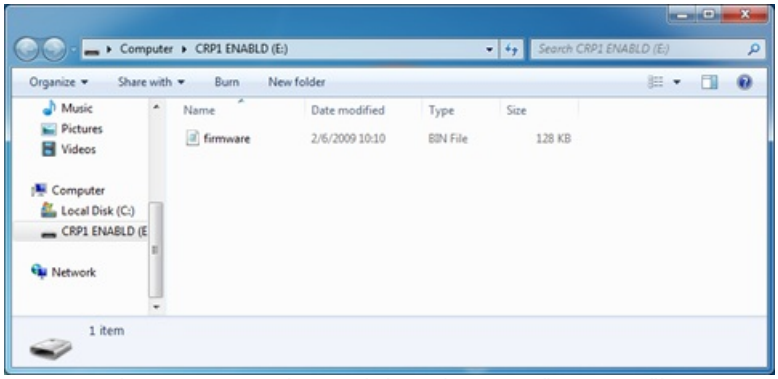

Fig. 6.11. Dragging and dropping new firmware file

Reconnect device and check firmware version. It should now represent the one it was updated to.

Testing With “THE VINCI” software

To test IOMOD 4RTD 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:

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

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.

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