



elseta

ELSETA

IOMOD 16DI

User manual

Elseta

/2017

V1.0

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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 16DI

Conforms to the following standards:

EMC:

Radiation EN 55022 (Class A)

1 emitted radiation (30-1000MHz)

Second radiation conductors (0.15-30MHz)

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.

Manufacturer contact:

Equipment quality controller

UAB Aedilis "

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SAFETY REQUIREMENTS

This equipment Operating notes, which must be met for your personal safety, as well as to avoid damage to the equipment. These notes 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'S MANUAL USES SYMBOLS



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

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.

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1. Introduction

IOMOD 16DI is small sized stand-alone Modbus (RTU) or IEC 60870-5-103 digital input controller. IOMOD is used for industrial applications, where digital signaling is used and robust communication is needed. IOMOD is ideal solution for applications such as data acquisition, observation, control, process monitoring, testing and measurement at remote places. It is controlled over Modbus or IEC 60870-5-103 protocol, and can be used with any SCADA system.

2. Features

- 16 digital inputs with configurable input inversion
- Galvanically isolated inputs
- Configurable over USB
- Drag And Drop firmware upgrade over USB
- RS485 communication
- LED input indications, + Data transmission (Rx and Tx) indication.
- Small sized case with removable front panel
- DIN rail mount
- Operating temperature $-20 \div +70^{\circ}\text{C}$
- Power Requirements: 12-24 VDC

3. Device working information

IOMOD 16DI uses Modbus (RTU) or IEC 60870-5-103 protocol over RS485 interface. Protocol used by device can be changed by uploading corresponding firmware. Default communication settings are: 9600 baudrate, 8N1, Slave address - 1.

IEC 60870-5-103 working information

Initialization:

IOMOD uses standart communication scheme. Initiation, control messages and queries is initiated by master (controlling station), while IOMOD device (controlled station) only answers requests and statuses. First message sent by master is RESET CU to restart communication. When device answers with ACK, master proceeds with acquiring General Interrogation and sending time synchronization.

Data polling:

When this initialization is complete, master polls IOMOD device with class 1 and class 2 requests. Class 2 is used when master polls for a cyclic data. Controlled device responds when spontaneous data exists and master then sends request for Class 1. Controlled station responds with time tagged message.

Input messages:

When input status changes, device filters input glitches with user configurable filter time. When filter is passed device sends “spontaneous” message with “Function type” as input address (default function type of inputs – 160), and “Info number” as input pin number.

IEC 60870-5-103 telegram description

Initialization

Master (controlling station) sends “Link Reset CU” or “Link Reset FCB” commands, which is function code “0” or “7” within fixed frame telegram.

Example: | 0x10 | 0x40 | 0x01 | 0x41 | 0x16 |

Device (controlled station) responds with ACK.

Master, requesting Link status must send fixed frame telegram with function code “9”. Device then responds with “Access Demand” (function code “11”).

On first “Class 1” request, device will send its identification string. If there is spontaneous messages to send, they will be sent first.

Time synchronization

Master initiating time synchronization, must send variable frame, with function code “User data with ACK”, ASDU type “6” and Cause of Transmission “8”. Info elements must contain 7-byte time structure.

Read input status

GI is initiated by master with variable frame, including function code “3” (User data with ACK), ASDU type “7” and Cause of Transmission “9”. Slave device then responds with ACK. Master gets GI data by polling with Class 2 request till slave transmits “End of GI” (Cause of Transmission – “10”). IOMOD device responds with time tagged message, including DPI states of inputs. Input numbers is represented by “Info number” in protocol.

Device configuration

Input inverting and polarity selection:

Input polarity selection (active signal selection) is done by connecting appropriate supply to COM pin. Further explained in section 5: Mounting and installation guide.

Input inversion does logical inversion of signals.

Input grouping:

Sometimes two inputs must be captured as one DPI input. Inputs can be grouped into pairs of two. Only two neighbor pins can be grouped into pair, while first pin in pair must be odd number pin. When grouped, second pin in the pair is not used anymore – all approaches to this pin generates an error. For

example – IN1 and IN2 can be grouped, after that IN2 is not used; IN2 and IN3 *can not* be grouped; IN3 and IN4 can be grouped, but IN4 is not used, etc.

Fig. 3.1 shows inputs ungrouped and controlled independently. In this mode, General Interrogation will be composed of 16 input states. Notice $+V_{IO}$ and $-V_{IO}$ connection: when COM is connected to negative power supply voltage, inputs are controlled by positive voltage.

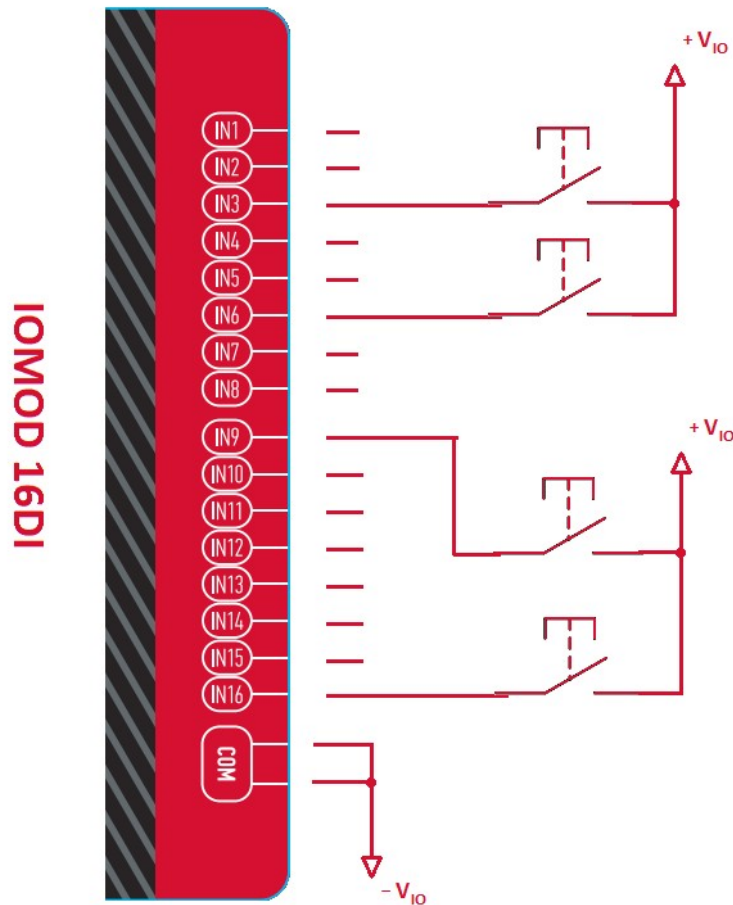


Fig. 3.1

In addition to this, Fig. 3.2 shows 1st + 2nd and 11th + 12th inputs are grouped into pair. Now, General Interrogation will be composed of 14 input states (with IN2 and IN12 missing). Input numbers is represented by “Info number” in protocol. Here, COM is connected to positive voltage of power supply and inputs are controlled by negative voltage.

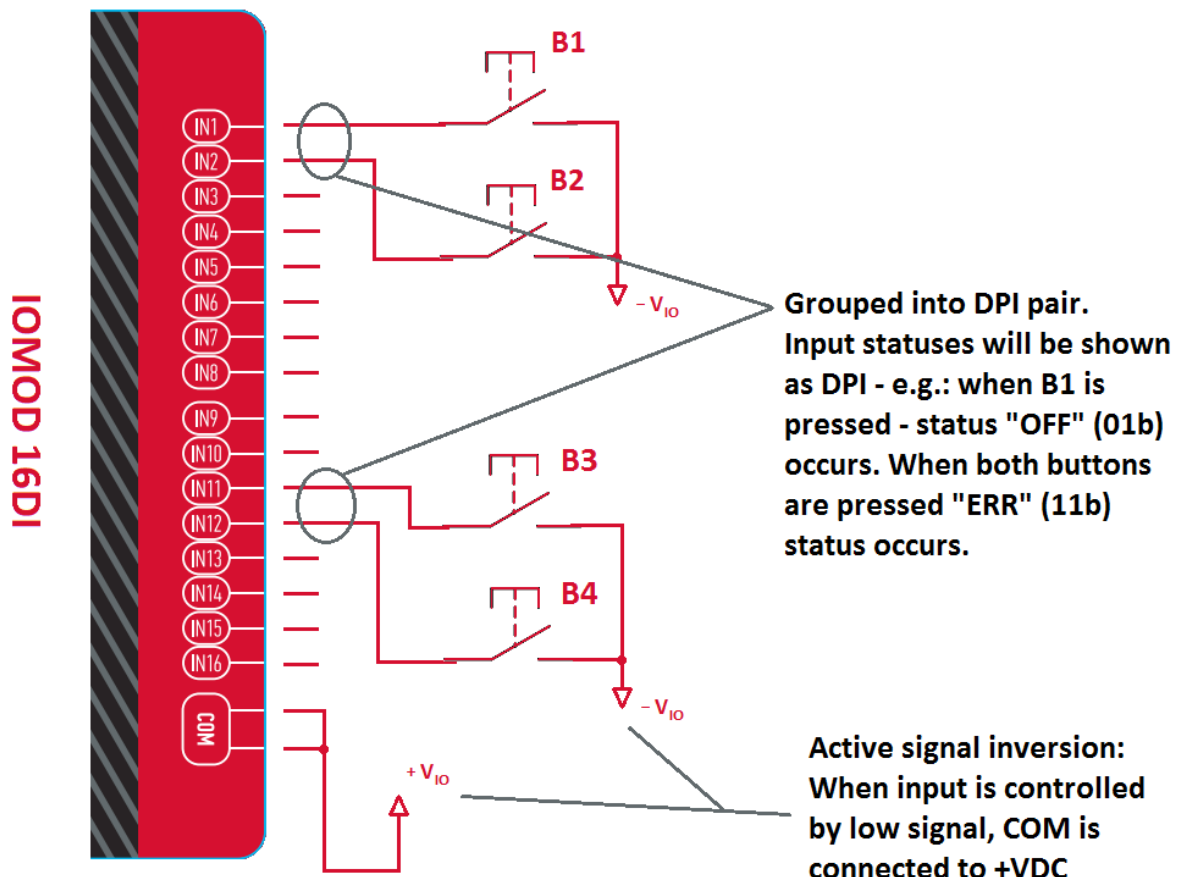


Fig. 3.2

Input filter:

Input filter is simple glitch filter with time input. This filter time corresponds to stable time that input must achieve before sending status change.

Addressing configuration:

Devices Input address is configurable. This addresses in IEC 60870-5-103 protocol is considered as "Function Type". Input address is 160 by default.

Device is addressed by "Link address", which is 1 by default.

Testing With "THE VINCI" software

To test IOMOD with default settings, user connects device through RS485 to IEC 60870-5-103 master. Example using “The Vinci Expert” as serial interface converter and adapter to PC with “The Vinci” software. When opening “The Vinci” software, choose IEC 60870-5-103 – Master mode. Initial settings – 9600 baudrate; 8 data, no parity, 1 stop bit. Press start, send time synchronization, General interrogation and go to “Statistic” tab:

TI	Cause	ASDU	FUN	INF	Value	Status	TimeTag	Count	Name
(TI=005)	Start/restart	1	255	1 (0)	2	ASC=IOMOD16I ... -	-	0	-
(TI=008)	End of g. int	1	255	0 (0)	SCAN:0	-	-	3	-
(TI=001)	General inter	1	160	1 (0)	OFF[01]	SIN=0	[W]2017.03.20 15:21:53.978	0	-
(TI=001)	General inter	1	160	2 (0)	OFF[01]	SIN=1	[W]2017.03.20 15:21:54.082	0	-
(TI=001)	General inter	1	160	3 (0)	OFF[01]	SIN=2	[W]2017.03.20 15:21:54.189	0	-
(TI=001)	General inter	1	160	4 (0)	OFF[01]	SIN=3	[W]2017.03.20 15:21:54.296	0	-
(TI=001)	General inter	1	160	5 (0)	OFF[01]	SIN=4	[W]2017.03.20 15:21:54.403	0	-
(TI=001)	General inter	1	160	6 (0)	OFF[01]	SIN=5	[W]2017.03.20 15:21:54.510	0	-
(TI=001)	General inter	1	160	7 (0)	OFF[01]	SIN=6	[W]2017.03.20 15:21:54.617	0	-
(TI=001)	General inter	1	160	8 (0)	OFF[01]	SIN=7	[W]2017.03.20 15:21:54.724	0	-
(TI=001)	General inter	1	160	9 (0)	OFF[01]	SIN=8	[W]2017.03.20 15:21:54.831	0	-
(TI=001)	General inter	1	160	10 (0)	OFF[01]	SIN=9	[W]2017.03.20 15:21:54.938	0	-
(TI=001)	General inter	1	160	11 (0)	OFF[01]	SIN=10	[W]2017.03.20 15:21:55.045	0	-
(TI=001)	General inter	1	160	12 (0)	OFF[01]	SIN=11	[W]2017.03.20 15:21:55.152	0	-
(TI=001)	General inter	1	160	13 (0)	OFF[01]	SIN=12	[W]2017.03.20 15:21:55.259	0	-
(TI=001)	General inter	1	160	14 (0)	OFF[01]	SIN=13	[W]2017.03.20 15:21:55.367	0	-
(TI=001)	General inter	1	160	15 (0)	OFF[01]	SIN=14	[W]2017.03.20 15:21:55.475	0	-
(TI=001)	General inter	1	160	16 (0)	OFF[01]	SIN=15	[W]2017.03.20 15:21:55.583	0	-

Fig. 3.5

As seen in Fig. 3.5, Inputs are shown with info numbers 1-16, and function type - 160.

GI, time synchronization options can be found at right side of the program, in “System” tab.

Fig. 3.6 shows 1st + 2nd, 5th + 6th and 11th + 12th Inputs grouped (notice order of info numbers). These pairs is shown INTERM (00) because both inputs of pair are off (giving binary representation of 00b).

THE VINCI PROTOCOL ANALYZER

File Tags Options Help



Protocol: IEC 60870-5-103

Stop

Port A: COM39

Baudrate: 9600

Format: even,8,1

Extra
Set VIN

Settings	Console	Events	Statistic	The Vinci Expert					
TI	Cause	ASDU	FUN	INF	Value	Status	TimeTag	Count	Name
(TI=005)	Start/restart	1	255	1 (0)	2	ASC=IOMOD16I ...	-	0	-
(TI=008)	End of g. int	1	255	0 (0)	SCAN:0	-	-	3	-
(TI=001)	General inter	1	160	1 (0)	INTERIM[00]	SIN=0	[W]2017.03.20 15:25:42.960	0	-
(TI=001)	General inter	1	160	3 (0)	OFF[01]	SIN=2	[W]2017.03.20 15:25:43.067	0	-
(TI=001)	General inter	1	160	4 (0)	OFF[01]	SIN=3	[W]2017.03.20 15:25:43.174	0	-
(TI=001)	General inter	1	160	5 (0)	INTERIM[00]	SIN=4	[W]2017.03.20 15:25:43.281	0	-
(TI=001)	General inter	1	160	7 (0)	OFF[01]	SIN=6	[W]2017.03.20 15:25:43.396	0	-
(TI=001)	General inter	1	160	8 (0)	OFF[01]	SIN=7	[W]2017.03.20 15:25:43.503	0	-
(TI=001)	General inter	1	160	9 (0)	OFF[01]	SIN=8	[W]2017.03.20 15:25:43.609	0	-
(TI=001)	General inter	1	160	10 (0)	OFF[01]	SIN=9	[W]2017.03.20 15:25:43.716	0	-
(TI=001)	General inter	1	160	11 (0)	INTERIM[00]	SIN=10	[W]2017.03.20 15:25:43.823	0	-
(TI=001)	General inter	1	160	13 (0)	OFF[01]	SIN=12	[W]2017.03.20 15:25:43.930	0	-
(TI=001)	General inter	1	160	14 (0)	OFF[01]	SIN=13	[W]2017.03.20 15:25:44.037	0	-
(TI=001)	General inter	1	160	15 (0)	OFF[01]	SIN=14	[W]2017.03.20 15:25:44.144	0	-
(TI=001)	General inter	1	160	16 (0)	OFF[01]	SIN=15	[W]2017.03.20 15:25:44.251	0	-

Fig. 3.6

4. Technical information

System		
1.	Dimensions	101 x 119 x 17.5, mm
2.	Case	ABS, green
3.	Working environment	Indoors
4.	Working temperature	-20 ÷ +70°C
5.	Recommended operating conditions	5 – 60°C and 20 – 80%RH;
6.	Configuration	USB
7.	Firmware upgrade	USB – mass storage device
Electrical specifications		
8.	Inputs	16 X 3kV isolated 12-24VDC; Selectable inversion.
Power		
9.	Power Supply	9V to 33V
10.	Current consumption	130 mA

5. Mounting and installation guide

IOMOD 16DI RS485 interface

IOMOD 16DI 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.

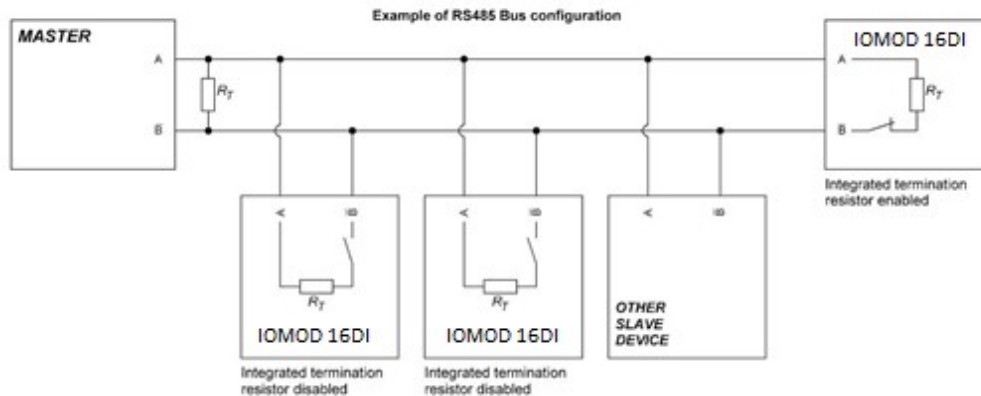


Fig. 5.1

IOMOD 16DI 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.

IOMOD 16DI inputs

Typical application of IOMOD 16DI inputs is shown on Fig. 5.2. When default configuration for inputs is applied, user will see inputs connected to +12-24V as “high” or state “1” and input status LED will glow.

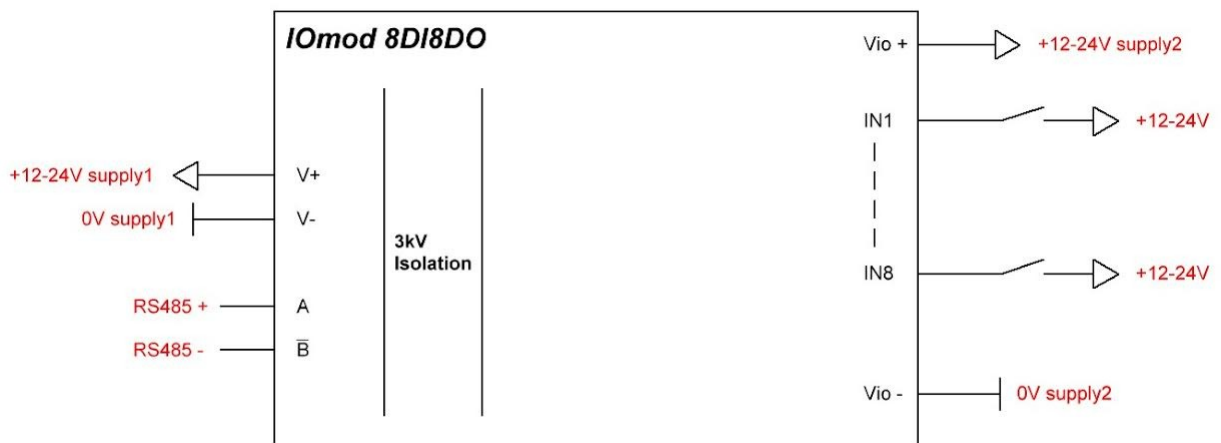


Fig. 5.2

User also can configure to enable pull-up resistors (function is applied for all inputs) and software input inversion. With this configuration, user will see inputs connected to 0V (see Fig. 5.3) as “high” or state “1”, input status LED will NOT glow.

6. Configuration over USB

Driver installation

Device requires USB drivers to work as virtual com port. First-time connection between device and computer could result in “Device driver software was not successfully installed” error.

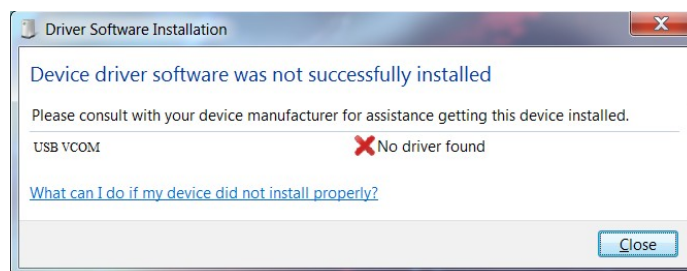


Fig. 6.1

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

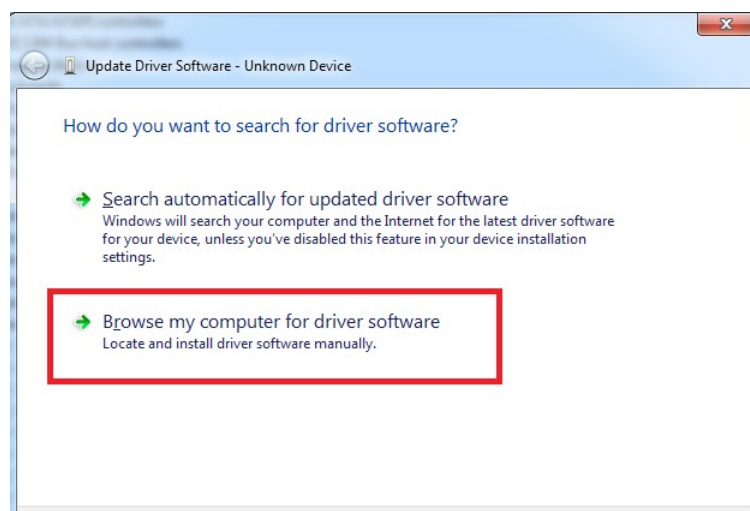


Fig. 6.2

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).

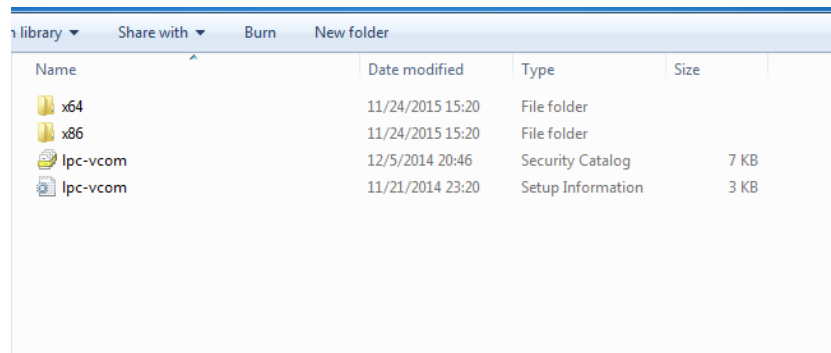


Fig. 6.3

IOMOD 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 V-COM port with terminal software (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:

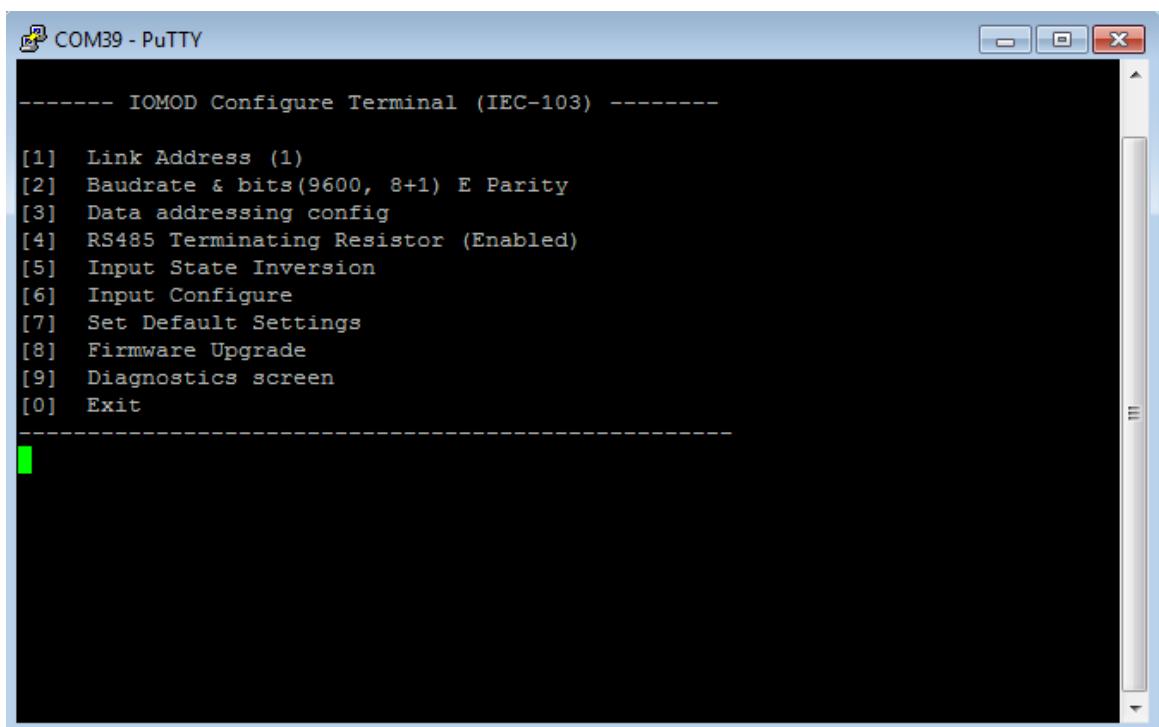


Fig. 6.4

Navigation is performed by sending number to terminal. User then proceeds by following further on-screen instructions. For example, to set Baudrate, press [2] to enter Baudrate screen; press [1] to edit; enter new configuration; press [RETURN] to save, or [ESC] to cancel changes. When done, press [0] (exit) before disconnecting device. Default values is set by pressing [6] on main screen, and confirming changes [1].

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

Main Menu

	Menu Name	Function	Values	Default Values
1.	Link Address	Setts Link address	1-255	1
2.	Baudrate, Parity and stop bits	Enters configuring screen for communication settings	8+1 or 8+2 (Data+Stop), None, Odd, Even, Mark, Space (Parity)	9600, 8+1, Parity -None
3.	Data addressing config	Enters configuring screen for Input address (function type)	1 – 255	160
4.	RS485 Terminating Resistor	RS485 120 Ohms Terminating Resistor	0 - 1 (off/on)	1
5.	Input state inversion	Input inversion (Inverts input states in protocol logic)	0 - 1 (off/on)	0 (not inverted)
6.	Input configure	Enters screen for configuring (see 6.1 – 6.5 rows below)	-	-
6.1	Input grouping;	Groups or ungroups inputs	16 inputs ungrouped or 8 pairs grouped max	All inputs ungrouped by default
6.2	Input filter time;	Input glitch filter – minimum stable time to detect input	1 – 60000 milliseconds	100
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 states	-	-
0.	Exit	Exit and disconnect	-	-

Protocol simulator

When entered diagnostics screen, user can turn on protocol simulator by pressing [9]. When protocol simulator is turned on, device will communicate through USB port rather than RS-485 line. Communication on RS-485 line is closed and all IEC-103 commands will be accepted only from USB. To exit this mode user must restart device.

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 when entered firmware upgrade mode.

Device reconnects as mass storage device:



Fig. 6.5

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

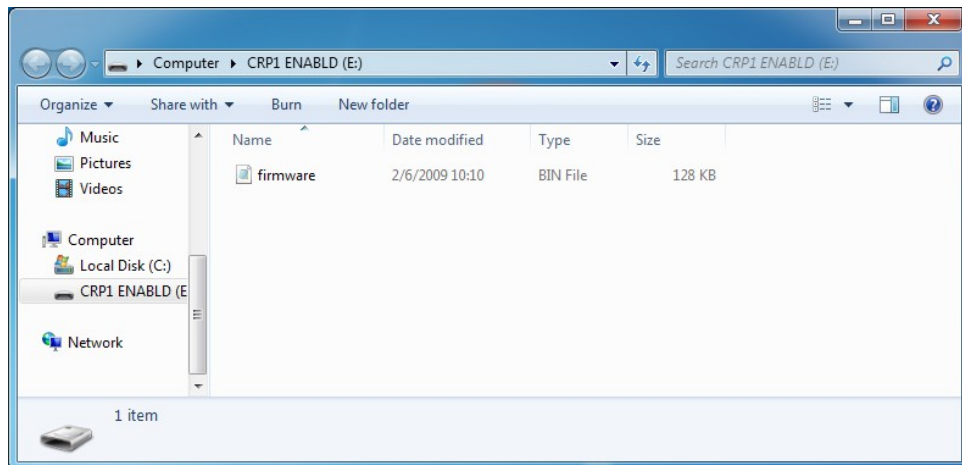


Fig. 6.5

Reconnect device, set default settings and check firmware version.

7. Information of the equipment manufacturer



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8. Document history

Version	Date	Author	Description
V1.0	2017.03.20	L.S.	Initial IEC 60870-5-103 documentation