

# Firmware version 1

- IOMOD 4Cs4Vs User Manual

# IOMOD 4Cs4Vs User Manual

## Introduction

IOMod 4Cs4Vs is a compact-sized stand-alone power meter for measuring analog AC input signals from low-power current and voltage sensors. It measures three phases of AC voltages and currents with additional inputs for neutral/residual voltage and current. The measured and calculated values are transmitted to the host system via communication protocol **IEC 60870-5-103** or **Modbus RTU**.

## Features

- 4 AC current sensor inputs according to IEC 60044-8 (nominal value 225mV)
- 4 AC voltage sensor inputs according to IEC 60044-7 (nominal value  $3.25/\sqrt{3}$  V)
- Communication protocols : IEC 60870-5-103 or Modbus RTU
- 32 samples per cycle
- FFT-based calculation with harmonic information
- RS485 interface with a switchable terminating resistor
- Status and data transmission (Rx and Tx) indication.
- Configurable over USB
- Drag-and-Drop firmware upgrade over USB
- A small-sized case with a removable front panel
- DIN rail mount
- Operating temperature: from -30 to +70°C
- Power Requirements: 12-24 VDC

## Common configuration information

1. Nominal system frequency. In order to get correct three-phase system measurements, a user must select nominal system frequency – either 50 Hz or 60 Hz.
2. Process parameters. There user can set rated primary current and voltage values which are used for calculating measured data in primary values. Those values are available only via float registers in the Modbus RTU protocol.
3. Configuration of sensors. The power meter is designed to work with standard low-power current and voltage sensors with a nominal output value of 225 mV for the current sensor and  $3.25/\sqrt{3}$  V (1.876 V) for the voltage sensor. If current sensors have some deviation from the nominal value, a user can define the exact sensor voltage. The new value will be set the same for all current sensors inputs. Each voltage sensor input has a separate correction parameter called the magnitude factor. This factor is used to multiply measured voltage. For example, if a sensor has a 5% lower output voltage, the user can set the magnitude to 1050. The actual factor will be 1.05 and the measured value will be multiplied by this factor. This factor can be used in cases when several measuring devices are connected to the same sensor in parallel. In this case, the parallel connection will reduce the internal resistance of the sensor and consequently output voltage. The magnitude factor can be used to compensate for this deviation.
4. Communication protocol. Selection of IEC 60870-5-103 or Modbus RTU communication protocol.

## Connection diagram

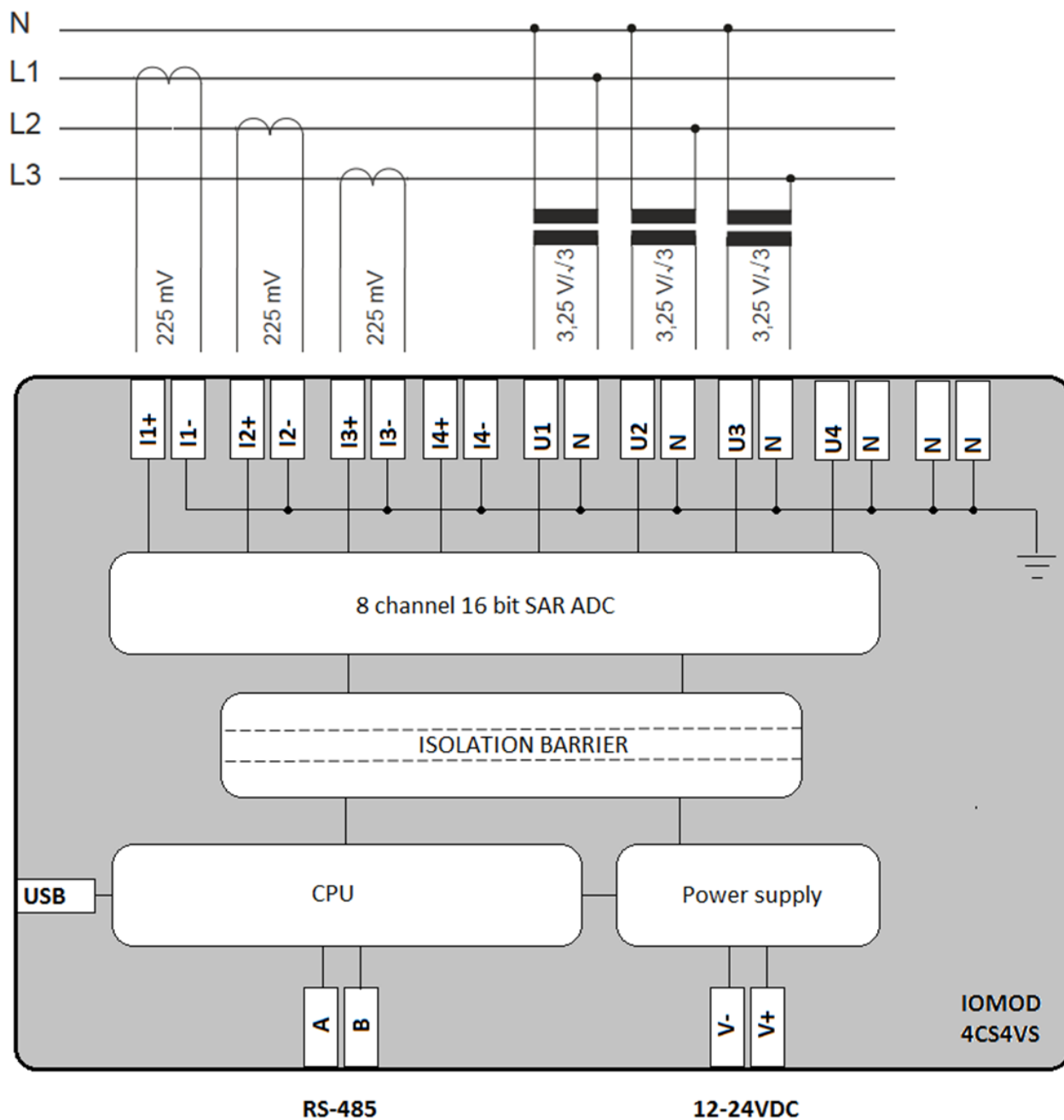


Fig. 4.1. IOMOD 4CS4VS internal structure and connection diagram

## Technical information

System		
1.	Dimension	101 x 119 x 17.5 mm
2.	Case	ABS, black
3.	Working environment	Indoor
4.	Working temperature	-30   +70
5.	Recommended operating conditions	5 – 60°C and 20 – 80%RH;
6.	Configuration	USB – configuration terminal via com port
7.	Firmware upgrade	USB – mass storage device

Electrical specifications		
8.	Inputs	16-bit resolution, Input resistance: ~1 MOhm Input capacitance: ~170 pF Input Ranges: $\pm 10$ V (amplitude); Nominal values: <ul style="list-style-type: none"><li>• Current input:<ul style="list-style-type: none"><li>◦ 225 mV (rms);</li></ul></li><li>• Voltage input:<ul style="list-style-type: none"><li>◦ 1.876 V (rms);</li></ul></li></ul> Overvoltage protection of all inputs up to $\pm 20$ V (amplitude)
Power		
9.	Power Supply	9 V to 33 V
10.	Current consumption	40 mA @ 12 VDC, 20 mA @ 24 VDC

# RS485 Interface

IOMod 4Cs4Vs has an integrated 120  $\Omega$  termination resistor, which can be enabled or disabled via the configuration terminal. It is recommended to use termination at each end of the RS485 cable. See the typical connection diagram in Fig. 6.1.

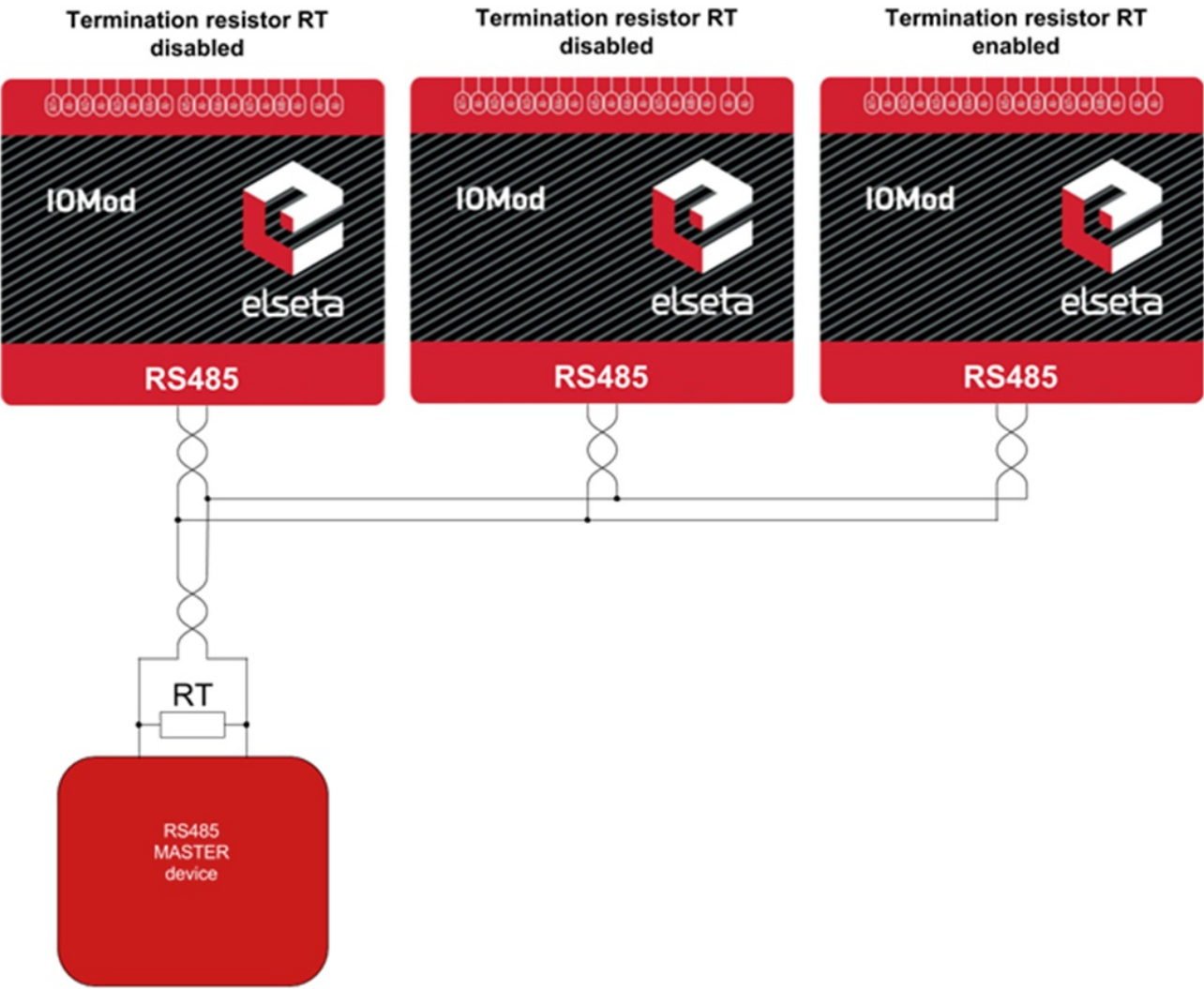


Fig. 6.1. Typical IOMod connection diagram

IOMod 4Cs4Vs has a 1/8 Unit load receiver which allows having up to 255 units on a single line (compared to standard 32 units). To reduce reflections keep the stubs (cable distance from the main RS485 bus line) as short as possible.

# Configuration over USB

## Driver installation

The device requires USB drivers to work as a Virtual COM port. The first-time connection between the device and the computer could result in a “Device driver software was not successfully installed” error (as in Fig. 7.1).

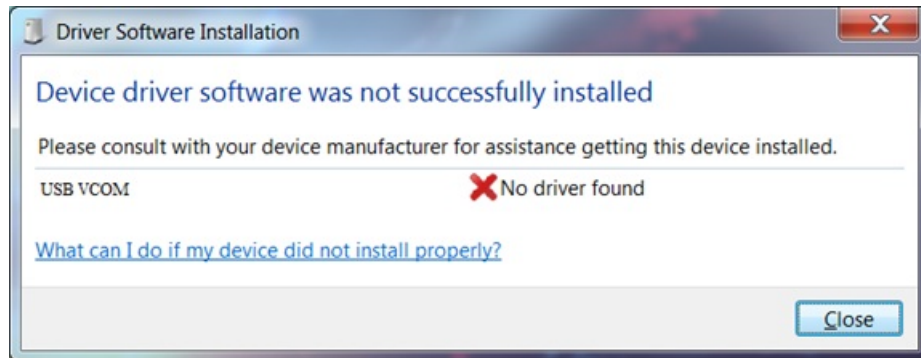


Fig. 7.1. Unsuccessful device software installation error

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”; the screen as in Fig. 7.2. should appear:

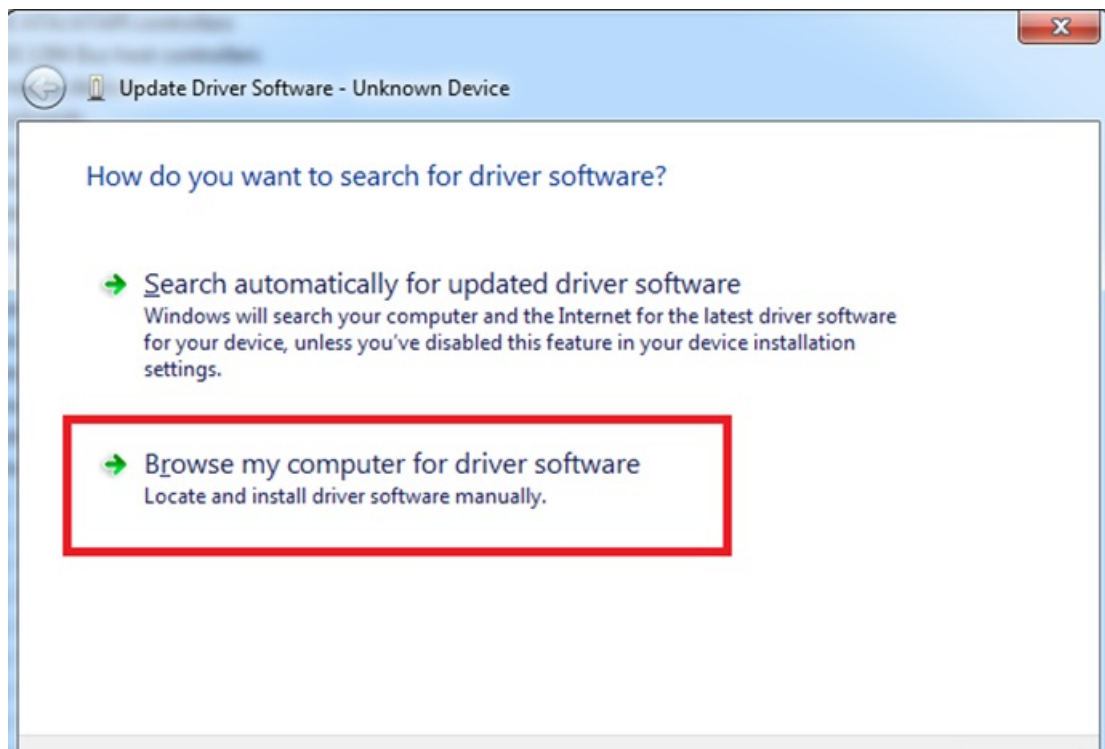


Fig. 7.2. Device driver software update message

- 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. 7.3).

Name	Date modified	Type	Size
x64	11/24/2015 15:20	File folder	
x86	11/24/2015 15:20	File folder	
lpc-vcom	12/5/2014 20:46	Security Catalog	7 KB
lpc-vcom	11/21/2014 23:20	Setup Information	3 KB

Fig. 7.3. Device driver folder content

## IOMod configuration via PuTTY terminal

A configuration of the IOMod device is done through CLI (Command Line Interface) on the virtual COM port. Drivers needed for Microsoft Windows to install VCOM will be provided. To open up CLI simply connect to a specific V-COM port with terminal software (advised to use PuTTY terminal software. If other software is being used, a user might need to send <return> symbol after each command). When connected user should immediately see the main screen (Fig. 7.4).

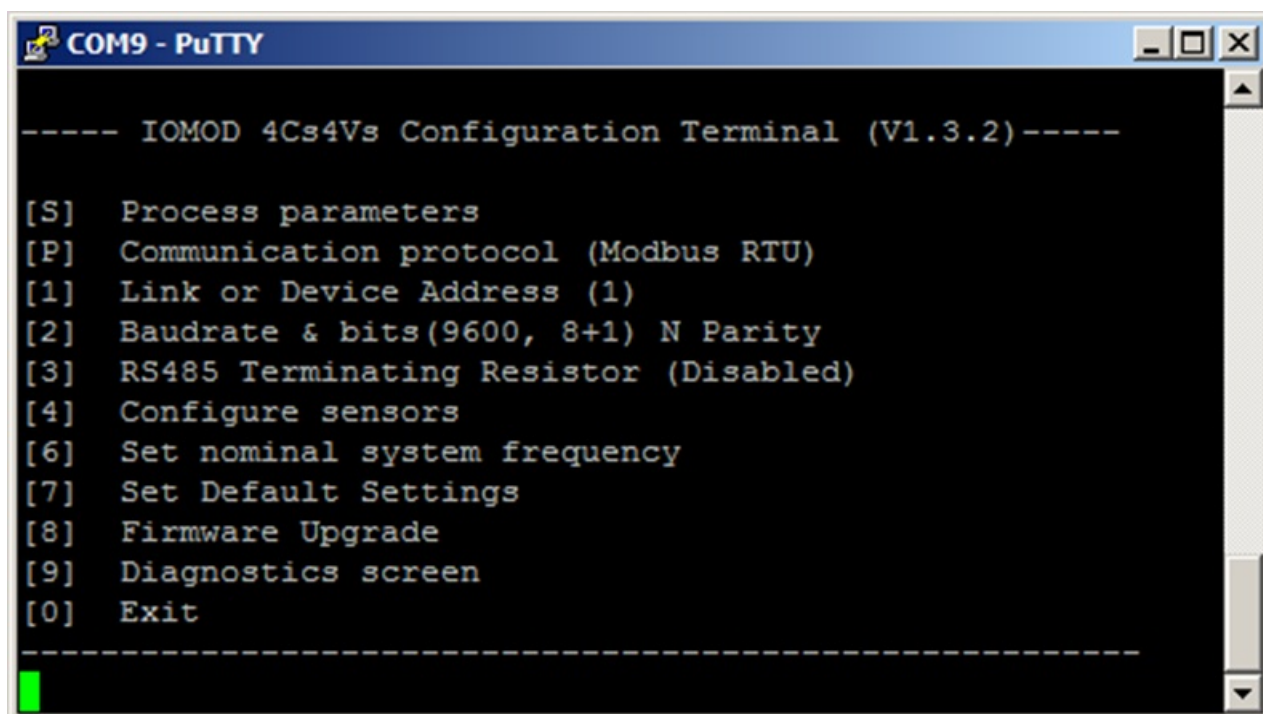


Fig. 7.4. The main menu

Navigation is performed by sending the character shown in square brackets to a terminal. A user then proceeds by following on-screen instructions. For example, to set the baud rate, press [2] to enter a new link address - press [1]; press [RETURN] to save, or [ESC] to cancel changes. When done, press [0] (exit) before disconnecting the device. Default values are set by pressing [7] on the main screen, and confirming changes [1].

**It is highly advised to exit the main screen before disconnecting the device**

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

## Configuration terminal menu

Menu Name	Submenu	Values	Default Values
[S]	Process parameters	[1] Set rated primary voltage [2] Set rated primary current	1 V 1 A

[P]	Communication protocol	[1] IEC103 [2] Modbus RTU	- -	Modbus RTU
[1]	Link or device Address	Set link or device address	1-254	1
[2]	Baud rate, Parity and Stop bits	[1] Set 8 Data bits + 1 Stop bit [2] Set 8 Data bits + 2 Stop bit [3] Configure baud rate [4] Configure Parity	- - 100-256000 None/ Odd / Even / Mark/ Space	1 Stop bit 9600 Even
[3]	RS485 Terminating Resistor	[1] Enable [2] Disable	- -	Disabled
[4]	Configure sensors	[1] - magnitude factor of voltage sensor 1 [2] - magnitude factor of voltage sensor 2 [3] - magnitude factor of voltage sensor 3 [4] - magnitude factor of voltage sensor 4 [5] - current sensor nominal value	100-3000 100-3000 100-3000 100-3000 100-3000 mV	1000 1000 1000 1000 225 mV
[5]	Select measurand set and scale factor*  *(this menu is visible only when the IEC103 protocol is activated)	[1] Measurand set 1 [2] Measurand set 2 [3] Measurand set 3 [4] Measurand set 4 [5] Scale factor 1.2 [6] Scale factor 2.4 [7] Function type	- - - - - - 1-255	Measurand set 4 Scale factor 1.2 253
[6]	Set nominal system frequency	[1] - 50 Hz [2] - 60 Hz	- -	50 Hz
[7]	Set Default Settings	[1] - confirm [0] - cancel	- -	-
[8]	Firmware Upgrade	[1] - confirm [0] - cancel	- -	-
[9]	Diagnostics	Raw input values	-	-
[0]	Exit	Exit and disconnect	-	-

## IEC 60870-5-103 operational information

When the IEC-60870-5-103 protocol is selected IOMod uses a standard communication scheme. Initiation, control messages, and queries are initiated by a master (controlling station), while the IOMod device (controlled station) only answers requests and sends values. The first message sent by the master should be RESET CU to restart communication. When *acknowledge* (ACK) packet is sent from a slave device, a master may proceed with acquiring *General Interrogation* and sending *Time synchronization* packets.

When this initialization is complete, the master should poll the IOMod device with Class 1 and Class 2 requests. Class 2 is used when the master polls for cyclic data. The controlled device responds when spontaneous data exists and the master then sends a request for Class 1. The controlled station responds with a time-tagged message.

As IOMod 4Cs4Vs doesn't have any digital inputs, only analog ones, therefore the general interrogation returns nothing. Values of measurements are returned cyclically as a response to Class 2 data request

Specific settings for the IEC 60870-5-103 protocol:

3. Measurand set selection. A user can select which predefined measurand set will be transmitted to the host system. Available measurand sets are presented in table 8.1.
4. Scale factor. The communication protocol IEC 60870-5-103 only lets 13-bit signed values in the range of -1...+1. When an IEC 60870-5-103 measurand, for example, phase voltage, is scaled as 2.4, it means that the measurand value 1 corresponds to  $2.4 \times U_n$ , measurand value 0.5 corresponds to  $1.2 \times U_n$ , and so on. If the measurand value, in this case, exceeds  $2.4 \times U_n$ , the IEC 60870-5-103 object value saturates at its maximum value and an overflow flag is set in the IEC 60870-5-103 object transmission
5. Device function type. By default, IOMod has IEC 60870-5-103 Function Type set to 253. If this Function type for some reason is not suitable – a user can define any other type

Table 8.1. Measurand sets

Set Nr.	TYPE	FUN*	INF	Qty of data	Information elements (measurands)
1	9	253	148	9	I1, I2, I3, U1, U2, U3, P, Q, f
2	9	253	149	23	I1, I2, I3, I4, U1, U2, U3, U4, P1, P2, P3, Q1, Q2, Q3, S1, S2, S3, PF1, PF2, PF3, U12ph, U23ph, U13ph
3	9	253	150	60	I1, I2, I3, IN, U1, U2, U3, UN, P1, P2, P3, Q1, Q2, Q3, S1, S2, S3, PF1, PF2, PF3, U12, U23, U13, f, THDU1, THDU2, THDU3, THDI1, THDI2, THDI3, I1_H2, I1_H3, I1_H5, I1_H7, I1_H9, I2_H2, I2_H3, I2_H5, I2_H7, I2_H9, I3_H2, I3_H3, I3_H5, I3_H7, I3_H9, U1_H2, U1_H3, U1_H5, U1_H7, U1_H9, U2_H2, U2_H3, U2_H5, U2_H7, U2_H9, U3_H2, U3_H3, U3_H5, U3_H7, U3_H9
4	9	253	151	54	I1, I2, I3, IN, U12, U23, U13, UN, S, P, Q, PF, THDU1, THDU2, THDU3, THDI1, THDI2, THDI3, I1_H3, I1_H5, I1_H7, I1_H9, I2_H3, I2_H5, I2_H7, I2_H9, I3_H3, I3_H5, I3_H7, I3_H9, U1_H3, U1_H5, U1_H7, U1_H9, U2_H3, U2_H5, U2_H7, U2_H9, U3_H3, U3_H5, U3_H7, U3_H9, P1, P2, P3, Q1, Q2, Q3, U1ph, U2ph, U3ph, U1, U2, U3

No.	Designation	Measured quantity
1	I1	Phase L1 current with standard scaling (1.2 or 2.4)
2	I2	Phase L2 current with standard scaling (1.2 or 2.4)
3	I3	Phase L3 current with standard scaling (1.2 or 2.4)
4	I4	IN channel current with standard scaling (1.2 or 2.4)
5	U1	Phase L1 voltage with standard scaling (1.2 or 2.4)



6	U2	Phase L2 voltage with standard scaling (1.2 or 2.4)
7	U3	Phase L3 voltage with standard scaling (1.2 or 2.4)
8	U4	UN channel voltage with standard scaling (1.2 or 2.4)
9	P1	Phase L1 real power with standard scaling (1.2 or 2.4)
10	P2	Phase L2 real power with standard scaling (1.2 or 2.4)
11	P3	Phase L3 real power with standard scaling (1.2 or 2.4)
12	P	Total 3 phase real power (P1+P2+P3) with standard scaling (1.2 or 2.4) divided by 3
13	Q1	Phase L1 reactive power with standard scaling (1.2 or 2.4)
14	Q2	Phase L2 reactive power with standard scaling (1.2 or 2.4)
15	Q3	Phase L3 reactive power with standard scaling (1.2 or 2.4)
16	Q	Total 3 phase reactive power (Q1+Q2+Q3) with standard scaling (1.2 or 2.4) divided by 3
17	S1	Phase L1 apparent power with standard scaling (1.2 or 2.4)
18	S2	Phase L2 apparent power with standard scaling (1.2 or 2.4)
19	S3	Phase L3 apparent power with standard scaling (1.2 or 2.4)
20	S	Total 3 phase apparent power (S1+S2+S3) with standard scaling (1.2 or 2.4) divided by 3
21	PF1	Phase L1 power factor with standard scaling (1.2 or 2.4)
22	PF2	Phase L2 power factor with standard scaling (1.2 or 2.4)
23	PF3	Phase L3 power factor with standard scaling (1.2 or 2.4)
24	PF	Total 3-phase power factor with standard scaling (1.2 or 2.4)
25	U12ph	Phase angle between U1 and U2 without scaling in 0.1deg
26	U23ph	Phase angle between U2 and U3 without scaling in 0.1deg
27	U13ph	Phase angle between U1 and U3 without scaling in 0.1deg
28	f	Phase L1 voltage frequency with fixed scaling 50
29	IN	Calculated neutral current with standard scaling (1.2 or 2.4)
30	UN	Calculated neutral voltage with standard scaling (1.2 or 2.4)
31	U12	Calculated phase-to-phase voltage with standard scaling (1.2 or 2.4) divided by SQRT(3)

32	U23	Calculated phase-to-phase voltage with standard scaling (1.2 or 2.4) divided by SQRT(3)
33	U13	Calculated phase-to-phase voltage with standard scaling (1.2 or 2.4) divided by SQRT(3)
34	THDU1	Total harmonic distortions of U1 voltage in 0.1%
35	THDU2	Total harmonic distortions of U2 voltage in 0.1%
36	THDU3	Total harmonic distortions of U3 voltage in 0.1%
37	THDI1	Total harmonic distortions of I1 current in 0.1%
38	THDI2	Total harmonic distortions of I2 current in 0.1%
39	THDI3	Total harmonic distortions of I3 current in 0.1%
40	I1_H2	2 <sup>nd</sup> harmonic level of I1 current in 0.1%
41	I1_H3	3 <sup>rd</sup> harmonic level of I1 current in 0.1%
42	I1_H5	5 <sup>th</sup> harmonic level of I1 current in 0.1%
43	I1_H7	7 <sup>th</sup> harmonic level of I1 current in 0.1%
44	I1_H9	9 <sup>th</sup> harmonic level of I1 current in 0.1%
45	I2_H2	2 <sup>nd</sup> harmonic level of I2 current in 0.1%
46	I2_H3	3 <sup>rd</sup> harmonic level of I2 current in 0.1%
47	I2_H5	5 <sup>th</sup> harmonic level of I2 current in 0.1%
48	I2_H7	7 <sup>th</sup> harmonic level of I2 current in 0.1%
48	I2_H9	9 <sup>th</sup> harmonic level of I2 current in 0.1%
49	I3_H2	2 <sup>nd</sup> harmonic level of I3 current in 0.1%
50	I3_H3	3 <sup>rd</sup> harmonic level of I3 current in 0.1%
51	I3_H5	5 <sup>th</sup> harmonic level of I3 current in 0.1%
52	I3_H7	7 <sup>th</sup> harmonic level of I3 current in 0.1%
53	I3_H9	9 <sup>th</sup> harmonic level of I3 current in 0.1%
54	U1_H2	2 <sup>nd</sup> harmonic level of U1 voltage in 0.1%
55	U1_H3	3 <sup>rd</sup> harmonic level of U1 voltage in 0.1%

56	U1_H5	5 <sup>th</sup> harmonic level of U1 voltage in 0.1%
57	U1_H7	7 <sup>th</sup> harmonic level of U1 voltage in 0.1%
58	U1_H9	9 <sup>th</sup> harmonic level of U1 voltage in 0.1%
59	U2_H2	2 <sup>nd</sup> harmonic level of U2 voltage in 0.1%
60	U2_H3	3 <sup>rd</sup> harmonic level of U2 voltage in 0.1%
61	U2_H5	5 <sup>th</sup> harmonic level of U2 voltage in 0.1%
62	U2_H7	7 <sup>th</sup> harmonic level of U2 voltage in 0.1%
63	U2_H9	9 <sup>th</sup> harmonic level of U2 voltage in 0.1%
64	U3_H2	2 <sup>nd</sup> harmonic level of U3 voltage in 0.1%
65	U3_H3	3 <sup>rd</sup> harmonic level of U3 voltage in 0.1%
66	U3_H5	5 <sup>th</sup> harmonic level of U3 voltage in 0.1%
67	U3_H7	7 <sup>th</sup> harmonic level of U3 voltage in 0.1%
68	U3_H9	9 <sup>th</sup> harmonic level of U3 voltage in 0.1%
69	U1ph	Phase angle of U1 without scaling in 0.1deg
70	U2ph	Phase angle of U2 without scaling in 0.1deg
71	U3ph	Phase angle of U3 without scaling in 0.1deg

## Modbus RTU operational information

When Modbus RTU protocol is selected IOMod acts as a slave device and waits for requests from the Modbus master. For measurement, the reading master can send a Read Holding Register request (FC 03) or a Read Input Register (FC 04). Both requests give the same value which depends on the register number only.

In order to change internal settings, the Modbus master can send a Write Single Register (FC 06) request. Request with an unsupported function code or register number out of range will be answered with the corresponding exception. Measurement results in nominal values have integer type, while results in primary values are 32-bit float type.

Table 9.1. List of registers with measurement results in nominal values.

Address (Dec)	Designation	Parameter	Multiplier	Read/Write	Unit
0	I1	Phase L1 current	Data * 100	R	%
1	I2	Phase L2 current	Data * 100	R	%
2	I3	Phase L3 current	Data * 100	R	%
3	I0	Calculated neutral current	Data * 100	R	%
4	U12	Calculated phase to phase voltage L1 – L2	Data * 100	R	%
5	U23	Calculated phase to phase voltage L2 – L3	Data * 100	R	%

6	U13	Calculated phase to phase voltage L1 – L3	Data * 100	R	%
7	U0	Calculated zero sequence voltage	Data * 100	R	%
8	S	Total 3 phase apparent power (S1+S2+S3)	Data * 100	R	%
9	P	Total 3 phase active power (P1+P2+P3)	Data * 100	R	%
10	Q	Total 3 phase reactive power (Q1+Q2+Q3)	Data * 100	R	%
11	PF	Total 3 phase power factor	Data * 100	R	%
12	THDU1	Total harmonic distortions of U1 voltage	Data * 100	R	%
13	THDU2	Total harmonic distortions of U2 voltage	Data * 100	R	%
14	THDU3	Total harmonic distortions of U3 voltage	Data * 100	R	%
15	THDI1	Total harmonic distortions of I1 current	Data * 100	R	%
16	THDI2	Total harmonic distortions of I2 current	Data * 100	R	%
17	THDI3	Total harmonic distortions of I3 current	Data * 100	R	%
18	I1_H3	3 <sup>nd</sup> harmonic level of I1 current	Data * 100	R	%
19	I1_H5	5 <sup>nd</sup> harmonic level of I1 current	Data * 100	R	%
20	I1_H7	7 <sup>nd</sup> harmonic level of I1 current	Data * 100	R	%
21	I1_H9	9 <sup>nd</sup> harmonic level of I1 current	Data * 100	R	%
22	I2_H3	3 <sup>nd</sup> harmonic level of I2 current	Data * 100	R	%
23	I2_H5	5 <sup>nd</sup> harmonic level of I2 current	Data * 100	R	%
24	I2_H7	7 <sup>nd</sup> harmonic level of I2 current	Data * 100	R	%
25	I2_H9	9 <sup>nd</sup> harmonic level of I2 current	Data * 100	R	%
26	I3_H3	3 <sup>nd</sup> harmonic level of I3 current	Data * 100	R	%
27	I3_H5	5 <sup>nd</sup> harmonic level of I3 current	Data * 100	R	%
28	I3_H7	7 <sup>nd</sup> harmonic level of I3 current	Data * 100	R	%
29	I3_H9	9 <sup>nd</sup> harmonic level of I3 current	Data * 100	R	%
30	U1_H3	3 <sup>nd</sup> harmonic level of U1 voltage	Data * 100	R	%
31	U1_H5	5 <sup>nd</sup> harmonic level of U1 voltage	Data * 100	R	%
32	U1_H7	7 <sup>nd</sup> harmonic level of U1 voltage	Data * 100	R	%
33	U1_H9	9 <sup>nd</sup> harmonic level of U1 voltage	Data * 100	R	%
34	U2_H3	3 <sup>nd</sup> harmonic level of U2 voltage	Data * 100	R	%
35	U2_H5	5 <sup>nd</sup> harmonic level of U2 voltage	Data * 100	R	%

36	U2_H7	7 <sup>nd</sup> harmonic level of U2 voltage	Data * 100	R	%
37	U2_H9	9 <sup>nd</sup> harmonic level of U2 voltage	Data * 100	R	%
38	U3_H3	3 <sup>nd</sup> harmonic level of U3 voltage	Data * 100	R	%
39	U3_H5	5 <sup>nd</sup> harmonic level of U3 voltage	Data * 100	R	%
40	U3_H7	7 <sup>nd</sup> harmonic level of U3 voltage	Data * 100	R	%
41	U3_H9	9 <sup>nd</sup> harmonic level of U3 voltage	Data * 100	R	%
42	P1	Phase L1 active power	Data * 100	R	%
43	P2	Phase L2 active power	Data * 100	R	%
44	P3	Phase L3 active power	Data * 100	R	%
45	Q1	Phase L1 reactive power	Data * 100	R	%
46	Q2	Phase L2 reactive power	Data * 100	R	%
47	Q3	Phase L3 reactive power	Data * 100	R	%
48	U1ph	Phase angle of U1 voltage	Data * 100	R	deg
49	U2ph	Phase angle of U2 voltage	Data * 100	R	deg
50	U3ph	Phase angle of U3 voltage	Data * 100	R	deg
51	U1	Phase L1 voltage	Data * 100	R	%
52	U2	Phase L2 voltage	Data * 100	R	%
53	U3	Phase L3 voltage	Data * 100	R	%
54	F	Frequency of phase L1 voltage	Data * 100	R	Hz
55	I4	Input I4 current	Data * 100	R	%
56	U4	Input U4 voltage	Data * 100	R	%

Table 9.2. List of registers with internal settings values.

Address (Dec)	Designation	Parameter	Multiplier	Read/Write	Unit
75	PC	Primary current value	Data	R/W	A
76	PV	Primary voltage value	Data	R/W	V
77	VS1	Amplitude correction factor U1	Data	R/W	-
78	VS2	Amplitude correction factor U2	Data	R/W	-
79	VS3	Amplitude correction factor U3	Data	R/W	-
80	VS4	Amplitude correction factor U4	Data	R/W	-
81	CS1	Current sensor nominal value	Data	R/W	mV

Table 9.3. List of float registers with measurement results in primary values.

Address (Dec)	Designation	Parameter	Multiplier	Read/ Write	Unit
100	I1	Phase L1 current		R	A
102	I2	Phase L2 current		R	A
104	I3	Phase L3 current		R	A
106	I0	Calculated neutral current		R	A
108	U12	Calculated phase to phase voltage L1 – L2		R	V
110	U23	Calculated phase to phase voltage L2 – L3		R	V
112	U13	Calculated phase to phase voltage L1 – L3		R	V
114	U1	Phase L1 voltage		R	V
116	U2	Phase L2 voltage		R	V
118	U3	Phase L3 voltage		R	V
120	U0	Calculated zero sequence voltage		R	V
122	U1ph	Phase angle of U1 voltage		R	deg
124	U2ph	Phase angle of U2 voltage		R	deg
126	U3ph	Phase angle of U3 voltage		R	deg
128	S	Total 3 phase apparent power		R	kVA
130	P	Total 3 phase active power		R	kW
132	Q	Total 3 phase reactive power		R	kVAr
134	PF	Total 3 phase power factor		R	-
136	S1	Phase L1 apparent power		R	kVA
138	S2	Phase L2 apparent power		R	kVA
140	S3	Phase L3 apparent power		R	kVA
142	P1	Phase L1 active power		R	kW
144	P2	Phase L2 active power		R	kW
146	P3	Phase L3 active power		R	kW

148	Q1	Phase L1 reactive power		R	kVAr
150	Q2	Phase L2 reactive power		R	kVAr
152	Q3	Phase L3 reactive power		R	kVAr
154	PF1	Phase L1 power factor		R	-
156	PF2	Phase L2 power factor		R	-
158	PF3	Phase L3 power factor		R	-
160	F	Frequency of phase L1 voltage			Hz
162	THDU1	Total harmonic distortions of U1 voltage		R	%
164	THDU2	Total harmonic distortions of U2 voltage		R	%
166	THDU3	Total harmonic distortions of U3 voltage		R	%
168	THDI1	Total harmonic distortions of I1 current		R	%
170	THDI2	Total harmonic distortions of I2 current		R	%
172	THDI3	Total harmonic distortions of I3 current		R	%
174	I1_H3	3 <sup>nd</sup> harmonic level of I1 current		R	%
176	I1_H5	5 <sup>nd</sup> harmonic level of I1 current		R	%
178	I1_H7	7 <sup>nd</sup> harmonic level of I1 current		R	%
180	I1_H9	9 <sup>nd</sup> harmonic level of I1 current		R	%
182	I2_H3	3 <sup>nd</sup> harmonic level of I2 current		R	%
184	I2_H5	5 <sup>nd</sup> harmonic level of I2 current		R	%
186	I2_H7	7 <sup>nd</sup> harmonic level of I2 current		R	%
188	I2_H9	9 <sup>nd</sup> harmonic level of I2 current		R	%
190	I3_H3	3 <sup>nd</sup> harmonic level of I3 current		R	%
192	I3_H5	5 <sup>nd</sup> harmonic level of I3 current		R	%
194	I3_H7	7 <sup>nd</sup> harmonic level of I3 current		R	%

196	I3_H9	9 <sup>nd</sup> harmonic level of I3 current		R	%
198	U1_H3	3 <sup>nd</sup> harmonic level of U1 voltage		R	%
200	U1_H5	5 <sup>nd</sup> harmonic level of U1 voltage		R	%
202	U1_H7	7 <sup>nd</sup> harmonic level of U1 voltage		R	%
204	U1_H9	9 <sup>nd</sup> harmonic level of U1 voltage		R	%
206	U2_H3	3 <sup>nd</sup> harmonic level of U2 voltage		R	%
208	U2_H5	5 <sup>nd</sup> harmonic level of U2 voltage		R	%
210	U2_H7	7 <sup>nd</sup> harmonic level of U2 voltage		R	%
212	U2_H9	9 <sup>nd</sup> harmonic level of U2 voltage		R	%
214	U3_H3	3 <sup>nd</sup> harmonic level of U3 voltage		R	%
216	U3_H5	5 <sup>nd</sup> harmonic level of U3 voltage		R	%
218	U3_H7	7 <sup>nd</sup> harmonic level of U3 voltage		R	%
220	U3_H9	9 <sup>nd</sup> harmonic level of U3 voltage		R	%
222	I4	Input I4 current		R	A
224	U4	Input U4 voltage		R	V

## Firmware upgrade over USB

To update device firmware user must:

- Enter the main configuration menu;
- Enter the Firmware update screen by pressing [8];
- Confirm the update by pressing [1];

The device should now enter Firmware Upgrade mode.

**i** It is recommended to close the terminal window after entering firmware upgrade mode

The device should then reconnect as a mass storage device (Fig. 10.1).



Fig. 10.1. Reconnecting as a mass storage device



Delete the existing file “firmware.bin” and simply upload a new firmware file by dragging and dropping as in Fig. 10.2.

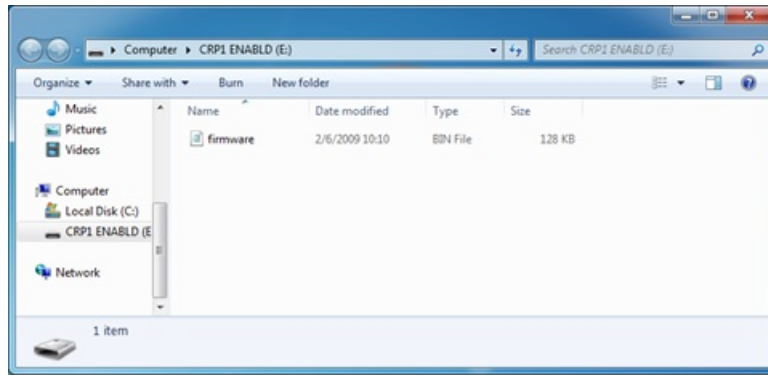


Fig. 10.2 Mass storage device for firmware upload

Reconnect the device and check the firmware version. It should have changed.