

Modbus RTU Communication Module

for SHARKY 775 and SCYLAR INT 8 by Diehl Metering

User Manual

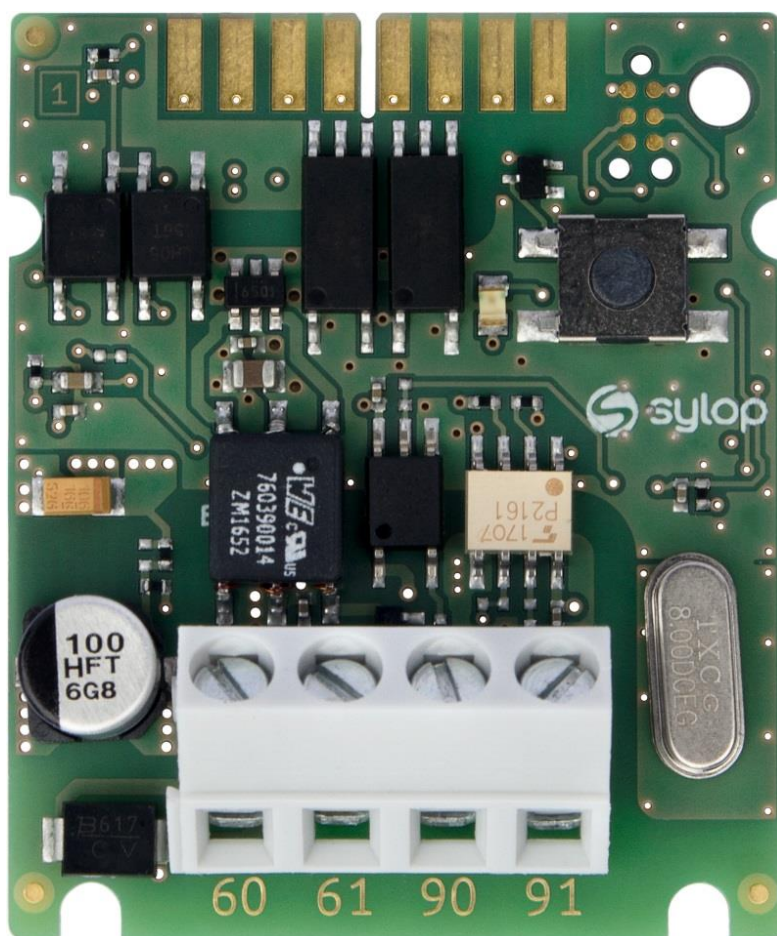


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1 Introduction

This User Manual refers to Modbus RTU Communication Module identified by Sylop under product number M/N: 11024.

Modbus RTU Communication Module is designed to get data from SHARKY 775 ultrasonic compact energy meters or SCYLAR INT 8 energy calculators manufactured by Diehl Metering and share the data in Modbus RTU network using EIA-485 (formerly RS-485) channel. The module is designed to be installed inside housing of the meter in dedicated extension card slot. The module periodically reads the data from the meter using EN 13757-3 standard (known as M-Bus). The data update rate can be defined.

The purpose of the User Manual is to explain how to safely use this product. The document presents how to correctly install the module, how to properly connect power supply and communication network to the module and how to configure the module to work within Modbus RTU network. In addition, for easy product use, this document describes how to read and understand the data from the module.



NOTE

Please read this document carefully before any use of the product. Important information can be found in each section.

2 Safety Instructions

Follow the safety guidelines below to ensure your personal safety and to protect your equipment and work environment.



WARNING

The installation and/or electrical connection and/or configuring the product should be made by qualified personnel only, trained in the installation and use of electrical equipment.



DANGER

Do not touch any parts of product during installation work when the power supply voltage is on.

Risk of serious injuries or death and/or at least product damage!

Turn off the power supply voltage during product installation.




ESD CAUTION

This product is sensitive to electrostatic discharge (ESD). It is recommended that standard static precautions be taken in handling and assembly of this module to prevent damage which may be induced by ESD. Failure to follow proper handling and installation procedures describe in this document can cause damage. ESD damage can range from performance degradation to device failure for which Sylop is not responsible.

2.1 Declaration of Conformity

The module is complaint with European Union harmonization legislation and standards for Information Technology Equipment as stated in the EU Declaration of Conformity below.



EU declaration of conformity

Product

Modbus RTU Communication Module - identified by manufacturer under product number M/N: 11024

Manufacturer

*Sylop spółka z ograniczoną odpowiedzialnością spółka komandytowa
ul. Bociana 6A/4
31-231 Kraków
Poland*

This declaration of conformity is issued under the sole responsibility of the manufacturer.

Object of the declaration

Modbus RTU Communication Module for use with SHARKY 775 ultrasonic compact energy meters and SCYLAR INT 8 energy calculators manufactured by Diehl Metering.

The object of the declaration described above is in conformity with the relevant Union harmonisation legislation:

- 1. Directive 2011/65/EU of the European Parliament and of the Council of 8 June 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment*
- 2. Directive 2014/30/EU of the European Parliament and of the Council of 26 February 2014 on the harmonisation of the laws of the Member States relating to electromagnetic compatibility*


References to the relevant harmonised standards or normative documents used or references to the other technical specifications in relation to which conformity is declared:

*EN 50581:2012
EN 55022:2010
EN 55022:2010/AC:2011
EN 55024:2010
EN 55024:2010/A1:2015
EN 61000-3-2:2014
EN 61000-3-3:2013*


Krakow, 2018-02-27

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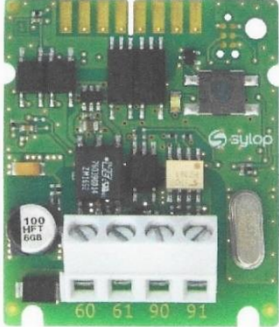
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Picture 1 - Top view



Picture 2 - Bottom view

Picture 2.1 - Scan of product EU Declaration of Conformity

2.2 Disposal of waste equipment



WEEE CAUTION

This product is electronic equipment and it must not be disposed of with other domestic waste. It must be separately collected and recycled as waste electrical and electronic equipment (WEEE) according to currently valid local legislation.

The separate collection and recycling of waste equipment at the time of disposal will help to conserve natural resources and ensure that it is recycled in a manner that protects human health and the environment.

3 Technical parameters

Parameter	Value
Operating Voltage	12 - 24 V AC/DC \pm 10% (SELV power supply only)
Maximum Power Consumption	500 mW
Communication Channel Interface	EIA-485 (galvanically isolated, 1/8 Unit Load)
Communication Protocol	Modbus RTU
Communication Parameters	Baud rate (bits per second): 1200, 2400, 4800, 9600, 14400, 19200, 38400, 56000, 57600, 115200 Data bits: 8 Parity bit: even, odd, none Stop bits: 1, 2
Operating Temperature	0 - 55 °C
Recommended Storage Temperature	5 - 35 °C
Dimensions	37,2 mm x 44,8 mm x 16,2 mm
Weight	13 g
Weight with package	15 g
Packing	ESD shielding bag



DANGER

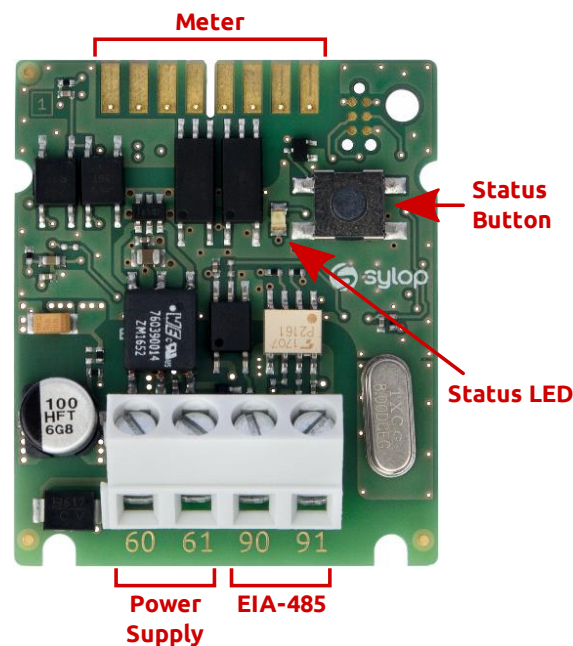
Use SELV power supply only!

Risk of serious injuries or death and/or at least product damage!

The product is designed to use with one power supply module per one product for safety reason.

4 Module interfaces

Interface name	Description
Meter	Internal connection with the meter. Connection is realized by using ribbon cable offered by Diehl Metering (P/N: 3013651).
Power Supply	Screw connector terminals 60 and 61 (polarity independent).
EIA-485	Screw connector terminals 90 (non-inverting, +) and 91 (inverting, -).
Status Button	Used to restore device default settings and check device status.
Status LED	Used to signal transmission in Modbus RTU network and to confirm default setting restore. Status LED lights up when Status Button is pressed.



Picture 4.1- Module interfaces

5 Module installation

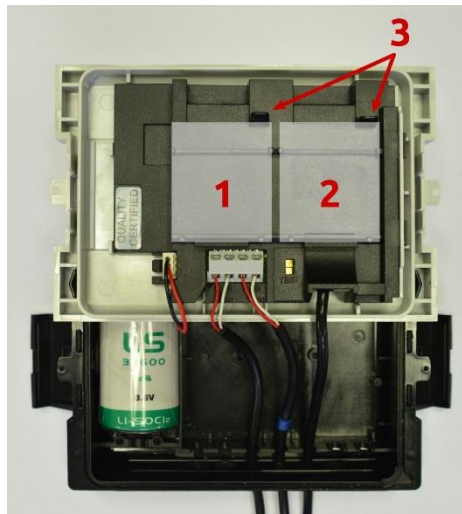
Module can only be installed in one of the following types of meters manufactured by Diehl Metering:

- SHARKY 775 ultrasonic compact energy meters
- SCYLAR INT 8 energy calculators

No other meters are supported.

5.1 Placing in meter

SHARKY 775 and SCYLAR INT 8 meters have two slots for extension modules. Modbus RTU Communication Module can be installed in one of them. These slots are marked by number 1 and 2 in the picture below. Each slot have fixing lugs to help installing extension module and stabilize its position.



1. Primary extension slot
2. Secondary extension slot
3. Module fixing lugs

Picture 5.1 - Meter internal view

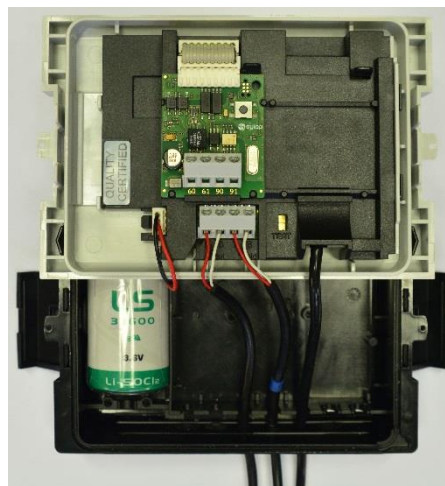


ESD CAUTION

This product is sensitive to electrostatic discharge (ESD). It is recommended that standard static precautions be taken in handling and assembly of this module to prevent damage which may be induced by ESD. Failure to follow proper handling and installation procedures describe in this document can cause damage. ESD damage can range from performance degradation to device failure for which Sylop is not responsible.

Module installation steps:

1. Open the meter by releasing side catches and take front panel off as described in *Installation and User Guide for SHARKY 775 Ultrasonic Compact Energy Meter* or *Installation and User Guide for SCYLAR INT 8 Calculator*.
2. Localize appropriate extension slot on front panel back side.
3. Place the module into one of slots (see Picture 5.1). Pay attention to positioning elements. They must match to the cuts on the module.
4. Press the module towards to front panel of the meter to latch the module with the fixing lug.
5. Check that module is stable installed in slot.
6. Connect module with meter by ribbon cable (see Picture 5.2).



Picture 5.2 - Module installed in meter



NOTE

For more information about installing extension modules and their combination, see *Installation and User Guide for SHARKY 775 Ultrasonic Compact Energy Meter* or *Installation and User Guide for SCYLAR INT 8 Calculator*.

5.2 Power supply wiring

The module contains two-wire terminal for power supply connection marked as 60 and 61. Module operating voltage range is 12-24 V AC/DC $\pm 10\%$. Connection to SELV power supply unit is polarity independent and is galvanically isolated from the meter.

Recommended SELV power supply unit is Breve PSS 10 230-24 V AC Transformer (P/N: 16024-0150).



DANGER

Use SELV power supply only!

Risk of serious injuries or death and/or at least product damage!

The product is designed to use with one power supply module per one product for safety reason.

5.2.1 Power supply cable

Terminals are suitable for wires up to 2,5 mm². To connect module with SELV power supply unit use two-wire OMY cables or similar, e.g. 2x0,75 mm² 300 V OMYp cable.



NOTE

Required length of cable between the module and the power supply unit shall be less than 1 meter.

5.2.2 Connection schematic



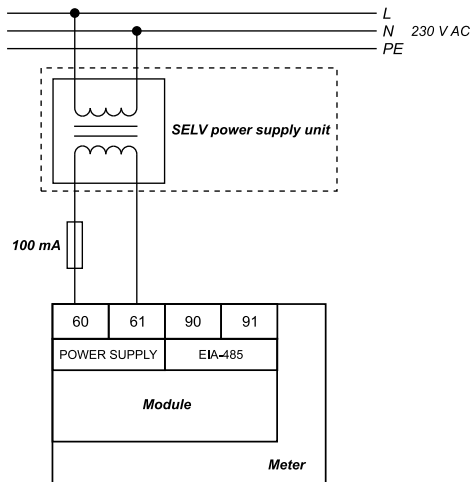
DANGER

Do not touch any parts of product during installation work when the power supply voltage is on.

Risk of serious injuries or death and/or at least product damage!

Turn off the power supply voltage during product installation.

Connection of the module to power supply is presented on the following schematic below.



Picture 5.3 - Connection of power supply



Picture 5.4 - Power supply wiring example

Connecting steps:

1. Guide the power supply cable through the wire protecting sleeve into the bottom part of the meter.
2. Connect the cable to power supply terminals in module (see Picture 5.4).



WARNING

Do not connect power supply wires to the EIA-485 interface connectors 90 and 91. It can damage the module!



NOTE

It is recommended to use 100 mA fuse between SELV power supply unit and the module.

5.3 EIA-485 network channel wiring

Modbus RTU Communication Module contains two-wire terminal for connecting network cable to EIA-485 (formerly RS-485) channel. The module has galvanically isolated EIA-485 interface. The EIA-485 interface is polarity dependent. Non-inverting signal shall be connected to terminal marked as 90 (+) and inverting signal shall be connected to terminal marked as 91 (-). The maximum EIA-485 channel length is 1200 m.

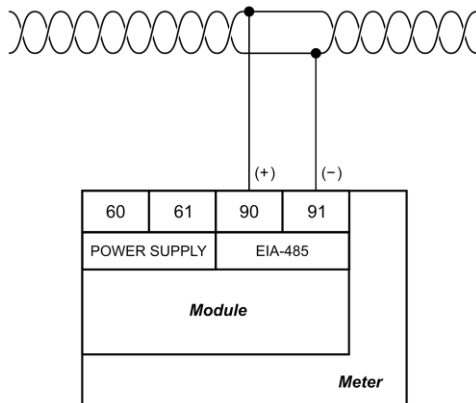
5.3.1 EIA-485 cable

Terminals are suitable for wires up to 2,5 mm². To connect the module with EIA-485 bus use two-wire twisted-pair cable with nominal characteristic impedance 120 Ω without or with shield. If shielded cable is used, shield shall not be connected or grounded.

Recommended cable is BELDEN 9841 1x2x24AWG shielded twisted-pair or similar.

5.3.2 Connection schematic

Correct EIA-485 wiring is presented on pictures bellow.



Picture 5.5 - EIA-485 interface connection



Picture 5.6 - Example of correctly wired module

Connecting steps:

1. Guide the EIA-485 cable through the wire protecting sleeve into the bottom part of the meter.
2. Connect the cable to EIA-485 terminals in module (see Picture 5.6).

5.3.3 Network topology and termination

EIA-485 standard required that nodes should be connected in a bus topology network only. In bus topology the devices can be connected to EIA-485 transmission line via stubs. Stubs should be as short as possible to limit signal reflections.

Transmission line should always be terminated at both ends of the bus to avoid reflections that can cause data errors.



Picture 5.7 - Bus topology in EIA-485 network channel

Proper termination requires the matching of the terminating resistors to characteristic impedance of the transmission line.

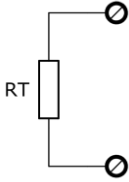
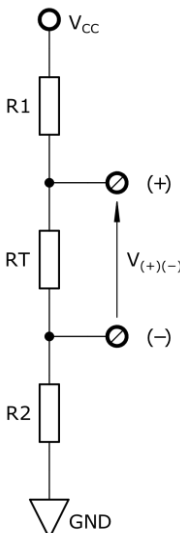
There are two termination types for EIA-485 channel: standard termination and termination with fail-safe biasing.

Standard termination can be used in low-noise domestic environment only. In standard termination, each end of bus should be terminated with 120 Ω resistor.

Termination with fail-safe biasing is required in industrial environment and it is highly recommended by Sylop. When network distance is below 100 m fail-safe biasing at one end of the bus is often sufficient. The other end

of the bus shall be terminated with 120 Ω resistor. For network distance longer than 100 m fail-safe biasing at both ends of the bus is necessary.

Fail-safe biasing circuit is a resistive voltage divider with consists of a pull-up, terminator, and pull-down resistors. It provides the necessary differential bus voltage, $V_{(+)(-)}$, when no device transmits data over the bus. In addition, sufficient noise margin should be added when the device is operated in harsh industrial environments. To ensure sufficient noise margin, the value of the receiver input voltage $V_{(+)(-)}$ must be the sum of the receiver input threshold V_{IT_max} and maximum permissible noise margin V_{NOISE} .

Termination type	Schematic	Values
Standard termination		$R_T = 120 \Omega$
Termination with fail-safe biasing		$R_T = 138 \Omega; \pm 5\%; \frac{1}{4} W$ $R_1, R_2 = 470 \Omega; \pm 5\%; \frac{1}{4} W$ Assumptions: <ul style="list-style-type: none"> • Single fail-safe network • $V_{CC_min} = 4,75 V$ • $V_{NOISE} = 100 mV$ • $V_{IT_max} = 200 mV$ • $V_{(+)(-)} = V_{IT_max} + V_{NOISE} = 300 mV$



NOTE

Modbus RTU Communication Module $\frac{1}{8}$ Unit Load (UL) transceiver is used.

Termination with fail-safe biasing reduces the maximum number of bus loads due to additional common-mode loading.

For network without fail-safe biasing the maximum number of $\frac{1}{8}$ UL transceivers is 256.

For single fail-safe network the maximum number of $\frac{1}{8}$ UL transceivers is 51.

For more information about EIA-485 network termination please refer to *External Fail-Safe Biasing of RS-485 Networks* application notes by Renesas Electronics Corporation.

5.4 First power-up

First power-up of Modbus RTU Communication Module should be performed before closing the meter housing. Please refer to following table for steps necessary.

Step	Action	Correct result
1	Turn on power supply	Status LED blinks once
2	Press Status Button on module	Status LED lights on during button is pressed
3	Read any Modbus register by using Modbus RTU application with default communication parameters (see 6.2.2 Configuration registers)	Status LED blinks during communication and response with proper data from the module is received by Modbus master application

If all three tests are passed, the module is ready to use and housing of the meter can be closed. If any test fails, see 8 Troubleshooting guide for more information.

5.5 Closing housing of meter

To close properly the meter with the module inside, follow steps below:

1. Check that module is correctly installed in extension slot.
2. Check that all cables are in appropriate position and screwed tight.
3. If there is a lot of loose cables inside meter housing, pull them to the outside of the meter.
4. Place front panel to bottom part of meter housing starting from left edge of meter housing (see Picture 5.8).
5. Close the meter housing with the side latches (see Picture 5.9).



Picture 5.8 - Closing meter housing starting from left edge



Picture 5.9 - Closing meter housing with the side latches

6 Modbus RTU interface

Modbus is the most widely used network protocol in industrial environment. It is often used to connect a supervisory computer with a remote terminal unit (RTU) in supervisory control and data acquisition (SCADA) systems. Modbus RTU is the most common implementation available for Modbus using EIA-485 (formerly RS-485) channel.

Modbus RTU is used to establish master-slave communication between electronic devices. That means that it is based upon request/reply mechanism. Transmission is initialized by master and it sends the request message which contains address of slave (called Slave ID) - address of device requested to answer and a function code - specific request for particular data. The slave in response sends the requested data. Modbus RTU Communication Module is slave device.

Modbus RTU is used a compact, binary representation of the data for protocol communication. Modbus RTU Communication Module store the data in object types called registers - Input register and Holding Registers which have 16 bits size. Registers provided by this device can be found in *6.2 Modbus registers*.

Modbus RTU Communication Module supports following functions (function codes):

- Read Holding Registers (0x03)
- Read Input Registers (0x04)
- Write Single Register (0x06)
- Write Multiple Registers (0x10)

To make communication with Modbus RTU Communication Module simple, measurement data from the meter are stored by the module in both types of registers - holding registers and input registers. Therefore measurement data can be read by using function code 0x03 or 0x04. To modify module configuration, function code 0x06 or 0x10 should be used.



NOTE

Modbus RTU Communication Module sends data with Most Significant Register First and Most Significant Byte First ("byte swap" or "word swap" is not used for decoding data).

The development and update of Modbus protocols has been managed by the Modbus Organization. For more information about Modbus standard please refer to following documents - *Modicon Modbus Protocol Reference Guide* and *MODBUS over Serial Line - Specification and Implementation Guide*.

6.1 Device addressing

Single Modbus RTU network over EIA-485 channel (called Modbus bus) can contain only one master, and up to 247 slaves. Master - usually PC has full control of the communication - can perform read or write requests. Slave device can only answer to requests, it cannot actively query other devices in the network. Each slave device in the network has to have its own unique address - Slave ID. Slave ID can be assigned from range 1 - 247. Address 0 is reserved for broadcast message. Master node has no specific address assigned.



NOTE

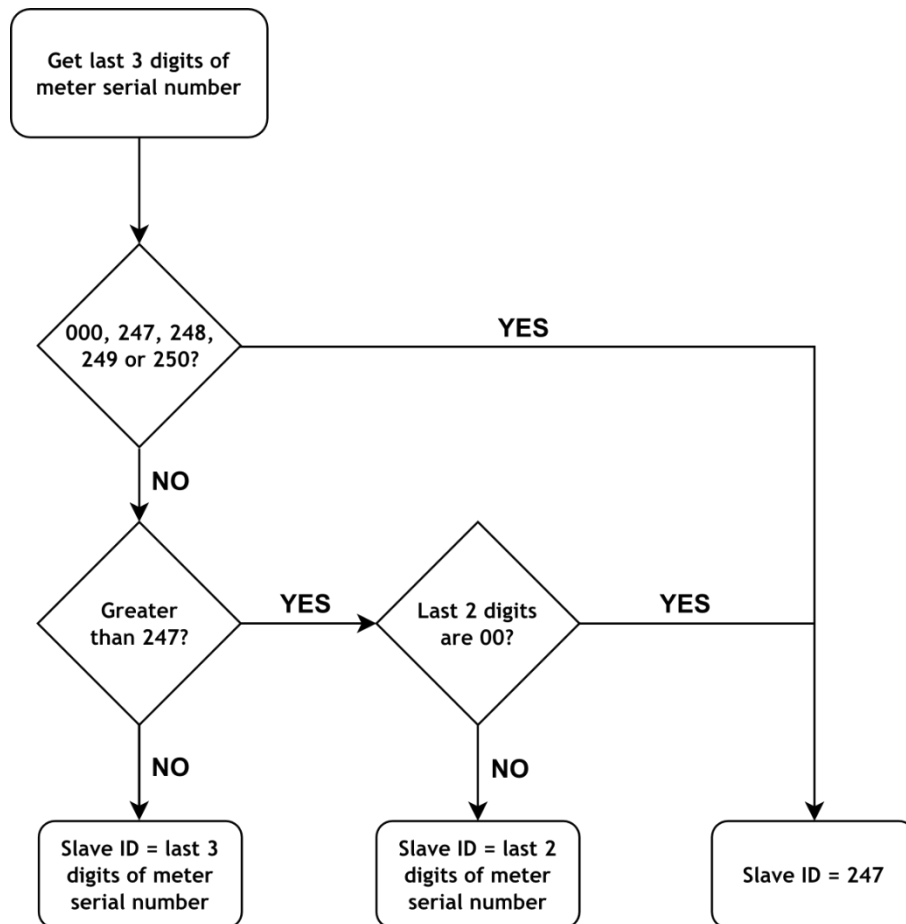
Please take care not to setup two slave devices with the same Slave ID, it will lead to frame collisions on Modbus bus.

Master uses Slave ID to correctly address particular device on the Modbus network. Slave ID 0 is used to perform broadcast order to all devices on the bus. Note that slave nodes do not respond to broadcast messages.

Slave Address	Function
0	Broadcast
1 - 247	Specific slave address
248 - 255	Reserved

6.1.1 Automatic Slave ID

Automatic Slave ID functionality is supported by Modbus RTU Communication Module. This option allows the module to set Modbus Slave ID basing on meter serial number. Special precautions are made to ensure that only valid Slave ID is generated. See the algorithm on Picture 6.1 for details on which Slave ID shall be set, when Automatic Slave ID functionality is enabled.



Picture 6.1 - Automatic Slave ID functionality algorithm

Example Automatic Slave ID calculations is shown below.

Last 3 digits of meter serial number	Slave ID of module	Last 3 digits of meter serial number	Slave ID of module
#### #000	247	#### #296	96
#### #001	1	#### #297	97
#### #002	2	#### #298	98
...	...	#### #299	99
#### #240	240	#### #300	247
#### #246	246	#### #301	1
#### #247	247	#### #302	2
#### #248	247
#### #249	247	#### #398	98
#### #250	247	#### #399	99
#### #251	51	#### #400	247
#### #252	52	#### #401	1
...



NOTE

Automatic Slave ID functionality is enabled in Modbus RTU Communication Module by default.

To disable or enable Automatic Slave ID functionality write data to Modbus Register 41001 (Modbus Address 1000) as described in table below.

Automatic Slave ID functionality	Register Value (higher byte)	Register Value (lower byte)	Description
Disabled	0 (0x00 hex)	Slave ID in range 1-247 (0x01-0xF7 hex)	Static Slave ID
Enabled	1 (0x01 hex)	Slave ID in range 1-247 (0x01-0xF7 hex)	Slave ID will be updated after first readout of heat meter data.

6.2 Modbus registers

Modbus RTU Communication Module supports both types of Modbus registers:

- Holding - read/write, register number (4#####),
- Input - read only, register number (3#####).

Each register is 16 bits (2 bytes) size and it has unique register address. The measurement data from the meter are stored by the module in both types of registers - holding registers and input registers.



NOTE

There are two conventions to address registers in Modbus. Take care when accessing registers. Addressing method can depend on the application used. Some applications may use only long format (Modbus Register) and some may use short format (Modbus Address).

To get Modbus Address subtract offset 40001 (for holding registers) or 30001 (for input registers) from Modbus Register.

For example to get Modbus Address to read Volume value: 40011 (Modbus Register) - 40001 (offset for holding registers) = 10 (Modbus Address)

6.2.1 Measurement data registers

Description	Modbus Register	Modbus Register Type	Modbus Address	Data Value Type	Read only (RO) Read/write (R/W)
Energy ^{1,2}	30001 or 40001	Input or Holding	0	Int32	RO
Energy (Unit factor) ¹	30003 or 40003	Input or Holding	2	UInt16	RO
Energy (Unit name) ²	30004 or 40004	Input or Holding	3	8 char ASCII	RO
Energy (Unit ID) ^{2,3}	30008 or 40008	Input or Holding	7	UInt16	RO
Energy (Float) ²	30009 or 40009	Input or Holding	8	IEEE 754	RO
Volume ^{1,2}	30011 or 40011	Input or Holding	10	Int32	RO
Volume (Unit factor) ¹	30013 or 40013	Input or Holding	12	UInt16	RO
Volume (Unit name) ²	30014 or 40014	Input or Holding	13	8 char ASCII	RO
Volume (Unit ID) ^{2,3}	30018 or 40018	Input or Holding	17	UInt16	RO
Volume (Float) ²	30019 or 40019	Input or Holding	18	IEEE 754	RO
Power ^{1,2}	30021 or 40021	Input or Holding	20	Int32	RO
Power (Unit factor) ¹	30023 or 40023	Input or Holding	22	UInt16	RO
Power (Unit name) ²	30024 or 40024	Input or Holding	23	8 char ASCII	RO
Power (Unit ID) ^{2,3}	30028 or 40028	Input or Holding	27	UInt16	RO
Power (Float) ²	30029 or 40029	Input or Holding	28	IEEE 754	RO
Flow rate ^{1,2}	30031 or 40031	Input or Holding	30	Int32	RO
Flow rate (Unit factor) ¹	30033 or 40033	Input or Holding	32	UInt16	RO
Flow rate (Unit name) ²	30034 or 40034	Input or Holding	33	8 char ASCII	RO
Flow rate (Unit ID) ^{2,3}	30038 or 40038	Input or Holding	37	UInt16	RO
Flow rate (Float) ²	30039 or 40039	Input or Holding	38	IEEE 754	RO
Forward temperature ^{2,4}	30041 or 40041	Input or Holding	40	Int16	RO
Forward temperature (Unit name) ²	30042 or 40042	Input or Holding	41	8 char ASCII	RO
Forward temperature (Unit ID) ^{2,3}	30046 or 40046	Input or Holding	45	UInt16	RO

Description	Modbus Register	Modbus Register Type	Modbus Address	Data Value Type	Read only (RO) Read/write (R/W)
Forward temperature (Float) ²	30047 or 40047	Input or Holding	46	IEEE 754	RO
Return temperature ^{2,4}	30049 or 40049	Input or Holding	48	Int16	RO
Return temperature (Unit name) ²	30050 or 40050	Input or Holding	49	8 char ASCII	RO
Return temperature (Unit ID) ^{2,3}	30054 or 40054	Input or Holding	53	UInt16	RO
Return temperature (Float) ²	30055 or 40055	Input or Holding	54	IEEE 754	RO
Temperature difference ^{2,4}	30057 or 40057	Input or Holding	56	Int16	RO
Temperature difference (Unit name) ²	30058 or 40058	Input or Holding	57	8 char ASCII	RO
Temperature difference (Unit ID) ^{2,3}	30062 or 40062	Input or Holding	61	UInt16	RO
Temperature difference (Float) ²	30063 or 40063	Input or Holding	62	IEEE 754	RO
Tariff Energy 1 ^{1,2}	30065 or 40065	Input or Holding	64	Int32	RO
Tariff Energy 1 (Unit factor) ¹	30067 or 40067	Input or Holding	66	UInt16	RO
Tariff Energy 1 (Unit name) ²	30068 or 40068	Input or Holding	67	8 char ASCII	RO
Tariff Energy 1 (Unit ID) ^{2,3}	30072 or 40072	Input or Holding	71	UInt16	RO
Tariff Energy 1 (Float) ²	30073 or 40073	Input or Holding	72	IEEE 754	RO
Tariff Volume 1 ^{1,2}	30075 or 40075	Input or Holding	74	Int32	RO
Tariff Volume 1 (Unit factor) ¹	30077 or 40077	Input or Holding	76	UInt16	RO
Tariff Volume 1 (Unit name) ²	30078 or 40078	Input or Holding	77	8 char ASCII	RO
Tariff Volume 1 (Unit ID) ^{2,3}	30082 or 40082	Input or Holding	81	UInt16	RO
Tariff Volume 1 (Float) ²	30083 or 40083	Input or Holding	82	IEEE 754	RO
Tariff Energy 2 ^{1,2}	30085 or 40085	Input or Holding	84	Int32	RO
Tariff Energy 2 (Unit factor) ¹	30087 or 40087	Input or Holding	86	UInt16	RO
Tariff Energy 2 (Unit name) ²	30088 or 40088	Input or Holding	87	8 char ASCII	RO
Tariff Energy 2 (Unit ID) ^{2,3}	30092 or 40092	Input or Holding	91	UInt16	RO
Tariff Energy 2 (Float) ²	30093 or 40093	Input or Holding	92	IEEE 754	RO
Tariff Volume 2 ^{1,2}	30095 or 40095	Input or Holding	94	Int32	RO
Tariff Volume 2 (Unit factor) ¹	30097 or 40097	Input or Holding	96	UInt16	RO
Tariff Volume 2 (Unit name) ²	30098 or 40098	Input or Holding	97	8 char ASCII	RO
Tariff Volume 2 (Unit ID) ^{2,3}	30102 or 40102	Input or Holding	101	UInt16	RO
Tariff Volume 2 (Float) ²	30103 or 40103	Input or Holding	102	IEEE 754	RO
Tariff Energy 3 ^{1,2}	30105 or 40105	Input or Holding	104	Int32	RO
Tariff Energy 3 (Unit factor) ¹	30107 or 40107	Input or Holding	106	UInt16	RO
Tariff Energy 3 (Unit name) ²	30108 or 40108	Input or Holding	107	8 char ASCII	RO
Tariff Energy 3 (Unit ID) ^{2,3}	30112 or 40112	Input or Holding	111	UInt16	RO
Tariff Energy 3 (Float) ²	30113 or 40113	Input or Holding	112	IEEE 754	RO
Tariff Volume 3 ^{1,2}	30115 or 40115	Input or Holding	114	Int32	RO
Tariff Volume 3 (Unit factor) ¹	30117 or 40117	Input or Holding	116	UInt16	RO
Tariff Volume 3 (Unit name) ²	30118 or 40118	Input or Holding	117	8 char ASCII	RO
Tariff Volume 3 (Unit ID) ^{2,3}	30122 or 40122	Input or Holding	121	UInt16	RO
Tariff Volume 3 (Float) ²	30123 or 40123	Input or Holding	122	IEEE 754	RO
Tariff Energy 4 ^{1,2}	30125 or 40125	Input or Holding	124	Int32	RO
Tariff Energy 4 (Unit factor) ¹	30127 or 40127	Input or Holding	126	UInt16	RO
Tariff Energy 4 (Unit name) ²	30128 or 40128	Input or Holding	127	8 char ASCII	RO
Tariff Energy 4 (Unit ID) ^{2,3}	30132 or 40132	Input or Holding	131	UInt16	RO

Description	Modbus Register	Modbus Register Type	Modbus Address	Data Value Type	Read only (RO) Read/write (R/W)
Tariff Energy 4 (Float) ²	30133 or 40133	Input or Holding	132	IEEE 754	RO
Tariff Volume 4 ^{1,2}	30135 or 40135	Input or Holding	134	Int32	RO
Tariff Volume 4 (Unit factor) ¹	30137 or 40137	Input or Holding	136	UInt16	RO
Tariff Volume 4 (Unit name) ²	30138 or 40138	Input or Holding	137	8 char ASCII	RO
Tariff Volume 4 (Unit ID) ^{2,3}	30142 or 40142	Input or Holding	141	UInt16	RO
Tariff Volume 4 (Float) ²	30143 or 40143	Input or Holding	142	IEEE 754	RO
Pulse Input Volume 1 ^{1,2}	30145 or 40145	Input or Holding	144	Int32	RO
Pulse Input Volume 1 (Unit factor) ¹	30147 or 40147	Input or Holding	146	UInt16	RO
Pulse Input Volume 1 (Unit name) ²	30148 or 40148	Input or Holding	147	8 char ASCII	RO
Pulse Input Volume 1 (Unit ID) ^{2,3}	30152 or 40152	Input or Holding	151	UInt16	RO
Pulse Input Volume 1 (Float) ²	30153 or 40153	Input or Holding	152	IEEE 754	RO
Pulse Input Volume 2 ^{1,2}	30155 or 40155	Input or Holding	154	Int32	RO
Pulse Input Volume 2 (Unit factor) ¹	30157 or 40157	Input or Holding	156	UInt16	RO
Pulse Input Volume 2 (Unit name) ²	30158 or 40158	Input or Holding	157	8 char ASCII	RO
Pulse Input Volume 2 (Unit ID) ^{2,3}	30162 or 40162	Input or Holding	161	UInt16	RO
Pulse Input Volume 2 (Float) ¹	30163 or 40163	Input or Holding	162	IEEE 754	RO
Error Code ⁵	30165 or 40165	Input or Holding	164	Hex	RO
Heat Meter Serial Number (Fixed)	30166 or 40166	Input or Holding	165	UInt32	RO
Heat Meter Serial Number (ASCII)	30168 or 40168	Input or Holding	167	8 char ASCII	RO
Periodical Log 0 Date - Day	30172 or 40172	Input or Holding	171	UInt16	RO
Periodical Log 0 Date - Month	30173 or 40173	Input or Holding	172	UInt16	RO
Periodical Log 0 Date - Year	30174 or 40174	Input or Holding	173	UInt16	RO
Periodical Log 0 Energy ^{1,2}	30175 or 40175	Input or Holding	174	Int32	RO
Periodical Log 0 Energy (Unit factor) ¹	30177 or 40177	Input or Holding	176	UInt16	RO
Periodical Log 0 Energy (Unit name) ²	30178 or 40178	Input or Holding	177	8 char ASCII	RO
Periodical Log 0 Energy (Unit ID) ^{2,3}	30182 or 40182	Input or Holding	181	UInt16	RO
Periodical Log 0 Energy (Float) ²	30183 or 40183	Input or Holding	182	IEEE 754	RO
Periodical Log 0 Volume ^{1,2}	30185 or 40185	Input or Holding	184	Int32	RO
Periodical Log 0 Volume (Unit factor)	30187 or 40187	Input or Holding	186	UInt16	RO
Periodical Log 0 Volume (Unit name) ²	30188 or 40188	Input or Holding	187	8 char ASCII	RO
Periodical Log 0 Volume (Unit ID) ^{2,3}	30192 or 40192	Input or Holding	191	UInt16	RO
Periodical Log 0 Volume (Float) ²	30193 or 40193	Input or Holding	192	IEEE 754	RO

¹ Value in integer format for the same group of registers (e.g. Energy) have to be multiplied by Unit factor to get the valid output value. Float value should not be multiplied by Unit factor.

² Unit of value is in appropriate Unit name/Unit ID registers.

³ Available values for Unit ID registers are listed in 6.3 *Unit ID lookup table*.

⁴ This register contains temperature with accuracy to one decimal place. To get value in degrees, content of this register must be multiplied by 0,1.

⁵ Available values are listed in 6.6 *Error codes*.

6.2.2 Configuration registers

Description	Modbus Register	Modbus Register Type	Modbus Address	Data Value Type	Default Value	Possible Values	Read only (RO) Read/Write (R/W)
Modbus Slave ID ^{1,2}	41001	Holding	1000	UInt16	0x0101	0xHHLL where HH = 0x01 or 0x00 LL = 0x01 - 0xF7	R/W
Update rate ^{3,4}	41002	Holding	1001	UInt16	150	0 - 65535	R/W
Baud rate	41003	Holding	1002	UInt32	9600	1200, 2400, 4800, 9600, 14400, 19200, 38400, 56000, 57600, 115200	R/W
Data bits	41005	Holding	1004	UInt16	8	8	R/W
Parity ⁵	41006	Holding	1005	1 char ASCII	78 ('N')	110 ('n'), 111 ('o'), 101 ('e'), 78 ('N'), 79 ('O'), 69 ('E')	R/W
Stop bits	41007	Holding	1006	UInt16	1	1, 2	R/W
Enable Periodical Log 0 data ⁶	41008	Holding	1007	UInt16	0	0, 1	R/W

¹ Lower byte of this register (LL) is Slave ID of the module in the range 1-247 (0x01-0xF7 hex).

² If the higher byte (HH) is set to 1, the Slave ID will be updated to the heat meter serial number. If the higher byte is set to 0, the Slave ID is static. For more information see *6.1.1 Automatic Slave ID*.

³ By default Update rate is 15 seconds. When Update rate is set to 0, the module does not read data from heat meter.

⁴ This register contains time value with accuracy to one decimal place. That is why Modbus Register value 150 means 15,0 seconds.

⁵ This register is set by the ASCII char value - 'E' for Even parity (69 dec, 0x45 hex), 'O' for Odd parity (79 dec, 0x4F hex) and 'N' for None parity (78 dec, 0x4E hex)

⁶ For more information see *6.5 Periodical Log 0 functionality*.

6.2.3 Information Registers

Description	Modbus Register	Modbus Register Type	Modbus Address	Data Value Type	Read only (RO) Read/write (R/W)
Module Serial Number	32001	Input	2000	UInt32	RO
Module Model Number	32003	Input	2002	UInt32	RO
Module Firmware Version ¹	32005	Input	2004	UInt16	RO

¹ Higher byte of the register is major number of firmware version (0x##00 hex). Lower byte of the register is minor number of firmware version (0x00## hex).

6.3 Unit ID lookup table

Each group of measuring data registers contain information about units. This information is stored in two registers:

- Unit name - unit in human-readable ASCII format,
- Unit ID - unit identification number.

All available Unit ID numbers with their appropriate names are collected in table below.

Unit ID	Unit name	Unit ID	Unit name	Unit ID	Unit name	Unit ID	Unit name	Unit ID	Unit name
0	None	10	cal	20	m ³	30	kGal/min	40	GBtu/h
1	mWh	11	kcal	21	mGal	31	MGal/min	41	°C
2	Wh	12	Mcal	22	Gal	32	mW	42	°F
3	kWh	13	Gcal	23	kGal	33	W		
4	MWh	14	Btu	24	MGal	34	kW		
5	GWh	15	kBtu	25	ml/h	35	MW		
6	J	16	MBtu	26	l/h	36	GW		
7	kJ	17	GBtu	27	m ³ /h	37	Btu/h		
8	MJ	18	ml	28	mGal/min	38	kBtu/h		
9	GJ	19	l	29	Gal/min	39	MBtu/h		

6.4 Calculation examples

This example presents how to read and interpret measurement data in Modbus registers of the module, based on Energy value. Energy measurements data read from the meter by the module is stored in 10 (ten) Modbus registers available from Modbus Register 30001 or 40001 (Modbus Address 0). In this example the module is installed in the meter with serial number 51241026, and Automatic Slave ID functionality is enabled, so module Slave ID is 26 (0x1A) - see 6.1.1 *Automatic Slave ID*.


For request of Modbus master to the module with Slave ID 26 as follow:

Slave ID	Function Code	Modbus Address of first register in group	Size of Modbus register group	CRC
0x1A	0x04	0x0000	0x000A	0x73E6

The module responds data as follow:

Slave ID	Function Code	Number of data bytes to follow	Raw data read form the module										CRC
0x1A	0x04	0x14	0x0000	0x3039	0x0001	0x4D4A	0x0000	0x0000	0x0000	0x0008	0x4640	0xE400	0x7246

Raw data in hexadecimal format (hex) received from the module are collected in table below.

Value on meter display	Modbus Register (Modbus Address)	Register value in hex	Modbus Register (Modbus Address) of data	Data Value Type	Data value in hex	Data value
	30001 or 40001 (0)	0x0000	Energy - 30001 or 40001 (0)	Int32	0x00003039	12345
	30002 or 40002 (1)	0x3039				
	30003 or 40003 (2)	0x0001	Energy (Unit factor) - 30003 or 40003 (2)	UInt16	0x0001	1
	30004 or 40004 (3)	0x4D4A	Energy (Unit name) - 30004 or 40004 (3)	8 char ASCII	0x4D4A000000000000	MJ
	30005 or 40005 (4)	0x0000				
	30006 or 40006 (5)	0x0000				
	30007 or 40007 (6)	0x0000				
	30008 or 40008 (7)	0x0008	Energy (Unit ID) - 30008 or 40008 (7)	UInt16	0x0008	8
	30009 or 40009 (8)	0x4640	Energy (Float) - 30009 or 40009 (8)	IEEE 754	0x4640E400	12345,000
	30010 or 40010 (9)	0xE400				

To read energy value in fixed-point data format, following calculation must be done:

*Energy Value = Energy register * Unit factor register [Unit name register]*

Energy Value = 12345 * 1 MJ = 12345 MJ = 12,345 GJ

Energy value in floating-point data format can be read directly.

Energy Float Value = 12345 MJ = 12,345 GJ

Unit name is presented in human-readable ASCII format or it can be obtained through Unit ID lookup table. In this example Unit ID register indicate value 8, that means value unit is MJ.

i

NOTE

Pay attention when using floating-point type values according to IEEE 754. Floating-point values are calculated by the module based on fixed-point values data from the meter. When using floating-point values, precision can be lost and value presented in Modbus register may not be equal to value on meter display. It is recommended to use fixed-point value (Int32 and UInt16) Modbus registers to read always proper data. The floating-point values are introduced in the module just for convenience, when additional calculations cannot be done by Modbus master application.

6.5 Periodical Log 0 functionality

Modbus RTU Communication Module has functionality to read Periodical Log 0 data from the meter and update appropriate Modbus registers with Energy, Volume and Date values (Modbus Addresses 171-192).



NOTE

Periodical Log 0 functionality is disabled in Modbus RTU Communication Module by default.

To enable this option write 1 to Modbus Register 41008 (Modbus Address 1007). This functionality allows reading only one data block (data block 0) from periodical log memory in the meter. Allowed values for Enable Periodical Log 0 register are listed in table below.

Periodical Log 0 functionality	Enable Periodical Log 0 data register value	Description
Disabled	0 (0x00 hex)	Periodical Log 0 registers contain not valid values.
Enabled	1 (0x01 hex)	Modbus registers from addresses 171 to 192 contain values read from Periodical Log 0 data block.

Please note that enabling this option may change default readout from the meter by M-Bus protocol. By default, the module reads data from the meter without defining the response (selecting Application Reset-Subcode) - default telegram is sent to the meter (if not special telegram content is agreed).

After enabling Periodical Log 0 functionality the module reads data from the meter with responses from Application Reset-Subcodes: 0x00 (All) and 0x40 (Multi tariff billing).

Disabling Periodical Log 0 functionality results in data readout with Application Reset-Subcode 0x00 (All) without returning to default telegram.

6.6 Error codes

In Modbus RTU Communication Module error codes are stored in Modbus Register 30165 or 40165 (Modbus Address 164). This register contains information about communication state between the module and the meter and presents errors read directly from the meter.

Description	Heat Meter Error	Error Code value in 30165 or 40165 Modbus Register	Priority
No error	-	0x00 00	-
No data update from heat mater	-	0x01 00	1
Basic parameter error in flash or RAM	C-1	0x00 08	2
Defective primary voltage (only if mains unit used) > Supply from backup battery	E-8	0x00 04	3
Hardware error of US measurement > Transducer defective or short-circuit	E-4	0x00 28	4
Temperature range exceeds [-9.9°C - 190°C] > Sensor short-circuit or sensor break	E-1	0x00 50	5
No meaningful ultrasonic receive signal > Air in the measuring path	E-7	0x00 70	6
Battery almost flat	E-9	0x00 84	7
Forward and return sensor reversed	E-3	0x00 B0	8
Wrong direction of flow in volume measuring component > Flow rate = 0	E-6	0x00 D0	9
Leakage detected	Leak error	0x00 F0	10
Communication not possible (to frequent data update rate from heat mater) > Set higher value in 41002 Modbus Register	E-5	0x00 10	11

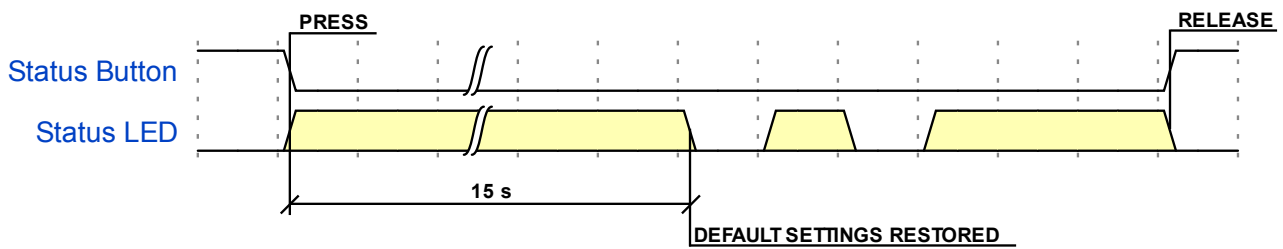


NOTE

Only one error is shown at the time by priority.

7 Restore to default settings

To restore Modbus RTU Communication Module to default settings, press Status Button for at least 15 seconds. Restore is confirmed by blinking of Status LED (see Picture 7.1). All configuration registers are restored to default value (see 6.2.2 *Configuration registers*).



Picture 7.1 - Process of restoring to default settings

Default settings restore function is useful when currently configured communication settings of the module are unknown.



NOTE

If Modbus RTU Communication Module is connected to the meter during default settings restore, its Modbus Slave ID will be automatically updated based on meter serial number (see 6.1.1 *Automatic Slave ID*).

8 Troubleshooting guide

When it seems like that Modbus RTU Communication Module doesn't operate correctly please refer to following table.

Problem symptom	Possible cause	Action to fix the problem
Device does not respond to Modbus requests	Module is not powered correctly	Check power supply connection (see 3 <i>Technical parameters</i> and 5.2.1 <i>Power supply cable</i>).
	Incorrect EIA-485 wiring	Check proper EIA-485 connection (see 5.3 <i>EIA-485 network channel wiring</i>).
	Incorrect Modbus communication parameters	Check communication parameters - Slave ID, baud rate, number of bits parity and number of stop bits. If current communication settings of the module are unknown restore the module to default settings (see 7 <i>Restore to default settings</i>).
	Incorrect Modbus addressing	Make sure that Slave ID is unique to every device on the network (see 6.1 <i>Device addressing</i>). Make sure that there is only one Modbus master on the network. If current Slave ID of the module is unknown restore the module to default settings (see 7 <i>Restore to default settings</i>).
Unable to read values from meter	Module ribbon connection with meter is broken	Check module ribbon connector (see 5.1 <i>Placing in meter</i>). If module ribbon connector is broken replace it with new one.
	Update rate register is set to 0	Check Update rate register value. If it is set to 0, change it.
	Meter display shows error code E-5.	This problem exist only when meter is powered from battery. Make sure that update rate interval is greater than 3 minutes (for more information refer to Installation and User Guide for SHARKY 775 or SCYLAR INT 8 meters).
Unable to close meter housing	Module is installed improperly	Reinstall module in meter extension slot (see 5.1 <i>Placing in meter</i>).
	Improper wires leading	Check if there is enough space inside housing to placing module and wires.
Status LED lights on constantly	Application fault	Contact supplier for more information.

9 Firmware change list

Firmware version	Description
1.0	Initial version

10 Ordering

To order Modbus RTU Communication Module please contact Diehl Metering sales representative and refer to M/N: 11024.