BENDER
The Power in Electrical Safety©

Manual

COM462RTU

BMS-Modbus/RTU gateway for the connection
of Bender devices with BMS support
using Modbus/RTU
Software version: D415 V1.0

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1. Making effective use of this document

1.1 How to use this manual

This operating manual will concern qualified experts in electrical engineering and communication technology!

To make it easier for you to understand and revisit certain sections of text and instructions in the manual, we have used symbols to identify important instructions and information. The meaning of these symbols is explained below:

Information which is designed to help you make the best use of the product is highlighted with the information symbol

Information which refers to hazards is highlighted with the warning symbol

1.2 Overview of chapters

- Making effective use of this document:
  This chapter gives you instructions on how to use this documentation
- Safety instructions
  This chapter describes the dangers during installation and when operating the device
- Product description:
  This chapter describes the scope of delivery and features of the product

- Installation, connection and commissioning:
  This chapter shows the steps to take up to commissioning
- BMS-Modbus/RTU gateway COM462RTU:
  This chapter describes the display and operating elements
- Data access using Modbus/RTU protocol:
  Describes how to send requests to the Modbus/RTU slave of the COM462RTU and how the responses are to be interpreted
- Modbus process image in the COM462RTU's memory
  In this chapter, the representation of BMS data on Modbus/RTU structures is described in detail
- Technical data:
  In addition to the technical data you will find here ordering data
- Troubleshooting:
  This chapter offers service and support in case of malfunction. In addition you will also find here information on our Technical Service department
- INDEX:
  The key word index assists you in finding the term you are searching for.

1.3 Quick reference guide

Connection of the COM462RTU

If you are familiar with the installation and connection of electrical devices, particularly with Modbus/RTU, you can start right away with the wiring diagram on page 16.
It may also be helpful to refer to the block diagrams representing an application example with an internal BMS bus on page 14.

Using the Modbus/RTU functions

Information about this field can be found as of page 25.

2. Safety instructions

2.1 Work activities on electrical installations

- Only skilled persons are permitted to carry out the work necessary to install, commission and run a device or system.
- Compliance with applicable regulations governing work on electrical installations, and with the regulations derived from and associated with them, is mandatory. EN 50110 is of particular importance in this regard.

Any work on electrical installations which is not carried out properly can lead to death and injury!

- If the device is being used in a location outside the Federal Republic of Germany, the applicable local standards and regulations must be complied with. European standard EN 50110 can be used as a guide.

2.2 Intended use

The BMS-Modbus/RTU gateway COM462RTU connects the serial Bender BMS bus to the serial Modbus/RTU. The gateway converts alarms, measured values and statuses from the BMS bus to Modbus/RTU. Control commands can be converted from Modbus/RTU to BMS bus.

This allows connection to Modbus networks. The gateway is operated on the **internal** BMS bus.

2.3 Address setting and termination

In order to ensure proper functioning of the BMS/Modbus/RTU gateway COM462RTU, correct address assignment and termination of the BMS bus and the Modbus/RTU is of utmost importance.

Assigning addresses that are already used by existing devices in the BMS or Modbus/RTU networks concerned may cause serious malfunctions.

Ensure correct address setting and termination of the COM462RTU. For details refer to “Commissioning” on page 18.

Interface on the Modbus/RTU side

The COM462RTU is always operated as slave on the Modbus/RTU side. Therefore, the COM462RTU and its Modbus/RTU has to be communicated to the Modbus/RTU master.

Interface on the BMS side

COM462RTU can be operated as master or slave.

3. Product description

3.1 Scope of delivery

You will receive:

- the COM462RTU
- an operating manual

3.2 Short description

The BMS-Modbus/RTU gateway COM462RTU contains a Modbus/RTU slave that converts BMS data for a Modbus master.
A setting menu makes it possible to configure the COM462RTU using the setting menu (see "Commissioning" on page 18.).

3.3 Properties

- Setting of address data for the BMS bus and Modbus/RTU and date and time setting using the internal operating menu.
- Time synchronisation for all BMS bus devices
- Operation on the internal BMS bus
- Modbus/RTU data access to the internal BMS bus, max. 150 BMS devices
- Commands can be sent from an external application (e.g. visualisation software) to BMS devices and measured values read.

3.4 Possible applications

- The use of professional visualisation programs by converting BMS data to Modbus/RTU protocols.
- Observing and analysing Bender products that support communication, such as RCMS, EDS and MEDICS® systems

3.5 Details about the Modbus RTU

The Modbus RTU (Remote Terminal Unit) field bus has been specified by Modicon, a company under the Schneider Automation brand and made available to the market license-free.
Modbus uses the serial hardware interface RS-485 and communicates via a two-wire, twisted copper wire. A transmission rate of 19200 baud is standard.
Key data:

- Master-slave communication
- Up to 32 bus devices per network, or up to 247 bus devices (with repeater)
- Baud rate between 1200 and 57600 bit/s
- Diagnostics mechanisms

4. Installation, connection and commissioning

If you are familiar with the configuration of Modbus/RTU networks, you can carry out the connection of the COM462RTU by yourself. ***Otherwise please contact your EDP administrator!***

4.1 Preliminary considerations

1. Have all the questions as regards the installation been answered by the technician responsible for the installation?
2. The device is operated on the internal bus. Is the BMS address to be set known?
   If, apart from the COM462RTU, an alarm indicator and test combination MK800 is connected to the internal bus, the COM462RTU **must not** have the address 1 (master).
   You will find more detailed information on the BMS topic, in particular about the wiring of bus devices, in the separate document "BMS bus". You can download the document from the download area of the website `www.bender-de.com`.
3. Is the Modbus/RTU address to be set known?

4.2 COM462RTU on the internal BMS bus

Bender systems such as EDS46x/49x, RCMS46x/49x and MEDICS communicate with each other via the Bender measuring device interface BMS.
The BMS-Modbus/RTU gateway COM462RTU provides the coupling between the BMS bus and Modbus/RTU networks. The following block diagram illustrates the operation of the gateway in an internal BMS bus.

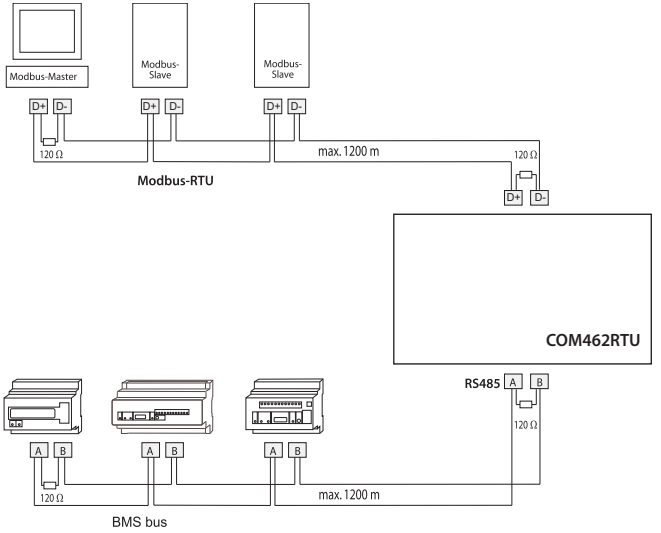


*Fig. 4.1: Block diagram of a coupling between an **internal** BMS bus and Modbus/RTU*

Internal and external BMS bus

The majority of Bender devices communicates via the internal BMS bus.

Individual devices, such as MK800, TM800 or Bender panels can communicate via both the internal BMS bus (BMS i) and the external BMS bus (BMS e).

The BMS-Modbus/RTU gateway COM462RTU can only communicate via the internal BMS bus (BMS i).

4.3 Installing the device

Possible methods of mounting:

- DIN rail mounting
- Screw mounting with 2 x M4 (dimension diagram on page 63)

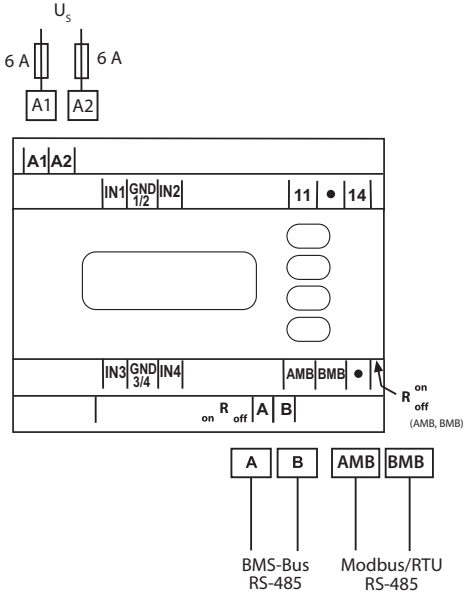
When installing the device, please take into consideration that the device is only to be used in locations that are protected from unauthorised entry! This can be installation works in a switchboard cabinet, for example.

4.4 Connecting the device

For UL application, the following is to be observed:

- Supply voltage U_s see nameplate and ordering information
- Maximum ambient temperature 55 °C
- For use in pollution degree 2 environments
- Only 60/75-°C copper wires are to be used
- Tightening torque for terminals 0.5...0.6 Nm

Connect the terminals and sockets on the COM462RTU according to the wiring diagram.



Terminal	Description
A1, A2	Connection to the supply voltage, 6 A fuse recommended, two-pole fuses should be used on IT systems. For UL and CSA applications, it is mandatory to use 5 A fuses
A, B	Connection to the BMS bus (internal) with shielded cable (e.g. J-Y(St)Y 2x0.8)
AMB, BMB	Connection Modbus/RTU with shielded cable (e.g. J-Y(St)Y2x0.8)
$R_{on/off}$ (A, B)	Switch for BMS bus termination. When the device is installed at the end of the bus, set the termination switch to "on".
$R_{on/off}$ (AMB, BMB)	Switch for Modbus/RTU termination. When the device is installed at the end of the bus, set the termination switch to "on".
IN1, GND1/2, IN2	Currently has no function (digital inputs)
11, 14	Currently has no function (alarm relay K1)
IN3, GND3/4, IN4	Currently has no function (digital inputs)

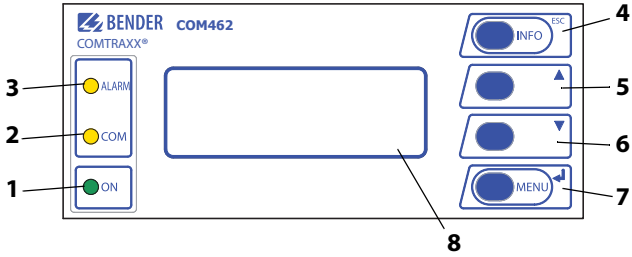
4.5 Commissioning

1. Apply the supply voltage to the COM462RTU. The green "ON" LED illuminates.
2. Set language and time.
3. Set the BMS bus. The COM462RTU is operated on the internal BMS bus.
4. Set the Modbus/RTU.

For details about the settings refer to the chapter "Menu overview of the functions adjustable at the device" on page 24.

5. BMS-Modbus/RTU gateway COM462RTU

5.1 Display and operating elements



	Key
1	"ON“ LED lights when supply voltage is applied
2	"COM“ LED lights when the gateway is responding to BMS requests
3	"ALARM" LED, lights when an internal device error occurs
4	"INFO" button, to query the COM462RTU for device-specific information ESC To exit the menu function without changing parameters
5	"▲" button: to move up in the menu, to increase the parameter value
6	"▼" button: to move down in the menu, to decrease values
7	"MENU" button for starting and exiting the menu "↵" button to confirm parameter change
8	LC display for standard and menu mode

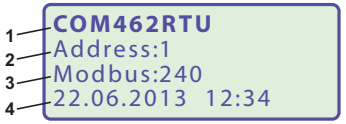
5.1.1 Automatic contrast setting for the display

The display contrast control is factory set to an optimum value. In exceptional cases, it may be necessary to adjust the contrast manually.

Simultaneously press the "ESC" and "↵" buttons. All available contrast modes are continuously indicated in an infinite loop: minimum contrast, maximum contrast, no contrast (lasting some seconds), then the same cycle starts again. If the button "▼" is additionally pressed, the contrast modes will be displayed in the opposite direction.
Release the button as soon as the desired level of contrast is reached.

5.1.2 Display in standard mode

Network-related parameters will be indicated.



	Key
1	Device type
2	BMS address of the COM462RTU
3	Modbus address of the COM462RTU
4	Current date and time

5.1.3 Display in menu mode

Use the "MENU" button to switch to the Menu mode.

A blinking cursor supports menu navigation.

- You can access the individual menus by means of the "▲" or "▼" button.
- Press the "↵" button to confirm the selection of a menu or any setting you changed.
- To leave the respective menu level or discard a setting which is not confirmed yet, press the "ESC" button.

Menu mode is exited if no button is pressed for longer than five minutes.

Menu item	Function	Page
Exit	Exit menu mode	
1. Settings	Make the necessary settings for this device	22
2. Info	Display information on device type and firmware versions. The same information as indicated in the standard mode when pressing the "INFO" button.	24

5.2 Factory setting

All factory settings you will find in the table on page 22.

5.3 Menu 1: Settings on the device

The menu is divided into three levels. All menus listed in the table can be called via the main menu "1. Settings" in the uppermost menu level. All control buttons are explained on page 19.

5.3.1 Operating example: Setting the BMS address

The example shows the operating principle. All settings are carried out in the same way.

1. Press the "MENU" button on the COM462RTU
2. Select "1. Settings" > "1. Interface" > "1. Address". The factory-set BMS address will be displayed and can be changed now.
3. Modify the addresses using the buttons "▲" or "▼".
4. Confirm the modified BMS address with "Enter".

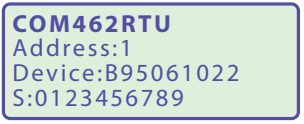
Menu level 2	Menu level 3	Factory setting	Description
1. Interface	1. Address	2	Set the BMS address of COM462RTU: 1…99 (internal BMS bus)
	2. Interval	2 s	Set the cycle time 1…3 s for the sequence: - Querying alarms in the BMS bus - Querying new bus devices - Offering the BMS master function
	3. Failure monitoring	5	Number of BMS bus cycles until a BMS device failure is signalled. The setting is only effective when the COM462RTU has the master function on the BMS bus (address 1). Adjustable cycles: 1...10
2. Modbus	1. Address	2	Set the Modbus/RTU address for COM462RTU: 2…247

Menu level 2	Menu level 3	Factory setting	Description
	2. Baud rate	19200	Set the baud rate
	3. Parity	even	Set the parity
	4. Control	off	Switch on or switch off the control commands via Modbus
3. Language	1. English	Deutsch	Selection of the operating language
	2. Deutsch		
	3. Français		
4. Clock	1. Format	d.m.y	Date format: m-d-y / d.m.y
	2. Date	01.01.2010	Date
	3. Time	00:00	Time
	4. CEST	off	Select Central European Summer Time: off = Function switched off DST = Automatic switchover, USA, CDN CEST = Automat. switchover, Central Europe on = set time zone + 1 h
5. Password	1. Password	000	Enter/change password: 0…999
	2. Status	off	Enable/disable password protection for parameter setting via the buttons of the COM462RTU
6. Service	For authorised Bender Service personnel only.		

5.3.2 Menu 2: Display INFO list

Open the "INFO" menu:

- In the standard mode: press the "INFO" button or
- In the menu mode: select function "2. Info".



This menu displays information about the device and the software. Navigate in the list using the "▼" resp. the "▲" button.

1. Name of the device
2. BMS address
3. Order number
4. Serial number
5. Software version
6. Manufacturer's address

Please have this information to hand if you need to contact us for assistance by telephone.

6. Data access using Modbus/RTU protocol

Request to the COM462RTU are sent using the function code 0x03 (read several registers). The COM462RTU generates a function-related response and returns it.

6.1 Exception code

If a request cannot be answered for whatever reason, the COM462RTU sends a so-called exception code with which possible faults can be narrowed down.

Exception code	Description
0x01	Impermissible function
0x02	Impermissible data access
0x03	Unacceptable data value
0x04	Slave device error
0x05	Acknowledgement of receipt (answer will be time-delayed)
0x06	Request not accepted (repeat request, if necessary)
0x08	Memory: Parity Error
0x0A	Gateway path not available
0x0B	Gateway error

6.2 Modbus requests

The required words of the process image can be read from the input registers in the COM462RTU using the function code 0x03. For this purpose, the start address and the number of the registers to be read out have to be entered.
Example:
The Words 0 and 1 are to be read out from the input registers 0x100 and 0x101.

Byte	Name	Example
Byte 0	Address	0x02
Byte 1	Function	0x03
Byte 2, 3	Start address	0x01 00
Byte 4, 5	Number of registers	0x00 02
Byte 6, 7	CRC16	0x12 34

6.3 Modbus responses

The responses consist of 2 bytes per register.

Byte	Name	Example
Byte 0	Address	0x02
Byte 1	Function	0x03
Byte 2	Number of data bytes	0x04
Byte 3…6	Information	0xAB CD 01 23
Byte 7, 8	CRC16	0x12 34

6.4 Structure of the exception code

Byte	Name	Example
Byte 0	Address	0x02
Byte 1	Code + 0x80	0x83
Byte 2	Data	0x04
Byte 3, 4	CRC16	0x12 34

6.5 Modbus address structure for BMS devices

Function	Address range	Number of bytes	Number of Words
Device type	0x00…0x09	20 bytes	10 Words
Timestamp	0x0A…0x0D	8 bytes	4 Words
Common alarm	0x0E (High byte)	1 byte	0.5 Words
No BMS bus connection	0x0E (Low byte)	1 byte	0.5 Words
Unused	0x0F	2 bytes	1 Word
Channel 1…32	0x10…0x8F	32 x 8 bytes	128 Words
Alarm and test Channel 33…64	0x90…0xFC	218 x 8 bytes	109 Words

7. Modbus process image in the memory of the COM462RTU

The device holds a process image in the memory. It represents the current statuses and values of up to 150 BMS devices for each monitored internal BMS bus.

7.1 Requesting data

7.1.1 Modbus function code

The memory in the COM462RTU can be read using the Modbus function 0x03 (read several registers). The size of the data volume to be queried depends on the number of bytes selected in the Modbus client being used. Up to 125 Words (0x7D) can be read by one single request.
An individual addressable byte, such as the set bit of a stored common alarm, can also be read out.

7.1.2 How are memory areas organised?

Memory utilisation	Start address	End of the memory area	Size of the memory area
Reference values for testing purposes	0x0000	0x00FF	0x0100
Process image	0x0100	0x95FF	0x9500
Unused	0x96FF	0xFFFF	0x6900

In some Modbus clients, an offset of 1 must be added to the register addresses. Example: Process image start address = 0x0101.

The assignment of the memory addresses and the associated memory content is described below.

7.2 Memory scheme of the process image

7.2.1 BMS device address assignment on the Modbus

As illustrated in the table, the Modbus start address for the respective process image is derived from the BMS device address. 256 (0x100) Words or 512 bytes are reserved for each BMS device. They contain all the information requested and transmitted from the bus.

BMS device address	Modbus address ranges of the process images in the memory			
	Word			
	HiByte	LoByte		
		00	…	FF
1	0x**01**	Device 1		
2	0x**02**	Device 2		
3	0x**03**	Device 3		
…	…	…		
32	0x**20**	Device 32		
…	…	…		
150	0x**96**	Device 150		

Tab. 7.1: Modbus start address for each BMS device for which a request is to be sent.

7.2.2 Memory scheme of an individual BMS device

BMS devices feature various types of analogue and/or digital channels. Please take into consideration that there are device-specific differences:

- BMS devices usually feature 12 channels
- MK800/TM800 supports up to 64 digital channels in the master mode
- The channels 33 to 64 transmit digital messages only

Use the tables on page 30 and page 33 to determine the start address to request the following device parameters:

- Device type
- Timestamp
- Common alarm
- Device error
- BMS channel

Example:
In our example, channel 2 of the device with BMS address 3 is queried. How is the start address determined for querying the channel? In our example, the relevant cells in the table are marked bold.

1. The first part of the address 0x03 (High-Byte) is applied from table 7.1 for BMS device address 3.
2. The second part of the address 0x14 (Low-Byte) is applied from table 7.2 for channel 2. Apply number 4 from the same table for the number of words to be queried: (0x14 to 0x17 = 0x04).
3. The start address 0x0314 is made up of the High and Low-Byte.

Memory image of a BMS device

LoByte	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0x00	---------- Device type ----------										---- Time stamp ----				C	D	R.
0x10	Channel 1				Channel 2				Channel 3				Channel 4			
0x20	Channel 5				Channel 6				Channel 7				Channel 8			
0x30	Channel 9				Channel 10				Channel 11				Channel 12			
0x40	Channel 13				Channel 14				Channel 15				Channel 16			
0x50	Channel 17				Channel 18				Channel 19				Channel 20			
0x60	Channel 21				Channel 22				Channel 23				Channel 24			
0x70	Channel 25				Channel 26				Channel 27				Channel 28			
0x80	Channel 29				Channel 30				Channel 31				Channel 32			
0x90	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64
0xA0	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.
0xB0	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.
0xC0	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.

0x**D0**	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.
0x**E0**	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.
0x**F0**	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.

Tab. 7.2: Modbus address assignment of the channels in a BMS device; Hex representation: horizontal = units, vertical = sixteens

Abbreviations for memory contents:
C = Common alarm
D = Device lost (device failure)
R. = Reserved

A detailed description of the data formats for the device type, timestamp etc. is given below.

7.2.3 Device type

Word 0x00	0x01	0x02	0x03	0x04	0x05	0x06	0x07	0x08	0x09
ASCII text, 10 Words/20 bytes									

The device type is set by a BMS bus scan.

7.2.4 Timestamp

Word 0x0A		0x0B		0x0C		0x0D	
HiByte	LoByte	HiByte	LoByte	HiByte	LoByte	HiByte	LoByte
Year YY		Month MM	Day DD	Hour hh	Minute MM	Second ss	Reserve d

The timestamp is set according to a datagram received from a transmitting device.

7.2.5 C = Common alarm und D = Device lost (device failure)

Word 0x0E	
HiByte	LoByte
C	D
Common alarm, 1byte: LSB = 0 or 1	Device error, 1 byte: LSB = 0 or 1

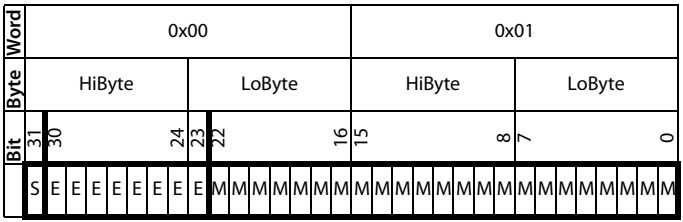
The common alarm bit is set as soon as an alarm status from the respective BMS device is detected.
The device error bit is set when communication with the respective BMS device is no longer possible.

7.2.6 Channels 1 to 32 with analogue and/or digital values

Word 0x00		0x01		0x02		0x03	
HiByte	LoByte	HiByte	LoByte	HiByte	LoByte	HiByte	LoByte
Floating point value (Float)				AT&T	R&U	Channel description	

Every analogue BMS device channel can contain alarm messages, operating messages, measured values, test messages and descriptive text. Both analogue and digital information can be transmitted.
AT&T = Alarm type and test type (internal/external)
R&U = Range and unit
For details on the channel description refer to chapter 7.4.

7.2.6.1 Float = Floating point value of the BMS channels



Representation of the bit order for processing analogue measured values according to IEEE 754
S = Sign
E = Exponent
M = Mantissa

7.2.6.2 A&T = Alarm type and test type (internal/external)

Bit	7	6	5	4	3	2	1	0	Meaning
	Test external	Test internal	Status	Reserved	Reserved	Alarm	Error		
Alarm type	x	x	x	x	x	0	0	0	No alarm
	x	x	x	x	x	0	0	1	Prewarning
	0	0	x	x	x	0	1	0	Device error
	x	x	x	x	x	0	1	1	Reserved
	x	x	x	x	x	1	0	0	Alarm (yellow LED), e.g. insulation fault
	x	x	x	x	x	1	0	1	Alarm (red LED)
	x	x	x	x	x	1	1	0	Reserved
	x	x	x	x	x	…	…	…	Reserved
	x	x	x	x	x	1	1	1	Reserved
Test	0	0	x	x	x	x	x	x	No test
	0	1	x	x	x	x	x	x	Internal test
	1	0	x	x	x	x	x	x	External test

The alarm type is coded by the bits 0 to 2. The bits 3 and 4 are reserved and always have the value 0. Bit 5 usually has the value 0 and represents the digital value of the status (this column is relevant for the SMI472 only).
Bit 6 or 7 are usually set when an internal or external test has been completed. Other values are reserved. The complete byte is calculated from the sum of the alarm type and the test type.

7.2.6.3 R&U = Range and unit

Bit	7	6	5	4	3	2	1	0	Meaning
Unit	x	x	x	0	0	0	0	0	Invalid (init)
	x	x	x	0	0	0	0	1	No unit
	x	x	x	0	0	0	1	0	Ω
	x	x	x	0	0	0	1	1	A
	x	x	x	0	0	1	0	0	V
	x	x	x	0	0	1	0	1	%
	x	x	x	0	0	1	1	0	Hz
	x	x	x	0	0	1	1	1	Baud
	x	x	x	0	1	0	0	0	F
	x	x	x	0	1	0	0	1	H
	x	x	x	0	1	0	1	0	°C
	x	x	x	0	1	0	1	1	°F
	x	x	x	0	1	1	0	0	Second
	x	x	x	0	1	1	0	1	Minute
	x	x	x	0	1	1	1	0	Hour
	x	x	x	0	1	1	1	1	Day
	x	x	x	1	0	0	0	0	Month
	x	x	x	…	…	…	…	…	Reserved
	x	x	x	1	1	1	1	0	CODE
	x	x	x	1	1	1	1	1	Reserved
	x	x	x	…	…	…	…	…	Reserved
	x	x	x	1	1	1	1	1	Reserved

Bit	7	6	5	4	3	2	1	0	Meaning
Range of validity	0	0	x	x	x	x	x	x	True value
	0	1	x	x	x	x	x	x	True value is smaller
	1	0	x	x	x	x	x	x	True value is larger
	1	1	x	x	x	x	x	x	Invalid value

The unit is coded in the bits 0 to 4.
The bits 6 and 7 describe the range of validity of a value. Bit 5 is reserved.
The whole byte is calculated from the sum of the unit and the range of validity.

Note!
If the unit byte refers to CODE, the recorded value or status will result in a text message. The content of this text message is described in the table on page 39 or page 45. The floating point value contains an internal CODE but no valid measured value.

7.2.6.4 Channel description

Word	0x03																dezi-mal	Bedeutung
Byte	HiByte											LoByte						
Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0		
Alarme und Warnungen	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Reserviert
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	Isolationsfehler
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	2	Überlast
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	3	Übertemperatur
	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	4	Ausfall Leitung 1
	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	5	Ausfall Leitung 2
	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	6	Isolation OP-Lampe
	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	7	Reserviert
	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	8	Ausfall Verteiler
	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	9	Sauerstoff
	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	10	Vakuum
	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	11	Narkosegas
	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	12	Druckluft 5 Bar
	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...

A code with the associated descriptive text is available for each channel. The table above only shows an extract from the texts. For a complete list of the available codes or texts refer to page 45.

7.2.6.5 Channel 33 to 64

Bit	7	6	5	4	3	2	1	0	Meaning
	Test external	Test internal	Status	Reserved	Reserved	Alarm	Error		
Alarm type	x	x	x	x	x	0	0	0	No alarm
	x	x	x	x	x	0	0	1	Prewarning
	0	0	0	x	x	0	1	0	Device error
	x	x	x	x	x	0	1	1	Reserved
	x	x	x	x	x	1	0	0	Alarm (yellow LED), e.g. insulation fault
	x	x	x	x	x	1	0	1	Alarm (red LED)
	x	x	x	x	x	1	1	0	Reserved
	x	x	x	x	x	…	…	…	Reserved
	x	x	x	x	x	1	1	1	Reserved
Test	0	0	x	x	x	x	x	x	No test
	0	1	x	x	x	x	x	x	Internal test
	1	0	x	x	x	x	x	x	External test

The BMS channels 33 to 64 only provide digital information. The information is coded as alarm or message type or test type (internal, external).
The coding is similar to the data format AT&T for the channels 1 to 32, with the exception of the additional bit 4, which is used for coding device errors, e.g. connection faults or internal device errors.

7.3 Reference data records of the process image

To make it easier to check the configuration and the Modbus/RTU data access to BMS devices, COM462RTU provides a reference data record at the **virtual** BMS address 0.

A real BMS device cannot have BMS address 0!
Address 0 only serves to simulate data access.

Special features of the Modbus communication are the byte offset and the word and byte order in the memory (Big Endian). At the end of this chapter, a few examples of correct configuration are given, which might be helpful.

7.3.1 Address assignment of the reference data record

As shown in the following table, the Modbus start address for access to the reference data record is derived from BMS device address 0.

	Modbus addresses for the reference data record				
Virtual BMS device address	**Word**	LoByte			
		00	**0E**	**10**	**14**
0	HiByte 0x**00**	Device type	Common alarm	Channel 1	Channel 2

Tab. 7.3: The start addresses for the reference data record request

The start addresses provide the following reference values:

- 0x0000: TEST (device type)
- 0x000E: 1 (common alarm, LSB of the high byte is set)
- 0x0010: 230 V undervoltage (reference value on channel 1)
- 0x0014: 12.34 A overcurrent (reference value on channel 2)

7.3.2 Reference value on channel 1

The following reference value is stored in this channel: 230.0 V undervoltage

Word 0x10		0x11		0x12		0x13	
HiByte	LoByte	HiByte	LoByte	HiByte	LoByte	HiByte	LoByte
0x43	0x66	0x00	0x00	0x00	0x04	0x00	0x4D
Floating point value (Float)				AT&T	R&U	Description	
230,0				No/No	Volt	Undervoltage	

Tab. 7.4: Reference data stored in channel 1

7.3.3 Reference value on channel 2

The following reference value is stored in this channel: 12.34 A

Word 0x14		0x15		0x16		0x17	
HiByte	LoByte	HiByte	LoByte	HiByte	LoByte	HiByte	LoByte
0x41	0x45	0x70	0xA4	0x00	0x03	0x00	0x4A
Floating point value (Float)				AT&T	R&U	Description	
12,34				No/No	Ampere	Overcurrent	

Tab. 7.5: Reference data stored in channel 2

7.3.4 Explanation of how to access floating point values

The test value 12.34 can be read out via Modbus/RTU using Modbus function 0x03 at the address 0x0014. The test value has a size of 2 words.

Proceed as follows:

1. Determine the correct byte offset
   Interpreting both words as unsigned integer values should result in the following values:
   Word 1 with address 0x14: unsigned integer value => 16709 (0x4145)
   Word 2 with address 0x15: unsigned integer value => 28836 (0x70A4)
2. Determine the correct byte resp. word swap
   There are four different combinations of swapping. The only correct value is 12.34.
   All swapping combinations are represented in the following table.

Hex value sequence	Word 1		Word 2		Floating point value
	Byte 1	Byte 2	Byte 3	Byte 4	
CORRECT	**A 41**	**B 45**	**C 70**	**D A4**	**12,34**
Word swapping	C 70	D A4	A 41	B 45	4.066E+29
Byte swapping	B 45	A 41	D A4	C 70	3098,27
Word and byte swapping	D A4	C 70	B 45	A 41	-5.21E-17

7.4 Channel descriptions for the process image

Value	Measured value description alarm message/ operating message	Note
0		
1 (0x01)	Insulation fault	
2 (0x02)	Overload	
3 (0x03)	Overtemperature	
4 (0x04)	Failure line 1	
5 (0x05)	Failure Line 2	
6 (0x06)	Ins.fault OPlight	Insulation fault operating theatre light
7 (0x07)		
8 (0x08)	Failure distribution board	
9 (0x09)	Failure oxygen	
10 (0x0A)	Failure vacuum	
11 (0x0B)	Anaesthetic gas	
12 (0x0C)	Compressed air 5 bar	

Value	Measured value description alarm message/ operating message	Note
13 (0x0D)	Compressed air 10 bar	
14 (0x0E)	Failure nitrogen	
15 (0x0F)	Failure CO2	
16 (0x10)	Insulation UPS	Insulation fault UPS
17 (0x11)	Overload UPS	
18 (0x12)	Converter UPS	
19 (0x13)	UPS fault	
20 (0x14)	UPS emergency operation	
21 (0x15)	UPS test run	
22 (0x16)	Failure air conditioning	
23 (0x17)	Batt.op. OP-L	Battery operated operating theatre light
24 (0x18)	Batt.op. OP-S	Battery operated Sat OP light
25 (0x19)	Fail.norm.supply	Failure normal power supply

Value	Measured value description alarm message/ operating message	Note
26 (0x1A)	Fail.safet.supply	Failure safety power supply
27 (0x1B)	Failure UPS	Failure additional power supply
28 (0x1C)	Ins.safety supply	
29 (0x1D)	Fail.N conductor	
30 (0x1E)	Short distr.panel	Short-circuit distribution board
31 (0x1F)		
32 (0x20)		
33 (0x21)		
34 (0x22)		
35 (0x23)	Standby function	Measuring function switched off (standby)
36 (0x24)		
37 (0x25)		
38 (0x26)	Batt.op. UPS	Battery operation, special safety power supply

Value	Measured value description alarm message/ operating message	Note
39 (0x27)	Phase sequ. left	
40 (0x28)	Failure UPS	Failure battery supported safety power supply
41 (0x29)		
66 (0x42)		
67 (0x43)	Function test by:	Date
68 (0x44)	Service by:	Date
69 (0x45)	Ins.fault locat	Insulation fault location
70 (0x46)	Peak	Fault EDS system
71 (0x47)	Insulation fault	Insulation resistance in Ω
72 (0x48)	Current	Measured value in A
73 (0x49)	Undercurrent	
74 (0x4A)	Overcurrent	
75 (0x4B)	Residual current	Measured value in A

Value	Measured value description alarm message/ operating message	Note
76 (0x4C)	Voltage	Measured value in V
77 (0x4D)	Undervoltage	
78 (0x4E)	Overvoltage	
79 (0x4F)	Frequency	Measured value in Hz
80 (0x50)		
81 (0x51)	Asymmetry	
82 (0x52)	Capacitance	Measured value in F
83 (0x53)	Temperature	Measured value in °C
84 (0x54)	Overload	Measured value in %
85 (0x55)	Digital input	State 0 or 1
86 (0x56)	Insulation fault	Impedance
87 (0x57)	Insulation fault	Alarm from an insulation fault locator
88 (0x58)	Load	Measured value in %
89 (0x59)	Total Hazard Current	THC
90 (0x5A)	Inductance	Measured value in H

Value	Measured value description alarm message/ operating message	Note
97 (0x61)	Service code	Information about service intervals
101 (0x65)	Mains power connection	
102 (0x66)	Earth connection	
103 (0x67)	Short CT	CT short-circuit
104 (0x68)	No CT connected	
105 (0x69)	Short temp.sensor	Short-circuit temperature sensor
106 (0x6A)	Temp.sensor open.	Connection temperature sensor
107 (0x6B)	K1	Fault contactor K1
108 (0x6C)	K2	Fault contactor K2

Value	Measured value description alarm message/ operating message	Note
109 (0x6D)		
110 (0x6E)		
111 (0x6F)	No address	Failure BMS device
112 (0x70)		
113 (0x71)	Failure K1/Q1	Failure contactor K1/Q1
114 (0x72)	Failure K2/Q2	Failure contactor K2/Q2
115 (0x73)	Device error	Fault ISOMETER
116 (0x74)	Manual mode	K1/2 manual mode
117 (0x75)	Open circuit K1on	Line to K1 on interrupted
118 (0x76)	Open circ. K1off	Line to K1 off interrupted
119 (0x77)	Open circuit K2 on	Line to K2 on interrupted
120 (0x78)	Open circ. K2 off	Line to K2 off interrupted
121 (0x79)	K/Q1on	Fault
122 (0x7A)	K/Q1off	Fault
123 (0x7B)	K/Q2on	Fault
124 (0x7C)	K/Q2off	Fault

Value	Measured value description alarm message/ operating message	Note
125 (0x7D)	Failure K3	
126 (0x7E)	Q1	Fault
127 (0x7F)	Q2	Fault
128 (0x80)	No Master	
129 (0x81)	Device error	
130 (0x82)		
131 (0x83)	Fault RS-485	
132 (0x84)		
133 (0x85)		
134 (0x86)		
135 (0x87)		
136 (0x88)		
137 (0x89)	Short-circuit Q1	
138 (0x8A)	Short-circuit Q2	
139 (0x8B)	CV460	CV460 fault
140 (0x8C)	RK4xx	Fault RK4xx

Value	Measured value description alarm message/ operating message	Note
141 (0x8D)	Address collision	BMS address has been assigned several times
142 (0x8E)	Invalid address	
143 (0x8F)	Several masters	
144 (0x90)	No menu access	
145 (0x91)	Own address	
201 (0xC9)	Line 1 normal op	
202 (0xCA)	Line 2 normal op	
203 (0xCB)	Switch. el. 1 on	
204 (0xCC)	Switch. el. 2 on	
205 (0xCD)		
206 (0xCE)	Auto mode	
207 (0xCF)	Manual mode	
208 (0xD0)		

Value	Measured value description alarm message/ operating message	Note
209 (0xD1)		
210 (0xD2)	Line AV on	
211 (0xD3)	Line SV on	
212 (0xD4)	Line UPS on	
213 (0xD5)	Channel disabled	
214 (0xD6)	SwitchBackLock	Switching back interlocking function active
215 (0xD7)	Phase sequ. right	
216 (0xD8)	Switch. el. pos.0	
217 (0xD9)	Line BSV on	
218 (0xDA)	on	SMO48x: Alarm, relay

To convert the data of parameters, you will need data type descriptions. Text representation is not necessary in this case.

Value	Description of parameters
1023 (0x3FF)	Parameter/measured value invalid. The menu item of this parameter is not displayed.
1022 (0x3FE)	No measured value/no message
1021 (0x3FD)	Measured value/parameter inactive
1020 (0x3FC)	Measured value/parameter only temporarily inactive (e.g. during the transfer of a new parameter). Display in the menu "...".
1019 (0x3FB)	Parameter/measured value (unit not displayed)
1018 (0x3FA)	Parameter (Code selection menu) units not indicated
1017 (0x3F9)	String max. 18 characters (e.g. device type, -variant, …)
1016 (0x3F8)	
1015 (0x3F7)	Time
1014 (0x3F6)	Date day
1013 (0x3F5)	Date month
1012 (0x3F4)	Date year
1011 (0x3F3)	Register address (unit not displayed)
1010 (0x3F2)	Time

Value	Description of parameters
1009 (0x3F1)	Factor multiplication [*]
1008 (0x3F0)	Factor division [/]
1007 (0x3EF)	Baud rate

7.5 Modbus control commands

Commands can be sent to BMS devices by an external application (e.g. visualisation software).
Control via Modbus can be enabled or disabled in the browser menu" 1. Settings" > "2. Modbus" > "4. Control".

Command structure (example)

Request:

Byte	Name	Example
Byte 0	Address	0x02
Byte 1	Function	0x10
Byte 2, 3	Start address	0x01 10
Byte 4, 5	Number of registers	0x00 02
Byte 6	Number of bytes	0x04
Byte 7...10	Information	0x00 0A 01 02
Byte 11,12	CRC16	0x12 34

Answer:

Byte	Name	Example
Byte 0	Address	0x02
Byte 1	Function	0x10
Byte 2, 3	Start address	0x01 10
Byte 4, 5	Number of registers	0x00 02
Byte 6, 7	CRC16	0x12 34

Writing to register:

- Use the address of COM462RTU
- Use function code 0x10 (write several registers)
- Enter the start address in the register
- Enter the number of registers to which data is to be written

Read register:

- To read, use function code 0x03 (read several registers).

Possible response in the register "Status"

0	Busy	Command is being processed.
1	Error	An error has occurred.
2	Ready	Command has been processed successfully.

Control commands for the internal BMS bus

Register Ext	Register Int	Register Channel	Register Command	Function
1	1-150	0	1	Test Isometer
1	1-150	0	2	Test changeover device PRC
1	1-150	0	3	Start automatic test changeover 1->2. end after time T(test)
1	1-150	0	4	Start test generator without changeover
1	1-150	0	5	Switchover to line 1
1	1-150	0	6	Switchover to line 2
1	0	0	7	RESET alarm (broadcast)
1	0	0	8	RESET alarm EDS (broadcast)
1	1-150	0	9	Buzzer off [for alarm address] (BC)
1	1-150	1-12	10	Switch on relay/ switch
1	1-150	1-12	11	Switch off relay/ switch

8. Technical data

( )* = factory setting

8.1 Tabular data

Insulation coordination acc. to IEC 60664-1

Rated insulation voltage ..... AC 250 V
Rated impulse withstand voltage/pollution degree 4 kV/3

Supply voltage

Supply voltage U_S ..... see ordering information
Frequency range U_S ..... see ordering information
Power consumption ..... see ordering information

LED indicators

ALARM ..... internal device error
COM ..... data traffic BMS bus
ON ..... operation indicator

Interfaces

BMS bus internal:
Interface/protocol ..... RS-485/BMS bus internal
Operating mode ..... master/slave (slave)*
Baud rate BMS internal ..... 9.6 kbit/s
Cable length ..... ≤ 1200 m
Cable, twisted in pairs, shielded, shield connected to PE on one side ..... J-Y(St)Y2x0.8
Connection, BMS internal ..... terminals A, B
Terminating resistor ..... 120 Ω (0.25 W)
Device address, BMS bus internal ..... 1...99 (2)*
Modbus/RTU:
Interface/protocol RS-485/Modbus/RTU
Operating mode ..... slave
Baud rate Modbus/RTU ..... 9.6...57.6 kbit/s
Cable length ..... ≤ 1200 m

Cable, twisted in pairs, shielded, shield connected to PE on one side	J-Y(St)2x0.8
Connection, Modbus/RTU	terminals D+, D-
Terminating resistor	120 Ω (0.25 W)
Device address, Modbus/RTU	2 . . . 247 (2)*

General data

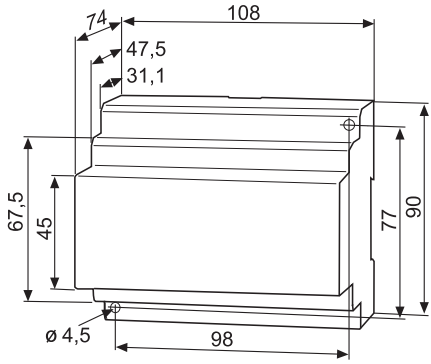
EMC	EN 61326-1
Classification of climatic conditions acc. to IEC 60721:	
Stationary use	3K5
Transport	2K3
Long-term storage	1K4
Operating temperature	-10 . . . +55 °C
Classification of mechanical conditions acc. to IEC 60721:	
Stationary use	3M4
Transport	2M2
Long-term storage	1M3
Operating mode	continuous operation
Mounting	display oriented

Connection

Connection type	screw-type terminals
Connection properties:	
Rigid/flexible	0.2 . . . 4/0.2 . . . 2.5 mm^2 (AWG 24 . . . 12)
Multi-conductor connection (2 conductors with the same cross section):	
Rigid/flexible	0.2 . . . 1.5/0.2 . . . 1.5 mm^2
Stripped length	8 . . . 9 mm
Tightening torque	0.5 . . . 0.6 Nm
Degree of protection, internal components (IEC 60529)	IP30
Degree of protection, terminals (IEC 60529)	IP20
Type of enclosure	X460
Screw mounting	2 x M4
DIN rail mounting acc. to	IEC 60715
Flammability class	UL94V-0
Software version	D415 V1.0x
Weight	≤ 310 g

( )* = factory setting

8.2 Dimension diagram



8.3 Standards, approvals, certifications

For information about UL applications refer to page 16.

Other interface protocols
Connection to SCADA systems (Supervisory Control and Data Acquisition) and/or PLCs via OPC, BACnet or other protocols on request.

8.4 Ordering information

Type	Supply voltage/ frequency range U_S	Power consumption		Art. No.
COM462RTU BMS-Modbus/ RTU gateway	AC/DC 76…276 V */ AC 42…460 Hz/DC For UL application: U_S AC = 76…250 V, 10…35 mA, 42…460 Hz U_S DC = 76…250 V, 6…21 mA	3.5…40 VA, 2.4 W	**UL:** Approval available **Lloyds**: Approval pending	B 9506 1022

*Absolute values

9. Troubleshooting

9.1 Damage in transit

If you find transport damage on the receipt of delivery, have the damage confirmed by the delivery agent on handover. In case of doubt, please contact:
Bender GmbH & Co.KG
Londorfer Straße 65
35305 Gruenberg, Germany
06401 807-0

9.2 Malfunctions

If the COM462RTU causes malfunctions in the connected networks, please refer to this operating manual.

9.2.1 What should be checked?

Check whether..

- The device is supplied with the correct supply voltage
- The BMS bus cable is correctly connected and terminated (120 Ω)
- The Modbus/RTU cable is correctly connected and terminated (120 Ω)
- The BMS address is correctly set
- The Modbus/RTU address is correctly set and communicated to the master

9.2.2 Where do you get help?

If, despite thorough study of the technical manual and intensive trouble-shooting in your installation, you cannot rectify the fault related to the BMS-Modbus/RTU gateway COM462RTU, please contact our Service department:

Tel.: **+49 6401 807-760 or 0700BENDERHELP**
Fax: **+49 6401 807-259**
E-mail: **info@bender-service.com**

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