MANUAL

MRP31.0 Modbus RTU communication module

Universal Motor Controller UMC100.3

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Important notice

Description
The MRP31.0 device allows the connection of the Universal Motor Controller UMC100.3 to a Modbus RTU network.

Target group
This manual is intended for the use of specialists in electrical installation and control and automation engineering, who are familiar with the applicable national standards.

Safety requirements
The responsible staff must ensure that the application or use of the products described satisfy all the requirements for safety, including all the relevant laws, regulations, guidelines and standards.

Using this manual

Symbols
This manual contains symbols to point the reader to important information, potential risks and precautionary information. The following symbols are used:

⚠	Sign to indicate a potentially dangerous situation that can cause damage to the connected devices or the environment.
!	Sign to indicate important information and conditions.
⊗	Sign to indicate a potentially dangerous situation that can cause human injuries.

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Terms and abbreviations

SMK3.0	Single mounting kit for fieldbus interfaces, EtherNet/IP interface EIU32.0 and the PROFIBUS termination unit PDR31.0
UMC100.3	Universal Motor Controller
RTU	MODBUS "Remote Terminal Unit" transmission mode
LED	(Light Emitting Diodes)
MTQ22-FBP.0	Modbus TCP communication interface

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Related documents

Technical documentation	Document no.
UMC100.3 manual	2CDC135032D0204
MRP21-FBP.xxx Manual (Predecessor of the MRP31.0)	2CDC194001D0203

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Document history

09.2014	1.0	Initial release
09.2017	1.1	Revision A
09.2019		New template

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Table of contents

Overview

This chapter contains a short description of the RS-485 standard and the MRP31.0 Modbus Interface module.

RS485 Standard

RS-485 is a serial interface standard for communication over a twisted-pair cable. Because the RS-485 signal transmission is differential, it provides better protection against noise and longer transmission distances than the RS-232. RS-485 is a half-duplex multi-drop network, which means that multiple devices may reside on line. Only one transmitter may be active at any given time. The RS-485 standard specifies only the electrical characteristics of the bus system.
The RS-485 transmission line consists of two wires, A and B. The signal transmission is based on the voltage difference between the wires. The potential difference between the two wires determines the logic state bit: when B is at higher voltage than A, the state is defined as bit 1 (data high) and when A is at higher voltage than B, the state is defined as bit 0 (data low).
Ground wire and cable shield should be connected to prevent common mode voltage between the network devices from drifting outside the allowable limits. RS-485 bus cable should be terminated with a 120 Ohm resistor on both ends to prevent signal reflection.

The MRP31.0 Modbus Interface

The MRP31.0 Modbus communication interface is an optional device for the UMC100.3 which enables the connection of the UMC100.3 to a RS-485 network. The MRP31.0 provides galvanic isolation between the UMC100.3 and the RS-485 network.
• Use operator panel UMC100-PAN on UMC100.3 to set bus address, baud rate and timeout of the Modbus communication. Parity and frame length are automatically detected
• MRP31.0 supports the RTU transmission mode only
• MRP31.0 is considered as a slave on the Modbus RTU network. Only one master can communicate with the MRP31.0 at a time.

Through the interface you can:
• Give control commands to the UMC100.3 (for example Start, Stop, Fault Reset)
• Read status information and actual process values from the UMC100.3
• Read device diagnosis information

Top View   **Side View**

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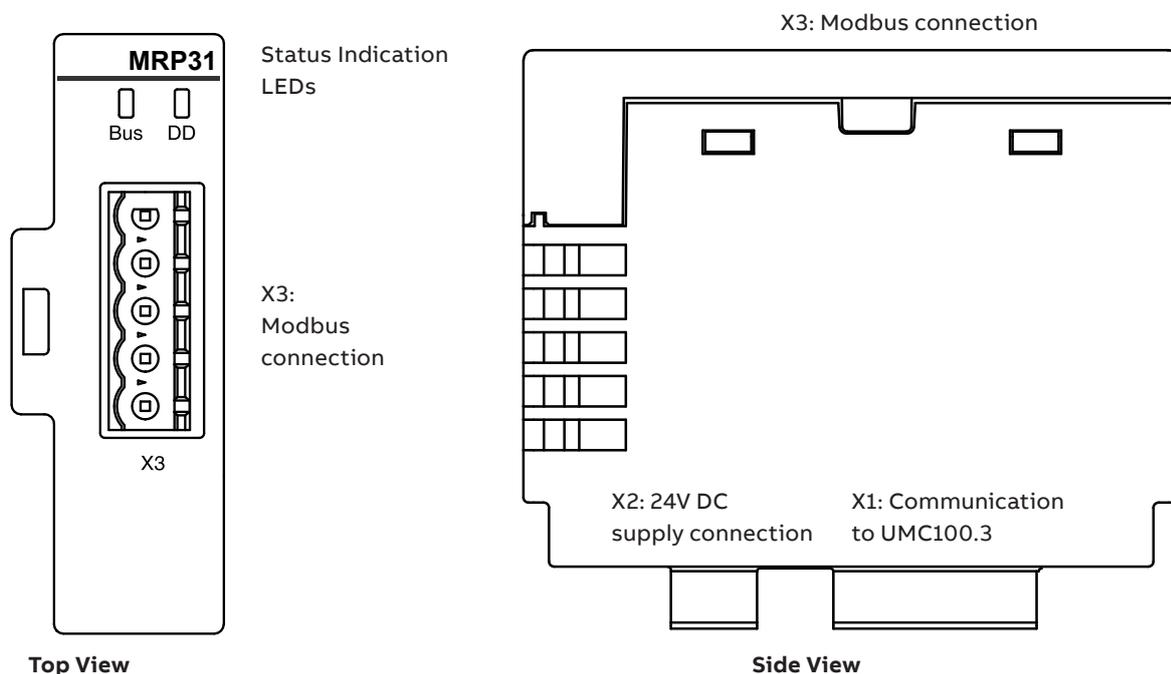
Installation

Mechanical installation

The Modbus interface module MRP31.0 can be mounted either on the UMC100.3 itself or separately from the UMC100.3 using the single mounting kit (SMK3.0).

Mounting the MRP31.0 on the UMC100.3
When the module is installed directly on the UMC100.3 the UMC100.3 with MRP31.0 acts like a device with integrated Modbus RTU communication. No additional accessories are needed.
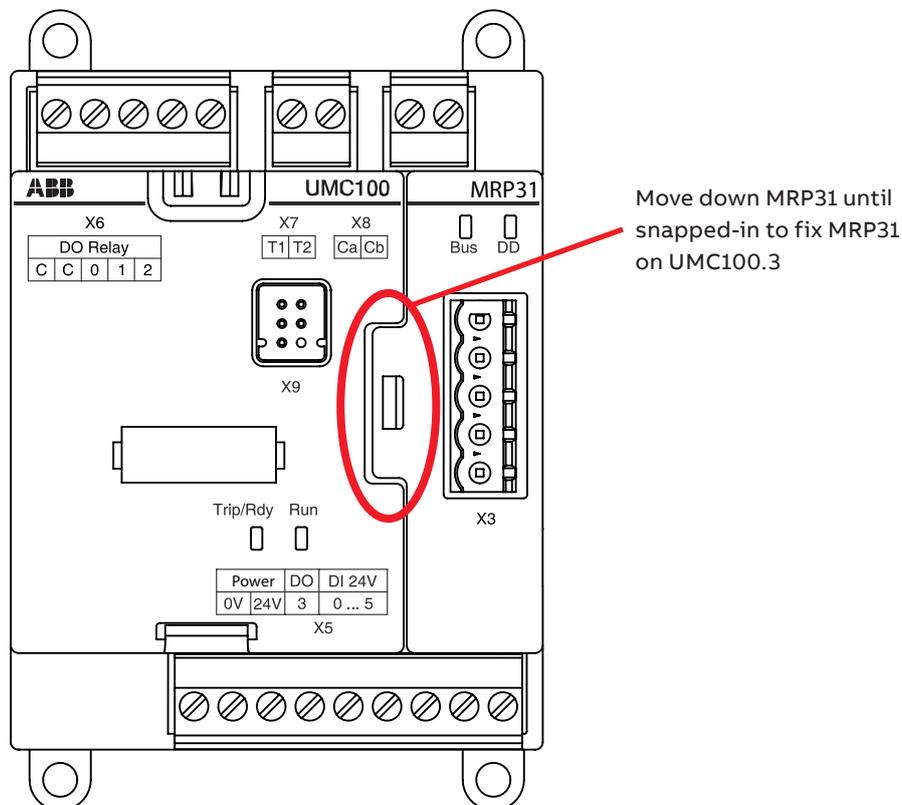

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01   Image shows UMC100.3 DC.

Mounting the MRP31.0 remote from the UMC100.3
When the communication interface is installed remote from the UMC100.3 - e.g. in the cable chamber of a motor control center - the MRP31.0 must be separately supplied. This makes it possible to keep the MRP31.0 online even in the case when the drawer is removed. Ready made cables are available. But it is also possible to use own cables. For more details see section „Using MRP31.0 in a Drawout System".

Mounting and dismounting
The single mounting kit (SMK3.0) can be either mounted on a DIN rail hat or fixed with screws on a fitting panel.

Mounting   Dismounting

click
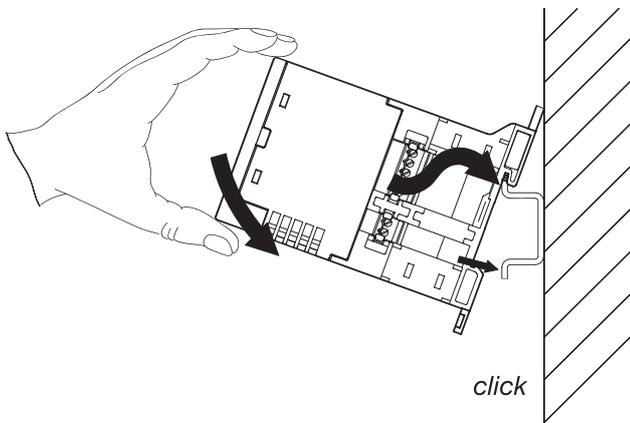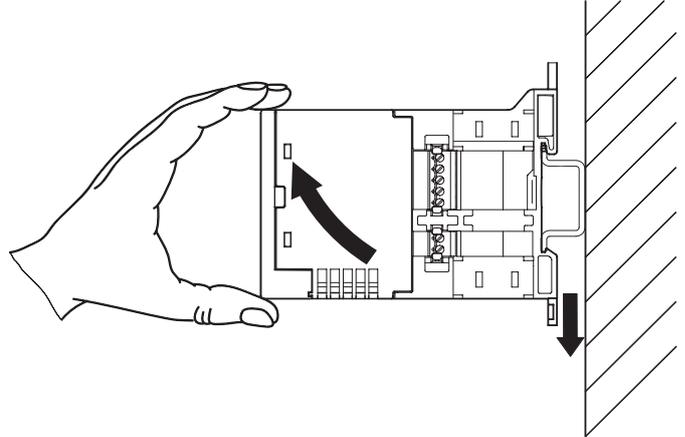
—
02   Mounting and dismounting the MRP31.0 on a 35 mm standard mounting rail.

Mounting the MRP31.0 on the single mounting kit

Step 1:
Plug in the communication and
power supply connectors.
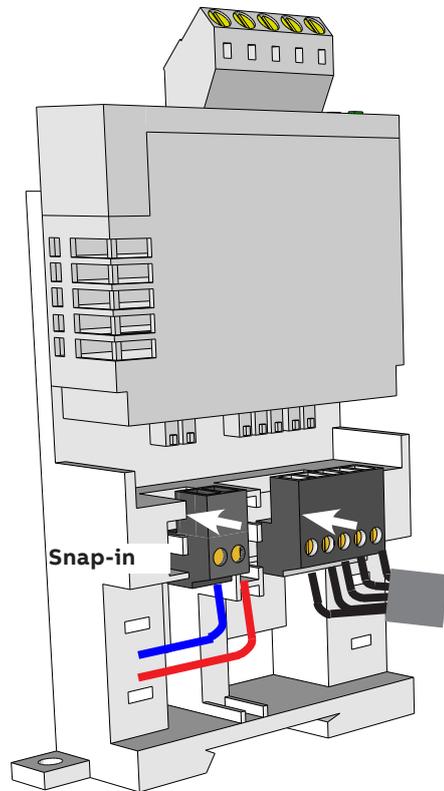
Step 2:
Move down the MRP31.0
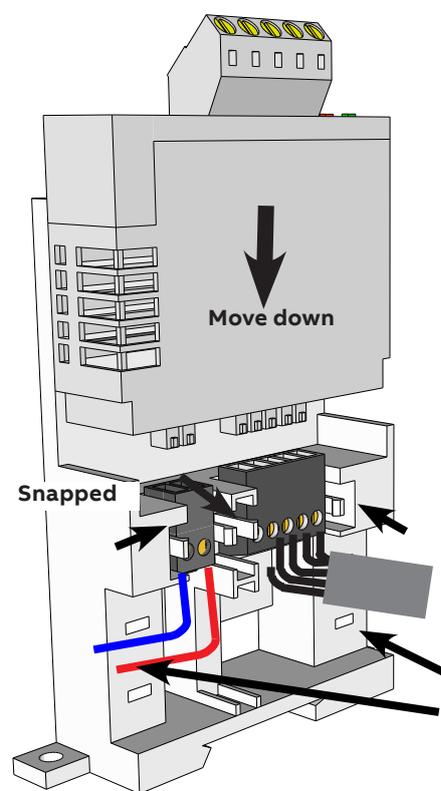
Step 3:
Move down the MRP31.0 until
snapped in

Move down

Snapped
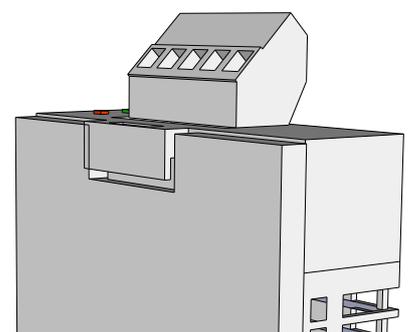
Snap-in

Step 4:
Fix cable with cable ties
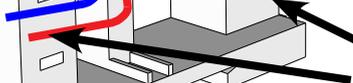
Demounting the MRP31.0
Follow the shown procedure for demounting the MRP31.0 from UMC100.3 or SMK3.0.
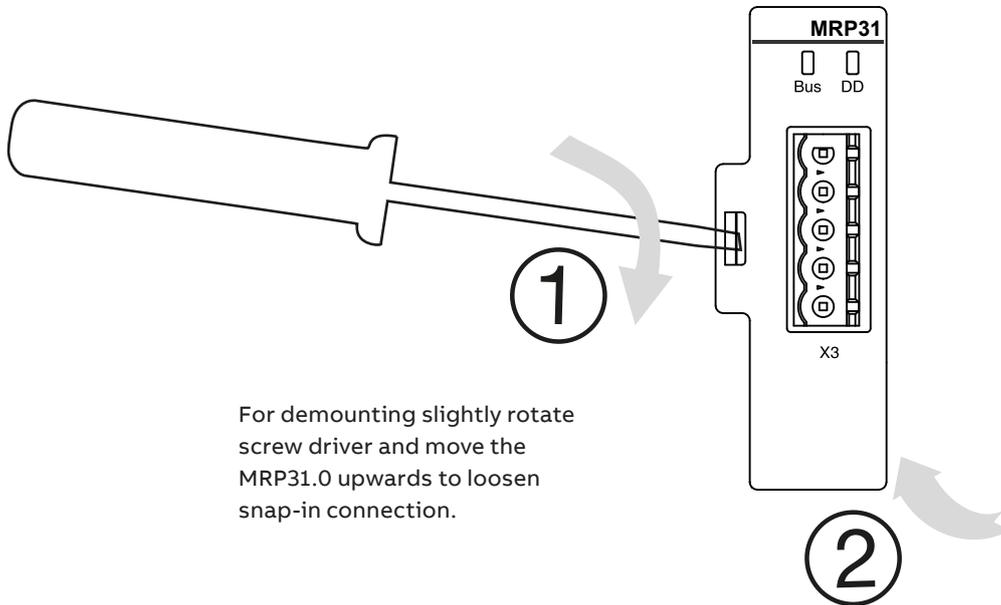
For demounting slightly rotate screw driver and move the MRP31.0 upwards to loosen snap-in connection.

Electrical installation

Modbus Connection
Connect Modbus to X3.

General
Arrange the communication cables as far away from the motor cables as possible. Avoid parallel runs. Use bushings at cable entries.

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Connector X3

PIN	Description
1	Bus cable shield. Connected internally to GND via a capacitor.
2	
3	GND. Isolated signal ground
4	Data A (inverting)
5	Data B (non inverting)

Bus termination
Bus termination is required to prevent signal reflections from the bus cable ends. The MRP31 Modbus interface module is not equipped with internal bus termination

> (!) Termination with an external termination resistor of 120 h between Data A and Data B should be foreseen on devices located at bus ends.

Communication settings
The MRP31.0 communication settings are done using a control panel UMC100-PAN plugged onto a UMC100.3 (panel menu: communication / Modbus RTU) and are copied then automatically to the MRP31.0. After changing communication settings perform a power cycle.

Master supervision
It is possible to configure a maximal time without telegrams from the master before the UMC100.3 triggers the configured busfault reaction.

Modbus bus timeout
Time range   0 ... 65535 ms
Default   0 ms (deactivated)

Baudrate
Supported baudrates
1200, 2400, 4800, 9600, 19200, 57600 Baud

Modbus data frame
• 8 E 1   (8 databits, even parity, 1 stopbit)
• 8 O 1   (8 databits, odd parity, 1 stopbit)
• 8 N 2   (8 databits, no parity, 2 stopbits)
• 8 N 1   (8 databits, no parity, 1 stopbit)

Slave address
Allowed addresses   1 ... 247

> (!) If the MRP31.0 is used with an oldUMC100-FBP.0, then the baud rate is automatically set depending on the bus address.
> See the MRP21-FBP.xxx manual for additional information.

Number of nodes in a Modbus network
Each bus segment can have a maximum of 32 active devices which includes the Modbus master and the slaves.

Network length
The end-to-end length of the Modbus network is limited. The maximum recommended length is 1000 m. The use of passive bus stub lines should be avoided. To bridge long distances between the Modbus master and the slaves (e.g. between the control room and the motor control center) it is recommended to use fiber optic converters.

Modbus TCP
UMC100.3 can be directly integrated in a Modbus TCP EtherNet network by using the MTQ22-FBP.0 interface.

Modbus line with MRP31.0 directly connected to UMC100.3 in a drawout system
The following figure shows a simplified diagram on how to connect the UMC100.3 to a Modbus network. Required grounding of the Modbus cable is not shown in this figure.

⚠️ Ground wire and cable shield should be connected to prevent common mode voltage between the network devices from drifting outside the allowable limits.

Modbus-Master

⊠ Termination active

L_T

Network Length

Modbus Cable

Modbus Cable

UMC100.3 and MRP31.0 mounted in drawer

⊠

Termination active
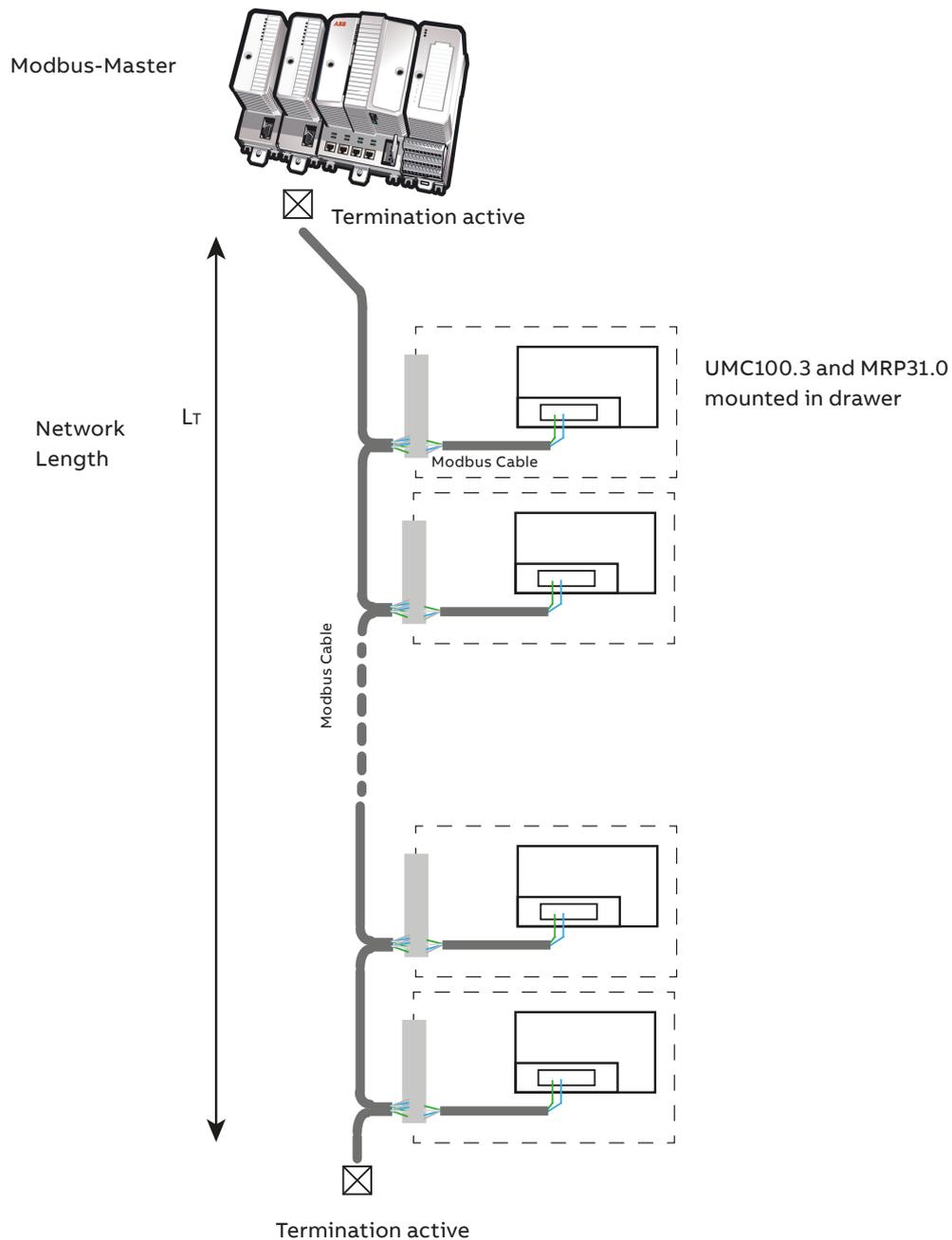
Modbus line with MRP31.0 mounted outside a drawer using single mounting kit (SMK3.0)

The following figure shows a simplified diagram on how to connect the UMC100.3 to a Modbus network if the UMC100.3 is inside a drawer and the Modbus communication interface is mounted outside the drawer e.g. in the cable compartment. In drawout systems this solution has several benefits:

• Modbus address is stored in the Modbus communication interface in addition to the UMC100.3. In case of a drawer re-placement the new - not addressed - UMC100.3 takes over the bus address automatically.

• Swapping of drawers detected if "Address Check" in UMC100.3 enabled. I.e. it is not possible to accidentally start the wrong motor because of swapped drawer.

Required grounding of the Modbus cable is not shown in this figure.

(1) 24V DC supply for the MRP31.0 communication interface. This lets the MRP31.0 stay active even in case the drawer is withdrawn.

(2a) Ready made connection cable from SMK3.0 X1 to backside of drawer.

(2b) Ready made connection cable from inside drawer to UMC100.3 X1

(3) UMC100.3 mounted inside a drawer

(4) Modbus communication adapter with single mounting kit (SMK3.0).
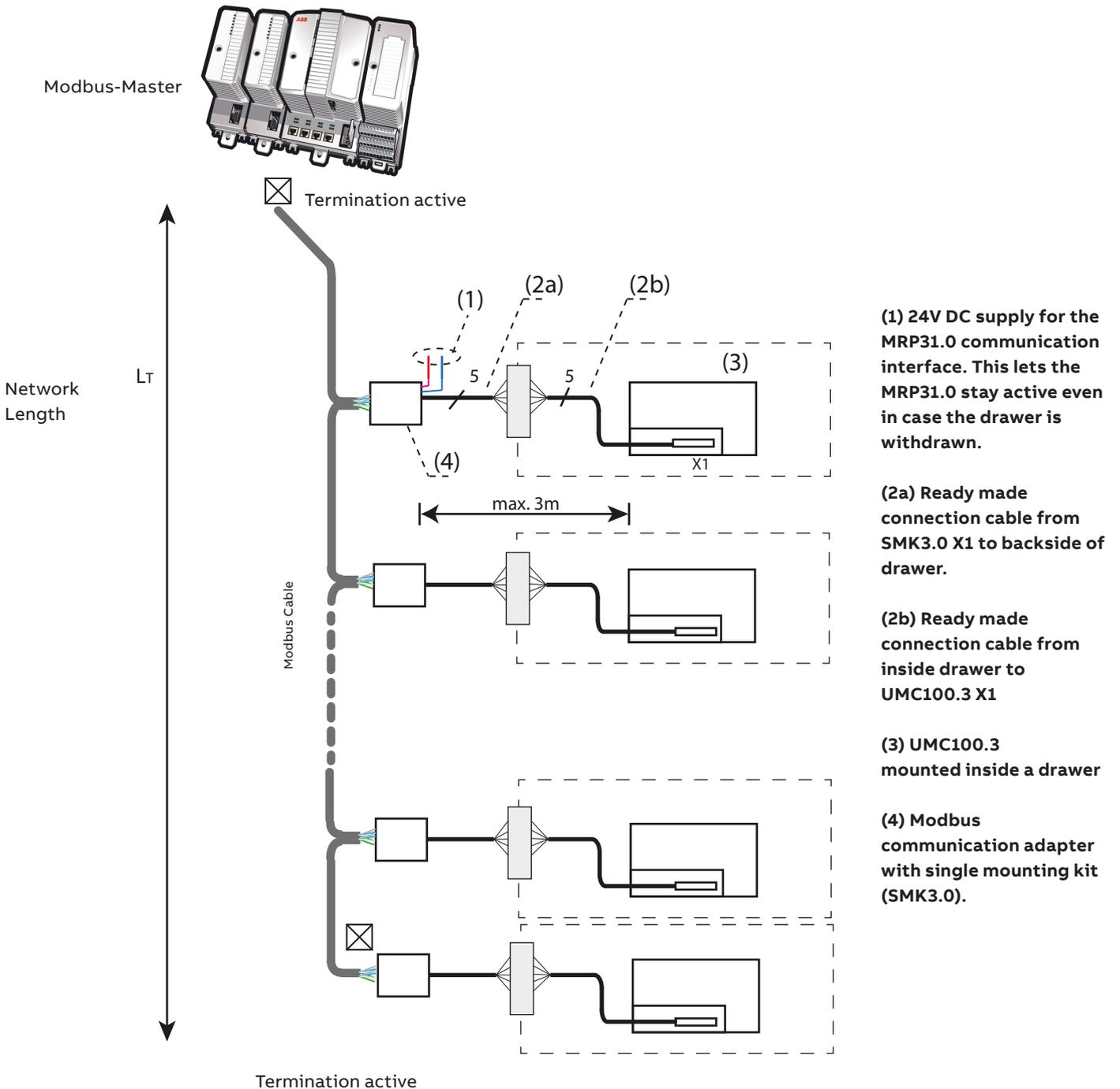
Diagnosis

Diagnosis and behavior in case of an error

The MRP31.0 module provides diagnosis information about the status of the connected UMC100.3, its own status and the status of the Modbus connection. Diagnosis information is shown
- with the locally available LEDs and
- via Modbus services.

Checklist

In case of trouble use the following checklist to track down the problem:

RS485
• Are the termination resistors placed at the end of the line?
• Never place any termination resistors on a drop cable.
• Is the line polarity correct? Are the lines by accident swapped?
• Is the maximum line length exceeded?

MODBUS parameters
• Is the baud rate correctly adjusted?
• Is the MODBUS master in RTU mode?
• Is the slave address correct?
• Are there two devices with the same address in the system?

MODBUS master
• Is the request to response timeout correct?
• Is the MODBUS silent interval between two telegrams > 3.5 character times?
• Notice that the slave device will not give any response when it is addressed with a broadcast (slave address = 0)

MODBUS slave
• Has the device a unique MODBUS address?
• Same baud rate set as used in the master?
• Is the function code supported?
• Has the request a valid quantity of coils, inputs, registers?
• Power supply turned on?

Modbus interface diagnosis

Diagnosis information is locally displayed using LEDs located on the front side of the Modbus interface.

LED Bus (red, green)	LED DD (red, green)	Meaning
Off	Off	Power Supply missing
Green flashing		- Connection to master missing - Bus address of UMC different form the one configured in the master - I/O size mismatch between device and master
Red flashing		Parameter mismatch between device and master
Red		Communication lost, supervision timeout time exceeded
Green		OK, normal data exchange
Amber flashing	Amber flashing	Initializing
	Green flashing	Waiting for communication from UMC
	Green	OK, normal data exchange
	Red flashing	Connection to UMC lost
	Red	Internal fault. Replace communication interface.

Modbus exception codes

Code	Name	Meaning
01	ILLEGAL FUNCTION	The function code received in the request is not an allowable action for the slave. It could also indicate that the slave is in the wrong state to process a request of this type, for example because it is not configured
02	ILLEGAL DATA ADDRESS	The data address received in the request is not an allowable address for the slave.
03	ILLEGAL DATA VALUE	A value contained in the request data field is not an allowable value for slave. This indicates a fault in the structure of the remainder of a complex request, such as that the implied length is incorrect.
04	SLAVE DEVICE FAILURE	An unrecoverable error occurred while the slave was attempting to perform the requested action. - Wrong configuration - Not supported baud rate - Serial device connected, but parallel device addressed - Parallel device connected, but serial device addressed - Connected serial device defective

Modbus communication and Register Map for UMC100.3

Devices on a Modbus network offer their data in registers to a Modbus master. There is the possibility to read or write single bits (coils) or whole words (registers).

The following Modbus requests are supported:

Commands	MODBUS Function Codes	Starting address
Read binary input values	FC 1 Read Coils FC 2 Read Discrete Inputs	0000 Hex
Write binary output values	FC 15 Write Multiple Coils	0100 Hex
Read analog input values	FC 3 Read Holding Registers FC 4 Read Input Registers	0200 Hex
Write analog output values	FC 16 Write Multiple Registers	0300 Hex
Read diagnostic data	FC 3 Read Holding Registers FC 4 Read Input Registers	2000 Hex
Return query data	FC 8 Sub Function 00	n.a.

The following table shows in which registers the UMC100.3 data and diagnosis can be accessed:

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Analog inputs of UMC100.3 acc. to the UMC100.3 manual section
A1 parameters and data structures on a Fieldbus

Register	Data							
0x0200	Motor Current in % of I_e (0% - 800%)							
0x0201	Analog Word (Thermal Load: 0% - 100%)							
0x0202	Analog Word (Time to trip in seconds)							
0x0203	Analog Word (Time to restart in seconds)							
0x0204	Analog Word (Active power in selected scale)							
0x0205	DX1xx DI7	DX1xx DI6	DX1xx DI5	DX1xx DI4	DX1xx DI3	DX1xx DI2	DX1xx DI1	DX1xx DI0
	-	-	Run Time Exceeded	Out of Position	Torque Open	Torque Closed	End Pos Open	End Pos Closed
0x0206	U Imbal. warn	U Imbal. trip	Undervoltage warn	Undervoltage trip	Underpower warn	Underpower trip	Overpower warn	Overpower trip
	Earth fault warning	Earth fault trip	Cooling time running	-	THD warning	No start possible	1 start left	More than 1 start left

—
Analog outputs of UMC100.3 acc. to the UMC100.3 manual section
A1 parameters and data structures on a Fieldbus

Register	Data
0x0300	Analog Word
0x0301	Analog Word
0x0302	Analog Word
0x0303	Analog Word

The function of some bits can differ in case the control functions Actuator 1...4, Overload Relay or Transparent are configured. Please refer to the UMC100.3 manual in this case.

—
Access to the monitoring data of UMC100.3 acc. to the UMC100.3 manual section
A1 parameters and data structures on a Fieldbus

Register	Bit 7 Bit 15	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit1	Bit 0 Bit 8
0x0000	Summary Warning	Summary Fault	Local Control	Reverse Lockout Time3	Overload warning	Run Forward / Opening	Off	Run Reverse / Closing
	UMC100 DI5	UMC100 DI4	UMC100 DI3	UMC100 DI2	UMC100 DI1	UMC100 DI0	Run Fast Forward	-

—
Access to the command data of UMC100.3 acc. to the UMC100.3 manual section
A1 parameters and data structures on a Fieldbus

Register	Bit 7 Bit 15 Bit 23 Bit 31	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit1	Bit 0 Bit 8 Bit 16 Bit 24
0x0100	-	Fault Reset	Auto Mode	Prepare Emergency Start	-	Run Forward / Opening	Off	Run Reverse / Closing
	UMC100 DO2	UMC100 DO1	UMC100 DO0	UMC100 24V DC Out	-	-	Run Fast Forward	-
0x0101	VI15x DO0	-	-	-	DX1xx DO3	DX1xx DO2	DX1xx DO1	DX1xx DO0
	-	-	-	-	-	-	-	-

—
Word oriented access to diagnosis data of UMC100.3 acc. to the UMC100.3 manual section
A1 Parameters and Data Structures on a Fieldbus

Register	Bit 7 Bit 15	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit1	Bit 0 Bit 8
0x2000	Checkback missing	PTC wiring failure	PTC hot	Pre-warning thermal model	Locked rotor during start-up (stall)	Phase imbalance	Phase loss	Thermal overload trip
	Actuator problem	UMC self-test error	Earth fault pre-warning	Earth fault trip (internal or externally triggered)	I above high current warning threshold	I above high current trip threshold	I below low current warning threshold	I below low current trip threshold
0x2001	Trip/Warning from Aux-Fault function block input 5	Trip/Warning from Aux-Fault function block input 4	Trip/Warning from Aux-Fault function block input 3	Trip/Warning from Aux-Fault function block input 2	Trip/Warning from AuxFault function block input 1	HW fault on IO module	Custom application error	IO module missing
	-	-	-	-	Trip triggered from Multifunction input DI2	Trip triggered from Multifunction input DI1	Trip triggered from Multifunction input DI0	Trip / Warning from AuxFault function block input 6
0x2002	-	-	THD Warning	Voltage out of spec	Overload power	Underload power	-	-
	-	-	Cooling Time Running	Just one start left	Num Starts Overrun	-	-	-
0x2003	Extended diagnosis is available.	Parameter out of range	-	-	-	-	-	-
	Fault code. See section "Error Handling, Maintenance and Service-> Fault Messages" for a description of the code.							

The function of some bits can differ in case the control functions Actuator 1...4, Overload Relay or Transparent are configured. Please refer to the UMC100.3 manual in this case.

Technical data

Data at T_a = 25 °C and rated values, unless otherwise indicated

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General data

Supply voltage	24 V DC + 30% / - 20% (19.2 … 31.2 V DC)
Current consumption	30 mA
Supported Communication Protocols	Modbus RTU
Physical Interface	2-wire RS485
Integrated termination resistors	no
Possible bus addresses (set via UMC100)	1 … 247
Supported baudrates	1200, 2400, 4800, 9600, 19200, 57600 Baud
Pollution degree	3

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Standards / directives

Product standard	Modbus Specification
RoHS directive	2011/65/EU

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Environmental data

|		
Ambient air temperature	Operation	0 … +60 °C
	Storage	- 25 … +70 °C
Vibration (sinusoidal) acc. to IEC/EN 60068-2-6		4 g / 10 …. 150 Hz (mounted on UMC100.3 / SMK3.0)
Shock (half-sine) acc. to IEC/EN 60068-2-27		15 g / 11 ms

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General data

Degree of protection	IP20	
Mounting	UMC100.3	SMK3.0
Mounting position	Any	
Altitude	2000 - 4000 m at max. 40 °C	
Duty time	100 %	
Weight	0.039 kG	

Dimensional drawings

Main device
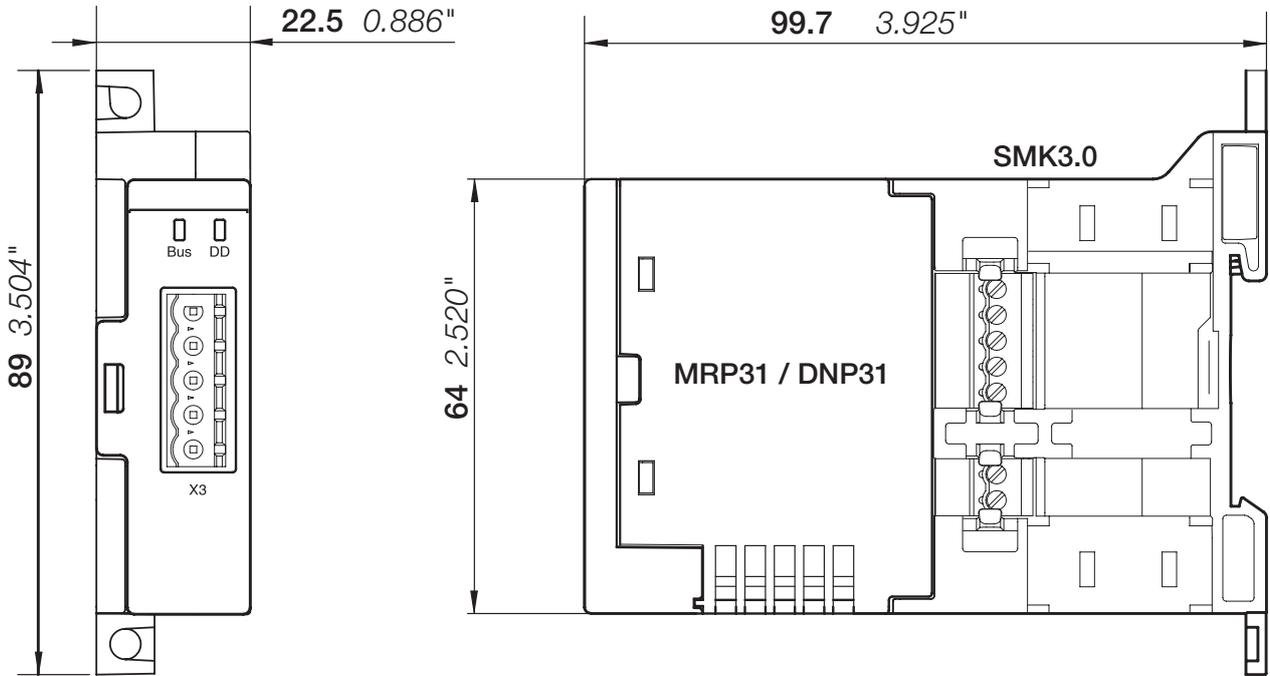
Connection cables
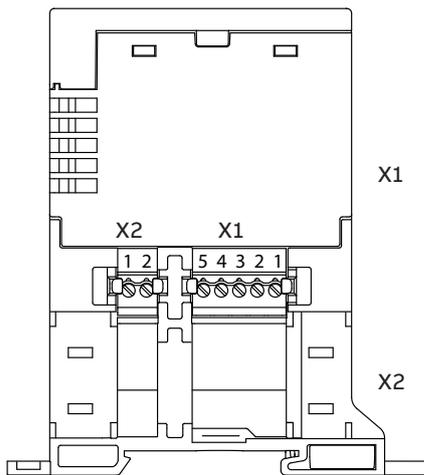
Pin	Color	Function
5	Blue	VDD
4	Brown	VCC
3	Black	Communication
2	Grey	Communication
1	White	Diagnosis

Pin	Function
2	24 V DC
1	0 V DC

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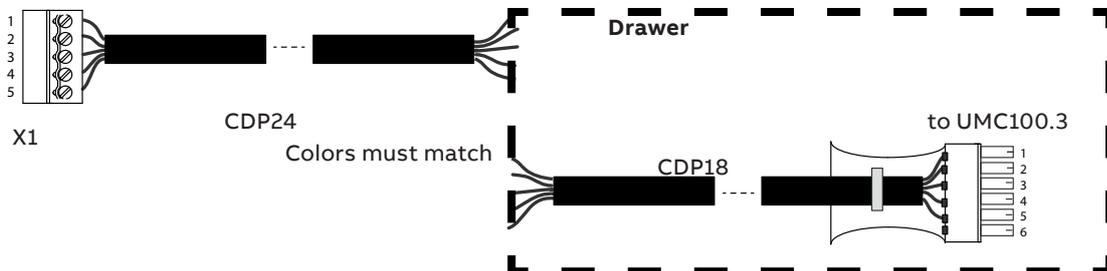
Ordering data

Order code	Type	Description
1SAJ251000R0001	MRP31.0	Modbus RTU communication interface
1SAJ929600R0001	SMK3.0 *	Single mounting kit for separate mounting of the communication interface
1SAJ929180R0015	CDP18.150 **	Cable between UMC100.3 and drawer inside, 1.5 m
1SAJ929240R0015	CDP24.150 **	Cable between SMK3.0 and drawer outside, 1.5 m
1SAJ929610R0001	SMK3-X2.10	Terminal block 2-pol. for SMK3.0 supply, 10 pcs.
1SAJ929620R0001	SMK3-X1.10	Terminal block 5-pol. for SMK3.0 communication, 10 pcs.

*   is delivered including terminal block for power supply connection
** ready cables with terminal block on one end and one open end

ABB

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**You can find the address of your local sales organization
on the ABB homepage**

abb.com/lowvoltage