SOLVIMUS
METERING SOLUTIONS

HARDWARE MANUAL MBUS-M13

M-BUS MASTER OEM MODULE MBUS-M13

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1 General hints and conventions

1.1 About this document

This manual provides guidance and procedures for a fast and efficient installation and start-up of the units described in this manual. It is imperative to read and carefully follow the safety guidelines.

1.2 Legal bases

1.2.1 Copyright

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1.2.2 Personnel qualifications

The use of the product described in this manual requires special personnel qualifications. All responsible persons have to familiarize themselves with the underlying legal standards to be applied, e. g.:

- Valid standards
- Handling of electronic devices

The solvimus GmbH does not assume any liability whatsoever resulting from improper handling and damage incurred to both, solvimus own and third-party products, by disregarding detailed information in this manual.

1.2.3 Technical condition of specified devices

The supplied components are equipped with hardware and software configurations, which meet the individual application requirements. Changes in hardware, software and firmware are permitted exclusively within the framework of the various alternatives that are documented in the specific manuals. The solvimus GmbH will be exempted from any liability in case of changes in hardware or software as well as to non-compliant usage of components.

Please send your request for modified and new hardware or software configurations directly to the solvimus GmbH.

1.3 Symbols

- Danger: Always observe this information to protect persons from injury.
- Warning: Always observe this information to prevent damage to the device.
- Attention: Marginal conditions that must always be observed to ensure smooth and efficient operation
- ESD (Electrostatic Discharge): Warning of damage to the components through electrostatic discharge. Observe the precautionary measure for handling components at risk of electrostatic discharge.
- Note: Make important notes that are to be complied with so that a trouble-free and efficient device operation can be guaranteed.

- Additional information: References to additional literature, manuals, data sheets and internet pages.

1.4 Font conventions

Names of paths and data files are marked in italic-type. According to the system, Slashes or Backslashes are used.

e. g.: *D:\Data*

Menu items are marked in italic-type, bold letters.

e. g.: ***Save***

Sub-menu items or navigation steps within a web browser are marked by using an arrow between two menu items or tabs.

e. g.: ***File*** → ***New***

Pushbuttons or input fields are marked with bold letters.

e. g.: **Input**

Keys are marked with bold capital letters within angle brackets.

e. g.: **<F5>**

The print font for program codes is Courier.

e. g.: `END_VAR`

Names of variables, designators and configuration fields are marked in italic-type.

e. g.: *Value*

1.5 Number notation

Numbers a noted according to this table:

Number code	Example	Note
Decimal	100	Normal notation
Hexadecimal	0x64	C Notation
Binary	'100'	in quotation marks
	'0110.0100'	nibbles separated with dot

Table 1: Numbering systems

1.6 Safety guidelines

- All power sources to the device must always be switched off before carrying out any installation, repair or maintenance work.

Replace any defective or damaged device/module (e. g.: in the event of deformed contacts), as the functionality of the device in question can no longer be ensured on a long-term basis.

The components are not resistant against materials having seeping and insulating properties. Belonging to this group of materials is: e. g. aerosols, silicones, triglycerides (found in some hand creams).

If it cannot be ruled out that these materials appear in the component environment, then the components must be installed in an enclosure that is resistant against the above mentioned materials.

Clean tools and materials are generally required to operate the device/module.

- Only use a soft, wet cloth for cleaning. Soapy water is allowed. Pay attention to ESD.
- Do not use solvents like alcohol, acetone etc. for cleaning.
- Do not use contact sprays, which could possibly impair the functioning of the contact area and may cause short circuits.

⚠ Components, especially OEM modules, are designed for the mounting into electronic housings. Those devices shall not be touched when powered or while in actual operation. The valid standards and guidelines applicable for the installation of switch cabinets shall be adhered to.

The devices are equipped with electronic components that may be destroyed by electrostatic when touched. It is necessary to provide good grounding to personnel, working environment and packing. Electro-conductive parts and contacts should not be touched.

1.7 Scope

This manual describes the devices mentioned in the title, supplied by solvimus GmbH, Ilmenau.

1.8 Abbreviations

Abbreviation	Meaning
AE, AI	Analog Input, Analog Input terminal
AA, AO	Analog Output, Analog Output terminal
DE, DI	Digital Input, Digital Input terminal
DA, DO	Digital Output, Digital Output terminal
ESD	Electro-Static Discharge
I/O	Input / Output
ID	Identification, Identifier, unique identification mark
M-Bus	Meter-Bus (EN 13757, part 2 - 3)
OEM	Original Equipment Manufacturer
wM-Bus	Wireless Meter-Bus (EN 13757, part 3 - 4)

Table 2: Abbreviations

1.9 Versions

Version	Date	Editor	Changes
1.00	2013-04-30	Remo Reichel	Initial translation, derived from German v 1.04
1.01	2013-08-09	Remo Reichel	Additional technical data, fixed reference schematic
1.02	2014-06-17	Sebastian Bauer	Fixed schematics of MBUS-M13-G
1.07	2015-01-09	Remo Reichel	Amendment of technical data, synchronization to the German version tag
1.08	2018-02-06	Sven Ladegast	Updated document to actual corporate design.

Table 3: Versions of this document

2 General Information

The module MBUS-M13 and its variants are compact M-Bus (Meter-Bus) masters. It is responsible for the power supply of the connected slaves and also for the communication with them.

Especially in the scope of smart metering M-Bus is used for automated meter reading.

Additional information on M-Bus can be found here:

- http://www.m-bus.com/

2.1 Structure of the module

The module MBUS-M13 and its variants are populated single-sided. Pin headers with a spacing of 2.54 mm can be used for connecting the corresponding pads.

The following figure shows the module:

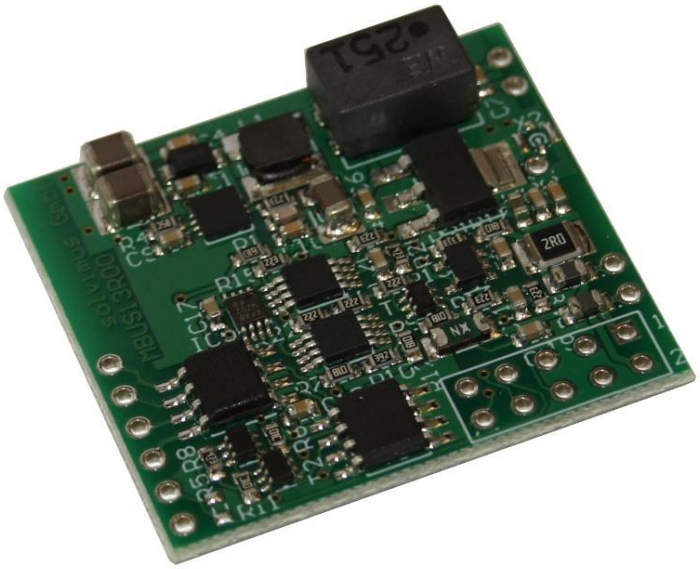


Figure 1: The module MBUS-M13

The module is integrating all necessary components for the operation of the M-Bus. The internal power supply generates the bus voltages 24 V and 36 V as well as 3.3 V for internal use and also for connecting some external logic (e. g.: a microcontroller).

2.2 Variants

There are 3 variants available.

The variant MBUS-M13-S is the standard version, serving as a fully integrated M-Bus master and the level converter. The connection of the control logic is realized by using a simple TTL UART interface, which is galvanically isolated from the M-Bus levels. The connection is established through the pads at the edge of the module.

The variant MBUS-M13-G has no unit for electrical isolation. It is suitable for simple systems. The connection is established through the connector X1.

The variant MBUS-M13-M has no internal 3.3 V power supply and no electrical isolation. The connection is only established through connector X1.

With the variants -S and –G, the internal 3.3 V power supply can also be used for direct connection of small logic modules (e. g.: a microcontroller with LCD display). In that way, certain compact applications such as a gateway or a data logger only need a single 24 VDC.

⚠ The internal 3.3 V supply can handle loads with a maximum current consumption of 50 mA.

2.3 Pin assignment

The module MBUS-M13 is made for connection via pin headers with a spacing of 2.54 mm. The following figure shows the top view:

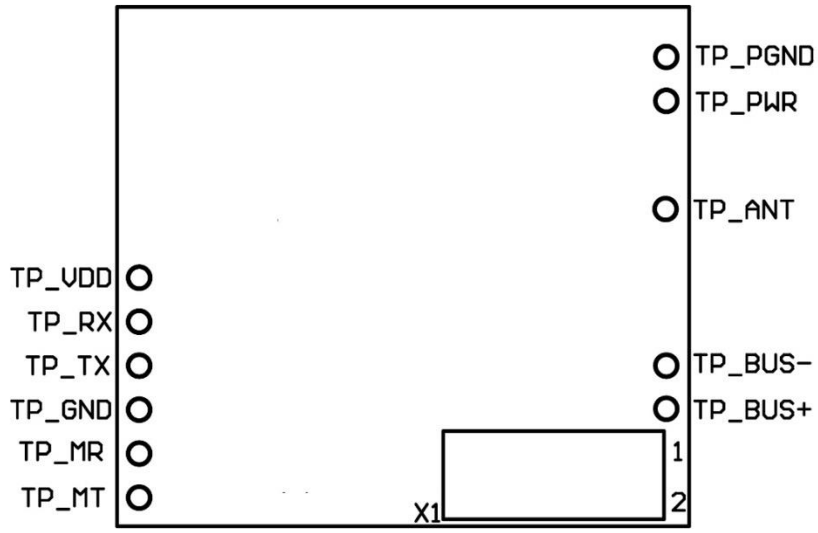


Figure 2: Top view of MBUS-M13 with its pads

The function of each pin will be explained in following tables.

2.3.1 Terminals at the edge for pin headers

Terminal	Description	-S	-G	-M
TP_VDD	galvanically isolated logic, positive supply 3,0 V ... 5,0 VDC	VDDiso	nc	nc
TP_RX	galvanically isolated logic, UART Receiver (to RX)	RXiso	nc	nc
TP_TX	galvanically isolated logic, UART Transmitter (from TX)	TXiso	nc	nc
TP_GND	galvanically isolated logic, negative supply (ground)	GNDiso	nc	nc
TP_MR	do not connect	nc	nc	nc
TP_MT	do not connect	nc	nc	nc
TP_PGND	M-Bus-side negative power supply, Ground (0 VDC)	GND	nc	nc
TP_PWR	M-Bus-side positive power supply (24 VDC)	24VDC	nc	nc
TP_ANT	do not connect	nc	nc	nc
TP_BUS-	M-Bus, low-side	M-Bus-	M-Bus-	M-Bus-
TP_BUS+	M-Bus, high-side	M-Bus+	M-Bus+	M-Bus+

Table 4: Function of the terminals for the pin header

2.3.2 Connector X1

Pin	Name	Description	-S	-G	-M
1	MB+	M-Bus, high-side	nc	nc	M-Bus+
2	MB-	M-Bus, low-side	nc	nc	M-Bus-
3	VCC	positive logic power supply 3,3 VDC	nc	VDD	VDD
4	24V	positive M-Bus power supply 24 VDC	nc	24 VDC	24V DC
5	GND	negative power supply, Ground	nc	GND	GND
6	#COL	collision interrupt (see section: 11)	#COL	#COL	#COL
7	WRX	do not connect	nc	nc	nc
8	WTX	do not connect	nc	nc	nc
9	RX	UART Receiver (to RX)	nc	RX	RX
10	TX	UART Transmitter (from TX)	nc	TX	TX

Table 5: Pin assignment of connector X1

2.4 Dimensions

Following drawing shows the dimensions of the module:

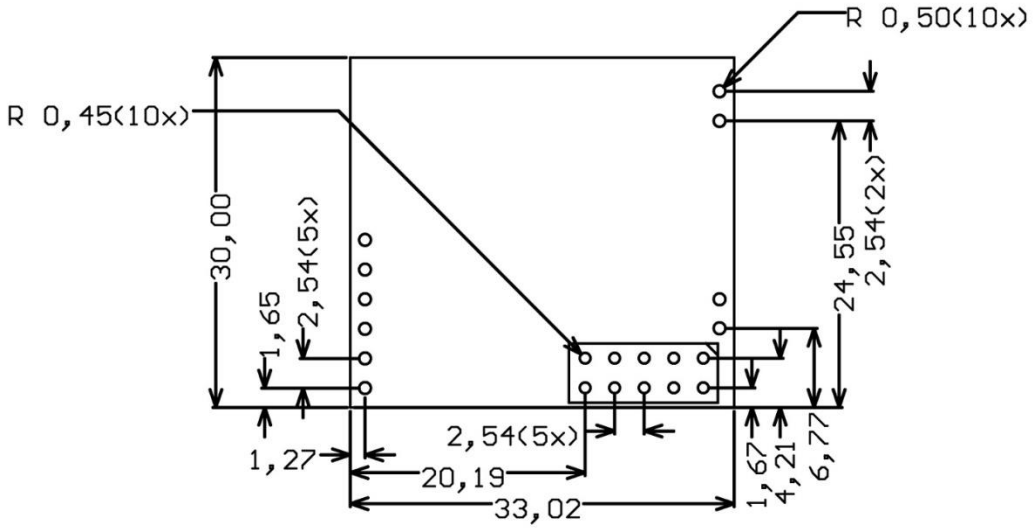


Figure 3: Mechanical dimensions and position of pads of MBUS-M13 (values are in mm)

2.5 Ordering information

Item name	Order number
MBUS-M13-S	500325
MBUS-M13-G	500327*
MBUS-M13-M	500328*
MBUS-M13-S1 (all pin headers and X1 assembled at the bottom side)	500336*
MBUS-M13-M1 (X1 assembled at the bottom side)	500339*
MBUS-M13-G1 (X1 assembled at the bottom side)	500340*

*delivery only upon request

Table 6: Ordering information

3 Operation

The module MBUS-M13 is a compact M-Bus (Meter-Bus) master. In detail, it is a physical level converter, allowing the communication between a serial UART interface (TTL) and M-Bus slaves.

3.1 Wiring diagrams

The following examples give a brief overview on how to connect the module MBUS-M13. It should be noted that nomenclature is chosen according to typical interface transceivers (such as MAX232). *TX* should be therefore *TXin*, data transmitted from the logic to the bus, and *RX* is *RXout*, data received from the bus to the logic.

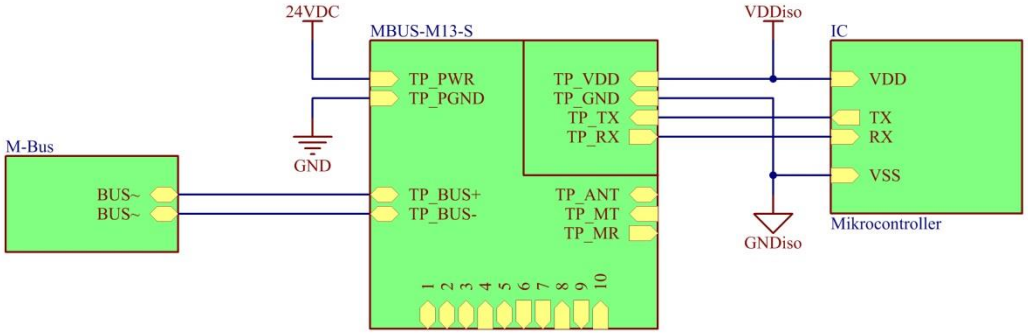


Figure 4: Variant MBUS-M13-S with galvanically isolated interface to external logic

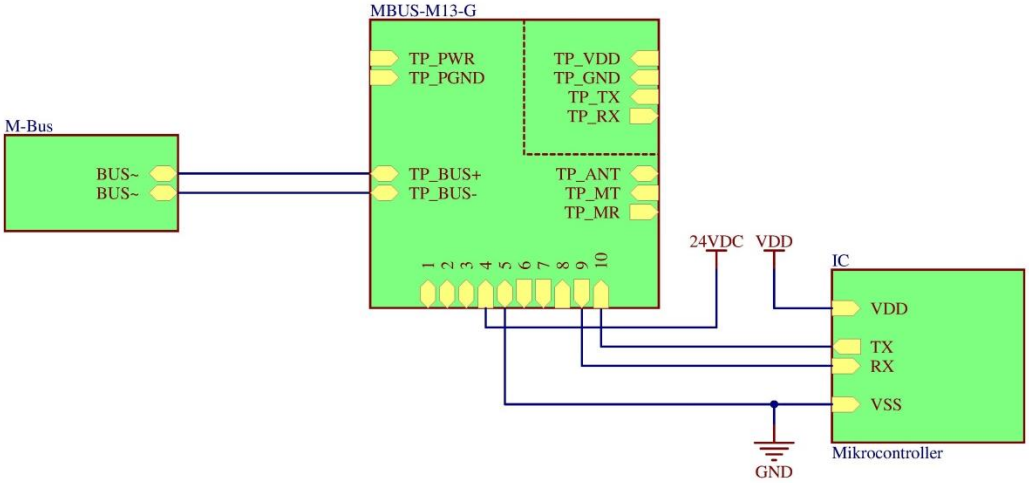


Figure 5: Variant MBUS-M13-G with direct interface to external logic

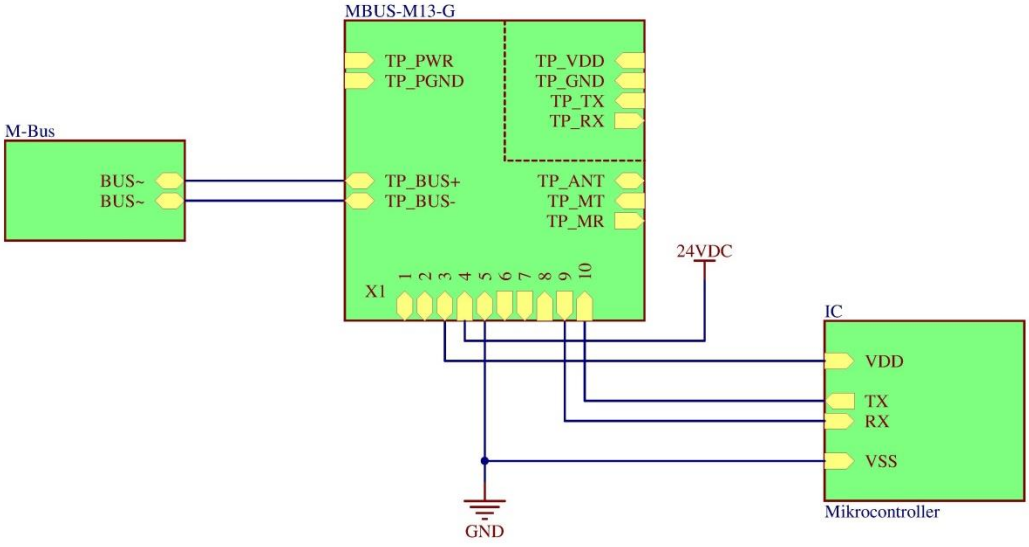


Figure 6: Variant MBUS-M13-G powering the external logic (3.3 VDC) on its own (max. 50 mA)

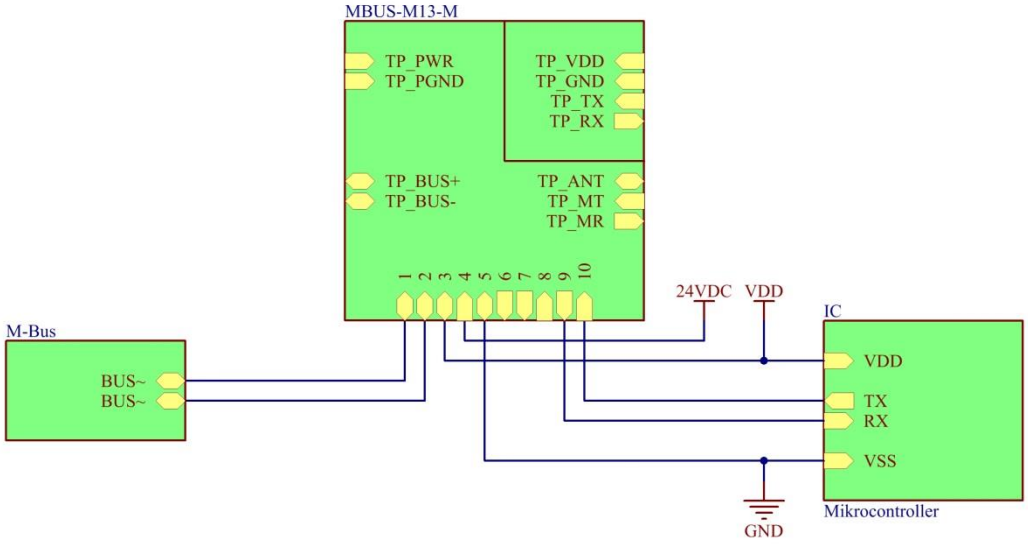


Figure 7: Variant MBUS-M13-M using only the connector X1

3.2 Reference circuit with collision indication and EMC precautions

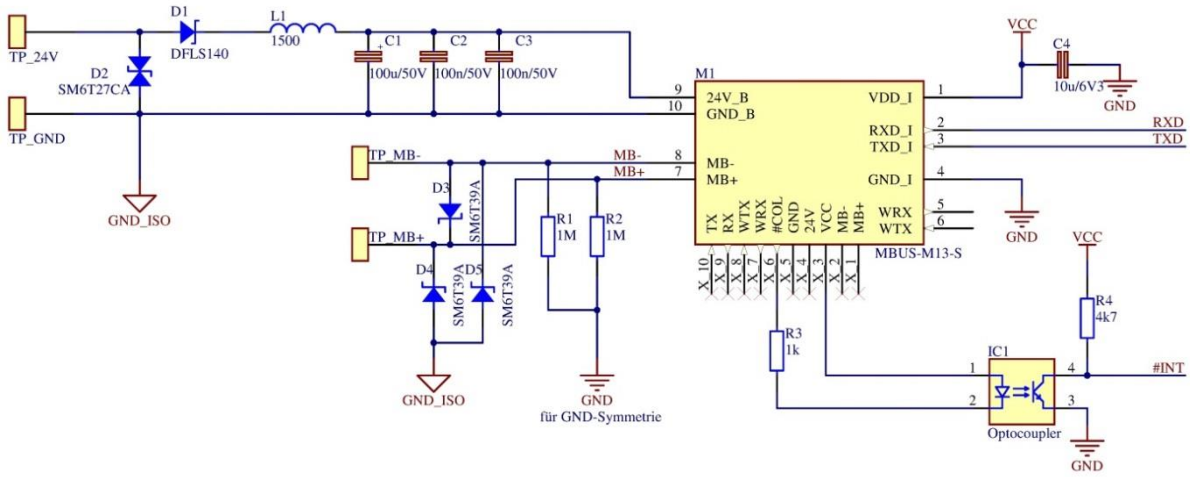


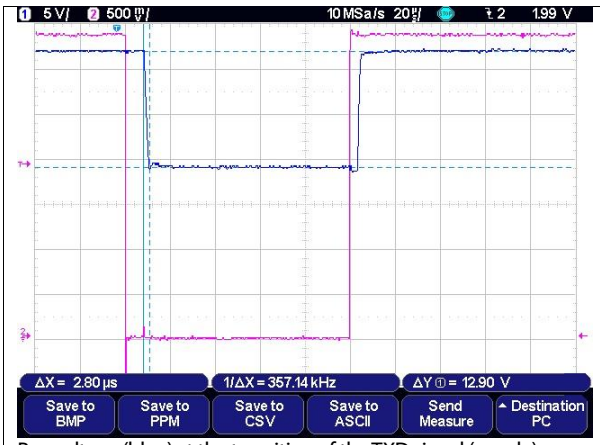
Figure 8: Reference circuit for MBUS-M13-S

3.3 Technical data

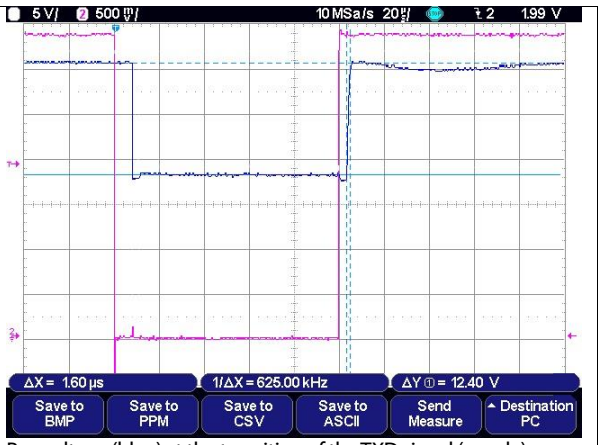
Parameter	Value
Power supply	24 VDC, +2/-10 %
Current consumption in idle state (without bus load)	approx. 27 mA
Power consumption in idle state (without bus load)	<0,7 W
Power dissipation of internal power circuit (at maximum bus load)	<1,3 W
Voltages M-Bus	24 V (space) and 36 V (mark)
Ampacity M-Bus	150 mA (approx. 80 unit loads)
Short circuit protection M-Bus	PTC resettable fuse at MB+
Trip point of resettable fuse (at 25°C ambient temperature), theoretical values in the data sheet (without taking internal impedance of module into account)	approx. 900 ms@360 mA, approx. 450 ms@440 mA, approx. 220 ms@530 mA, approx. 50 ms@3300 mA
Reset behavior of fuse (at 25°C ambient temperature)	approx. 2,5 s@36 mA
Power supply for logic (isolated side, variant -S only) (TP_VDD)	3,0 ... 5,0 VDC
Power supply for logic (non-isolated side) at X1 (VCC)	3,3 VDC
Ampacity of logic power supply (variants -S and -G) at X1 (VCC)	50 mA
Internal pull-up resistor at pin #COL at X1 (open collector)	1 kOhm
Ampacity of pin #COL an X1 (sink current)	10 mA
Maximum baud rate	19200 Bit/s
Dimensions (variant -S, without pin headers)	30 mm x 33 mm x 6,5 mm
Galvanic isolation (variant -S only)	1 kV
Environmental conditions for operation	0 ... 50 °C, <95 % humidity
Environmental conditions for storage	-20 ... 85 °C, <95 % humidity

Table 7: Technical data

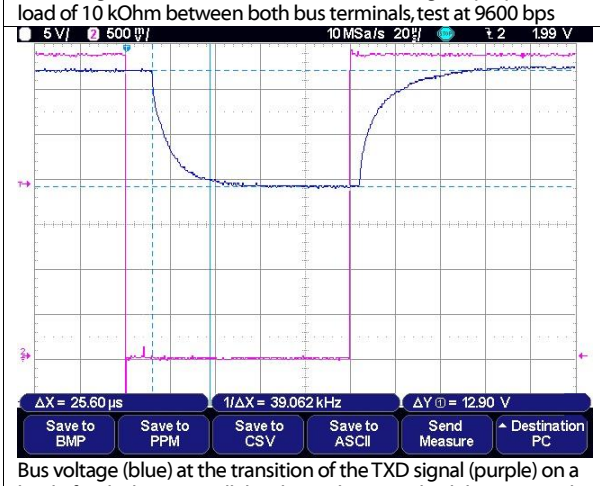
3.4 Timing and performance diagrams



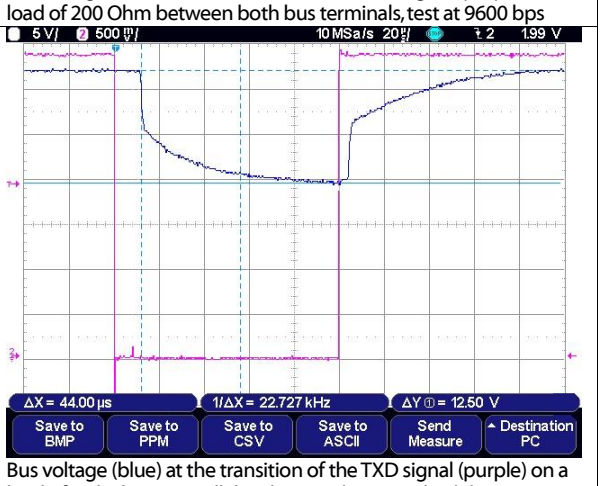
Bus voltage (blue) at the transition of the TXD signal (purple) on a load of 10 kOhm between both bus terminals, test at 9600 bps



Bus voltage (blue) at the transition of the TXD signal (purple) on a load of 200 Ohm between both bus terminals, test at 9600 bps



Bus voltage (blue) at the transition of the TXD signal (purple) on a load of 10 kOhm in parallel with 1 uF between both bus terminals, test at 9600 bps



Bus voltage (blue) at the transition of the TXD signal (purple) on a load of 10 kOhm in parallel with 2.2 uF between both bus terminals, test at 9600 bps

Table 8: Oscillogram of signal transitions

Condition	10 kOhm	200 Ohm	10 kOhm || 1 uF	10 kOhm || 2.2 uF
Parameter				
Bus voltage high	36.8 V	35.6 V	36.8 V	36.8 V
Bus voltage low	24 V	23.6 V	24.1 V	24.3 V
Fall time	<3 us	<1 us	approx. 45 us	approx. 60 us
Rise time	<3 us	<3 us	approx. 25 us	approx. 45 us
Delay at falling edge	approx. 8 us	approx. 8 us	approx. 12 us	approx. 12 us
Delay at rising edge	approx. 4 us	approx. 4 us	approx. 4 us	approx. 4 us

Table 9: Conditions and results of performance measurements