# Documentation

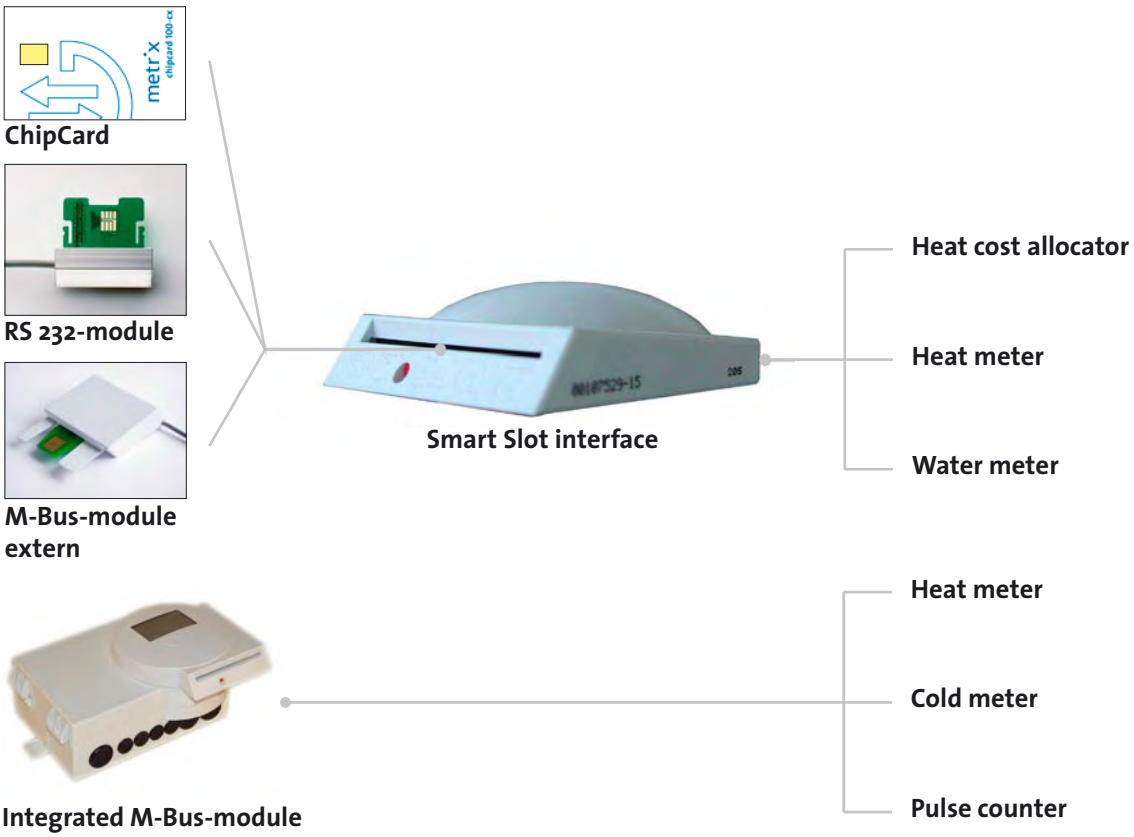
**M-Bus**
**130-mbx**

ISTEC
Flow Measurement & Control

## Introduction

The Istec M-Bus module is part of the Smart Slot communications family. With the integrated SmartSlot technology, Istec offers automatic consumer data read-out and transmission. The technology gives the customer the freedom to choose which form of communication he would like to use and has an ideal solution for each application.

The following methods of data transmission are available:




### About M-Bus

The meter bus (abbreviated: M-Bus) was primarily conceived for central and remote reading of consumption meters. The M-Bus is defined in EN 1434-3 and is based on the so-called master-slave principle. The master meter requests that one or several other meters (slaves) sequentially send their data to it. Data transmission on the M-Bus is carried out bidirectionally. Communication between slaves is not provided for. Within the M-Bus system, only one communication master and up to 250 slaves (measuring devices) are possible. However, expansion of the transmission network can be divided up into segments and expanded almost without limitation by means of what are known as repeaters.

A two conductor cable is all that is required for data transmission and power supply. Permissible cable routings (topology) are line, tree, and star layouts as well as any combination of these forms. Ring topology is not allowed. A bus terminator is not required.

The expansion of the network and the maximum transmission speed is restricted by the number of M-Bus units, protection circuits, the cable routing, and the type of cable used.

### M-Bus-Module

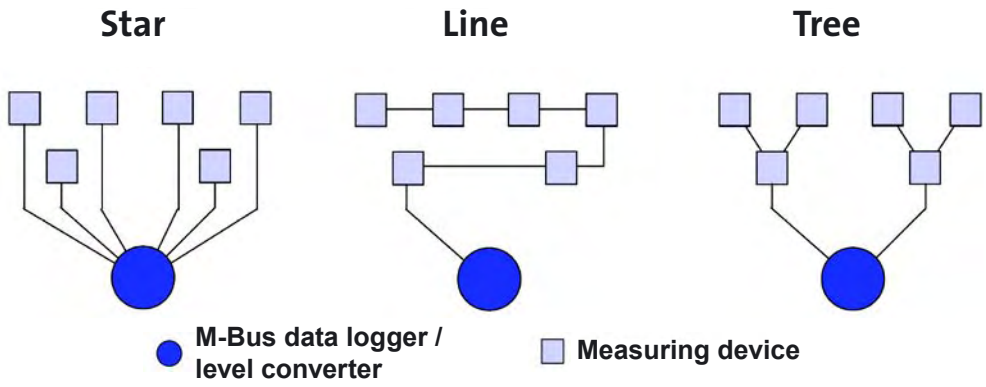
The M-Bus module is installed by plugging it into the SmartSlot in the measuring instrument. The module has its own processor that communicates with the measuring device. The module is powered via the M-Bus and can thus remain at the measuring point across several calibration periods.

The module, as it is does not have its own has secondary address, accepts the serial number of the connected measuring instrument as part of the secondary address while reading the measured value. This read-in occurs every 24 hours after the unit's first start-up operation (the module does not have its own, battery-buffered clock; i.e., after a supply failure, the 24-hour interval recommences). Read-out can also be triggered by a command (send UD 51d0).

Only the current data (present in RAM) in the respective measuring instrument can be read-out as a daily value and reference day value.

### Planning and installation

Bus topology
The M-Bus supports almost all kinds of network layouts so that a demand-oriented topology can be selected.
Star, line, and tree layouts can be selected. Ring topology cannot be used in M-Bus networks.



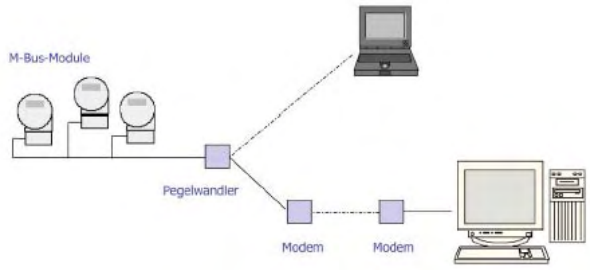

Star: All measuring instruments are wired directly to the central point. In the case of an error, the measuring instrument can be switched on or off to localize the defect.

Line: The measuring instruments are wired sequentially. While this is cost-effective, start-up operation and troubleshooting can be costly under certain circumstances. Due to the high voltage drop, this structure is not recommended.

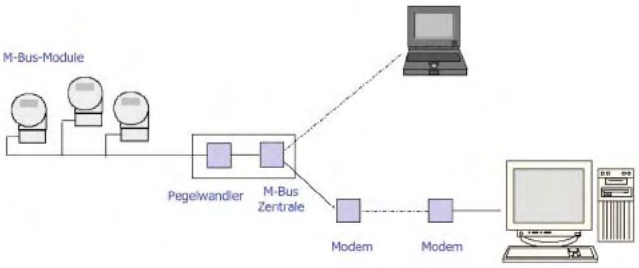
Tree: This is a combination of star and line structures. The individual branches are created as lines so that a defect will merely affect the corresponding branch. Repeaters (signal amplifiers) are utilized to advantage in the branches and ensures additional safety and isolation of the individual sections.

## Bus configuration without data storage

The M-Bus configuration illustrated below shows a system in which no data is buffered. Nevertheless, the current data as well as the reference-day value can be read out at any desired time.
In the first case, a PC with serial interface serves for reading out on-site; in the second case, a modem is connected to the level converter. Thus, the values can be read from a remote PC by phone. For this purpose, the level converter must have a modem connection.




Bus-configeration without data memory




Bus-configeration with data memory

## Bus configuration with data storage

In this configuration, the measured values are continuously read by an M-Bus master suited for this and stored in memory.

These values can then be read once again on-site using a PC or via the modem. This procedure has the advantage that interim values are also present and corresponding intermediate readings and calculations are possible.

## Network expansion

The total bus system expansion is essentially restricted by the number of M-Bus units in the segment, the distribution of units in the bus segment, the resistance of the bus line utilized (voltage drop on the bus line) and the speed of transmission.

The expansion of the transmission network can be divided into segments using repeaters and is expandable to almost any limit. That means all M-Bus units connected to the same repeater or level converter belong to the same M-Bus segment. Up to 250 terminal devices can be connected to one separate repeater on one segment.

Simple application examples with a level converter for a maximum cable capacity of 150 nF/km are listed in the following table.

| Example of use with one level converter | Maximum distance | Total length of cables | cable dia-meter | Numbers of M-Bus devises | Maximum transfere rate |
|---|---|---|---|---|---|
| Small buildings | 350 m | 1000 m | 0.8 mm2 | 250 | 9600 Baud |
| Big buildings | 350 m | 4000 m | 0.8 mm2 | 250<br>64 | 2400 Baud<br>9600 Baud |
| Small settlements | 1000 m | 4000 m | 0.8 mm2 | 64 | 2400 Baud |
| Big settlements | 3000 m | 5000 m | 1.5 mm2 | 64 | 2400 Baud |
| Village, District | 5000 m | 7000 m | 1.5 mm2 | 16 | 300 Baud |
| Point-Point connection | 10000 m | 10000 m | 1.5 mm2 | 1 | 300 Baud |

Source: Manual for heatcost billing (Vienna/Kreuzberg), 5.Edition, ISBN 3-8041-4977-4.

## Cabling

| | |
|---|---|
| conductors required:..... 2 | max. cable length per segment: ..... 1000m |
| Number of units per segment: ..... 250 | max. number segments:..... theoretically unlimited |

M-Bus uses only 2 conductors for data transmission and supply of the meters. Reversing the two bus conductors is allowed and does not cause an error. The M-Bus is thus the bus requiring the least amount of wiring. The stated number of units in M-Bus systems is always based on a current consumption of 1.5 mA per unit. As this bus current is not always sufficient for high-quality metering systems, individual M-Bus units can require more current from the bus. This reduces the maximum number of units that can be operated in one segment.

## In order to minimize malfunctions, some basic principles should always be taken into consideration:

- Ensure all cable connections are as short as possible !
- Lay all data cables as far away from power cables as possible !
- Ensure a large separation between data cables and critical powered untis (motors, transformers, switching stations, radio units, etc.) !
- Do not perform any other function in the same cable (e.g. bell) !
- Use only cables with twisted wires !
- Do not use shielded cable !
- Ground coupling must not be carried out via the bus system. Overall, the bus system must be operated either without ground coupling or with a maximum of one ground couple. If this is not the case, currents via the bus system can interfere with the data transmission or even destroys the units !

Standard lines such as those used in communications technology can be used for wiring. The following cables are recommended:

**Type of cable:**

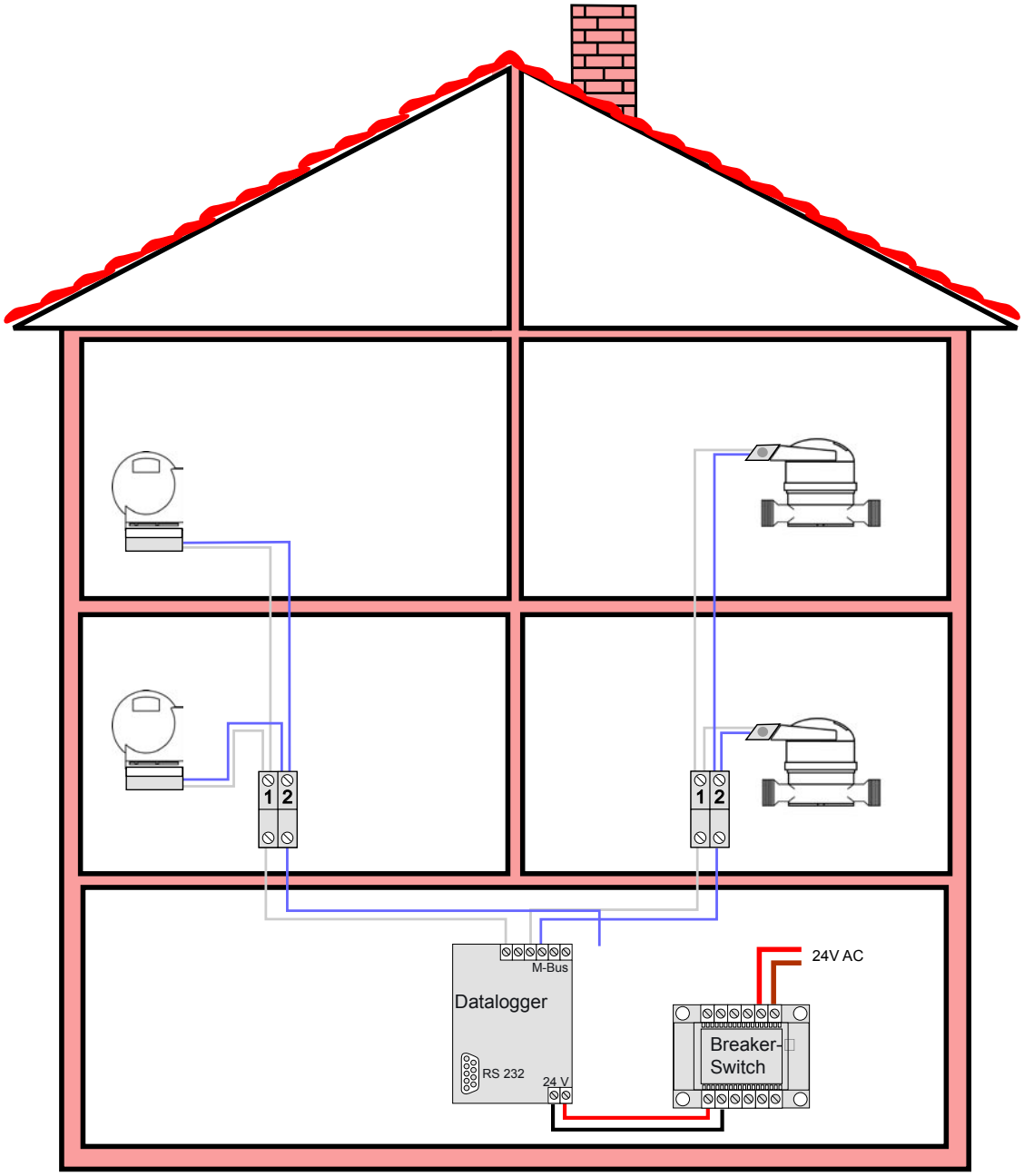
- 2 conductors, +M and -M (twisted, not shielded)

Whenever possible, 2-core, twisted cable should be employed as it possesses the best transmission characteristics. The use of shielded cable over long distances leads to signal distortion due to the higher transmission-line capacitance.

**Cable cross-section:**

-Network expansion less than 1000 m
Cross-section 0.8 mm2 (diameter 0.9 mm)
e.g. J-Y-ST-Y-2x2x0.8 wiring cable
-Network expansions longer than 1 km
Cross-section 1.5 mm2 (diameter 1.25 mm)

## Example of M-Bus-wiring diagram for heating- and sanitary installations (external M-Bus)

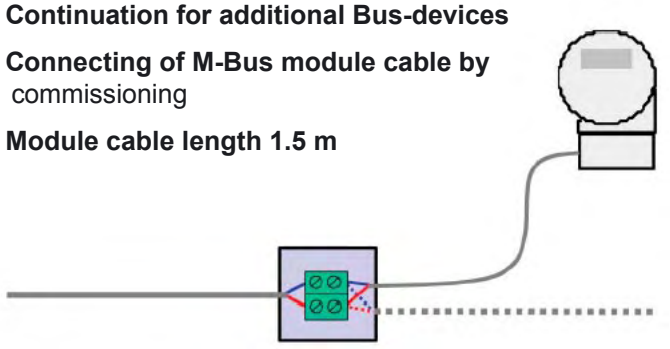



## Distribution box

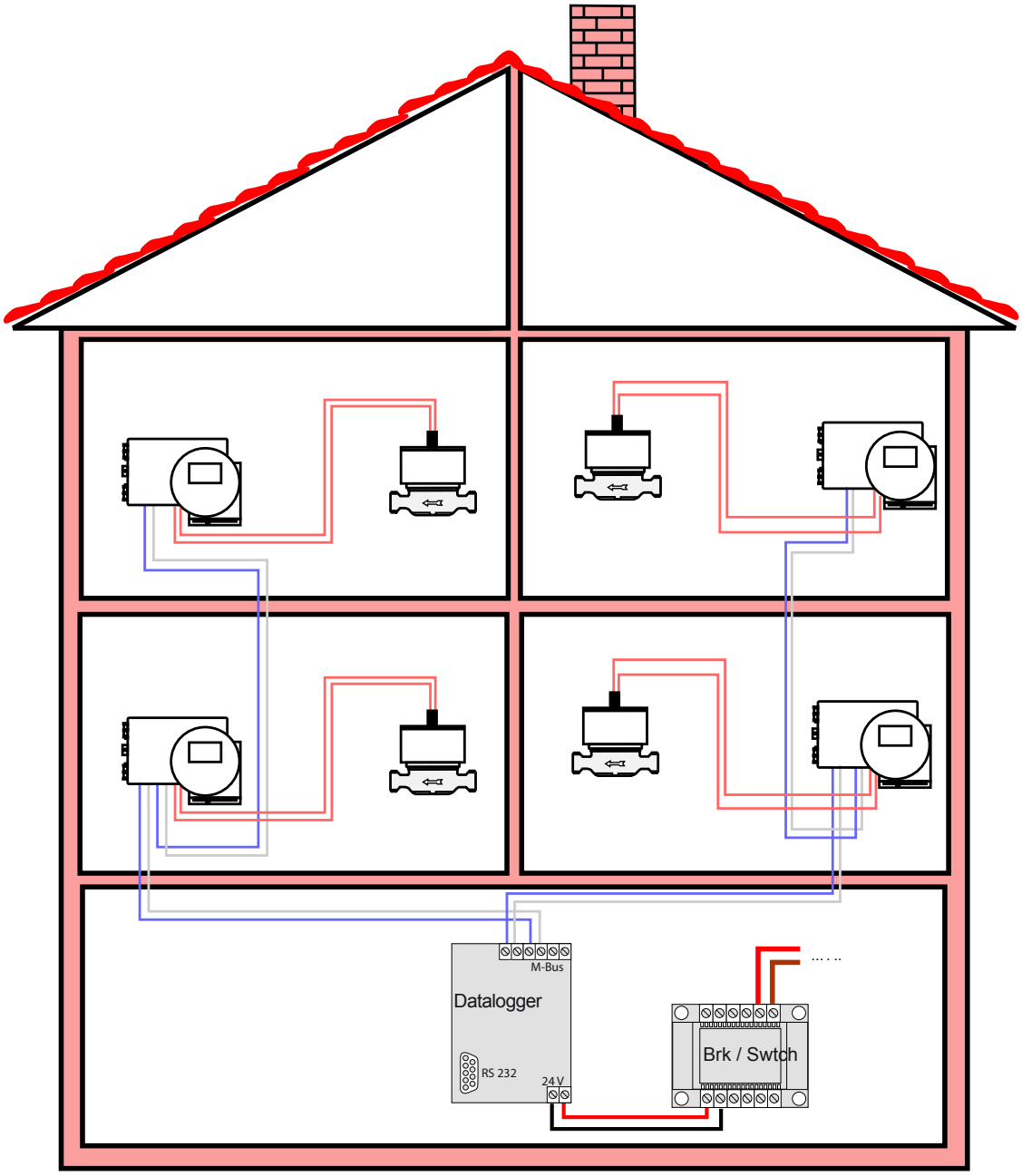
A suitable distribution box must be provided and installed by a qualified electrician. The M-Bus-device must than be wired up in this distribution box.

### Distribution box

- **B-Bus supply to 2-way connecter block**
- **Continuation for additional Bus-devices**
- **Connecting of M-Bus module cable by** commissioning
- **Module cable length 1.5 m**



**Example of M-Bus-wiring diagram for heating- and sanitary installations (internal M-Bus / split version 235-mmx)**



**Addressing / Start-up operation**

Primary addressing:

1 .. 250 intended for measuring instruments

0, 251..255 special addresses

Secondary addressing:

8-digit serial number (along with manufacturer ID, version, and type of device)

Manufacturer ID:

3-digit ID, in mx devices = BER

In order for the M-Bus units to be addressable, they must be given an ID – an „M-Bus address“.
This address is divided into a primary and a secondary address.

## Primary address

The primary address is intended for fast device access. It consists of a number from 1 to 250. This number can be allocated to any M-Bus subscriber. The meter can then be addressed and read using this number.

## Secondary address

If two or more units have been allocated the same primary address a collision will occur during direct reading as several units try to answer the master simultaneously.

The secondary address was created for such a case. It is device-specific and normally corresponds to the serial number of the unit. In its entirety, the secondary address consists of the serial number, the manufacturer ID, version, and type of device. By setting the primary (253) and secondary address each device can be specifically addressed. As the secondary address consists of 8-digit positions, the probability of a coincidental match is very small.

## Manufacturer ID

In addition to the identification described above, each device has a manufacturer ID. In mx, this is BER. Other manufacturer designations are, e.g., REL = relay.

## Special primary addresses

The primary addresses 0 and 251 to 255 are reserved for special tasks, and should not and cannot be used for device addressing.

The address 0 is used for the device initial state; i.e., the device has not yet been addressed and put into operation using this number. The M-Bus modules are also supplied with the primary address of 0, unless the customer has requested otherwise.

| Address | Use |
|---|---|
| **251, 252** | **possible later use in the standard** |
| **253** | **for secondary addressing** |
| **254** | **for commands to all devices with a reply** |
| **255** | **for commands to all devices without a reply** |

## Start-up operation sequence for the M-Bus module

Start-up operation of the M-Bus modules and other bus subscribers must proceed as follows:

1.) Setting the reference day

If the terminal units are to be programmed with a reference day, the desired reference day must be set in the measuring instrument using the chip card before connection to the M-Bus modules

2.) Read-out and addressing

In order to be able to read out the serial number and the current measurement data from the connected measuring instrument, a command must be sent to all M-Bus modules:

***Send the command „Read-out“ (send UD 51d0) to all modules***
***=> Read out the serial number of the device and => set the secondary address***

3.) Search for primary and secondary addresses

After that, the search for modules can be started. Initially, all primary addresses are queried and tagged as free, pro grammed, or multiple allocations. After that, the secondary addresses are searched and listed.

4.) Addressing the device (allocation of primary address)

In the following steps, these modules can now be allocated with a freely programmable address.

5.) Reading the initial value

Finally, the current memory content of the measuring instruments is read from each module.

6.) Write a project list

After completion, a list should be compiled in which the primary address, the corresponding serial number (secondary address), type of device, the initial value, and the installation location is apparent.

**Glossary**

## General

The M-Bus is based on European standard EN 1434 as a normed interface for calorimeters and is used for the teletransmission of meter data. The normed data protocol is dealt with in Part 3 of EN 1434. Apart from calorimeters, water, gas, and, electricity meters can also sometimes be equipped with M-Bus. M-Bus has been standardised since 1997. Meters that were supplied with M-Bus interfaces before this date do not fully correspond with the standard.

## Operating principle

The M-Bus is based on the master-slave principle. The master sequentially requests one or several meters via the M-Bus module to send their data to it. Communication between the slaves is not possible. Data transmission on the M-Bus is carried out bidirectionally, during which work ensues in the master-to-slave direction with voltage differences. An open-circuit voltage of 35 V to 40 V is applied to the repeater output as a logical 1 (mark). The logical 0 (space) corresponds to a voltage of -12 V. In the other direction, from slave to master, current differences are used. Current consumption of approx. 1.5 mA can be measured in the idle-circuit condition as a logical 1 for each slave. Logical 0 designates an increased current consumption of approx. 11-20 mA.

## System components

Devices such as the master, level converter, repeater, and modem, as well as terminal units with their own M-Bus modules are designated system components.

## Lightning protection (power surge protection)

Under certain circumstances, it makes sense to install power surge protection for the M-Bus system components. The installation of power surge protection (observe local regulations) is definitely advisable for open cable routing.

## Baud rate

The transmission speed with which a terminal device will communicate with the master (and vice-versa) is determined by the baud rate. Terminal devices normally operate at 300 or 2400 baud.

## Data format

The M-Bus data format: Asynchronous, 11-bit character length (1 start bit, 8 data bits, 1 parity bit (even parity), 1 stopbit)

## Terminal devices

A unit with an M-Bus module that occupies a separate M-Bus address. A terminal device is often referred to as a slave.

## M-Bus master

An M-Bus master is an „intelligent“ level converter that independently reads the M-Bus modules (meters), and, if equipped to do so, can store their values in its own memory. The master supplies the M-Bus with the required voltage. Its memory can also be read out from a PC with the corresponding software.

## Master

A central M-Bus unit or a PC with read-out software is referred to as a master.

## Modem

A modem enables data transmission of meter readings via the public phone network. Modems used in an M-Bus system must fully support the M-Bus format; i.e., the 11-bit format must be supported. Some of the latest modems work with a 10-bit format and cannot be used with M-Bus systems.

## Node

A node: each individual system component in an M-Bus system is designated as a node. Each master, repeater, and each meter (terminal device) is a node.

## Level converter

The level converter is an interface converter that converts the signals from a PC via the RS 232 interface to an M-Bus signal. This device supplies the M-Bus with the required voltage. The level converter is connected between the master and the terminal device.

## Primary address

The primary address is used for identification of the terminal device within the M-Bus system. If the primary address is used for identification, every terminal device must be provided with a different primary address between 1 and 250.

## Repeater

A repeater serves for signal amplification on the M-Bus and is used for long line lengths.

## Secondary address

As with the primary address, the secondary address is used to identify the terminal device. If the secondary address is used, each terminal device must be provided with a different address. Normally, the terminal device’s 8-digit serial number is used. In its entirety, the secondary address consists of the serial number, the manufacturer ID, version, and device type.

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