GOSSEN METRAWATT

Remote Meter Reading via M-Bus

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SONDERDRUCK

1 M-Bus

The M-bus is an inexpensive solution for widespread networking and remote meter reading for large numbers of heat meters, gas meters, water meters and energy meters from various manufacturers. The task of reading out small amounts of data per energy consumption meter at fairly large time intervals places only minimal demands on transmission speed, and allows for very long transmission distances using simple, standard cables. The M-Bus (meter bus) is based upon the European standard for heat meters, namely EN 1434-3, with regard to data exchange and interfaces.

1.1 System Overview

Consumption meters distributed throughout homes and industrial operations are connected via the M-Bus to a central master, which supplies all of the interconnected meters with electrical power, gathers data, generates consumption profiles and forwards them to the master consumption logging and billing point. Data is transmitted to the meter reader's pocket PC either directly via serial interface, indirectly by means of modems via public telephone lines, or via an optical interface (IrDA).

Incoming data are collected at a server and are saved to a database. Various users are then able to visualize and analyze the data using clients and appropriate software products, or export them to EXCEL® or user-specific billing software for processing. A web server application can be used to process the data, thus allowing for worldwide available on the Internet.

Where large complexes are involved, M-Bus consumption-billing data are often transmitted to parallel installed building service control systems, where they are processed as part of the facility management concept.

Corresponding links between the two systems are implemented either at the lower level by means of protocol converters, or at the upper level using databases.

When consumption logging devices are retrofitted at locations where no M-Bus had previously been available, data can also be transmitted by radio and then incorporated into existing M-Bus installations. This method is being used to an ever greater extent for retrofitting billing systems in real estate holdings.

The M-Bus was developed as a mutual project by TECHEM, Texas Instruments and the university at Paderborn, Germany.

1.2 User Benefits

Use of the M-Bus for remote reading of consumption meters offers various advantages to utility companies, billing service providers and end users:

- Fast, error-free reading
- Simple processing of electronic data
- Accelerated receipt of payments thanks to immediate billing as soon as consumption data is gathered
- Minimal remote meter reading personnel, even for difficult to access meters
- Preservation of the customer's private sphere
- Meter reading on short notice reduces costs associated with meter replacement and tariff changes
- Acquirement of statistical consumption data allows for system and tariff optimization

Broad acceptance of the M-Bus amongst meter manufacturers, planners, installation technicians and end users is achieved by means of:

- Minimal additional costs for connecting the consumption meters to the bus
- Use of a commercially available, easy to use technology
- Good interference immunity and secure data transmission
- Open system with international standardization

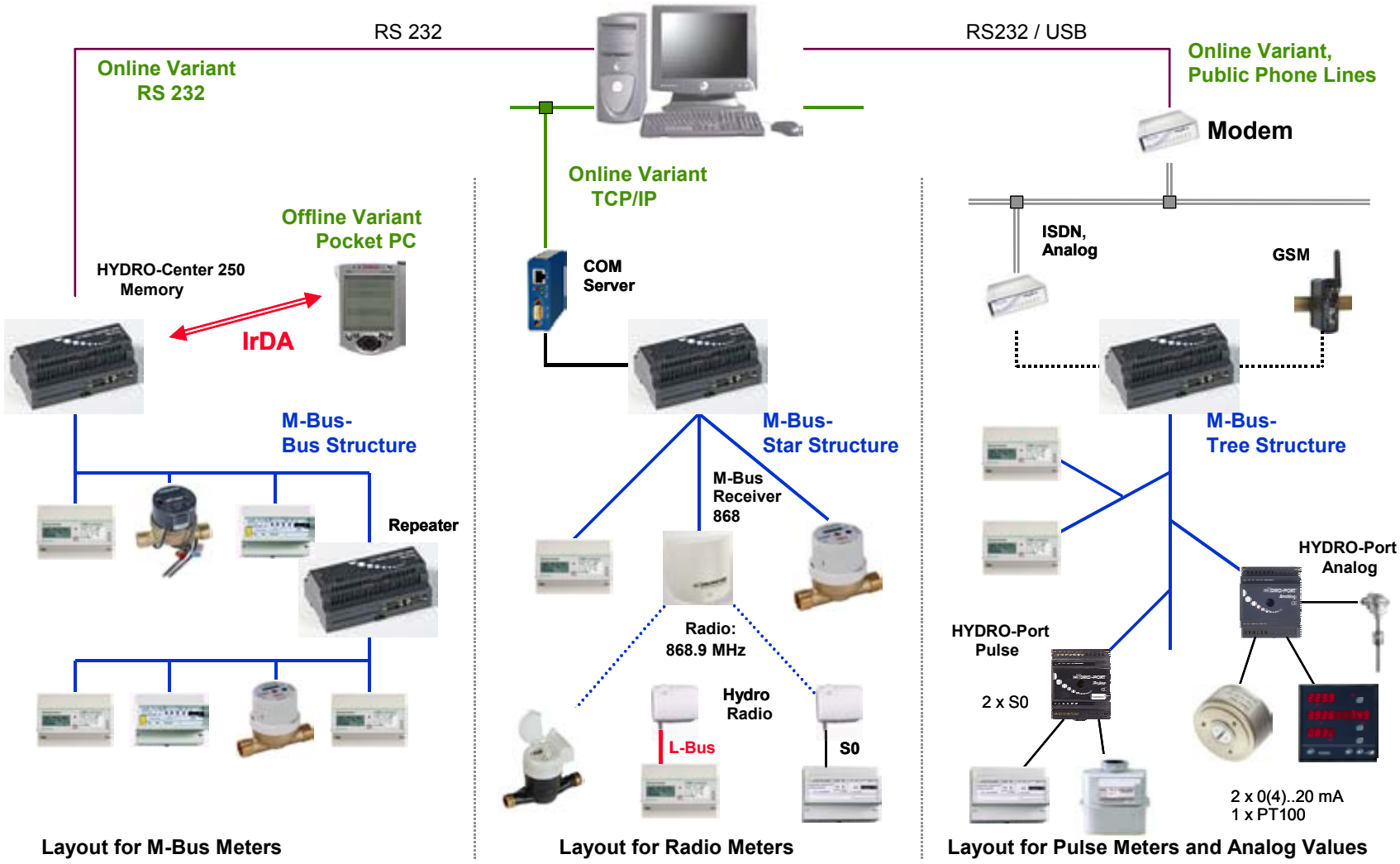

Figure 1: M-Bus System Overview

1.3 M-Bus Technology in Brief

The technical characteristics of the M-Bus are ideally matched to remote meter reading requirements, for which the system was originally developed. These characteristics include:

- Simple, reverse-polarity protected wiring for one pair of wires in a standard telephone cable used for both data transmission and power supply
- Flexible bus topology in linear, star and tree configuration within any given segment, up to 250 users can be connected with a cable length of approximately 1000 meters
- Unlimited system expansion by combining segments into networks with the help of repeaters or masters
- Transmission rate can be adjusted to the specific application within a range of 300 to 38,400 baud with a standard speed of 2400 baud (bits per second)
- Users are electrically isolated and short-circuit proof, i.e. no bus failure in the event of an error at an individual user
- Outstanding data security thanks to high signal level, bus monitoring and diagnosis
- Automatic error detection by means of parity and checksum with a hamming distance of 4 and repetition of data transmission in the event of an error

1.4 Communication Basics

The M-Bus is optimized for querying decentrally acquired measured values by means of a master, and thus makes use of the **master-slave process** for communications purposes.

The M-Bus master initializes communication and addresses the individual slaves either directly using the terminal device's selected primary address (1 to 250), or, in the case of larger installations with more than 250 users, indirectly via address 253 and the secondary addressing procedure.

The master requests the terminal device (1 to 250) to transmit data by means of **primary addressing**. The addressed slave responds with a standard data record which, in the simplest of all cases, consists of the meter reading, the measured medium, the device type, its serial number and the manufacturer's code.

By means of **secondary addressing**, the master uses special address 253 and requests all terminal devices to transmit data, after which it addresses a single terminal device using serial number, manufacturer's code and medium. The addressed slave responds with the standard data record.

Bi-directional **data transmission** from **master to slave** is triggered by changing voltage in the M-Bus. In the idle state (mark), a bus voltage of 36 V prevails at the master's output, and voltage at the master is reduced by 12 V to 24 V in order to initialize the active state (space). The input circuits at the terminal devices recognize this reduction and convert it into receive data.

Data transmission from **slave to master** is triggered by changing current at the terminal device. In the idle state, the slave requires a maximum of 1.5 mA, which corresponds to maximum permissible current demand for supplying one slave with power. In order to initialize the active state, the slave increases its current demand to a level of 11 to 20 mA via the interface module. The master's input circuit recognizes the current increase and converts it to receive data.

1.4 System Components for M-Bus Networks

1.4.1 M-Bus Master

The **M-Bus master** independently acquires and manages all data from the respective M-Bus installation with up to 250 terminal devices. The master can read the interconnected consumption meters at an adjustable interval, and save the meter readings to permanent memory. In the case of masters with integrated display, the customer or caretaker always has access to current meter readings.

A serial interface or an Ethernet port is used for connection to data logging computers, as well as process and building management systems. Consumption data logging and billing centers can access meter readings directly via public telephone lines, if the master is equipped with an integrated or external modem (analog, ISDN, GSM). Masters with a radio interface for gathering data from consumption meters are available in the meantime as well.

Figure 2: M-Bus Master

Alternatively, a master can be created using an M-Bus level converter and a computer with appropriate software. In this case, it doesn't matter if the computer is connected directly to the signal converter or via modem. This cost-effective solution is used primarily in small systems for temporary read-out, or for connecting the M-Bus to computer-based host systems.

M-Bus micro-masters for connection to a laptop are offered for mobile use. They are used for configuring the parameters of individual terminal devices, for service purposes, and for easy read-out of small systems with up to 10 terminal devices. The master application is run on the interconnected laptop, which supplies operating power to the micro-master and all connected terminal-devices.

1.4.2 M-Bus Terminal Devices

All consumption meters with integrated M-Bus interface can be used as M-Bus terminal devices or slaves. The interface and the device are supplied with power from the bus. The interface module switches the terminal device to internal power supply, or initializes the storage of data to non-volatile memory (EEPROM), in the event of power failure. Devices without internal power supply or battery are only operable as long as the master is functional.

An extensive range of M-Bus consumption meters is offered by various manufacturers for media including water, heat, electricity and gas.

Figure 3: M-Bus Terminal Devices – Water Meter, Heat Meter, Energy Meter

1.4.3 M-Bus Converters

Conventional consumption meters with pulse output can be connected to the M-Bus via **pulse converter modules**. The modules can be read out to one or more inputs, and assure uninterrupted functioning in the event of power failure by means of an internal battery. The input pulses are converted into consumption values by means of adjustable parameters. Some of the modules even replicate the cutoff date function.

Figure 4: M-Bus Converter with Pulse Input

Analog converter modules are available for connecting consumption meters or sensors with 0/4 to 20 mA current outputs to the M-Bus. It is thus possible to acquire process quantities such as temperature, pressure, fill-level and flow rate via the M-Bus. An external power pack is usually required for operation of these modules.

Figure 5: M-Bus Converter with Analog Input

1.4.4 M-Bus Repeater

In the case of installations with many users, the M-Bus is subdivided into segments which may include up to 250 terminal devices each with any desired topology. Each individual segment is controlled by one repeater output which corresponds to the output of a master. The repeater's input stage is the same as the input stage of a terminal device. In a greatly simplified form, a repeater is nothing more than an analog level converter.

1.4.5 M-Bus Remote Data Read-Out

Remote data read-out of M-Bus systems is possible via public telephone lines. Analog and ISDN telephone cables, as well as wireless GSM networks are utilized for data transmission. Favorable tariffs are available from radio network operators for pure data transmission. The M-Bus master is linked to the respective telecommunications network by means of appropriate modems, and exchanges data with the billing center via its corresponding counterpart.

An **M-Bus modem master** is available for remote read-out of very small systems, which is a combination of a master and a modem for 20 terminal devices in a single housing.

1.4.6 M-Bus Manual Read-Out

Manual read-out of M-Bus networks is used primarily for applications for which no telephone connection is available. Commercially available **pocket computers** or **laptops** with application software and **hand-held display devices** developed especially for this purpose are used to this end. Data are transmitted optically via IrDA or with a cable via the serial interface between the hand-held terminal and the permanently installed M-Bus master. Data stored to the display device are uploaded to the billing center at a later point in time.

Figure 6: Pocket PC for Manual Read-Out

1.4.7 M-Bus Billing Center

The billing center consists of a server which collects consumption data from various M-Bus networks by means of remote data read-out and saves them to a database. Various clients are able to access the collected data with the help of visualization and analysis software, and evaluate the meter readings in tabular or graphic form. Manual and automatic export functions are available for processing consumption data with host billing systems.

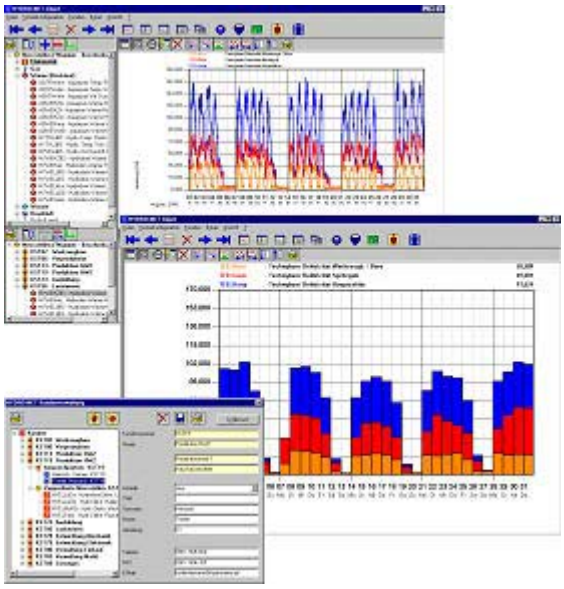

Figure 7: Examples of Billing and Evaluation Software

1.5 System Components for Radio Transmission

Meter readings can be radio transmitted with the **Hydro-Radio system**. Data are received by a hand-held terminal when walking or driving by. Stationary operation is implemented by means of a receiver with M-Bus connection.

The internationally unrestricted radio frequency of 868.95 MHz is used together with the PRIOS protocol for data transmission, as recommended by CEN TC 294. Range depends upon other locally utilized radio frequencies and terrain. A range of up to 400 meters is possible in open areas, which is reduced to 30 to 100 meters in buildings.

1.5.1 M-Bus Receiver 868

The **M–Bus receiver** is designed for use in stationary M-Bus systems. It receives and stores radio data from up to 1000 different consumption meters for heat, water, gas and electricity.

Figure 8: M-Bus Radio Receiver

The last received radio telegram can be read out from the M-Bus meter at freely definable time intervals. Up to 3 M-Bus receivers can be connected to a HYDRO-CENTER 60, and up to 12 can be connected to a HYDRO-CENTER 250. The software included in the HYDRO-CENTER accepts data which has been received more than one time only once.

1.5.2 Bluetooth Receiver

The **Bluetooth receiver** is designed for collecting meter reading while walking or driving by. It communicates with the portable HYDRO–POCKET via Bluetooth®, and is compatible with other terminals as well.

1.5.3 Hydro-Radio Module 868

The **Hydro-Radio module** is suitable for connecting consumption meters to stationary M-Bus systems, as well as for mobile use. It transmits data automatically every 8 seconds over a period of 15 years without replacing the battery.

Figure 9: Hydro-Radio Module 868

The **variant with pulse input** is suitable for all types of meters which are equipped with a pulse generator (dry contact) and an open collector (type NPN). The meter reading and the pulse rate have to be set at the radio module via the optical interface.

Figure 10: U389A Electrical Energy Meter, U389B with Pulse Input

The **variant with L-bus input** is suitable for all types of meters which are equipped with an L-bus interface. The L-bus (low-voltage bus) does not require the high M-Bus level, but is otherwise compatible with regard to transmission protocol and bit coding. The consumption meter transmits meter reading, medium and status via the L-bus. As opposed to the module with pulse input, setting is not required.

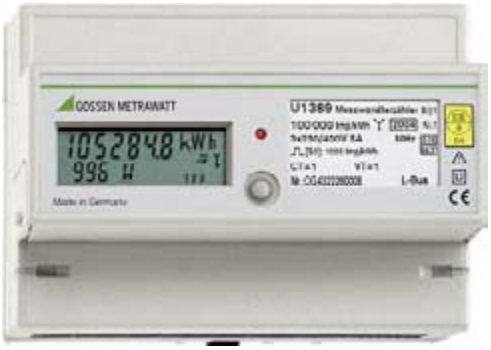

Figure 11: U128x Electrical Energy Meter, U138x with L-Bus (feature W3)

1.5.4 Hydro-Radio 868 Terminal Devices

Meters with integrated radio module are already available for various media. These products can be incorporated directly into the Hydro-Radio system.

Figure 11: Water Meter with Integrated Radio Module

1.6 Additional Information

Comprehensive information regarding the M-Bus can be accessed and downloaded at the M-Bus user group website: www.m-bus.com.

The interfaces included with Gossen Metrawatt's U128x and U138x active energy meters are described in detail in the following documents which can be accessed at www.gossenmetrawatt.com:

- M-Bus Interface Description
- L-Bus Interface Description

1.6.1 Bibliography

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