Siemeca AMR®™
Network Node WTT16/WTX16
M-Bus Specification

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For intra-company use only

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Abstract:

This document describes how to communicate on the M-bus with a network node (up to V2.1) made by Siemens Building Technologies electronic. The document has been created to support customer-specific applications.

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1 General Remarks about the M-Bus

M-Bus Architecture

The M-bus is a pure master / slave bus, i.e., the master determines when communication takes place and which data are transmitted. An M-bus slave is not capable, for example, of transmitting a message on its own to the master in the event of an error. The M-bus design allows the production of low-cost and, most of all, energy-saving slaves, i.e., meters. This is of crucial importance for ensuring that meters will be operational for a period of many years.

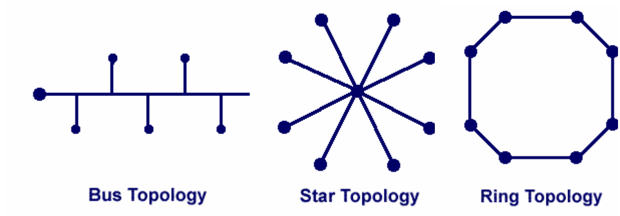
Feeding of M-Bus

The M-bus – slave interface is fed by the bus and has a defined current consumption of 1.5 mA. This current consumption is called one M-bus load. In order to feed the actual meter, more power can be drawn from the M-bus, so that current consumption may exceed 1.5 mA. Consequently, the meter will operate with more than one M-bus load. This fact is important for dimensioning the M-bus system. A repeater or an M-bus master is able to drive a certain number of M-bus devices (with one M-bus load). Whenever a meter draws several M-bus loads, the number of devices to be connected must be reduced accordingly or a repeater must be employed. The M-bus standard allows a device to draw up to four M-bus loads. The number of M-bus loads should be looked up in the operating instructions for the devices concerned.

The bus is protected against polarity reversal for easy installation. In other words, thanks to the voltage-modulated signal that the master uses to the slaves, the polarity of the two leads does not matter when the device is connected. The slaves, for their part, respond with a current-modulated signal. There is a significant disadvantage to it, too. Communication is possible only between the master and the slave. A slave can never receive the current-modulated signals of another slave.

M-Bus Topology

The topology of an M-bus connection can be flexibly adjusted to the conditions in the field. For this reason, both pure lines or bus structures and a star topology can be used. No form of ring topology is permitted, however.



M-Bus Range

The M-bus is a long-range bus capable of linking meters to the M-bus master via a two-wire connection that extends over several kilometers. The range of the M-bus line is mainly determined by the capacity of the cable and the diameter. The greater the cable capacity per 100 meters of cable and the smaller the cross-section of the line used, the shorter the range will be. Accordingly, a parallel connection of several M-bus lines (star topology) will equally reduce the maximum range. If the range within an existing cable network needs to be increased, it helps to operate the meters at a transmission rate of 300 bauds instead of the preset 2,400 bauds. (See also Annex.) Another way to extend the range is to use an M-bus repeater. Such a device receives the signals from the M-Bus master in the first M-bus segment and transmits them in the second M-bus segment to the slaves in an amplified manner (and vice versa). Additionally, it assures the feeding of the second M-bus segment, with the number of loads that can be connected depending both on that segment and on transmission loss. Maximum M-bus ranges are listed in the Annex. If the loads available are not sufficient, additional repeaters may be connected in series or in parallel.

M-Bus Data Transmission Format

Under the Intel format (little endian), data points greater than one byte are transmitted with the least significant byte first. Within a byte, however, bits are transmitted with the most significant bit first (bit 7).

Example:

A consumption value 123456 (BCD-coded) would be transmitted on the M-bus in the following sequence: 56 34 12. Therefore, binary transmission would be “01010110 00110100 00010010” (without showing any start, stop and parity bits).

M-Bus Addressing

An M-bus device (slave) may have two addresses:

- Primary address
- Secondary address

Primary Address

The primary address is determined with the aid of the service tool when the devices are installed. Numbers from 0 to 250 may be assigned to a primary address. Thus, a maximum of 251 devices can be addressed on a primary address M-bus. Primary address "0“ is preset by the manufacturer. It should always be changed during installations, so that a device you may have forgotten will still be found in a search run.

Primary address "253" indicates that the secondary address is used for identifying the M-bus device. The secondary address is transmitted in the application layer.

Address "254" is used as a test address. This means that every M-bus device will always respond to this address, irrespective of its own primary address. For this reason, the test address may only be used when exactly one M-bus slave is connected to the bus. Otherwise, collisions will occur when device responses are sent back.

Address "255" is used as broadcast address. This means that all the M-bus devices connected to the bus receive and process the command from the master. However, no receipt confirmation will be sent back to the master in that case. For this reason, the broadcast address should not be employed to parameterize important settings. There are devices where the primary address cannot be changed. Such devices can only be addressed through an M-bus master which supports secondary addresses.

Secondary Address

The secondary address is a globally unambiguous number assigned by the manufacturer.

The secondary address in the M-bus consists of four parts:

- Device identification (device ID = consecutive number, e.g., 12345678)
- Manufacturer's ID (unambiguous code identifying the manufacturer, e.g., 12901 = "LSE")
- Version (software version of the device)
- Medium (physical measurand of the device, e.g., 6 = "hot water")

In the secondary address, the maximum number of devices is limited only by the characteristics of the cable and the storage capacity of the M-bus master. M-bus systems administered through the secondary address may comprise several thousand devices. A detailed description of the secondary address is provided on Page 18.

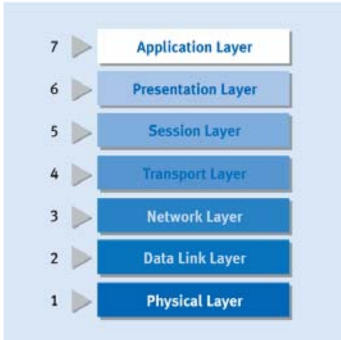
M-Bus Standard

The M-bus was first standardized with the heat meter in EN1434-3 [5]. Since 2005, the M-bus has been standardized in EN13757, together with the COSEM Protocol, as a standard in its own right. The M-bus itself is governed by EN13757-2 [2] and EN13757-3 [3].

The OSI Reference Model

In the last few years, a specific model has gained general acceptance for the description of communication between two machines.

Its underlying idea is to separate the various functions or layers of communication and to assign them to different functional blocks. However, not all of those seven layers are really needed or implemented in every communication link.



The M-bus standard only provides for the following layers:

- Application layer [3]
- Data link layer [2], [4]
- Physical layer [2], [4]

The description of the data link layer relates almost entirely to [1] in this context.

This document is structured according to the three OSI layers supported. For an understanding of the M-bus protocol, knowledge of the application layer of the M-bus is indispensable. If the creation of a separate M-bus master is intended, purchase of the European standard EN13757 listed in the next section is recommended. (The requirements to be met by the hardware are described in [2], while the protocol is set out in [3].

2 References

[1]	EN60870-5-2	Telecontrol equipment and systems – Part 5: Transmission protocols, Main Section 2: Link transmission procedures
[2]	EN13757 – 2	Communication systems for remote reading of meters – Part 2: Physical and link layers
[3]	EN13757 – 3	Communication systems for remote reading of meters – Part 3: Dedicated application layer
[4]	EN13757 – 4	Communication systems for remote reading of meters – Part 4: Wireless meter readout (radio meter reading for operation in the 868 MHz to 870 MHz SDR band)
[5]	EN1434 – 3	Heat meters – Part 3: Data exchange and interfaces
[6]	Data Sheet	„Siemeca™ AMR Remote Meter Readout System – Data Points of Meters“

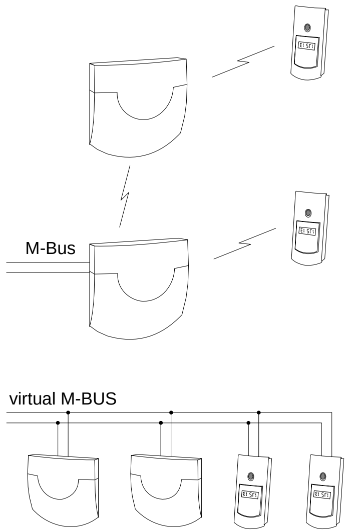
Internet download:

An older version of [2] is available at:
http://www.m-bus.com/files/W4A21021.pdf,

while an older version of [3] can be downloaded from:
http://www.m-bus.com/files/W4B21021.pdf.

3 The Network Node

Radio and M-Bus Devices



The network node (without gateway) is a system device whose job it is to receive and store the data from radioing meters and to make them available for the readout process.

Since the M-bus is a pure master-slave bus, which does not allow messages from the slave to the master to be sent spontaneously, the data received via radio are stored. The M-bus master is in a position at any time to call up a copy of the data.

As a general principle, an M-bus master cannot access the radio channel directly. In order to make the stored radio device accessible to the M-bus master, the network node simulates the existence on the bus of each radioing meter received as a "real" M-bus device. Consequently, the M-bus master addresses the meter directly and also gives the appearance of receiving a response directly from the meter. In other words, the master is not "aware" that, in reality, it is communicating with an entirely different device.

As a result, a network node represents the following devices on the M-bus:

- The network node directly connected to the bus (i.e., itself)
- All the network nodes existing within the radio network
- All the radioing meters existing within the radio network

The number of devices that a network node represents on the M-bus can be determined on the basis of the information shown on the LCD display (sum of B and C levels). Since most radioing meters only possess transmitters but no receivers and since the travel time in the radio channel is much greater than the M-bus standard would permit, many commands that access the devices are only partly executed or are refused (e.g., "Change Cutoff Date").

3.1 Physical Layer

Interfaces

Data can be read out through the following interfaces:

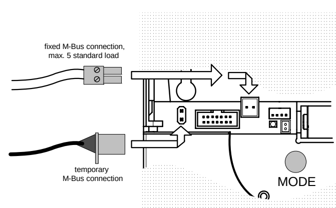
- Radio
- M-bus
- RS232 (WTT16.232 or WTX16.232 only)
- IrDA (network node firmware version 2.2 and higher)

The Radio Interface

In order for the radio interface to be used, a PC equipped with a PC radio module (WTZ.RM) and the ACT26 service tool are required. This interface is not suited for accessing user-specific readout programs and will not be dealt with further in the present material.

M-Bus Interface

The M-bus interface of the WTT16 / WTX16 is an M-bus slave which conforms to the standard, and it features one M-bus load. The M-bus interface is accessible either through a temporary plug-in connection or through a screwed connection for permanent assembly. This interface can only be addressed through an M-bus master module. For this, the proper M-bus master, such as that of the WTX16.GSM or WTX16.IP, is needed.



Alternatively, the M-bus interface of the WTT16 / WTX16 can be addressed with a PC and a special PC – M-bus adapter, such as the WHZ3.USB or WFZ.MBM, and corresponding M-bus master software. The M-bus interface of the WTT16 / WTX16 may be addressed with 2,400 bauds or 300 bauds. Other baud rates will not be accepted. The master recognizes the baud rate automatically. No parameterization is required.

Data are transmitted asynchronously byte by byte. A byte is sent with one start bit, eight data bits, one even parity bit and one stop bit. There must not be any gap between individual bytes. This means that the next start bit has to follow after one or two stop bits. The M-bus standard prescribes minimum and maximum response times for the M-bus slave.

This time interval starts after the telegram has been sent by the master. The slave has to sent a reply back to the master within this time interval.

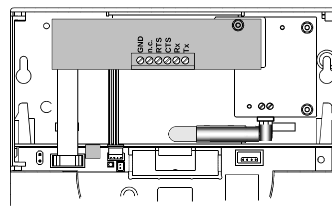
Minimum response delay: 11 bit times

Maximum response delay: 330 bit times + 50 ms

Reading device data consumes additional current. Therefore, the operational life of the battery-powered WTT16 network node is shorter than that of other network nodes within the network. For this reason, it is recommended that the network node readout through the M-bus be limited to one readout per day. If 500 meters are stored, this would correspond to an additional battery consumption of some 3 %.

The RS-232 Serial Interface

The RS-232 interface is only available in the special WTT16.232 and WTX16.232 models. This interface is intended for connecting the network node directly to a PC. M-bus master software like ACT26 may be used for the communication with the network node. The data rate is freely selectable from 300 bauds to 9,600 bauds and can be set with the ACT26 service tool.



Data are transmitted asynchronously byte by byte. A byte is sent with one start bit, eight data bits, one even parity bit and one stop bit. There should not be any gaps between individual bytes. Gaps of up to 8 milliseconds will be accepted, however. The response times of the RS-232 interface are identical to those of the M-bus interface.

Reading device data consumes additional current. For this reason, the operational life of the battery-powered WTT16.RS232 network node is shorter than that of other network nodes within the network. Therefore, it is recommended that the network node readout through the RS-232 interface be limited to one readout per day. If 500 meters are stored, this would correspond to an additional battery consumption of about 5 %.

3.2 Data Link Layer

Telegram Format

The M-bus standard supports several telegram formats in accordance with [1], Format FT1.2:

Single Character	Short Frame	Control Frame	Long Frame
E5h/A2h	start 10h	start 68h	start 68h
	C field	L field = 3	L field
	A field	L field = 3	L field
	check sum	start 68h	start 68h
	stop 16h	C field	C field
		A field	A field
		CI field	CI field
		check sum	user data (0-252 byte)
		stop 16h	check sum
			stop 16h

Single Character

This format contains one E5h (229d) character and serves to acknowledge (CONFIRM) the last successful transmission. Should the node detect that more than one of the stored devices are addressed, it will send the A2h (162d) character as a negative acknowledgement (COLLISION) to signal an apparent collision.

Start and Stop Symbols

Through these symbols, the link layer is in a position to recognize the beginning and end of a telegram unambiguously.

L Field

The L field describes the length of a telegram. The length information takes into consideration all the characters of a telegram, excluding start and stop symbols, the check sum and the L field itself. The two fields should be identical. Otherwise, the telegram is to be discarded.

C Field

The C field (control field) controls the link layer functions of the telegram. The C field is based on standard [1].

A Field

The address field indicates the primary address of the slave that the master is communicating with.

CI Field

The CI field (control information field) controls the functions of the application layer. Through them, this layer determines the structure and significance of the data relayed in the telegram.
User Data
The data points relayed in a data structure, together with such information as length and type data. This data structure is described in greater detail in [3] and consists of a DIB (data information block), VIB (value information block) and DATA (value / user data).

Check Sum

The check sum constitutes the sum (without carry flag) of all the bytes transmitted. It is sent for checking the consistency of telegrams.

Types of M-Bus Telegrams

The table below shows the types of M-bus telegrams (C fields) supported by the network node. Any use of C fields not indicated in the table will lead to an application error. (See "Application Error.")
The Annex lists the telegram types as examples.

Name	C Field Binary	C Field Hex.	Telegram Format	Description
SND_NKE	0100 0000	40	Short frame	Initialization of slave
SND_UD	01F1 0011	53/73	Long / control frame	Send user data to slave
REQ_UD2	01F1 1011	5B/7B	Short frame	Request for class 2 data
RSP_UD	0000 1000	08	Long / control frame	Data transfer from slave to master after request

Table 1: Telegram Types (C Fields) Supported by Network Node (F: FCB Bit)

Follow-up Telegrams (FCB)

Under the M-bus standard [3], large amounts of data can be transmitted by means of follow-up telegrams. Follow-up telegrams are not supported at the network node. If the Frame Count Valid bit (FCV, C Field Bit 4) is set, the Frame Count Bit (FCB, C Field Bit 5) will be ignored.

Normalize / Confirm

In the event of primary address and test address agreement or in the event of a secondary address, a Normalize telegram (SND_NKE) will be acknowledged on a selected device through the E5h (CONFIRM) single handshake signal. Whenever a selected device receives a Normalize telegram addressed to another device, the selection will be cancelled.

Send Data / Confirm

Commands are transmitted from the master to the slave by means of a Send User Data telegram (SND_UD). Every Send User Data telegram with a correct primary address, correct secondary address or test address will be confirmed through the E5h (CONFIRM) single handshake signal. Such confirmation will take place if the telegram is received correctly, irrespective of whether the meter knows the data or is able to store them (link layer confirmation). Whenever Send Data are transmitted with the broadcast address (broadcast; primary address = 255), no confirmation will take place. If a response to a command is expected, the master needs to perform a request (REQ_UD2).

Request Data / Respond Data

To receive data from an M-bus slave, the master must retrieve the data after a command through a special request. Only then will the actual response be transmitted from the slave to the master.
Of the request telegrams defined in the M-bus standard [3], only request user data 2 (REQ_UD2) will be supported by the network node. The retrieval of all the information will thus be effected through the master. The reply is sent back in the Respond User Data telegram (RSP_UD). Request User Data 1 (REQ_UD1) will not be processed. However, a CONFIRM will be sent back in response to a valid REQ_UD1.

M-Bus Protocol

In reply to a request user data (REQ_UD2), the M-bus slave will send a response data telegram (RSP_UD) of the type shown below.

start character	1	$ 68	not changeable
telegram length	2	$ 6F	length = 111 bytes
telegram length	3	$ 6F	
start character	4	$ 68	not changeable
c-field	5	$ 08	respond with data
address field	6	$ AA	primary device address (e.g. =170)
ci-field	7	$ 72	variable structure response
device identification	8	$ 78	device identification
device identification	9	$ 56	(e.g. 12345678)
device identification	10	$ 34	
device identification	11	$ 12	
manufacturer id	12	$ 65	manufacturer (e.g. = 3265h = lse)
manufacturer id	13	$ 32	
version	14	$ 03	software version (e.g =03)
medium	15	$ 08	heat cost allocator
access number	16	$ 1B	number of interrogations (e.g. = 27)
status	17	$ 00	error status (e.g. no error)
signature byte 1	18	$ 00	no encryption
signature byte 2	19	$ 00	no encryption
variable data			
checksum	…	$ xx	to check bit errors during transmission
stop character	…	$ 16	not changeable

Actual data are transmitted with one or several variable length data points (in the 'variable data' part). Those data points can be transmitted in an arbitrary order, which may change even from one transmission to the next.

Each data point starts with control fields (DIF, DIFE, VIF, VIFE), which describe the decryption (length, format, unit, etc.) of the data value. A detailed description of these control fields is provided in [3].

Addressing The network node supports primary and secondary addressing.

Primary Addressing

Primary addresses 0...250 can be assigned to the network node. Primary address "0“ is preset by the manufacturer. In addition to the assigned primary address, the network node also responds to test address 254 and broadcast address 255. The primary address always serves to address the M-bus connected network node itself. The (virtual) devices stored in it can only be addressed through secondary addressing. (See also Page 8.)

Secondary Addressing

If the master sets the primary address to 253, the slaves will be identified through the secondary address. The slave, for its part, will respond with the correct primary address (provided that it has a primary address). The devices stored in the network node do not have any primary address and will equally respond on the M-bus with primary address 253.

The secondary address succeeds the CI field (CI = 72) and is always structured as follows:

Name	Format	Example
Device Identification	4 bytes (BCD)	01234567
Manufacturer Code	2 bytes (binary)	3265h (12901dez.) = "LSE"
Version	1 byte (binary)	01h
Medium	1 byte (binary)	0Eh

Table 2: Secondary Address on the M-bus

The example shown in Table 2 is transmitted on the M-bus in the following order:

67 45 23 01 65 32 01 0E

Device Identification

The device identification is always given as an 8-digit figure shown in binary-coded decimal numbers (BCD).

Manufacturer ID

The manufacturer ID shows the manufacturer's globally unique code. The manufacturer ID may be computed from the three letters of the manufacturer identifier. The following formula is used for this purpose:

Manufacturer ID = [ASCII(1st letter) – 64] x 32 x 32
+ [ASCII(2nd letter) – 64] x 32
+ [ASCII(3rd letter) – 64]

Siemens Building Technologies electronic (formerly known as Landis und Staefa electronic) with the "LSE" identifier thus carries the manufacturer ID "12901."

Version

The version provides the current software version of the device. Since the software version is part of the address, a network node will change its address following a software update. In other words, should a node be given a software update after it had been connected to an M-bus master, a new search run needs to be performed, so that the master can address this network node again.

Medium

The medium indicates the physical measurand of the device. Medium 14 has been set aside for the network node which is not a meter.

Medium (decimal)	Medium (hex)	Meaning
00	00	Other
01	01	Oil
02	02	Electricity
03	03	Gas
04	04	Heat (volume measurement in return pipe)
05	05	Steam
06	06	Hot water (30°C to 90°C)
07	07	Cold water
08	08	Heat cost allocator
09	09	Compressed air
10	0A	Cold (volume measurement in return pipe)
11	0B	Cold (volume measurement in flow pipe)
12	0C	Heat (volume measurement in flow pipe)
13	0D	Heat / cold
14	0E	Network node / system device
15	0F	Unknown

Table 3: List Showing all the Media Supported in Accordance with [3]

Extended Secondary Addressing

If the device identification is subsequently changed (e.g., when a radio pulse adaptor for water meters is retrofitted), Siemeca devices will automatically and additionally broadcast a fabrication number. The fabrication number is a copy of the original device ID. It prevents any address conflict from occurring on the M-bus (and on the radio channel), even if the same device ID has inadvertently been programmed in two different devices. The master has to use extended selection for that purpose.

However, if a meter is simultaneously registered in two networks or two network nodes from one network are connected to the M-bus, there will still be a collision, even if extended selection (without wild cards) is used. The reason for such a collision is that the meter is simulated on the M-bus by two network nodes. Thus, the same device address does, indeed, exist twice on the M-bus.

3.3 Application Layer

Master to Slave
CI Field (Master)

The following table lists the CI fields which the network node accepts from the master. Any CI field other than those given will result in an application error. (See Application Error.)

SND_UD: master->slave	CI Field	Frame Format	Remark
application reset	50h	control frame	
application select	50h	long frame	Additional sub code is used for selection.
send data [1)]	51h	long frame	
selection of slaves	52h	long frame	
deselection of slaves	56h	long frame	
set baud rate [2)]	B8h...BDh	control frame	Not for M-Bus! RS-232 only!

Table 4: CI Fields Accepted by Network Node

Note ⓘ:

An acknowledgment (CONFIRM / COLLISION) is sent in response to an SND_DU, even if the CI field is not recognized or the command is not executed. The acknowledgment applies to successful transmission on the link layer only. Any application error that may have occurred can be queried through an REQ_UD2.

The Set Baud Rate command can only be applied to the RS-232. The baud rate is automatically switched (300 bauds / 2,400 bauds) at the M-bus interface. The command will be ignored.

Application Reset / Select

With the aid of Application Reset, the response of the network node can be configured for the meters stored. To this end, three groups of data may be selected:

Selected Data	Meaning
Standard Data	Contains current values, cutoff date values and error information.
Statistical Data	Contains the consumption of the first measurand at the end of each month concerned.
Tariff Data	Contains the consumption of the second measurand at the end of each month concerned (water meters only).

Table 5: Data Groups that May Be Selected at the Network Node for Each Meter Stored

Whenever an application reset is performed on a meter stored in the network node, the standard and statistical data will be configured as a standard response. An application reset can also be used to delete an application error.

Application Reset

		(Hex) Code
CI field	1	50

Application Select

		(Hex) Code	
CI Field	1	50	
Sub code for application select	2	30	Example: standard + statistical data

The following combinations are possible:

Application Select	Selected Data for Response
10	Standard data only
20	Standard data only
30	Standard and statistical data
40	Standard and tariff data
Other	No impact. Application select will be ignored (no application error).

Table 6: Coding for Application Select

Application Select is stored permanently and preserved until the next Application Select or Application Reset is effected. Application Select can only be executed on meters. The network node will ignore any form of Application Select.

Send Data

Send Data is used for transmitting commands to the network node or to the devices stored in it.

Send Data

Send Data		(Hex) Code	
CI Field	1	51	
DIF	2	01	Example: Set primary address to "1."
VIF	3	7A	
Value	4	01	

Select / Deselect

The Select command serves to select a specific device on the M-bus for communication. "Select" is required only if the slave is to be operated through a secondary address. Only one device may be selected on the bus at any given time. Otherwise, collisions may be caused by slaves responding simultaneously. In such a case, not only invalid responses, but also telegrams with a seemingly correct content may reach the master, so that deselection will be compulsory. Nor may any wildcards be used in the selection process, as they are bound to result in multiple selection.

Select

		(Hex) Code	
CI Field	1	52	
Device ID (4th byte)	2	78	Device ID = 12345678
Device ID (3rd byte)	3	56	
Device ID (2nd byte)	4	34	
Device ID (1st byte)	5	12	
Manufacturer (2nd byte)	6	65	Manufacturer ID "LSE" = 12901 (decimal)
Manufacturer (1st byte)	7	32	
Version	8	01	Software version = 01
Medium	9	08	Heat cost allocator

When the communication is finished, the device needs to be deselected. Deselection should always take place at the end of any given communication and not just when the next communication with another device starts.

There are several ways to deselect a device in the network node:

- "Deselect" command on the device selected
- "Select" command on another device
- SND_NKE on the selected device or another device
- Change of data rate

Deselect

		(Hex) Code	
CI Field	1	56	
Device ID (4th byte)	2	78	Device ID = 12345678
Device ID (3rd byte)	3	56	
Device ID (2nd byte)	4	34	
Device ID (1st byte)	5	12	
Manufacturer (2nd byte)	6	65	Manufacturer ID "LSE" = 12901 (decimal)
Manufacturer (1st byte)	7	32	
Version	8	01	Software version = 01
Medium	9	08	Heat cost allocator

Extended Select / Deselect

If the network node identifies a COLLISION following selection (without wildcards), a conflict of address may exist. This means that the same device ID is used in two meters. In a case of this kind, extended selection, which takes the fabrication number into account, would be helpful. (See also Page 20.)

Extended Select		(Hex) Code	
CI Field	1	52	
Device ID (4th byte)	2	78	Device ID = 12345678
Device ID (3rd byte)	3	56	
Device ID (2nd byte)	4	34	
Device ID (1st byte)	5	12	
Manufacturer (2nd byte)	6	65	Manufacturer ID "LSE" = 12901 (decimal)
Manufacturer (1st byte)	7	32	
Version	8	01	Software version = 01
Medium	9	08	Heat cost allocator
DIF	10	0C	
VIF	11	78	
Device ID (4th byte)	12	32	Fabrication number= 98765432
Device ID (3rd byte)	13	54	
Fabrication number(2nd byte)	14	76	
Fabrication number(1st byte)	15	98	

Set Baud Rate

Using the CI fields listed in the table, the baud rate can be set at the RS-232 interface. Owing to the fact that the baud rate is automatically recognized and set, any baud rate setting through the M-bus will be ignored.

CI Field (Hex)	B8	B9	BA	BB	BC	BD
Baud rate	300	600	1200	2400	4800	9600

Table: Baud Rates Which May Be Set at the RS-232 Interface of the Network Node

Slave to Master
CI Field (Slave)

If the network node has received an REQ_UD2, it will respond with an RSP_UD. The table below shows the various responses possible.

RSP_UD: slave -> master	CI Field	Frame Format	Remarks
Report of application error	70h	Long frame	Used in case of application error
Respond variable data	72h	Long frame	Standard or command response

Application Error

If an M-bus master triggers an invalid command on the network node, the successful transmission of the command will be acknowledged (CONFIRM "E5h"). Together with the next request (REQ_UD2), an application error (report of application error) will then be sent instead of a normal response (RSP_UD).

Application Error		(Hex) Code	
CI Field	1	70	
Application error code	2	10	Example

The following application errors may occur:

(Decimal) Application Error Code	(Hex) Application Error Code	Meaning
00	00h	Non-specified error
01	01h	CI field not supported.
02	02h	Telegram does not fit into input buffer.
04	04h	Premature end of telegram
05	05h	More than 10 DIFEs in a single data point
06	06h	More than 10 VIFEs in a single data point
08	08h	The application is very busy and cannot respond at present.
16	10h	Access refused. (User, password or authorization invalid.)
17	11h	Command not recognized or supported.
18	12h	Parameter missing or wrong.
19	13h	Unknown receiver address

Table 7: Application Errors of Network Node The application errors contained in the lines highlighted in gray are not listed in [3].

The application error may be queried as often as required. However, it will be deleted automatically after about four minutes. Also, it will be reset by every new command. This way, the standard response of the network node can be obtained by an Application Reset prior to the Request.

Standard Response of the Network Node

If the network node is sent a Request (REQ_UD2), with no command preceding it, the network node will always send back the standard response as its response (RSP_UD).

The standard response to a Request will also be given following a command for which no response is generated, but was executed without any application error occurring (positive feedback).

A command, in respect to which a response is expected, will produce the command response (RSP_UD) after the Request (REQ_UD2) or an application error if the command could not be executed successfully. In order to force the standard response of the network node, an Application Reset can be requested.

The response telegram of the network node is always composed of an invariable and a variable part and is structured in the following manner: (This table shows the application layer only.)

Standard Response		(Hex) Code	
CI Field	1	72	
Device ID (4th byte)	2	78	Device ID = 12345678
Device ID (3rd byte)	3	56	
Device ID (2nd byte)	4	34	
Device ID (1st byte)	5	12	
Manufacturer (2nd byte)	6	65	Manufacturer ID "LSE" = 12901 (decimal)
Manufacturer (1st byte)	7	32	
Version	8	22	Software version = 22 (equivalent to V2.2)
Medium	9	14	Network node / system device
Access number	10	03	Example: Consecutive telegram number = 3
Status	11	04	Example: Weak battery indication
Signature (2nd byte)	12	00	Encryption always 00 00.
Signature (1st byte)	13	00	
Variable data..	...	xx	Start of variable data
….		xx	

The CI field is followed by an 8-byte secondary address, as described in the Secondary Addressing section.

The Invariable Part of the Response Telegram

Access Number

The access number is a consecutive number, which is increased with every Request (REQ_UD2). If the value 255 is surpassed, numbering will restart at 0. This field ensures that telegrams and check sums always change, even if the current meter reading remains unchanged.

Status / Error Codes

The status represents the error status of the network node or the error status of the device stored in it. The status is coded in a bit-by-bit manner.

Error Bit	(Hex.) Value in the Event of a Single Error	(Decimal) Value in the Event of a Single Error	Meaning
0	00h	00h	No error
	01h	01h	Reserved
1	02h	02h	Application alert (atypical consumption)
	03h	03h	Reserved
2	04h	04h	Weak battery
3	-	-	Permanent error (in combination)
4	-	-	Minor error (temporary error (in combination))
5	28h		Serious device error (permanent error)
6	50h		Values measured outside of permissible range (temporary error)
7	88h		Communication permanently interrupted (permanent error)
	90h		Communication temporarily interrupted (temporary error)

Table 8: Error Codes in Status Field. The lines highlighted in gray are defined by the manufacturer (by SBTE in this case).

Status bits 5, 6 and 7 are always set together with bit 3 or 4. Status bit 7 is set by the network node if the connection to the device is interrupted. Any attempt by the network node to reestablish the connection will be marked as temporary interruption of communication. If such attempts remain unsuccessful, the status will be converted to permanent interruption of communication. Communication errors are displayed with an error date.

Status bits 5 and 6 are taken over from the device received. Bit 6 shows a temporary device error, which may correct itself (e.g., temperature in flow pipe too high). Bit 5 indicates a permanent device error (serious error), which requires servicing in any case whatsoever. The exact cause of the error in the malfunctioning device can be determined directly on the device by means of a service tool. Permanent device errors are transmitted with an error date.

There may even be several errors occurring together.

Example:

1. Error code 168 (A8h) indicates a permanent device error and permanent interruption of communication at the same time.
2. Error code 188 (BCh) shows a discharged battery, a permanent device error and temporary interruption of communication at the same time.

Signature

In accordance with [3], the signature shows whether and how the telegram is encrypted. The encryption on the M-bus is not supported in the network node. It is always 00 00.

The Variable Part of the Response Telegram

The variable data points start after the signature. These may vary as a function of the commands given by the M-bus master or as a function of the device configuration or the software version. Each data point starts with a DIF field. From the DIF or the DIFEs that may exist, the lengths of the data point and, with it, the beginning of the next data point can be determined. The use of DIF and DIFE control fields is explained in the M-bus standard [3].

Operating Hours

This value shows the number of hours elapsed since the network node was started up.

Example:

0C 22 34 12 00 00
indicates 1,234 operating hours, hence 51 days.

Current Date & Time

This data point shows the date and time of the network node. Being a type F data point, this data point is encrypted in accordance with [3].

Example:

04h 6Dh 1B 06 CE 06
corresponds to June 5, 2006, 5:27 a.m. (Standard Winter Time).

Albatross ID

This value provides an unambiguous device type identifier. This value is used to ensure the exact identification of devices for service tools and does not have to be stored or transmitted for billing purposes.

Example:

06 FD 0C 14 00 0E 00 22 03
is an Albatross ID of the WTT16.

Device Type (ASN)	This data point shows the device type. For the network node, the device type is either WTT16 or WTX16. Device types are presented as a 5-character ASCII string in inverse order.
Example:	0D FD 0B 05 36 31 54 54 57 shows a WTT16.
Status / Error Date	The error date contains a valid value if the meter status indicates a permanent device error or temporary or permanent interruption of communication. (See also Page 29.) An invalid date is shown with FFh FFh.
Example:	32 6C FF FF This is not a valid error date.
Network Index	For servicing purposes, it is often useful to establish exactly in which radio network the network node is located. This data point furnishes such information.
Example:	02 FA 3D *nn kk*

nn	M-bus primary address of the network node through which the radioing devices are presented on the M-bus – 8-bit binary coded
kk	is the primary radio broadcast address of the node itself. The primary radio broadcast address of a network node is shown on display level A - 8-bit binary coded.

Example:	02 FA 3D 02 0A shows network node 10. It forms part of the network that is reached through the network node with M-bus primary address 02 on the M-bus.
Main Battery Power Consumption	This data point shows the remaining capacity of the exchangeable main battery in percent. Since this consumption cannot be presented as a normal M-bus data point, the unit of this value is shown with a variable VIF. The unit is ASCII-coded and rendered in inverse order according to the M-bus. It shows "% Batt." A 255 consumption value signals that the network node concerned is fed externally and not fed through a battery. There is no data point for the capacity of the backup battery.

Example: 01 7C 06 54 54 41 42 20 25 64
indicates a remaining capacity of 100 percent.

Since no binding device replacement interval has been set for the network node (calibration validity) – as is the case for water meters, for instance – the node may be operated up to the end of the battery life.

3.4 Special Network Node Commands

Selection of a Device in the Memory

In order to be able to read the addresses of the stored devices, the master needs to select the correct position in the memory. The memory block and the memory location are required for that. There are two memory blocks:

Memory Block	Memory Location	Explanation
#1	1..500	Contains the addresses of all the meters stored.
#2	1..12	Contains the addresses of all the network nodes stored.

Table 9: The memory block is selected through special DIFs and DIFEs [3].

Memory block #1 (meters): DIF = 42h
A DIFE is required for memory block #2.
Memory block #2 (network nodes): DIF=82h DIFE=01h

The individual device is selected within the memory block through the memory location number.

"Last Memory Location" Command

In order for all the devices to be read out efficiently, the occupied memory area must be known. Typically, memory occupancy starts with memory location 1. This command allows the last memory location number used to be read. Various memory locations may not be occupied (e.g., when the device has been deleted). For this reason, an unused memory location does not signal the end of the occupied memory. The command may be applied to memory blocks #1 and #2.

SND_UD #1: 48 FD 22
SND_UD #2: 88 01 FD 22

The response to an REQ_UD2 refers to the largest memory location used, either for the meter memory (#1) or the network node memory (#2).

RSP_UD #1: 42 FD 22 mp mp
RSP_UD #2: 82 01 FD 22 mp mp

mp mp the largest memory location number used (memory position) – (16-bit binary value (unsigned integer))

"Read Secondary Address" Command

Many devices are stored at one single memory location in the network node. This command furnishes the complete secondary address for the memory location selected in the event that the memory location is used.

SND_UD #1:
42 7A mp mp 08 79

SND_UD #2:
82 01 7A mp mp 08 79

The mp mp value constitutes a 16-bit binary value (integer) for the identification of the memory location selected. The lowest-value byte is transmitted first (LSB first).

Example:

42 7A 23 01 08 79
selects memory location 291 (=123h).

Depending on the memory block selected, the command provides the following responses after an REQ_UD2:

RSP_UD #1:
42 7A mp mp 07 79 id id id id ma ma vv mm

RSP_UD #2:
82 01 7A mp mp 07 79 id id id id ma ma vv mm

If there is a secondary address at this memory location, whose device ID is different from the fabrication number, the following response will appear:

RSP_UD #1:
42 7A mp mp 07 79 id id id id ma ma vv mm 0C 78 fn fn fn fn

RSP_UD #2:
82 01 7A mp mp 07 79 id id id id ma ma vv mm 0C 78 fn fn fn fn

mp mp	queried memory location number (memory position) – (16-bit binary value (unsigned integer))
id id id id	Device ID – 32-bit (8-digit) BCD-coded
ma ma	Manufacturer code – 16-bit binary value (unsigned integer)
vv	Version – 8-bit binary value (unsigned integer)
mm	Medium – 8-bit binary value (unsigned integer)

Example: RSP_UD: 42 7A 23 01 07 79 78 56 34 12 65 32 14 0E 0C 78 32 54 76 98

Memory block	#1 (DIF = 42)
Memory position	291 (123h)
Device ID	12345678
Manufacturer ID	LSE (3265h)
Version	20 (14h)
Medium	14 (0Eh)

In the response, too, the lowest-value byte is transmitted first (LSB first).

If the memory location is not used or if the memory location number selected is invalid, only a shortened response will come up:

RSP_UD #1:
42 7A mp mp

RSP_UD #2:
82 01 7A mp mp

mp mp queried memory location number (memory position) – (16-bit binary value (unsigned integer))

Search Run und Readout of an M-bus with Network Node

In order for an M-bus master to communicate with an M-bus slave, the master must know the address of the device. To this end, it must learn in all the available devices on the M-bus when it is first started. The master uses different approaches for primary-address and secondary-address devices.

Search Run of Primary-address Devices

A total 251 M-bus slaves may be connected to an M-bus line.

1. Accessing test address 254 with SND_NKE
    a. If no response has been received within the maximum response delay, there are no devices on the M-bus. (The master should repeat the test.)
    b. If exactly one CONFIRM has been received within the maximum response delay, there is only one device on the M-bus. The master sends an REQ_UD2 to read out the device data.

c. If more than one CONFIRM or something else has been received as CONFIRM, there is more than one user on the M-bus. The primary search run is started.

2. Commencing with address 0, an SND_NKE is sent to each primary address. The next address will not be called up until the maximum response delay has elapsed.

   a. If a CONFIRM is received, the master will send an REQ_UD2 to the valid primary address to read out the device data.

   b. If several CONFIRMs or something else are received, the test at this address should be repeated. If the result proves to be the same, two devices have been programmed with the same primary address. An alert or an error message should be issued. After that, the search run is to be continued.

The primary search run may be shortened by the user predefining the maximum number of M-bus devices.

Search Run of Secondary-address Devices (Wildcard Search)

The devices stored in the network node cannot be accessed by primary addressing. If this is the case, the master will resort to the wildcard search described in [3]. Under this method, the master will use wildcards for parts of the address which are accepted by every M-bus slave. Depending on the result – i.e., whether none, one or several devices respond – the address will be broken down further.

As wildcard symbol, "F" is used in BCD-coded parts of the address, while "FFh" is used in binary-coded parts of the address.

Example:

The following network nodes are connected on an M-bus. But only the network nodes "selected" respond to a "Select" sent to address FF 0F 00 10 65 32 FF 0E (LSB first).

Device ID	Manufacturer ID	Version	Medium	Response to a Select
10000**001**	LSE	20d	14d	Yes
10000**987**	LSE	20d	14d	Yes
1000**1**001	LSE	20d	14d	No
10000001	LSE	21d	14d	Yes
10000001	LSE	20d	15d	No

Readout of Device List from Network Node

The wildcard search will take the longer, the more users there are on the M-bus. Since a network node may represent up to 500 devices and 12 network nodes on the M-bus and several network nodes (from different networks) may be connected to the M-bus, a wildcard search would possibly take many hours to complete. For this reason, another method for learning in devices has been implemented in version 1.4 and higher.

1. A primary search run is carried out. In this run, all the devices with unambiguous primary addresses will be found.
2. The M-bus devices recognized must be identified as network nodes. For this purpose, the secondary address of each M-bus device found is checked. Each of the following conditions have to be met:
    a. Manufacturer must be LSE (3265h or 12901).
    b. Version must be higher or equal to 0Eh (or 14d).
    c. Medium must be equal to 0EH (or 14d).
3. The following procedure is applied to each network node identified:
    a. Select network node.
    b. Send Last Memory Location command (memory block #1) to the primary address of the network node and wait for CONFIRM.
    c. Send REQ_UD2. The response will contain the last valid memory location.
    d. Send Read Secondary Address command to memory location 1 and wait for CONFIRM.
    e. Send REQ_UD2. The response contains the secondary address of the device at memory location 1. This address will be stored in the device list of the master.
    f. Using a memory location number increased by 1 in each case, repeat steps d. and e. until the last valid memory location has been read out.
    g. If network node information is to be read out as well, steps b. through f. also need to be repeated for memory block #2.

h. Now, the master possesses a complete list of all the devices of this network node. The network node is to be deselected.

4. Once the secondary addresses of all the stored devices have been read out and stored in the device list, the M-bus master will start the read-out process.

    a. To this end, every device registered in the device list is to be selected.

    b. Using an REQ_UD2, the current data of the devices are queried.

    c. The device is to be deselected thereafter. (This may also be done by selecting the next device.)

5. Now, the data of the devices not recognized as network nodes under step 2. should be read out as well.

6. In conclusion, the bus is to be reset by an SND_NKE sent to the primary address of a network node.

The disadvantage of the procedure described above is that only primary-address M-bus devices and the radioing meters stored will be found. Correct M-bus devices, which do not support primary addressing, will only be found through a wildcard search. The same applies to situations in which more than one M-bus device is employed and where the primary address is permanently programmed to 0 and cannot be changed. Collisions on primary address 0 can only be prevented by using the secondary address or by switching off competing devices.

4 Meters

Memory Block
(storage number)

Not only does each meter transmit the current consumption reading, it also relays the consumption at predefined times. As a consequence, there are several dates and numerous consumption values. In order for them to be presented in the right context, the data points belonging together use the same memory block number (storage number.

Memory Block	Meaning
#0	Current consumption
#0	Current status and device information
#1	Consumption at cutoff date
#8..#25	Statistics (consumption at end of month)

Table 10: Use of Memory Blocks in Meters

It should be noted that meters do not switch from Standard Summer Time to Standard Winter Time and back. Therefore, a one-hour difference to real time may occur even in new devices.

4.1 Current Data (Memory Block #0)

The Annex lists an example of communication between the meter and the M-bus master for all the data points presented.

Albatross ID

This value provides an unambiguous device type identifier. This value is used by service tools and need not be stored or transmitted for billing purposes.

Example:

06 FD 0C 2B 00 07 00 5D 02 is the Albatros ID of the WFM36.

Network Index

For servicing purposes, it will be helpful to find out in which radio network the meter is received. This data point furnishes such information.

02 FA 3D *nn kk*

nn — M-bus primary address of the network node through which the meter is represented on the M-bus – 8-bit binary coded

kk — is the primary radio broadcast address of the node that receives the meter directly and transmits its data. The primary radio broadcast address of a network node is shown on display level A - 8-bit binary coded.

Example:

02 FA 3D 02 0A
shows that the meter is received by network node 10 and distributed in the network. The network node carrying M-bus primary address 02 presents the meter on the M-bus.

Current Date & Time

This data point shows the time when the consumption data are generated in the meter and sent off. As running time in the radio network may stretch over several days (or be considerably longer in the event of an error), the current date and time of the meter are perceptibly different from the actual readout time. Being a type F data point, this data point is encrypted in accordance with [3].

Example:

04 h6 Dh 1B 06 CE 06
corresponds to June 5, 2006, 5:27 a.m. (Standard Winter Time).

Current Consumption

This value shows the current consumption at the current date.

Example:	0C 13 35 00 00 00 shows a current consumption of 35 liters.
Leakage Duration	In selected volume meters, such as WFx36 water meters, leakage duration is transmitted as well. This current value is given in hours and describes the period since when water has been consumed without any interruption (e.g., in the event of a defective toilet flushing mechanism). When leakage duration exceeds a predefined limit, an additional application alert will be transmitted in the status message. (See Page 29.)
Example:	02 BB 56 05 00 shows that consumption has been uninterrupted for five hours.
Status / Error Date	The error date contains a valid value when the meter status indicates a permanent device error or temporary or permanent interruption of communication. (See also "Status / Error Codes" on Page 29.) An invalid date is presented with FFh FFh.
Example:	32 6C FF FF This is no valid error date.

4.2 Cutoff Date Data (Memory Block #1)

Cutoff Date

The cutoff date shows the end of a billing period and is usually set to December 31 of each year. It can be changed directly on the meter by means of service tools. The cutoff date is presented with memory block #1. If no cutoff date has been reached yet, either
FF FF ("x x x") or FF FC ("31.12.--") will be transmitted.

Example:

42 6C DE 04
shows the most recent cutoff date in relation to April 30, 2006.

42 6C FF FC
shows that the next cutoff date has been preprogrammed for December 31. But no cutoff date has been exceeded yet. (Cutoff date is still invalid.)

Consumption at Cutoff Date

This value shows the consumption of the meter at the end of a given cutoff date. If no cutoff date has been exceeded yet, "0" consumption will be transmitted. There are two consumption values at the cutoff date for heat meters or heat / cold meters.

Heat Meters (Medium 04d)

- Heat energy consumption marked as tariff 0
- Volume consumed marked as tariff 0

Example:

4C 04 34 12 00 00
shows a consumption of 12.34 kWh, while

4C 13 23 01 00 00
shows a consumption of 123 liters.

Heat / Cold Meters (Medium 13d)

- Heat energy consumption marked as tariff 0
- Cold energy consumption marked as tariff 1

Example:

4C 04 34 12 00 00
shows a (heat) consumption of 12.34 kWh, while

CC 10 04 23 01 00 00
shows a (cold) consumption of 1.23 kWh.

4.3 Statistical Data (Memory Block $\geq$ #8)

Statistics

At the beginning of the subsequent month, the network node will receive the consumption of the meter at the last day of the preceding month (end-of-month value). This value is stored in the network node. The network node is capable of storing 13 end-of-month values (up to version 1.4) or 18 end-of-month values (version 2.0 and higher). End-of-month values are stored as statistical values. Statistics always start on memory block #8. It is there that the oldest value is stored. The statistical value stored most recently is found at the highest memory location number. When all the memory locations are occupied, the oldest value is discarded. The second oldest value is stored in memory block #8, with the third oldest kept in memory block #9 and so on. The most recent statistical value is stored in the highest memory block (#25 in version 2.0 and higher and #20 up to version 1.4). In the event that a statistical value could not be transmitted due to radio interference, a gap will be left when the next statistical value is transmitted. The value that could not be transmitted will be filled with FF.

Example:

Description	DIF/DIFE (Hex)	VIF/VIFE (Hex)	(Hex) Value (Example)
Number of memory blocks transmitted	89 04	FD 22	03
Date of most recent memory block	82 05 (memory block #10)	6C	DF 05
Time gap between memory blocks (always one month)	89 04	FD 28	01
Memory block #10	8C 05	13	23 01 00 00
Memory block #9 (transmission error)	CC 04	13	FF FF FF FF
Memory block #8	8C 04	13	95 00 00 00

The example shows the statistical values of a water meter, which was read out from the network node three months after its installation.

The following consumption values can be obtained from the statistical data points of the above example:

	Date	Value
Last end-of-month value	May 31, 2006	123 liters (10^{-3} m^3)
Second (penultimate) end-of-month value	April 30, 2006	x x x (invalid)
First end-of-month value	March 31, 2006	95 liters (10^{-3} m^3)

4.4 Overview of Data Points for Siemeca Meter Statistics

A broadsheet (see [6]) provides an overview of the data points supported by Siemeca devices.

5 Annex

5.1 M-Bus Ranges

The table below serves as a general guideline for the ranges achievable with the M-bus. However, the properties of the speci
especially those of the M-bus master, need to be considered as well. The following calculation example is based on an M-bus
with an WZC.P250 level converter. If WZC.P250s are connected in series, the maximum cable length will increase accordingl

Type of System	Maximum Distance	Cumulative Cable Length	Diameter or Cross-section of Cable	Number of M-Bus Devices (Slaves)	Ma Tra
Small Residential Buildings	350 m	1,000 m	0.8 mm	250	9,6
Larger Residential Buildings	350 m	4,000 m	0.8 mm	250	2,4
				64	9,6
Smaller Neighborhoods	1,000 m	4,000 m	0.8 mm	64	2,4
Larger Neighborhoods	3,000 m	5,000 m	1.5 mm	64	2,4

5.2 Types of M-Bus Telegrams

Note: $00 means a hexadecimal number.

req_ud2

		Code	
start character	1	$ 10	
c-field	2	$ 5b	request for data with fcb=0 (or $7b with fcb=1)
address field	3	$ aa	device address = 170
checksum	4	$ 05	
stop character	5	$ 16	

RSP_UD

start character	1	$ 68	not changeable
telegram length	2	$ 6f	length = 111 bytes
telegram length	3	$ 6f	
start character	4	$ 68	not changeable
c-field	5	$ 08	respond with data
address field	6	$ aa	primary device address (e.g. =170)
ci-field	7	$ 72	variable structure response
device identification	8	$ 78	device identification
device identification	9	$ 56	(e.g. 12345678)
device identification	10	$ 34	
device identification	11	$ 12	
manufacturer id	12	$ 65	manufacturer (e.g. = 3265h = lse)
manufacturer id	13	$ 32	
version	14	$ 03	software version (e.g =03)
medium	15	$ 08	heat cost allocator
access number	16	$ 1b	number of interrogations (e.g. = 27)
status	17	$ 00	error status (e.g., no error)
signature byte 1	18	$ 00	no encryption
signature byte 2	19	$ 00	no encryption
variable data			
checksum	…	$ xx	to check bit errors during transmission
stop character	…	$ 16	not changeable

SND_UD

start character	1	$ 68	
telegram length	2	$ 08	length
telegram length	3	$ 08	
start character	4	$ 68	
c-field	5	$ 53	send user data; fcb=0 (7 3 fcb = 1)
address field	6	$ aa	device address = e.g., 170
ci-field	7	$ 51	data send
variable data	…	x x	
...		x x	
checksum		x x	
stop character	last	$ 16	

confirm

acknowledgement byte	$ e5

5.3 Meter Readout from Network Node

The following is an example of communication between the 5750010 water meter and the M-bus master.

Master:	SELECT	68 0B 0B 68 73 FD 52 10 00 75 05 65 32 2B 07 15 16
Slave:	CONFIRM	E5
Master:	REQ_UD2	10 7B FD 78 16
Slave:	RSP_UD2	
	DLL header	68 5B 5B 68 08 FD
	APL header	72 10 00 75 05 65 32 2B 07 04 00 00 00
	Albatros ID	06 FD 0C 2B 00 07 00 5D 02
	Network index	02 FA 3D 02 0A
	Current date	04 6D 1B 06 CE 06
	Current consumption	0C 13 35 00 00 00
	Cutoff date	42 6C FF FC
	Consumption at cutoff date	4C 13 00 00 00 00
	Error date	32 6C FF FF
	Statistical length	89 04 FD 22 03
	Statistical date (#10)	82 05 6C DF 05
	Statistical interval	89 04 FD 28 01
	Memory block #10	8C 05 13 23 01 00 00
	Memory block #9	CC 04 13 FF FF FF FF
	Memory block #8	8C 04 13 95 00 00 00
	Check sum + postamble	D3 16
Master:	SND_NKE	10 40 FD 3D 16
Slave:	CONFIRM	E5

Keyword Index

T

V

This documentation only provides general descriptions and/or performance characteristics, which, in a given case, may not always apply in the manner presented or may change as products evolve. Desired performance characteristics shall only be binding if expressly agreed in the relevant contract signed.

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