BS EN 13757-3:2013

BSI Standards Publication

Communication systems for and remote reading of meters

Part 3: Dedicated application layer

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National foreword

This British Standard is the UK implementation of EN 13757-3:2013. It supersedes BS EN 13757-3:2004 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee PEL/894, Remote Meter Reading.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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Foreword

This document (EN 13757-3:2013) has been prepared by Technical Committee CEN/TC 294 “Communication systems for meters and remote reading of meters”, the secretariat of which is held by DIN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by November 2013, and conflicting national standards shall be withdrawn at the latest by November 2013.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN 13757-3:2004.

It shall be noted that the following significant technical changes compared to the previous edition have been incorporated in this European Standard:

— Extension of existing frames formats for different data protocols to support various wireless transmission schemes (harmonisation with EN13757-4).

— Adding an annex with a Smart Metering profile based on the requirements of the “Smart Meter Coordination Group” of the ESO´s.

— Adding an annex to have a unique translation of M-Bus-data points to OBIS-Codes.

— Update of the encryption methods to the state of the art.

— Enhancement of data points for electricity meter.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association.

EN 13757, *Communication systems for meters and remote reading of meters* consists of the following parts:

— *Part 1: Data exchange*

— *Part 2: Physical and link layer*

— *Part 3: Dedicated application layer*

— *Part 4: Wireless meter readout*

— *Part 5: Wireless relaying*

— *Part 6: Local bus*

According to the CEN-CENELEC Internal Regulations, the national standards organisations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

Introduction

This document belongs to a series of parts of EN 13757, which covers communication systems for meters and remote reading of meters. EN 13757-1 contains generic descriptions and a communication protocol. EN 13757-2 contains a physical and a link layer for twisted pair based Meter-Bus (M-Bus). EN 13757-4 describes wireless communication (often called wireless M-Bus or wM-Bus). EN 13757-5 describes the wireless network used for repeating, relaying and routing for the different modes of EN 13757-4. EN 13757-6 describes a twisted pair local bus for short distance (Lo-Bus).

This dedicated application layer (M-Bus-Protocol) can be used with various physical layers and with link layers and network layers, which support the transmission of variable length binary transparent messages. Frequently, the physical and link layers of EN 13757-2 (twisted pair) and EN 13757-4 (wireless) as well as EN 13757-5 (wireless with routing function) or the alternatives described in EN 13757-1 are used. This dedicated application layer has been optimised for minimum battery consumption of meters, especially for the case of wireless communication to ensure long battery lifetimes of the meters. Secondly, it is optimised for minimum message length to minimise the wireless channel occupancy and hence the collision rate. Thirdly, it is optimised for minimum requirements towards the meter processor regarding requirements of RAM size, code length and computational power.

An overview of communication systems for meters is given in EN 13757-1, which also contains further definitions.

This standard concentrates on the meter communication. The meter communicates with one (or occasionally several) fixed or mobile communication partners which again might be part of a private or public network. These further communication systems might use the same or other application layer protocols, security, privacy, authentication, and management methods.

To facilitate common communication systems for CEN-meters (e.g. gas, heat, water meters and heat cost allocators) and for electricity meters, in this standard occasionally electricity meters are mentioned. All these references are for information only and are not standard requirements. The definition of communication standards for electricity meters (possibly by a reference to CEN standards) remains solely in the responsibility of CENELEC.

NOTE 1 Annex L describes how parts of this standard and of EN 13757-2 and EN 13757-4 can be used to implement smart meter functionalities. Similar functionalities could also be implemented using other physical and link layers.

NOTE 2 For information on installation procedures and their integration in meter management systems, see Annex M.

1 Scope

This European Standard applies to communication systems for meters and remote reading of meters.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 13757-1, *Communication system for meters and remote reading of meters — Part 1: Data exchange*

EN 13757-2, *Communication systems for meters and remote reading of meters — Part 2: Physical and link layer*

EN 13757-4, *Communication systems for meters and remote reading of meters — Part 4: Wireless meter readout (Radio meter reading for operation in the 868 MHz to 870 MHz SRD band)*

EN 13757-5, *Communication systems for meters and remote reading of meters — Part 5: Wireless relaying*

EN 62056-21, *Electricity metering — Data exchange for meter reading, tariff and load control — Part 21: Direct local data exchange (IEC 62056-21)*

EN 62056-5-3, *Electricity metering data exchange — The DLMS/COSEM Suite — Part 5-3: DLMS/COSEM application layer (IEC 62056-5-3:2013)*

NOTE Further information and examples are available in the download area of http://www.m-bus.com.

3 Terms and definitions, abbreviated terms and numbers

For the purposes of this document, the following terms and definitions apply.

3.1 Terms and definitions

3.1.1
byte
an octet of bits

3.1.2
datagram
unit of data transferred from source to destination

Note 1 to entry: In previous versions of EN 13757-3 datagram was called telegram.

3.1.3
message
functional set of data transferred from source to destination

Note 1 to entry: A message may consist of one or more datagrams.

3.2 List of abbreviated terms

ACC-DMD Access Demand

ACC-NR	Access – No Reply
ACK	Acknowledge
AES	Advanced Encryption Standard
BCD	Binary Coded Decimal numbers
CI	Control Information field
CBC	Cipher Block Chaining
CMD	Command
CNF-IR	Confirm Installation Request
DES	Data Encryption Standard
DIB	Data Information Block
DIF	Data Information Field
DIFE	Data Information Field Extensions
DLMS	Device Language Message Specification
DRH	Data Record Header
E	Extension bit
LSB	Least Significant Byte
LSBit	Least Significant Bit
MDH	Manufacturer Data Header
MSB	Most Significant Byte
MSBit	Most Significant Bit
OBIS	Object Identification System (EN 62056-61)
REQ-UD	Request User Data (class 1 or 2)
RSP_UD	Respond User Data
RSSI	Received Signal Strength Indicator
SM-CG	Smart Meter Co-ordination Group
SND-IR	Send Installation Request
SND-NKE	Send Link Reset
SND-NR	Send – No Reply
SND-UD	Send User Data
VIB	Value Information Block

VIF Value Information Field

VIFE Value Information Field Extensions

3.3 Hexadecimal and binary numbers

Hexadecimal numbers are designated by a following "h"

Binary numbers are designated by a following “b”

Decimal numbers have no suffix!

4 General principles: CI-field

4.1 Overview

All higher protocol layer messages have a variable length. The length information is part of the link layer. It shall be known to the application layer in order to properly terminate its decoding of each datagram. Each message starts with a 1-byte CI (control information) field, which distinguishes between various message types and application functions and header length. It is also used to distinguish between true application layer communication and management commands for lower layers. The meaning of the remaining bytes of the message depends also on the value of the CI-field.

The fixed header structures after CI-fields are:

— No data header (None) (0 bytes), as for CI=78h: If the message contains such a “none” header the meter identification is taken from the link layer; additional control fields for application layer (like configuration field) are non-existent.

— Short data header (4 bytes or more), as for CI=7Ah: If the message contains such a “short” header, the meter identification is taken from the link layer; data header length is at least 4 bytes. Additional bytes may follow in dependency of the selected encryption mode. If no encryption is applied (encryption mode 0), the header has the minimum length of 4 bytes.

— Long data header (12 bytes or more), as for CI=72h: If the message contains such a “long” header, this header contains (independent of transmission direction) the meter identification; data header length is at least 12 bytes. Additional bytes may follow in dependency of the selected encryption mode. If no encryption is applied (encryption mode 0), the header has the minimum length of 12 byte.

When using a long data header, the meter application address is contained in this header, whereas the manufacturer assigned unique link layer address may be different (but still within the common universally unique address structure). This allows, for example, a wired to wireless converter to supply the supported meter application address in the long data header and its own address in the radio link layer. For a simple meter, which doesn’t need an additional converter, the short header is sufficient.

Refer to Annex J for the details of the CI-field specific frame structure.

Table 1 — CI-field codes used by the master or the slave

CI-field	Direction	Header	Higher layer protocol
00h-1Fh	Reserved for DLMS-based applications		DLMS (See EN 13757-1)
20h-4Fh	Reserved		
50h	Application reset or select to device	None	M-Bus

Table 1 *(continued)*

CI-field	Direction	Header	Higher layer protocol
51h	Data send to device	None	M-Bus (not for wireless)
52h	Selection of device	None	Generic
53h	Application reset or select to device	Long	M-Bus
54h-59h	Reserved		
5Ah	Command to device	Short	M-Bus
5Bh	Command to device	Long	M-Bus
5Ch	Synchronise action		
5Dh-5Fh	Reserved		
60h	Command to device	Long	Application layer DLMS/ COSEM with OBIS-Identifier (EN 62056-5-3)[a]
61h	Command to device	Short	Application layer DLMS/ COSEM with OBIS-Identifier (EN 62056-5-3)[a]
62h-63h	Reserved		
64h	Command to device	Long	Reserved for OBIS-type value descriptors[a]
65h	Command to device	Short	Reserved for OBIS-type value descriptors[a]
66h-68h	Reserved		
69h	Response from device (M-Bus-Format frame)	None	See Annex K
6Ah	Response from device (M-Bus-Format frame)	Short	See Annex K
6Bh	Response from device (M-Bus-Format frame)	Long	See Annex K
6Ch	Time sync to device	Long	Generic
6Dh	Time sync to device	Long	Generic
6Eh	Application error from device	Short	Generic
6Fh	Application error from device	Long	Generic
70h	Application error from device	None	Generic
71h	Alarm from device	None	Generic
72h	Response from device	Long	M-Bus
73h	Response from device (M-Bus-Compact frame)	Long	See Annex K
74h	Alarm from device	Short	Generic
75h	Alarm from device	Long	Generic
76h-77h	Reserved		
78h	Response from device	None	M-Bus
79h	Response from device (M-Bus-Compact frame)	None	See Annex K

Table 1 *(continued)*

CI-field	Direction	Header	Higher layer protocol
7Ah	Response from device	Short	M-Bus
7Bh	Response from device (M-Bus-Compact frame)	Short	See Annex K
7Ch	Response from device	Long	Application layer DLMS/ COSEM with OBIS-Identifier (EN 62056-5-3)[a]
7Dh	Response from device	Short	Application layer DLMS/ COSEM with OBIS-Identifier (EN 62056-5-3)[a]
7Eh	Response from device	Long	Reserved for OBIS-type value descriptors[a]
7Fh	Response from device	Short	Reserved for OBIS-type value descriptors[a]
80h	Transport layer to device	Long	See EN 13757-4
81h	Network layer data		See EN 13757-5
82h	Reserved for network management data		See EN 13757-5
83h	Network management data		See EN 13757-5
84h	Transport layer to device (M-Bus-Compact frame expected)	Long	See Annex K
85h	Transport layer to device (M-Bus-Format frame expected)	Long	See Annex K
86h-88h	Reserved		See EN 13757-4, EN 13757-5
89h	Reserved for network management data from device		See EN 13757-5
8Ah	Transport layer from device	Short	See EN 13757-4
8Bh	Transport layer from device	Long	See EN 13757-4
8Ch-8Fh	Link layer extension		See EN 13757-4
90h-9Fh	Reserved		
A0h-B7h	Manufacturer specific		
B8h	Set baud rate to 300 Bd		
B9h	Set baud rate to 600 Bd		
BAh	Set baud rate to 1 200 Bd		
BBh	Set baud rate to 2 400 Bd		
BCh	Set baud rate to 4 800 Bd		
BDh	Set baud rate to 9 600 Bd		

Table 1 *(continued)*

CI-field	Direction	Header	Higher layer protocol
BEh	Set baud rate to 19 200 Bd		
BFh	Set baud rate to 38 400 Bd		
C0h-FFh	Reserved		
NOTE All SND_UD datagrams are acknowledged in the link layer, even if the function of these CI-fields is not implemented.			
[a] These application protocols also contain OBIS identifiers. In the M-Bus application protocol, these OBIS identifiers are not included, but they can be added afterwards. For generating the OBIS identifiers from M-Bus data records, Annex O shall be used.			

Every data header for wireless M-Bus (EN 13757-4) shall contain at least:

— access number;

— status byte;

— configuration field.

Alternatively, the link extension (CI=8Ch – 8Fh) may be applied.

NOTE Multi byte values in short or long header are transmitted with LSB first.

4.2 Application reset and application select (CI = 50h, 53h) (optional)

4.2.1 Application reset

With the CI-field 50h or 53h (without additional parameter), the master can release a reset of the application layer in the slaves. Each slave itself decides which parameters to change, e.g. which data output is default – after it has received such an application reset.

4.2.2 Application select with subcode (optional)

It is allowed to use optional parameters after CI = 50h or 53h. In this case, the CI-field acts as application select. If more bytes follow, the first byte is the application select subcode. Further bytes are ignored. The application select subcode defines which message function and which sub message is requested by the master. The data type of this parameter is 8 bit binary. The upper 4 bits define the message type or message application and the lower 4 bits define the number of the sub message or datagram number (the meaning of this number is device specific). The lower 4 bits may be ignored for slaves which provide only a single datagram for each application. The use of the value zero for the number of the sub message means that all datagrams are requested.

Slaves with only one type of message may ignore application select and the added parameters. The following codes can be used for the upper 4 bits of the first parameter:

Table 2 — Coding of the upper 4 bits of the first parameter after CI = 50h or 53h

Coding	Description	Examples
0000b	All	
0001b	User data	Consumption
0010b	Simple billing	Current and fixed date values + dates
0011b	Enhanced billing	Historic values
0100b	Multi tariff billing	

Table 2 *(continued)*

Coding	Description	Examples
0101b	Instantaneous values	For regulation
0110b	Load profile values for management	
0111b	Reserved	
1000b	Installation and startup	Bus address, fixed dates
1001b	Testing	High resolution values
1010b	Calibration	
1011b	Manufacturing	
1100b	Development	
1101b	Self test	
1110b	Reserved	
1111b	Reserved	

4.3 Slave select (52h) (optional)

The CI-field code 52h is used for the management of the optional secondary addressing (see 11.3).

4.4 Synchronise action (CI = 5Ch) (optional)

This CI-field can be used for synchronising functions in slaves and masters (e.g. clock synchronisation). Special actions or parameter loads may be prepared but their final execution is delayed until the reception of such a special CI-field command. No data follows this CI-code.

NOTE Wireless M-Bus does not provide broadcast communication. Therefore, this function cannot be used for wireless M-Bus.

4.5 Clock synchronisation (CI = 6Ch, 6Dh) (optional)

For wireless communication (but not limited to this one), the clock synchronisation is executed by a special protocol for clock synchronisation. For this protocol CI-fields 6Ch and 6Dh are used. Annex H.3 specifies the transmission of clock synchronisation to meter.

Alternatively, the clock may set by an M-Bus-command. The communication partner may send date and time in all command messages to ensure that the meter can detect a replay of an old command. The meter shall not use this time stamp for synchronisation of its clock except when a dedicated action code (see Table 37) was added.

4.6 Report of application errors (slave to master) (CI = 6Eh, 6Fh and 70h) (optional)

For details of the report of general application errors, see 8.3. For error reporting of individual data elements, see 8.4.

4.7 Report of alarm status (slave to master) (CI = 71h, 74h and 75h) (optional)

For details of the report of alarm status errors, see Annex D.

4.8 Variable Data Send (master to slave) (CI = 51h, 5Ah, 5Bh, 60h, 61h, 64h, 65h)

These CI-field codes are used to indicate a message of application data sent from master to slave.

The CI-fields CI = 51h, 5Ah and 5B are used to transport the M-Bus protocol as described in this standard starting from Clause 6. For details, refer to Clause 5.

The CI-fields CI = 60h and 61h are used to transport the COSEM-Protocol as described in EN13757-1 and EN 62056-5-3.

The CI-fields CI = 64h and 65h are reserved so far for an alternative OBIS based protocol.

4.9 Variable Data Respond (slave to master) (CI = 69h to 6Bh, 72h, 73h, 78h to 7Fh)

These CI-field codes are used to indicate a message of application data responded from slave to master.

The CI-fields 72h, 78h and 7Ah are used to transport the M-Bus protocol as described in this standard starting from Clause 6. For details, refer to Clause 5.

The CI-fields 69h, 6Ah and 6Bh, as well as 73h, 79h and 7B, are used to transport the M-Bus protocol in the compact format. For details, refer to Annex K.

The CI-fields CI = 7Ch and 7Dh are used to transport the COSEM-Protocol as described in EN13757-1 and EN 62056-5-3.

The CI-fields CI = 7Eh and 7Fh are reserved so far for an alternative OBIS based protocol.

4.10 Baud rate switch commands B8h – BFh (optional)

These optional commands can be used by a master to switch the baud rate of a slave. For details, see 11.2.

5 Variable Data Send and Variable Data Respond

5.1 Introduction

The data headers of the Variable Data Send with the CI-field codes as listed in 4.8 are used to indicate the variable data structure in long frames (SND_UD) with optional fixed header.

The data headers of the Variable Data Respond with the CI-field codes as listed in 4.9 are used to indicate the variable data structure in long frames (RSP_UD) with optional fixed header.

Table 3 shows the way this data is represented.

Table 3 — Variable data structure in answer send and respond direction

Data header (resp.)	Variable data blocks (records)	MDH(opt.)	Optional manufacturer specific data)
None header Short header Long header	Variable number	1 byte	Variable number

5.2 Structure of none data header

This structure has no data header. The first byte following the CI-field is the start of the first data record. This data structure does not support transmission properties like encryption, access number or an additional meter address.

This structure can be used together with the extended link layer of EN 13757-4.

5.3 Structure of short data header

The first 4 bytes after the CI-field consist of a block with a fixed length and structure (see Table 4).

The short data header is used for systems supporting the physical and link layer of wireless M-bus communication (refer to EN 13757-4). In this standard, the link layer address contains the information fields of the manufacturer, the device type, the version and the identification number. If the meter address is identical with link layer address or the meter address was clearly selected before, then the 8 bytes of the meter address do not have to be added in the application layer again.

Table 4 — Short data header

Access No.	Status	Configuration
1 byte	1 byte	2 byte

The structure of the short header can be enlarged by additional bytes in dependency of the encryption mode (refer to 5.12.6.5).

5.4 Structure of long data header

The first 12 bytes after the CI-field consist of a block with a fixed length and structure (see Table 5).

Table 5 — Long data header

Ident. no.	Manufr.	Version	Device type	Access no.	Status	Configuration
4 byte	2 byte	1 byte	1 byte	1 byte	1 byte	2 byte

The address fields always contain the address of the meter independent of the transmission direction. In case of wireless communication based on EN 13757-4, this CI-field shall be used when the link layer address differs from meter address.

The structure of the long header can be enlarged by additional bytes in dependency of the encryption mode (refer to 5.12.6.4).

5.5 Identification number

The **identification number** is either a fixed fabrication number or a number changeable by the customer, coded with 8 BCD packed digits (4 byte), and which thus runs from 00000000 to 99999999. It can be preset at fabrication time with a unique number, but can be changeable afterwards, especially if, in addition, a unique and not changeable fabrication number (DIF = 0Ch, VIF = 78h, see 7.2) is provided.

5.6 Manufacturer identification

The field **manufacturer** is coded unsigned binary with 2 bytes. This manufacturer ID is calculated from the ASCII code of EN 62056-21 manufacturer ID (three uppercase letters) with the following formula:

$$\text{Man. ID} = [\text{ASCII}(\text{1st letter}) - 64] \times 32 \times 32 + [\text{ASCII}(\text{2nd letter}) - 64] \times 32 + [\text{ASCII}(\text{3rd letter}) - 64] \quad (1)$$

NOTE The flag association, UK (http://www.dlms.com/) administers these three letter manufacturers ID of EN 62056-21.

5.7 Version identification

The field version specifies the generation or version of the device and depends on the manufacturer. It can be used to make sure that within each version number the identification number is unique.

The value FFh is reserved as a wildcard and shall not be used by any device.

5.8 Device type identification

The device type is coded as follows:

Table 6 — Device type identification

Device type (previously called medium)	**Code bin. Bit 7 … 0**	**Code hex.**
Other	0000 0000	00
Oil meter	0000 0001	01
Electricity meter	0000 0010	02
Gas meter	0000 0011	03
Heat meter	0000 0100	04
Steam meter	0000 0101	05
Warm water meter (30 °C … 90 °C)	0000 0110	06
Water meter	0000 0111	07
Heat cost allocator	0000 1000	08
Compressed air	0000 1001	09
Cooling meter (volume measured at return temperature: outlet)	0000 1010	0A
Cooling meter (volume measured at flow temperature: inlet)	0000 1011	0B
Heat meter (volume measured at flow temperature: inlet)	0000 1100	0C
Combined heat / cooling meter	0000 1101	OD
Bus / system component	0000 1110	0E
Unknown device type	0000 1111	0F
Reserved for consumption meter	…	10 to 13
Calorific value	0001 0100	14
Hot water meter (≥ 90 °C)	0001 0101	15
Cold water meter	0001 0110	16
Dual register (hot/cold) water meter [a]	0001 0111	17
Pressure meter	0001 1000	18

Table 6 *(continued)*

Device type (previously called medium)	Code bin. Bit 7 … 0	Code hex.
A/D converter	0001 1001	19
Smoke detector	0001 1010	1A
Room sensor (e.g. temperature or humidity)	0001 1011	1B
Gas detector	0001 1100	1C
Reserved for sensors	....	1D to 1F
Breaker (electricity)	0010 0000	20
Valve (gas or water)	0010 0001	21
Reserved for switching devices	....	22 to 24
Customer unit (display device)	0010 0101	25
Reserved for customer units	....	26 to 27
Waste water meter	0010 1000	28
Garbage	0010 1001	29
Reserved for carbon dioxide	0010 1010	2A
Reserved for environmental meter	....	2B to 2F
Reserved for system devices	....	30
Communication controller (Gateway)	0011 0001	31
Unidirectional repeater	0011 0010	32
Bidirectional repeater	0011 0011	33
Reserved for system devices	....	34 to 35
Radio converter (system side)[b]	0011 0110	36
Radio converter (meter side)[c]	0011 0111	37
Reserved for system devices	....	38 to 3F
Reserved	....	40 to FF

[a] Such a meter registers water flow above a limit temperature in a separate register with an appropriate tariff ID.

[b] A radio converter at system side operates as radio master like a wireless communication partner.

[c] A radio converter at meter side operates as radio slave like an RF-meter.

5.9 Access number

5.9.1 Overview

The access number is a part of the fixed header. It is used by the extended link layer, the transport layer or the application layer protocol. It is coded as a 1-byte unsigned binary number. It has originally been added to support the wired M-Bus of EN 13757-2 and signals to the user that its meter has been read out by the pull-type readout of EN 13757-2. This function supports the detection of unwanted frequent readouts. For the typical push type frequent transmit modes of radio devices based on the EN 13757-4, this usage is no longer sensible. Acceptable maximum readout or transmit frequency is either an issue of legal requirements or of a contract between the meter reading organisation and the consumer. For devices based on the EN 13757-4, the access number shall be applied for clear indication of a new datagram for both pushed data as well as for requested data by strict rules of increments. For the partner-generated datagrams, relaxed generation rules simplify the implementation. The detection rules are identical between meter and partner; i.e. a datagram with an identical access number is considered a repetition of an identical previously already received datagram and shall be ignored. All datagrams with a different access number than the last received datagram are considered as a new data datagram. The term “new data” means that the meter application provides newer measurement values than in the last (old) data datagram.

NOTE 1 This link layer oriented function is not sufficient to uniquely identify messages from an application. If an application requires such a unique identification of a message, a data record with a VIF of =FDh,08h (unique message identification) and a data length of at least 4 bytes is added to each message.

NOTE 2 If both extended link layer and transportation layer exist, then the access number of the extended link layer will be applied for the timing of synchronous transmission, whereas the access number in the transport layer will be used to indicate new data.

5.9.2 Generation of access number for meter initiated datagrams

If a meter generates a datagram (SND-NR, SND-IR, ACC-DMD or ACC-NR), the access number is incremented (modulo 256) by one before or after each new transmission of the meter.

If the meter supports the feature of synchronised transmission for battery operated receiver (refer to EN 13757-4) then the access number shall be incremented by one and only one with every synchronous transmission. For every asynchronous transmission between two synchronous datagrams, the meter shall use the access number from the last synchronous transmission. To avoid the detection of zero consumption, it is recommended to add a time stamp or an incremental counter (VIFE "unique message identification") to the message content if one or several asynchronous transmissions are sent in the interval between two synchronous transmissions. If such asynchronous transmission contains new data, the extended link layer may be applied to separate the indication of synchronous transmission from the indication of new data.

After the power up of the meter, its value of the access number shall be set by a randomised initial value from 0 to 255. The access number of the meter shall not be resettable.

When the datagram is a response to a datagram of the communication partner (i.e. ACK, RSP-UD or other) then the access number repeats the received access number of the communication partner. Otherwise, the access number of the meter is used.

NOTE Meter initiated datagrams are not allowed by the wired M-Bus standard (refer to EN13757-2).

5.9.3 Generation of access number for partner generated datagrams

If the communication partner generates a wireless datagram (SND-UD, SND-NKE, REQ-UD1, REQ-UD2), each such datagram shall use a different value of the access number within 300 s or within a frequent access cycle as defined in EN 13757-4. A simple increment is recommended to fulfil this requirement. If the partner transmits an answer to the meter (i.e. ACK or CNF-IR with CI-field), the transmitted access number of the partner repeats the received access number of the meter. After the power up of the communication partner, its value is undefined, but an initial value of zero is recommended. For the usage of the FCB, see E.7.

For the wired communication according to EN13757-2, the meter shall increment its own access number before or after each response (RSP_UD) to the communication partner. If the communication partner (M-Bus-master) transmits an access number (e.g. SND-UD), it may be ignored.

NOTE The communication partner has to provide an access number in case of encrypted commands.

5.10 Status byte in meter messages

Table 7 — Coding of the status field

Bit	Meaning with bit set	Significance with bit not set
0,1	See Table 8	See Table 8
2	Power low	Power ok
3	Permanent error	No permanent error
4	Temporary error	No temporary error
5	Specific to manufacturer	Specific to manufacturer
6	Specific to manufacturer	Specific to manufacturer
7	Specific to manufacturer	Specific to manufacturer

Table 8 — Application errors coded with the status field

Status bit 1 bit 0	Application status
0 0	No error
0 1	Application busy
1 0	Any application error
1 1	Abnormal condition / alarm

The status bits shall be used in this meaning:

Power low — Warning - The bit “power low” is set only to signal interruption of external power supply or the end of battery life.

Permanent error — Failure - The bit “permanent error” is set only if the meter signals a fatal device error (which requires a service action). Error can be reset only by a service action.

Temporary error — Warning – The bit “temporary error” is set only if the meter signals a slight error condition (which not immediately requires a service action). This error condition may later disappear.

Any application error — Shall be used to communicate a failure during the interpretation or the execution of a received command, e.g. if a not decrypt able message was received.

Abnormal conditions — Shall be used if a correct working application detects an abnormal behaviour like a permanent flow of water by a water meter.

NOTE More detailed error signalling can be provided by the VIF/VIFE FDh/17h (refer to Annex H) in the message body. If a failure happens because of a wrong command it responds with a message of application error with CI= 6Eh, 6Fh, 70h.

5.11 Status byte in partner messages

Table 9 — Meaning of status byte for partner messages

Bit no.	Value
0 ... 5	Last received RSSI value from this meter for a reception level in range of: -128 ... -6dbm Reception level is calculated by -130dbm+2 * RSSI value (1 ... 62) If RSSI value = 0 no RSSI value or wired communication If RSSI value = 1 RSSI value is -128dbm or below If RSSI value = 63 the reception level is > -6dbm
6	Reserved (0 by default)
7	Reserved (0 by default)

The value of « 0 » in bits 0…5 means either that the partner does not provide RSSI values or that the partner has so far not received any message from the meter. Information about link quality is helpful for the rating of several radio links between a meter and different partners. It will also be used for signalling the link quality to an installation service tool. Therefore, the partner should support a valid RSSI value.

5.12 Configuration field (previously: signature field)

5.12.1 General

The **configuration field** contains information about the encryption mode and the number of encrypted bytes. Depending on the mode, it may contain additional information about:

- meter accessibility;
- contents of the message;
- repeated wireless datagrams;
- synchronous wireless transmissions.

If no functionality of the configuration field is used, its value shall be 0000h. Table 10 shows where to find the mode bits. The number of encrypted bytes is contained in the low byte of the configuration field (bit 0 – bit 7). The exact coding of those bits depends on the mode.

Table 10 — General definition of the configuration field

MS Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	LS Bit 0
mode specific	mode specific	mode specific	reserved	mode bit 3	mode bit 2	mode bit 1	mode bit 0	mode specific	mode specific	mode specific	mode specific	mode specific	mode specific	mode specific	mode specific
X	X	X	0	M	M	M	M	X	X	X	X	X	X	X	X

5.12.2 Functions

The use of encryption provides the following functions:

- data privacy for consumption meter values;
- detecting simulated meter transmission;
- preventing later replay of old meter values;
- preventing the detection of zero consumption by comparing messages.

5.12.3 Structure of encrypted messages

a) The long or short data header (see 5.3 or 5.4) is always unencrypted. The last word of this block is the configuration field. If the number of encrypted bytes in the configuration field is zero (even if the encryption mode differs from zero) the following data are unencrypted.

b) If the transmission uses configuration field functionality (like encryption), the method has to be defined with the mode bits in the high byte of configuration field. Table 11 shows the already defined modes.

c) The encrypted data follow directly after the configuration field, thus forming the beginning of the application data e.g. DIF/VIF-structured part of the message for M-Bus. The calculation of the length of encrypted data is mode specific.

Table 11 — Definition of the mode bits (encryption method)

Mode	Meaning
0	No encryption used
1	Reserved
2	DES encryption with CBC; initialisation vector is zero (deprecated)
3	DES encryption with CBC; initialisation vector is not zero (deprecated)
4	Reserved
5	AES encryption with CBC; initialisation vector is not zero
6	Reserved
7	Reserved
8 – 15	Reserved

5.12.4 Partial encryption

a) If the number of encrypted bytes is less than the total length of the data in this datagram then unencrypted data may follow after the encrypted data. They shall start at a record boundary, i.e. the first byte after the encrypted data will be interpreted as a DIF.

b) If a partially encrypted message shall contain encrypted manufacturer specific data, a record with a suitable length DIF (possibly a variable length string DIF) and a VIF = 7Fh (manufacturer specific data record) shall be used instead of the usual MDH-DIF = 0Fh. This is required to enable after decryption standard DIF/VIF-decoding of a previously partially encrypted message containing encrypted manufacturer specific data.

5.12.5 Encryption methods DES (modes 2 and 3)

Table 12 — Definition of the configuration field for encryption modes 2 and 3

MS Bit 15	**Bit 14**	**Bit 13**	**Bit 12**	**Bit 11**	**Bit 10**	**Bit 9**	**Bit 8**	**Bit 7**	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**LS Bit 0**
reserved	reserved	reserved	reserved	mode bit 3	mode bit 2	mode bit 1	mode bit 0	number of encr. bytes	number of encr. bytes	number of encr. bytes	number of encr. bytes	number of encr. bytes	number of encr. bytes	number of encr. bytes	number of encr. bytes
0	0	0	0	M	M	M	M	N	N	N	N	N	N	N	N

a) Due to the withdrawal of standards ANSI X3.92:1981 and ANSI X3.106:1983, new implementations based on DES are not recommended.

b) Cipher Block Chaining (CBC) method as described in INCITS/ISO 8372:1987 with an initial initialisation vector of zero: (encryption method code = 02xxh). In this case, the message should contain the current date before the meter reading data. Thus, the data after the date record changes once per day even if the meter index itself is constant. This prevents an undetectable later replay of stored encrypted meter readings by a hacker.

c) The initialisation vector with length 64 bits of this standard may alternatively be defined by the first 6 bytes of the identification header in mode 1 sequence, i.e. identification number in the lowest 4 bytes followed by the manufacturer ID in the two next higher bytes and finally by the current date coded as in record structure "G" for the two highest bytes. Thus, all encrypted data change once per day even if the data content itself is constant. This prevents an undetectable later replay of any stored encrypted data by a hacker.

   In this case the encryption method is coded as "03xxh".

d) To simplify the verification of correct decoding and to prevent an undetected change in the identification of the not encrypted header, the encrypted part of the message shall contain at least together with the appropriate application layer coding (DIF and VIF) again the same identification number as in the unencrypted header.

e) Due to the mathematical nature of the DES-algorithm, the encrypted length contained in the low byte of the configuration field (see Table 12) shall be an integer multiple of 8 byte if the high byte signals DES-Encryption. Unused bytes in the last 8-byte block shall be filled with appropriately structured dummy data records to achieve the required record boundary at the end of the encrypted data. One or several bytes containing the filler DIF = 2Fh shall be used to fill such gaps.

f) The application of certain encryption methods might be prohibited by local laws.

5.12.6 Encryption methods AES-128 (mode 5)

5.12.6.1 General

Encryption according to the AES-128 (Data Encryption Standard) as described in NIST FIPS 197.

5.12.6.2 Encryption mode 5

a) Cipher Block Chaining (CBC) method as described in NIST SP800-38A.

b) Definition of the configuration field according to Table 13:

Table 13 — Definition of the configuration field for encryption mode 5

MS Bit 15	**Bit 14**	**Bit 13**	**Bit 12**	**Bit 11**	**Bit 10**	**Bit 9**	**Bit 8**	**Bit 7**	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**LS Bit 0**
bidirectional communication	accessibility	synchronised	reserved	mode bit 3	mode bit 2	mode bit 1	mode bit 0	number of encr. blocks	number of encr. blocks	number of encr. blocks	number of encr. blocks	content of message	content of message	repeater access	hop counter
B	A	S	0	M	M	M	M	N	N	N	N	C	C	R	H

c) The coding of the configuration field for the AES encryption mode with a dynamic initialisation vector is 5 (MMMM=0101b). The high nibble “NNNN” of the lower byte declares the number of encrypted 16-byte blocks (see Table 13).

d) The initialisation vector for encryption mode 5 is (written in low to high order according to the AES standard FIPS 197):

Table 14 — Initialisation vector mode 5 for the CBC-AES-128

LSB	1	2	3	4	5	6	7	8	9	10	11	12	13	14	MSB
Manuf. (LSB)	Manuf. (MSB)	ID (LSB)	..	..	ID (MSB)	Ver-sion	Device type	Acc. no.	..	..	..	..	..	..	Acc. no.

The initialisation vector always contains the address of the meter.

e) Since the meter access number changes with each new transmission, the initialisation vector is different in each new transmission of meter data. Due to the mathematical properties of the encryption algorithm, this changes the complete message even if the unencrypted data (e.g. the meter index) is constant (e.g. because of zero consumption) which might indicate an uninhabited apartment and might hence be some indication for possible burglars. This protection may be increased by using an additional time stamp or an incremental counter (VIFE "unique message identification") in the first block.

f) To simplify the verification of correct decoding and to prevent an undetected change in the identification of the not encrypted header, the encrypted part of the message shall start with two bytes “2Fh” (see 5.12.6.4).

g) Due to the mathematical nature of the AES-algorithm, the encrypted length contained in the low byte of the configuration field shall be an integer multiple of 16 bytes if the high byte signals AES-encryption. Unused bytes in the last 16-byte block shall be filled with appropriately structured dummy data records to achieve the required record boundary at the end of the encrypted data. One or several bytes containing the filler DIF = 2Fh shall be used to fill such gaps.

h) Partial encryption may be used to allow unencrypted access to operational parameters. The encrypted bytes follow as zero, one or several encrypted 16-byte blocks directly after the header. Optional unencrypted bytes may follow the encrypted blocks if the link layer datagram length signals more bytes than the encryption length of 16*NNNNb bytes in the low byte of the configuration field.

i) The full 16-byte key shall be assigned by the manufacturer together with the meter identification and safely transferred to its customers. The format is according to FIPS 197.

j) The application of certain encryption methods might be prohibited by local laws.

5.12.6.3 Additional functionality of configuration field

The configuration field in general declares the length and method of data encryption. For encryption mode 5, additional communication status bits are defined. For the communication on wired M-Bus, all bits in the configuration field except “MMMM” and “NNNN” shall be set to “0”.

Bit 0 (H) and bit 1 (R) of the configuration field are reserved for use in repeated messages (see EN 13757-5). A meter shall always set H=0b and R=0b in a transmitted message. The meter may ignore these bits in a received message.

Bit 2 and bit 3 (CC) are used to describe the contents of the message (refer to Table 15). The definition distinguishes between a meter and a partner message. The declaration of the authentication methods helps the meter to detect the authentication method used by the message originator (refer to Table16).

Table 15 — Contents of meter message

Bit 3 C	**Bit 2 C**	**Contents of the message**
0	0	Standard data message with unsigned variable meter data
0	1	Reserved for signed data message
1	0	Static message (consists of parameter, OBIS-definitions and other data points which are not frequently changed). Static messages shall be transmitted at least twice a day.
1	1	Reserved for future extensions

Table 16 — Contents of partner message

Bit 3 C	Bit 2 C	Contents of data point authentication
0	0	Standard command message
0	1	Reserved for authenticated command message type 1
1	0	Reserved
1	1	Reserved for future extensions

Bit 13 (S) is used to declare a synchronised transmission. If the transmission timing (predictable transmission time) fulfils the requirements of a synchronous transmission as defined in EN 13757-4, it shall mark this transmission with a set bit 13. Otherwise, the bit 13 shall always be 0.

The configuration field bits 14 (A) and 15 (B) (**A**ccessibility and **B**idirectional communication) are used as defined in Table 17 for access control to the meter.

Table 17 — Accessibility of a meter

Bit 15 B	Bit 14 A	Accessibility of a meter
0	0	Meter/actuator provides no access window (unidirectional meter)
0	1	Meter supports bidirectional access in general, but there is no access window after this transmission
1	0	Meter provides a short access window only immediately after this transmission
1	1	Meter provides unlimited access (at least until the next transmission)

5.12.6.4 Decryption verification

In order to verify that the message is decrypted correctly, the encrypted part starts with a known sequence. The header will be expanded by decryption verification in dependency of the selected encryption mode. A device supporting encryption mode 5 shall start with 2 bytes of 2Fh (AES-check) before the first data record.

Since the message must have an encrypted length of an integer multiple of 16 bytes, idle filler bytes often will also be added at the end of the last encrypted block.

NOTE The decryption verification is independent of the wired or wireless transmission.

5.12.7 Examples

Annex P shows examples with both unencrypted and encrypted data.

5.13 Address structure if used together with the wireless link layer according to EN 13757-4

The link layer of EN 13757-4 contains an 8-byte address, which starts with a 2-byte manufacturer identification according to EN 62056-21 (see 5.6), followed by 6 bytes consisting of the identification number, version and device type, as shown in Table 18.

Table 18 — Address structure of the wireless link layer

Manufacturer identification	Identification number	Version	Device type
2 byte	4 byte(BCD)	1 byte	1 byte

The content of the fields shall be according to 5.5, 5.6, 5.7 and 5.8.

The 8-byte address in the long header of this standard uses the same elements but they are structured in a different order (see Table 5 in 5.4).

6 Variable data blocks (records)

6.1 General

The single datagram has a maximum length of 255 bytes. The data, together with information regarding coding, length and the type of data, is transmitted in data records in arbitrary sequence. According to EN 13757-2, the maximum space for data is 252 bytes. The effective usable space depends on the layers with variable length below the application layer and the applied header type and the encryption method. This restriction is required to enable gateways to other link- and application layers. The Manufacturer Data Header (MDH) is made up by the character 0Fh or 1Fh and indicates the beginning of the manufacturer specific part of the user data and shall be omitted if there is no manufacturer specific data (refer also to 6.4).

Table 19 — Structure of a data record (transmitted from left to right)

DIF	DIFE	VIF	VIFE	Data
1 byte	0 … 10 (1 byte each)	1 byte	0 … 10 (1 byte each)	0 … N byte
Data Information Block (DIB)		Value Information Block (VIB)		
Data Record Header (DRH)				

Each data record consists of a Data Record Header (DRH) and the value (data). The DRH in turn consists of the Data Information Block (DIB) to describe the length, type and coding of the data and the Value Information Block (VIB) to give the value of the unit and the multiplier.

NOTE An application message can contain either just a single data record but also an arbitrary number of such data records in arbitrary order, each describing and containing a data element. For examples of such multi record messages see Annex E, or for further information on M-Bus see Annex G.

6.2 Data Information Block (DIB)

The DIB contains at least one byte of Data Information Field (DIF), and can be extended by a maximum of ten Data Information Field Extensions (DIFE).

6.3 Data Information Field (DIF)

The following information is contained in a DIF:

Table 20 — Coding of the Data Information Field (DIF)

Bit 7	6	5	4	3	2	1	0
Extension bit (E)	LSB of storage number	Function field		Data field : Length and coding of data			

6.4 Data field

The data field shows how the data from the master shall be interpreted in respect of length and coding. The following table contains the possible coding of the data field:

Table 21 — Coding of the data field

Length in bit	Code	Meaning	Code	Meaning
0	0000	No data	1000	Selection for readout
8	0001	8 bit integer/binary	1001	2 digit BCD
16	0010	16 bit integer/binary	1010	4 digit BCD
24	0011	24 bit integer/binary	1011	6 digit BCD
32	0100	32 bit integer/binary	1100	8 digit BCD
32 / N	0101	32 bit real	1101	Variable length
48	0110	48 bit integer/binary	1110	12 digit BCD
64	0111	64 bit integer/binary	1111	Special functions

For a detailed description of data types, refer to Annex A ”Coding of data records” (e. g. BCD = type A, Real = type H). The coding as “integer/binary" implies always type B (signed integer) unless the VIF/-VIFE of the record implies another data type (e.g. date/time).

Variable length:

With data field = `1101b´ several data types with variable length can be used. The length of the data is given after the DRH with the first byte of real data, which is here called LVAR (e.g. LVAR = 02h: ASCII string with two characters follows).

If LVAR is used as the variable length of a wireless M-Bus data container (see Annex N) it counts the number of bytes inside the container.

LVAR = 00h – BFh 8-bit text string according to ISO 8859–1 with LVAR (0 to 191) characters

NOTE 1 A text string (like all other multibyte data) is transmitted “least significant byte first”.

LVAR = C0h – C9h : Positive BCD number with (LVAR – C0h, i.e. 0 to 9)*2 digits (0 to 18 digits)

LVAR = D0h – D9h : Negative BCD number with (LVAR – D0h)*2 digits (0 to 18 digits)

LVAR = E0h – EFh : Binary number with (LVAR – E0h) bytes (0 to 15 bytes)

LVAR = F0h-F4h: Binary number with 4*(LVAR-ECh) bytes (16, 20, 24, 28, 32 bytes)

LVAR = F5h Binary number with 48 bytes

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LVAR = F6h Binary number with 64 bytes

Others LVAR values : Reserved

Like all multibyte fields the last character is transmitted first.

NOTE 2 In previous versions of EN 13757-3, LVAR=F8h was used for floating point number according to IEEE 754, but it is no longer applicable.

Special functions (data field = 1111b):

Table 22 — DIF-coding for special functions

DIF	Function
0Fh	Start of manufacturer specific data structures to end of user data
1Fh	Same meaning as DIF = 0Fh + more records follow in next datagram
2Fh	Idle filler (not to be interpreted), following byte = DIF of next record
3Fh … 6Fh	Reserved
7Fh	Global readout request (all storage numbers, units, tariffs, function fields)

If data follows after DIF = 0Fh or 1Fh these are manufacturer specific unstructured data. The number of bytes in these manufacturer specific data can be calculated from the link layer information on the total length of the datagram. The DIF 1Fh signals additionally a request from the slave to the master to readout the slave once again. The master shall readout the slave until there is no DIF = 1Fh inside the responded datagram (multi-datagram message readout) or use an application reset. The variable data block of the next datagram starts with a normal DIF. If a multi-datagram message contains M-Bus records only, but no manufacture specific data, the DIF 1Fh has to be the last byte in the application frame of all except the last datagram.

6.5 Function field

The function field gives the type of data as follows:

Table 23 — Function field

Code	Description	Code	Description
00b	Instantaneous value	01b	Maximum value
10b	Minimum value	11b	Value during error state

6.6 Storage number

The bit 6 of the DIF serves as the LSB of the storage number of the data concerned, and the slave can in this way indicate and transmit various stored metering values or historical values of metering data. This bit is the least significant bit of the storage number and allows therefore the storage numbers 0 and 1 to be coded. If storage numbers higher than “1” are needed, following (optional) DIFE´s contain the higher bits. The storage number 0 signals a current value.

NOTE Each storage number is associated with a dedicated time point. Each data record with the same storage number refers the value to this (common) time point given by this storage number. A time/date record for each storage number can be included somewhere in the message to signal this time point associated with this storage number. This date or date/time is coded with a data record with a VIF=E110110n. Normally (but not necessarily) higher storage numbers indicate an older time point. A sequential block of storage numbers can be associated with a sequence of equidistantly spaced time points (profile). Such a block can be described by its starting time, by the time spacing, by the first storage number of such a block and by the length of such a block. For an example see Annex I.

6.7 Extension bit (E)

The extension bit (MSBit) signals that more detailed or extended descriptions (data field extension = DIFE)-bytes follow. E = 1 if other VIFE or DIFE follow.

6.8 Data Information Field Extension (DIFE)

Each DIFE (maximum ten) contains again an extension bit to show whether a further DIFE is being sent. Besides giving the next most significant bits of the storage number, DIFEs allow the transmission of information about the tariff and the subunit of the device. In this way, exactly as with the storage number, the next most significant bit or bits will be transmitted. Table 24 shows the structure of a DIFE:

Table 24 — Coding of the Data Information Field Extension (DIFE)

Bit	7	6	5	4	3	2	1	0
Value	Extension Bit (E)	(Device) Subunit	Tariff		Storage number			

With the maximum of ten DIFEs, which are provided, there are 41 bits for the storage number, 20 bits for the tariff and 10 bits for the subunit of the meter. There is no application conceivable in which this immense number of bits could all be used.

6.9 Tariff information

For each (unique) value type designation given by the following VIB at each unique time point (given by the storage number) of each unique function (given by the function field), there might exist still various different data, measured or accumulated under different conditions. Such conditions could be time of day, various value ranges of the variable (i.e. separate storage of positive accumulated values and negative accumulated values) itself or of other signals or variables or various averaging durations. Such variables, which could not be distinguished otherwise, are made different by assigning them different values of the tariff variable in their data information block.

NOTE This includes but is not necessarily restricted to various tariffs in a monetary sense. It is at the distinction of the manufacturer to describe for each tariff (except 0) what is different for each tariff number. Again, as with the storage numbers, all variables with the same tariff information share the same tariff associating condition.

6.10 Subunit information

A slave component may consist of several functionally and logically independent subunits of the same or of different functionality. Either such a device uses several different primary and/or secondary addresses or it uses the subunit information field for addressing a logically independent subunit within a device that uses only one primary and/or secondary address. This is recommended for devices which represent a physical collection of several truly independent (often similar or identical) devices. For devices which share common information and values and have logical connections, an approach with a common link layer (i.e. a single address) is recommended. The various subunits can include their specific information into a common message and have them differentiated by the individual subunit number in the subunit-data field of their records.

7 Value Information Block (VIB)

7.1 General

After a DIF (with the exception of Table 22) or a DIFE without a set extension bit there follows the VIB. This consists at least of the value information field (VIF) and can be expanded with a maximum of 10 VIF-extensions (VIFE). The VIF and also the VIFEs with a set MSBit show that another VIFE will follow. In the value information field VIF, the other seven bits give the unit and the multiplier of the transmitted value.

Table 25 — Coding of the Value Information Field (VIF)

Bit	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
Value	Extension Bit (E)	Unit and multiplier (value)						

There are five types of coding depending on the VIF:

a) **Primary VIF: E000 0000b … E111 1011b**

The unit and multiplier are taken from Table 26 Primary VIF-codes (7.2).

b) **Plain-text VIF: E111 1100b**

In case of VIF = 7Ch / FCh, the true VIF is represented by the following ASCII string with the length given in the first byte.

Annex C.2 shows an example for a plain text VIF.

c) **Linear VIF-extension: FDh and FBh**

In case of VIF = FDh and VIF = FBh the true VIF is given by the next byte (i.e. the first VIFE) and the coding is taken from Table 28 in 7.4 and Table 29 (for secondary VIF) in 7.5, respectively. This extends the available VIFs by another 256 codes.

d) **Any VIF: 7Eh / FEh**

This VIF-Code can be used in direction master to slave for readout selection of all VIFs. See special function in 6.4.

e) **Manufacturer specific: 7Fh / FFh**

In this case, the remainder of this data record including VIFEs has manufacturer specific coding.

7.2 Primary VIFs (main table)

The first section of the main table contains integral values, the second typically averaged values, the third typically instantaneous values and the fourth block contains parameters (E: extension bit).

Table 26 — Primary VIF-codes

Coding	Description	Range coding		Range
E000 0nnn	Energy	$10^{(nnn-3)}$	Wh	0,001 Wh to 10 000 Wh
E000 1nnn	Energy	$10^{(nnn)}$	J	0,001 kJ to 10 000 kJ
E001 0nnn	Volume [a]	$10^{(nnn-6)}$	m^3	0,001 l to 10 000 l
E001 1nnn	Mass	$10^{(nnn-3)}$	kg	0,001 kg to 10 000 kg
E010 00nn	On time	nn = 00b nn = 01b nn = 10b nn = 11b	seconds minutes hours days	Duration of meter power up
E010 01nn	Operating time	coded like OnTime		Duration of meter accumulation
E010 1nnn	Power	$10^{(nnn-3)}$	W	0,001 W to 10 000 W
E011 0nnn	Power	$10^{(nnn)}$	J/h	0,001 kJ/h to 10 000 kJ/h
E011 1nnn	Volume flow	$10^{(nnn-6)}$	m^3/h	0,001 l/h to 10 000 l/h
E100 0nnn	Volume flow ext.	$10^{(nnn-7)}$	m^3/min	0,000 1l/min to 1 000 l/min
E100 1nnn	Volume flow ext.	$10^{(nnn-9)}$	m^3/s	0,001 ml/s to 10 000ml/s
E101 0nnn	Mass flow	$10^{(nnn-3)}$	kg/h	0,001 kg/h to 10 000 kg/h
E101 10nn	Flow temperature	$10^{(nn-3)}$	°C	0,001 °C to 1 °C
E101 11nn	Return temperature	$10^{(nn-3)}$	°C	0,001 °C to 1 °C
E110 00nn	Temperature difference	$10^{(nn-3)}$	K	1 mK to 1 000 mK
E110 01nn	External temperature	$10^{(nn-3)}$	°C	0,001 °C to 1 °C
E110 10nn	Pressure	$10^{(nn-3)}$	bar	1 mbar to 1 000 mbar
E110 1100	Date (actual or associated with a storage number/function)			Data field =0010b, type G
E110 1101 [b]	Date and time (actual or associated with a storage number/function)			Data field= 0100b, type F
E110 1101 [b]	Extended time point (actual or associated with a storage number/function)	Time to s		Data field= 0011b, type J
E110 1101 [b]	Extended date and time point (actual or associated with a storage number/function)	Time and date to sec.		Data field= 0110b, type I
E110 1110	Units for H.C.A.			Dimensionless
E110 1111	Reserved for a future third table of VIF-extensions			
E111 00nn	Averaging duration	nn coded like on time		
E111 01nn	Actuality duration	nn coded like on time		
E111 1000	Fabrication no			See Annex E.8.2
E111 1001	(Enhanced) identification			
E111 1010	Address			For EN 13757-2: one byte link layer address, data type C (x = 8) For EN 13757-4: data field 0110b (6 byte header-ID) or 0111b (full 8 byte header)

[a] For gas it is the temperature converted volume, unless a VIFE signals volume at metering- conditions or volume at base-conditions.

[b] Meaning depends on data field.

7.3 VIF-codes for special purposes

Table 27 — Special VIF-codes

Coding	Description	Purpose
1111 1011 (FBh)	First extension of VIF-codes	True VIF is given in the first VIFE and is coded using (Table 29 in 7.5) (128 new VIF-Codes)
E111 1100	VIF in following string (length in first byte)	Allows user definable VIF´s (in plain ASCII-String) [a]
1111 1101 (FDh)	Second extension of VIF-codes	True VIF is given in the first VIFE and is coded using (Table 28 in 7.4) (128 new VIF-Codes)
1110 1111 (EFh)	Reserved for third extension table of VIF-codes	reserved for a future table especially for electricity meters
E111 1110	Any VIF	Used for readout selection of all VIF´s (see 6.4, 7.1)
E111 1111	Manufacturer specific	VIFE´s and data of this block are manufacturer specific
[a] Coding the VIF in an ASCII-String in combination with the data in an ASCII-String (data field in DIF = 1101 b) allows the representation of data in a free user defined form (see Annex C.2).		

7.4 Main VIFE-code extension table (following VIF = FDh for primary VIF)

Table 28 — Main VIFE-code extension table

Coding	Description	Group
E000 00nn	Credit of 10^{nn-3} of the nominal local legal currency units	Currency units
E000 01nn	Debit of 10^{nn-3} of the nominal local legal currency units	
E000 1000	Unique message identification (previously named “Access number (transmission count)”) [g]	
E000 1001	Device type	
E000 1010	Manufacturer	
E000 1011	Parameter set identification	Enhanced identification
E000 1100	Model / Version	
E000 1101	Hardware version number	
E000 1110	Metrology (firmware) version number	
E000 1111	Other software version number	
E001 0000	Customer location	
E001 0001	Customer	
E001 0010	Access code user	
E001 0011	Access code operator	Improved selection
E001 0100	Access code system operator	and other user requirements

Table 28 *(continued)*

Coding	Description	Group
E001 0101	Access code developer	
E001 0110	Password	
E001 0111	Error flags (binary) (device type specific)	
E001 1000	Error mask	
E001 1001	Security key [i]	
E001 1010	Digital output (binary)	
E001 1011	Digital input (binary)	
E001 1100	Baud rate [baud]	
E001 1101	Response delay time [bit-times]	
E001 1110	Retry	
E001 1111	Remote control (device specific e.g. gas valve)	
E010 0000	First storage number for cyclic storage	
E010 0001	Last storage number for cyclic storage	
E010 0010	Size of storage block	
E010 0011	Reserved	Enhanced storage
E010 01nn	Storage interval [sec(s) … day(s)] [a]	management
E010 1000	Storage interval month(s)	
E010 1001	Storage interval year(s)	
E010 1010	Operator specific data [h]	
E010 1011	Time point second (0 to 59)	
E010 11nn	Duration since last readout [sec(s) … day(s)] [a]	
E011 0000	Start (date/time) of tariff [b]	
E011 00nn	Duration of tariff (nn=01 … 11: min to days)	
E011 01nn	Period of tariff [sec(s) to day(s)] [a]	
E011 1000	Period of tariff months(s)	Enhanced tariff
E011 1001	Period of tariff year(s)	management
E011 1010	Dimensionless / no VIF	
E011 1011	Data container for wireless M-Bus protocol [f]	
E011 11nn	Period of nominal data transmissions [sec(s) to day(s)] [a] (e.g. for RF-transmissions)	Installation and start up
E100 nnnn	10^{nnnn-9} volts	Electrical units
E101 nnnn	$10^{nnnn-12}$ A	
E110 0000	Reset counter	
E110 0001	Cumulation counter	
E110 0010	Control signal	
E110 0011	Day of week [e]	
E110 0100	Week number	

Table 28 *(continued)*

Coding	Description	Group
E110 0101	Time point of day change	
E110 0110	State of parameter activation	
E110 0111	Special supplier information	
E110 10pp	Duration since last cumulation [hour(s) … years(s)][c]	
E110 11pp	Operating time battery [hour(s)..years(s)][c]	
E111 0000	Date and time of battery change[b]	
E111 0001	RF level units: dBm[d]	
E111 0010	Daylight savings (beginning, ending, deviation) data type K	
E111 0011	Listening window management data type L	
E111 0100	Remaining battery life time (days)	
E111 0101	Number times the meter was stopped	
E111 0110	Data container for manufacture specific protocol[f]	
E111 0111 – E111 1111	Reserved	

a nn = 00 second(s)
01 minute(s)
10 hour(s)
11 day(s)

b The information about usage of data type F (date and time) or data type G (date), I (time to seconds) or J (extended date/time) can be derived from the data field (0010b: type G / 0011b: type J, 0100: type F).

c pp = 00 hour(s)
01 day(s)
10 month(s)
11 year(s)

d Typically this VIFE is used in context with a function field of 00b of the leading DIF. If this VIFE used together with the function field 10 b it declares a preset quality limit of the reception level which was exceeded (e.g. RF-Level > -80dBm). If this VIFE is used together with the function field 11 b it declares the typical noise level detected by this radio device.

e Data type A (1 = Monday; 7 = Sunday, 0 = all the days).

f Using this VIFE as a data container for wireless M-Bus or manufacturer specific protocol in combination with the variable length DIF = 0Dh (LVAR from 00h to BFh only, see Annex N).

g The unique message identification is not resettable.

h This data point is reserved for the transport of any special information for the operator. It shall not be used by the vendor!

i Typically the security key needs to be set with data field LVAR , due to its large size.

7.5 Alternate VIFE-code extension table (following VIF = FBh for primary VIF)

Table 29 — Alternate extended VIF-code table

Coding	Description	Range Coding	Range
E000 000n	Energy	$10^{(n-1)}$ MWh	0.1 MWh to 1 MWh
E000 001n	Reactive energy	$10^{(n)}$ kVARh	1 to 10 kVARh
E000 010n	Apparent energy	$10^{(n)}$ kVAh	1 to 10 kVAh
E000 011n	Reserved		
E000 100n	Energy	$10^{(n-1)}$ GJ	0.1 GJ to 1 GJ
E000 101n	Reserved		
E000 11nn	Energy	$10^{(n-1)}$ MCal	0.1 MCal to 100 MCal
E001 000n	Volume	$10^{(n+2)}$ m^3	
E001 001n	Reserved		
E001 01nn	Reactive power	$10^{(nn-3)}$ kVAR	0.001 kVAR to 1 kVAR
E001 100n	Mass	$10^{(n+2)}$ t	100 t to 1 000 t
E001 101n	Relative humidity	$10^{(n-1)}$ %	0.1 % to 100 %
E001 1100 – E001 1111	Reserved		
E010 0000	Volume	$feet^3$	
E010 0001	Volume	0,1 $feet^3$	
E010 0010	Reserved		[a]
E010 0011	Reserved		[a]
E010 0100	Reserved		[a]
E010 0101	Reserved		[a]
E010 0110	Reserved		[a]
E010 0111	Reserved		
E010 100n	Power	$10^{(n-1)}$ MW	0,1 MW to 1 MW
E010 1010	Phase U-U (volt. to volt.)		0.1°
E010 1011	Phase U-I (volt. to current)		0.1°
E010 11nn	Frequency	$10^{(nn-3)}$ Hz	0.001 Hz to 1 Hz
E011 000n	Power	$10^{(n-1)}$ GJ/h	0,1 GJ/h to 1 GJ/h
E011 001n	Reserved		
E011 01nn	Apparent power	$10^{(nn-3)}$ kVA	0.001 kVA to 1 kVA
E011 1000 – E101 0111	Reserved		
E101 1000 – E110 0111	Reserved		[a]
E110 1nnn	Reserved		
E111 00nn	Reserved		[a]
E111 01nn	Cold/warm temperature limit	$10^{(nn-3)}$ °C	0,001 °C to 1 °C
E111 1nnn	Cum. max. of active power	$10^{(nnn-3)}$ W	0,001 W to 10 000 W

[a] These codes were used until 2004, now they are reserved for future use.

NOTE Refer also to Annex C for non-metric units.

7.6 Combinable (orthogonal) VIFE-Code extension table

This code follows immediately the VIF or the VIFE (in case of code extension) and modifies its meaning.

Table 30 — Combinable (orthogonal) VIFE-table

VIFE-Code	Description
E000 xxxx	Reserved for object actions (master to slave): see Clause 9 or for error codes (slave to master): see 8.4
E001 0100	Relative deviation[a]
E001 0000 – E001 0100	Reserved
E001 0101 –E001 1100	Record error codes (slave to master); (see 8.4)
E001 1101	Standard conform data content[b]
E001 1110	Compact profile with registers[c]
E001 1111	Compact profile without registers[c]
E010 0000	Per second
E010 0001	Per minute
E010 0010	Per hour
E010 0011	Per day
E010 0100	Per week
E010 0101	Per month
E010 0110	Per year
E010 0111	Per revolution / measurement
E010 100p	Increment per input pulse on input channel number p
E010 101p	Increment per output pulse on output channel number p
E010 1100	Per litre
E010 1101	Per m^3
E010 1110	Per kg
E010 1111	Per K (Kelvin)
E011 0000	Per kWh
E011 0001	Per GJ
E011 0010	Per kW
E011 0011	Per (K*l) (Kelvin*litre)
E011 0100	Per V (volt)
E011 0101	Per A (ampere)
E011 0110	Multiplied by s
E011 0111	Multiplied by s / V
E011 1000	Multiplied by s / A
E011 1001	Start date(/time) of[d, e]

Table 30 *(continued)*

VIFE-Code	Description
E011 1010	VIF contains uncorrected unit or value at metering conditions instead of converted unit
E011 1011	Accumulation only if positive contributions (forward flow contribution)
E011 1100	Accumulation of abs value only if negative contributions (backward flow)
E011 1101	Reserved for alternate non-metric unit system (according to Annex C)
E011 1110	Value at base conditions[f]
E011 1111	OBIS-declaration (data type C follows in case of binary coding)
E100 u000	U = 1: upper, u = 0: lower limit value
E100 u001	Number of exceeds of lower u = 0) / upper (U = 1) limit
E100 uf1b	Date (/time) of: b = 0: begin, b = 1: end of, f = 0: first, f = 1: last[b] u = 0: lower, u = 1: upper limit exceed
E101 ufnn	Duration of limit exceed (u, f: as above, nn = duration)
E110 0fnn	Duration of[a, b] (f: as above, nn = duration)
E110 1u00	Value during lower (u = 0), upper (u = 1) limit exceed
E110 1001	Leakage values
E110 1101	Overflow values
E110 1f1b	Date (/time) of[a] (f,b: as above)
E111 0nnn	Multiplicative correction factor for value (not unit): 10^{nnn-6}
E111 10nn	Additive correction constant: 10^{nn-3} • unit of VIF (offset)[g]
E111 1100	Extension of combinable (orthogonal) VIFE-Code (refer to Table 31)
E111 1101	Multiplicative correction factor for value (not unit): 10^3
E111 1110	Future value
E111 1111	Next VIFEs and data of this block are manufacturer specific

a Use the multiplier VIFE E111 0nnn to generate % or ppm values, e.g. multiplier of 10-2.

b This VIFE shall be attached to a special VIFE if the content of the related data point has not a manufacture specific use but conforms exclusively to the definitions of the Annex H.

c This VIFE declares a series of data points as compact profile. According to Annex I.

d ”Date(/time) of” or ”Duration of” relates to the information which the whole Data Record Header contains.

e The information about usage of data type F (date and time) or data type G (date) can be derived from the data field (0010b: type G / 0100: type F).

f Used either to indicate that the consumption value is referenced, respectively converted to base conditions (e.g. gas volume at base temperature and base pressure) or for the base condition itself (e.g. reference/ base temperature or reference/ base pressure).

g The additive correction constant is given as a separate data record.

The codes of Table 31 follow immediately after the VIFE=FCh of Table 30.

Table 31 — Extension of combinable VIFE-table (following VIFE = FCh of combinable (orthogonal) VIFE-table)

VIFE-Code	Description
E000 0000	Reserved
E000 0001	At phase L1
E000 0010	At phase L2
E000 0011	At phase L3
E000 0100	At neutral (N)
E000 0101	Between phase L1 and L2
E000 0110	Between phase L2 and L3
E000 0111	Between phase L3 and L1
E000 1000 – E000 1111	Reserved
E001 0000	Accumulation of abs. value for both positive and negative contribution (absolute count)[a]
E001 0001 – E111 1111	Reserved

[a] This extension is used in special case if the meter index counts up independent of the polarity of the meter (for both directions).

8 Application layer status and error reporting

8.1 General

The acknowledgement by the data link layer reports only a successful communication. Errors happened by the handling of the transmitted application data are not reported. There are three different techniques for the reporting of application errors.

8.2 Status field

The presence and type of an application error shall be indicated by the status field in the variable data structure (refer to Table 8 in 5.10).

8.3 General application layer errors

For reporting general application errors, a slave can use a RSP_UD datagram with CI = 6Eh, 6Fh or 70h and zero, one or several data bytes, which describe the type of error:

Table 32 — Application error (no header)

CI=70h	Optional first error code byte (1 byte - see Table 35)

Table 33 — Application error (short data header)

CI=6Eh	Short data header (see Annex J)	Optional first error code byte (1 byte - see Table 35)

Table 34 — Application error (long data header)

CI=6Fh	Long data header (see Annex J)	Optional first error code byte (1 byte - see Table 35)

The following values for DATA are defined:

Table 35 — First error code byte for general application errors

Byte	Designation	Type of error
00h	Unspecified error	Unspecified error: also if data field is missing
01h	CI-field error	Unimplemented CI-field
02h	Buffer overflow	Buffer too long, truncated
03h	Record overflow	Too many records
04h	Record error	Premature end of record
05h	DIFE overflow	More than 10 DIFE's
06h	VIFE overflow	More than 10 VIFEs
07h	-	Reserved
08h	Application busy	Application too busy for handling readout request
09h	Credit overflow	Too many readouts (for slaves with limited readouts per time)
0Ah…0Fh	-	Reserved
11h	No function	Function not implemented (command unknown or not supported)[a]
12h	Data error	Data to be supplied not available[a]
13h	Routing/Relaying error	Cannot route/relay data further[a]
14h	Access violation	Data access right violation[a]
15h	Parameter error	Parameter is missing or wrong[a]
16h	Size error	The amount of data requested cannot be handled[a]
17h to 1Fh	-	Reserved
20h	Wrong encryption key	Decryption fails
21h	Wrong encryption method	Encryption method not supported
22h to EFh	-	Reserved
F0h	-	Dynamic application error[b]
F1h…FFh	-	Manufacture specific application error

a These error codes are applied in EN 13757-5.

b The data point is coded as M-Bus-specific data point with a leading DIF/ VIF. The declaration is vendor specific. The dynamic application error is limited to 7 bytes.

8.4 Record errors

To report errors belonging just to a special record and not to the full application, the slave can add to the defective record a VIFE containing one of the values of Table 36 to code the type of application error, which has occurred for this record.

Table 36 — Codes for record errors (E = Extension bit)

VIFE-Code	Type of record error	Error group
E000 0000	None	DIF errors
E000 0001	Too many DIFEs	
E000 0010	Storage number not implemented	
E000 0011	Unit number not implemented	
E000 0100	Tariff number not implemented	
E000 0101	Function not implemented	
E000 0110	Data class not implemented	
E000 0111	Data size not implemented	
E000 1000 to E000 1001	Reserved	
E000 1010	Reserved	VIF errors
E000 1011	Too many VIFEs	
E000 1100	Illegal VIF-Group	
E000 1101	Illegal VIF-Exponent	
E000 1110	VIF/ DIF mismatch	
E000 1111	Unimplemented action	
E001 0000 to E001 0100	Not used for record errors	
E001 0101	No data available (undefined value)	Data errors
E001 0110	Data overflow	
E001 0111	Data underflow	
E001 1000	Data error	
E001 1001 to E001 1011	Reserved	
E001 1100	Premature end of record	Other errors

In case of record errors the data maybe invalid. The slave has some options to transmit the data:

— data field = 0000b: no data;

— data field = 0000b: no data and idle filler (DIF = 02Fh): fill record up to the normal length;

— other data field: dummy data of correct length;

— other data field: unsafe or estimated data.

9 Generalised object layer

The fundamental idea of an object is the encapsulation of data and methods or actions for the data. In case of writing data to a slave the master software can pack data and information about the action, which the slave shall do with this data, in one data record. This variable data record with actions is now called an object. Following any VIF including a VIF = FDh or VIF = FBh with the true value information in the first VIFE, another (usually the last) VIFE can be added which contains a code signalling object actions according to the following table.

Table 37 — Action codes for the generalised object layer (master to slave)

VIFE-Code binary	Action	Explanation
E000 0000	Write (replace)	Replace old with new data
E000 0001	Add value	Add data to old data
E000 0010	Subtract value	Subtract data from old data
E000 0011	OR (set bits)	Data OR old data
E000 0100	AND	Data AND old data
E000 0101	XOR (toggle bits)	Data XOR old data
E000 0110	AND NOT (clear bits)	NOT data AND old data
E000 0111	Clear	Set data to zero
E000 1000	Add entry	Create a new data record
E000 1001	Delete entry	Delete an existing data record
E000 1010	Delayed action	A CI = 5Ch will follow and execute the desired action
E000 1011	Freeze data	Freeze data to storage no.
E000 1100	Add to readout-list	Add data record to RSP_UD
E000 1101	Delete from readout-list	Delete data record from RSP_UD
E000 111x	Reserved	
NOTE The object action "write/ replace" (VIFE = E000 0000) is the default and is assumed if there is no VIFE with an object action for this record.		

10 Manufacturer specific unstructured data block

The MDH consists of the character 0Fh or 1Fh (DIF = 0Fh or 1Fh) and indicates that all following data are manufacturer specific. When the total number of bytes given from the link/network layers and the number of record-structured bytes and the length of the fixed header is known, the number of remaining unstructured manufacturer specific bytes can be calculated.

NOTE Structured manufacturer specific data (i.e. those with a known data structure including variable length binary or ASCII but with a manufacturer specific meaning or unit) can be described using normal data records with a value information field of VIF = E1111111b.

The MDH = 1Fh is used for multi datagram messages (refer to 6.4).

11 Management of lower layers

11.1 General

Because changing of parameters like baud rate and address by higher layers is not allowed in the ISO-OSI-Model, a management layer beside and above the three layers of the collapsed model is defined.

Table 38 — Management layer of the M-Bus link layer according EN 13757-2

Management layer	
Application layer	
Transport layer	Secondary address selection via address 253 and CI = 52h
Data link layer	primary Address + 254 (255)/ 251

The addresses 0..250 are used as primary addresses for meters on the M-Bus. The address 254 can be used for addressing a single meter with an unknown primary address (as long as only one meter is connected to the master). The address 255 is applied as broadcast address (without acknowledge). The address 251 is applied for managing the (primary) M-Bus level converter/ bridge and the address 253 (selection) for the optional secondary addressing via the transport layer (see 11.3).

11.2 Switching baud rate for M-Bus link layer according to EN 13757-2

All slaves shall be able to communicate with the master using the minimum transmission speed of 300 Bd. Split baud rates between transmit and receive are not allowed, but there can be devices with different baud rates on the bus.

In point to point connections the slave is set to another baud rate by a control frame (SND_UD with L-Field = 3) with address FEh and one of the following CI-field codes.

For safety reasons a baud rate switch command to the (unacknowledged) broadcast address 255 is not recommended.

Table 39 — CI-field codes for baud rate switching

CI-field	**B8h**	**B9h**	**BAh**	**BBh**	**BCh**	**BDh**	**BEh**	**BFh**
Baud	300[a]	600[b]	1 200[b]	2 400[a]	4 800[b]	9 600[a]	19 200[b]	38 400[b]

a Recommended standard baud rates.

b These baud rates are reserved for special operator agreement only.

The slave always confirms the correctly received datagram by transmitting an E5h with the old baud rate and uses the new baud rate from now on, if it is capable of this. Otherwise the slave stays at its previous baud rate after the E5h acknowledge. To make sure that a slave without auto speed detect has properly switched to the new baud rate and that it can communicate properly at the new baud rate in its segment, it is required that, after a baud rate switch to a baud rate other than 300 Bd, the master attempts immediately (< 2 min) after the baud rate switch command a communication. If (even after the appropriate number of retries) this is not acknowledged by the slave, the master shall issue a baud rate set command (at the attempted new baud rate) back to the previous baud rate. If a slave without auto speed detect does not receive a valid communication at the new baud rate within 2 min to 10 min of the baud rate switch command, the slave shall fall back to its previous baud rate. This is required individually and sequentially for each addressable slave. For compatibility with older slaves with fall back to 300 Bd, the master should also attempt a communication at 300 Bd if the slave does not answer at its last baud rate.

11.3 Selection and secondary addressing

This technique allows the M-Bus protocol to logically "connect" a slave with a certain (secondary) address and it then associates this selected slave with the primary address of 253 (FDh). So the maximum number of 250 addresses (primary) is extended by this technique to an arbitrary number of possible slaves, effectively increasing the address range of the link layer. This function is only enabled by a SND_UD with CI-field 52h to address 253.

When addressing in the data link layer with the help of the A-field, the problem of the address allocation could arise. The addresses are normally set to a value of 0 by the manufacturer of the meters, in order to designate them as unconfigured slaves. A very laborious method of address allocation consists of setting the addresses when installing the slaves, for example, with DIP switches. A further method of address allocation is to determine the bus addresses when connecting the equipment to the bus with the master software. This sends a command for address allocation (see E.3) to the address 0. In this case the slaves shall, however, all be successively connected to the bus, which very much gets in the way of a simple installation procedure.

When addressing in the transport layer, however, these disadvantages are avoided and the address region is essentially extended beyond the number of 250 with primary addressing (A-field). The addressing of the slaves takes place with secondary addressing with the help of the following so-called selection.

Table 40 —Structure of a datagram for selecting a slave

68h	0Bh	0Bh	68h	53h/ 73h	FDh	52h	ID1-4	Man 1-2	Gen	Dev	CS	16h

The master sends a SND_UD with the control information 52h to the address 253 (FDh) and fills the specific meter secondary address (identification number, manufacturer, version and device type) with the values of the slave which is to be addressed. After the reception of the address FDh the selection mode is entered. If then the proper CI-selection code CI = 52h is received, the internal selection bit is set; otherwise, it is reset. If further data bytes follow, they are compared with the corresponding internal addresses respective values of the meter. If they disagree, the selection bit is cleared; otherwise, it is left unchanged. Thus, “selecting” a meter with only a proper CI-field and no further data will select all meters on the bus capable of secondary addressing. A set selection bit means that this slave can be addressed (e.g. REQ_UD) with the bus address FDh and in this example will reply with RSP_UD. In other words, the transport layer has associated this slave with the address FDh.

During selection, individual positions of the secondary addresses can be occupied with wildcards (Fh). Such a wildcard means that this position will not be taken account of during selection, and that the selection will be limited to specific positions, in order to address complete groups of slaves (multicasting). In the identification number, each individual digit can be wildcarded by a wildcard nibble Fh while the fields for manufacturer, version and device type can be wildcarded by a wildcard byte FFh.

The state of the selection remains unchanged until the slave is deselected with a selection command (as described above) with non-matching secondary addresses, or a SND_NKE to address 253. In case of a SND_NKE to address 253 a selected slave has to acknowledge the deselection with a single 0E5h. The slave, which uses mode 1 for multibyte records, will be selected by a datagram with the CI-field 52h and the correct secondary address, but it will be deselected by a datagram with any other secondary address.

A slave with implemented primary and secondary addressing shall also answer datagrams to its primary address. A SND_NKE to its primary address (0..250, 254, 255) will not influence the internal selection bit for the secondary addressing mode. This is comparable to the FCB management, where primary and secondary addressing is also handled separately.

A slave with only secondary addressing (i.e. internal primary address = 253) shall occupy the address field in the RSP_UD datagram with FDh to signal that it will not participate in primary addressing.

A slave with implemented primary and secondary addressing shall occupy the address field in the RSP_UD telegram with its own primary address to signal its accessibility via this primary address. The slave shall ignore the state of the FCB-Bit if it receives a SELECT message (CI-field = 52h).

11.4 Generalised selection procedure

For including new or restructured identification parameters into a selection procedure an enhanced definition of the selection datagram (CI = 52h) can be used.

After the 8 byte of the fixed selection header may also follow standard records with data. In this case only those meters will be selected where, in addition to the fixed header, all record data agree. In most but not all cases this means that the DIF and parts of the VIF (not exponent) shall match. Again wildcard rules apply to the record data (digit wildcard for BCD-coded data and byte wildcard for binary or string data).

With this generalised selection it will be possible to select slaves using e.g. additional fabrication number, longer identification numbers, customer location and more information.

After the field “device type” the 8-digit BCD-fabrication number follows. Parts of the fabrication number (Fab1 … Fab4) can be occupied with wildcards (Fh).

Enhanced selection with fabrication number

The identification number can be used as a customer number and then can be changed by the operator. Therefore, it can be possible that two slaves have the same secondary address. For this reason the selection datagram can be extended by a **fabrication number** to make sure that in any case all slaves are distinguishable. This number is a serial number allocated during manufacture, coded with 8 BCD packed digits (4 byte) like the identification number, and thus runs from 00000000 to 99999999.

The following table shows the structure of an enhanced selection datagram released by the master.

Table 41 — Application layer structure of a datagram for enhanced selection (mode 1)

CI=52h	ID1 (LSB)	ID2	ID3	ID4	Man1	Man 2	Ver	Dev. Type	DIF= 0Ch	VIF=78h	Fab1	Fab2	Fab3	Fab4

After the field device type the new data is given in form of a structured data record with DIF = 0Ch and VIF = 78h. Parts of the fabrication number (Fab1 … Fab4) can be occupied with wildcards (Fh).

If a fabrication number exists and is needed for the selection procedure, the slave shall add this data to the variable data blocks in every RSP-UD datagram. If the fabrication number and enhanced selection is not implemented in a slave this device shall not confirm the enhanced selection datagram and shall be deselected.

Enhanced selection should be used only if the normal kind of selection is not successful.

11.5 Searching for installed slaves

11.5.1 Primary addresses

To read out all installed slaves the master software shall know all the slaves which are connected to the bus. Therefore, the software searches for slaves with primary addressing by sending a REQ_UD2 to all allowed addresses (1 … 250) with all available baud rates. The master notes used primary addresses with the respective baud rates.

11.5.2 Secondary addresses

The secondary addressing described in the preceding section draws attention to the problem of determining the secondary addresses of slaves connected to the bus. The master can read out the slaves making use of secondary addresses with previous selection (see 11.4). Testing all possible identification numbers with the master software would take years since the identification number offers millions of combinations. For this reason, a procedure was developed for the rapid and automatic determination of already installed slaves.

11.5.3 Wildcard searching procedure

The following wildcard searching procedure uses the occupation of individual parts of the secondary address with wildcards (Fh) for selection.

In this case with the identification number (BCD), each individual position, and by manufacturer, version and device type (binary coding), only one complete byte, can be occupied with wildcards. The master begins the selection using a SND_UD with the control information 52 h (mode 1), and occupies all positions in the identification number, except the top one, with wildcards. The top position is run through in ten selections from 0 to 9 (0FFFFFFF to 9FFFFFFF).

If after such a selection the master receives no acknowledgement, it goes to the next selection. If the master receives an E5h, it sends a REQ_UD2 and learns the secondary address of the slaves from the reply datagram, as long as no collision occurs. If there is a collision after the selection or the REQ_UD2, the master varies the next positions and holds the existing one. If there is a collision, for example at 5FFFFFFF, the selection is run through from 50FFFFFF to 59FFFFFF. If in this case collisions again occur, then a change is made to a variation of the next position. After running through a complete position, the next higher position is processed up to 9.

With this wildcard searching procedure, it will be seen that at least the top position shall be run through in order to reach all slaves. Running through further positions may be necessary, depending on the number of the slaves and the distribution of the identification numbers. This procedure allows a statement of the maximum number of selections in relation to the number of slaves, but as a disadvantage frequent collisions may occur. The wildcard searching procedure shall be performed for all used baud rates and both byte sequences (mode 1 and 2).

The search procedure can be extended with searching for manufacturer, generation and finally device types to find slaves, which have the same identification number. It is also possible to search for all slaves of a certain manufacturer or all slaves of a certain device type by setting the corresponding value. With extended selection meters, which differ only in their manufacturer, specific fixed fabrication number can be distinguished.

NOTE For further information on Wildcard search procedure (secondary search), see Annex F.

Annex A
(normative)

Coding of data records

The following data types are used inside the application layer:

Type A: Unsigned integer BCD := XUI4 [1 to 4] <0 to 9 BCD>

Table A.1 — Type A: Unsigned BCD

2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	
Digit 10				Digit 1				1UI4 [1 to 4] < 0 to 9 BCD > := digit 10^0
8	4	2	1	8	4	2	1	2UI4 [5 to 8] < 0 to 9 BCD > := digit 10^1
...	...	...	...	...	...	...	...	...
8	4	2	1	8	4	2	1	XUI4 [5 to 8] < 0 to 9 BCD > := digit 10^{X-1}

Digits values of Ah – Eh in any digit position signals invalid.

A hex code Fh in the MSD position signals a negative BCD number in the remaining X-1 digits. For details of this coding see Annex B.

Type B: Binary integer := I[1..X] <(-2^{X-1} +1) to +(2^{X-1}-1)>

Table A.2 — Type B: Signed integer

2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	
								1B1 [X] := S = sign: S <0> := positive
...							...	S <1> := negative
S	2^{X-2}						2^{X-8}	negative values in two´s complement

The coding "1000…0000b" signals "invalid"

Type C: Unsigned integer:= UI[1..X] < 0 to 2^X-2>

Table A.3 — Type C: Unsigned integer

2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	UI8 [1 to..8] <(0 to 255)>
...							...	
2^{X-1}	2^{X-2}						2^{X-8}	

NOTE 1 The data field coding as 'integer/binary' always applies to Type B (signed integer) except Type C (unsigned integer) is explicit declared by the special VIF/VIFE.

The coding "1111…1111b" signals "invalid"

Type D: Boolean (1 bit binary information):= XB1 B1[i] < 0 to 1>

Table A.4 — Type D: Boolean

2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	XB1: B1[i] < 0 to 1>
...							...	B1[i] <0> := false
2^{X-1}							2^{X-8}	B1[i] <1> := true

NOTE 2 The data field coding as 'integer/binary' always applies to Type B (signed integer) except Type D (Boolean) is explicit declared by the special VIF/VIFE.

Type E: Obsolete

Type F: Compound CP32: Date and time

Table A.5 — Type F: Date and time (CP32)

2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	Min: UI6 [1 to 6] < 0 to 59> ; 63 : every minute
2^{15}	2^{14}	2^{13}	2^{12}	2^{11}	2^{10}	2^9	2^8	Hour: UI5 [9 to 13] < 0 to 23> ; 31 : every hour
2^{23}	2^{22}	2^{21}	2^{20}	2^{19}	2^{18}	2^{17}	2^{16}	Day : UI5 [17 to 21] < 1 to 31> ; 0 : every day
2^{31}	2^{30}	2^{29}	2^{28}	2^{27}	2^{26}	2^{25}	2^{24}	Month: UI4 [25 to 28] < 1 to 12> ; 15 every month
								Year: UI7 [22 to 24 ; 29 to 32] < 0 to 99> ; 127 every year
								Hundred year: UI2 [14 to 15] < 0 to 3> this year is 1900+100*hundred year + year
								IV B1 [8] IV<0> = valid ; IV <1> = invalid
								SU B1 [16] IV<0> = standard time ; IV <1> = summer time
								RES1 B1 [7] <0> reserved for future use

For compatibility with old meters with a circular two digit date it is recommended to consider in any master software the years “00” to “80” as the years 2000 to 2080.

Type G: Compound CP16: Date

Table A.6 — Type G: Date (CP16)

2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	Day:	UI5 [1 to 5] < 1 to 31 > “0”: every day
2^{15}	2^{14}	2^{13}	2^{12}	2^{11}	2^{10}	2^9	2^8	Month:	UI4 [9 to 12] < 1 to 12 > “15”: every month
								Year:	UI7 [6 to 8,13 to 16] < 0 to 99 > 127: every year

For compatibility with old meters with a circular two digit date it is recommended to consider in any master software the years “00” to “80” as the years 2000 to 2080. A value of FFh in both bytes (that means FFh FFh) shall be interpreted as invalid.

Type H: Floating point according to IEEE-standard

"Short floating point number IEEE STD 754" = R32IEEESTD754

R32IEEESTD754 := R32.23 {Fraction, Exponent, Sign}

Fraction	=	F := UI23 [1to 23] < 0 to 1-2^{-23}>	
Exponent	=	E := UI8 [24 to 31] < 0 to 255 >	
Sign	=	S := BS1 [32]	S <0> = positive
			S <1> = negative

F <0> and E <0>	:= (-1) S ∗ 0	= ± zero
F <≠0> and E <0>	:= (-1) S ∗ 2E-126(0.F)	= denormalised numbers
E <1 to 254>	:= (-1) S ∗ 2E-127(1.F)	= normalised numbers
F <0> and E <255>	:= (-1) S ∗ ∞	= ± infinite
F <≠0> and E <255>	:= NaN	= not a number, regardless of S

Table A.7 — Type H: Floating point

Bits	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**
Octet 1	F = Fraction							
	2^{-16}	2^{-17}	2^{-18}	2^{-19}	2^{-20}	2^{-21}	2^{-22}	2^{-23}
Octet 2	F = Fraction							
	2^{-8}	2^{-9}	2^{-10}	2^{-11}	2^{-12}	2^{-13}	2^{-14}	2^{-15}
Octet 3	E (LSB)	F = Fraction						
	2^{-0}	2^{-1}	2^{-2}	2^{-3}	2^{-4}	2^{-5}	2^{-6}	2^{-7}
Octet 4	Sign	E = Exponent						
	S	2^{7}	2^{6}	2^{5}	2^{4}	2^{3}	2^{2}	2^{1}

The following ranges are specified by IEE Std 754–1985 for floating point arithmetic's

Range:($-2^{128} + 2^{104}$) to ($+2^{128} - 2^{104}$), that is $-3,4*10^{38}$ to $+3,4*10^{38}$

Smallest negative number:-2^{-149},that is: $-$ $1,4*10^{-45}$

Smallest positive number:$+2^{-149}$, that is: + $1,4*10^{-45}$

Type I: Year down to second

Data field = 0110 (48 bits)

Table A.8 — Type I: Date and time (CP48)

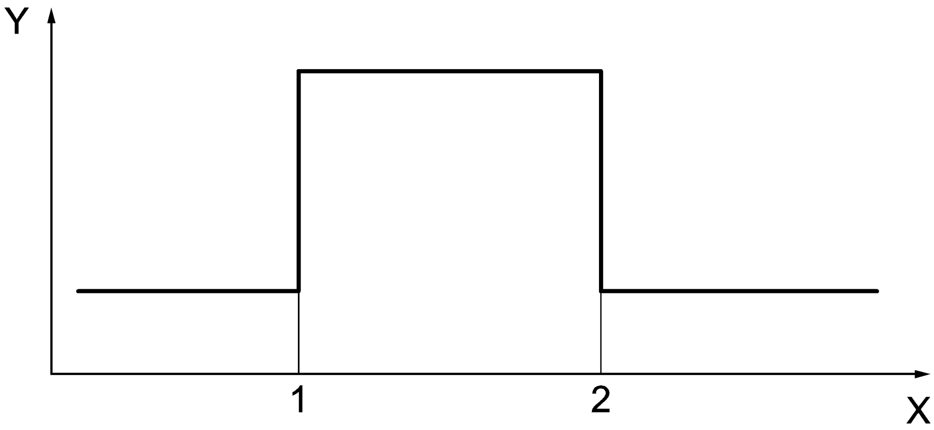
Byte/ bit	**MSBit**							**LSBit**
LSB	8	7	6	5	4	3	2	1
	16	15	14	13	12	11	10	9
	24	23	22	21	20	19	18	17
	32	31	30	29	28	27	26	25
	40	39	38	37	36	35	34	33
MSB	48	47	46	45	44	43	42	41

Local time :		
Second	UI6 [1 to 6]	<0 to 59> ; 63 : every second [1]
Minute	UI6 [9 to 14]	<0 to 59> ; 63 : every minute[2]
Hour	UI5 [17 to 21]	<0 to 23>; 31 : every hour [2]
Day	UI5 [25 to 29]	<1 to 31> <0> (0= not specified)[2]
Month	UI4 [33 to 36]	<1 to 12> <0> 0= not specified [2]
Year	UI7 [30 to 32+37 to 40]	<0 to 99> <127> 127= not specified[2]
Day of the week	UI3 [22 to 24]	<1 to 7> 1= Monday 7= Sunday 0= not specified[2]
Week	UI6 [41 to 46]	<1 to 53> 0= not specified [2]
Time invalid	UI1 [16]	1= invalid ; 0 = valid
Time during daylight savings	UI1 [7]	1= yes (summer time) ; 0 = no
Leap year	UI1 [8]	1= leap year ; 0 = standard year
Daylight savings deviation (hour)[3]	UI1 [15]	<0 to 1> (1= + 0 = -)
	UI2 [47 to 48]	<0 to 3> 0 = no daylight savings

1) Other values reserved for future uses.

2) Based on EN 62056-62 (COSEM).

3) Number of hour by which the local time shall be corrected at daylight savings begin.



Key

Y deviation
X time
1 daylight savings begin
2 daylight savings end

Figure A.1 — Change of time by daylight savings

Type J: Time of day

Data field = 0011 (24 bits)

Table A.9 — Type J = Time (CP24)

Byte /bit	**MSBit**							**LSBit**
LSB	8	7	6	5	4	3	2	1
	16	15	14	13	12	11	10	9
MSB	24	23	22	21	20	19	18	17

Local time :

Second	UI6 [1 to 6]	<0 to 59> ; 63 : every second [4)]
Minute	UI6 [9 to 14]	<0 to 59> ; 63 : every minute [4)]
Hour	UI5 [17 to 21]	<0 to 23>; 31 : every hour [4)]

000000h: time invalid.

4) Other values reserved for future uses.

Type K: Daylight savings

Data field = 0100 (32 bits)

Table A.10 — Type K: Daylight savings

Byte/bit	**MSBit**							**LSBit**
LSB	8	7	6	5	4	3	2	1
	16	15	14	13	12	11	10	9
	24	23	22	21	20	19	18	17
MSB	32	31	30	29	28	27	26	25

Daylight savings enable	UI1 [16]	<0 to 1>[5] 1 enables daylight savings function
Deviation from local time to the Greenwich Mean Time (hour):	UI5 [6 to 8 + 14 to 15]	<0 to 23 > <31> 31= not specified [6]
Daylight savings begin (given in local time):		
Hour	UI5 [1 to 5]	<0 to 23>[6]
Day	UI5 [9 to 13]	<1 to 31>[6]
Month	UI4 [25 to 28]	<1 to 12>[6]
Daylight savings end: (given in local time):		
Day	UI5 [17 to 21]	<1 to 31>[6]
Month	UI4 [29 to 32]	<1 to 12>[6]
Daylight savings deviation (hour)[6]	UI1[24]	<0 to 1> 1= + 0 = -
	UI2 [22 to 23]	<0 to 3> 0 = no daylight savings

[5] Other values reserved for future uses.

[6] Number of hour by which the local time shall be corrected at beginning of daylight savings.

Type L: Listening window management

Data field = 1101 (variable length LVAR=EBh)

Table A.11 — Type L: Listening window management

Byte/bit	**MSBit**							**LSBit**
LSB	8	7	6	5	4	3	2	1
	16	15	14	13	12	11	10	9
	24	23	22	21	20	19	18	17
	32	31	30	29	28	27	26	25
	40	39	38	37	36	35	34	33
	48	47	46	45	44	43	42	41
	56	55	54	53	52	51	50	49
	64	63	62	61	60	59	58	57
	72	71	70	69	68	67	66	65
	80	79	78	77	76	75	74	73
MSB	88	87	86	85	84	83	82	81

This command is used to initialise the window listening management, which defines when the meter is in "normal mode" or "power saved mode".

We choose the week(s) while the meter could be in normal mode. Set to 1 the matching bit(s): bit 1 to bit 53. The first week of the year is represented by bit 1, .. , the 52nd by the bit 52.

We choose the day(s) while the meter could be in normal mode. All the weeks are identical for this choice. Set to 1 the matching bit(s): bit 54 to bit 60. Sunday is represented by bit 54, Monday by bit 55, .. , Saturday by bit 60.

We choose the hour(s) while the meter could be in normal mode. All the days are identical for this choice. Set to 1 the matching bit(s): bit 61 to bit 83. The first hour is represented by bit 61, .. the 24th hour by bit 84.

We choose the quarter(s) of an hour, while the meter could be in normal mode. All the hours are identical for this choice. Set to 1 the matching bit(s): bit 85 to bit 88. The first quarter is represented by bit 85, .. the fourth quarter by the bit 88 .

At one point, the meter is in "normal mode" if the bits for week, day and hour are set to 1. The meter is in "power saved mode" if one or more of the bits for week, day and hour is set to 0.

For example:

If bits 3, 55, 56, 61 and 62 are set to 1 and the others are set to 0. The meter is in normal mode between 0 and 2 hour on Monday and Tuesday of the third week of the year.

If bits 3, 55, 56, 61,63, 85 and 86 are set to 1 and the others are set to 0 the meter is in normal mode in the first and second quarter of hour 0 and hour 2 , between 0:00' and 0:30' and between 2:00' and 2:30', on Monday and Tuesday of the third week of the year.

Annex B
(normative)

Interpretation of hex-codes Ah – Fh in BCD-data fields

B.1 General description standard reference

This standard allows multi-digit BCD-coded data fields. It does, however, not contain information about what happens if a non-BCD hex code (Ah – Fh) is detected by the master software.

B.1.1 Purpose

a) Define the treatment of non BCD-digits in slave to master RSP_UD-datagrams.

To fully define a master software including error treatment; such a definition would be desirable.

b) Utilise these codes for simplified error treatment by slave.

1) Simple visible error signalling.

To simplify the design of slaves with integrated displays, the above mentioned non-BCD states of the variables should be both transmittable in the form of suitable (hex) codes but also be displayable directly from the value codes of a 7-segment (usually LCD) display by extending the normal ten entry BCD to 7-segment decoding a 16-entry decoding table.

B.2 Definition

B.2.1 Hex code meanings

a) Ah – Eh

Such a code in any digit position signals a general error of the complete data field. The display at the meter or a remote readout device should display an appropriate symbol at the appropriate display position. (see Table B.1)

b) Fh

Such a code in the MSD digit position signals a “minus-sign” in front of the remaining (N–1) digit number. In any other digit position it signals an error.

EXAMPLE A 4-digit BCD code of "F321" will be interpreted by the master software as "– 321" and displayed as “- 321” on a 4-digit only display.

B.2.2 LCD-decoding table

Table B.1 — Decoding table

0	1	2	3	4	5	6	7	8	9	Ah	Bh	Ch	Dh	Eh	Fh
"0"	"1"	"2"	"3"	"4"	"5"	"6"	"7"	"8"	"9"	"A"	"b"	"C"	" "	"E"	"–"

Annex C
(normative)

VIF coding for special units

C.1 Non-metric units

If the VIF-Extension code 3Dh (non-metric units) is used, the standard metric units of the VIF table is substituted as follows:

Table C.1 — Metric/non-metric units

Standard VIF	Standard unit and range	Non-metric unit and range	Type
E0000nnn	0,001 Wh to 10 000 Wh	0,001 kBTU to 10 000 kBTU	Energy
E0010nnn	0,001 l to 10 000 l	0,001 USgal to 10 000 USgal	Volume
E1000nnn	0,0001 l/min to 1 000 l/min	0,0001 USgal/min to 1 000 USgal/min	Volume flow.
E0101nnn	0,001 W to 10 000 W	0,001 mBTU/s to 10 000 mBtu/s	Power
E10110nn	0,001 °C to 1 °C	0,001°F to 1 °F	Temp. forward
E10111nn	0,001 °C to 1 °C	0,001°F to 1 °F	Temp. return
E11101nn	0,001 °C to 1 °C	0,001°F to 1 °F	Cold/ warm temperature limit
E11000nn	0,001°C to 1 °C	0,001°F to 1 °F	Temp. difference

C.2 Plain text units

In case of VIF = 7Ch / FCh the applied unit is represented by the following ASCII string with the length given in the first byte. The rightmost character is transmitted first. This plain text VIF allows the user to code units that are not included in the VIF tables.

Table C.2 — Data record structure for plain text VIF usage

DIB	VIB	ASCII length	ASCII string	Value

Example (all values are hex):

0C	DIF means 8 digit BCD value
FC	VIF means plain text VIF following
A2	VIFE means “per hour”
73	VIFE means “*10E-3”
04	ASCII length means 4 byte ASCII string following
6C 61 67 69	ASCII string means “igal”
26 08 42 75	Value = 75420826

Coded value = 75420826 igal/h * 10E-3 (= 75420,826 Imperial Gallons / hour)

C.3 Remote enablement/disablement of valve/breaker

The device type « breaker » (20h) and « valve » (21h) allows the definition of physically or logically separated media controlled device with separate address. Otherwise, the valve/breaker may be integrated in the metering device. Therefore, the address of the meter has to apply. The VIF/VIFE=FDh 1Fh allows to control both logically integrated and logically separate valve/breaker. If a device has other functions in addition to metering, the device type is set according to the metering function which is associated with the (default) subunit =0 in the DIF. A (secondary) switch function shall be associated with the subunit =1. Other additional functions may use higher subunit numbers. If detailed functional requirements for the different media are available, more suggestion for the usage of existing element to implement these functions would be possible. To enable/disable a valve the values in the least significant byte after VIF/VIFE=FDh 1Fh shall follows the Table C.3.

Table C.3 — Values for the remote control of the valve

Value	Meaning
00	Valve closed
01	Valve opened
02	Valve released, not open
03..255	Reserved

It is recommended to apply additional a time stamp or a sequence counter together with the switch command to detect the replay of an expired switch command.

<u>Example to close a valve together with the sequence counter of 3:</u>

04h FDh 08h 03h 00h 00h 00h 01h FDh 1Fh 00

Annex D
(informative)

Alarm protocol

D.1 M-Bus according EN13757-2

The master software polls the maximum 250 alarm devices by requesting time critical data. A slave can transmit an acknowledgement signalling no alarm or a datagram with alarm protocol with the CI-field 71h (no header), 74h (short header) or 75h (long header) to report an alarm state. Refer to Annex J.

The alarm state is coded with data Type D (Boolean; in this case 8 bit). Set bits signal alarm bits or alarm codes. The meaning of these bits is manufacturer specific.

The time out for time critical communication is set to 11 bit … 33 bit periods to ensure a fast poll of all alarm devices. With a baud rate of 9 600 Bd and all 250 slaves reporting an alarm just in time before a timeout occurs each slave will be polled in periods of maximum 5,5 s. This seems to be fast enough for alarms in building control systems and other applications. For faster alarm systems the number of alarm sensors could be limited to 63 (reducing the worst case overall signal delay to less than 1,5 s) or increase the transmission speed to 38 400 Bd and achieve the same speed for up to 250 devices.

The functionality of the FCB- and FCV-bit shall be fully implemented in this alarm protocol to ensure that one-time alarms are safely transmitted to the master. If the slave has reported an one-time alarm and the next REQ_UD1 has a toggled FCB (with FCV = 1) the slave will answer with an ACK (acknowledge) signalling no alarm. Otherwise it will repeat the last alarm frame to avoid that the alarm message gets lost. If the meter does not support the alarm protocol it has always to respond with an ACK.

D.2 Wireless M-Bus according to EN 13757-4

The meter may initiate the transmission of an alarm message or response to the REQ-UD1 of the communication partner. A slave can transmit an acknowledgement signalling no alarm (after REQ-UD1 only) or an alarm message with the CI-field 71h (no header), 74h (short header) or 75h (long header) to report an alarm state. Refer to Annex J.

The alarm state is coded with data Type D (Boolean, in this case 8 bit). Set bits signal alarm bits or alarm codes. The meaning of these bits is manufacturer specific.

Annex E
(informative)

Examples

E.1 General

The Application protocol specific data unit begins with the CI-field and does not include checksum and stop byte. The application protocol specific data are transmitted by the other layers of the communication system.

The following examples give the whole datagram for a twisted pair M-Bus link layer (EN 13757-2). Nevertheless other physical and link layers (e.g. EN 13757-4) could also be used.

E.2 Example for a RSP_UD with variable data structure answer:

(All values are hex.)

68 1F 1F 68	Header of RSP_UD datagram (length 1Fh = 31d bytes)
08 02 72	Field = 08 (RSP), address 2, CI-field 72H (var.,LSByte first)
78 56 34 12	Identification number = 12345678
24 40 01 07	Manufacturer ID = 4024h (PAD in EN 62056-21), generation 1, water
55 00 00 00	TC = 55h = 85d, Status = 00h, Configuration = 0000h
03 13 15 31 00	**Data block 1:** unit 0, storage No. 0, no tariff, instantaneous volume, 12565 l (24 bit integer)
DA 02 3B 13 01	**Data block 2:** unit 0, storage No. 5, no tariff, maximum volume flow, 113 l/h (4 digit BCD)
8B 60 04 37 18 02	**Data block 3:** unit 1, storage No. 0, tariff 2, instantaneous energy, 218,37 kWh (6 digit BCD)
18 16	Checksum and stop sign

E.3 Example baud rate switch:

The master switches the slave (in point-to-point connection) from now 2 400 Bd to 9 600 Bd.

(all values are hex.)

Master to slave: 68 03 03 68 53 FE BD 0E 16 with 2 400 Bd.

Slave to master: E5 with 2 400 Bd.

From that time on the slave communicates with the transmission speed 9 600 Bd, if the slave can handle 9 600 Bd, otherwise it remains at 2 400 Bd.

In bus mode this is followed within $<$ 2 min by an acknowledged communication (i.e. SND_NKE) at 9 600 Bd.

Master to slave: 10 40 FE 3E 16.

Slave to master: E5.

E.4 Example application select with subcode:

The master releases an enhanced application select to all slaves. All datagrams of the user data type are requested.

(All values are hex.)

Master to slave: 68 04 04 68 53 FE 50 10 B1 16.

Slave to master: E5.

E.5 Writing data to a slave

The master can send data to a slave using a SND_UD with CI-field 51h, 5Ah or 5Bh.

The following table shows the data structure for a write message. The order of the first three blocks in the following figure can be turned round, but the write only data record is at the end of the message. All records are optional.

Table E.1 — Data structure for writing data

Primary address record	Enhanced identification record	Normal data records	Write only data records

a) Primary address record.

The primary address record is optional and consists of three bytes:

Table E.2 — Coding of primary address

DIF = 01h	VIF = 7Ah	Data = Address (1 byte binary)

With this data record a primary address can be assigned to a slave in point to point connections. The master knows all the used addresses on the bus and forbid setting the address of a slave to an already used address. Otherwise, both slaves with the same address could not be read out anymore.

b) Enhanced identification record.

With this optional data record, the identification (secondary address) can be changed. There are two cases to be distinguished:

1) Data is only the identification number

Table E.3 — Coding of single identification number

DIF = 0Ch	VIF = 79h	Data = Identification No. (8 digit BCD)

2) Data is the complete identification

Table E.4 — Coding of complete secondary address

DIF = 07h	VIF = 79h	Data = complete ID (64 bit integer)

The data is packed exactly as in the readout header of a CI = 72 variable protocol with low byte first.

Table E.5 — Structure of secondary address

Identification no.	Manufacturer ID	Version	Device Type
4 byte	2 byte	1 byte	1 byte

— Normal data records:

The data records, which can be read out with a REQ_UD2, are sent back to the slave with the received DIF and VIF and the new data contents. Additional features can be implemented using the generalised object layer (see Clause 9).

— Write-only data:

Data, which cannot be read out of the slave with a normal data block, can be transmitted using the VIF = 7Fh for manufacturer specific coding. The DIF has a value corresponding to the type and length of data.

After receiving the SND_UD correctly without any error in data link layer, the slave answers with an acknowledgement (E5h). The slave decides whether to change variables or not after a data write from the master. In case of errors in executing parts of or whole write instructions the slave can decide whether to change no variables or single correct variables. The slave can report these errors to the master in the next RSP_UD datagram using some of the methods which are described in 8.3.

There are some methods for implementing write protect, for example allowing only one write after a hardware reset of the processor or enabling write if a protect disable jumper is set.

Examples (all values are hex.)

EXAMPLE 1 Set the slave to primary address 8 without changing anything else:

68 06 06 68 53 FE 51 01 7A 08 25 16

EXAMPLE 2 Set the complete identification of the slave (ID = 01020304 (BCD), Man = 4024h (PAD), Ver = 1, Dev. Type = 4 (heat):

68 0D 0D 68 53 FE 51 07 79 04 03 02 01 24 40 01 04 95 16

EXAMPLE 3 Set identification number of the slave to "12345678 (BCD)" and the 8 digit BCD-counter (unit 1 kWh) to 107 kWh.

68 0F 0F 68 53 FE 51 0C 79 78 56 34 12 0C 06 07 01 00 00 55 16

E.6 Configuring data output

E.6.1 General

For default, the slave transmits all his data with a RSP_UD. It could be useful for some applications to read only selected data records out of one or more devices. There are two ways to select data records.

E.6.2 Selection without specified data field

The selection of the wanted data records can be performed with a SND_UD (CI-field = 51h/55h) and data records containing the data field 1000b, which means "selection for readout request". The following VIF defines the selected data as listed in EN 1434–3 and no data are transmitted. The answer data field is determined by the slave. The master can select several variables by sending more data blocks with this data field in the same datagram.

Special multiple values can be selected with the following methods:

— Any VIF:

  The VIF-code 7Eh (any VIF) is especially for readout request of "all VIF" from the slave and can be interpreted as a selection wildcard for the value information field.

— Global readout request:

  The DIF-code 7Fh is defined as "selection of all data for readout request", i.e. all storage numbers, units, tariffs and functions. If this DIF is the last byte of user data or the VIF = 7Eh follows, then all data is requested. So the selection of all data of one slave can de done with a SND_UD and the character 7Fh as the user data. If a DIF unequal to 7Eh follows, then all data records with this VIF are selected for readout.

— All tariffs:

  The highest tariff number in the selection record is defined as selection of "all tariffs". For example, the tariff 1111b (15) means selection of all tariffs in a record with two DIFE´s.

— All storage numbers:

  A selection of all storage numbers can be done with the maximum storage number if there is a minimum of one DIFE. For example the highest storage number is 1Fh (31d) with one DIFE and 1FFh (511d) with two DIFE´s.

— All units:

  "All units" can be selected by using a Data Record Header with minimum two DIFEs and the highest unit number.

— High resolution readout:

  The master can select the slave to answer with the maximum resolution to a given value/unit by a VIF with "nnn" = 000 (minimum exponent for range coding). The meter may then answer with a resolution of e.g. 1mWh (VIF = 0000000b) or some higher decimal value if required. The unit values have been chosen so that their minimum provides sufficient resolution even for calibration. A readout request for a VIF with "nnn" = max (maximum exponent for range coding) signals a request for the standard resolution of the meter.

After the next REQ_UD2 the slave answers with the selected data in his own format, if the requested data are available. Otherwise the slave transmits his normal data and the master has to find out that the data are not the requested ones. If there are more than one variables with the selected VIF, the device shall send all these data records.

E.6.3 Selection with specified data field

The master is able to perform a readout request with a specified data field by using the object action "add to readout list" (VIFE = E000 1100b) from VIFE-table for object actions (see Clause 9). The master transmits a SND_UD (CI-field = 51h/5Ah/5Bh) with a data record which consists of the desired DIF (data field), VIF and the VIFE = 0Ch/ 8Ch. No data follows this VIFE and the slave shall ignore the data field on reception. The slave shall transmit this data record with the requested data field from now on, if he is capable of this. If the slave does not support this data field (data coding), it can report a record error using one of the VIFE = E000 011x (data class not implemented or data size not implemented).

E.6.4 Deselection of data records

The master can release an application reset of the application layer and especially a fall back to the slave standard RSP_UD datagram by transmitting a SND_UD with the CI-field 50h.

Single data records can be deselected by transmitting a data record with DIF, VIF and the VIFE for the object action "Delete from readout-list" (VIFE = E000 1101b).

If the selected data is supported by the slave but too long for one RSP_UD datagram (especially for readout of all historic values), the slave transmits an additional data record consisting only of the DIF=1Fh, which means that more data records follow in the next respond datagram. In this case the master reads out the slave again until the respond datagram is only a 0E5h (no data) or there is no DIF = 1Fh in the RSP_UD.

To avoid loss of respond datagrams the slave shall in this case support the Frame Count Bit (FCB). If the master wants to prematurely end such a multi datagram message sequential readout of the selected data, it may send an application reset with CI = 50h instead of further REQ_UD2´s.

EXAMPLE 1 A slave with address 7 is to be configured to respond with the data records containing volume (VIF = 13h: volume, unit 1l) and flow temperature (VIF = 5Ah: flow temp., unit 0.1 °C):

68 07 07 68 | 53 07 51 08 13 08 5A 28 16

EXAMPLE 2 A slave with address 1 is to be configured to respond with all storage numbers, all tariffs, and all VIF´s from unit 0:

68 06 06 68 53 01 51 C8 3F 7E 2A 16

EXAMPLE 3 A slave with address 3 is to be configured to respond with all data for a complete readout of all available. After that the master can poll the slave to get the data:

68 04 04 68 53 03 51 7F 26 16

With these actions, the master can alter the data of the slaves or configure the output data of the slaves (actions 12 and 13). The actions 0 to 6 alter the data of the slave by replacing the old data (action 0, equals to data write without VIFE) or do arithmetical or logical operations with the old and the transmitted data.

NOTE This method of configuring the readout list (action 12 and 13) allows not only the adding but also the removal of elements in contrast to the method of using the DIF = 1000b-type of readout request (described before).

All these actions can be used for normal slaves and for intelligent masters which are manipulated by a higher order master.

The functions "add entry" and "delete entry" are useful to tell an intelligent master to add e.g. a new data record like maximum or minimum values of any slave.

With the action "freeze data to storage #" the master can tell the slave to freeze the current value corresponding to the transmitted VIF, unit, tariff and function to a certain storage number given in the DIF/DIFE´s. In this case, the data field inside the VIF has got the value 0000b (no data). This action allows freeze of selected values or multiple freeze with VIF = 7Eh (all VIF). The date/time shall also be frozen to the same storage number.

EXAMPLE 4 Set the 8 digit BCD-Counter (instantaneous, current value, no tariff, unit 0) with VIF = 06 (1kWh) of the slave with address 1 to 107 kWh:

68 0A 0A 68 53 01 51 0C 86 00 07 01 00 00 3F 16

EXAMPLE 5 Same as in example 1) but add 10 kWh to the old data:

68 0A 0A 68 53 01 51 0C 86 01 10 00 00 00 48 16

EXAMPLE 6 Add an entry with an 8 digit BCD-Counter (instantaneous, current value, no tariff, unit 0, 1kWh) with the start value of 511 kWh to the data records of the slave with address 5:

68 0A 0A 68 53 05 51 0C 86 08 11 05 00 00 59 16

EXAMPLE 7 Freeze actual flow temperature (0.1 °C: VIF = 5Ah) of the slave with address 1 into the storage number 1:

68 06 06 68 53 01 51 40 DA 0B CA 16

E.7 FCB and selection

E.7.1 FCB-implementation slave

A slave with implemented secondary addressing and with implemented FCB-administration has a "Last received FCB"-memory bit for the communication via the pseudo primary address 253 (FDh). If it can communicate also alternatively over some other primary address (except the special addresses 254 and 255) an additional "Last received FCB"-memory bit for each of these primary addresses is required. A valid selection datagram will not only set the internal selection bit but will also clear the internal "Last received FCB"-memory bit associated with secondary addressing via the pseudo primary address 253 (FDh). The master will start the communication (REQ_UD2 or SND_UD) after any selection datagram (CI = 52h) with the FCV-bit set and the FCB-bit set. If a slave has more than one alternative secondary address, only a single "Last received FCB"-memory bit for all secondary addresses is required.

E.7.2 FCB-implementation master

The master implements a "Next FCB image"-bit for each primary address and for the pseudo primary address 253 (FDh). Although these "Next FCB image"-bit might be used for many slaves, no confusion exists, since for accessing another slave a selection datagram is required which will define the future FCB sequence both for slave and master.

If the master applies one of the new application frames with a short or long data header (refer to chapter 5.2, 5.3 and 5.4), it shall increase the access number each time when the FCB was changed.

EXAMPLE

Master> SND_NKE 10 40 FD 3D 16

SND-NKE clears the FCB

Master>	SELECT	68 0B 0B 68 73 FD 52 78 94 07 57 3B 3D 43 07 EE 16
Slave_1>	ACK	E5

SELECT clears the FCB of address 253

Master>	REQ_UD2	10 7B FD 58 18
Slave_1>	RSP_UD	68 xx xx 68 08 01 72 Response_1 cc 16
Master>	SELECT	68 0B 0B 68 53 FD 52 44 33 22 11 3B 3D 28 07 13 16
Slave_2>	ACK	E5

SELECT clears the FCB of address 253

Master>	REQ_UD2	10 7B FD 58 18
Slave_2>	RSP_UD	68 xx xx 68 08 02 72 Response_1 cc 16
Master>	SND_UD	68 xx xx 68 53 FD 51 Command_1 cc 16
Slave_2>	ACK	E5
Master>	REQ_UD2	10 7B FD 58 18
Slave_2>	RSP_UD	68 xx xx 68 08 02 72 Response_2 1F cc 16

Master missed last RSP_UD and asks again for the same frame

Master>	REQ_UD2	10 7B FD 58 18
Slave_2>	RSP_UD	68 xx xx 68 08 02 72 Response_2 1F cc 16

Master understood last RSP_UD and asks for the next frame of the multi frame answer

Master>	REQ_UD2	10 5B FD 58 18
Slave_2>	RSP_UD	68 xx xx 68 08 02 72 Response_3 cc 16

E.8 Special slave features

E.8.1 General

Some optional or recommended features of the slaves will be described in this sub-clause.

E.8.2 Use of the fabrication number

The fabrication number is a serial number allocated during manufacture. It is part of the variable data block (DIF = 0Ch and VIF = 78h) and coded with 8 BCD packed digits (4 byte).

EXAMPLE

68 15 15 68header of RSP_UD datagram (length 1Fh = 31d bytes)

08 02 72 C-field = 08 (RSP), address 2, CI field 72H (var.,LSByte first)

78 56 34 12identification number = 12345678

24 40 01 07 manufacturer ID = 4024h (PAD in EN 61107), generation 1, water

13 00 00 00 TC = 13h = 19d, Status = 00h, Configuration = 0000h

0C 78 04 03 02 01 fabrication number = 01020304

9D 16 checksum and stop sign

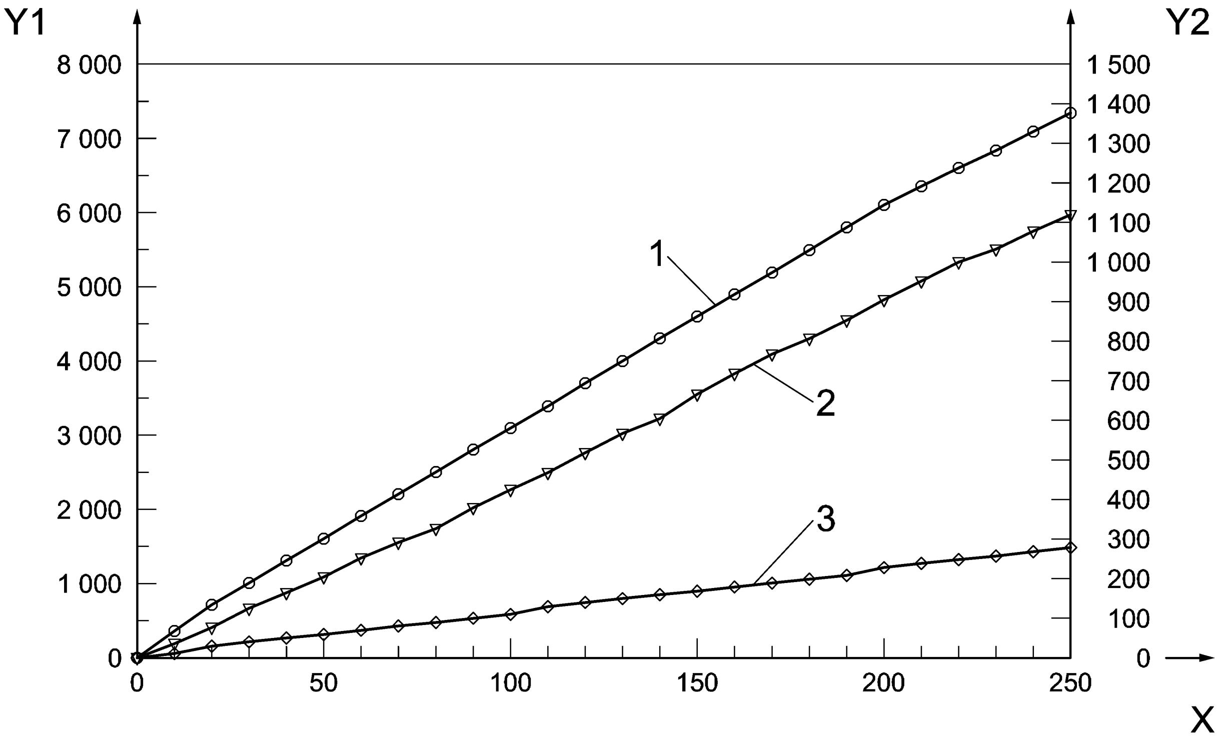
The use of this number is recommended if the identification number is changeable. In this case, two or more slaves can get the same secondary address and cannot be uniquely selected. The fabrication number together with manufacturer, version and device type field build a unique number instead. Suitable masters use this number for an enhanced selection method if two or more slaves have the same identification number (see 9.3).

Annex F
(informative)

Secondary search

F.1 General

The search procedure has been simulated to find the minimum, the average and the maximum number of selections as a function of the number of slaves. For the minimum number of attempts the optimum distribution of the identification numbers, for the maximum number the most unfavourable, and for the average number of attempts a random distribution was chosen. The following diagram shows the result of these calculations:



Key

1 number of selections (worst case)

2 number of selections (best case/random case)

3 number of slaves

Figure F.1 — Number of selections with wildcard searching procedure

F.2 Instructions for implementation of wildcard search

The following program flow diagram shows the realisation of the wildcard searching procedure, whereby the search is made only with the identification number. The codes for manufacturer, version and device type are in general specified with wildcards, but can be changed by the user in order (for example) to locate all meters from a particular manufacturer. In order to avoid the categorisation by a factor of eight of the "For-To" loops for the eight positions, the array "Value" is defined with 8 byte numbers, which are intended to define the contents of the positions. The digit number of the identification number which is presently running is noted in the variable "Pos" of type byte.

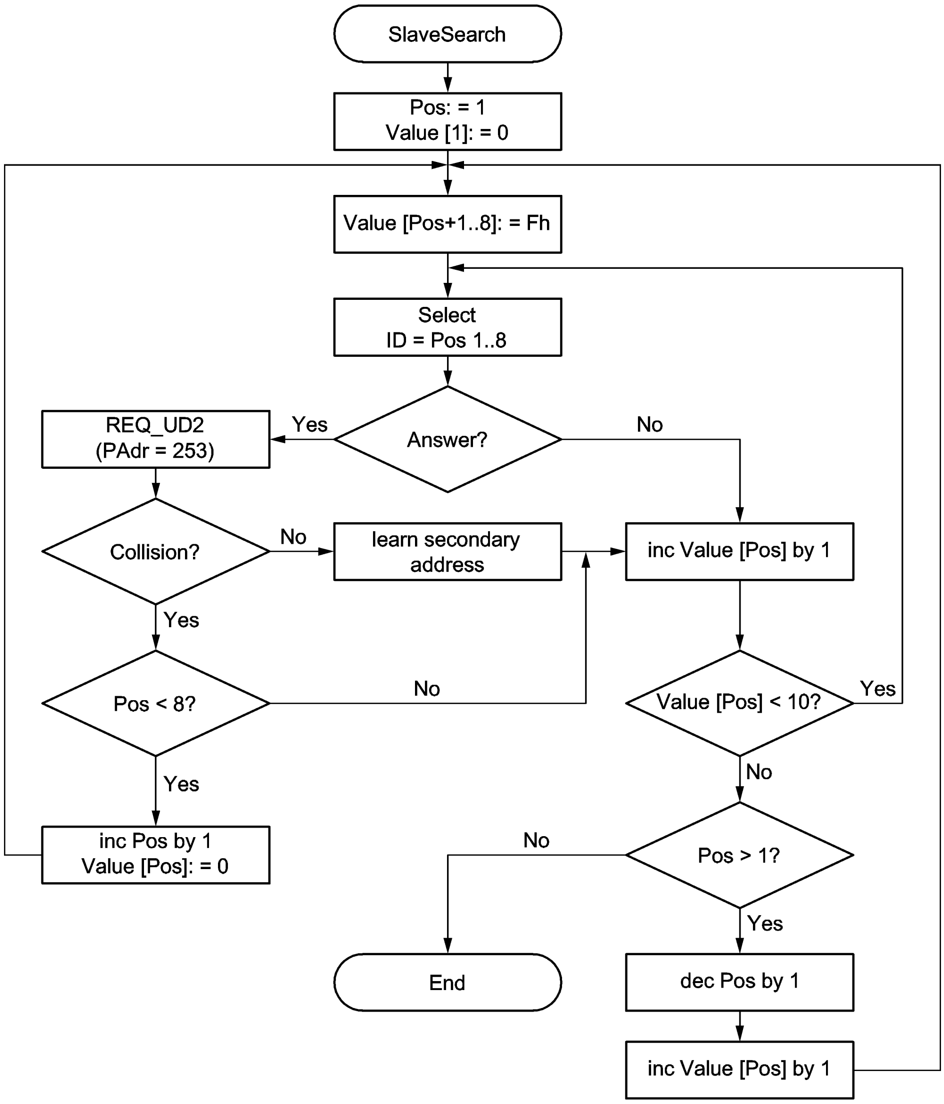


Figure F.2 — Flow diagram for slave search with wildcards

The routine begins at the first position, and implements the following actions for the value of this position from 0 to 9:

— selection with the ID-Nr. Pos 1, Pos 2, …, Pos 8;

— if no reply, Value [Pos] is raised by 1;

— if there is a reply, a REQ_UD2 is sent to address 253, and if the datagram is correctly received the secondary address is learnt and the Value [Pos] raised by 1;

— if there is a collision a jump is made to the next position (Pos increased by 1), as long as the last position has not yet been reached;

— after going through a complete position from 0 to 9 the subroutine proceeds to the next lower position, or ends the search if the position Nr. 1 has already been processed.

The following table shows an example for secondary addresses in order from top to bottom as they will be found by the master software:

Table F.1 — Secondary addresses found with a wildcard search of four slaves

No.	Identification no.	Manufacturer (hex.)	Version (hex.)	Device type (hex.)
1	14 491 001	1057	01	06
2	14 491 008	4567	01	06
3	32 104 833	2010	01	02
4	76 543 210	2010	01	03

Search Process:

1) Start with ID = 0FFFFFFF: no reply

2) ID = 1FFFFFFF: collision between Nr.1 and Nr.2

3) ID = 10FFFFFF, 11FFFFFF, 12FFFFFF, 13FFFFFF: no reply

4) ID = 14FFFFFF: collision between Nr.1 and Nr.2

5) Repeated steps 3 to 4 up to the ID = 1449100F

6) Learn ID = 14491001 and 14491008

7) Go backwards to 19999999

8) ID = 2FFFFFFF: no reply

9) ID = 3FFFFFFF: learn ID = 32104833

10) .ID = 4FFFFFFF, 5FFFFFFF, 6FFFFFFF: no reply

11) ID = 7FFFFFFF: learn ID = 76543210

12) ID = 8FFFFFFF, 9FFFFFFF: no reply

13) End of the search

Annex G
(informative)

International reference works

WWW-server operated by the M-Bus user group at “http://www.m-bus.com” provides information on the M-Bus.

Annex H
(informative)

Special sequences for wireless M-Bus devices

H.1 VIF/VIFE/VIFE = FDh 97h 1Dh (error flag)

If the data point VIF/VIFE/VIFE = FDh 97h 1Dh is used, then the two least significant bytes of error flag have the following meaning:

Table H.1 — Least significant error byte (EF1)

b7	b6	b5	b4	B3	B2	b1	b0
2^{7}	2^{6}	2^{5}	2^{4}	2^{3}	2^{2}	2^{1}	2^{0}

Table H.2 — Meaning of error bits in the least significant error byte (EF1)

Bit	Meaning with set bit	Explanation
b0	Tamper	In case of a detected unauthorised try of a manipulation
b1	Battery low	Set in case of under voltage
b2	External alarm	
b3	Battery cut or disconnection	In case of hard voltage drop
b4	Any hardware error	e.g. Checksum error of memory chip
b5	Connection interrupt	e.g. Radio adapter lost connection to meter or valve
b6	Reserved	Set always to 0
b7	Reserved	Set always to 0

NOTE 1 A clear bit marks a state of normal operation.

NOTE 2 In previous EN13757-3:2004 this field code is also RSSI-level. The RSSI-level shall be coded with separate VIF/VIFE = FDh 71h.

Table H.3 — Second least significant error byte (EF2)

b7	b6	b5	b4	B3	B2	b1	b0
2^{15}	2^{14}	2^{13}	2^{12}	2^{11}	2^{10}	2^{9}	2^{8}

The meaning of the second least significant error byte is reserved for future extensions. Additional bytes may follow. The use of these following bytes is manufacturer specific.

If the meter detects an error and marks this condition in this data point it also has to set the related bit in the status byte. If the meter receives a command clearing one or several bits of this error flag then the related bits of the status byte have to be cleared too.

H.2 VIF/VIFE/VIFE = FDh 9Fh 1Dh for passing remote control on a node

If the data point VIF/VIFE/VIFE = FDh 9Fh 1Dh for a wireless M-Bus device is used the least significant byte of remote control has the following meaning:

Table H.4 — Least significant byte of the remote control (RC1)

b7	b6	b5	b4	B3	b2	b1	b0
2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0

Table H.5 — Remote control (RC1): adjust power

b0	b1	Power adjust for a radio product, the bits of the first byte of remote control have the following meaning:
0	0	do nothing
0	1	reserved for future use
1	0	decrease power (one step)
1	1	increase power (one step)

Table H.6 — Remote control (RC1): enable test mode

b3	**b4**	**b5**	**Test mode**
0	0	0	do nothing
0	0	1	test mode : temporary emission of permanent "0" [a]
0	1	0	test mode : temporary emission of permanent "0101" [a]
0	1	1	test mode : temporary emission of permanent carrier , no modulation [a]
1	0	0	test mode : temporary emission of permanent "1" [a]
1	0	1	test mode : temporary reception [a]
1	1	0	reserved for future use
1	1	1	reserved for future use

[a] The duration of the temporary emission/reception shall be declared by the vendor.

Table H.7 — Remote control (RC1): power save mode

b6	**Mode select**
0	power save mode
1	normal mode

Table H.8 — Remote control (RC1): reserved

b2	reserved for future use
b7	reserved for future use

The meaning of following bytes is reserved for future extensions.

H.3 Clock synchronisation

Two additional CI-fields (6Ch and 6Dh) shall be used to set a new date/time, or to do an incremental time correction independent of the application layer used otherwise. Since these are essentially SND_UD-type datagrams they shall be acknowledged by the meter with an ACK. They use the full long header that contains the application address of the slave (in addition to the partner address in the link layer). The commands should be encrypted to prevent unauthorised date/time changes in the meter. The last four 2Fh filler bytes should be used for additional command verification. The date and time uses data formats I and J as specified in Annex A. The TC-field is used for control timing actions and is specified as:

Table H.9 — Structure of TC-field

Bit no.	Value
0,1	00 (Bit1=0; Bit0=0) – set time 01 (Bit1=0; Bit0=1) – add time difference 10 (Bit1=1; Bit0=0) – subtract time difference 11 (Bit1=0; Bit0=0) – reserved
2..7	Reserved (0 by default)

a) Set new date and time

Table H.10 — Application frame “time setting” with CI=6Ch (Set date and time)

CI=6Ch	Long Data-Header (refer to Annex J)	TC-Field (1 byte) (set time)	Date/time in Format I (6 byte, LSB first)	Reserved (3 bytes=0)	Command verification (4 byte = 4 * ”2Fh”)

Under metrological aspects, this command is always considered as a clock reset by the slave.

b) Add/Subtract Time Offset

Add/Subtract Time Offset to the current slave time to either correct a slave clock drift or to correct a possible slave time error due to a communication delay of a previous set date/time command.

Table H.11 — Application frame “time adjustment” with CI=6Dh (Add/Subtract Time Offset)

CI=6Dh	Long Data-Header (refer to Annex J)	TC-Field (1 byte) (add or subtract)	Time in Format J (3 byte, LSB first)	Reserved (6 bytes=0)	Command verification (4 byte = 4 * ”2Fh”)

If this command is either received by the slave more than 60 s after the last command or the partner access number is different from the last command, then the add/subtract time command shall be executed, otherwise it is considered as a repetition of the last time correction command and shall be ignored.

The communication partner shall provide the correct time (UTC) for every bidirectional meter both periodically and on event. In the following cases, a clock synchronisation shall be applied:

- once every day (as long as the partner has a valid time);
- when the partner gets back to the valid time;
- after the installation of a new meter; and
- after a communication interrupt for more than 24 h.

The time service of the communication partner is not an obligatory command. The change of the meter clock is in the responsibility of the meter itself and shall consider device type specific requirements as defined in dedicated standards and references. An example of clock synchronisation datagram is listed in Annex P.6.

Annex I
(normative)

Transmission of profiles

I.1 The standard load profile

When a meter generates a lot of periodical consumption values in one transmission it may be more efficient to transport a load profile instead of a list with pairs of consumption data and consumption value.

Example: load profile of consumption values for a water meter

Table I.1 — Example for load profile: plain data

1st value at the end of the month	2008-01-31	65 liters (10^{-3} m^3)
2nd value at the end of the month	2008-02-29	209 liters
3rd value at the end of the month	2008-03-31	423 liters
4th value at the end of the month	2008-04-30	755 liters
Last value at the end of the month	2008-05-31	1013 liters

This load profile shall be transmitted as follows:

Table I.2 — Example for load profile: M-Bus-sequence

Description	DIF/DIFE (Hex)	VIF/VIFE (Hex)	Value (Hex) (Example)
Count of transmitted storage numbers (optional)	89 04	FD 22	05
Interval to the next storage number (here 1 month)	89 04	FD 28	01
Date of last storage number (#12)	82 06	6C	1F 15
Storage number #8	8C 04	13	65 00 00 00
Storage number #9	CC 04	13	09 02 00 00
Storage number #10	8C 05	13	23 04 00 00
Storage number #11	CC 05	13	55 07 00 00
Storage number #12	8C 06	13	13 10 00 00

The first transmitted data points are the profile parameter count, data and interval. Thereafter follows the cumulated consumption value per interval starting from the storage number #8. The lower storage numbers remain reserved for single values like the current consumption or the consumption at the due day etc.

I.2 The M-Bus compact profile

I.2.1 General

The M-Bus compact profiles are used to transport a series of values with a fix space between each value. In addition to the compact profile, a base value and a base time is required to declare a start time and the value of the profile. Additional base parameters like the OBIS-declaration may be added as well. The base time is chained with the compact profile by using the same storage number in the DIF/DIFE. The base value and the base parameters are chained with the compact profile by using the same storage-, tariff- and subunit numbers in the DIF/DIFE of the data record. If one of these numbers differs from the compact profile, it has to be assumed that the base value or base parameters are missed.

I.2.2 The base value and base parameter

The data point base value is the eldest value of the data series. It shall always exist unless the increment mode “Absolute value” (00b) is used. In the absence of the base value, the first entry in the profile is used as the first value of the data series instead. The base value and the base parameters may be used with any DIF/DIFE and VIF/VIFE.

Table I.3 — Base value record (connected via storage-, tariff-, subunit number and VIF/ VIFEx)

DIF/DIFE	VIF/VIFEx	Base value

I.2.3 The base time

The base time shall be encoded with one of the Types F to J (refer to Annex A). It corresponds to the base value, even if it does not exist. Therefore, the first entry in the compact profile is always related to the base time added by one space interval.

Table I.4 — Base time record (connected via the storage number)

DIF/DIFE	VIF (time/date Type F, G, I, J)	Time/date value

I.2.4 Structure of the compact profile

The compact profile record itself starts (like each M-bus data point) with a DIF (DIFE) and a VIF (VIFE) but with an additional (new) orthogonal VIFE signalling a “compact profile”.

The profile record uses a data structure with variable length (DIF= xDh) followed by a length byte with values between 3 and 191 (0BFh). The whole length is accumulated by two control bytes plus N*(element length), where N is the number of elements of the profile. Consequently, the length of “2” signals an empty profile.

Table I.5 — Profile record (connected via storage-, tariff-, subunit number and VIF/VIFEx)

DIF/DIFE with variable length DIF=xDh	VIF/VIFEx VIFE = 1Eh/1Fh	LVAR # bytes (03h to BFh)	Spacing control byte	Spacing value byte	Oldest Profile Value	…

NOTE For the binary integers (low nibble of the DIF=1 to 4, 6 or 7) the incremental modes 01b and 10b use unsigned integers (data type C), whereas the increment modes 00b and 11b use signed integers (data type B). Refer to Annex A.

The first byte (spacing control byte) of this variable length record structure contains the data size of each individual element in the lower four bits (as in the lower nibble of the DIF definitions, but excluding variable length elements). The next higher two bits signal the time spacing units (00b = sec, 01b = min, 10b = hours and 11b = days). The highest two bits signal the increment mode of the profile (00b = absolute value (signed), 01b = positive (unsigned) increments, 10b = negative (unsigned) increments, 11b = signed difference (deviation of last value – next value)). All values of the profile are initially preset with the coding for “illegal”, e.g. -128 for signed byte, 255 for unsigned byte, -32768 for signed word etc. (refer to Annex A, type B and C). Invalid values shall also be used in case of an overflow of an incremental value.

Table I.6 — Spacing control byte

bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0
2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0

Table I.7 — Structure of spacing control byte

bit 6..7: Increment mode	bit 4..5: Spacing unit	bit 0..3: Element size
00b= Absolute value	00b= seconds	Profile DIF, low nibble only, but except 0Dh and except 0Fh
01b= Increments	01b= minutes	
10b= Decrements	10b= hours	
11b= Signed difference	11b= days/month	

After the space control byte follows the space value byte (single byte) giving the number of the time spacing units between the profile values. It allows between 1 and 250 time units (s,m,h,d) as time spacing. The values 251, 252 and 255 are reserved. To be able to additionally code monthly and half-monthly profile spacing, the value 253 is used for half-monthly spacing and the value 254 is used for monthly spacing. Both are used together with the spacing unit “days/month”. Spacing unit 0 is used to code a list of values which are not spaced in time. This could be any type of table with up to four columns.

Table I.8 — Spacing value byte

Spacing value	**Spacing unit**	**Meaning**
0	00b-11b[a]	Elements of an array, not spacing in time
1-250	all	Number of days, hours, minutes or seconds between values
251	all	Reserved
252	all	Reserved
253	00b-10b 11b	Reserved; a half month between values
254	00b 01b 10b 11b	Reserved six full months between values three full months between values a full month between values
255	all	Reserved

a The spacing unit is used to address up to four columns. If one column is needed, only the spacing unit 00b shall be used. When several columns are needed the spacing unit describes the concerned column number by formular spacing unit +1 (e.g. spacing unit 01b indicates column 2).

These first two fixed bytes are followed by the oldest value of the profile, the next oldest value etc., until the end of the variable length structure is reached. Note that if each profile value uses a DIF- data format with a length of more than one byte, each individual profile value is in the "least significant byte first" order.

I.2.5 Types of Compact profile

The M-Bus supports two types of compact profiles:

— "Compact profile with registers" for the transport of a limited number of values with an assigned register number (e.g. recent value);

— "Compact profile without registers" for the transport of an unlimited number of values as a series with no assignment to a register (e.g. load profile).

The definition of both compact profile types is identical with an exception in the use of the storage number. The transmission of several profiles (e.g. for two tariffs) in parallel is possible, but it requires a different coding in the DIF/DIFE or the VIF/VIFE e.g. by the use of different tariff numbers. As long as the storage numbers are identical, all compact profiles are related to the same base time.

I.2.6 Compact profile with registers (orthogonal VIFE=1Eh)

This compact profile has to be selected if the assignment of a historical value to a cumulation register is required.

The first requested register number is coded by the storage number, which is used for the base time, the base value and the compact profile. The first value inside the compact profile is related to the second requested register number, the second value to the third register and so on. To support up to 125 registers, a fix coding with a DIF and two DIFEs shall always be used.

A data series may also contain non-periodic entries, e.g. in the case of a changed device status. Such a case can be transmitted by chaining several profiles (see example).

Example: absolute profile of monthly consumption values (Tariff 1) of an electricity meter

Table I.9 — Example of compact profile with registers: Plain data

Event	OBIS-Code	Date/Time	Value
Periodic value	1.8.1*32	01.01.2010 00:00	150 kWh
Periodic value	1.8.1*33	01.02.2010 00:00	100 kWh
Periodic value	1.8.1*34	01.03.2010 00:00	130 kWh
Non-periodic value	1.8.1*35	25.03.2010 13:12	90 kWh
Periodic value	1.8.1*36	01.04.2010 00:00	50 kWh
Periodic value	1.8.1*37	01.05.2010 00:00	160 kWh

Table I.10 — Example of compact profile with registers: M-Bus data records

Data point type	Stor.	Tariff	M-Bus data record
Base time	#32	T0	86h 80h 01h 6Dh 00h 00h A0h 41h 11h 35h
Base value	#32	T1	84h 90h 01h 03h F0h 49h 02h 00h
Profile 1 (2 values: #33;#34)	#32	T1	8Dh 90h 01h 83h 1Eh 0Ah 04h FEh A0h 86h 01h 00h D0h FBh 01h 00h
Base time	#35	T0	C6h 81h 01h 6Dh 0Bh 0Ch 8Dh 59h 13h 0Ch
Base value	#35	T1	C4h 91h 01h 03h 90h 5Fh 01h 00h
Base time	#36	T0	86h 82h 01h 6Dh 00h 00h 80h 41h 14h 0Dh
Base value	#36	T1	84h 92h 01h 03h 50h C3h 00h 00h
Profile 2 (1 value: #37)	#36	T1	8Dh 92h 00h 83h 1Eh 06h 04h FEh 00h 71h 02h 00h

I.2.7 Compact profile without registers (orthogonal VIFE=1Fh)

The compact profiles without registers shall start with the storage number #8. They may use a flexible number of DIF's and DIFE's. Chained compact profiles without registers use (unlike the compact profiles with registers) the next higher storage number. The use of the storage number #0 is not permitted for compact profiles without registers.

Example: incremental load profile; 3 hourly volume values after midnight coded with BCD.

Table I.11 — Example of compact profile without registers: Plain data

Base value	01.01.2010 00:00	12300,0 m^3
Oldest profile value	01.01.2010 01:00	12300,3 m^3
Second oldest value	01.01.2010 02:00	12300,5 m^3
Third oldest value	01.01.2010 03:00	12301,6 m^3

Table I.12 — Example of compact profile without registers: M-Bus data records

Data point type	Stor.	Tariff	M-Bus data record
Base time	#8	T0	84h 04h 6Dh 00h 20h 41h 11h
Base value	#8	T0	8Bh 04h 15h 00h 30h 12h
Profile	#8	T0	8Dh 04h 95h 1Fh 05h 69h 01h 03h 02h 11h

Annex J
(informative)

The structure of higher protocol layers

This annex shows the frame structure of none, short and long header after CI-field:

Application layer without a fixed header (none)

- The length of this header is limited to the one byte of CI-field.
- Applied in direction downwards to the meter with CI = 50h; 51h; 52h.
- Applied in direction upwards from the meter with CI = 69h; 70h; 71h; 78h; 79h.

Table J.1 — Application layer without a fixed header (none)

CI	Data

NOTE 1 This frame neither supports access number nor encryption.

Application layer with a short header

- The length of the short header is 4 byte (without AES-Check).
- Applied in direction downwards to the meter with CI = 5Ah; 61h; 65h.
- Applied in direction upwards from the meter with CI = 6Ah; 6Eh; 74h; 7Ah; 7Bh; 7Dh; 7Fh.

Table J.2 — Application layer with a short header

CI	ACC	STS	Conf. Field	AES-Check	Data

NOTE 2 The AES-Check is only available if encryption mode 5 is used.

Application layer with a long header

- The length of the long header is 12 byte (without AES-Check).
- Applied in direction downwards to the meter with CI = 53h; 5Bh; 60h; 64h; 6Ch, 6Dh.
- Applied in direction upwards from the meter with CI = 6Bh; 6Fh; 72h; 73h; 75h; 7Ch; 7Eh.

Table J.3 — Application layer with a long header

CI	Ident. no	Manuf.	Ver.	Dev. Type	ACC	STS	Conf. Field	AES-Check	Data

NOTE 3 The long header is typically used if the meter address itself is not available in the link layer.

NOTE 4 The AES-Check is only available if encryption mode 5 is used.

Transport layer with a short header (no user data)

- The length of the short header is 4 byte (encryption is not applied).
- Applied in direction upwards from the meter with CI = 8Ah.

Table J.4 — Transport layer with a short header

CI	ACC	STS	Conf. Field

Transport layer with a long header (no user data)

- The length of the long header is 12 byte (encryption is not applied).
- Applied in direction downwards to the meter with CI = 80h; 84h; 85h.
- Applied in direction upwards from the meter with CI = 8Bh.

Table J.5 — Transport layer with a long header

CI	Ident. no	Manuf.	Ver.	Dev. Type	ACC	STS	Conf. Field

NOTE 5 The long header is typically used if the meter address itself is not available in the link layer.

Explanation:

CI	Control Information field
Ident. no	Identification number (serial number) (part of meter address)
Manuf.	Manufacturer acronym (part of meter address)
Ver.	Version (part of meter address)
Dev. Type	Device type (part of meter address)
ACC	Access number (from the master initiated session uses communication unit access number; from the slave initiated session uses meter access number)
STS	Status (from the master to slave used for communication unit status (RSSI); from the slave to master used for meter status)
Conf.Word	Configuration field
AES-Check	2 byte sequence 2Fh 2Fh for verification of successful decryption
Data	Application data; coding depends on used application or service protocol

Annex K
(normative)

Compact M-Bus frame

K.1 General

Communication channels like radio are limited in capacity of data transfer. The new optional M-Bus-Compact frame provides an extension of the existing M-Bus Application protocol. It reduces size of transmitted data up to 40 %, by the separation of the Data Information Fields (DIF/DIFE) and Value Information Fields (VIF/VIFE) from the M-Bus-data. This is achieved by adding two additional fFrame types to the traditional full M-Bus frame

— M-Bus Compact frame (for the transmission of compact data)

— M-Bus Format frame (for the transmission of Data Information Fields and Value Information Fields)

The receiver of the M-Bus-Compact frame uses the stored DIF/VIF of an M-Bus-Format frame or full M-Bus frame in context with the values of the received M-Bus-Compact frame to generate an updated full M-Bus frame. The suitable M-Bus Format frame can be detected by the Format Signature transmitted in the M-Bus-Compact frame. The M-Bus-Compact frame shall be used only if the frame structure (order and coding of data points) remains unchanged for a certain time. If the frame structure changes, an M-Bus Format frame or a full M-Bus frame shall be transmitted repeatedly until the communication partner has reliably received it. The communication partner shall check if the stored M-Bus format frame is outdated by verifying the Full-Frame-CRC with every recovered full M-Bus frame. The original Full-Frame-CRC is transmitted inside the M-Bus compact frame. It is recommended to repeat the full M-Bus frame periodically even if the DIF/VIFs of the full M-Bus frame do not change. This provides a backward compatibility to communication partners that do not support compact M-Bus frames.

The use of the M-Bus-Compact or the M-Bus-Format frame is limited to wireless transmission based on EN 13757-4.

NOTE The separation of the DIF/VIF (describing unit and resolution of consumption data) from measured values might be in contradiction with local regulations.

The partial encryption of messages can also be applied for the Compact and Format frame. Be aware that both the Full-Frame-CRC and the Format Signature are always located in the encrypted part of the message and will be not readable as long as the applied encryption key is unknown. In case of partial encryption, the first DIF of the unencrypted part of the message shall not be an idle filler 2Fh.

K.2 CI-fields of the Full and the Compact M-Bus frame

The partner may request one of the available frame formats of the wireless meter by applying a special CI-field (see Table K.1) within the request of user data (REQ-UD2).

Table K.1 — CI-fields for the request of Full and Compact and Format M-Bus frame format

Frame	CI-fields for the request REQ-UD2
Full M-Bus frame	80h
M-Bus-Compact frame	84h
M-Bus-Format frame	85h

The Full M-Bus frame shall be supported by each meter, which conforms to this European Standard. The support of the M-Bus Compact and the M-Bus Format frame is optional. If the meter does not support the requested frame format it shall response an application error instead (see Table 35).

For the response to a request or for an unsolicited transmission of the wireless meter it marks the applied frame format by a special CI-field too. Table K.2 shows the related CI-fields for the Full M-Bus frame as well as for the M-Bus-Compact and the M-Bus-Format frame with all variants of the application layer header. The content of the short and long header is listed in Annex J.

Table K.2 — CI-fields for the full and Compact and Format M-Bus frame format

	No data-header	Short data-header	Long data-header
Full M-Bus frame	78h	7Ah	72h
M-Bus-Compact frame	79h	7Bh	73h
M-Bus-Format frame	69h	6Ah	6Bh

K.2.1 Full M-Bus frame

Table K.3 — Structure of full M-Bus frame

CI	Data header	DIF [1]	VIF [1]	Data [1]	DIF [2]	VIF [2]	VIFE [2]	Data [2]

The Full M-Bus frame contains all Information of a full M-Bus frame. It can be used to derive an M-Bus Format frame including the Format Signature (refer to K.4). The Full M-Bus frame can be transmitted alternative to an M-Bus-Format frame. It provides full backward compatibility but it is even longer than an M-Bus Format frame.

K.2.2 M-Bus- Compact frame

Table K.4 — Structure of M-Bus-Compact frame

CI	Data header	Format-Signature	Full-Frame-CRC	Data [1]	Data [2]

The M-Bus Compact frame contains only the data without any Data Information Fields or Value Information Fields. Immediately after the data header (if existing) follows a 2 byte Format-Signature for the detection of the related M-Bus Format frame and a 2 byte Full-Frame-CRC for the verification of the recovered full M-Bus frame. The M-Bus compact frame is intended to be transmitted frequently to update the communication partner with the current consumption data.

In case of block cipher encryption the remaining bytes of the last block in the M-Bus-Compact frame shall be filled with value 2Fh.

NOTE The data header contains the AES check bytes if applicable (refer to Annex J).

K.2.3 M-Bus-Format frame

Table K.5 — Structure of M-Bus-Format frame

CI	Data header	LF	Format-Signature	DIF [1]	VIF [1]	DIF [2]	VIF [2]	VIFE [2]

The M-Bus Format frame contains no data but Data Information Fields or Value Information Fields of the M-Bus frame. It shall be transmitted either in case of changed M-Bus format or periodically with a rare interval. The Format Signature shall be used as identifier to this format frame.

In case of block cipher encryption the remaining bytes of the last block in the M-Bus-Format frame shall be filled with the value 2Fh. These filler bytes are not included in the length field (LF).

The length field (LF) counts the number of bytes (including the Format Signature) before the idle filler, which were inserted by the block cipher of the format frame. The default value of the length field is zero. If no application layer encryption is applied, the length field remains unchanged.

NOTE 1 The length field is in the responsibility of the encryption module.

NOTE 2 The data header contains the AES check bytes if applicable (refer to Annex J).

K.3 Calculation of the Full-Frame-CRC

The M-Bus-Compact frame contains a Full-Frame–CRC. The checksum shall be calculated over the full M-Bus-frame from the first byte of the application data to the end of the last data record (excluding data header, any AES check bytes in the header and link layer CRC).

The CRC polynomial is: $x^{16} + x^{13} + x^{12} + x^{11} + x^{10} + x^8 + x^6 + x^5 + x^2 + 1$

The initial value is: 0

The final CRC is complemented

K.4 Calculation of the Format Signature

The M-Bus Compact frame and the M-Bus Format frame contain a Format Signature. This is a CRC-Checksum. It shall be calculated only over the M-Bus-Format frame from the first DIF to the last VIF or DIF (excluding data header, any AES check bytes in the header, Format Signature, length field, any data bytes, encryption filler bytes in the end and link layer CRC). If the Format Signature is derived from a full M-Bus frame then an M-Bus Format frame has to be generated first.

The CRC polynomial is: $x^{16} + x^{13} + x^{12} + x^{11} + x^{10} + x^8 + x^6 + x^5 + x^2 + 1$

The initial value is: 0

The final CRC is complemented

K.5 Frame examples

K.5.1 General

The following different examples are given to show the relations between the three frame types: Full M-Bus frame, M-Bus Compact frame and M-Bus Format frame. The meter transmits the following three data sets:

- Energy = 123,4 Wh;
- Volume = 567,8 $m^{3;}$ and
- Power = 901,2 W.

K.5.2 Example without data header

In this example, the frames use the CI-fields without data header. FOS refers to Format Signature, FFC refers to Full-Frame-CRC and LF refers to length field.

Full M-Bus frame (CI = 78h):

```
CI  DIF VIF Data    DIF VIF Data    DIF VIF Data

78h 02h 02h D2h 04h 02h 15h 2Eh 16h 02h 2Ah 34h 23h
```

M-Bus-Format frame (CI = 69h):

```
CI  LF FOS FOS DIF VIF DIF VIF DIF VIF

69h 008h FOS FOS 02h 02h 02h 15h 02h 2Ah
```

M-Bus-Compact frame (CI = 79h):

```
CI  FOS FOS FFC FFC Data    Data    Data

79h FOS FOS FFC FFC D2h 04h 2Eh 16h 34h 23h
```

K.5.3 Example with short data header, no encryption

In this example, the frames use the CI-fields with short data header but no encryption is used. FOS refers to Format Signature, FFS refers to Full-Frame-CRC and LF refers to length field.

Full M-Bus frame (CI = 7Ah):

```
CI  ACC STS ConfFLD DIF VIF Data    DIF VIF Data    DIF VIF Data

7Ah 01h 00h 00h 00h 02h 02h D2h 04h 02h 15h 2Eh 16h 02h 2Ah 34h 23h
```

M-Bus-Format frame (CI = 6Ah):

```
CI  ACC STS ConfFLD LF FOS FOS DIF VIF DIF VIF DIF VIF

6Ah 01h 00h 00h 00h 008h FOS FOS 02h 02h 02h 15h 02h 2Ah
```

M-Bus-Compact frame (CI = 7Bh):

```
CI  ACC STS ConfFLD FOS FOS FFC FFC Data    Data    Data
```

```
7Bh 01h 00h 00h 00h FOS FOS FFC FFC D2h 04h 2Eh 16h 34h 23h
```

K.5.4 Example with short data header, encryption mode 5

In this example, the frames use the CI-fields with short data header with the use of encryption mode 5. FOS refers to Format Signature, FFS refers to Full-Frame-CRC and LF refers to length field. The fields included in brackets [ ] show the block to be encrypted using encryption mode 5. This example further shows how partial encrypted frames are handled in M-Bus-Format frames and M-Bus-Compact frames.

Full M-Bus frame (CI = 7Ah):

```
CI  ACC STS ConfFLD AES-CHK DIF VIF Data    DIF VIF Data    ...

7Ah 01h 00h 10h 05h[2Fh 2Fh 02h 02h D2h 04h 02h 15h 2Eh 16h ...

Filler DIF              DIF VIF Data

2Fh 2Fh 2Fh 2Fh 2Fh 2Fh]02h 2Ah 34h 23h
```

M-Bus-Format frame (CI = 6Ah):

```
CI  ACC STS ConfFLD AES-CHK LF FOS FOS DIF VIF DIF VIF DIF ...

6Ah 01h 00h 10h 05h[2Fh 2Fh 0Ch FOS FOS 02h 02h 02h 15h 2Fh ...

DIF DIF DIF DIF DIF Filler DIF DIF VIF

2Fh 2Fh 2Fh 2Fh 2Fh 2Fh]       02h 2Ah
```

M-Bus-Compact frame (CI = 7Bh):

```
CI  ACC STS ConfFLD AES-CHK FOS FOS FFC FFC Data    Data    ...

7Bh 01h 00h 10h 05h[2Fh 2Fh FOS FOS FFC FFC D2h 04h 2Eh 16h ...

Filler DIF              Data

2Fh 2Fh 2Fh 2Fh 2Fh 2Fh]34h 23h
```

As shown in the example above, the filler bytes of the Full M-Bus frame are included in the M-Bus-format frame. This makes it possible to reconstruct the original Full M-Bus frame including filler bytes and partial encrypted frames.

Annex L
(informative)

Use of standards for smart metering applications

L.1 General

If this informative Annex is applied, all requirements of Annex L shall be fulfilled.

This annex shows the preferred methods of using the standards EN 13757-2, EN 13757-3, EN 13757-4 and EN 13757-5 for implementing the required functionalities of smart metering applications as suggested by the Smart Meter Coordination Group (SMCG) of CEN, CENELEC and ETSI. For twisted pair connection of meters the physical and link layer of EN13757-2 is suggested. For wireless connection, the physical and link layer of EN 13757-4 is suggested. For wireless communication, it is distinguished between “meters” and “communication partner”. Such a communication partner might be a dedicated receiver, an apartment oriented display, a concentrator, a multi-utility server for several media or another (possibly electricity) meter. In any case, the partners are located in fixed locations and are usually mains powered.

L.2 Data integrity

All data integrity is based on the European Standards of EN 60870-5-1.

For twisted pair connection, EN 13757-2 ensures integrity class I2.

For wireless communication EN 13757-4 ensures integrity class I3. This is required for the possibly extremely noisy wireless communication channel.

L.3 Privacy

For data privacy it is required to use the (symmetrical) AES-128 encryption for all messages carrying consumer data. Each meter shall be given an individual encryption key at the time of manufacture. Since each meter shall also have a unique identification number, this pair of numbers shall be safely transferred to the customer of the meter (often the utility). The safe distribution of this meter associated pair of numbers to other participants of smart metering is then the task of this primary customer.

NOTE The aim of this encryption is only privacy (not signature or authentication). The communication partner(s) of such a meter communication can decode the encryption if he (or they) have a copy of the encryption key of each of the meters associated with him and then recode it with other encryption techniques or with other encryption keys.

L.4 Signature

Mainly for possible legal requirements, it has been suggested that meter messages whose data are used for billing might require a legally safe signature.

NOTE According to the European Cooperation in Legal Metrology (WELMEC), even if a signature is used in doubt still the value visible at the meters display has priority. Thus, the use of signed values does currently not improve the legal situation of the billing. No strict legal requirements for the use of only signed values for billing purposes are known.

L.5 Authentication

If some external device wants to send critical commands to the meter such a command might require a safe authentication. As far as no metering critical data or commands are transmitted, a symmetrical key might be sufficient, if the key is unique to the meter and if the key can be safely transmitted (i.e. not over an open wireless link) between the partners. This is a typical situation for a remotely controlled valve, which is installed by a net operator who receives the key associated with a given valve via a safe communication channel from the valve manufacturer.

L.6 Billing

For billing purposes, the required values and transmit intervals (for unidirectional wireless communication in push-mode) or wakeup/receive time intervals (for bidirectional wireless communication) are a question of the standards for the meter devices. For offline tariffing, especially for unidirectional transmitting meters, a higher readout frequency is required.

To support battery operated repeater, the transmission timing of the radio device shall be as for synchronised meters, conforming to EN 13757-4.

L.7 Consumer feedback

L.7.1 Introduction

For a consumer feedback both about the meter index (or accumulated cost) and the instantaneous power or flow rate, a more frequent transmission of such values (than required for billing) might be necessary. In addition, it is distinguished between the case where the meter itself generates and transmits the instantaneous power/flow rate values and the case where the consumer display or some other device will generate these instantaneous values from index differences and time differences. In the last case, the index values need a sufficient resolution (usually much higher than useful for billing). If the index value can be generated internally synchronously with the wireless transmit time points the receiving device can calculate the required time difference with sufficient accuracy and resolution. Even in the case of a fixed delay between value generation and transmission there will be no problem. Also if the time difference is sufficiently small (i.e. less than 1 s or 1 % of the transmit interval) there would be no problem. In the remaining cases (longer or variable delay), a meter (usable for consumer feedback of instantaneous values) shall include a record with the time delay in its message.

The following paragraphs demonstrate possible definitions in future meter standards: As long as meter standards do not provide requirements for the different situations in a meter the following requirements shall be used. If the applicable meter standard contains different requirements for one or several parameters, the meter standard shall have priority.

L.7.2 Required values and their resolution and accuracy

L.7.2.1 General

Each message for billing purposes shall at least contain the current metered value with the meter accuracy and sufficient resolution for billing. Each message for consumer information shall contain sufficient information and accuracy to enable the consumer unit to display the power/flow with sufficient accuracy and resolution. This can either be implemented via extra data points for flow/power or by sufficient resolution of the meter index and sufficient information about the time between indexed values. Unified messages for both purposes may be used if both requirements are met.

L.7.2.2 Required resolution if an extra data point for flow/power) is transmitted.

The required value resolutions for meter with additional data points for flow/power are:

Table L.1 — Required value resolution for meter with power/flow data

Medium	**Billing**	**Power/flow resolution**
Electricity	≤ 1 kWh	≤ 1 W
Water	≤ 1 m³	No requirement
Gas QMax ≤6 m³/h	≤ 1 m³	≤ 10 l/h
Gas QMax ≤60 m³/h	≤ 1 m³	≤ 100 l/h
Gas QMax > 60 m³/h	≤ 1 m³	≤ 1000 l/h
Heat / Cold Qp < 10 m³/h	≤ 1 kWh	No requirement
Heat / Cold Qp < 100 m³/h	≤ 10 kWh	No requirement
Heat / Cold Qp ≥ 100 m³/h	≤ 100 kWh	No requirement
Heat cost allocation	No requirement	No requirement

It is recommended that the averaging duration for power/flow values is similar to the average update interval (mean time between two transmissions of messages with updated consumption data). A shorter averaging period might produce strongly variant snapshot values with little user information (especially for gas and water meters with a typically strongly fluctuating flow), a longer averaging period will produce only time delayed display values. If the meters averaging duration is below 50 % or above 200 % of the average update interval the meter documentation shall point this out.

L.7.3 Required resolution if no extra data point for flow (respectively power) is transmitted.

L.7.3.1 General

If the meter transmits only index values, the consumer unit shall be able to calculate the flow respectively power with sufficient resolution and accuracy from the index value and the time interval between the index values. This requires the following index resolutions.

Table L.2 — Required value resolution without power/flow data

Medium	Index resolution
Electricity	≤ 0,1 Wh
Water	≤ 1 m³
Gas QMax ≤ 6 m³/h	≤ 10 l
Gas QMax ≤ 60 m³/h	≤ 100 l
Gas QMax > 60 m³/h	≤ 1 000 l
Heat / Cold	No requirement
Heat cost allocation	No requirement

L.7.3.2 Required time information

In addition, if there is no power/flow information present there are requirements for the accuracy and resolution of the current time difference between the index values to ensure a time interval accuracy and resolution of ≤ 1 %. These requirements can be fulfilled by one of the following alternatives.

L.7.3.3 Correlated transmission

If the meter spontaneously transmits the index value with a fixed delay of less than half the transmission interval and if such a delay varies by less than 1 % of the transmission interval then the consumer unit can calculate the index time difference from the message arrival times with sufficient resolution and accuracy.

L.7.3.4 Uncorrelated transmission

If the difference of delays of transmission time points varies by more than 1 % of the transmission interval, each message shall contain sufficient time information to calculate this time difference. This can either be implemented with a (date)/time data point with a resolution of 1 s in each message or with a data point signalling the current time delay between index time and transmit time with a resolution of 1 s.

L.7.4 Transmission on request

If the meter transmits the index value due to a request it has to refer to the time of the value generation at the moment of the first transmission of the request (REQ_UD2) by the consumer unit. The meter may generate the response with a fixed delay, which shall not vary by more than 1 s. A potential runtime of the request from the consumer unit to the meter shall be considered. Hence, a unique reference time is given even when the response is repeated several times.

L.8 Advanced tariffing and prepayment

L.8.1 General

In contrast to electricity, almost all media (gas, heat and water) can be stored or at least buffered. This reduces the attractiveness and possible generation of savings via time or load dependent tariffs. For the cases where multi-tariffing is still required the field tariff in the DIF record descriptor provides the option to associate any type of value (i. e. any VIF) with a tariff index. Considering the options of DIF extension an almost unlimited number of tariffs can be implemented. The VIFs for management of tariff time windows (period, start, duration) allow flexible definition of multiple tariffs. The association with of a tariff with a tariff number is flexible. In addition, the use of separate registers for each flow direction is supported via a suitable orthogonal VIF. A detailed logging of error and limit exceeds and the registration of maxima/minima and registration during some error state is also supported.

L.8.2 Prepayment

The addition of currency units to the VIF table allows the support of prepayment functions. A prepayment value can be read, written, added or subtracted. For security aspects such commands may require authentication. A simple symmetrical encryption method can be used for this if there is a safe key transport between the meter and the prepayment authority is implemented. A separate key for prepayment functions is suggested. Other prepayment functionalities might be implemented using existing DIF/VIF combinations or other may be added if detailed requirements from the device side are available.

Annex M
(informative)

Installation and registration

M.1 General

The way to equip a building with new meters or exchange existing ones differs significantly depending on the history and the working process of the meter site operator. This standard intends to support different installation processes. The answers to the following questions decide on the installation procedure.

- Who defines the pairing of the meter and the gateway?
- Is an online connection to the back office of the Meter Site Operator necessary or possible?
- Is a fast feedback after the installation to the local service technician required?

To readout a meter, the operator needs the address of the meter and the communication address of the meter site, e.g. IP-Address of the host gateway. The operator has to register all gateways as well as all meter addresses and their host gateway. The pairing of a meter and a gateway or another partner device may be done

a) either automatically (no predefinition),

b) predefined by the operator,

c) or predefined by the service technician.

Solution a) requires an online connection to the Meter Site Operator to assign a detected meter during or after the installation to one of the partner devices in range.

Solution b) loads meter parameters into the partner device before the installation. This can be done via online connection or already be preconfigured in the partner device before its installation.

Solution c) does not need an online connection. The service technician assigns the meter to the partner device directly on site.

Besides the pairing of the meter and the partner device, the related keys for encryption and/or authentication have to be allocated to the concerning partner device.

The assignment procedure may be independent of the communication type like uni- or bidirectional communication or the selected communication mode. But in small details differences may exist. The assignment of a meter with exactly one communication partner is always required for bidirectional wireless meters, at least for transmitting information or commands to a meter. For a unidirectional transmitting meter, it is not required to have only one single communication partner. In fact, it could be helpful for a wireless diversity to register the meter in each communication partner which is able to receive this meter. Otherwise, a bidirectional meter allows the test of the operational reliability of the communication link or encryption key immediately after the registration.

For some pairing methods, additional meter functionality is required. This optional functionality is described below.

M.2 Registration with meter support

M.2.1 Introduction

Some meters support the functionality of installation messages (« SND-IR »). These messages can be manually initiated only either by a push button (or similar event) or via a command communicated by some mobile service device to the meter. Thereafter the meter sends several installation messages in short intervals. For structure and timing of these messages, refer to EN 13757-4. The receiving partner device takes these installation messages as a request for registration. The reaction of the partner device depends on whether it was enabled for the registration of new meters (Registration Mode). The Registration Mode has to be set before the meter installation by a service technician. If the Registration Mode was enabled and an installation message was received, the partner device registers the new device and responds a Registration Feedback. Independent of the Registration Mode, the partner device has always to respond an RF-Link Feedback after the reception of an installation message.

The “registration with meter support” does not require an online link to the meter site operator during the installation phase and provides a feedback to the service technician immediately after the meter installation.

M.2.2 RF-Link feedback

Every communication partner device which receives installation messages (« SND-IR ») from a meter shall respond to such messages by emitting a « SND_NKE »-datagram which contains the meter’s link address and the partner’s unique ID. For complete structure and timing of these messages, see EN 13757-4. This message is not intended for the meter but for reception via an optional mobile service receiver. For that reason, the link feedback is transmitted outside of the usually very limited reception timeslot of the bidirectional battery driven meter. Such an RF-link feedback message may also contain the RF reception level for this meter. The mobile reception tool is able to display and/or store the meter link address and the reception level (if available) for each meter, whose partner device could establish a radio link with the meter. A possible missing answer signals to the installer that another communication partner or some repeater has to be installed. This can then be done immediately. Hence, the service technician leaves the building, no second access is necessary.

M.2.3 Registration feedback

For a direct (i.e.) offline registration of a meter without the assistance of the Meter Site Operator the concerning partner shall be set for a limited time into the Registration Mode. The installer shall insure that only one communication partner within the maximum communication distance of the meter is set simultaneously into such a Registration Mode. In this case, these registration confirmation messages (« CNF-IR ») are transmitted in the small dedicated reception windows of bidirectional meters to give a registration confirmation to the meter, so it may stop transmitting installation messages. For a complete structure and timing of these messages, see EN 13757-4. These registration confirmation messages might also be received by some mobile installation support receiver and further signalled to the installer and stored there. Further actions can be controlled remotely.

M.3 Registration without meter support

To reduce the meter requirements and the service actions of the installer, the support of installation messages may not be provided by all meters. Meters for such a remote based registration start transmitting directly after the mechanical installation or even transmit always. No special functionality of the meter for registration is required. If a possible communication partner receives meter messages from a meter so far unknown it enters the meter-ID together with the reception time in a special list. The back office of the Meter Site Operator may be notified via push mode or it might be queried occasionally. There may be special rules for a backbone meter installation process (either for any newly detected meters or for predefined meters only). The back office of the Meter Site Operator may assign (register) such a meter to a single communication partner. If the Meter Site Operator already knows the meter ID, it also knows the associated meter encryption key, which (if required) might then be downloaded to this communication partner or to another system component where decryption is required. This key download requires a high-level privacy link, which is often possible in the private or public networks for such system level communication which is outside the scope of this standard. The advantage of this method without meter support is, besides speed and simplicity of the installation process, the flexibility to add or change communication partner(s) without requiring access to the meter which might be located within an apartment. Another advantage is that both installation sequences (meter first or partner first) can be realised. This method is therefore often used when the communication partner is located outside the apartments, e.g. for partners communicating with meters of several apartments. The drawback of this method is the missing feedback to the service technician at installation time about the existence and the quality of the wireless link.

This method may also be applied for meters which actually support installation messages, e.g. when the communication partner was replaced or updated.

Annex N
(informative)

M-Bus data container

N.1 Explanation

The M-Bus data container is used to pack a full wireless M-Bus frame into a wired M-Bus message. It comes into action for instance in a radio to M-Bus adapter. This is a device which receives frames in any format and provides the data on a wired M-Bus interface.

The benefit of this method is that the original radio frame can be passed through to the communication end points. So any functionality (i.e. data decryption) is easily possible and can be done in a common way.

N.2 Definition

The M-Bus data container is defined as an independent data record and can be positioned anywhere inside the M-Bus variable data block.

Table N.1 — Structure of data record

DIF	VIF	VIFE	LVAR	Data
0Dh	FDh	3Bh or 76h	Length	i.e. 29h 44h …

The Data Information Field (DIF) is always 0Dh, which shows the variable length of the record. The Value Information Field (VIF) is FDh with a specific VIFE for protocol definition. The length is coded as LVAR = 00h – BFh.

Two possibilities are defined:

— 3Bh used for wireless M-Bus protocol;

— 76h used for manufacturer specific protocol.

These are enhancements of Table 28 and are called respectively “Data container for wireless M-Bus protocol” and "Data container for manufacturer specific protocol". The LVAR byte, which is advertised with DIF 0Dh, shows in this case the number of bytes inside the data container and shall not be interpreted as an 8-bit text string.

For the wireless M-bus protocol (VIFE 3Bh), the data block contains the original radio frame starting with the L and the C field as stated in the EN 13757-4. The CRC blocks of the radio frame are not included in the wireless M-Bus data container.

For the manufacturer specific protocol (VIFE 76h), the content of the data block is not predefined and can be used complying to manufacturers requests.

The maximum length of a wired M-Bus datagram is limited. Therefore, the possibility to split the radio frame in two or more parts is given. In this case, the DIF 1Fh shall be used at the end of the variable data block. It shows more bytes are transferred in the next datagram. With a toggled FCB of the C field this can be verified.

N.3 Example

Wired M-Bus communication between a master and a radio to M-Bus adapter

SA = ID of the radio device; Fa = ID of the radio to M-Bus adapter

Slave select from master

68 11 11 68 73/53 FD 52 SA0 SA1 SA2 SA3 Man0 Man1 Ver Med 0C 78 Fa0 Fa1 Fa2 Fa3 Ch 16

Answer

E5

Request (REQ-UD2) from master

10 7B/5B FD ChS 16

Answer (RSP-UD) from radio to M-Bus adapter

68 LL LL 68 08 FD 72 SAd0 SAd1 SAd2 SAd3 Man0 Man1 Ver Med

07	M-Bus Transmission Counter
00	Status of the M-Bus/radio adapter
00 00	Control word of the M-Bus/radio adapter (no encryption used on wired M-Bus)
0C 78 Fa0 Fa1 Fa2 Fa3	Serial number (secondary address of M-Bus/radio adapter)
	Following optional data records like:
03 74 04 00 00	Time since last radio message reception [4 s]
01 FD 71 A1	RSSI (radio signal strength, -95 dBm)
	Following wireless M-Bus data container including **original wM-Bus frame**

0D FD 3B 57 **56 44 Man0 Man1 SAd0 SAd1 SAd2 SAd3 Gen Med 7A 34 00 40 05 F7 9F C4 79 E7 16 8F F2 82 BF 4D 4F 41 28 ... B9 17 E7** CS 16

Annex O
(normative)

Translating M-Bus type record descriptors to OBIS-type record descriptors

The following tables are declared to be normative in the sense that if a translation from VIF/DIF values to OBIS codes is necessary, exactly that translation given in the table must be used. It is not meant that VIF/DIF values must be used under any circumstances, as OBIS codes can also be transmitted as such.

O.1 Translation of predefined data record types

This list describes how a communication partner can “translate” received M-Bus record into OBIS type records.

The B-Field of the OBIS Code shall be build from the subunit in related DIFE of data point (refer to chapter 6.10). If the meter uses one channel only then the subunit and also the B-Field of the OBIS Code is 0 (as listed in this table). If a meter uses more than one channel then the subunit and also B-Field of OBIS Code is declared channel number which starts with 1.

Table O.1 — M-Bus-OBIS-Translation: legend

Symbol/ Bit symbol	**Meaning**
M	Mandatory (These data objects have to be specified)
Ax	Alternatively (At least one of the data objects marked with 'A' and an identical number x is mandatory)
O	Optional (These data objects do not need to exist)
ssss ssss	Status byte, according to Table 7
cccc	Coding of the data field, according to Table 21 (except real, variable length, selection for readout, special functions)
n	One or more bits, according to Tables 26, 28, 29 and 30
VZ	Recent value 0 ≤ VZ ≤ 99 or 101 ≤ VZ ≤ 124
x	Definition of the bit of the M-Bus storage number, which is equivalent to the billing period counter (VZ) (see Tables 20 and 24); value range 0 … 99 and 101 ..124

Table O.2 — M-Bus-OBIS-Translation: general (for all devices)

	Type	OBIS-Code	Description	DIF/DIFE or fixed fields [binary]	VIF/VIFE [binary]
	Abstract	0	All media		
M	Error status	0-0:97.97.0*255	Status according to EN13757-3		
	–		Status	ssss ssss	
M	Current time	0-0:0.9.1*255	Local time (Receiving time of communication partner)		
	–		Data object generated automatically by communication partner!		
M	Current date	0-0:0.9.2*255	Local date (Receiving date of communication partner)		
	–		Data object generated automatically by communication partner!		
M	Device address	0-0:96.1.1*255	Device address (assigned by the manufacturer)		
	–		Complete device address (manufacturer, meter ID, version, device type)		
O	Ownership number	0-0:96.1.9*255	Ownership number (optional)		
	–		Fixed length	0000 cccc	1111 1101 0001 0001
	–		Variable length	0000 1101	1111 1101 0001 0001
O	Metering point ID	0-0:96.1.10*255	Identification of the metering point		
	–		Fixed length	0000 cccc	1111 1101 0001 0000
	–		Variable length	0000 1101	1111 1101 0001 0000
O	Serial number	0-0:96.1.0*255	Serial number (assigned by the manufacturer)		
	–		Fixed length	0000 1100	0111 1000

Table O.3 — M-Bus-OBIS-Translation: electricity meter

	Type	OBIS-Code	Description	DIF/DIFE or fixed fields [binary]	VIF/VIFE [binary]
	Electricity	1	02_h (see Table 6)		
A1	Meter count	1-0:1.8.0*255	Active energy import (+A), current value		
	–	kWh	10e-6 … 10e+1	0000 cccc	0000 0nnn
	–	kWh	10e+2 … 10e+3	0000 cccc	1111 1011 0000 000n
	–	kWh	10e+5 … 10e+6	0000 cccc	1111 1011 1000 000n 0111 1101
O	Meter count	1-0:1.8.0*VZ	Active energy import (+A), recent value		
	–	kWh	10e-6 … 10e+1	1x00 cccc 1000 xxxx 0000 00xx	0000 0nnn
	–	kWh	10e+2 … 10e+3	1x00 cccc 1000 xxxx 0000 00xx	1111 1011 0000 000n
	–	kWh	10e+5 … 10e+6	1x00 cccc 1000 xxxx 0000 00xx	1111 1011 1000 000n 0111 1101
A1	Meter count	1-0:2.8.0*255	Active energy export (-A), current value		
	–	kWh	10e-6 … 10e+1	0000 cccc	1000 0nnn 0011 1100
	–	kWh	10e+2 … 10e+3	0000 cccc	1111 1011 1000 000n 0011 1100
	–	kWh	10e+5 … 10e+6	0000 cccc	1111 1011 1000 000n 1111 1101 0011 1100
O	Meter count	1-0:2.8.0*VZ	Active energy export (-A), recent value		
	–	kWh	10e-6 … 10e+1	1x00 cccc 1000 xxxx 0000 00xx	1000 0nnn 0011 1100
	–	kWh	10e+2 … 10e+3	1x00 cccc 1000 xxxx 0000 00xx	1111 1011 1000 000n 0011 1100
	–	kWh	10e+5 … 10e+6	1x00 cccc 1000 xxxx 0000 00xx	1111 1011 1000 000n 1111 1101 0011 1100
O	Time of device	1-0:0.9.1*255	Current time at time of transmission		
	–	Type F		0000 0100	0110 1101
O	Date of device	1-0:0.9.2*255	Current date at time of transmission		
	–	Type G		0000 0010	0110 1100
	–	Type F		0000 0100	0110 1101

Table O.3 *(continued)*

	Type	OBIS-Code	Description	DIF/DIFE or fixed fields [binary]	VIF/VIFE [binary]
O	Time, date of count	1-0:0.1.2*255	Run time difference between measurement of current value and transmission		
				0000 cccc	0111 01nn
O	Date of count	1-0:0.1.2*VZ	Local date at time of recent meter value		
	–	Type G		1x00 0010 1000 xxxx 0000 00xx	0110 1100
	–	Type F		1x00 0100 1000 xxxx 0000 00xx	0110 1101
O	Time integral	1-0:0.8.2*255	Averaging duration for current power value		
	–	h or min or sec		0000 cccc	0111 00nn

Table O.4 — M-Bus-OBIS-Translation: heat cost allocator

	Type	OBIS-Code	Description	DIF/DIFE or fixed fields [binary]	VIF/VIFE [binary]
	HCA	4	08_h (see Table 6)		
M	Meter count	4-0:1.0.0*255	Unrated integral, current value		
	–	HCA	10e+0	0000 cccc	0110 1110
M	Meter count	4-0:1.2.0*255	Unrated integral, set date value		
	–	HCA	10e+0	0100 cccc	0110 1110
O	Time of device	4-0:0.9.1*255	Current time at time of transmission		
	–	Type F		0000 0100	0110 1101
O	Date of device	4-0:0.9.2*255	Current date at time of transmission		
	–	Type G		0000 0010	0110 1100
	–	Type F		0000 0100	0110 1101
O	Time, date of count	4-0:0.1.2*255	Run time difference between measurement of current value and transmission		
				0000 cccc	0111 01nn
M	Date of count	4-0:0.1.10*255	Local date at set date	(target date)	
	–	Type G		0100 0010	0110 1100

Table O.5 — M-Bus-OBIS-Translation: cooling meter

	Type	OBIS-Code	Description	DIF/DIFE or fixed fields [binary]	VIF/VIFE [binary]
	Cooling	5	$0A_h$, $0B_h$ (see Table 6)	(Cooling only)	
M	Meter count	5-0:1.0.0*255	Energy (*A*), total, current value		
	–	kWh	10e-6 … 10e+1	0000 cccc	0000 0nnn
	–	kWh	10e+2 … 10e+3	0000 cccc	1111 1011 0000 000n
	–	kWh	10e+5 … 10e+6	0000 cccc	1111 1011 1000 000n 0111 1101
	–	GJ	10e-9 … 10e-2	0000 cccc	0000 1nnn
	–	GJ	10e-1 … 10e+0	0000 cccc	1111 1011 0000 100n
	–	GJ	10e+2 … 10e+3	0000 cccc	1111 1011 1000 100n 0111 1101
O	Meter count	5-0:1.2.0*255	Energy (*A*), total, set date value		
	–	kWh	10e-6 … 10e+1	0100 cccc	0000 0nnn
	–	kWh	10e+2 … 10e+3	0100 cccc	1111 1011 0000 000n
	–	kWh	10e+5 … 10e+6	0100 cccc	1111 1011 1000 000n 0111 1101
	–	GJ	10e-9 … 10e-2	0100 cccc	0000 1nnn
	–	GJ	10e-1 … 10e+0	0100 cccc	1111 1011 0000 100n
	–	GJ	10e+2 … 10e+3	0100 cccc	1111 1011 1000 100n 0111 1101
O	Power	5-0:8.0.0*255	Power (energy flow) (*P*), average, current value		
	–	W	10e-3 … 10e+4	0000 cccc	0010 1nnn
	–	kJ/h	10e-3 … 10e+4	0000 cccc	0011 0nnn
O	Flow rate	5-0:9.0.0*255	Flow rate, average (V_a/t), current value		
	–	m^3/h	10e-6 … 10e+1	0000 cccc	0011 1nnn
O	Time of device	5-0:0.9.1*255	Current time at time of transmission		
	–	Type F		0000 0100	0110 1101

Table O.5 *(continued)*

	Type	OBIS-Code	Description	DIF/DIFE or fixed fields [binary]	VIF/VIFE [binary]
O	Date of device	5-0:0.9.2*255	Current date at time of transmission		
	–	Type G		0000 0010	0110 1100
	–	Type F		0000 0100	0110 1101
O	Time, date of count	5-0:0.1.2*255	Run time difference between measurement of current value and transmission		
				0000 cccc	0111 01nn
O	Date of count	5-0:0.1.10*255	Local date at set date		
	–	Type G		0100 0010	0110 1100
O	Time integral	5-0:0.8.5*255	Averaging duration for current power value		
	–	h *or* min *or* sec		0000 cccc	0111 00nn

Table O.6 — M-Bus-OBIS-Translation: combined heat and cooling meter

	Type	OBIS-Code	Description	DIF/DIFE or fixed fields [binary]	VIF/VIFE [binary]
	Cooling	5	$0D_h$ (cooling) (see Table 6)	(Combined heat/cooling)	
M	Meter count	5-0:1.0.0*255	Energy (*A*), total, current value		
	–	kWh	10e-6 … 10e+1	1000 cccc 0001 0000	0000 0nnn
	–	kWh	10e+2 … 10e+3	1000 cccc 0001 0000	1111 1011 0000 000n
	–	kWh	10e+5 … 10e+6	1000 cccc 0001 0000	1111 1011 1000 000n 0111 1101
		kWh	10e-6 … 10e+1	0000 cccc	1000 0nnn 0011 1100
		kWh	10e+2 … 10e+3	0000 cccc	1111 1011 1000 000n 0011 1100
		kWh	10e+5 … 10e+6	0000 cccc	1111 1011 1000 000n 1111 1101 0011 1100
	–	GJ	10e-9 … 10e-2	1000 cccc 0001 0000	0000 1nnn
	–	GJ	10e-1 … 10e+0	1000 cccc 0001 0000	1111 1011 0000 100n
	–	GJ	10e+2 … 10e+3	1000 cccc 0001 0000	1111 1011 1000 100n 0111 1101
		GJ	10e-9 … 10e-2	0000 cccc	1000 1nnn 0011 1100
		GJ	10e-1 … 10e+0	0000 cccc	1111 1011 1000 100n 0011 1100
		GJ	10e+2 … 10e+3	0000 cccc	1111 1011 1000 100n 1111 1101 0011 1100
O	Meter count	5-0:1.2.0*255	Energy (*A*), total, set date value		
	–	kWh	10e-6 … 10e+1	1100 cccc 0001 0000	0000 0nnn
	–	kWh	10e+2 … 10e+3	1100 cccc 0001 0000	1111 1011 0000 000n
	–	kWh	10e+5 … 10e+6	1100 cccc 0001 0000	1111 1011 1000 000n 0111 1101
	–	kWh	10e-6 … 10e+1	0100 cccc	1000 0nnn 0011 1100
	–	kWh	10e+2 … 10e+3	0100 cccc	1111 1011 1000 000n 0011 1100
	–	kWh	10e+5 … 10e+6	0100 cccc	1111 1011 1000 000n 1111 1101 0011 1100
	–	GJ	10e-9 … 10e-2	1100 cccc 0001 0000	0000 1nnn

Table O.6 *(continued)*

	Type	OBIS-Code	Description	DIF/DIFE or fixed fields [binary]	VIF/VIFE [binary]
	–	GJ	10e-1 … 10e+0	1100 cccc 0001 0000	1111 1011 0000 100n
	–	GJ	10e+2 … 10e+3	1100 cccc 0001 0000	1111 1011 1000 100n 0111 1101
	–	GJ	10e-9 … 10e-2	0100 cccc	1000 1nnn 0011 1100
	–	GJ	10e-1 … 10e+0	0100 cccc	1111 1011 1000 100n 0011 1100
	–	GJ	10e+2 … 10e+3	0100 cccc	1111 1011 1000 100n 1111 1101 0011 1100
O	Power	5-0:8.0.0*255	Power (energy flow) (*P*), average, current value		
	–	W	10e-3 … 10e+4	1000 cccc 0001 0000	0010 1nnn
	–	kJ/h	10e-3 … 10e+4	1000 cccc 0001 0000	0011 0nnn
O	Flow rate	5-0:9.0.0*255	Flow rate, average (V_a/t), current value		
	–	m³/h	10e-6 … 10e+1	1000 cccc 0001 0000	0011 1nnn
O	Time of device	5-0:0.9.1*255	Current time at time of transmission		
	–	Type F		1000 0100 0001 0000	0110 1101
O	Date of device	5-0:0.9.2*255	Current date at time of transmission		
	–	Type G		1000 0010 0001 0000	0110 1100
	–	Type F		1000 0100 0001 0000	0110 1101
O	Time, date of count	5-0:0.1.2*255	Run time difference between measurement of current value and transmission		
				0000 cccc	0111 01nn
O	Date of count	5-0:0.1.10*255	Local date at set date		
	–	Type G		1100 0010 0001 0000	0110 1100
O	Time integral	5-0:0.8.5*255	Averaging duration for current power value		
	–	h *or* min *or* sec		0000 cccc	0111 00nn

This table consists of the cooling meter counts of combined heat/cooling meters (Device Type = 0Dh). Refer to heat meter for heat meter counts.

Table O.7 — M-Bus-OBIS-Translation: heat meter

	Type	OBIS-Code	Description	DIF/DIFE or fixed fields [binary]	VIF/VIFE [binary]
	Heat	6	04_h, $0C_h$, $0D_h$(heat) (see Table 6)	(Heat only and combined heat/cooling)	
M	Meter count	6-0:1.0.0*255	Energy (*A*), total, current value		
	–	kWh	10e-6 … 10e+1	0000 cccc	0000 0nnn
	–	kWh	10e+2 … 10e+3	0000 cccc	1111 1011 0000 000n
	–	kWh	10e+5 … 10e+6	0000 cccc	1111 1011 1000 000n 0111 1101
	–	GJ	10e-9 … 10e-2	0000 cccc	0000 1nnn
	–	GJ	10e-1 … 10e+0	0000 cccc	1111 1011 0000 100n
	–	GJ	10e+2 … 10e+3	0000 cccc	1111 1011 1000 100n 0111 1101
O	Meter count	6-0:1.2.0*255	Energy (*A*), total, set date value		
	–	kWh	10e-6 … 10e+1	0100 cccc	0000 0nnn
	–	kWh	10e+2 … 10e+3	0100 cccc	1111 1011 0000 000n
	–	kWh	10e+5 … 10e+6	0100 cccc	1111 1011 1000 000n 0111 1101
	–	GJ	10e-9 … 10e-2	0100 cccc	0000 1nnn
	–	GJ	10e-1 … 10e+0	0100 cccc	1111 1011 0000 100n
	–	GJ	10e+2 … 10e+3	0100 cccc	1111 1011 1000 100n 0111 1101
O	Power	6-0:8.0.0*255	Power (energy flow) (*P*), average, current value		
	–	W	10e-3 … 10e+4	0000 cccc	0010 1nnn
	–	kJ/h	10e-3 … 10e+4	0000 cccc	0011 0nnn
O	Flow rate	6-0:9.0.0*255	Flow rate, average (V_a/t), current value		
	–	m^3/h	10e-6 … 10e+1	0000 cccc	0011 1nnn

Table O.7 *(continued)*

	Type	OBIS-Code	Description	DIF/DIFE or fixed fields [binary]	VIF/VIFE [binary]
O	Time of device	6-0:0.9.1*255	Current time at time of transmission		
	–	Type F		0000 0100	0110 1101
O	Date of device	6-0:0.9.2*255	Current date at time of transmission		
	–	Type G		0000 0010	0110 1100
	–	Type F		0000 0100	0110 1101
O	Time, date of count	6-0:0.1.2*255	Run time difference between measurement of current value and transmission		
				0000 cccc	0111 01nn
O	Date of count	6-0:0.1.10*255	Local date at set date		
	–	Type G		0100 0010	0110 1100
O	Time integral	6-0:0.8.5*255	Averaging duration for current power value		
	–	h *or* min *or* sec		0000 cccc	0111 00nn

Table O.8 — M-Bus-OBIS-Translation: gas meter

	Type	OBIS-Code	Description	DIF/DIFE or fixed fields [binary]	VIF/VIFE [binary]
	Gas	7	03_h (see Table 6)	-	
A1	Meter count	7-0:3.0.0*255	Volume (meter), metering conditions (V_m), forward, absolute, current value		
	–	m³	10e-6 … 10e+1	0000 cccc	1001 0nnn 0011 1010
	–	m³	10e-3 … 10e+4	0000 cccc	1001 0nnn 1111 1101 0011 1010
A1	Meter count	7-0:3.1.0*255	Volume (meter), temperature converted (V_{tc}), forward, absolute, current value		
	–	m³	10e-6 … 10e+1	0000 cccc	0001 0nnn
	–	m³	10e-3 … 10e+4	0000 cccc	1001 0nnn 0111 1101
A1	Meter count	7-0:3.2.0*255	Volume (meter), base conditions (V_b), forward, absolute, current value		
	–	m³	10e-6 … 10e+1	0000 cccc	1001 0nnn 0011 1110
	–	m³	10e-3 … 10e+4	0000 cccc	1001 0nnn 1111 1101 0011 1110
O	Meter count	7-0:3.0.0*VZ	Volume (meter), metering conditions (V_m), forward, absolute, recent value		
	–	m³	10e-6 … 10e+1	1x00 cccc 1000 xxxx 0000 00xx	1001 0nnn 0011 1010
	–	m³	10e-3 … 10e+4	1x00 cccc 1000 xxxx 0000 00xx	1001 0nnn 1111 1101 0011 1010
O	Meter count	7-0:3.1.0*VZ	Volume (meter), temperature converted (V_{tc}), forward, absolute, recent value		
	–	m³	10e-6 … 10e+1	1x00 cccc 1000 xxxx 0000 00xx	0001 0nnn
	–	m³	10e-3 … 10e+4	1x00 cccc 1000 xxxx 0000 00xx	1001 0nnn 0111 1101
O	Meter count	7-0:3.2.0*VZ	Volume (meter), base conditions (V_b), forward, absolute, recent value		
	–	m³	10e-6 … 10e+1	1x00 cccc 1000 xxxx 0000 00xx	1001 0nnn 0011 1110
	–	m³	10e-3 … 10e+4	1x00 cccc 1000 xxxx 0000 00xx	1001 0nnn 1111 1101 0011 1110
O	Flow rate	7-0:43.15.0*255	Flow rate at metering conditions, averaging period 1 (default period = 5 min), current interval (V_m/t_1)		
	–	m³/h	10e-6 … 10e+1	0000 cccc	1011 1nnn 0011 1010

Table O.8 *(continued)*

	Type	OBIS-Code	Description	DIF/DIFE or fixed fields [binary]	VIF/VIFE [binary]
O	Flow rate	7-0:43.16.0*255	Flow rate, temperature converted, averaging period 1(default period = 5 min), current interval (V_{tc}/t_1)		
	–	m³/h	10e-6 … 10e+1	0000 cccc	0011 1nnn
O	Flow rate	7-0:43.17.0*255	Flow rate at base conditions, averaging period 1 (default period = 5 min), current interval (V_b/t_1)		
	–	m³/h	10e-6 … 10e+1	0000 cccc	1011 1nnn 0011 1110
O	Base temperature	7-0:41.2.0*255	defined Temperature, absolute, at base conditions (T_b) or for conversion (T_{tc})		
	–	°C	10e-3 … 10e+0	0000 cccc	1101 10nn 0011 1110
O	Base pressure	7-0:42.2.0*255	defined Pressure, absolute, at base conditions (p_b)		
	–	bar	10e-3 … 10e+0	0000 cccc	1110 10nn 0011 1110
	–	bar	10e-6 … 10e-3	0000 cccc	1110 10nn 1111 0011 0011 1110
O	Time of device	7-0:0.9.1*255	Current time at time of transmission		
	–	Type F		0000 0100	0110 1101
O	Date of device	7-0:0.9.2*255	Current date at time of transmission		
	–	Type G		0000 0010	0110 1100
	–	Type F		0000 0100	0110 1101
O	Time, date of count	7-0:0.1.2*255	Run time difference between measurement of current value and transmission		
				0000 cccc	0111 01nn
O	Date of count	7-0:0.1.2*VZ	Local date at time of recent meter value, billing period 1 (default value = 1 day)		
	–	Type G		1x00 0010 1000 xxxx 0000 00xx	0110 1100
	–	Type F		1x00 0100 1000 xxxx 0000 00xx	0110 1101
O	Time integral	7-0:0.8.28*255	Averaging duration for current flow rate value		
	–	h *or* min *or* sec		0000 cccc	0111 00nn

Table O.9 — M-Bus-OBIS-Translation: water meter (cold)

	Type	OBIS-Code	Description	DIF/DIFE or fixed fields [binary]	VIF/VIFE [binary]
	Cold Water	8	07_h (see Table 6)		
M	Meter count	8-0:1.0.0*255	Volume (*V*), accumulated, total, current value		
	–	m³	10e-6 … 10e+1	0000 cccc	0001 0nnn
	–	m³	10e-3 … 10e+4	0000 cccc	1001 0nnn 0111 1101
O	Meter count	8-0:1.2.0*255	Volume (*V*), accumulated, total, set date value		
	–	m³	10e-6 … 10e+1	0100 cccc	0001 0nnn
	–	m³	10e-3 … 10e+4	0100 cccc	1001 0nnn 0111 1101
O	Flow rate	8-0:2.0.0*255	Flow rate, average (V_a/t), current value		
	–	m³/h	10e-6 … 10e+1	0000 cccc	0011 1nnn
O	Time of device	8-0:0.9.1*255	Current time at time of transmission		
	–	Type F		0000 0100	0110 1101
O	Date of device	8-0:0.9.2*255	Current date at time of transmission		
	–	Type G		0000 0010	0110 1100
	–	Type F		0000 0100	0110 1101
O	Time, date of count	8-0:0.1.2*255	Run time difference between measurement of current value and transmission		
				0000 cccc	0111 01nn
O	Date of count	8-0:0.1.10*255	Local date at set date		
	–	Type G		0100 0010	0110 1100
O	Time integral	8-0:0.8.6*255	Averaging duration for current flow rate value		
	–	h *or* min *or* sec		0000 cccc	0111 00nn

Table O.10 — M-Bus-OBIS-Translation: water meter (hot, warm)

	Type	OBIS-Code	Description	DIF/DIFE or fixed fields [binary]	VIF/VIFE [binary]
	Hot Water	9	06_h, 15_h (see Table 6)		
M	Meter count	9-0:1.0.0*255	Volume (*V*), accumulated, total, current value		
	–	m³	10e-6 … 10e+1	0000 cccc	0001 0nnn
	–	m³	10e-3 … 10e+4	0000 cccc	1001 0nnn 0111 1101
O	Meter count	9-0:1.2.0*255	Volume (*V*), accumulated, total, set date value		
	–	m³	10e-6 … 10e+1	0100 cccc	0001 0nnn
	–	m³	10e-3 … 10e+4	0100 cccc	1001 0nnn 0111 1101
O	Flow rate	9-0:2.0.0*255	Flow rate, average (V_a/t), current value		
	–	m³/h	10e-6 … 10e+1	0000 cccc	0011 1nnn
O	Time of device	9-0:0.9.1*255	Current time at time of transmission		
	–	Type F		0000 0100	0110 1101
O	Date of device	9-0:0.9.2*255	Current date at time of transmission		
	–	Type G		0000 0010	0110 1100
	–	Type F		0000 0100	0110 1101
O	Time, date of count	9-0:0.1.2*255	Run time difference between measurement of current value and transmission		
				0000 cccc	0111 01nn
O	Date of count	9-0:0.1.10*255	Local date at set date		
	–	Type G		0100 0010	0110 1100
O	Time integral	9-0:0.8.6*255	Averaging duration for current flow rate value		
	–	h *or* min *or* sec		0000 cccc	0111 00nn

O.2 Online addition of an entry for the M-Bus to OBIS conversion table

When a meter uses an M-Bus data point, which is not declared in O.1 "M-Bus-OBIS Conversion table" in this European standard and which is required for billing, then it should assign the suggested concerning OBIS-code for this data point as static data by this special data point. This OBIS-declaration should be sent as static data (refer to Table 15).

The OBIS-declaration uses the original DIF/VIF-combination of the declared M-Bus-data point added by the orthogonal VIFE "OBIS-declaration" (3Fh so far reserved). The value of this new data point consists of the assigned OBIS-code. The OBIS-code may be coded as BCD or binary value. In the low nibble of the original DIF (bold marked) is the content replaced by length and coding of OBIS-code. The binary value for the OBIS-code is always unsigned. Use "binary" if recent value (OBIS-F)>99.

<u>EXAMPLE</u> max. flow rate of a water meter

A water meter supports a maximum flow rate value e.g. 0,123 m^3/h. The M-Bus data point for max. flow rate is coded as e. g.:

1**A**h DIF; maximum value; 4 digits BCD

3Bh VIF; Flow rate with unit 10^{-3} m^3/h

23h 01h Value 123

The relevant OBIS-declaration 8-0:2.5.0*255 will be transmitted either binary or with BCD-numbers.

<u>BCD-coding:</u>

The relevant OBIS-Declaration will be transmitted as 12 digits BCD by:

1**E**h DIF; maximum value; 12 digits BCD

BBh VIF; Flow rate with unit 10^{-3} m^3/h; VIFE follows

3Fh VIFE "OBIS-declaration"

AAh 00h 05h 02h 00h 08h Value; OBIS-code 8-0:2.5.0*255

NOTE The BCD Value "AA" in OBIS-field "F" signals an invalid value (refer to Annex A). This corresponds to a recent value of 255.

<u>Binary coding:</u>

<u>Alternatively,</u> the relevant OBIS-declaration will be transmitted, e.g. as 48-bit binary by:

1**6h** DIF; maximum value; 48 bit binary

BBh VIF; flow rate with unit 10^{-3} m^3/h; VIFE follows

3Fh VIFE "OBIS-declaration"

FFh 00h 05h 02h 00h 08h Value; OBIS-code 8-0:2.5.0*255

Annex P
(informative)

Datagram examples for the M-Bus and the wM-Bus

P.1 Gas meter

Gas meter example

Medium	Gas
Manufacturer	ELS
Serial number	12345678
Version	51
Forward absolute meter volume, temperature converted	28504,27 m²
Date and time of readout	31.05.2008 23:50
Error code binary	0

AES key according to FIPS 197 (LSB first):
= Manu. spec. at least 8 bytes unique for each meter
= 01 02 03 04 05 06 07 08 09 0A 0B 0C 0D 0E 0F 11

AES CBC initial vector according to FIPS 197 (LSB first):
= M Field + A Field + 8 bytes Access No
= 93 15 78 56 34 12 33 03 2A 2A 2A 2A 2A 2A 2A 2A

Table P.1 — SND-NR - Gas meter (wM-Bus)

SND_NR (wM-Bus)					
		wM-Bus frame	**Gas meter example**		
Byte No	**Field Name**	**Content**	**Bytes [hex] plain**	**Bytes [hex] AES coded**	
1	L Field	Length of data (46 bytes)	2Eh	2Eh	Linklayer (DLL)
2	C Field	44h in Normal mode	44h	44h	
3	M Field	Manufacturer code	93h	93h	
4	M Field	Manufacturer code	15h	15h	
5	A Field	Serial No LSB (BCD)	78h	78h	
6	A Field	Serial No (BCD)	56h	56h	
7	A Field	Serial No (BCD) (= 12345678)	34h	34h	
8	A Field	Serial No MSB (BCD)	12h	12h	
9	A Field	Version (or Generation number)	33h	33h	
10	A Field	Device type (Medium=Gas)	03h	03h	

Table P.1 *(continued)*

SND_NR (wM-Bus)						
		wM-Bus frame	**Gas meter example**			
Byte No	**Field Name**	**Content**	**Bytes [hex] plain**	**Bytes [hex] AES coded**		
11	CRC 1		33h	33h		
12	CRC 1		63h	63h		
13	CI Field	7Ah means 4 bytes header	7Ah	7Ah		
14	Access No.	Transmission counter	2Ah	2Ah		
15	Status	State contents errors and alerts	00h	00h		
16	Configuration	NNNNCCRHb (2 encr. blocks)	00h	20h		
17	Configuration	BAS0MMMMb (unidir., AES)	00h	05h		
18	AES-Verify	Encryption verification	2Fh	59h		
19	AES-Verify	Encryption verification	2Fh	23h		
20	DR1	DIF (8 digit BCD)	0Ch	C9h		
21	DR1	VIF (Volume 0,01 m²)	14h	5Ah		
22	DR1	Value LSB	27h	AAh	AES-Encrypted Block 1	Application layer (APL)
23	DR1	Value	04h	26h		
24	DR1	Value (= 28504,27 m²)	85h	D1h		
25	DR1	Value MSB	02h	B2h		
26	DR2	DIF (Time at readout; Type F)	04h	E7h		
27	DR2	VIF (Date, Time)	6Dh	49h		
28	DR2	Value LSB	32h	3Bh		
29	CRC 2		16h	2Ah		
30	CRC 2		7Fh	8Bh	DLL	
31	DR2	Value	37h	01h		
32	DR2	Value (31.05.2008 23:50)	1Fh	3Eh		
33	DR2	Value MSB	15h	C4h		
34	DR3	DIF (2 byte integer)	02h	A6h		
35	DR3	VIF (VIF-Extension Table FD)	FDh	F6h		
36	DR3	VIFE (error flag)	17h	D3h		
37	DR3	Value LSB	00h	52h	AES-Encrypted Block 2	Application layer (APL)
38	DR3	Value MSB (= 0)	00h	9Bh		

Table P.1 *(continued)*

SND_NR (wM-Bus)					
		wM-Bus frame	**Gas meter example**		
Byte No	**Field Name**	**Content**	**Bytes [hex] plain**	**Bytes [hex] AES coded**	
39	Dummy	Fill Byte due to AES	2Fh	52h	
40	Dummy	Fill Byte due to AES	2Fh	0Eh	
41	Dummy	Fill Byte due to AES	2Fh	DFh	
42	Dummy	Fill Byte due to AES	2Fh	F0h	
43	Dummy	Fill Byte due to AES	2Fh	EAh	
44	Dummy	Fill Byte due to AES	2Fh	6Dh	
45	Dummy	Fill Byte due to AES	2Fh	EFh	
46	Dummy	Fill Byte due to AES	2Fh	C9h	
47	CRC 3		E1h	55h	DLL
48	CRC 3		B3h	B2h	
49	Dummy	Fill Byte due to AES	2Fh	9Dh	
50	Dummy	Fill Byte due to AES	2Fh	6Dh	
51	Dummy	Fill Byte due to AES	2Fh	69h	
52	Dummy	Fill Byte due to AES	2Fh	EBh	
53	Dummy	Fill Byte due to AES	2Fh	F3h	
54	CRC 4		25h	ECh	DLL
55	CRC 4		EEh	8Ah	

Table P.2 — RSP-UD - Gas meter (M-Bus)

RSP_UD (M-Bus)				
		M-Bus frame	**Gas meter example**	
Byte No	**Field name**	**Content**	**Bytes [hex] plain**	
1	Start	Start byte	68h	Linklayer (DLL)
2	L Field	Length of data (32 bytes)	20h	
3	L Field	Length of data (32 bytes)	20h	
4	Start	Start byte	68h	
5	C Field	Respond user data	08h	
6	A-Field	Secondary addressing mode	FDh	
7	CI Field	72h means 12 bytes header	72h	Application layer (APL)
8	Ident.Nr.	Serial No LSB (BCD)	78h	
9	Ident.Nr.	Serial No (BCD)	56h	
10	Ident.Nr.	Serial No (BCD) (=12345678)	34h	
11	Ident.Nr.	Serial No MSB (BCD)	12h	
12	Manufr	Manufacturer code	93h	
13	Manufr	Manufacturer code	15h	
14	Version	Version (or Generation number)	33h	
15	Device type	Device type (Medium=Gas)	03h	
16	Access No.	Transmission counter	2Ah	
17	Status	State contents errors and alerts	00h	
18	Configuration	no Encryption	00h	
19	Configuration	no Encryption	00h	
20	DR1	DIF (8 digit BCD)	0Ch	
21	DR1	VIF (Volume 0,01 m^3)	14h	
22	DR1	Value LSB	27h	
23	DR1	Value	04h	
24	DR1	Value (= 28504,27 m^3)	85h	
25	DR1	Value MSB	02h	
26	DR2	DIF (Time at readout; Type F)	04h	
27	DR2	VIF (Date, Time)	6Dh	
28	DR2	Value LSB	32h	
29	DR2	Value	37h	
30	DR2	Value (31.05.2008 23:50)	1Fh	
31	DR2	Value MSB	15h	

Table P.2 *(continued)*

		RSP_UD (M-Bus)		
		M-Bus frame	**Gas meter example**	
Byte No	**Field name**	**Content**	**Bytes [hex] plain**	
32	DR3	DIF (2 byte integer)	02h	
33	DR3	VIF (FD-Table)	FDh	
34	DR3	VIFE (error flag)	17h	
35	DR3	Value LSB	00h	
36	DR3	Value MSB (= 0)	00h	
37	Checksum		89h	DLL
38	Stop	Stop byte	16h	

P.2 Water meter

Water meter example

Medium	Water
Manufacturer	HYD
Serial number	92752244
Version	41
Main volume counter	2850427 l
Volume flow	127 l/h
Volume counter at set date	1445419 l
Set date	31.04.2007
Error code binary	0

AES key according to FIPS 197 (LSB first):
= Manu. spec. at least 8 bytes unique for each meter
= 82 B0 55 11 91 F5 1D 66 EF CD AB 89 67 45 23 01

AES CBC initial vector according to FIPS 197 (LSB first):
= M Field + A Field + 8 bytes Access No
= 24 23 44 22 75 92 29 07 1F 1F 1F 1F 1F 1F 1F 1F

Table P.3 — SND-NR - Water meter (wM-Bus)

SND_NR (wM-Bus)					
		wM-Bus frame	**Water meter example**		
Byte No	**Field name**	**Content**	**Bytes [hex] plain**	**Bytes [hex] AES coded**	
1	L Field	Length of data (46 bytes)	2Eh	2Eh	Linklayer (DLL)
2	C Field	44h in Normal mode	44h	44h	
3	M Field	Manufacturer code	24h	24h	
4	M Field	Manufacturer code	23h	23h	
5	A Field	Serial No LSB (BCD)	44h	44h	
6	A Field	Serial No (BCD)	22h	22h	
7	A Field	Serial No (BCD) (= 92752244)	75h	75h	
8	A Field	Serial No MSB (BCD)	92h	92h	
9	A Field	Version (or Generation number)	29h	29h	
10	A Field	Device type (Medium=Water)	07h	07h	
11	CRC 1		38h	38h	
12	CRC 1		D1h	D1h	
13	CI Field	7Ah means 4 bytes header	7Ah	7Ah	
14	Access No.	Transmission counter	1Fh	1Fh	
15	Status	State contents errors and alerts	00h	00h	

Table P.3 *(continued)*

		SND_NR (wM-Bus)			
		wM-Bus frame	**Water meter example**		
Byte No	**Field name**	**Content**	**Bytes [hex] plain**	**Bytes [hex] AES coded**	
16	Configuration	NNNNCCRHb (2 encr. blocks)	00h	20h	Application layer (APL)
17	Configuration	BAS0MMMMb (unidir., AES)	00h	05h	
18	AES-Verify	Encryption verification	2Fh	05h	AES-Encrypted Block 1
19	AES-Verify	Encryption verification	2Fh	9Bh	
20	DR1	DIF (8 digit BCD)	0Ch	4Dh	
21	DR1	VIF (Volume liter)	13h	12h	
22	DR1	Value LSB	27h	F7h	
23	DR1	Value (= 2850427)	04h	35h	
24	DR1	Value	85h	5Eh	
25	DR1	Value MSB	02h	4Dh	
26	DR2	DIF (6 digit BCD)	0Bh	F6h	
27	DR2	VIF (Volume flow l/h)	3Bh	DFh	
28	DR2	Value LSB	27h	4Ch	
29	CRC 2		15h	FFh	DLL
30	CRC 2		83h	36h	
31	DR2	Value (= 127)	01h	67h	
32	DR2	Value MSB	00h	BEh	
33	DR3	DIF (8 digit BCD, Storage No 1)	4Ch	FBh	
34	DR3	VIF (Volume liter)	13h	7Ah	
35	DR3	Value LSB	19h	54h	
36	DR3	Value (= 1445419)	54h	76h	AES-Encrypted Block 2
37	DR3	Value	44h	11h	
38	DR3	Value MSB	01h	2Fh	
39	DR4	DIF (Data type G, Storage No 1)	42h	F4h	
40	DR4	VIF (Date)	6Ch	48h	
41	DR4	Value LSB	FFh	BFh	
42	DR4	Value MSB (= 31.12.2007)	0Ch	98h	
43	DR5	DIF (2 byte integer)	02h	1Ah	
44	DR5	VIF (FD-Table)	FDh	F9h	
45	DR5	VIFE (error flag)	17h	06h	
46	DR5	Value LSB	00h	4Ch	
47	CRC 3		DAh	B7h	DLL
48	CRC 3		B5h	43h	

Table P.3 *(continued)*

		SND_NR (wM-Bus)				
		wM-Bus frame	**Water meter example**			
Byte No	**Field name**	**Content**	**Bytes [hex] plain**	**Bytes [hex] AES coded**		
49	DR5	Value MSB (= 0)	00h	0Ah		
50	Dummy	Fill Byte due to AES	2Fh	CDh		
51	Dummy	Fill Byte due to AES	2Fh	43h		
52	Dummy	Fill Byte due to AES	2Fh	A1h		
53	Dummy	Fill Byte due to AES	2Fh	97h		
54	CRC 4		BDh	CBh	DLL	
55	CRC 4		18h	FDh		

Table P.4 — RSP-UD - Water meter (M-Bus)

RSP_UD (M-Bus)				
		M-Bus frame	**Water meter example**	
Byte No	**Field name**	**Content**	**Bytes [hex] plain**	
1	Start	Start byte	68h	Linklayer (DLL)
2	L Field	Length of data (41 bytes)	29h	
3	L Field	Length of data (41 bytes)	29h	
4	Start	Start byte	68h	
5	C Field	Respond user data	08h	
6	A-Field	Secondary addressing mode	FDh	
7	CI Field	72h means 12 bytes header	72h	Application layer (APL)
8	Ident.Nr.	Serial No LSB (BCD)	44h	
9	Ident.Nr.	Serial No (BCD)	22h	
10	Ident.Nr.	Serial No (BCD) (=12345678)	75h	
11	Ident.Nr.	Serial No MSB (BCD)	92h	
12	Manufr	Manufacturer code	24h	
13	Manufr	Manufacturer code	23h	
14	Version	Version (or Generation number)	29h	
15	Device type	Device type (Medium=Water)	07h	
16	Access No.	Transmission counter	1Fh	
17	Status	State contents errors and alerts	00h	
18	Configuration	no Encryption	00h	
19	Configuration	no Encryption	00h	
20	DR1	DIF (8 digit BCD)	0Ch	
21	DR1	VIF (Volume liter)	13h	
22	DR1	Value LSB	27h	
23	DR1	Value (= 2850427)	04h	
24	DR1	Value	85h	
25	DR1	Value MSB	02h	
26	DR2	DIF (6 digit BCD)	0Bh	
27	DR2	VIF (Volume flow l/h)	3Bh	
28	DR2	Value LSB	27h	
29	DR2	Value (= 127)	01h	
30	DR2	Value MSB	00h	

Table P.4 *(continued)*

RSP_UD (M-Bus)				
		M-Bus frame	Water meter example	
Byte No	Field name	Content	Bytes [hex] plain	
31	DR3	DIF (8 digit BCD, Storage No 1)	4Ch	
32	DR3	VIF (Volume liter)	13h	
33	DR3	Value LSB	19h	
34	DR3	Value (= 1445419)	54h	
35	DR3	Value	44h	
36	DR3	Value MSB	01h	
37	DR4	DIF (Data type G, Storage No 1)	42h	
38	DR4	VIF (Date)	6Ch	
39	DR4	Value LSB	FFh	
40	DR4	Value MSB (= 31.12.2007)	0Ch	
41	DR5	DIF (2 byte integer)	02h	
42	DR5	VIF (FD-Table)	FDh	
43	DR5	VIFE (error flag)	17h	
44	DR5	Value LSB	00h	
45	DR5	Value MSB (= 0)	00h	
46	Checksum		99h	DLL
47	Stop	Stop byte	16h	

P.3 Heat meter

Heat meter example

Medium	Heat (outlet)
Manufacturer	HYD
Serial number	12345678
Version	42
Main energy counter	2850427 kWh
Main volume counter	703476 l
Energy counter at set date	1445419 kWh
Set date	31.12.2007
Volume flow	127 l/h
Power	329,7 W
Flow temperature	44,3 °C
Return temperature	25,1 °C
Error code binary	0

AES key according to FIPS 197 (LSB first):
= Manu. spec. at least 8 bytes unique for each meter
= D3 51 D9 0E 58 C8 E8 C8 EF CD AB 89 67 45 23 01

AES CBC initial vector according to FIPS 197 (LSB first):
= M Field + A Field + 8 bytes Access No
= 24 23 78 56 34 12 2A 04 26 26 26 26 26 26 26 26

Table P.5 — SND-NR - Heat meter (wM-Bus)

SND_NR (wM-Bus)					
		wM-Bus frame	**Heat meter example**		
Byte No	**Field name**	**Content**	**Bytes [hex] plain**	**Bytes [hex] AES coded**	
1	L Field	Length of data (62 bytes)	3Eh	3Eh	Linklayer (DLL)
2	C Field	44h in Normal mode	44h	44h	
3	M Field	Manufacturer code	24h	24h	
4	M Field	Manufacturer code	23h	23h	
5	A Field	Serial No LSB (BCD)	78h	78h	
6	A Field	Serial No (BCD)	56h	56h	
7	A Field	Serial No (BCD) (=12345678)	34h	34h	
8	A Field	Serial No MSB (BCD)	12h	12h	
9	A Field	Version (or Generation number)	2Ah	2Ah	
10	A Field	Device type (Medium=Heat_outlet)	04h	04h	

Table P.5 *(continued)*

SND_NR (wM-Bus)						
		wM-Bus frame	**Heat meter example**			
Byte No	**Field name**	**Content**	**Bytes [hex] plain**	**Bytes [hex] AES coded**		
11	CRC 1		9Dh	9Dh		
12	CRC 1		CCh	CCh		
13	CI Field	7Ah means 4 bytes header	7Ah	7Ah		
14	Access No.	Transmission counter	26h	26h		
15	Status	State contents errors and alerts	00h	00h		
16	Configuration	NNNNCCRHb (3 encr. blocks)	00h	30h		
17	Configuration	BAS0MMMMb (unidir., AES)	00h	05h		
18	AES-Verify	Encryption verification	2Fh	92h		
19	AES-Verify	Encryption verification	2Fh	A9h		
20	DR1	DIF (8 digit BCD)	0Ch	7Fh		
21	DR1	VIF (Energy kWh)	06h	11h		
22	DR1	Value LSB	27h	B4h	AES-Encrypted Block 1	
23	DR1	Value (= 2850427)	04h	7Ah		
24	DR1	Value	85h	E8h		
25	DR1	Value MSB	02h	5Eh		
26	DR2	DIF (8 digit BCD)	0Ch	72h		
27	DR2	VIF (Volume liter)	13h	B2h		
28	DR2	Value LSB	76h	01h		
29	CRC 2		6Bh	FAh		
30	CRC 2		35h	91h	DLL	
31	DR2	Value (= 703476)	34h	C6h		
32	DR2	Value	70h	AAh		
33	DR2	Value MSB	00h	64h		
34	DR3	DIF (8 digit BCD, Storage No 1)	4Ch	43h		
35	DR3	VIF (Energy kWh)	06h	82h		
36	DR3	Value LSB	19h	8Bh		
37	DR3	Value (= 1445419)	54h	E7h		
38	DR3	Value	44h	1Bh		
39	DR3	Value MSB	01h	B9h	AES-Encrypted Block 2	Application layer (APL)
40	DR4	DIF (Data type G, Storage No 1)	42h	ECh		
41	DR4	VIF (Date)	6Ch	F1h		
42	DR4	Value LSB	FFh	BAh		
43	DR4	Value MSB (= 31.12.2007)	0Ch	E8h		

Table P.5 *(continued)*

SND_NR (wM-Bus)					
		wM-Bus frame	**Heat meter example**		
Byte No	**Field name**	**Content**	**Bytes [hex] plain**	**Bytes [hex] AES coded**	
44	DR5	DIF (6 digit BCD)	0Bh	A0h	
45	DR5	VIF (Volume flow l/h)	3Bh	74h	
46	DR5	Value LSB	27h	E9h	
47	CRC 3		19h	E1h	DLL
48	CRC 3		04h	29h	
49	DR5	Value (= 127)	01h	86h	
50	DR5	Value MSB	00h	Abh	
51	DR6	DIF (6 digit BCD)	0Bh	FAh	
52	DR6	VIF (Power 100 mW)	2Ah	44h	
53	DR6	Value LSB	97h	8Dh	
54	DR6	Value (= 3297)	32h	DAh	AES-Encrypted Block 3
55	DR6	Value MSB	00h	BCh	
56	DR7	DIF (4 digit BCD)	0Ah	ECh	
57	DR7	VIF (Flow Temp. 100 m °C)	5Ah	F6h	
58	DR7	Value LSB	43h	17h	
59	DR7	Value MSB (= 443)	04h	50h	
60	DR8	DIF (4 digit BCD)	0Ah	05h	
61	DR8	VIF (Return Temp. 100 m °C)	5Eh	59h	
62	DR8	Value LSB	51h	22h	
63	DR8	Value MSB (= 251)	02h	85h	
64	DR9	DIF (2 byte integer)	02h	2Eh	
65	CRC 4		7Dh	0Eh	DLL
66	CRC 4		68h	CDh	
67	DR9	VIF (FD-Table)	FDh	93h	
68	DR9	VIFE (error flag)	17h	B9h	
69	DR9	Value LSB	00h	B2h	
70	DR9	Value MSB (= 0)	00h	ABh	
71	Dummy	Fill Byte due to AES	2Fh	76h	
72	CRC 5		D7h	51h	DLL
73	CRC 5		DBh	A6h	

Table P.6 — RSP-UD - Heat meter (M-Bus)

RSP_UD (M-Bus)				
		M-Bus frame	**Heat meter example**	
Byte No	**Field name**	**Content**	**Bytes [hex] plain**	
1	Start	Start byte	68h	Linklayer (DLL)
2	L Field	Length of data (60 bytes)	3Ch	
3	L Field	Length of data (60 bytes)	3Ch	
4	Start	Start byte	68h	
5	C Field	Respond user data	08h	
6	A-Field	Secondary addressing mode	FDh	
7	CI Field	72h means 12 bytes header	72h	Application layer (APL)
8	Ident.Nr.	Serial No LSB (BCD)	78h	
9	Ident.Nr.	Serial No (BCD)	56h	
10	Ident.Nr.	Serial No (BCD) (=12345678)	34h	
11	Ident.Nr.	Serial No MSB (BCD)	12h	
12	Manufr	Manufacturer code	24h	
13	Manufr	Manufacturer code	23h	
14	Version	Version (or Generation number)	2Ah	
15	Device type	Device type (Medium=Heat_outlet)	04h	
16	Access No.	Transmission counter	26h	
17	Status	State contents errors and alerts	00h	
18	Configuration	no Encryption	00h	
19	Configuration	no Encryption	00h	
20	DR1	DIF (8 digit BCD)	0Ch	
21	DR1	VIF (Energy kWh)	06h	
22	DR1	Value LSB	27h	
23	DR1	Value (= 2850427)	04h	
24	DR1	Value	85h	
25	DR1	Value MSB	02h	
26	DR2	DIF (8 digit BCD)	0Ch	
27	DR2	VIF (Volume liter)	13h	
28	DR2	Value LSB	76h	
29	DR2	Value (= 703476)	34h	
30	DR2	Value	70h	
31	DR2	Value MSB	00h	

Table P.6 *(continued)*

RSP_UD (M-Bus)				
		M-Bus frame	**Heat meter example**	
Byte No	**Field name**	**Content**	**Bytes [hex] plain**	
32	DR3	DIF (8 digit BCD, Storage No 1)	4Ch	Application layer (APL)
33	DR3	VIF (Energy kWh)	06h	
34	DR3	Value LSB	19h	
35	DR3	Value (= 1445419)	54h	
36	DR3	Value	44h	
37	DR3	Value MSB	01h	
38	DR4	DIF (Data type G, Storage No 1)	42h	
39	DR4	VIF (Date)	6Ch	
40	DR4	Value LSB	FFh	
41	DR4	Value MSB (= 31.12.2007)	0Ch	
42	DR5	DIF (6 digit BCD)	0Bh	
43	DR5	VIF (Volume flow l/h)	3Bh	
44	DR5	Value LSB	27h	
45	DR5	Value (= 127)	01h	
46	DR5	Value MSB	00h	
47	DR6	DIF (6 digit BCD)	0Bh	
48	DR6	VIF (Power 100 mW)	2Ah	
49	DR6	Value LSB	97h	
50	DR6	Value (= 3297)	32h	
51	DR6	Value MSB	00h	
52	DR7	DIF (4 digit BCD)	0Ah	
53	DR7	VIF (Flow Temp. 100 m °C)	5Ah	
54	DR7	Value LSB	43h	
55	DR7	Value MSB (= 443)	04h	
56	DR8	DIF (4 digit BCD)	0Ah	
57	DR8	VIF (Return Temp. 100 m °C)	5Eh	
58	DR8	Value LSB	51h	
59	DR8	Value MSB (= 251)	02h	
60	DR9	DIF (2 byte integer)	02h	
61	DR9	VIF (FD-Table)	FDh	
62	DR9	VIFE (error flag)	17h	
63	DR9	Value LSB	00h	
64	DR9	Value MSB (= 0)	00h	
65	Checksum		C8h	DLL
66	Stop	Stop byte	16h	

P.4 Heat cost allocator

Example for heat cost allocator with RF-Adapter

Medium	Heat cost allocation
Manufacturer	QDS
Serial number of radio module	11223344
Serial number of meter (HCA)	55667788
Version	85
Status (Low power/battery low)	4
Current consumption value	1234 HCA units
Set date	30.04.2007
Consumption at set date	23456 HCA units
Current temperature at sensor	25 °C

AES key according to FIPS 197 (LSB first):
= Manu. spec. at least 8 bytes unique for each meter
= 00 01 02 03 04 05 06 07 08 09 0A 0B 0C 0D 0E 0F

AES CBC initial vector according to FIPS 197 (LSB first):
= M Field + A Field + 8 bytes Access No
= 93 44 88 77 66 55 55 08 00 00 00 00 00 00 00 00

Table P.7 — SND-NR - H.C.A. (wM-Bus)

SND_NR (wM-Bus)					
		wM-Bus frame	**Heat cost allocator example**		
Byte No	**Field name**	**Content**	**Bytes [hex] plain**	**Bytes [hex] AES coded**	
1	L Field	Length of data (46 bytes)	29h	29h	Linklayer (DLL)
2	C Field	44h in Normal mode	44h	44h	
3	M Field	Manufacturer code	93h	93h	
4	M Field	Manufacturer code	44h	44h	
5	A Field	Serial No LSB (BCD)	44h	44h	
6	A Field	Serial No (BCD)	33h	33h	
7	A Field	Serial No (BCD) (= 11223344)	22h	22h	
8	A Field	Serial No MSB (BCD)	11h	11h	
9	A Field	Version (or Generation number)	55h	55h	
10	A Field	Device type (Medium=HCA)	08h	08h	
11	CRC 1		6Ch	6Ch	
12	CRC 1		B1h	B1h	

Table P.7 *(continued)*

SND_NR (wM-Bus)						
		wM-Bus frame	**Heat cost allocator example**			
Byte No	**Field name**	**Content**	**Bytes [hex] plain**	**Bytes [hex] AES coded**		
13	CI Field	72h means 12 bytes header	72h	72h	Application layer (APL)	
14	Meter-ID	Serial No LSB (BCD)	88h	88h		
15	Meter-ID	Serial No (BCD)	77h	77h		
16	Meter-ID	Serial No (BCD) (= 55667788)	66h	66h		
17	Meter-ID	Serial No MSB (BCD)	55h	55h		
18	Meter-Man.	Meter Manufacturer code	93h	93h		
19	Meter-Man.	Meter Manufacturer code	44h	44h		
20	Meter-Vers.	Version (or Generation number)	55h	55h		
21	Meter-Med.	Device type (Medium=HCA)	08h	08h		
22	Access No.	Transmission counter	00h	00h		
23	Status	State contents errors and alerts	04h	04h		
24	Configuration	NNNNCCRHb (1 encr. block)	00h	10h		
25	Configuration	BASOMMMMb (unidir., AES)	00h	05h		
26	AES-Verify	Encryption verification	2Fh	00h		
27	AES-Verify	Encryption verification	2Fh	DFh		
28	DR1	DIF (6 digit BCD)	0Bh	E2h		
29	CRC 2		25h	27h	DLL	
30	CRC 2		CCh	F9h		
31	DR1	VIF (HCA-units)	6Eh	A7h	AES-Encrypted Block 1	Application layer (APL)
32	DR1	Value LSB	34h	82h		
33	DR1	Value (= 001234 HCA-Units)	12h	14h		
34	DR1	Value MSB	00h	6Dh		
35	DR2	DIF (Data type G, Storage No 1)	42h	15h		
36	DR2	VIF (Date)	6Ch	13h		
37	DR2	Value LSB	FEh	58h		
38	DR2	Value MSB (= 30.04.2007)	04h	1Ch		
39	DR3	DIF (6 digit BCD, Storage No 1)	4Bh	D2h		
40	DR3	VIF (HCA-units)	6Eh	F8h		
41	DR3	Value LSB	56h	3Fh		
42	DR3	Value (= 023456 HCA-Units)	34h	39h		
43	DR3	Value MSB	02h	04h		
44	DR4	DIF (1 byte integer)	01h	01h	Plain	
45	DR4	VIF (Temperature at heating)	5Bh	5Bh		
46	DR4	Value (= 25 Grad Celsius)	19h	19h		

Table P.7 *(continued)*

SND_NR (wM-Bus)					
		wM-Bus frame	**Heat cost allocator example**		
Byte No	**Field name**	**Content**	**Bytes [hex] plain**	**Bytes [hex] AES coded**	
47	CRC 3		11h	61h	DLL
48	CRC 3		9Ah	09h	

Table P.8 — RSP-UD - H.C.A. (M-Bus)

RSP_UD (M-Bus with Encryption)					
		M-Bus frame	**HCA example**		
Byte No	**Field name**	**Content**	**Bytes [hex] plain**	**Bytes [hex] AES coded**	
1	Start	Start byte	68h	68h	Linklayer (DLL)
2	L Field	Length of data (32 bytes)	22h	22h	
3	L Field	Length of data (32 bytes)	22h	22h	
4	Start	Start byte	68h	68h	
5	C Field	Respond user data	08h	08h	
6	A-Field	Secondary addressing mode	FDh	FDh	
7	CI Field	72h means 12 bytes header	72h	72h	Application layer (APL)
8	Ident.Nr.	Serial No LSB (BCD)	88h	88h	
9	Ident.Nr.	Serial No (BCD)	77h	77h	
10	Ident.Nr.	Serial No (BCD) (=12345678)	66h	66h	
11	Ident.Nr.	Serial No MSB (BCD)	55h	55h	
12	Manufr	Manufacturer code	93h	93h	
13	Manufr	Manufacturer code	44h	44h	
14	Version	Version (or Generation number)	55h	55h	
15	Device type	Device type (Medium=HCA)	08h	08h	
16	Access No.	Transmission counter	00h	00h	
17	Status	State contents errors and alerts	04h	04h	
18	Configuration	NNNNCCRHb (1 encr. block)	00h	10h	
19	Configuration	BAS0MMMMb (AES)	00h	05h	
20	AES-Verify	Encryption verification	2Fh	00h	AES-Encrypted Block 1
21	AES-Verify	Encryption verification	2Fh	DFh	
22	DR1	DIF (6 digit BCD)	0Bh	E2h	
23	DR1	VIF (HCA-units)	6Eh	A7h	
24	DR1	Value LSB	34h	82h	
25	DR1	Value (= 001234 HCA-Units)	12h	14h	
26	DR1	Value MSB	00h	6Dh	
27	DR2	DIF (Data type G, Storage No 1)	42h	15h	
28	DR2	VIF (Date)	6Ch	13h	
29	DR2	Value LSB	FEh	58h	
30	DR2	Value MSB (= 30.04.2007)	04h	1Ch	

Table P.8 *(continued)*

RSP_UD (M-Bus with Encryption)					
		M-Bus frame	**HCA example**		
Byte No	**Field name**	**Content**	**Bytes [hex] plain**	**Bytes [hex] AES coded**	
31	DR3	DIF (6 digit BCD, Storage No 1)	4Bh	D2h	
32	DR3	VIF (HCA-units)	6Eh	F8h	
33	DR3	Value LSB	56h	3Fh	
34	DR3	Value (= 023456 HCA-Units)	34h	39h	
35	DR3	Value MSB	02h	04h	
36	DR4	DIF (1 byte integer)	01h	01h	Plain
37	DR4	VIF (Temperature at heating)	5Bh	5Bh	
38	DR4	Value (= 25 Grad Celsius)	19h	19h	
39	Checksum		F0h	40h	DLL
40	Stop	Stop byte	16h	16h	

P.5 Installation procedure with a special installation message

Example for COM controller

Medium	System
Manufacturer	OMS
Serial number	33445566
Version	10 (e.g. V 1.0)

Gas meter example

Medium	Gas
Manufacturer	ELS
Serial number	12345678
Version	51 (e.g. V 5.1)
Model/Version	BKG4
Hardware version	15 (e.g. V 1.5)
Metrology Firmware version	11 (e.g. V 1.1)
Other software version	10 (e.g. V 1.0)
Metering Point ID	DE 123456 49074 00000000000012345678

AES key according to FIPS 197 (LSB first):

= Manu. spec. at least 8 bytes unique for each meter
= 01 02 03 04 05 06 07 08 09 0A 0B 0C 0D 0E 0F 11

AES CBC initial vector according to FIPS 197 (LSB first):

= M Field + A Field + 8 bytes Access No
= 93 15 78 56 34 12 33 03 01 01 01 01 01 01 01 01

Table P.9 — SND-IR (wM-Bus)

SND-IR (wM-Bus - short address)					
		wM-Bus frame	**Gas meter -> COM**		
Byte No	**Field name**	**Content**	**Bytes [hex] plain**	**Bytes [hex] AES coded**	
1	L Field	Length of data (78 bytes)	4Eh	4Eh	Linklayer (DLL)
2	C Field	46h in Installation Mode	46h	46h	
3	M Field	Manufacturer code	93h	93h	
4	M Field	Manufacturer code	15h	15h	
5	A Field	Serial No LSB (BCD)	78h	78h	
6	A Field	Serial No (BCD)	56h	56h	
7	A Field	Serial No (BCD) (=12345678)	34h	34h	
8	A Field	Serial No MSB (BCD)	12h	12h	
9	A Field	Version (or Generation number)	33h	33h	
10	A Field	Device type (Medium=Gas)	03h	03h	

Table P.9 *(continued)*

SND-IR (wM-Bus - short address)					
		wM-Bus frame	Gas meter -> COM		
Byte No	**Field name**	**Content**	**Bytes [hex] plain**	**Bytes [hex] AES coded**	
11	CRC 1		52h	53h	
12	CRC 1		2Eh	2Eh	
13	CI Field	7Ah means 4 bytes header	7Ah	7Ah	Application layer (APL)
14	Access No.	Transmission counter	01h	01h	
15	Status	State contents errors and alerts	00h	00h	
16	Configuration	NNNNCCRHb (3 encr. blocks, static tlg.)	08h	38h	
17	Configuration	BASOMMMMb (bidir., RX off, AES)	80h	85h	
18	AES-Verify	Encryption verification	2Fh	C8h	AES-Encrypted Block 1
19	AES-Verify	Encryption verification	2Fh	51h	
20	DR1	DIF (Variable length)	0Dh	9Ch	
21	DR1	VIF (Extension)	FDh	92h	
22	DR1	VIFE (Version)	0Ch	ABh	
23	DR1	LVAR (= 4 byte text string)	04h	D2h	
24	DR1	Value (LSB)	34h	F3h	
25	DR1	Value (= BKG4)	47h	B2h	
26	DR1	Value	4Bh	DFh	
27	DR1	Value (MSB)	42h	1Fh	
28	DR2	DIF (16-bit Integer/Binary)	02h	63h	
29	CRC 2		40h	01h	DLL
30	CRC 2		41h	38h	
31	DR2	VIF (Extension)	FDh	87h	
32	DR2	VIFE (Hardware version)	0Dh	30h	
33	DR2	Value LSB (=1.5)	05h	2Ch	
34	DR2	Value MSB	01h	5Ah	
35	DR3	DIF (16-bit Integer/Binary)	02h	23h	
36	DR3	VIF (Extension)	FDh	A7h	AES-Encrypted Block 2
37	DR3	VIFE (Metrology Firmware version)	0Eh	6Ah	
38	DR3	Value LSB (= 1.1)	01h	1Fh	
39	DR3	Value MSB	01h	96h	
40	DR4	DIF (16-bit Integer/Binary)	02h	29h	
41	DR4	VIF (Extension)	FDh	CBh	
42	DR4	VIFE (Other firmware version)	0Fh	65h	
43	DR4	Value LSB (= 1.0)	00h	64h	
44	DR4	Value MSB	01h	8Ah	

Table P.9 *(continued)*

SND-IR (wM-Bus - short address)					
		wM-Bus frame	**Gas meter -> COM**		
Byte No	**Field name**	**Content**	**Bytes [hex] plain**	**Bytes [hex] AES coded**	
45	DR5	DIF (Variable length)	0Dh	3Eh	
46	DR5	VIF (Extension)	FDh	A5h	
47	CRC 3		0Dh	B1h	DLL
48	CRC 3		BEh	9Bh	
49	DR5	VIFE (customer location)	10h	A9h	AES-Encrypted Block 3
50	DR5	LVAR (=33 byte text string)	21h	31h	
51	DR5	Value LSB	38h	54h	
52	DR5	Value (= 000000000000012345678)	37h	3Eh	
53	DR5	Value	36h	9Eh	
54	DR5	Value	35h	C8h	
55	DR5	Value	34h	4Dh	
56	DR5	Value	33h	37h	
57	DR5	Value	32h	6Eh	
58	DR5	Value	31h	80h	
59	DR5	Value	30h	9Ch	
60	DR5	Value	30h	C6h	
61	DR5	Value	30h	CEh	
62	DR5	Value	30h	C7h	
63	DR5	Value	30h	3Ch	
64	DR5	Value	30h	B9h	
65	CRC 4		02h	ECh	DLL
66	CRC 4		34h	B1h	

Table P.9 *(continued)*

SND-IR (wM-Bus - short address)						
		wM-Bus frame	**Gas meter -> COM**			
Byte No	**Field name**	**Content**	**Bytes [hex] plain**	**Bytes [hex] AES coded**		
67	DR5	Value	30h	91h		Application layer (APL)
68	DR5	Value	30h	68h		
69	DR5	Value	30h	4Eh		
70	DR5	Value	30h	B3h		
71	DR5	Value	30h	B3h		
72	DR5	Value	30h	21h	AES-Encrypted Block 4	
73	DR5	Value (= 49074)	34h	BFh		
74	DR5	Value	37h	39h		
75	DR5	Value	30h	FBh		
76	DR5	Value	39h	F6h		
77	DR5	Value	34h	7Eh		
78	DR5	Value (= 123456)	36h	64h		
79	DR5	Value	35h	4Fh		
80	DR5	Value	34h	4Fh		
81	DR5	Value	33h	EAh		
82	DR5	Value	32h	A0h		
83	CRC 5		1Dh	3Ah	DLL	
84	CRC 5		01h	2Eh		
85	DR5	Value	31h	EFh		
86	DR5	Value (= DE)	45h	AAh		
87	DR5	Value MSB	44h	D8h		
88	Dummy	Fill Byte due to AES	2Fh	58h		
89	Dummy	Fill Byte due to AES	2Fh	12h		
90	CRC 6		4Fh	98h	DLL	
91	CRC 6		F2h	3Eh		

Table P.10 — CNF-IR (wM-Bus)

CNF-IR (wM-Bus)					
		wM-Bus frame	**COM -> Gas meter**		
Byte No	**Field name**	**Content**	**Bytes [hex] plain**	**Bytes [hex] AES coded**	
1	L Field	Length of data (22 bytes)	16h	16h	Linklayer (DLL)
2	C Field	06h in Installation Mode	06h	06h	
3	M Field	Manufacturer code	B3h	B3h	
4	M Field	Manufacturer code	3Dh	3Dh	
5	A Field	Serial No LSB (BCD)	66h	66h	
6	A Field	Serial No (BCD)	55h	55h	
7	A Field	Serial No (BCD) (=33445566)	44h	44h	
8	A Field	Serial No MSB (BCD)	33h	33h	
9	A Field	Version (or Generation number)	0Ah	0Ah	
10	A Field	Device type (Medium=Communication Controller)	31h	31h	
11	CRC 1		9Dh	9Dh	
12	CRC 1		AEh	AEh	
13	CI Field	80h means 12 byte header	80h	80h	Application layer (APL)
14	Ident.Nr.	Serial No LSB (BCD)	78h	78h	
15	Ident.Nr.	Serial No (BCD)	56h	56h	
16	Ident.Nr.	Serial No (BCD) (=12345678)	34h	34h	
17	Ident.Nr.	Serial No MSB (BCD)	12h	12h	
18	Manufr	Manufacturer code	93h	93h	
19	Manufr	Manufacturer code	15h	15h	
20	Version	Version (or Generation number)	33h	33h	
21	Device type	Device type (Medium=Gas)	03h	03h	
22	Access No.	Transmission counter	01h	01h	
23	Status	Cont. recept. level (-80dBm)	19h	19h	
24	Configuration	NNNNCCRHb	00h	00h	
25	Configuration	BAS0MMMMb (bidir., RX on, no encr.)	C0h	C0h	
26	CRC 2		14h	14h	DLL
27	CRC 2		97h	97h	

P.6 Send a command with an acknowledge

A SND-UD is applied to transport a command to a meter. When C-field 53h or 73h is applied, the meter will acknowledge a successful reception of the command. The bit “application error” in the status byte of the meter acknowledge indicates that an application error has happened during command execution.

Example for COM controller

Medium/device type	COM controller
Manufacturer	HYD
Serial number	90123456
Version	8

Water meter with RF adapter example

Medium/device type	Water
Manufacturer	HYD
Serial number water meter	92752244
Serial number RF adapter	43886102
Version	41

AES key according to FIPS 197 (LSB first):
= Manu. spec. at least 8 bytes unique for each meter
= 82 B0 55 11 91 F5 1D 66 EF CD AB 89 67 45 23 01

AES CBC initial vector according to FIPS 197 (LSB first):
= M Field + A Field + 8 bytes Access No
= 24 23 44 22 75 92 29 07 7D 7D 7D 7D 7D 7D 7D 7D

Table P.11 — SND-UD (wM-Bus)

SND-UD; Correction of time (wM-Bus)					
		wM-Bus frame	**COM-> water meter**		
Byte No	**Field name**	**Content**	**Bytes [hex] plain**	**Bytes [hex] AES coded**	
1	L Field	Length of data (38 bytes)	26h	26h	Linklayer (DLL)
2	C Field	Send user data	53h	53h	
3	M Field	Manufacturer code	24h	24h	
4	M Field	Manufacturer code	23h	23h	
5	A Field	Serial No LSB (BCD)	56h	56h	
6	A Field	Serial No (BCD)	34h	34h	
7	A Field	Serial No (BCD)	12h	12h	
8	A Field	Serial No MSB (BCD) of COM controller	90h	90h	
9	A Field	Version (or Generation number)	08h	08h	
10	A Field	Device type (COM controller)	31h	31h	
11	CRC 1		CBh	CBh	
12	CRC 1		8Eh	8Eh	

Table P.11 *(continued)*

SND-UD; Correction of time (wM-Bus)					
		wM-Bus frame	COM-> water meter		
Byte No	**Field name**	**Content**	**Bytes [hex] plain**	**Bytes [hex] AES coded**	
13	CI Field	Special CI to add/subtract time offset	6Dh	6Dh	Application Layer
14	Ident.Nr.	Serial No LSB (BCD)	44h	44h	
15	Ident.Nr.	Serial No (BCD)	22h	22h	
16	Ident.Nr.	Serial No (BCD)	75h	75h	
17	Ident.Nr.	Serial No MSB (BCD) of meter	92h	92h	
18	Manufr	Manufacturer code	24h	24h	
19	Manufr	Manufacturer code	23h	23h	
20	Version	Version (or Generation number)	29h	29h	
21	Device type	Device type (Medium = Water)	07h	07h	
22	Access No.	Transmission counter	7Dh	7Dh	
23	Status	State (no RSSI level available)	00h	00h	
24	Configuration	NNNNCCRHb (1 encr. block)	00h	10h	
25	Configuration	BAS0MMMMb (bidir., RX on, AES)	C0h	05h	
26	AES-Verify	Encryption verification	2Fh	3Ah	
27	AES-Verify	Encryption verification	2Fh	97h	
28	TC-Field	Add time difference	01h	31h	
29	CRC 2		77h	14h	DLL
30	CRC 2		61h	25h	
31	Time	Value format J, LSB	32h	FBh	AES Encrypted Block 1
32	Time	Value (add 1 minute, 50 seconds)	01h	F4h	
33	Time	Value MSB	00h	34h	
34	Reserved	Reserved, set to 0	00h	68h	
35	Reserved	Reserved, set to 0	00h	1Ch	
36	Reserved	Reserved, set to 0	00h	41h	
37	Reserved	Reserved, set to 0	00h	54h	
38	Reserved	Reserved, set to 0	00h	78h	
39	Reserved	Reserved, set to 0	00h	FBh	
40	CMD-Verify	Command verification	2Fh	EAh	
41	CMD-Verify	Command verification	2Fh	0Bh	
42	CMD-Verify	Command verification	2Fh	C6h	
43	CMD-Verify	Command verification	2Fh	6Eh	
44	CRC 3		79h	A0h	DLL
45	CRC 3		F1h	27h	

Table P.12 — ACK long (wM-Bus)

ACK (wM-Bus - long Address)					
		wM-Bus frame	**water meter ->COM**		
Byte No	**Field name**	**Content**	**Bytes [hex] plain**	**Bytes [hex] AES coded**	
1	L Field	Length of data (22 bytes)	16h	16h	Linklayer (DLL)
2	C Field	Acknowledge	00h	00h	
3	M Field	Manufacturer code	24h	24h	
4	M Field	Manufacturer code	23h	23h	
5	A Field	Serial No LSB (BCD)	02h	02h	
6	A Field	Serial No (BCD)	61h	61h	
7	A Field	Serial No (BCD)	88h	88h	
8	A Field	Serial No MSB (BCD) of RF-Adapter	43h	43h	
9	A Field	Version (or Generation number)	29h	29h	
10	A Field	Device type (Medium=Water)	07h	07h	
11	CRC 1		34h	34h	
12	CRC 1		87h	87h	
13	CI Field	8Bh means 12 byte header	8Bh	8Bh	Application layer (APL)
14	Ident.Nr.	Serial No LSB (BCD)	44h	44h	
15	Ident.Nr.	Serial No (BCD)	22h	22h	
16	Ident.Nr.	Serial No (BCD)	75h	75h	
17	Ident.Nr.	Serial No MSB (BCD) of meter	92h	92h	
18	Manufr	Manufacturer code	24h	24h	
19	Manufr	Manufacturer code	23h	23h	
20	Version	Version (or Generation number)	29h	29h	
21	Device type	Device type (Medium=Water)	07h	07h	
22	Access No.	Transmission counter	7Dh	7Dh	
23	Status	State contents errors and alerts	00h	00h	
24	Configuration	NNNNCCRHb	00h	00h	
25	Configuration	BAS0MMMMb (bidir, RX off)	80h	80h	
26	CRC 2		EFh	EFh	DLL
27	CRC 2		D5h	D5h	

P.7 Request of the selected data

A REQ_UD2 is used either to request the standard meter consumption data or to read responses of a command or prove successful execution of a command. After a command, the RSP_UD may consist of either the expected answer to that command (e.g. “get valve state”) or the standard answer if the command “set new key” was applied, or an “application error” if the execution of the command was not successful (e.g. using the wrong encryption key for this meter). An application error will be indicated in the status byte of the meter’s acknowledge datagram.

Example for COM controller

Medium	COM controller
Manufacturer	TCH
Serial number	66778899
Version	12
Status (no error)	0
Meter-RSSI	-84 dBm

Example for heat cost allocator

Medium	Heat Cost Allocatior
Manufacturer	TCH
Serial number	12345678
Version	143
Status (no error)	0
Current cunsumption value	12345 HCA units
Due date	31.12.2009
Consumption at due date	23456 HCA units

AES key according to FIPS 197 (LSB first):
= Manu. spec. at least 8 bytes unique for each meter
= 00 01 02 03 04 05 06 07 08 09 0A 0B 0C 0D 0E 0F

AES CBC initial vector according to FIPS 197 (LSB first):
= M Field + A Field + 8 bytes Access No
= 68 50 78 56 34 12 8F 08 02 02 02 02 02 02 02 02

Table P.13 — REQ-UD2 (wM-Bus)

REQ_UD2 (wM-Bus)					
		wM-Bus frame	**COM> HCA**		
Byte No	**Field name**	**Content**	**Bytes [hex] plain**	**Bytes [hex] AES coded**	
1	L Field	Length of data (22 bytes)	16h	16h	Linklayer (DLL)
2	C Field	Request user data class 2 (5Bh or 7Bh)	5Bh	5Bh	
3	M Field	Manufacturer code	68h	68h	
4	M Field	Manufacturer code	50h	50h	
5	A Field	Serial No LSB (BCD)	99h	99h	
6	A Field	Serial No (BCD)	88h	88h	
7	A Field	Serial No (BCD) (=66778899)	77h	77h	
8	A Field	Serial No MSB (BCD) of COM controller	66h	66h	
9	A Field	Version (or Generation number)	0Ch	0Ch	
10	A Field	Device type (Medium=COM controller)	31h	31h	
11	CRC 1		29h	29h	
12	CRC 1		80h	80h	
13	CI Field	COM-> Meter	80h	80h	Application layer (APL)
14	Ident.Nr.	Meter-ID	78h	78h	
15	Ident.Nr.	Meter-ID	56h	56h	
16	Ident.Nr.	Meter-ID	34h	34h	
17	Ident.Nr.	Meter-ID	12h	12h	
18	Manufr	Meter-Manufacturer-ID	68h	68h	
19	Manufr	Meter-Manufacturer-ID	50h	50h	
20	Version	Meter-Version	8Fh	8Fh	
21	Device type	Meter-Device-Type	08h	08h	
22	Access No.	Transmission counter	02h	02h	
23	Status	State (RSSI level -84dBm)	17h	17h	
24	Configuration	NNNNCCRHb	00h	00h	
25	Configuration	BAS0MMMMb, (bidir., RX on, no encr.)	C0h	C0h	
26	CRC 2		ABh	ABh	DLL
27	CRC 2		85h	85h	

Table P.14 — RSP-UD (wM-Bus data)

RSP-UD (wM-Bus - short address)					
		wM-Bus frame	HCA ->COM		
Byte No	**Field name**	**Content**	**Bytes [hex] plain**	**Bytes [hex] AES coded**	
1	L Field	Length of data (30 bytes)	1Eh	1Eh	Linklayer (DLL)
2	C Field	Respond user data	08h	08h	
3	M Field	Manufacturer code	68h	68h	
4	M Field	Manufacturer code	50h	50h	
5	A Field	Serial No LSB (BCD)	78h	78h	
6	A Field	Serial No (BCD)	56h	56h	
7	A Field	Serial No (BCD) (=12345678)	34h	34h	
8	A Field	Serial No MSB (BCD) of meter	12h	12h	
9	A Field	Version (or Generation number)	8Fh	8Fh	
10	A Field	Device type (Medium=HCA)	08h	08h	
11	CRC 1		99h	99h	
12	CRC 1		38h	38h	
13	CI Field	7Ah means 4 bytes header	7Ah	7Ah	APL
14	Access No.	Transmission counter	02h	02h	
15	Status	State contains errors and alerts	00h	00h	
16	Configuration	NNNNCCRHb (1 encr. block)	10h	10h	
17	Configuration	BAS0MMMMb, (bidir.,RX off; AES)	85h	85h	
18	AES-Verify	Encryption verification	2Fh	FDh	AES-Encrypted Block 1 / Application layer
19	AES-Verify	Encryption verification	2Fh	26h	
20	DR1	DIF (24 bit binary, Storage No 0)	03h	EFh	
21	DR1	VIF (HCA-units)	6Eh	68h	
22	DR1	Value LSB	39h	ACh	
23	DR1	Value (= 012345d = 003039h HCA-Units)	30h	F6h	
24	DR1	Value MSB	00h	5Bh	
25	DR2	DIF (16 bit binary, Storage No 1)	42h	AEh	
26	DR2	VIF (Date type G)	6Ch	02h	
27	DR2	Value LSB	3Fh	8Bh	
28	DR2	Value MSB (= 31.12.2009)	1Ch	FDh	
29	CRC 2		75h	44h	DLL
30	CRC 2		5Dh	CAh	

Table P.14 *(continued)*

RSP-UD (wM-Bus - short address)					
		wM-Bus frame	**HCA ->COM**		
Byte No	**Field name**	**Content**	**Bytes [hex] plain**	**Bytes [hex] AES coded**	
31	DR3	DIF (24 bit binary, Storage No 1)	43h	C1h	
32	DR3	VIF (HCA-units)	6Eh	88h	
33	DR3	Value LSB	A0h	D8h	
34	DR3	Value (= 023456 = 005BA0h HCA-Units)	5Bh	A9h	
35	DR3	Value MSB	00h	72h	
36	CRC 3		23h	F4h	DLL
37	CRC 3		5Ch	77h	

or alternative

Table P.15 — RSP-UD (wM-Bus Appl.error)

RSP_UD (wM-Bus - Appl. Error)					
		wM-Bus frame	**HCA -> COM**		
Byte No	**Field name**	**Content**	**Bytes [hex] plain**	**Bytes [hex] AES coded**	
1	L Field	Length of data (11 bytes)	1Eh	1Eh	Linklayer (DLL)
2	C Field	Respond user data	08h	08h	
3	M Field	Manufacturer code	68h	68h	
4	M Field	Manufacturer code	50h	50h	
5	A Field	Serial No LSB (BCD)	78h	78h	
6	A Field	Serial No (BCD)	56h	56h	
7	A Field	Serial No (BCD) (=12345678)	34h	34h	
8	A Field	Serial No MSB (BCD)	12h	12h	
9	A Field	Version (or Generation number)	8Fh	8Fh	
10	A Field	Device type (Medium=HCA)	08h	08h	
11	CRC 1		99h	99h	
12	CRC 1		38h	38h	
13	CI Field	Application Error with 4 bytes header	6Eh	6Eh	APL
14	Access No.	Transmission counter	02h	02h	
15	Status	State “any application error”	02h	02h	
16	Configuration	NNNNCCRHb (1 encr. block)	10h	10h	
17	Configuration	BASOMMMMb, (bidir.,RX off; AES)	85h	85h	

Table P.15 *(continued)*

RSP_UD (wM-Bus - Appl. Error)						
		wM-Bus frame	**HCA -> COM**			
Byte No	**Field name**	**Content**	**Bytes [hex] plain**	**Bytes [hex] AES coded**		
18	AES-Verify	Encryption verification	2Fh	55h	AES-Encrypted Block 1	Application layer
19	AES-Verify	Encryption verification	2Fh	E8h		
20	Error Code	“Decryption key fails”	14h	39h		
21	Dummy	Fill byte due to AES	2Fh	71h		
22	Dummy	Fill byte due to AES	2Fh	F4h		
23	Dummy	Fill byte due to AES	2Fh	5Eh		
24	Dummy	Fill byte due to AES	2Fh	41h		
25	Dummy	Fill byte due to AES	2Fh	CCh		
26	Dummy	Fill byte due to AES	2Fh	B1h		
27	Dummy	Fill byte due to AES	2Fh	E0h		
28	Dummy	Fill byte due to AES	2Fh	F4h		
29	CRC 2		B0h	C9h	DLL	
30	CRC 2		E8h	23h		
31	Dummy	Fill byte due to AES	2Fh	2Fh		
32	Dummy	Fill byte due to AES	2Fh	71h		
33	Dummy	Fill byte due to AES	2Fh	F7h		
34	Dummy	Fill byte due to AES	2Fh	2Eh		
35	Dummy	Fill byte due to AES	2Fh	C7h		
36	CRC 3		25h	CEh	DLL	
37	CRC 3		EEh	CFh		

NOTE This example shows an "application error", which is responded instead of expected data because the partner applied a wrong key in the encrypted command.

P.8 Reset of the link by a SND-NKE

If the communication partner intends to finish communication, it sends a SND-NKE as last. The meter does not respond to this SND-NKE and stops the repetition of the last send datagram.

Example for COM controller

Medium	COM controller
Manufacturer	OMS
Serial number	66778899
Version	12
Meter-RSSI	-66 dBm
Access number	03

Example for cooling meter

Medium	cool_outlet
Manufacturer	QDS
Serial number of heat meter	11223344
Version	16
Status (no error)	0

Table P.16 — SND-NKE (wM-Bus)

SND-NKE (wM-Bus)					
		wM-Bus frame	COM-> cooling meter		
Byte No	Field name	Content	Bytes [hex] plain	Bytes [hex] AES coded	
1	L Field	Length of data (22 bytes)	16h	16h	Linklayer (DLL)
2	C Field	Request user data class 2 (5Bh or 7Bh)	40h	40h	
3	M Field	Manufacturer code	68h	68h	
4	M Field	Manufacturer code	50h	50h	
5	A Field	Serial No LSB (BCD)	99h	99h	
6	A Field	Serial No (BCD)	88h	88h	
7	A Field	Serial No (BCD) (=66778899)	77h	77h	
8	A Field	Serial No MSB (BCD) of COM controller	66h	66h	
9	A Field	Version (or Generation number)	0Ch	0Ch	
10	A Field	Device type (Medium=MUC)	31h	31h	
11	CRC 1		30h	30h	
12	CRC 1		A9h	A9h	

Table P.16 *(continued)*

SND-NKE (wM-Bus)					
		wM-Bus frame	**COM-> cooling meter**		
Byte No	**Field name**	**Content**	**Bytes [hex] plain**	**Bytes [hex] AES coded**	
13	CI Field	COM controller -> Meter (long header)	80h	80h	Application layer (APL)
14	Ident.Nr.	Serial No LSB (BCD)	44h	44h	
15	Ident.Nr.	Serial No (BCD)	33h	33h	
16	Ident.Nr.	Serial No (BCD) (=12345678)	22h	22h	
17	Ident.Nr.	Serial No MSB (BCD)	11h	11h	
18	Manufr	Manufacturer code	93h	93h	
19	Manufr	Manufacturer code	44h	44h	
20	Version	Version (or Generation number)	10h	10h	
21	Device type	Device type (Medium=Cool_outlet)	0Ah	0Ah	
22	Access No.	Transmission counter	03h	03h	
23	Status	State (RSSI level -66dBm)	20h	20h	
24	Configuration	NNNNCCRHb	00h	00h	
25	Configuration	BAS0MMMMb, (bidir., RX on, no encr.)	C0h	C0h	
26	CRC 2		1Eh	1Eh	DLL
27	CRC 2		80h	80h	

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