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Systemy komunikacji dla przyrządów pomiarowych

Część 3: Protokoły aplikacyjne

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Communication systems for meters - Part 3: Application protocols

Systèmes de communication pour compteurs - Partie 3 : Protocoles d'application

Kommunikationssysteme für Zähler - Teil 3: Anwendungsprotokolle

This European Standard was approved by CEN on 8 February 2018.

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European foreword

This document (EN 13757-3:2018) has been prepared by Technical Committee CEN/TC 294 "Communication systems for 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of an identical text or by endorsement, at the latest by October 2018 and conflicting national standards shall be withdrawn at the latest by October 2018.

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

This document together with EN 13757-7:2018 and CEN/TR 17167:2018 will supersede EN 13757-3:2013.

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

This document falls under Mandate EU M/441 "Standardisation mandate to CEN, CENELEC and ETSI in the field of measuring instruments for the development of an open architecture for utility meters involving communication protocols enabling interoperability" by providing the relevant definitions and methods for meter data transmission on application layer level. The M/441 Mandate is driving significant development of standards in smart metering.

The following significant technical changes have been incorporated in the new edition of this European Standard:

— extension of application select;

— introduction of second level table for VIFE = FDh;

— introduction of inverse compact load profile;

— introduction of new VIFE for descriptor;

— extension of VIFE = FCh table;

— extension of definitions for DIF = 0Fh/1Fh;

— transport and security services were moved to EN 13757-7;

— informative annexes from previous version of EN 13757-3 were moved to a new technical report CEN/TR 17167.

EN 13757 is currently composed with the following parts:

— *Communication systems for meters — Part 1: Data exchange*;

— *Communication systems for meters — Part 2: Wired M-Bus communication*;

— *Communication systems for meters — Part 3: Application protocols* ;

- *Communication systems for meters and remote reading of meters — Part 4: Wireless meter readout (Radio meter reading for operation in SRD bands)*;
- *Communication systems for meters — Part 5: Wireless M-Bus relaying*;
- *Communication systems for meters — Part 6: Local Bus*;
- *Communication systems for meters — Part 7: Transport and security services* ;
- *CEN/TR 17167, Communication systems for meters — Accompanying TR to* EN 13757-2,-3 *and –7, Examples and supplementary information.*

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, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

Introduction

This European Standard belongs to the EN 13757 series, which covers communication systems for 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). EN 13757-2 describes transport mechanism and security methods for data. The Technical Report CEN/TR 17167 contains informative annexes for EN 13757-2, EN 13757-3:2018 and EN 13757-7.

These upper M-Bus protocol layers can be used with various Physical Layers and with Data 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. These upper M-Bus protocol layers have been optimized for minimum battery consumption of meters, especially for the case of wireless communication, to ensure long battery lifetimes of the meters. Secondly, it is optimized for minimum message length to minimize the wireless channel occupancy and hence the collision rate. Thirdly, it is optimized 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, water, thermal energy 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 CEN/TR 17167:2018, Annex C specifies 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 CEN/TR 17167:2018, Annex D.

The European Committee for Standardization (CEN) draws attention to the fact that it is claimed that compliance with this document may involve the use of a patent concerning Image Transfer given in Annex I.

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CEN and CENELEC maintain online lists of patents relevant to their standards. Users are encouraged to consult the lists for the most up to date information concerning patents (ftp://ftp.cencenelec.eu/EN/IPR/Patents/IPRdeclaration.pdf).

1 Scope

This European Standard specifies application protocols for communication systems for meters.

This European Standard specifies application protocols, especially the M-Bus application protocol.

This European Standard is intended to be used with the lower layer specifications determined in EN 13757-2, EN 13757-4, EN 13757-5, EN 13757-6 and EN 13757-7.

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 13757-2, *Communication systems for meters - Part 2: Wired M-Bus communication*

EN 13757-4, *Communication systems for meters and remote reading of meters - Part 4: Wireless meter readout (Radio meter reading for operation in SRD bands)*

EN 13757-5, *Communication systems for meters - Part 5: Wireless M-Bus relaying*

EN 13757-6, *Communication systems for meters - Part 6: Local Bus*

EN 13757-7, *Communication systems for meters — Part 7: Transport and security services*

ISO/IEC 8859-1, *Information technology — 8-bit single-byte coded graphic character sets — Part 1: Latin alphabet No. 1*

ISO/IEC/IEEE 60559:2011, *Information technology — Microprocessor Systems — Floating-Point arithmetic*

3 Terms and definitions

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

3.1
byte
octet of bits

3.2
datagram
unit of data transferred from source to destination

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

3.3
fragment
datagram of a fragmented message

3.4
Final DIFE
additional last DIFE with the value 00h that marks a storage number as a register number

3.5
Hex-ASCII
base-16 numbers encoded as ASCII characters ('0'–'9', 'A'–'F')

[SOURCE: ANSI X9 TR-31:2010]

3.6
message
functional set of data transferred from source to destination

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

3.7
Register number
number of a predefined historical value register (like consumption value) corresponding to an OBIS value group F value

3.8
sublayer
subdivision of a layer

[SOURCE: ISO/IEC 7498-1]

4 Abbreviations and symbols

4.1 Abbreviations

ACK	Acknowledge
AES	Advanced Encryption Standard
AFL	Authentication and Fragmentation Sublayer
APL	Application Layer
ASCII	American Standard Code for Information Interchange
BCD	Binary Coded Decimal numbers
CI	Control Information field
CMD	Command
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 62056–6-1)
REQ-UD	Request User Data (class 1 or 2), (EN 13757–4)
RSP-UD	Respond User Data (EN 13757–4)
RSSI	Received Signal Strength Indicator
SND-NKE	Send Link Reset (EN 13757–4)
SND-UD	Send User Data (EN 13757–4)
SND-UD2	Send User Data 2 (EN 13757–4)
TPL	Transport Layer
VIB	Value Information Block
VIF	Value Information Field
VIFE	Value Information Field Extensions

4.2 Symbols

Hexadecimal numbers are designated by a following "$_{\text{h}}$".

Binary numbers are designated by a following "$_{\text{b}}$".

Decimal numbers have no suffix.

5 Selection of an application protocol

This European Standard supports several application protocols. A specific protocol shall be chosen accordingly to the selected CI-Field described in EN 13757-7:2018, 4.2. Beside the M-Bus protocol there are specific protocols described in the following clauses. Further application protocols applying DLMS/COSEM or M-Bus based usage of OBIS-type value descriptors are referenced in EN 13757-7:2018, Table 2. Annex H defines translation from M-Bus type record descriptors to OBIS-type record descriptors.

The support for the different commands or protocols declared by the CI-field is optional in the meter.

6 M-Bus protocol

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 are 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 M-Bus Application Layer data may consist of two segments of data. The first segment holds M-Bus data records (see 6.2). The second, optional segment, holds manufacturer specific data. (see Table 1).

Table 1 — Structure of a M-Bus APL with manufacturer specific data

APL Variable data blocks (Records)	MDH (optional)	Manufacturer specific data (optional)
Variable number	1 byte	Variable number

A Manufacturer Data Header (MDH) shall be inserted before the manufacturer specific data. The MDH is one of the characters $0F_h$ or $1F_h$. The MDH shall be omitted if there is no manufacturer specific data (see 6.5).

Unencrypted data following encrypted data shall start at a data record boundary, i.e. the first byte of unencrypted data shall be interpreted as a DIF.

Special data structures are defined in Annex F and in Annex G.

If nothing other declared then multi byte fields shall be transmitted with least significant byte first (little endian).

6.2 M-Bus data record

The structure of an M-Bus data record is shown in Table 2. The transmission order of the element is from left to right.

Table 2 — Data record structure

DIF	DIFE	VIF	VIFE	Data
1 byte	0 to 10 (1 byte each)	1 byte	0 to 10 (1 byte each)	0 to N bytes
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 consists of a Data Information Block (DIB) and a Value Information Block (VIB). The DIB specifies the length, type and coding of the data. The VIB specifies the unit for the data and the multiplier to use.

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 FprCEN/TR 17167:2017, Annex A, or for further information on M-Bus see FprCEN/TR 17167:2017, Annex C.

6.3 Data Information Block (DIB)

6.3.1 General

The DIB contains at least one byte of Data Information Field (DIF), and can be extended by a maximum of 10 Data Information Field Extensions (DIFE).

6.3.2 Data Information Field (DIF)

The coding of the DIF is shown in Table 3.

Table 3 — Data Information Field (DIF)

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

6.3.3 Data field

The data field shows how length and coding of data shall be interpreted. Table 4 shows the allowed codes for the data field.

Table 4 — Coding of the data field

Code	LengthSize in bit	Data type
0000_b	0	No data
0001_b	8	8 bit integer/binary
0010_b	16	16 bit integer/binary
0011_b	24	24 bit integer/binary
0100_b	32	32 bit integer/binary
0101_b	32	32 bit real
0110_b	48	48 bit integer/binary
0111_b	64	64 bit integer/binary
1000_b	0	Selection for readout
1001_b	8	2 digit BCD
1010_b	16	4 digit BCD
1011_b	24	6 digit BCD
1100_b	32	8 digit BCD
1101_b	N	Variable length
1110_b	48	12 digit BCD
1111_b	—	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 by default implies coding type B (signed integer). The coding may however be overridden by the settings in VIF/VIFE of the record (e.g. date/time).

Variable length:

A Code of 1101_b implies data with variable length. The length is coded in the first byte of the data, after the DRH and is named LVAR. (e.g. LVAR = 02_h shows that two bytes of data follows.)

If LVAR is used as the variable length of a wireless M-Bus data container (see FprCEN/TR 17167:2017, Annex F) it counts the number of bytes inside the container (Table 5).

Table 5 — LVAR interpretation

Range	Data Type	Calculation
00_h–BF_h[a]	8-bit text string according to ISO/IEC 8859-1	LVAR (0 to 191) characters
$C0_h$–$C9_h$	Positive BCD number	(LVAR–$C0_h$)*2 digits, 0 to 18 digits
$D0_h$–$D9_h$	Negative BCD number	(LVAR–$D0_h$)*2 digits, 0 to 18 digits
$E0_h$–EF_h	Binary number	(LVAR–$E0_h$) bytes, 0 to 15 bytes
$F0_h$–$F4_h$	Binary number	4*(LVAR–EC_h) bytes, 16, 20, 24, 28, 32 bytes
$F5_h$	Binary number	48 bytes
$F6_h$	Binary number	64 bytes
Others LVAR values	Reserved	

[a] If a wireless M-Bus data container is used it counts the number of bytes inside the container (see also Table 12, Footnote f).

All multi byte fields following LVAR (according Table 5) shall be transmitted with Least Significant Byte first.

A Code of 1111_b implies coding for special functions as specified in Table 6.

Table 6 — DIF-coding for special functions

DIF	Function
$0F_h$	Start of manufacturer specific data structures to end of user data (see 6.5)
$1F_h$	Same meaning as DIF = $0F_h$ + more records follow in next datagram (see 6.5)
$2F_h$	Idle filler (not to be interpreted), following byte = DIF of next record
$3F_h$ to $6F_h$	Reserved
$7F_h$	Global readout request (all storage numbers, units, tariffs, function fields)

6.3.4 Function field

The Function Field gives the type of value as specified in Table 7.

Table 7 — Function field

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

6.3.5 Storage number

Bit 6 of the DIF serves as the LSBit 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.

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_b. 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, the time spacing, the first storage number (of such a block) and the length of the block. For an example see Annex F.

Some meters require the assignment of historical values (like consumption values) to register numbers that are represented by OBIS value group F values. In this case the storage number is used to indicate the register number while the DIB shall be extended by a Final DIFE with the value 00h in order to mark the storage number as a register number. Register numbers up to 125 can be coded in this way (see Annex H.2).

6.3.6 Extension bit (E)

Bit 7, the Extension bit of the DIF, indicates when set, that additional data description follows in one or more Data Field Extension, DIFE, bytes.

6.3.7 Data Information Field Extension (DIFE)

There may be up to 10 successive DIFE bytes. The coding of the DIFE is shown in Table 8. Bit 7 (E) of a DIFE byte shows whether a further DIFE byte follows. Bit 6 is a part of the numbering of subunits. Bit 5 and 4 is a part of the numbering of the Tariff and bits 3 through 0 are a part of the Storage number. The full Storage number/Tariff/Subunit number is made up of a concatenation of the information from all of the DIFE's for a parameter.

Table 8 — 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 10 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.

The use of the Final DIFE is explained in 6.3.5.

6.3.8 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.

6.3.9 Subunit information

A device (meter) may consist of several functionally/logically independent subunits. Such a device may either use multiple different primary/secondary addresses or use the subunit information in the DIFE's to address independent subunits. The use of multiple addresses is recommended for collections of physically independent devices. Devices, that share common information, but have different logical entities, are recommended to use a single address and to differentiate between the different entities using the subunit information.

6.4 Value Information Block (VIB)

6.4.1 General

A DIB will, with the exception of the special values given in Table 6, be followed by a VIB. The VIB consists of a Value Information Field (VIF) byte and zero or more (up to 10) Value Information Field Extension (VIFE) bytes. VIF/VIFE use the same extension mechanism as specified for DIF and DIFE (see 6.3.6 and 6.3.7). The basic coding of the VIF is shown in Table 9.

Table 9 — 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 0000_b to E111 1010_b

The unit and multiplier are taken from Table 10.

b) Plain-text VIF: E111 1100_b

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

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

c) Linear VIF-extension: FD_h and FB_h

In case of VIF = FD_h and VIF = FB_h (see Table 11) the true VIF is given by the next byte (i.e. the first VIFE) and the coding is taken from Table 12 and Table 14, respectively. This extends the available VIFs by another 256 codes.

d) Any VIF: $7E_h$/FE_h

This VIF-Code can be used in direction master to slave for readout selection of all VIFs. See special function in 6.3.3.

e) Manufacturer specific: $7F_h$/FF_h

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

6.4.2 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 10 — 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 = 00_b nn = 01_b nn = 10_b nn = 11_b	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)	m3/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)	m3/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)	YYYY-MM-DD[c]		Data field = 0010_b, type G
E110 1101[b]	Date and time (actual or associated with a storage number/function)	YYYY-MM-DD hh-mm[c]		Data field = 0100_b, type F
E110 1101[b]	Time (actual or associated with a storage number/function)	hh:mm:ss[c]		Data field = 0011_b, type J
E110 1101[b]	Date and time (actual or associated with a storage number/function)	YYYY-MM-DD hh:mm:ss[c]		Data field = 0110_b, type I

Coding	Description	Range coding	Range
E110 1101[b]	Date and time or duration (actual or associated with a storage number/function)	YYYY-MM-DD hh:mm:ss,ppppp[c] or ssssssssss,ppppp[c]	Data field = 1101_b, type M
E110 1110	Units for HCA.		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 CEN/TR 17167:2018, Annex A.8.2
E111 1001	(Enhanced) identification		
E111 1010	Address		For EN 13757–2: data field 0001_b (1 byte link layer address,, data type C) For EN 13757–4: data field 0110_b (6 byte header-ID) or 0111_b (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. Other data fields shall be handled as invalid.

c YYYY – year
MM – month
DD – day
hh – hour
mm – minute
ss – second
pp – part of a second

6.4.3 VIF-codes for special purposes

Table 11 — Special VIF-codes

Coding	Description	Purpose
1111 1011 (FB_h)	First extension of VIF-codes	True VIF is given in the first VIFE and is coded using (Table 14) (128 new VIF-Codes)
E111 1100 (7C/FC)	VIF in following string (length in first byte)	Allows user definable VIF´s (in plain ASCII-String), see C.2[a]
1111 1101 (FD_h)	Second extension of VIF-codes	True VIF is given in the first VIFE and is coded using (Table 12) (128 new VIF-Codes)
1110 1111 (EF_h)	Reserved for third extension table of VIF-codes	reserved for a future table especially for electricity meters
E111 1110 (7E/FE)	Any VIF	Used for readout selection of all VIF´s (see 6.3.3, 6.4)
E111 1111 (7F/FF)	Manufacturer specific	VIFE´s and data of this block are manufacturer specific

a Coding the VIF in an ASCII-String is also allowed in combination with data as ASCII-String (using data field in DIF = 1101b).

6.4.4 VIFE-code extension tables

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

Table 12 — 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,k]	
E000 1001	Device type[k]	
E000 1010	Manufacturer[k]	
E000 1011	Parameter set identification[k]	Enhanced identification
E000 1100	Model/Version[k]	
E000 1101	Hardware version number[k]	
E000 1110	Metrology (firmware) version number[k]	
E000 1111	Other software version number[k]	
E001 0000	Customer location[k]	
E001 0001	Customer[k]	
E001 0010	Access code user[k]	
E001 0011	Access code operator[k]	Improved selection
E001 0100	Access code system operator[k]	and other user requirements
E001 0101	Access code developer[k]	
E001 0110	Password[k]	
E001 0111	Error flags (binary) (device type specific)[j] (see also E.1)	
E001 1000	Error mask[k]	
E001 1001	Security key[i,l,k]	
E001 1010	Digital output (binary)[j]	
E001 1011	Digital input (binary)[j]	
E001 1100	Baud rate [baud][k]	
E001 1101	Response delay time [bit-times][k]	
E001 1110	Retry	
E001 1111	Remote control (device specific, e.g. gas valve)[j] (see C.3)	
E010 0000	First storage number for cyclic storage[k]	

Coding	Description	Group
E010 0001	Last storage number for cyclic storage[k]	
E010 0010	Size of storage block (see F.1)[k]	
E010 0011	Descriptor for tariff and subunit[k] (see CEN/TR 17167:2018, Annex F)	
E010 01nn	Storage interval [sec(s) to day(s)][a]	management
E010 1000	Storage interval month(s) (see F.1)	
E010 1001	Storage interval year(s)	
E010 1010	Operator specific data[h]	
E010 1011	Time point second (0 to 59)[k]	
E010 11nn	Duration since last readout [sec(s) to day(s)][a,k]	
E011 0000	Start (date/time) of tariff	
E011 00nn	Duration of tariff (nn = 01 to 11: min to days)[k]	
E011 01nn	Period of tariff [sec(s) to day(s)][a,k]	
E011 1000	Period of tariff months(s)[k]	Enhanced tariff
E011 1001	Period of tariff year(s)[k]	management
E011 1010	Dimensionless/no VIF	
E011 1011	Data container for wireless M-Bus protocol[f]	See CEN/TR 17167:2018
E011 11nn	Period of nominal data transmissions [sec(s) to day(s)][a,k] (e.g. for RF-transmissions)	Installation and start up
E100 nnnn	10^{nnnn-9} volts	Electrical units
E101 nnnn	10nnnn–12 A	
E110 0000	Reset counter	
E110 0001	Cumulation counter	
E110 0010	Control signal	
E110 0011	Day of week[e,k]	
E110 0100	Week number[k]	
E110 0101	Time point of day change	
E110 0110	State of parameter activation[k]	
E110 0111	Special supplier information[k]	
E110 10pp	Duration since last cumulation [hour(s) to years(s)][c,k]	
E110 11pp	Operating time battery [hour(s) to years(s)][c]	
E111 0000	Date and time of battery change[b]	
E111 0001	RF level units: dBm[d]	

Coding	Description	Group
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)[k]	
E111 0101	Number times the meter was stopped[k]	
E111 0110	Data container for manufacture specific protocol[f]	See CEN/TR 17167:2018
E111 0111 – E111 1100	Reserved	
E111 1101	2nd level VIFE code extension table (Table 13)	
E111 1110 – E111 1111	Reserved	

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

b The information about usage of data type F (date and time) or data type G (date), I (date and time), J (time) or M (date and time or duration) can be derived from the data field (see Table 4).

c pp = 00_b hour(s)
01_b day(s)
10_b month(s)
11_b 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 = $0D_h$ (LVAR from 00_h to BF_h, see CEN/TR 17167:2018, Annex F).

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.

j Data type D according to Annex A.

k Binary data (see Table 4) shall be interpreted as data type A (unsigned BCD) or data type C (unsigned integer) according to Annex A.

l This VIFE is deprecated! The Security Information Transfer Protocol according to EN 13757–7, Annex A shall be used instead.

6.4.4.2 2nd level VIFE-code extension table (following VIF = FDh and VIFE = FDh)

Table 13 — 2nd level VIFE code extension table

Coding	Description	Group
E000 0000	Currently selected application[a]	
E000 0001	Reserved	
E000 001p[b]	Remaining battery lifetime (month or years)[c]	
E000 0100 – E111 1111	Reserved	

[a] The coding of the data content shall be according to 7.2.

[b] $P = 0_b$ month(s)
1_b year(s)

[c] Binary data (see Table 4) shall be interpreted as data type A (unsigned BCD) or data type C (unsigned integer) according to Annex A.

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

Table 14 — 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	$10^{(nn-1)}$ 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	Massd	$10^{(n+2)}$ t	100 t to 1 000 t
E001 101n	Relative humidity[d]	$10^{(n-1)}$ %	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

Coding	Description	Range Coding	Range
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
E110 1000	Resulting rating factor, K[d]	$2^{(-12)}$ (Units for HCA)/h[b]	
E110 1001	Thermal output rating factor, Kq[d]	Watt	
E110 1010	Thermal coupling rating factor overall, Kc[d]	$2^{(-12)}$	0 to 4[c]
E110 1011	Thermal coupling rating factor room side, Kcr[d]	$2^{(-12)}$	0 to 4[c]
E110 1100	Thermal coupling rating factor heater side, Kch[d]	$2^{(-12)}$	0 to 4[c]
E110 1101	Low temperature rating factor, Kt[d]	$2^{(-12)}$	0 to 4[c]
E110 1110	Display output scaling factor, KD[d]	$2^{(-12)}$ (Units for HCA)/KWh[b]	0 to 4 $kWh^{(-1)}$[c]

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

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

[b] "Units for HCA" is not physically unit, but a dimensionless quantity.

[c] Limited to the physical reasonable range.

[d] Binary data (see Table 4) shall be interpreted as data type A (unsigned BCD) or data type C (unsigned integer) according to Annex A.

6.4.6 Combinable (orthogonal) VIFE-Code extension table

The code from Table 15 follows immediately the VIF or the VIFE (in case of code extension) and modifies its meaning.

Table 15 — Combinable (orthogonal) VIFE-table

VIFE-Code	Description
E000 xxxx	Reserved for object actions (master to slave): see 6.4.7 or for error codes (slave to master): see 6.4.8
E001 0000 – E001 0001	Reserved
E001 0010	Average value
E001 0011	Inverse compact profile[c]
E001 0100	Relative deviation[a]
E001 0101 – E001 1100	Record error codes (slave to master); (see 6.4.8)
E001 1101	Standard conform data content[b]
E001 1110	Compact profile with register numbers[c]
E001 1111	Compact profile[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 m3
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)

VIFE-Code	Description
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]
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	Used 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, u = 0: lower, u = 1: upper limit exceed[d,e]
E101 ufnn	Duration of limit exceed (u, f: as above, nn = duration[h])
E110 0fnn	Duration of d (f: as above, nn = duration[h])
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 [d,e] (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 16)
E111 1101	Multiplicative correction factor for value (not unit): 103
E111 1110	Future value
E111 1111	Next VIFEs and data of this block are manufacturer specific

VIFE-Code	Description
[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 Annex E.	
[c] This VIFE declares a series of data points as compact profile. According to Annex F.	
[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), I (date and time), J (time) or M (date and time or duration) can be derived from the data field (see Table 4).	
[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.	
[h] nn = 00_b second(s) 01_b minute(s) 10_b hour(s) 11_b day(s)	

The codes of Table 16 follow immediately after the VIFE = FCh of Table 15.

Table 16 — 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	At quadrant Q1
E000 1001	At quadrant Q2
E000 1010	At quadrant Q3
E000 1011	At quadrant Q4
E000 1100	Delta between import and export (abs(Q1+Q4) – abs(Q2+Q3))
E000 1101 – E000 1111	Reserved
E001 0000	Accumulation of absolute value for both positive and negative contribution (absolute count)[a]
E001 0001	Data presented with type C according Annex A
E001 0010	Data presented with type D according Annex A
E001 0011	Reserved

VIFE-Code	Description
E001 0100	Direction: from communication partner to meter[b]
E001 0101	Direction: from meter to communication partner[b]
E001 0110 – 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). [b] Defines the applicable direction of specific parameters like RSSI-level.	

6.4.7 Generalized 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 Table 17.

Table 17 — Action codes for the generalized 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.		

6.4.8 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 18 to code the type of application error, which has occurred for this record.

Table 18 — 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 may be invalid. The slave has some options to transmit the data:

— data field = 0000_b: no data;

— data field = 0000_b: 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.

6.5 Manufacturer specific unstructured data block

The MDH (see 6.1) 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 1 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 = $7F_h$ or FF_h (see 6.4.1).

The DIF = $1F_h$ 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 = $1F_h$ 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 and no manufacturer specific data, the DIF $1F_h$ shall be the last byte in the application frame of all except the last datagram.

DIF = $1F_h$ should be used for unencrypted data (security mode 0 in EN 13757-7:2018, Table 19). DIF = $1F_h$ shall not be used in combination with enabled fragmentation within AFL (see EN 13757-7, EN 13757-6). For encrypted multi datagram messages fragmentation in AFL should be applied instead of DIF = $1F_h$.

NOTE 2 If DIF = $0F_h$ is used in combination with fragmentation in the AFL, the manufacturer specific data are continued in the successive fragments (without repeated application of DIF = $0F_h$ at the beginning of the successive fragment).

In case of partial encryption (see EN 13757-7:2018, 7.6.5) DIF = $0F_h$ and the manufacturer specific data shall be located completely outside of the encrypted area.

If manufacturer specific data are to be transported in the encrypted part of a partially encrypted message, a data record with a suitable DIF (possibly a DIF with variable length — see 6.3.3) and a VIF = $7F_h$ or FF_h (manufacturer specific data record — see 6.4.1) shall be used instead of the usual MDH-DIF = $0F_h$ or $1F_h$.

NOTE 3 A MDH hidden in the encrypted part of a partially encrypted message causes misinterpreting of following unencrypted data as long as encrypted data are not decrypted.

7 Application reset and application select

7.1 Application reset

With the CI-field 50_h or 53_h (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.

7.2 Application select with subcode

It is allowed to use optional parameters after CI = 50_h or 53_h. In this case, the CI-field acts as application select. If more bytes follow, these bytes are the application select subcode. Up to 10 subcode bytes are possible. The application select subcode defines which message function and which block is requested by the master. The data type of this parameter is 8 bit binary. The upper 4 bits of each byte define the message application and the lower 4 bits of each byte define the number of the block 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 block means that all datagrams are requested.

Message application and block number are calculated according to the following rules:

a) message from master to slave: CI = 50_h/53_h ax by cz;

b) message from slave to master: CI = $66_h/67_h/68_h$ ax by cz;

c) using the bytes ax, by, cz as 8 bit binary:

1) message application: a (if a ≤ F_h);

2) message application: a + b (if a = F_h and b ≤ F_h);

3) message application: a + b + c (if a = F_h, b = F_h and c ≤ F_h);

4) block number: x: Bit 0 to 3;

5) block number: y: Bit 4 to 7;

6) block number: z: Bit 8 to 11.

After the CI field up to 10 additional bytes are permitted. The above stated definitions are using only 3 additional bytes.

NOTE The usage of F_h for the application block ensures backward compatibility to previous revisions of this standard, e.g. CI = 50_h $F0_h$ 00_h is equal to CI = 50_h $F0_h$.

Slaves with only one type of message may ignore application select and the added parameters. The codes given in Table 19 are used for the upper 4 bits of the parameter bytes following the CI-Field:

Table 19 — Coding of the message application

Coding	Description	Examples
0	All	
1	User data	Consumption
2	Simple billing	Current and fixed date values + dates
3	Enhanced billing	Historic values
4	Multi tariff billing	
5	Instantaneous values	For regulation
6	Load profile values for management	
7	Static content	
8	Installation and startup	Bus address, fixed dates
9	Testing	High resolution values
10	Calibration	
11	Manufacturing	
12	Development	
13	Self test	
14	Configuration data	
15	User defined data	Data set selected by the user
16 to 25	Reserved	
26 to 45	Manufacturer specific usage	
from 46	Reserved	

7.3 Overview about CI-Fields for Application reset and Application select

If this feature is used it shall be implemented according to the definition in this clause. The CI fields given in Table 20 shall be supported for application reset or application select.

Table 20 — CI fields for application select

CI field	TPL header	Applicable to wM-Bus	Applicable to M-Bus	Name	Description
50_h	None	no	yes	Application reset or select to device (master to slave)	Selects the requested application or block in the application (with parameter) or resets to application to default state (without parameter)
53_h	long	yes	yes	Application reset or select to device (master to slave)	Selects the requested application or block in the application (with parameter) or resets to application to default state (without parameter)
54_h	none	no	yes	Request of selected application to device (master to slave)	Readout of selected application and next block (without parameter)
55_h	long	yes	yes	Request of selected application to device (master to slave)	Readout of selected application and next block (without parameter)
66_h	none	no	yes	Response of selected application from device (slave to master)	Transmission of selected application and next block
67_h	short	yes	no	Response of selected application from device (slave to master)	Transmission of selected application and next block
68_h	long	yes	yes	Response of selected application from device (slave to master)	Transmission of selected application and next block

All meters supporting several applications or one application with several blocks shall support these CI fields.

An application reset forces the fall-back to the standard response. The standard response is a (predefined) application. Typically the standard response is application 0. The standard response starts with block 0.

A SND-UD with "Request of selected application" is confirmed with ACK. The successive REQ-UD2 shall be replied with "Response of selected application". SND-UD2 can be used alternatively: The slave answers immediately with "Response of selected application". The return to the M-Bus application protocol is accomplished by using "Application reset" or "Application select".

7.4 Rules for application selection

7.4.1 Reset of current slave response

The current application selection is retained until:

— an application reset or application select is received,

— until timeout condition is reached, or

— a device reset has been accomplished.

Master should apply an application select after a voltage drop was detected.

NOTE A secondary address selection or deselection, SND-NKE or break does not lead to a change of the application selection.

7.4.2 Erroneous application select

An erroneous application select (selection of not supported application) shall be processed as application reset.

7.5 Rules for block selection

— First block:

The first block shall contain the most important information.

— Current block:

The selected application block is delivered as next block by the slave.

— Wrap around:

If no successive block is available the next transmitted block will be the first block (block 0).

— Wrong block selection:

If a master selects a block that is not available the next transmitted block will be the first block (block 0).

— Application reset:

After application reset the next transmitted block will be the first block (block 0).

7.6 Selected application block in M-Bus Application protocol

Application select shall be used by a master to select an application and a block from the slave. If a master requests a certain block from a slave and this block is not available in the currently selected application the slave can transmit a different block. Therefore it is necessary that the slave transmits the current block number in each block.

Using VIF = FD_h FD_h 00_h the slave should send message application and number of block in a message. If meters are providing more than one block in a selected application the defined data point shall be transmitted in each block. Otherwise the data point with the block number can be omitted.

If the M-Bus application protocol is encrypted the encryption of this data point is optional.

8 Clock synchronization

For wireless communication (but not limited to this one), the clock synchronization is executed by a special protocol for clock synchronization. For this protocol CI-fields $6C_h$ and $6D_h$ are used. E.3 specifies the transmission of clock synchronization 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 synchronization of its clock except when a dedicated action code (see Table 17) was added.

9 Report of alarm status (slave to master)

The Alarm state can be reported by Cl = 71_h, 74_h and 75_h. For details of the report of alarm status errors, see Annex D.

10 Report of application error

10.1 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 automatically reported but need to be requested by the master separately. After successful transmission of the Application error the meter response will be reset by sending another command or by applying an Application reset/select.

10.2 Status field

The presence and type of an application error shall be indicated by the status field in the TPL-header (see EN 13757-7:2018, 7.5.6). The status field is applied in every message with a short or long TPL-header.

10.3 General application layer errors

For reporting general application errors, a slave can use a RSP-UD datagram with CI = $6E_h$, $6F_h$ or 70_h and zero, one or several data bytes, which describe the type of error.

The defined values for an application error are given in Table 21.

Table 21 — First error code byte for general application errors

Byte	Designation	Type of error
00_h	Unspecified error	Unspecified error: also if data field is missing
01_h	CI-field error	Unimplemented CI-field
02_h	Buffer overflow	Buffer too long, truncated
03_h	Record overflow	Too many records
04_h	Record error	Premature end of record
05_h	DIFE overflow	More than 10 DIFE’s
06_h	VIFE overflow	More than 10 VIFEs
07_h	–	Reserved
08_h	Application busy	Application too busy for handling readout request
09_h	Credit overflow	Too many readouts (for slaves with limited readouts per time)
$0A_h$ to $0F_h$	–	Reserved
11_h	No function	Function not implemented (command unknown or not supported)[a]
12_h	Data error	Data to be supplied not available[a]
13_h	Routing/Relaying error	Cannot route/relay data further[a]
14_h	Access violation	Data access right violation[a]

Byte	Designation	Type of error
15_h	Parameter error	Parameter is missing or wrong[a]
16_h	Size error	The amount of data requested cannot be handled[a]
17_h to $1F_h$	–	Reserved
20_h	Security error	Message counter check. Decryption or Authentication fails or selected key is not available
21_h	Security mechanism not supported	Security mechanism is not supported
22_h	Inadequate security method	Security method or key is not applicable for this function
23_h to EF_h	–	Reserved
$F0_h$	–	Dynamic application error[b]
$F1_h$ to FF_h	–	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.

NOTE Errors which belongs to a specific M-Bus record can be coded by a record error (see 6.4.8).

11 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 (Table 25) to the (unacknowledged) broadcast address 255 is not recommended.

Table 22 — CI-field codes for baud rate switching

CI-field	$B8_h$	$B9_h$	BA_h	BB_h	BC_h	BD_h	BE_h	BF_h
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.

12 Synchronize action

If this feature is used it shall be implemented according to the definition in this clause.

The CI-field $5C_h$ can be used for synchronizing functions in slaves and masters (e.g. clock synchronization). Special actions or parameter loads may be prepared (see Table 17). But the final execution is delayed until the reception of such a special CI-field command. No data follows this CI-code.

13 Manufacturer specific protocols

With the usage of CI-Fields from A0h to B7h manufacturer specific application data protocols can be announced.

NOTE For the usage of manufacturer specific data inside the M-Bus application protocol refer to 6.5.

14 Other application protocols

Other application layer protocols are defined in EN 13757-7:2018, Table 2.

15 Image transfer

The image transfer protocol is defined in Annex I.

Annex A
(normative)

Coding of data records

Keys

X Number of applied bits as defined in the data field (see Table 4)

UI Unsigned integer

I Signed integer

B Array of bits

EXAMPLE **UI**4 [0 to 3] < 0 to 9 > means the 4 bits from position bit0 to position bit3 are coded as unsigned integer and can contain values from 0 to 9.

The following data types are used inside the application layer:

Type A: Unsigned integer BCD:

Table A.1 — Type A: Unsigned BCD

7	6	5	4	3	2	1	0	digit 10^0	**UI**4 [0 to 3] < 0 to 9 > ; < A to *F* > [a]
...	...	...	...	...	...	...	...	digit 10^1	**UI**4 [4 to 7] < 0 to 9 > ; < A to *F* > [a] ...
X–1			X–4	X–5			X–8	digit $10^{(X/4-2)}$	**UI**4 [X–8 to X–5] < 0 to 9 > ; < A to *F* > [a]:
								digit $10^{(X/4-1)}$	**UI**4 [X–4 to X–1] < 0 to 9 > ; < A to *F* > [a]

[a] Digits values of A_h to E_h in any digit position signals invalid. A hex code F_h in the most significant digit position signals a negative BCD number in the remaining X–1 digits. For details of this coding see Annex B.

Type B: Binary – Signed integer:

Table A.2 — Type B: Binary — Signed integer

7	6	5	4	3	2	1	0	**IX** [0 to (X–1)] < $(-2^{(X-1)}+1)$ to $(+2^{(X-1)}-1)$ > ;
...							...	< $-2^{(X-1)}$ > : invalid
X–1							X–8	

NOTE Negative values are in two's complement.

Type C: Binary – Unsigned integer:

Table A.3 — Type C: Binary — Unsigned integer

7	6	5	4	3	2	1	0	**UI**X [0 to (X−1)] < 0 to (+2^X −2) > ;
...							...	< 2^X −1 > : invalid
X−1							X−8	
NOTE 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.								

Type D: Boolean (array of 1 bit binary information)

Table A.4 — Type D: Boolean

7	6	5	4	3	2	1	0	State: **B**1[i] < 0 to 1 > for 0 ≤ i ≤ (X−1)
...							...	< 0 > : false ; < 1 > : true
X−1							X−8	
NOTE 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

Data field = 0100_b (32 bits)

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

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

Data field = 0010_b (16 bits)

Table A.6 — Type G: Date (CP16)

7	6	5	4	3	2	1	0	Day: **UI**5 [0 to 4] < 1 to 31 > < 0 > : every day
15	14	13	12	11	10	9	8	Month: **UI**4 [8 to 11] < 1 to 12 > < 15 > : every month
								Year: **UI**7 [5 to 7; 12 to 15] < 0 to 99 > [a] < 127 > : every year
NOTE A value of FFh in both bytes (that means FFFFh) shall be interpreted as invalid.								
[a] 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 H: Floating point

Type binary32 according to ISO/IEC/IEEE 60559:2011:

Fraction	F:	**UI**23 [0 to 22] < 0 to $(1-2^{-23})$ >	
Exponent	E:	**UI**8 [23 to 30] < 0 to 255 >	
Sign	S:	**B**1 [31]	< 0 > : positive
			< 1 > : negative

F < 0 > and E < 0 >	: = (−1) S*0	= ± zero
F < ≠0 > and E < 0 >	: = (−1) S*2E−126(0.F)	= denormalized numbers
E < 1 to 254 >	: = (−1) S*2E−127(1.F)	= normalized 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	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
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 ISO/IEC/IEEE 60559:2011 for type binary32 floating point arithmetic:

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

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

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

The NaN coding signals “invalid”.

Type I: Year down to second (Local time)

Data field = 0110_b (48 bits)

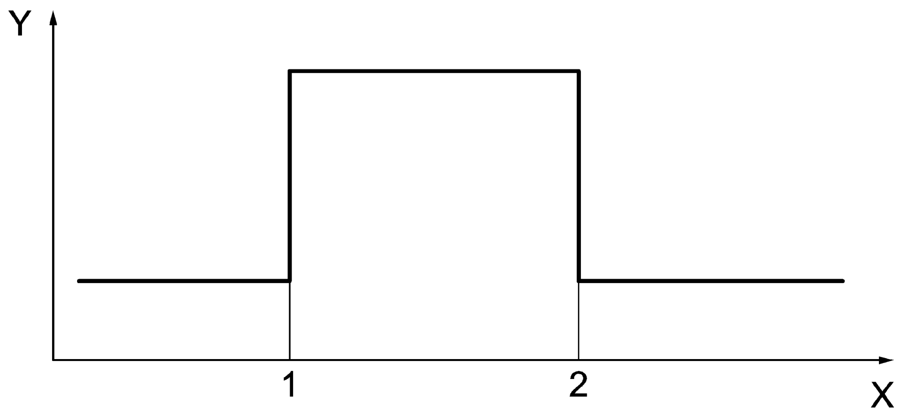
Table A.8 — Type I: Date and time (CP48)

7	6	5	4	3	2	1	0	Second: **UI6** [0 to 5] < 0 to 59 > ; < 63 > : every second[a]
15	14	13	12	11	10	9	8	Minute: **UI6** [8 to 13] < 0 to 59 > ; < 63 > : every minute[a]
23	22	21	20	19	18	17	16	Hour: **UI5** [16 to 20] < 0 to 23 > ; < 31 > : every hour[a]
31	30	29	28	27	26	25	24	Day: **UI5** [24 to 28] < 1 to 31 > ; < 0 > : not specified[a]
39	38	37	36	35	34	33	32	Month: **UI4** [32 to 35] < 1 to 12 > ; < 0 > : not specified[a]
47	46	45	44	43	42	41	40	Year: **UI7** [29 to 31; 36 to 39] < 0 to 99 > ; < 127 > : not specified[a]
								Day of the week[b]: **UI3** [21 to 23] < 1 to 7 > < 1 > : Monday; < 7 > : Sunday; < 0 > : not specified[a]
								Week: **UI6** [40 to 45] < 1 to 53 > ; < 0 > = not specified[a]
								Time invalid: **UI1** [15] < 1 > : invalid ; < 0 > : valid
								Time during daylight savings: **UI1** [6] < 1 > : yes (summer time) ; < 0 > = no
								Leap year **UI1** [7] < 1 > : leap year ; < 0 > : standard year
								Daylight savings deviation (hour)[c] **UI1** [14] < 0 to 1 > < 0 > : “–“ ; < 1 >: “+” ; **UI2** [46 to 47] < 0 to 3 > ; < 0 > : no daylight savings

a Other values reserved for future uses.

b Based on EN 62056–6-1 (COSEM).

c 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 (Local time)

Data field = 0011_b (24 bits)

Table A.9 — Type J = Time (CP24)

7	6	5	4	3	2	1	0	Second: **UI**6 [0 to 5] < 0 to 59 > ; < 63 > : every second[a]
15	14	13	12	11	10	9	8	Minute: **UI**6 [8 to 13] < 0 to 59 > ; < 63 > : every minute[a]
23	22	21	20	19	18	17	16	Hour: **UI**5 [16 to 20] < 0 to 23 > ; < 31 > : every hour[a]
A value of FF_h in all three bytes (that means $FFFFFF_h$) shall be interpreted as invalid. Note that in EN 13757–3:2013 the 000000h was applied to signal the state “invalid”. Unused bits shall be 0 except the value is invalid.								
[a] Other values are reserved for future usage.								

Type K: Daylight savings

Data field = 0100 (32 bits)

Table A.10 — Type K: Daylight savings

7	6	5	4	3	2	1	0	Daylight savings begin (given in local time):
15	14	13	12	11	10	9	8	Hour: **UI**5 [0 to 4] < 0 to 23 > ; < 31 > : not specified[a]
23	22	21	20	19	18	17	16	Day: **UI**5 [8 to 12] < 1 to 31 > [a]
31	30	29	28	27	26	25	24	Month: **UI**4 [24 to 27] < 1 to 12 > [a]
								Daylight savings end: (given in local time): Day: **UI**5 [16 to 20] < 1 to 31 > [a] Month **UI**4 [28 to 31] < 1 to 12 > [a] Daylight savings enable **UI**1 [15] < 0 to 1 > < 1 > enables daylight savings function Daylight savings deviation (hour)[b] **UI**1 [23] < 0 to 1 > < 0 > : "–" ; < 1 >: "+" **UI**2 [21 to 22] < 0 to 3 > ; < 0 > : no daylight savings Deviation from local time to the Greenwich Mean Time (hour): **UI**5 [5 to 7; 13 to 14] < 0 to 23 > ; < 31 > : not specified[a]

[a] Other values are reserved for future uses.

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

Type L: Listening window management

Data field = 1101_b (variable length LVAR = EB_h)

Table A.11 — Type L: Listening window management

Byte/bit	**MSBit**							**LSBit**
LSB	7	6	5	4	3	2	1	0
	15	14	13	12	11	10	9	8
	23	22	21	20	19	18	17	16
	31	30	29	28	27	26	25	24
	39	38	37	36	35	34	33	32
	47	46	45	44	43	42	41	40
	55	54	53	52	51	50	49	48
	63	62	61	60	59	58	57	56
	71	70	69	68	67	66	65	64
	79	78	77	76	75	74	73	72
MSB	87	86	85	84	83	82	81	80

This command is used to initialize 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 0 to bit 52. The first week of the year is represented by bit 0 to the 52nd by the bit 51.

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 53 to bit 59. Sunday is represented by bit 53, Monday by bit 54 to Saturday by bit 59.

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 60 to bit 83. The first hour is represented by bit 60 to the 24th hour by bit 83.

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 84 to bit 87. The first quarter is represented by bit 84 to the fourth quarter by the bit 87.

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.

EXAMPLE

If bits 2, 54, 55, 60 and 61 are set to 1 and the others are set to 0. The meter is in normal mode between 0 h and 2 h on Monday and Tuesday of the third week of the year.

If bits 2, 54, 55, 60, 62, 84 and 85 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.

Type M: Compound CP_LVAR: Date and time/duration

Data field 1101_b (variable length LVAR = E2 to EA_h)

This time format is coded according to the coordinated universal time (UTC). It corresponds to Epoch time. This data type can be adjusted in length and resolution.

Table A.12 — Type M: Date and time (CP_LVAR)

7	6	5	4	3	2	1	0	Duration since the starting time:
...							...	**I**(X−8) [0 to (X−9)] < $(-2^{(X-9)}+1)$ to $(+2^{(X-9)}-1)$ > [a]
X−9							X−16	< -2^{X-9} > : signals “invalid”
X−1	X−2	X−3	X−4				X−8	Time Offset: **I**5 [(X−8) to (X−4)]
								< −16 > : relative time (duration)[a,b,c] < −12 to +14 > : offset to UTC in hours[a,b] Resolution: **B**2 [(X−3) to (X−2)] < 0 > : 2 s < 1 > : 1 s < 2 > : 1/256 s < 3 > : 1/32768 s Starting time: **B**1 [X−1] < 0 > : 2013–01–01 at 00:00:00 (UTC)[c] < 1 > : 1970–01–01 at 00:00:00 (UNIX-Time)

[a] Negative values are in two’s complement.

[b] Other values are reserved for future uses.

[c] In case of relative time the bit Starting time shall be 0.

The time format Type M contains always the coordinated universal time. A deviation of the local time zone to UTC can be considered in the field time offset. Daylight savings shall not be used in this time format.

NOTE This format does not support time zones, which use a fraction of an hour to UTC.

A time offset of 10000_b specifies a point in time relative to a reference time. In this case the value in starting time does not care. If no specific reference time is declared the time of transmission shall be used.

For the application in the M-Bus-protocol the data type LVAR shall be used. The number of used data bits X is calculated by X = 8*(LVAR-$E0_h$).

EXAMPLE 1 A timestamp 2013–01–02 at 01:02:03 (UTC) presented by a 4 byte timer with a resolution in seconds and an offset of 1 h (=2013–01–02 02:02:03 CET) is codes as:

$0D_h$ $6D_h$ $E5_h$ $0B_h$ 60_h 01_h 00_h 21_h (= 90123 s after 2013–01–01 at 00:00:00 UTC).

EXAMPLE 2 An event 34,5 s before the meter transmission presented by a 2 byte timer with a resolution of 256th part of a second is coded as:

$0D_h$ $6D_h$ $E3_h$ 80_h DD_h 50_h (= −8832 · 1/256 s).

Annex B
(normative)

Interpretation of hex-codes A_h–F_h in BCD-data fields

B.1 General description standard reference

B.1.1 General

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

B.1.2 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) Utilize these codes for simplified error treatment by slave.

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 10 entry BCD to 7-segment decoding a 16-entry decoding table.

B.2 Definition

B.2.1 Hex code meanings

a) A_h–E_h

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) F_h

Such a code in the most significant 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**	**A_h**	**B_h**	**C_h**	**D_h**	**E_h**	**F_h**
"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 $3D_h$ (non-metric units, see Table 15) is used, the standard metric units of the VIF table is substituted as shown in Table C.1.

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
E11001nn	0,001°C to 1 °C	0,001°F to 1 °F	External temperature

C.2 Plain text units

In case of VIF = $7C_h/FC_h$ 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).

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 bytes 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 » (20_h) and « valve » (21_h) 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 shall apply. The VIF/VIFE = FD_h $1F_h$ 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 elements to implement these functions would be possible. To enable/disable a valve the values in the least significant byte after VIF/VIFE = FD_h $1F_h$ shall follow 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 to 255	Reserved

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

EXAMPLE To close a valve together with the sequence counter of 3:

04h FD_h 08_h 03_h 00_h 00_h 00_h 01_h FD_h $1F_h$ 00

Annex D
(informative)

Alarm protocol

D.1 M-Bus according EN 13757-2

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 71_h (no header), 74_h (short header) or 75_h (long header) to report an alarm state (EN 13757-7:2018, Annex A).

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 a 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 71_h (no header), 74_h (short header) or 75_h (long header) to report an alarm state (EN 13757-7:2018, Annex A).

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

Annex E
(informative)

Special sequences for M-Bus devices

E.1 VIF/VIFE/VIFE = FD_h 97_h $1D_h$ (error flag)

If the data point VIF/VIFE/VIFE = FD_h 97_h $1D_h$ is used, then the least significant bytes of error flag have the meaning given in Tables E.1, E.2 and E.3.

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

Bit	Meaning with set bit	Explanation
b0	Mechanical Tamper[a]	In case of critical mechanical modifications (e.g. opening the meter, module dismounting)
b1	Battery low	Set in case of under voltage or predicted end of life
b2	External alarm[a]	A critical error is provided by an external input
b3	Battery cut or disconnection	In case of hard voltage drop
b4	Hardware or software error	e.g. Checksum error of memory chip, watchdog timer, stack overflow
b5	Connection interrupt[a]	e.g. Adapter lost connection to meter by wire cut
b6	Magnetic tamper[a]	In case of detecting magnetic manipulation
b7	Standardized error byte following[b]	Set to 1: more standardized error bytes will follow Set to 0: manufacturer specific error bytes may follow
NOTE A clear bit marks a state of normal operation.		
[a] If this error is used together with a historical error of Table EF3 it should only give the current (real time) status. If a historical error is not provided this bit should be the (logical OR) combination of historical and real time behaviour. [b] The number of standardized and manufacture specific error bytes is defined by the data field in the DIF (see Table 4). The last standardized error byte shall use a b7 = 0_b		

Table E.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

Table E.4 — Meaning of error bits in the second least significant error byte (EF2)

Bit	Meaning with set bit	Explanation
b0	Unauthorised access attempt	In case of attempt of unauthorised access via local or remote interface, (e.g. wrong key, counter or password).
b1	Credit limit exceeded	Communication credit limit reached
b2	Leakage[a]	Recognizing continuously flow for a longer time
b3	No flow[a]	Recognizing no flow for a longer time (e.g. meter blocked or removed totally)
b4	Consumption out of range	Meter not used appropriate e.g. overflow (>Qmax), underflow (<Qmin)
b5	Sensor out of range[a]	Possible wrong installation of meter, e.g. a sensor detecting wrong input values like backward flow or too high temperature
b6	Clock Sync error	In case of missing synchronisation event or receiving unexpected big correction value
b7	Standardized error byte following[b]	Set to 1: more standardized error bytes will follow Set to 0: manufacturer specific error bytes may follow
NOTE A clear bit marks a state of normal operation.		
[a] If this error is used together with a historical error of Table EF3 it should only give the current (real time) status. If a historical error is not provided this bit should be the (logical OR) combination of historical and real time behaviour. [b] The number of standardized and manufacture specific error bytes is defined by the data field in the DIF (see Table 4). The last standardized error byte shall use a b7 = 0_b		

Table E.5 — Third least significant error byte (EF3)

b7	b6	b5	b4	b3	b2	b1	b0
2^{23}	2^{22}	2^{21}	2^{20}	2^{19}	2^{18}	2^{17}	2^{16}

Table E.6 — Meaning of error bits in the third least significant error byte (EF3)

Bit	Meaning with set bit	Explanation
b0	Historical mechanical tamper	In case of past mechanical modifications (e.g. opening the meter, module dismounting).
b1	Historical magnetic tamper	In case of past magnetic manipulation
b2	Historical connection interrupt	There was a connection problem e.g. to an adapter
b3	Historical external alarm	There was a critical error provided by an external input
b4	Historical leakage	A continuous flow was recognized for a longer time
b5	Historical no flow	No Flow was recognized for a longer time
b6	Historical sensor out of range	There was a sensor error like backward flow
b7	Standardized error byte following[a]	Set to 1: more standardized error bytes will follow Set to 0: manufacturer specific error bytes may follow
NOTE A clear bit marks a state of normal operation.		
a The number of standardized and manufacture specific error bytes is defined by the data field in the DIF (see Table 4). The last standardized error byte shall use a b7 = 0_b		

If the meter detects an error and marks this condition in this data point it shall also 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 shall be cleared too.

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

If the data point VIF/VIFE/VIFE = FD_h $9F_h$ $1D_h$ for a wireless M-Bus device is used the least significant byte of remote control has the meaning given in Tables E.4, E.5, E.6, E.7 and E.8.

Table E.7 — 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 E.8 — 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 E.9 — 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 E.10 — Remote control (RC1): power save mode

b6	Mode select
0	power save mode
1	normal mode

Table E.11 — Remote control (RC1): reserved

b2	reserved for future use
b7	reserved for future use

The meaning of following bytes is reserved for future extensions.

E.3 Clock synchronization

Two additional CI-fields ($6C_h$ and $6D_h$) 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 and/or authenticated to prevent unauthorized date/time changes in the meter. The last four $2F_h$ 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 given in Tables E.9, E.10 and E.11.

Table E.12 — Structure of TC-field

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

a) Set new date and time:

Table E.13 — Application frame “time setting” with CI = $6C_h$ (Set date and time)

CI = $6C_h$	Long Data-Header (EN 13757–7:2018, Annex A)	TC-Field (1 byte) (set time)	Date/time in Format I (6 bytes, LSB first)	Reserved (3 bytes = 00_h)	Command verification (4 bytes = 4*”$2F_h$”)

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 E.14 — Application frame “time adjustment” with CI = $6D_h$ (Add/Subtract Time Offset)

CI = $6D_h$	Long Data-Header (EN 13757–7:2018, Annex A)	TC-Field (1 byte) (add or subtract)	Time in Format J (3 bytes, LSB first)	Reserved (6 bytes = 00_h)	Command verification (4 bytes = 4*”$2F_h$”)

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 synchronization 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 CEN/TR 17167:2018, Annex G.6.

Annex F
(normative)

Transmission of profiles

F.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 containing pairs of consumption point of time and consumption value.

For example, Table F.1 gives a load profile of consumption values for a water meter.

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

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

Table F.2 shows how this load profile shall be transmitted.

Table F.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.

F.2 The M-Bus compact profile

F.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 shall be assumed that the base value or base parameters are missed.

F.2.2 The base value and base parameter

The data point base value (Table F.3) is the oldest value of the data series for VIFE = $1E_h/1F_h$ respectively the youngest value for VIFE = 13_h. It shall always exist unless the increment mode "Absolute value" (00_b) 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 F.3 — Base value record (connected via storage-, tariff-, subunit number and VIF/VIFEx)

DIF/DIFE	VIF/VIFEx	Base value

F.2.3 The base time

The base time (Table F.4) shall be encoded with one of the Types F to J or M (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 F.4 — Base time record (connected via the storage number)

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

F.2.4 Structure of the compact profile

The compact profile record (Table F.5) 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 = xD_h) followed by a length byte with values between 3 and 191 ($0BF_h$). 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 F.5 — Profile record (connected via storage-, tariff-, subunit number and VIF/VIFEx)

DIF/DIFE with variable length DIF = xD_h	VIF/VIFEx VIFE = $1E_h/1F_h/13_h$	LVAR # bytes (03_h to BF_h)	Spacing control byte	Spacing value byte	Profile Value	...

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

The first byte (spacing control byte, Tables F.6 and F.7) 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 (00_b = sec, 01_b = min, 10_b = hours and 11_b = days). The highest two bits signal the increment mode of the profile (00_b = absolute value (signed), 01_b = positive (unsigned) increments (all differences ≥ 0), 10_b = negative (unsigned) increments (all differences ≤ 0), 11_b = signed difference, with: difference = younger value minus older 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 F.6 — Spacing control byte

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 F.7 — Structure of spacing control byte

bit 6 to 7: Increment mode	bit 4 to 5: Spacing unit	bit 0 to 3: Element size
00_b = Absolute value	00_b = seconds	Profile DIF, low nibble only, but except $0D_h$ and except $0F_h$ (see Table 4)
01_b = Increments	01_b = minutes/month[a]	
10_b = Decrements	10_b = hours/month[a]	
11_b = Signed difference	11_b = days/month[a]	

[a] See Table F.8

After the space control byte follows the space value byte (single byte, Table F.8) 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 value 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 F.8 — Spacing value byte

Spacing value	Spacing unit	Meaning
0	00_b to 11_b[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	00_b to 10_b 11_b	Reserved; a half month between values
254	00_b 01_b 10_b 11_b	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 only one column is needed, the spacing unit 00b shall be used. When more than one column is used, the spacing unit describes the column number by the formula spacing unit +1 (e.g. spacing unit 01_b 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.

NOTE 2 The order of values is inverse for the "Inverse compact profile" (see F.2.8).

F.2.5 Types of compact profile

The M-Bus supports three types of compact profiles:

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

— "Compact profile" for the transport of an unlimited number of values as a series with no assignment to a register number (e.g. load profile);

— "Inverse compact profile" for the transport of an unlimited number of values as a series with no assignment to a register number (e.g. load profile).

The Compact profile with register numbers applies the storage numbers in a different way than the Compact profile (without register numbers) and the Inverse compact profile. 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.

F.2.6 Compact profile with register numbers (orthogonal VIFE = $1E_h$)

The Compact profile with register numbers shall be selected if the assignment of a historical value to an accumulation register number 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 register numbers, a coding with a Final DIFEs as specifies in 6.3.5 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 Table F.9 and Table F.10 show an absolute profile of monthly consumption values (Tariff 1) of an electricity meter.

Table F.9 — Example of compact profile with register numbers: 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 F.10 — Example of compact profile with register numbers: M-Bus data records

Data point type	Stor.	Tariff	M-Bus data record
Base time	#32	T0	86_h 80_h 81_h 00_h $6D_h$ 00_h 00_h $A0_h$ 41_h 11_h 35_h
Base value	#32	T1	84_h 90_h 81_h 00_h 03_h $F0_h$ 49_h 02_h 00_h
Profile 1 (2 values: #33;#34)	#32	T1	$8D_h$ 90_h 81_h 00_h 83_h $1E_h$ $0A_h$ 34_h FE_h $A0_h$ 86_h 01_h 00_h $D0_h$ FB_h 01_h 00_h
Base time	#35	T0	$C6_h$ 81_h 81_h 00_h $6D_h$ $0B_h$ $0C_h$ $8D_h$ 59_h 13_h $0C_h$
Base value	#35	T1	$C4_h$ 91_h 81_h 00_h 03_h 90_h $5F_h$ 01_h 00_h
Base time	#36	T0	86_h 82_h 81_h 00_h $6D_h$ 00_h 00_h 80_h 41_h 14_h $0D_h$
Base value	#36	T1	84_h 92_h 81_h 00_h 03_h 50_h $C3_h$ 00_h 00_h
Profile 2 (1 value: #37)	#36	T1	$8D_h$ 92_h 81_h 00_h 83_h $1E_h$ 06_h 34_h FE_h 00_h 71_h 02_h 00_h

F.2.7 Compact profile (orthogonal VIFE = $1F_h$)

The compact profiles shall start with the storage number > #0. They may use a flexible number of DIF's and DIFE's. Chained compact profiles use (unlike the compact profiles with register numbers) the next higher storage number. The use of the storage number #0 is not permitted for compact profiles.

EXAMPLE Tables F.11 and F.12 with incremental load profile; 3 hourly volume values after midnight coded with BCD.

Table F.11 — Example of compact profile: Plain data

Base value	01.01.2010 00:00	12 300,0 m^3
Oldest profile value	01.01.2010 01:00	12 300,3 m^3
Second oldest profile value	01.01.2010 02:00	12 300,5 m^3
Third oldest profile value	01.01.2010 03:00	12 301,6 m^3

Table F.12 — Example of compact profile: M-Bus data records

Data point type	Stor.	Tariff	M-Bus data record
Base time	#8	T0	84_h 04_h $6D_h$ 00_h 20_h 41_h 11_h
Base value	#8	T0	$8B_h$ 04_h 15_h 00_h 30_h 12_h
Profile	#8	T0	$8D_h$ 04_h 95_h $1F_h$ 05_h 69_h 01_h 03_h 02_h 11_h

F.2.8 Inverse compact profile (orthogonal VIFE = 13_h)

The inverse compact profile (Tables F.13 and F.14) is identical with compact profiles (VIFE = $1F_h$) except the order of data points. For this compact profile the base value is always the youngest value.

Table F.13 — Example of inverse compact profile: Plain data

Third youngest value	01.01.2010 00:00	12 300,0 m^3
Second youngest value	01.01.2010 01:00	12 300,3 m^3
Youngest profile value	01.01.2010 02:00	12 300,5 m^3
Base Time/Base value	01.01.2010 03:00	12 301,6 m^3

Table F.14 — Example of inverse compact profile: M-Bus data records

Data point type	Stor.	Tariff	M-Bus data record
Base time	#8	T0	84_h 04_h $6D_h$ 00_h 23_h 41_h 11_h
Base value	#8	T0	$8B_h$ 04_h 15_h 16_h 30_h 12_h
Profile	#8	T0	$8D_h$ 04_h 95_h 13_h 05_h 69_h 01_h 11_h 02_h 03_h

Note that in this example the Increment mode in the Profile is set to 01_b = Increments, because in the plain data in Table F.13 the metering values are increasing with the time.

Annex G
(normative)

Compact M-Bus frame

G.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 frame 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.

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

G.2.1 General

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

Table G.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	80_h
M-Bus-Compact frame	84_h
M-Bus-Format frame	85_h

The Full M-Bus frame (Table G.3) 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 21).

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 G.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 EN 13757-7:2018, Annex A.

Table G.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	78_h	$7A_h$	72_h
M-Bus-Compact frame	79_h	$7B_h$	73_h
M-Bus-Format frame	69_h	$6A_h$	$6B_h$

G.2.2 Full M-Bus frame

Table G.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 (Table G.5) including the Format Signature (Table G.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.

G.2.3 M-Bus- Compact frame

Table G.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 $2F_h$.

NOTE The data header contains the AES check bytes if applicable (refer to EN 13757–7:2018, Annex A).

G.2.4 M-Bus-Format frame

Table G.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 EN 13757–7:2018, Annex A).

G.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

G.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 shall 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

G.5 Frame examples

G.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 W_h;

— Volume = 567,8 m^3; and

— Power = 901,2 W.

G.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 = 78_h):

CI DIF VIF Data DIF VIF Data DIF VIF Data

78_h 02_h 02_h $D2_h$ 04_h 02_h 15_h $2E_h$ 16_h 02_h $2A_h$ 34_h 23_h

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

CI LF FOS FOS DIF VIF DIF VIF DIF VIF

69_h 008_h FOS FOS 02_h 02_h 02_h 15_h 02_h $2A_h$

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

CI FOS FOS FFC FFC Data Data Data

79_h FOS FOS FFC FFC $D2_h$ 04_h $2E_h$ 16_h 34_h 23_h

G.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 = $7A_h$):

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

$7A_h$ 01_h 00_h 00_h 00_h 02_h 02_h $D2_h$ 04_h 02_h 15_h $2E_h$ 16_h 02_h $2A_h$ 34_h 23_h

M-Bus-Format frame (CI = $6A_h$):

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

$6A_h$ 01_h 00_h 00_h 00_h 008_h FOS FOS 02_h 02_h 02_h 15_h 02_h $2A_h$

M-Bus-Compact frame (CI = $7B_h$):

CI ACC STS ConfFLD FOS FOS FFC FFC Data Data Data

$7B_h$ 01_h 00_h 00_h 00_h FOS FOS FFC FFC $D2_h$ 04_h $2E_h$ 16_h 34_h 23_h

G.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 = $7A_h$):

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

$7A_h$ 01_h 00_h 10_h 05_h[$2F_h$ $2F_h$ 02_h 02_h $D2_h$ 04_h 02_h 15_h $2E_h$ 16_h ...

Filler DIF DIF VIF Data

$2F_h$ $2F_h$ $2F_h$ $2F_h$ $2F_h$ $2F_h$]02_h $2A_h$ 34_h 23_h

M-Bus-Format frame (CI = $6A_h$):

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

$6A_h$ 01_h 00_h 10_h 05_h[$2F_h$ $2F_h$ $0C_h$ FOS FOS 02_h 02_h 02_h 15_h $2F_h$ ...

DIF DIF DIF DIF DIF Filler DIF DIF VIF

$2F_h$ $2F_h$ $2F_h$ $2F_h$ $2F_h$ $2F_h$] 02_h $2A_h$

M-Bus-Compact frame (CI = $7B_h$):

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

$7B_h$ 01_h 00_h 10_h 05_h[$2F_h$ $2F_h$ FOS FOS FFC FFC $D2_h$ 04_h $2E_h$ 16_h ...

Filler DIF Data

$2F_h$ $2F_h$ $2F_h$ $2F_h$ $2F_h$ $2F_h$]34_h 23_h

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 H
(normative)

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

H.1 General

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 tables shall be used. It is not meant that VIF/DIF values shall be used under any circumstances, as OBIS codes can also be transmitted as such.

H.2 Translation of predefined data record types

The following list of Tables H.1 to H.10 describes how a communication partner translates received M-Bus records into OBIS type records.

The B-Field of the OBIS Code shall be built from the subunit in related DIFE of data point (refer to 6.3.9). Only when the meter uses one channel the subunit and also the B-Field of the OBIS Code are 0 (as listed in this table). If a meter uses more than one channel then the subunit and also the B-Field of the OBIS Code are declared as channel number which starts with 1.

Table H.1 — M-Bus to OBIS translation: symbol explanation

Symbol/ Bit symbol	Meaning
M	Mandatory (These data objects shall 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 EN 13757–7:2018, Table 7
cccc	Coding of the data field, according to Table 4 (except real, variable length, selection for readout, special functions)
n	One or more bits, according to Tables 10, 12, 13 and 14
VZ	Previous recent value(s) $0 \leq VZ \leq 99$ or $101 \leq VZ \leq 125$
x	Definition of the bit of the M-Bus storage number, which is equivalent to the billing period counter (VZ) (see Tables 3 and 8); value range 0 to 99 and 101 to 125

Table H.2 — M-Bus to OBIS translation: general data (for all devices)

	Type	OBIS-Code	Description	DIF/DIFE or fixed fields [binary]	VIF/VIFE [binary]
	Abstract	Value group A = 0	All media		
M	Error status	0–0:97.97.0*255	Status according to EN 13757–7:2018, Table 15		
	–		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/asset identifier (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 H.3 — M-Bus to OBIS translation: electricity meter

	Type	OBIS-Code	Description	DIF/DIFE or fixed fields [binary]	VIF/VIFE [binary]
	Electricity	Value group A = 1	02_h (see EN 13757–7:2018, Table 13)		
A1	Meter count	1–0:1.8.0*255	Active energy import (+A), current value[a]		
	–	kWh	10e–6 to 10e+1	0000 cccc	0000 0nnn
	–	kWh	10e+2 to 10e+3	0000 cccc	1111 1011 0000 000n
	–	kWh	10e+5 to 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[b]		
	–	kWh	10e–6 to 10e+1	1x00 cccc 1000 xxxx 0000 00xx	0000 0nnn
	–	kWh	10e+2 to 10e+3	1x00 cccc 1000 xxxx 0000 00xx	1111 1011 0000 000n
	–	kWh	10e+5 to 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[a]		
	–	kWh	10e–6 to 10e+1	0000 cccc	1000 0nnn 0011 1100
	–	kWh	10e+2 to 10e+3	0000 cccc	1111 1011 1000 000n 0011 1100
	–	kWh	10e+5 to 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[b]		
	–	kWh	10e–6 to 10e+1	1x00 cccc 1000 xxxx 0000 00xx	1000 0nnn 0011 1100
	–	kWh	10e+2 to 10e+3	1x00 cccc 1000 xxxx 0000 00xx	1111 1011 1000 000n 0011 1100
	–	kWh	10e+5 to 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	OBIS-Code	Description	DIF/DIFE or fixed fields [binary]	VIF/VIFE [binary]
	–	Type G		0000 0010	0110 1100
	–	Type F		0000 0100	0110 1101
O	Time, date of count	1–0:0.1.2*255	Time stamp (local time) of the most recent billing period (commonly calculated from local date and local time information)		
				0000 cccc	0111 01nn
O	Date of count	1–0:0.1.2*VZ	Local date at time of recent meter value, billing period[b]		
	–	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* s		0000 cccc	0111 00nn

a The applied averaging period is provided in 1–0:0.8.2*255.

b Final DIFE shall be according to 6.3.5.

Table H.4 — M-Bus to OBIS translation: heat cost allocator

	Type	OBIS-Code	Description	DIF/DIFE or fixed fields [binary]	VIF/VIFE [binary]
	HCA	Value group A = 4	08_h (see EN 13757–7:2018, Table 13)		
M	Meter count	4–0:1.0.0*255	Unrated integral, current value		
	–	HCA	10e+0	0000 cccc	0110 1110
M	Meter count	4–0:1.3.0*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	4–0:0.9.3*255	Time stamp (local time) of the most recent billing period (commonly calculated from local date and local time information)		
				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
O	Rating factor	4–x:0.4.0*255	Resulting rating factor, K[a]		
		$h^{(-1)}$	resolution $2^{(-12)}$	0000 cccc	1111 1011 0110 1000
O	Rating factor	4–x:0.4.1*255	Thermal output rating factor, Kq[a]		
		Watt	resolution 1	0000 cccc	1111 1011 0110 1001
O	Rating factor	4–x:0.4.2*255	Thermal coupling rating factor overall, Kc[a]		
			resolution $2^{(-12)}$	0000 cccc	1111 1011 0110 1010

	Type	OBIS-Code	Description	DIF/DIFE or fixed fields [binary]	VIF/VIFE [binary]
O	Rating factor	4–x:0.4.3*255	Thermal coupling rating factor room side, Kcr[a] resolution $2^{(-12)}$	0000 cccc	1111 1011 0110 1011
O	Rating factor	4–x:0.4.4*255	Thermal coupling rating factor heater side, Kch[a] resolution $2^{(-12)}$	0000 cccc	1111 1011 0110 1100
O	Rating factor	4–x:0.4.5*255	Low temperature rating factor, Kt[a] resolution $2^{(-12)}$	0000 cccc	1111 1011 0110 1101
O	Rating factor	4–x:0.4.6*255 $kWh^{(-1)}$	Display output scaling factor, KD[a] resolution $2^{(-12)}$	0000 cccc	1111 1011 0110 1110

a See also Table 14.

Table H.5 — M-Bus to OBIS translation: cooling meter

	Type	OBIS-Code	Description	DIF/DIFE or fixed fields [binary]	VIF/VIFE [binary]
	Cooling	Value group A = 5	$0A_h$, $0B_h$ (see EN 13757–7:2018, Table 13)	(Cooling only)	
M	Meter count	5–0:1.0.0*255	Energy (A), total, current value		
	–	kWh	10e–6 to 10e+1	0000 cccc	0000 0nnn
	–	kWh	10e+2 to 10e+3	0000 cccc	1111 1011 0000 000n
	–	kWh	10e+5 to 10e+6	0000 cccc	1111 1011 1000 000n 0111 1101
	–	GJ	10e–9 to 10e–2	0000 cccc	0000 1nnn
	–	GJ	10e–1 to 10e+0	0000 cccc	1111 1011 0000 100n
	–	GJ	10e+2 to 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 to 10e+1	0100 cccc	0000 0nnn
	–	kWh	10e+2 to 10e+3	0100 cccc	1111 1011 0000 000n
	–	kWh	10e+5 to 10e+6	0100 cccc	1111 1011 1000 000n 0111 1101
	–	GJ	10e–9 to 10e–2	0100 cccc	0000 1nnn
	–	GJ	10e–1 to 10e+0	0100 cccc	1111 1011 0000 100n
	–	GJ	10e+2 to 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[a]		
	–	W	10e–3 to 10e+4	0000 cccc	0010 1nnn
	–	kJ/h	10e–3 to 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 to 10e+1	0000 cccc	0011 1nnn
O	Time of device	5–0:0.9.1*255	Current time at time of transmission		

	Type	OBIS-Code	Description	DIF/DIFE or fixed fields [binary]	VIF/VIFE [binary]
	–	Type F		0000 0100	0110 1101
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	5–0:0.9.3*255	Time stamp (local time) of the most recent billing period (commonly calculated from local date and local time information)		
				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* s		0000 cccc	0111 00nn

[a] The applied averaging period is provided in 5–0:0.8.5*255.

Table H.6 — M-Bus to OBIS translation: combined heat and cooling meter

	Type	OBIS-Code	Description	DIF/DIFE or fixed fields [binary]	VIF/VIFE [binary]
	Cooling	Value group A = 5	$0D_h$ (cooling) (see EN 13757–7:2018, Table 13)	(Combined heat/cooling)	
M	Meter count	5–0:1.0.0*255	Energy (*A*), total, current value		
	–	kWh	10e–6 to 10e+1	1000 cccc 0001 0000	0000 0nnn
	–	kWh	10e+2 to 10e+3	1000 cccc 0001 0000	1111 1011 0000 000n
	–	kWh	10e+5 to 10e+6	1000 cccc 0001 0000	1111 1011 1000 000n 0111 1101
		kWh	10e–6 to 10e+1	0000 cccc	1000 0nnn 0011 1100
		kWh	10e+2 to 10e+3	0000 cccc	1111 1011 1000 000n 0011 1100
		kWh	10e+5 to 10e+6	0000 cccc	1111 1011 1000 000n 1111 1101 0011 1100
	–	GJ	10e–9 to 10e–2	1000 cccc 0001 0000	0000 1nnn
	–	GJ	10e–1 to 10e+0	1000 cccc 0001 0000	1111 1011 0000 100n
	–	GJ	10e+2 to 10e+3	1000 cccc 0001 0000	1111 1011 1000 100n 0111 1101
		GJ	10e–9 to 10e–2	0000 cccc	1000 1nnn 0011 1100
		GJ	10e–1 to 10e+0	0000 cccc	1111 1011 1000 100n 0011 1100
		GJ	10e+2 to 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 to 10e+1	1100 cccc 0001 0000	0000 0nnn
	–	kWh	10e+2 to 10e+3	1100 cccc 0001 0000	1111 1011 0000 000n
	–	kWh	10e+5 to 10e+6	1100 cccc 0001 0000	1111 1011 1000 000n 0111 1101
	–	kWh	10e–6 to 10e+1	0100 cccc	1000 0nnn 0011 1100
	–	kWh	10e+2 to 10e+3	0100 cccc	1111 1011 1000 000n 0011 1100
	–	kWh	10e+5 to 10e+6	0100 cccc	1111 1011 1000 000n 1111 1101 0011 1100
	–	GJ	10e–9 to 10e–2	1100 cccc 0001 0000	0000 1nnn

	Type	OBIS-Code	Description	DIF/DIFE or fixed fields [binary]	VIF/VIFE [binary]
	–	GJ	10e–1 to 10e+0	1100 cccc 0001 0000	1111 1011 0000 100n
	–	GJ	10e+2 to 10e+3	1100 cccc 0001 0000	1111 1011 1000 100n 0111 1101
	–	GJ	10e–9 to 10e–2	0100 cccc	1000 1nnn 0011 1100
	–	GJ	10e–1 to 10e+0	0100 cccc	1111 1011 1000 100n 0011 1100
	–	GJ	10e+2 to 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[a]		
	–	W	10e–3 to 10e+4	1000 cccc 0001 0000	0010 1nnn
	–	kJ/h	10e–3 to 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		
	–	m^3/h	10e–6 to 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	5–0:0.9.3*255	Time stamp (local time) of the most recent billing period (commonly calculated from local date and local time information)		
				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* s		1000 cccc 0001 0000	0111 00nn

[a] The applied averaging period is provided in 5–0:0.8.5*255.

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

Table H.7 — M-Bus to OBIS translation: heat meter

	Type	OBIS-Code	Description	DIF/DIFE or fixed fields [binary]	VIF/VIFE [binary]
	Heat	Value group A = 6	04_h, $0C_h$, $0D_h$ (heat) (see EN 13757–7:2018, Table 13)	(Heat only and combined heat/cooling)	
M	Meter count	6–0:1.0.0*255	Energy (A), total, current value		
	–	kWh	10e–6 to 10e+1	0000 cccc	0000 0nnn
	–	kWh	10e+2 to 10e+3	0000 cccc	1111 1011 0000 000n
	–	kWh	10e+5 to 10e+6	0000 cccc	1111 1011 1000 000n 0111 1101
	–	GJ	10e–9 to 10e–2	0000 cccc	0000 1nnn
	–	GJ	10e–1 to 10e+0	0000 cccc	1111 1011 0000 100n
	–	GJ	10e+2 to 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 to 10e+1	0100 cccc	0000 0nnn
	–	kWh	10e+2 to 10e+3	0100 cccc	1111 1011 0000 000n
	–	kWh	10e+5 to 10e+6	0100 cccc	1111 1011 1000 000n 0111 1101
	–	GJ	10e–9 to 10e–2	0100 cccc	0000 1nnn
	–	GJ	10e–1 to 10e+0	0100 cccc	1111 1011 0000 100n
	–	GJ	10e+2 to 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[a]		
	–	W	10e–3 to 10e+4	0000 cccc	0010 1nnn
	–	kJ/h	10e–3 to 10e+4	0000 cccc	0011 0nnn
O	Flow rate	6–0:9.0.0*255	Flow rate, average (V_a/t), current value		

	Type	OBIS-Code	Description	DIF/DIFE or fixed fields [binary]	VIF/VIFE [binary]
	–	m^3/h	10e–6 to 10e+1	0000 cccc	0011 1nnn
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	Time stamp (local time) of the most recent billing period (commonly calculated from local date and local time information)		
				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* s		0000 cccc	0111 00nn

[a] The applied averaging period is provided in 6–0:0.8.5*255.

Table H.8 — M-Bus to OBIS translation: gas meter

	Type	OBIS-Code	Description	DIF/DIFE or fixed fields [binary]	VIF/VIFE [binary]
	Gas	Value group A = 7	03_h (see EN 13757–7:2018, Table 13)		
A1	Meter count	7–0:3.0.0*255	Volume (meter), metering conditions (V_m), forward, absolute, current value		
	–	m^3	10e–6 to 10e+1	0000 cccc	1001 0nnn 0011 1010
	–	m^3	10e–3 to 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		
	–	m^3	10e–6 to 10e+1	0000 cccc	0001 0nnn
	–	m^3	10e–3 to 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		
	–	m^3	10e–6 to 10e+1	0000 cccc	1001 0nnn 0011 1110
	–	m^3	10e–3 to 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[d]		
	–	m^3	10e–6 to 10e+1	1x00 cccc 1000 xxxx 0000 00xx	1001 0nnn 0011 1010
	–	m^3	10e–3 to 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[d]		
	–	m^3	10e–6 to 10e+1	1x00 cccc 1000 xxxx 0000 00xx	0001 0nnn
	–	m^3	10e–3 to 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[d]		
	–	m^3	10e–6 to 10e+1	1x00 cccc 1000 xxxx 0000 00xx	1001 0nnn 0011 1110

	Type	OBIS-Code	Description	DIF/DIFE or fixed fields [binary]	VIF/VIFE [binary]
	–	m^3	10e−3 to 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)[a]		
	–	m^3/h	10e−6 to 10e+1	0000 cccc	1011 1nnn 0011 1010
O	Flow rate	7–0:43.63.0*255	Flow rate at metering conditions, averaging period 4 (no default value), current interval (V_m/t_1)[a]		
	–	m^3/h	10e−6 to 10e+1	0000 cccc	1011 1nnn 0011 1010
O	Flow rate	7–0:43.16.0*255	Flow rate, temperature converted, averaging period 1 (default period 5 min), current interval (Vtc/t1)[b]		
	–	m^3/h	10e−6 to 10e+1	0000 cccc	0011 1nnn
O	Flow rate	7–0:43.64.0*255	Flow rate, temperature converted, averaging period 4 (no default value), current interval (V_{tc}/t_1)[b]		
	–	m^3/h	10e−6 to 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)[c]		
	–	m^3/h	10e−6 to 10e+1	0000 cccc	1011 1nnn 0011 1110
O	Flow rate	7–0:43.65.0*255	Flow rate at base conditions, averaging period 4 (no default value), current interval (V_b/t_1)[c]		
	–	m^3/h	10e−6 to 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 to 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 to 10e+0	0000 cccc	1110 10nn 0011 1110
	–	bar	10e−6 to 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

	Type	OBIS-Code	Description	DIF/DIFE or fixed fields [binary]	VIF/VIFE [binary]
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	Time stamp (local time) of the most recent billing period		
				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) d		
	–	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 period for current flow rate value		
	–	h *or* min *or* s		0000 cccc	0111 00nn

[a] If the data point 7–0:0.8.28*255 is present the OBIS-Code 7–0:43.63.0*255 (no default averaging value) applies. Otherwise the OBIS-Code 7–0:43.15.0*255 (averaging period 1) applies.

[b] If the data point 7–0:0.8.28*255 is present the OBIS-Code 7–0:43.64.0*255 (no default averaging value) applies. Otherwise the OBIS-Code 7–0:43.16.0*255 (averaging period 1) applies.

[c] If the data point 7–0:0.8.28*255 is present the OBIS-Code 7–0:43.65.0*255 (no default averaging value) applies. Otherwise the OBIS-Code 7–0:43.17.0*255 (averaging period 1) applies.

[d] Final DIFE shall be according to 6.3.5.

Table H.9 — M-Bus to OBIS translation: water meter (cold)

	Type	OBIS-Code	Description	DIF/DIFE or fixed fields [binary]	VIF/VIFE [binary]
	Cold Water	Value group A = 8	07_h (see EN 13757-7:2018, Table 13)		
M	Meter count	8–0:1.0.0*255	Volume (*V*), accumulated, total, current value		
	–	m^3	10e–6 to 10e+1	0000 cccc	0001 0nnn
	–	m^3	10e–3 to 10e+4	0000 cccc	1001 0nnn 0111 1101
O	Meter count	8–0:1.2.0*255	Volume (*V*), accumulated, total, set date value		
	–	m^3	10e–6 to 10e+1	0100 cccc	0001 0nnn
	–	m^3	10e–3 to 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[a]		
	–	m^3/h	10e–6 to 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	8–0:0.9.3*255	Time stamp (local time) of the most recent billing period (commonly calculated from local date and local time infomation)		
				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* s		0000 cccc	0111 00nn

a The applied averaging period is provided in 8–0:0.8.6*255.

Table H.10 — M-Bus to OBIS translation: water meter (hot, warm)

	Type	OBIS-Code	Description	DIF/DIFE or fixed fields [binary]	VIF/VIFE [binary]
	Hot Water	Value group A = 9	06_h, 15_h (see EN 13757-7:2018, Table 13)		
M	Meter count	9–0:1.0.0*255	Volume (*V*), accumulated, total, current value		
	–	m^3	10e–6 to 10e+1	0000 cccc	0001 0nnn
	–	m^3	10e–3 to 10e+4	0000 cccc	1001 0nnn 0111 1101
O	Meter count	9–0:1.2.0*255	Volume (*V*), accumulated, total, set date value		
	–	m^3	10e–6 to 10e+1	0100 cccc	0001 0nnn
	–	m^3	10e–3 to 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 [a]		
	–	m^3/h	10e–6 to 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	9–0:0.9.3*255	Time stamp (local time) of the most recent billing period (commonly calculated from local date and local time information)		
				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* s		0000 cccc	0111 00nn

[a] The applied averaging period is provided in 9–0:0.8.6*255.

H.3 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 "Translation of predefined data record types" in this draft 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 EN 13757-7:2018, Table 20).

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. The content of the low nibble of the original DIF (bold marked) is replaced by length and coding of OBIS code.

The binary value for the OBIS code is always unsigned. Use binary coding if OBIS value group $F > 99$.

For example, in the case of the 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.:

$1A_h$	DIF;	maximum value; 4 digits BCD
$3B_h$	VIF;	Flow rate with unit 10^{-3} m^3/h
23_h 01_h	Value 123	

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

BCD coding:

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

1Eh	DIF;	maximum value; 12 digits BCD
BBh	VIF;	Flow rate with unit 10^{-3} m^3/h; VIFE follows
3Fh	VIFE "OBIS declaration"	
AA_h 00_h 05_h 02_h 00_h 08_h	Value; OBIS code 8–0:2.5.0*255	

NOTE The BCD Value "AA" in OBIS value group F signals an invalid value (refer to Annex A). This corresponds to a current value indicated by 255.

Binary coding:

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

16_h	DIF;	maximum value; 48 bit binary
BB_h	VIF;	flow rate with unit 10^{-3} m^3/h; VIFE follows
$3F_h$	VIFE;	"OBIS declaration"
FF_h 00_h 05_h 02_h 00_h 08_h	Value;	OBIS code 8–0:2.5.0*255

Annex I
(normative)

Image Transfer

I.1 Image Transfer Phases

I.1.1 General

Image transfer makes it possible to transfer large amount of new generic data like new software, or configuration tables or tariff information to a device. When image download is performed, then an image is transferred from a Communicating partner to one or more devices. This may be the meter or a communications interface attached to the meter. The generic term device is used for the remainder of this section. The transfer of an image consists of a number of phases, of which some are optional. The phases are:

— transfer preparation;

— transfer synchronization;

— transfer of image;

— image validation;

— image activation.

Image Transfer is performed using frames with a specific sub-range of CI-fields. The Image Transfer service is applicable to any device using an M-bus transport protocol. The Image Transfer service is applicable to, but not constrained, to the M-bus Application Layer. The Image Transfer capability is Application Layer agnostic, i.e. it may be used for any type of Application Layer.

NOTE Other Application Layer protocols, like DLMS/COSEM, may as well take advantage of the Image Transfer service.

The details of the different phases are listed in the subsequent sections. An overview of the whole process is displayed in I.3.

A device may have the capability to enable/disable Image Transfer. Enabling of Image Transfer could be based on the prior consent of the device user.

It is assumed that users of the receiving device are informed about a download. As precondition an image download operation should be agreed between the responsible partners by enablement of such operation. The management of enablement or disablement in a device, including authorization of partners, is outside the scope of this standard.

I.1.2 Transfer Preparation

This phase is optional. The purpose of this phase is to ensure that the intended receivers of the image are ready to receive the image at the intended time of transfer. The phase consists of a number of individually addressed data exchanges between the Communication partner and each of the intended individual receiving devices. The result of this phase is that the intended receiving devices have received information about:

— what data will be exchanged,

— how data will be exchanged,

— when the data will be exchanged,

— how the data can be validated.

This exchange takes place using command as specified in I.2.4 and I.2.5. The intended receivers are, when this phase is over, ready to optionally synchronize and then receive the image.

I.1.3 Transfer Synchronization

This phase is optional. The purpose of this phase is to ensure that all of the intended receivers are ready to receive the image during the transfer phase. The communication partner is transmitting the synchronization command one or more times. A device that receives a synchronization command once may be idle until start of image transfer. Commands for initiating and performing the synchronization are specified in I.2.6.

The meter should open up a reception window which is long enough to catch the synchronization command, prior to the image transfer e.g.: 10 s before. It is recommended that the gateway provides the synchronization command sufficiently repeated, e.g.: each one or two seconds.

I.1.4 Image Transfer

This phase is mandatory. The purpose of this phase is to achieve that the intended receivers have received all the image blocks with full integrity. The phase can be subdivided into the following elements that may be executed iteratively.

NOTE 1 This takes into account that the Communicating partner will multicast, then check for reception, and based on this, again multicast a subset of missing blocks, check for reception once more, and so on.

— Transfer of the image. The image is divided into blocks that fit the frame size of the transport protocol. Transfer is performed one block at a time until all of the blocks in the image have been transferred. The transfer may be repeated one or more times. This is an activity common to all of the intended receivers. The Communicating partner will transfer the image to all of the intended receivers at one time. In case of a multicast the transfer is a no-reply type of transfer (SND-UD3). The image content structure is out of scope of this standard. The transfer takes place using commands specified in I.2.7.

— Verification of the reception of the received blocks (of the image). This is an activity individual to each of the intended receivers. The Communicating partner shall, for each image transferred collect status individually from each of the intended receivers. The image may be transmitted multiple times before the status is collected from the intended receivers. The verification takes place using commands specified in I.2.8.

— Calculation of the number of outstanding blocks and selection of blocks to be (re)transferred in next attempt until the full image has been transferred to all of the intended receivers. This is an activity performed by the communicating partner. The way this is implemented is manufacturer specific and outside the scope of this standard. The activity is based on the commands and responses specified in I.2.9 and I.2.10.

The intended result of this phase is that the full image, i.e. all of the blocks of the image has been received by all of the intended receivers, and that the integrity of the overall image has been secured.

NOTE 2 From a complexity point of view it may be easier just to send the image multiple times instead of checking the individual receivers. A receiver can, if it already has received a block, just skip the reception.

NOTE 3 The verification of the reception of the blocks of an image can cause the communicating partner to 'drop' one or more of the intended receivers during this phase, if they are not able to receive the blocks reliably.

I.1.5 Image Validation

This phase is mandatory. The purpose of this phase is to validate the image received, i.e. that:

— The entire image has been received. An intended receiver shall discard further processing in this phase if not all of the image has been received. The integrity and authenticity of the image may be ensured. This could be achieved by calculating an overall authentication code (MAC) and comparing it to a stored value previously received.

— The image is intended for the receiver (device). This could include that Image identifier field (name) of the image and the versions of the image are acceptable to the receiver (meter), information that may be a part of the internal structure of the image.

— The receiver (device) is in such a state that it is able to activate the image. This could include that the installed options and the current version of the software and hardware of the receiver support the activation.

The intended result of this phase is that the receiver (device) has validated the received image as applicable. A failure of the validation should make the receiver discard the image and report this in its status information. The detailed activities to perform are manufacturer specific and outside the scope of this standard. Command initiate the validation in a device and get the status from a device are specified in I.2.10, I.2.11 and I.2.12. The validation may be started implicitly.

I.1.6 Image Activation

This phase is mandatory. The purpose of this phase is to make the image transferred an active part in the device. The way this phase is executed is manufacturer specific and outside the scope of this standard. The intended result of this phase is that the new data are active. A failure of the activation should let the device be re-activated using a previous or default version of the image. A command that may be used to activate an image in a device is specified in I.2.15 and I.2.16.

I.2 Commands for Image Transfer

I.2.1 General

Commands for Image Transfer and the corresponding response are identified by specific values of the CI-field. The applicable CI-fields are listed in Table I.1:

Table I.1 — Image Transfer CI-fields

CI-field	Designation	Header	Remarks
$C0_h$	Command to device	Long	Image Transfer Application
$C1_h$	Response from device	Short	Image Transfer Application
$C2_h$	Response from device	Long	Image Transfer Application

I.2.2 Command and response structure

A message may hold more than one image transfer command. Each command is stored as a segment and shall have a structure as depicted in Table I.2 below. The segment ID makes it possible to link the commands and the corresponding responses.

Table I.2 — Internal structure of Image Transfer Command

Segment Length (SL)	Segment ID (SID)	Function field (F)	Sub-function field (SF)	Function parameters
2 bytes	1 byte	1 byte	1 byte	n bytes

The different elements are:

Segment Length: Length of this command segment

Segment ID Identifier of the segment

Function Field: Coding of the command (see Table I.4).

Sub-function Field: Optional, control bits for command execution and optional parameters. The detailed interpretation of this field depends on the function field.

Function parameters: Optional elements holding command specific data.

A response frame holds the concatenated result of the commands sent to a device in the foregoing command frame. The structure of the response frame is depicted in Table I.3 below.

Table I.3 — Internal structure of Image Transfer Response

Segment Length (SL)	Segment ID (SID)	Function field (F)	Sub-function field (SF)	Function parameters
2 bytes	1 byte	1 byte	1 byte	n bytes

The different elements are:

Segment Length: Length this response segment

Segment ID: Identifier of command segment generating this response

Function Field: Coding of the command responding to (see Table I.4)

Sub-function Field: Control bits for the response and optional parameters. The detailed interpretation of this field depends on the function field.

Function parameter(s): This optional field holds response specific data.

The segment Length is a multiple byte field. Function parameters may also contain multi byte fields. If nothing other is declared then multi byte fields shall be transmitted with the least significant byte first (little endian).

I.2.3 Function Field

The function field for an image transfer command shall have one of the values listed in Table I.4.

Table I.4 — Image Download Command/Response, Function Field

Function field	Function	CMD	Resp.	Multi[a]	Explanation
$00_h/80_h$[b]	Prepare	X	X		Send parameters for the download session
01_h	Synchronize	X		X	Synchronize state prior to the transfer
$02_h/82_h$	Transfer	X	X	X	Transfer the blocks of the image
$03_h/83_h$	Completion	X	X		Verify completion of transfer
$04_h/84_h$	State	X	X		Request current download state in the device
$05_h/85_h$	Validate	X	X	X	Validate the received image
$06_h/86_h$	Activate	X	X	X	Activate the image
$07_h/87_h$	Terminate	X	X	X	Terminate current phase or process
$08_h/88_h$	Active Images	X	X		Retrieve list of active images
09_h to $6F_h$/ 89_h to EF_h	Reserved				Reserved for Future Use
70_h to $7F_h$/ $F0_h$ to FF_h	Manufacture specific	X	X	X	Manufacturer specific commands

[a] Whether or not the command is applicable to multicast use as well. There is no response to a multicast command. Protection has to be taken into account for multicast messages.

[b] Most significant bit set indicates a response

The different commands are specified in the sections that follow.

I.2.4 Prepare command

I.2.4.1 General

The command sets up the condition for the image transfer. The structure of the command and the order of the fields is shown in Table I.5 below. The function has the sub-function as the initial field. This may be followed by optional fields, controlled by the bit mask in the sub-function.

Table I.5 — Prepare command structure

Function field	Sub-function field	Date and Time (optional)	Pace (optional)	Size information (optional)	Image identifier field (optional)	MAC field (optional)	Add. Info (optional)
00_h	1 byte	4 bytes	1 byte	5 bytes	8 bytes	19 bytes	2 bytes

The assignment of the different bits in the sub-function field is shown in Table I.6 below:

Table I.6 — Prepare command sub-function

b7	b6	b5	b4	b3	b2	b1	b0
RFU	RFU	INFO	MCAS	IDEN	SZIN	ADT	MAC

RFU Reserved for future use, set to 0

INFO: Additional Information. If this bit is set then the command contains an Additional Information field.

MCAS: Multicast. If this bit is set then the transfer of image will be done using multicast and the command contains the fields Date and Time and Pace.

IDEN: Image Identifier. If this bit is set then an Image identifier field is part of the command. The identity information field makes it possible to detect the proper frames during synchronization and transfer phases.

SZIN: Size information. If this bit is set then a Size information field is part of the command. The field specifies the size of the image, the size of the individual blocks and the number of times the multicast will be repeated.

ADT: Absolute date and time. If this bit is set the Date and Time field is given as an absolute date and time. If this bit cleared Date and Time is given as a relative value, the time from now until start.

MAC: Message Authentication Code. If this bit is set, a field holding device specific MAC over the full image is part of the command.

A more detailed description of the different fields follows in the next subclauses.

I.2.4.2 Image Identifier field

This field is an identification of the data/image to be distributed. It is, in case of multiple broadcasts, used by the device to reject image transfer frames which are not part of the current transfer for this device. It is structured according Table I.7.

Table I.7 — Structure of Image Identifier field

Manufacturer (LSB first)	**Version**	**Device type**	**Manufacturer Image Identifier**
2 bytes	1 byte	1 byte	4 byte

Manufacturer: Manufacturer identification according EN 13757–7:2018, 7.5.2

Version: Version identification according EN 13757–7:2018, 7.5.3

Device type: Device type information according EN 13757–7:2018, 7.5.4

Manufacturer image identifier: These four bytes are manufacturer specific. Every image as delivered by the manufacturer shall have a unique number.

The image identifier is not necessarily linked to the image content. Manufacturers should take care about the uniqueness and freshness of the Image identifier field for each new image transfers to devices located in multiple systems range coverage.

I.2.4.3 Date and Time field

This field holds the time when the synchronization or transfer will start. It indicates to the device when it shall be ready. It is a 4 bytes field, coded LSB first. The field contains, if the ADT bit in Sub-function is set, the absolute Date and Time for start, in EPOCH 2013, otherwise the field contains the number of seconds, to wait from on the end of the reception of the frame before, to start.

The EPOCH 2013 time format corresponds to $0D_h$ $6D_h$ $E5_h$ xx xx xx xx 20_h according to Annex A, Type M.

I.2.4.4 Pace

This field holds the time value between 2 blocks transmission. It is measured from start block to start block. Unit is seconds.

NOTE Detailed timing is described in 13757–4.

I.2.4.5 Size Information field

This field is 5 bytes. It holds information about the size of the data to be distributed. This is subdivided into the following:

— Total number of blocks, 2 bytes,

— size of the individual blocks in bytes, 2 bytes,

— number of times the multicast will be repeated, before a check of status is performed, 1 byte. Set to zero if multicast is not used,

It is structured according Table I.8.

Table I.8 — Structure of size information field

Total number of blocks (LSB first)	Individual block size (LSB first)	Repetition
2 bytes	2 bytes	1 byte

I.2.4.6 MAC field

This field holds a pre-calculated Message Authentication Code of the image, using the individual device specific key. This is for validation of the integrity of the transmitted image to the M-Bus device

NOTE end-to-end security of the image, between the original distributor or creator of the image and the M-Bus device may be additionally provided by other means. This is outside the scope of this specification.

The MAC field itself consists of two sub-fields as shown in Table I.9 below

Table I.9 — Structure of MAC field

MAC Algorithm ID	Key ID	Key Version	MAC Value
1 byte	1 byte	1 byte	16 bytes

The first byte indicates which MAC algorithm will be used. The second and third byte identify the individual device specific key, and version of the key, that shall be used in the MAC calculation. The last 16 bytes contain the MAC Value.

Key ID Identifies the key that is used in the MAC calculation. The exact use of the key is dependent on the particular MAC algorithm. The Key ID is as defined in EN 13757-7.

Key Version Key version is as defined in EN 13757-7 and identifies the version of the key. Shall be FF_h if no version is used.

The following MAC algorithms, shown in Table I.10, are currently specified:

Table I.10 — MAC Algorithms

MAC Algorithm ID	MAC Algorithm
01_h	8 byte truncated HMAC-SHA256[a]
02_h	16 byte truncated HMAC-SHA256
03_h	8 byte truncated AES128-CMAC[a]
04_h	16 bytes AES128-CMAC
05_h	12 bytes AES128-GMAC[a]
[a] The MAC and therefore also the MAC field has a fixed length i.e. used in the Prepare Command. In case of other MAC lengths see the hints how to fill up the MAC field in the following sections.	

Truncated HMAC Algorithms

The HMAC algorithm shall be used as specified in FIPS PUB 198-1. The SHA256 algorithm shall be used as specified in FIPS PUB 180-4.

MAC: The output of the HMAC-SHA256 algorithm shall be truncated to 8 or 16 bytes as indicated by the MAC Algorithm ID field. Truncation shall be applied as described in Clause 5 in NIST/SP 800-107 Revision 1, also taking into account the security consequences of truncation. The MAC value is transmitted MSB first (big endian). In case the MAC is truncated to 8 bytes, the first 8 bytes of the MAC Value field will be filled with the truncated HMAC-SHA256 value and the last 8 bytes will contain 00h.

CMAC and Truncated CMAC Algorithm

The use of the AES128-CMAC or truncated AES128-CMAC is indicated by the MAC Algorithms ID field, i.e. value 04_h or 03_h respectively. The CMAC value or truncated CMAC value shall be calculated according to NIST/SP 800-38B.

MAC: This field contains the truncated CMAC value or full CMAC value depending on the value of the MAC Algorithm ID (03h or 04h respectively). The CMAC value is transmitted MSB first (big endian). In case an 8 bytes truncated CMAC is used, the first 8 bytes of the MAC Value field will be filled with the truncated AES128-CMAC value and the last 8 bytes will contain 00_h.

AES128-GMAC Algorithm

The use of the AES128-GMAC algorithms is indicated by the value 05_h in the MAC Algorithm ID field. The AES128-GMAC algorithm shall be applied according to NIST/SP 800-38D.

MAC: In this case the MAC value shall be the Authentication Tag (T) and has a fixed length of 12 bytes. The first 12 bytes of the MAC Value will contain this Authentication Tag and the last 4 bytes will contain 00_h.

The AES128-GMAC algorithm uses an initialization vector IV as indicated in Table I.11

Table I.11 — GMAC Initialization Vector (IV)

Fixed Field								Invocation Field			
11	**10**	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
Manufacturer (LSB first)		Identification number (LSB first)				Version	Device Type	Manufacturer Image Identifier			

The Manufacturer Image Identifier is the invocation field in the IV. The Manufacturer Image Identifier is part of the Image Identifier field and is defined in I.2.4.2

I.2.4.7 Additional Information

The field is optional. It holds additional information defined by the manufacturer. The internal structure of this 2 bytes field is manufacturer specific.

I.2.5 Prepare response

This is the response to the Prepare command. The structure is shown in Table I.12 below: The optional fields are controlled by the bit mask in the sub-function field.

Table I.12 — Structure of Prepare response

Function Field	Sub-function field	Preparation Result	Image Identifier field (optional)	Size Information (optional)	Additional Information (optional)
80_h	1 byte	1 byte	8 bytes	5 bytes	2 bytes

The content of the sub-function field shall be interpreted as depicted in Table I.13.

Table I.13 — Prepare response sub-function

b7	b6	b5	b4	b3	b2	b1	b0
RFU	RFU	INFO	MCAS	IDEN	RDY	SZIN	AINF

RFU: Reserved for future use, set to 0 set to 0

AINF: Additional Information. If this bit is set then a 2 bytes Additional Info field follows. The internal structure is manufacturer specific.

MCAS: Multicast. When this bit is set, the device is able to handle multicast.

IDEN If this bit is set then an Image identifier field is part of the response. The field is formatted as described in I.2.4.2. If this field was present in the prepare command, then it shall also be present in the prepare response.

RDY: Ready. When this bit is cleared, the device is enabled / ready for software download.

SZIN: Size information. When this bit is cleared the device is able to handle the requested size as specified in the command. Otherwise this bit will be set and the Size information field is present (see I.2.4.5). It will then provide information about the supported block size and number of the meter

The content of the Preparation Result field shall be interpreted as depicted in Table I.14.

In case the Preparation Result field indicates that the Image size is too big (value 06h), the SZIN bit may be set in the sub-function field and the size information field will then be included in the response and indicate the image size that the M-Bus device supports.

Table I.14 — Preparation results

Value	Description
00_h	No error detected, preparation command accepted
01_h	SW update version not accepted
02_h	Minimum SW version not compliant
03_h	Minimum HW version not compliant
04_h	SW update disabled for device
05_h	Image type/update protocol not supported
06_h	Image size too big
07_h	Any other error
08_h–FF_h	RFU, set to 0

I.2.6 Synchronize Command

I.2.6.1 General

The command is used for synchronization of the image transfer. It may be sent one or more times before the start of the image transfer to handle compensation for clock uncertainty between receiving device and communication partner providing the image. This command is only applicable to wireless communication. It shall be sent unidirectional. A reply is not expected.

The structure of the command and the order of the fields are shown in Table I.15 below. The function has the sub-function as the initial field. This may be followed by optional fields, controlled by the bit mask in the sub-function.

Table I.15 — Synchronize command structure

Function field	Sub-function field	Image identifier field (optional)	Count Down
01_h	1 byte	8 bytes	2 bytes

See I.2.4.2 for Image identifier field definition.

The assignment of the different bits in the sub-function field is shown in Table I.16 below:

Table I.16 — Synchronize command sub-function

b7	b6	b5	b4	b3	b2	b1	b0
RFU		RFU		RFU	RFU	IDEN	CTDN

RFU: Reserved for future use, set to 0

IDEN: Identity information. This bit is set if an Image identifier field field follows. The field is formatted as shown in I.2.4.2. Identity information may be omitted but this is not recommended.

CTDN: Countdown. If this bit is set Countdown field contains duration in 1/256 s. If this bit is cleared the duration is given in seconds.

I.2.6.2 Count Down field

This field holds the time until the first packet of image transfer will start. It informs the device as to when it shall be ready. The internal structure of this field is 2 bytes unsigned data coded LSB first. The CTDN bit in the sub-function field specifies the scaling.

NOTE Detailed timing is described in 13757–4.

I.2.7 Transfer command

I.2.7.1 General

The command is used for the transfer of the actual image (see Table I.17).

Table I.17 — Transfer command structure

Function field	Sub-function field	Image identifier field (optional)	Block number	Remaining (optional)	Additional Info (optional)	Image block
02_h	1 byte	8 bytes	2 bytes	2 bytes	2 bytes	n bytes

See I.2.4.2 for Image identifier field definition.

The assignment of the different bits in the sub-function field is shown in Table I.18:

Table I.18 — Transfer command sub-function

b7	b6	b5	b4	b3	b2	b1	b0
RFU		RFU	REM	IDEN	SEQ		AINF

RFU: Reserved for Future Use, set to 0

REM: Remaining blocks. If this bit is set then command contains a remaining field.

IDEN: Identity information. This bit is set if an Image identifier field follows. The field is formatted as shown in I.2.4.2.

SEQ: Sequence State. The bits shall be set as shown below:

00_b = Not used

01_b = First block

10_b = Intermediate block

11_b = Last block

AINF: Additional Information. If this bit is set then the command contains an Additional Information field.

I.2.7.2 Block number

The field is mandatory. It holds the number of the block being transferred. The value shall be in the range 0 to Number of Blocks –1. Data with a value outside this range shall be discarded. It is a 2 bytes unsigned value coded LSB first.

I.2.7.3 Remaining field

The field is optional. It holds number of outstanding blocks. The value shall be in the range Number of Blocks −1 to 0. It is a 2 bytes unsigned value coded LSB first.

I.2.7.4 Additional Information

The field is optional. It holds additional information defined by the manufacturer. The internal structure of this 2 bytes field is manufacturer specific.

NOTE It is the responsibility of a provider of an image to ensure that it fits to the block size. It is the providers' task to define any padding algorithm need to support data not fitting the block size.

I.2.7.5 Image block

The field is mandatory. It holds the actual image data to be transferred.

I.2.8 Transfer Response

In case of unicast messaging, a M-Bus device may return an Transfer Response after each Transfer Command. The format of the response is shown in Table I.19.

Table I.19 — Structure of Transfer Response

Function Field	Sub-function field	Image identifier field (optional)
82_h	1 byte	8 bytes

The content of the sub-function field shall be interpreted as depicted in Table I.20.

Table I.20 — Transfer Response sub-function

b7	b6	b5	b4	b3	b2	b1	b0
RFU	RFU	RFU	IDEN	STATE			

RFU: Reserved for Future Use, shall be sent bit = 0 and be don't care value when received.

IDEN Image identifier field information. This bit is set if an Image identifier field follows. If IDEN was enabled in the received command then device shall also set this bit in the response. The Image identifier field is formatted as shown in I.2.4.2.

STATE The overall progress state of the transfer of the image, with the states as listed in Table I.29 – Overall state transfer.

I.2.9 Completion command

The command checks completeness of the image transfer. This is a point-to-point command send individually to all devices. The format of the command is shown in Table I.21. The receiving device shall respond to the command with a status whether or not image blocks have been lost.

The function has the sub-function field as the initial field. It may be followed by optional fields controlled by the bit mask in the sub-function field.

Table I.21 — Completion command structure

Function field	Sub-function field	Image identifier field (optional)	Additional Info (optional)
03_h	1 byte	8 bytes	2 bytes

The assignment of the different bits in the sub-function field is shown in Table I.22 below:

Table I.22 — Completion command sub-function

b7	b6	b5	b4	b3	b2	b1	b0
RFU	RFU	RFU	RFU	RFU	RFU	IDEN	AINF

RFU: Reserved for Future Use, set to 0

IDEN: Image identifier field information. This bit is set if an Image identifier field follows. The Image identifier field is formatted as shown in I.2.4.2.

AINF: Additional Information. If this bit is set then the command contains an Additional Information field. It is a 2 bytes field. The format is Manufacturer specific.

I.2.10 Completion response

I.2.10.1 General

This is the response to the Completion command. The structure is shown in Table I.23 below. The optional fields are controlled by the bit mask in the sub-function field.

Table I.23 — Structure of Completion response

Function Field	Sub-function field	Image identifier field (optional)	Total Number of lost blocks (optional)	Lost Blocks field (optional)
83_h	1 byte	8 bytes	2 bytes	n × 2 bytes

The content of the sub-function field shall be interpreted as depicted in Table I.24.

Table I.24 — Completion response sub-function

b7	b6	b5	b4	b3	b2	b1	b0
RFU	RFU	RFU	RFU	IDEN	TNLB	LIB	NBR

RFU: Reserved for future use, set to 0.

IDEN: Image identifier field information. This bit is set if an Image identifier field follows. If IDEN was enabled in the received command then this bit shall also be set in the response. The Image identifier field is formatted as shown in I.2.4.2.

TNLB: Total Number of Lost Blocks. If this bit is set a field indicating the total number of lost blocks is present in the response. If this bit is cleared the field is not included in the response.

LIB: Lost image blocks. If this bit is set, some Image blocks are missing. A list of Lost image blocks shall be included in the response. If this bit is cleared, all image blocks were received.

NBR No blocks received. If this bit is set it signals that no image blocks are received. As soon as one block is received this bit is cleared.

I.2.10.2 Total Number of Lost Blocks

This field shall inform to the Gateway the total number of missing blocks and it enables the Gateway to decide on how to proceed on the download process completion, e.g. full or partial restart. It is a 2 bytes unsigned value coded LSB first.

I.2.10.3 Lost Blocks Field

This field holds an array of 2-bytes elements. Each 2-bytes element refers to the missing block number. FFFFh is used to indicate that all following blocks in the list are missing. Provide the first element with FFFFh if no blocks are received. It is a set of unsigned values coded LSB first.

I.2.11 State command

The command requests the state of the individual receiver. The structure is shown in Table I.25. The optional fields are controlled by the bit mask in the sub-function field.

Table I.25 — State command structure

Function field	Sub-function field	Image identifier field (optional)	Additional Info (optional)
04_h	1 byte	8 bytes	2 bytes

The assignment of the different bits in the sub-function field is shown in Table I.26 below:

Table I.26 — State command sub-function

b7	b6	b5	b4	b3	b2	b1	b0
RFU	RFU	RFU	RFU	RFU	RFU	IDEN	AINF

RFU: Reserved for Future Use, shall be sent bit = 0 and be don’t care value when received.

IDEN: Image identifier field information. This bit is set if an Image identifier field follows. If IDEN was enabled in the received command then M-Bus device shall also set this bit in the response. The Image identifier field is formatted as shown in I.2.4.2.

AINF Additional Information. If this bit is set then the command contains an Additional Information field. It is a 2 bytes field. The format is Manufacturer specific.

I.2.12 State Response

A device shall return a State Response after receiving a State Command. The format of the response is shown in Table I.27 below.

Table I.27 — Structure of State response

Function Field	Sub-function field	Image identifier field (optional)
84_h	1 byte	8 bytes

The content of the sub-function field shall be interpreted as depicted in Table I.28.

Table I.28 — State response sub-function

b7	b6	b5	b4	b3	b2	b1	b0
RFU	RFU	RFU	IDEN	STATE			

RFU: Reserved for Future Use, shall be sent bit = 0 and be don’t care value when received.

IDEN Image identifier field information. This bit is set if an Image identifier field follows. If IDEN was enabled in the received command then device shall also set this bit in the response. The Image identifier field is formatted as shown in I.2.4.2.

STATE The overall progress state of the transfer of the image, with the states as listed in Table I.29.

Table I.29 — Overall state of the transfer

State	Value	Description
0	0000_b	Synchronization activated
1	0001_b	Synchronization terminated
2	0010_b	Transfer initiated[a]
3	0011_b	Transfer active[a]
4	0100_b	Transfer terminated[c]
5	0101_b	Transfer successful
6	0110_b	Transfer failed
7	0111_b	Validation initiated[a]
8	1000_b	Validation active[a]
9	1001_b	Validation successful
10	1010_b	Validation failed
11	1011_b	Activation initiated[a,b]
12	1100_b	Activation successful
13	1101_b	Activation failed
14	1110_b	Image Transfer Terminated[d]
15	1111_b	Idle

a The state initiated is reached once the device has received the command. The state active is reached once the device is processing/executing the command.

b A device is not expected to be able to respond while it is activating an image.

c To be used if the T_TR bit in the terminate command is set.

d To be used if the T_IT bit in the terminate command is set.

The image identifier field shall be present in the State Response, if this field was also present in the State Command.

I.2.13 Validate command

The command requests the individual device to validate the image received. The details of the validation process are manufacturer specific. The state and result of the validation activity can be retrieved using the State Command. The command, as shown in Table I.30, has only the sub-function as parameter.

Table I.30 — Validate command structure

Function field	Sub-function field	Image identifier field (optional)	Additional Info (optional)
05_h	1 byte	8 bytes	2 bytes

The assignment of the different bits in the sub-function field is shown in Table I.31 below:

Table I.31 — Validate command sub-function

b7	b6	b5	b4	b3	b2	b1	b2
RFU	RFU	RFU	RFU	RFU	RFU	IDEN	AINF

RFU: Reserved for Future Use, shall be sent bit = 0 and be don't care value when received.

IDEN Image identifier field information. This bit is set if an Image identifier field follows. The Image identifier field is formatted as shown in I.2.4.2.

AINF Additional Information. If this bit is set then the command contains an Additional Information field. It is a 2 bytes field. The format is Manufacturer specific.

I.2.14 Validate Response

In case of unicast messaging, a M-Bus device shall return an Validate Response after receiving a Validate Command. The format of the Response is shown in Table I.32.

Table I.32 — Structure of Validate Response

Function Field	Sub-function field	Image identifier field (optional)
85_h	1 byte	8 bytes

The content of the sub-function field shall be interpreted as depicted in Table I.33.

Table I.33 — Validate Response sub-function

b7	b6	b5	b4	b3	b2	b1	b0
RFU	RFU	RFU	IDEN	STATE			

RFU: Reserved for Future Use, shall be sent bit = 0 and be don't care value when received.

IDEN Image identifier field information. This bit is set if an Image identifier field follows. If IDEN was enabled in the received command then device shall also set this bit in the response. The Image identifier field is formatted as shown in I.2.4.2.

STATE The overall progress state of the transfer of the image, with the states as listed in Table I.29 – Overall state of the transfer.

I.2.15 Activate command

The command activates the image once transferred. The activation may be immediate or timed. The structure of the command and the order of the fields are shown in the following Table I.34.

Table I.34 — Activate command structure

Function field	Sub-function field	Image identifier field (optional)	Date and Time
06_h	1 byte	8 bytes	4 bytes

The assignment of the different bits in the sub-function field is shown in Table I.35 below:

Table I.35 — Activate command sub-function

b7	b6	b5	b4	b3	b2	b1	b0
RFU						IDEN	ADT

RFU: Reserved for future use, set to 0

IDEN Image identifier field information. This bit is set if an Image identifier field follows. The Image identifier field is formatted as shown in I.2.4.2.

ADT: Absolute Date and Time. If this bit is set, then activation time information in the Date and Time field is absolute, and given as EPOCH 2013. If this bit is cleared, then the activation time in the Data and Time is relative to the current time. An immediate activation is achieved by a Date and Time value of 'zero' and clearing ADT = 0b.

Date and Time field

This field holds the time when the transferred image shall be activated. It is a 4 bytes field coded LSB first. The field contains, if the ADT bit in Sub-function is set, the absolute Date and Time of activation, in EPOCH 2013, otherwise the field contains the number of seconds, to wait from on the end of the reception of the frame before, activation. In case the date is in the past an immediate activation is achieved.

The EPOCH 2013 time format corresponds to 0Dh 6Dh E5h xx xx xx xx 20h according to Annex A, Type M.

I.2.16 Activate Response

In case of unicast messaging, a M-Bus device shall return an Activate Response after receiving an Activate Command. The format of the response is shown in Table I.36 below.

Table I.36 — Structure of Activate Response

Function Field	Sub-function field	Image identifier field (optional)
86_h	1 byte	8 bytes

The content of the sub-function field shall be interpreted as depicted in Table I.37.

Table I.37 — Activate Response sub-function

b7	b6	b5	b4	b3	b2	b1	b0
RFU	RFU	RFU	IDEN	STATE			

RFU: Reserved for Future Use, shall be sent bit = 0 and be don't care value when received.

IDEN Image identifier field information. This bit is set if an Image identifier field follows. If IDEN was enabled in the received command then device shall also set this bit in the response. The Image identifier field is formatted as shown in I.2.4.2.

STATE The overall progress state of the transfer of the image, with the states as listed in Table I.29 – Overall state of the transfer

I.2.17 Terminate Command

The command terminates an image transfer phase or the whole image transfer process. The structure is shown in Table I.38. The optional fields are controlled by the bit mask in the sub-function field. The State command and State response supply information about the result.

Table I.38 — Terminate Command structure

Function field	Sub-function field	Image identifier field (optional)
07_h	1 byte	8 bytes

See I.2.4.2 for Image identifier field definition.

The assignment of the different bits in the sub-function field is shown in Table I.39 below:

Table I.39 — Terminate command sub-function

b7	b6	b5	b4	b3	b2	b1	b0
RFU	RFU	RFU	RFU	RFU	IDEN	T_TR	T_IT

RFU: Reserved for Future Use, shall be sent bit = 0 and be don’t care value when received.

IDEN Image identifier field information. This bit is set if an Image identifier field follows. The Image identifier field is formatted as shown in I.2.4.2.

T_IT: Terminate the whole image transfer process and restore initial device state before start of image download process.

T_TR: Terminate the transfer phase and restore device state before first block transfer

I.2.18 Terminate Response

In case of unicast messaging, a M-Bus device shall return an Activate Response after receiving an Activate Command. The format of the response is shown in Table I.40 below.

Table I.40 — Structure of Terminate Response

Function Field	Sub-function field	Image identifier field (optional)
87_h	1 byte	8 bytes

The content of the sub-function field shall be interpreted as depicted in Table I.41.

Table I.41 — Terminate Response sub-function

b7	b6	b5	b4	b3	b2	b1	b0
RFU	RFU	RFU	IDEN	STATE			

RFU: Reserved for Future Use, shall be sent bit = 0 and be don’t care value when received.

IDEN Image identifier field information. This bit is set if an Image identifier field follows. If IDEN was enabled in the received command then device shall also set this bit in the response. The Image identifier field is formatted as shown in I.2.4.2.

STATE The overall progress state of the transfer of the image, with the states as listed in Table I.29 – Overall state of the transfer.

I.2.19 Active Images Command

This is an optional command, and may not be supported by an M-Bus Device. This command shall be used to report on all images that are currently active on the M-Bus Device (see Table I.42).

Table I.42 — Active images command structure

Function field	Sub-function field
08_h	1 byte

The assignment of the different bits in the sub-function field is shown in Table I.43 below:

Table I.43 — Active images command sub-function

b7	b6	b5	b4	b3	b2	b1	b0
RFU, set to 0							

I.2.20 Active Images Response

A device shall return an Active Images Response after receiving an Active Images Command. The format of the response is shown in Table I.44.

Table I.44 — Active Images Response structure

Function Field	Sub-function Field	Active Images (optional)
88_h	1 byte	1 + n x 8 bytes

The content of the sub-function field shall be interpreted as depicted in Table I.45

Table I.45 — Active Images Response sub-function

b7	b6	b5	b4	b3	b2	b1	b0
RFU	RFU	RFU	RFU	RFU	RFU	RFU	LAI

RFU: Reserved for Future Use, shall be sent bit = 0 and be don’t care value when received.

LAI List of Active Images. If this bit is set, the Active Images field will be present in the response.

The Active Images field will report the current active images on the M-Bus device. The Active Images field is structured as shown in Table I.46:

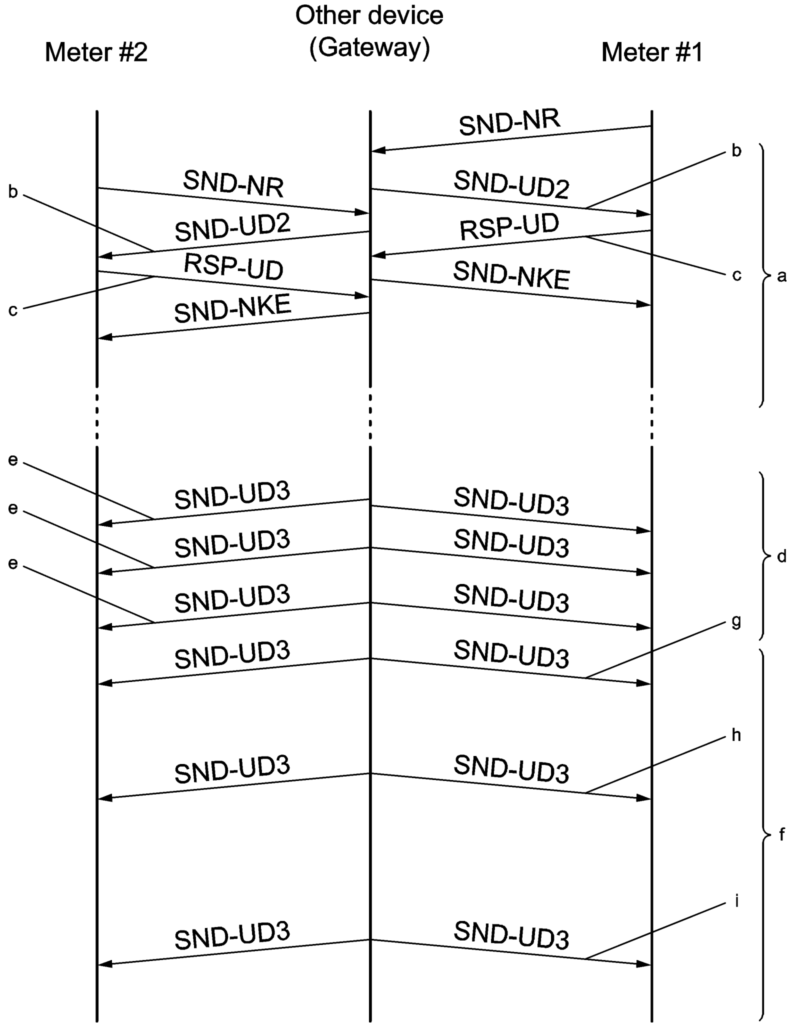
Table I.46 — Active Images field

Number of Active Images	List of Image identifier fields
1 byte	n x 8 bytes

The first byte indicates the number of active images on the M-Bus device. The following bytes gives the corresponding 8 bytes Image Identifier fields of the images that are currently active on the M-Bus Device.

I.3 Overview Image Transfer

The displayed sequence chart in Figure I.1 and Figure I.2 shows a possible process for Image Transfer for a general understanding. Some of the phases and messages are optional as stated in the respective clauses.



Key

a Phase 1 (point to point): Transfer Preparation

b Prepare Command

c Prepare Response

d Phase 2 (multicast): Synchronization

e Synchronize Command

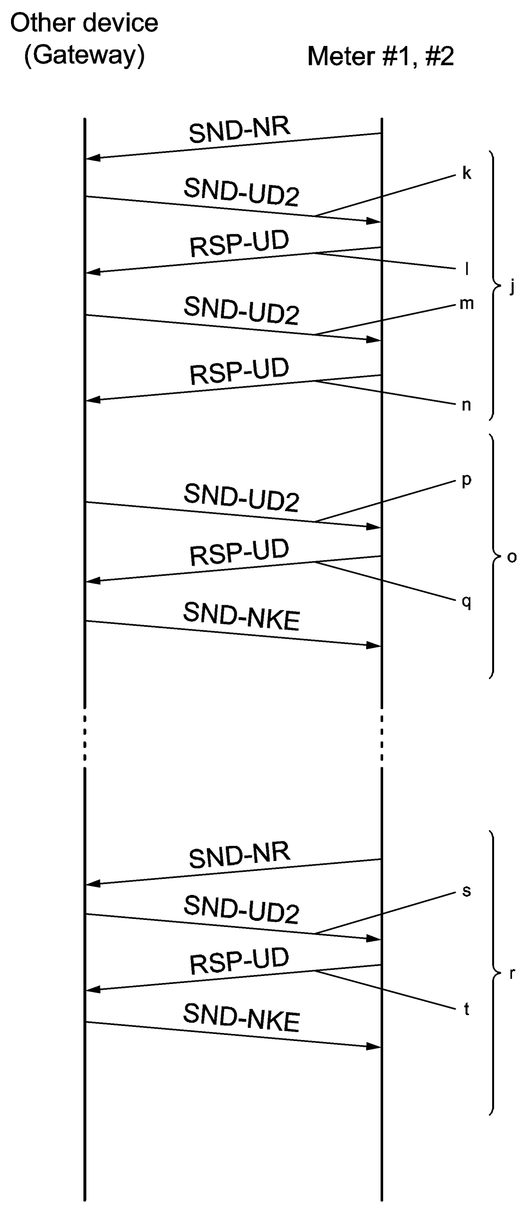
f Phase 3A (multicast): Transfer Image

g Transfer Command – Block 1

h Transfer Command – Block 2

i Transfer Command – Block 3

Figure I.1 — Image Transfer phases 1 to 3



Key

j Phase 3B (point to point): Check Completeness of transfer
k Complete Command
l Complete Response
m Optionally send a missing block with transfer command
n In case Transfer response reporting success
o Phase 4 (point to point): Image validation
p Validate Command
q Validate Response
r Phase 5 (point to point): Image Activation
s Activate Command
t Activate Response

Figure I.2 — Image Transfer phases 3 to 5

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[3] EN 13757–1, *Communication systems for meters - Part 1: Data exchange*

[4] EN 62056-6-2, *Electricity metering data exchange — The DLMS/COSEM suite — Part 6-2: COSEM interface classes*

[5] ISO/IEC 7498-1, *Information technology — Open Systems Interconnection — Basic Reference Model: The Basic Model — Part 1*

[6] ANSI X9 *TR-31:2010, Interoperable Secure Key Exchange Key Block Specification for Symmetric Algorithms*

[7] EN 62056-6-1, *Electricity metering data exchange — The DLMS/COSEM suite — Part 6-1: Object Identification System (OBIS)*