



BSI Standards Publication

**Communication system for meters -
Accompanying TR to EN 13757-2,-3 and -7,
Examples and supplementary information**

National foreword

This Published Document is the UK implementation of CEN/TR 17167:2018.

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

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

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Published by BSI Standards Limited 2018

ISBN 978 0 580 98980 3

ICS 91.140.50; 35.240.99; 33.200

Compliance with a British Standard cannot confer immunity from legal obligations.

This Published Document was published under the authority of the Standards Policy and Strategy Committee on 30 April 2018.

Amendments/corrigenda issued since publication

Date	Text affected
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ICS 33.200; 35.240.99; 91.140.50

English Version

**Communication system for meters - Accompanying TR to
EN 13757-2,-3 and -7, Examples and supplementary
information**

Systèmes de communication pour compteurs - Rapport
technique accompagnant les EN 13757-2,-3 et -7 -
Exemples et informations supplémentaires

Kommunikationssysteme für Zähler - Begleitender
Technischer Bericht zu EN 13757-2, -3 und -7,
Beispiele und ergänzende Informationen

This Technical Report was approved by CEN on 13 November 2017. It has been drawn up by the Technical Committee CEN/TC 294.

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European foreword

This document (CEN/TR 17167:2018) has been prepared by Technical Committee CEN/TC 294 “Communication systems for meters”, the secretariat of which is held by DIN.

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

Introduction

This document belongs to a series of parts of EN 13757, which covers communication systems for meters and remote reading of meters. EN 13757-1 contains generic descriptions and a communication protocol. EN 13757-2 contains a physical and a link layer for twisted pair based Meter-Bus (M-Bus). EN 13757-3 contains detailed description of the application protocols especially the M-Bus Protocol. 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 13757-7 describes transport mechanism and security methods for data.

These upper M-Bus protocol layers can be used with various physical layers and with link layers and network layers, which support the transmission of variable length binary transparent messages. Frequently, the physical and link layers of EN 13757-2 (twisted pair) and EN 13757-4 (wireless) as well as EN 13757-5 (wireless with routing function) or the alternatives described in EN 13757-1 are used. 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 document 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 meters and heat cost allocators) and for electricity meters, in this document 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.

Table 1 gives an overview of the annexes as well as a reference to the corresponding Annexes in the former EN 13757-3:2013 where applicable.

Table 1 — Relation between the annexes of this Technical report and EN 13757-3:2013

Annex	Description	Annex in EN 13757-3:2013
A	Datagram examples for a twisted pair M-Bus link layer	E
B	Secondary search implementation instructions	F
C	Consumer feedback for smart metering applications	L
D	Installation and registration procedures	M
E	Implementation of an M-Bus data container	N
F	Datagram examples for wired and wireless M-Bus	P
G	Implementation of Descriptors	—

1 Scope

This Technical Report contains additional information to the requirements determined in EN 13757-2, EN 13757-3 and EN 13757-7, in particular examples for the implementation, datagram examples secured by security mechanism of part 7 and additional non-normative requirements beyond meter communication itself.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <http://www.iso.org/obp>

3.1

byte

octet of bits

3.2

data integrity

property that data has not been altered or destroyed in an unauthorized manner

3.3

datagram

unit of data transferred from source to destination

3.4

integrity

see data integrity

3.5

key derivation

technique by which a (potentially large) number of keys are generated ("derived") from a single initial key and non-secret variable data with each resulting key using a non-reversible process

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

persistent key

cryptographic key which shall be kept a prolonged period

3.8**security mechanism**

mode of operation of a (symmetric) cryptographic algorithm

3.9**security mode**

mode number in configuration field identifying a set of applied security mechanisms

3.10**security service**

authenticity, confidentiality and data integrity

4 Symbols and abbreviations**4.1 Abbreviations**

ACK	Acknowledge
AES	Advanced Encryption Standard
AFL	Authentication and Fragmentation Layer
APL	Application Layer
BCD	Binary Coded Decimal numbers
CBC	Cipher Block Chaining (AES mode of operation)
CF	Configuration Field
CFE	Configuration Field Extension
CI	Control Information field
CMAC	Cipher-based MAC [Source: NIST/SP 800-38B]
CMD	Command
CNF-IR	Confirm Installation Request
CTR	Counter Mode encryption algorithm (AES mode of operation)
DIB	Data Information Block
DIF	Data Information Field
DIFE	Data Information Field Extensions
DLL	Data Link Layer
ELL	Extended Link Layer
GCM	Galois/Counter Mode, an algorithm for authenticated encryption with associated data (AES mode of operation)
IV	Initialisation Vector
LSB	Least Significant Byte
MAC	Message Authentication Code
NOTE	MAC is in other standards also used as an acronym for Media Access Control for data communication at the Physical Layer
MSB	Most Significant Byte

OBIS	Object Identification System (see IEC 62056-6-1)
REQ-UD	Request User Data (class 1 or 2)
RSP-UD	Respond User Data
RSSI	Received Signal Strength Indicator
SM-CG	Smart Meter Co-ordination Group
SND-IR	Send Installation Request
SND-NKE	Send Link Reset
SND-NR	Send – No Reply
SND-UD	Send User Data
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 “_h”.

Binary numbers are designated by a following “_b”.

Decimal numbers have no suffix.

The concatenation of fields is indicated by the symbol “||”. E.g. 12_h || 34_h results in 1234_h.

5 Overview

The supplementary information on the requirements determined in EN 13757-2, EN 13757-3 and EN 13757-7 is provided in the annexes of this Technical Report. Table 2 gives an Overview about these Annexes.

Annexes A, B and D are only applicable to wired M-Bus solution.

Annex C describes how parts of EN 13757-2, EN 13757-3, EN 13757-4 and EN 13757-7 can be used to implement smart meter functionalities. Similar functionalities could also be implemented using other physical and link layers.

Annex D provides information on installation procedures wireless meters and their integration in meter management systems.

Annex E contains a definition of two containers to transport special data via an M-Bus data point.

Annex F provides many examples of plain and encrypted/authenticated M-Bus messages for the wired and wireless M-Bus.

Annex G defines descriptors, i.e. special M-Bus data points, which have been added to explain the purpose of other M-Bus data points.

Table 2 — Overview of the Annexes

Annex	Description	Applicable for	
		wired M-Bus	wireless M-Bus
A	Datagram examples for a twisted pair M-Bus link layer	x	
B	Secondary search implementation instructions	x	
C	Consumer feedback for smart metering applications	x	x
D	Installation and registration procedures		x
E	Implementation of an M-Bus data container	x	x
F	Datagram examples for wired and wireless M-Bus	x	x
G	Implementation of Descriptors	x	x

Annex A (informative)

Examples

A.1 General

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

A.2 Example for a RSP-UD

(All values are hex.)

68 1F 1F 68	Link layer header of RSP-UD datagram (length $1F_h = 31d$ bytes)
08 02 72	C field = 08 (RSP), address 2, CI field 72h
78 56 34 12	Identification number = 12345678
24 40 01 07	Manufacturer ID = 4024_h ("PAD"), version = 1, device type = water meter
55 00 00 00	ACC = $55_h = 85d$, status = 00_h , configuration field = 0000_h
03 13 15 31 00	Data block 1: unit 0, storage No.0, no tariff, instantaneous volume, 12565 l (24 bit integer)
DA 02 3B 13 01	Data block 2: unit 0, storage No.5, no tariff, maximum volume flow, 113 l/h (4 digit BCD)
8B 60 04 37 18 02	Data block 3: unit 1, storage No.0, tariff 2, instantaneous energy, 218,37 kWh (6 digit BCD)
18 16	Checksum and stop sign

A.3 Example baud rate switch

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

(All values are hex.)

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

Slave to master: E5 with 2 400 Bd.

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

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

Master to slave: 10 40 FE 3E 16.

Slave to master: E5.

A.4 Example application select with subcode

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

(All values are hex.)

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

Slave to master: E5.

A.5 Writing data to a slave

The master can send data to a slave using a SND-UD with CI-field 51_h, 5A_h or 5B_h.

The following table shows the data structure for a write message. The order of the first three blocks in the following Table A.1 can be chosen freely, but the write only data record is at the end of the message. All records are optional.

Table A.1 — Data structure for writing data

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

a) Primary address record.

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

Table A.2 — Coding of primary addressA.

DIF = 01 _h	VIF = 7A _h	Data = Address (1 byte binary)
-----------------------	-----------------------	--------------------------------

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

b) Enhanced identification record.

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

1) Data are only the identification number

Table A.3 — Coding of single identification number

DIF = 0C _h	VIF = 79 _h	Data = Identification No. (8 digit BCD)
-----------------------	-----------------------	---

2) Data are the complete identification

Table A.4 — Coding of complete secondary address

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

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

Table A.5 — Structure of secondary address

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

— Normal data records:

The data records, which can be read out with a REQ_UD2, are sent back to the slave with the received DIF and VIF and the new data contents. Additional features can be implemented using the generalized object layer (see EN 13757-3:2018, 6.4.1).

— Write-only data:

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

After receiving the SND-UD correctly without any error in data link layer, the slave answers with an acknowledgement (E5_h). The slave decides whether to change variables or not after a data write from the master. In case of errors in executing parts of or whole write instructions the slave can decide whether to change no variables or single correct variables. The slave can report these errors to the master in the next RSP-UD datagram using some of the methods which are described in EN 13757-3:2018, 10.3.

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

Examples (all values are hex.)

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

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

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

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

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

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

A.6 Configuring M-Bus data output

A.6.1 General

For default, the slave transmits all its data according the selected message application by an Application select protocol (see EN 13757-3:2018, Clause 7). It could be useful for some scenarios to adapt this preselected message contents by an individual selection or deselection of specific data records.

The individual selection of data records is a temporary adaption of the message content of the currently selected message application. The next applied application reset or application select (according to EN 13737-3:2018, 5.3) will clear this temporary data record selection and the meter will send the original content of the message application.

The message application 15 “User defined” is dedicated to store the individual selected data record adaptations. Contrary to the other message applications the modification remains permanently even after an application reset or application select. The message application 15 can initially be empty or predefined by the manufacturer and is intended to be adapted by the user or operator.

This annex describes two ways to select or deselect data records individually.

A.6.2 Selection of data records with special data field

The selection of the wanted data records can be performed with a SND-UD and M-Bus data records containing the data field 1000_b , which means “selection for readout request” (according EN 13757-3:2018, Table 4). The following VIF defines the selected data as listed in EN 13757-3:2018 and no data are transmitted. The answer data field is determined by the slave. The master can select several variables by sending more data blocks with this data field in the same datagram.

Special multiple values can be selected with the following methods:

— Any VIF:

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

— Global readout request:

The DIF-code $7F_h$ is defined as “selection of all data for readout request”, i.e. all storage numbers, units, tariffs and functions. If this DIF is the last byte of user data or the VIF = $7E_h$ follows, then all data are requested. So the selection of all data of one slave can be done with a SND-UD and the character $7F_h$ as the user data. If a DIF unequal to $7E_h$ follows, then all data records with this VIF are selected for readout.

— All tariffs:

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

— All storage numbers:

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

— All units:

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

— High resolution readout:

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

After the next REQ-UD2 the slave answers with the selected data in his own format, if the requested data are available. Otherwise the slave transmits his normal data and the master has to find out that the data are not the requested. If there is more than one variable with the selected VIF, the device shall send all these data records.

A.6.3 Selection of data records with object action code

The master is able to perform a readout request with a specified data field by using the object action “add to readout list” (VIFE = E000 1100_b) from VIFE-table for object actions (see EN 13757-3:2018, Table 17). The master transmits a SND-UD with a data record which consists of the desired DIF (data field), VIF and the VIFE = 0C_h/8C_h. No data follows this VIFE and the slave shall ignore the data field on reception. The slave shall transmit this data record with the requested data field from now on, if he is capable of this. If the slave does not support this data field (data coding), it can report a record error using one of the VIFE = E000 011x (data class not implemented or data size not implemented).

A.6.4 Deselection of data records

The master can release an application reset of the application layer and especially a fall back to the slave standard RSP-UD datagram by transmitting an application reset or application select.

Single data records can be deselected by transmitting a data record with DIF, VIF and the VIFE for the object action “Delete from readout-list” (VIFE = E000 1101_b) (see EN 13757-3:2018, Table 17).

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

To avoid loss of respond datagrams the slave shall in this case support the Frame Count Bit (FCB). If the master wants to prematurely end such a multi datagram message sequential readout of the selected data, it may send an application reset or application select instead of further REQ-UD2's.

EXAMPLE 1 A slave with address 7 is to be configured to respond with the data records containing volume (VIF = 13h: volume, unit 1l) and flow temperature (VIF = 5Ah: flow temp., unit 0,1 °C):

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

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

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

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

68 04 04 68 53 03 51 7F 26 16

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

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

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

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

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

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

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

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

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

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

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

EXAMPLE 7 Freeze actual flow temperature (0,1 °C: VIF = 5Ah) of the slave with address 1 into the storage number 1:

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

A.7 FCB and selection

A.7.1 FCB-implementation slave

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

A.7.2 FCB-implementation master

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

If the master applies one of the new application frames with a short or long data header (refer to EN 13757-7:2018, 7.3 and 7.4), it shall increase the access number each time when the FCB was changed.

EXAMPLE

Master > SND-NKE 10 40 FD 3D 16

SND-NKE clears the FCB

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

Slave_1 > ACK E5

SELECT clears the FCB of address 253

Master > REQ-UD2 10 7B FD 58 18

Slave_1 > RSP-UD 68 xx xx 68 08 01 72 Response_1 cm³ 16

Master > SELECT 68 0B 0B 68 53 FD 52 44 33 22 11 3B 3D 28 07 13 16

Slave_2 > ACK E5

SELECT clears the FCB of address 253

Master > REQ-UD2 10 7B FD 58 18

Slave_2 > RSP-UD 68 xx xx 68 08 02 72 Response_1 cm³ 16

Master > SND-UD 68 xx xx 68 53 FD 51 Command_1 cm³ 16

Slave_2 > ACK E5

Master > REQ-UD2 10 7B FD 58 18

Slave_2 > RSP-UD 68 xx xx 68 08 02 72 Response_2 1F cc 16

Master missed last RSP-UD and asks again for the same frame

Master > REQ-UD2 10 7B FD 58 18

Slave_2 > RSP-UD 68 xx xx 68 08 02 72 Response_2 1F cc 16

Master understood last RSP-UD and asks for the next frame of the multi frame answer

Master > REQ-UD2 10 5B FD 58 18

Slave_2 > RSP-UD 68 xx xx 68 08 02 72 Response_3 cm³ 16

A.8 Use of the fabrication number

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

EXAMPLE

68 15 15 68 header of RSP-UD datagram (length 1F_h = 31d bytes)

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

78 56 34 12 identification number = 12345678

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

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

0C 78 04 03 02 01 fabrication number = 01020304

9D 16 checksum and stop sign

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

Annex B (informative)

Secondary search - Instructions for implementation of wildcard search

The following program flow diagram in Figure B.1 shows the realization of the wildcard searching procedure, whereby the search is made only with the identification number. The codes for manufacturer, version and device type are in general specified with wildcards, but can be changed by the user in order (for example) to locate all meters from a particular manufacturer. In order to avoid the categorization by a factor of eight of the “For-To” loops for the eight positions, the array “Value” is defined with 8 byte numbers, which are intended to define the contents of the positions. The digit number of the identification number which is presently running is noted in the variable “Pos” of type byte.

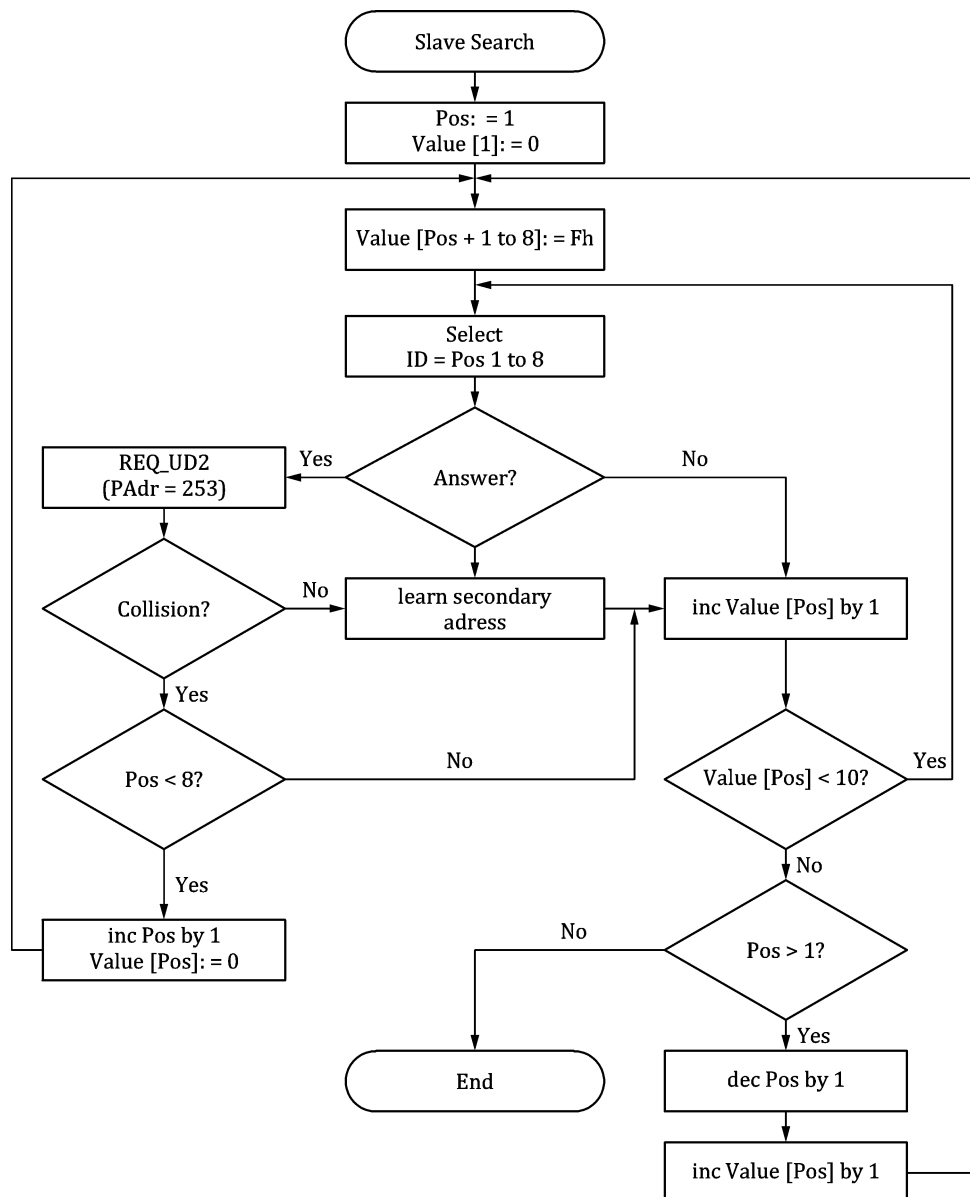


Figure B.1 — Flow diagram for slave search with wildcards

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

- selection with the ID-Nr. Pos 1, Pos 2, ..., Pos 8;
- if no reply, Value [Pos] is raised by 1;
- if there is a reply, a REQ_UD2 is sent to address 253, and if the datagram is correctly received the secondary address is learnt and the Value [Pos] raised by 1;
- if there is a collision a jump is made to the next position (Pos increased by 1), as long as the last position has not yet been reached;
- after going through a complete position from 0 to 9 the subroutine proceeds to the next lower position, or ends the search if the position Nr. 1 has already been processed.

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

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

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

Search Process:

- a) Start with ID = 0FFFFFFF: no reply
- b) ID = 1FFFFFFF: collision between Nr. 1 and Nr. 2
- c) ID = 10FFFFFF, 11FFFFFF, 12FFFFFF, 13FFFFFF: no reply
- d) ID = 14FFFFFF: collision between Nr. 1 and Nr. 2
- e) Repeated steps 3 to 4 up to the ID = 1449100F
- f) Learn ID = 14491001 and 14491008
- g) Go backwards to 19999999
- h) ID = 2FFFFFFF: no reply
- i) ID = 3FFFFFFF: learn ID = 32104833
- j) ID = 4FFFFFFF, 5FFFFFFF, 6FFFFFFF: no reply
- k) ID = 7FFFFFFF: learn ID = 76543210
- l) ID = 8FFFFFFF, 9FFFFFFF: no reply
- m) End of the search

Annex C **(informative)**

Consumer feedback for smart metering applications

C.1 General

This annex describes how the required functionalities of smart metering applications on consumer feedback as suggested by the Smart Meter Co-Ordination Group (SM-CG) of CEN, CENELEC and ETSI may be achieved using the standards EN 13757-2, EN 13757-3, EN 13757-4 and EN 13757-5. For twisted pair connection of meters the physical and link layer of EN 13757-2 are suggested. For wireless connection, the physical and link layer of EN 13757-4 are suggested. In wireless communication a differentiation is to be made between “meter” and “communication partner”. Such a communication partner might be a dedicated receiver, an in-home-device, a concentrator, a multi-utility server for several media or another (possibly electricity) meter. In any case the partners are located in fixed locations and usually have a mains supply.

To establish consumer feedback on the basis of meter indexes and/or the instantaneous power or flow rate, a more frequent transmission of such values appears to be necessary in comparison to the requirements for billing purposes. A distinction has to be made between the case where the meter itself generates and transmits the instantaneous power/flow rate values and the case where the in-home-device or some other device will generate these instantaneous values from index and time differences. In the latter case, the index values need a sufficient resolution (usually much higher than useful for billing). If the index value can be generated internally in synchronicity with the wireless transmission time points the receiving device can calculate the required time difference with sufficient accuracy and resolution. Even in the case of a fixed delay between value generation and transmission no calculation problem will occur. Also if the time difference is sufficiently small (i.e. less than 1 s or 1 % of the transmission interval) there will be no problem. In the remaining cases (i.e. longer or variable delays) a meter (usable for consumer feedback of instantaneous values) shall include a record with the time delay in its message.

The following sections demonstrate possible definitions in future meter standards. As long as an applicable meter standard does not provide requirements for the utilization of meters according to this annex, the following requirements shall be used. If the applicable meter standard contains specific requirements for one or several parameters described in this annex, the meter standard shall have priority.

C.2 Resolution of required values and accuracy of time information

C.2.1 General

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

C.2.2 Resolution in case of transmission of extra data points for power/flow rate

The value resolutions required for meters with additional data points for power/flow rate are listed in Table C.1:

Table C.1 — Required value resolution for meters with power/flow rate data

Medium	Billing	Power/flow rate resolution
Electricity	$\leq 1 \text{ kWh}$	$\leq 1 \text{ W}$
Water	$\leq 1 \text{ m}^3$	No requirement
Gas $Q_{\text{Max}} \leq 6 \text{ m}^3/\text{h}$	$\leq 1 \text{ m}^3$	$\leq 10 \text{ l/h}$
Gas $Q_{\text{Max}} \leq 60 \text{ m}^3/\text{h}$	$\leq 1 \text{ m}^3$	$\leq 100 \text{ l/h}$
Gas $Q_{\text{Max}} > 60 \text{ m}^3/\text{h}$	$\leq 1 \text{ m}^3$	$\leq 1\,000 \text{ l/h}$
Heat/Cooling $Q_p < 10 \text{ m}^3/\text{h}$	$\leq 1 \text{ kWh}$	No requirement
Heat/Cooling $Q_p < 100 \text{ m}^3/\text{h}$	$\leq 10 \text{ kWh}$	No requirement
Heat/Cooling $Q_p \geq 100 \text{ m}^3/\text{h}$	$\leq 100 \text{ kWh}$	No requirement
Heat cost allocation	No requirement	No requirement

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

C.2.3 Resolution in case of non-transmission of extra data points for power/flow rate

C.2.3.1 General

If the meter transmits only index values, the in-home-device shall be able to calculate power respectively flow rate with sufficient resolution and accuracy from the index value and the time interval between the index values. The index resolutions required for meters with no additional data points for power/flow rate are listed in Table C.2.

Table C.2 — Required value resolution for meters without power/flow rate data

Medium	Index resolution
Electricity	$\leq 0,1 \text{ Wh}$
Water	$\leq 1 \text{ m}^3$
Gas $Q_{\text{Max}} \leq 6 \text{ m}^3/\text{h}$	$\leq 10 \text{ l}$
Gas $Q_{\text{Max}} \leq 60 \text{ m}^3/\text{h}$	$\leq 100 \text{ l}$
Gas $Q_{\text{Max}} > 60 \text{ m}^3/\text{h}$	$\leq 1\,000 \text{ l}$
Heat/Cooling $Q_p < 10 \text{ m}^3/\text{h}$	$\leq 1 \text{ kWh}$
Heat/Cooling $Q_p < 100 \text{ m}^3/\text{h}$	$\leq 10 \text{ kWh}$
Heat/Cooling $Q_p \geq 100 \text{ m}^3/\text{h}$	$\leq 100 \text{ kWh}$
Heat cost allocation	No requirement

C.2.3.2 Assumptions on time information for wireless connections**C.2.3.2.1 General**

If there is no power/flow rate information coming from the meter directly, there are requirements for accuracy and resolution of the current time difference between the index values to ensure a time interval accuracy and resolution of $\leq 1 \%$. These requirements can be fulfilled by one of the following alternatives.

C.2.3.2.2 Correlated transmission

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

C.2.3.2.3 Uncorrelated transmission

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

C.2.4 Transmission on request

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

Annex D (informative)

Installation and registration

D.1 General

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

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

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

- a) either automatically (no predefinition),
- b) predefined by the operator,
- c) or predefined by the service technician.

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

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

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

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

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

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