Blue Book Ed. 13

EXCERPT FROM

Companion Specification for Energy Metering

COSEM Interface Classes and OBIS Object Identification System

DLMS User Association

device
language
message
specification

CONTENTS

Foreword to this Excerpt

This Excerpt has been abstracted from the full technical report to give potential users a flavour of the content of the Blue Book. It is not intended to provide sufficient information to allow a developer to implement the Protocol. This excerpt is about 45% of the content of the full technical report. Figure, Table and footnote numbering differs between this document and the full document.

Foreword

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Acknowledgement

The actual document has been established by the WG Maintenance of the DLMS UA.

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Status of standardization

The contents of this edition is the basis of a planned revision to:

- IEC 62056-6-1 Ed. 3:2017, Electricity Metering Data Exchange – The DLMS/COSEM suite – Part 6-1: Object identification system (OBIS); and
- IEC 62056-6-2 Ed. 3:2017, Electricity Metering Data Exchange – The DLMS/COSEM suite – Part 6-2: COSEM interface classes.

List of main technical changes in Edition 13

Item	Clause	Description
1. .	4.1.8.4	Addition of firmware – related objects to the mandatory list of objects to ensure that product certifications by the DLMS UA have improved traceability.
2.	4.3.2	Addition of non-SI units, footnote for converted volume, formula to describe Force (Newtons) and alternate pressure units (g/cm^2, atm) to Table 4.
3.	4.4.12	Addition of Communication Port Protection IC (class_id = 124, version = 0).
4.	4.4.8	Push Setup update to version 1.
5.	4.13	Update to the G3-PLC setup interface classes: including the G3-PLC MAC setup (class_id = 91) and the G3-PLC 6LoWPAN adaptation layer setup (class_id = 92) to be in line with IUT-T 9903:2017.
6.	6	Generic clause added to permit Data IC (class_id = 1) to be replaced with Register IC (class_id = 3) or Extended register IC (class_id = 4) in many applications, and related notes removed.
7.	6.4	Heat Cost Allocator relation to OBIS.
8.	6.5	Thermal energy meter relation to OBIS.
9.	6.7	Water meter relation to OBIS.
10.	7.3.4.3	Addition of Mexico.
11.	7.5.1	Additional value group C codes for reactive power inductive and capacitative, and line-to-line voltage.
12.	7.5.2.1	Additional value group D codes for average values for recording intervals 1 & 2.
13.	7.6.4	Heat Cost Allocator OBIS codes updates.
14.	7.7.4	Thermal energy meter OBIS codes updates.
15.	7.9.4	Water meter OBIS codes updates.

Introduction

Object modelling and data identification

Driven by the business needs of the energy market participants – generally in a liberalized, competitive environment – and by the desire to manage natural resources efficiently and to involve the consumers, the utility meter became part of an integrated metering, control and billing system. The meter is not any more a simple data recording device but it relies critically on communication capabilities. Ease of system integration, interoperability and data security are important requirements.

COSEM, the *Companion Specification for Energy Metering*, addresses these challenges by looking at the utility meter as part of a complex measurement and control system. The meter has to be able to convey measurement results from the metering points to the business processes which use them. It also has to be able to provide information to the consumer and manage consumption and eventually local generation.

COSEM achieves this by using *object modelling* techniques to model all functions of the meter, without making any assumptions about which functions need to be supported, how those functions are implemented and how the data are transported. The formal specification of COSEM interface classes forms a major part of COSEM.

To process and manage the information it is necessary to uniquely identify all data items in a manufacturer-independent way. The definition of OBIS, the *Object Identification System* is another essential part of COSEM. It is based on DIN 43863-3:1997, *Electricity meters – Part 3: Tariff metering device as additional equipment for electricity meters – EDIS – Energy Data Identification System.* The set of OBIS codes has been considerably extended over the years to meet new needs.

COSEM models the utility meter as a *server* application – see 4.1.7 – used by *client* applications that retrieve data from, provide control information to, and instigate known actions within the meter via controlled access to the COSEM objects. The *clients* act as agents for third parties i.e. the business processes of energy market participants.

The standardized COSEM interface classes form an extensible library. Manufacturers use elements of this library to design their products that meet a wide variety of requirements.

The server offers means to retrieve the functions supported, i.e. the COSEM objects instantiated. The objects can be organized to *logical devices and application associations* and to provide specific access rights to various clients.

The concept of the standardized interface class library provides different users and manufacturers with a maximum of diversity while ensuring interoperability.

1 Scope

The DLMS/COSEM specification specifies a data model and communication protocols for data exchange with metering equipment. It follows a three-step approach as illustrated in Figure 1.

Step 1, Modelling: This covers the data model of metering equipment as well as rules for data identification. The data model provides a view of the functionality of the meter, as it is available at its interface(s). It uses generic building blocks to model this functionality. The model does not cover internal, implementation-specific issues.

Step 2, Messaging: This covers the communication services and protocols for mapping the elements of the data model to application protocol data units (APDU).

Step 3, Transporting: This covers the services and protocols for the transportation of the messages through the communication channel.

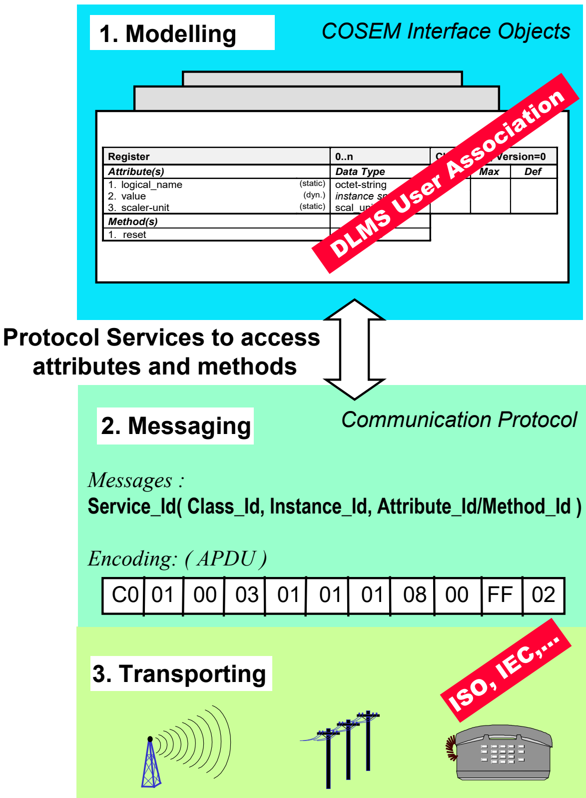


Figure 1 – The three steps approach of DLMS/COSEM: Modelling – Messaging – Transporting

Step 1 is specified in this document. It specifies the COSEM interface classes (ICs), the OBIS object identification system, and the use of interface objects for modelling the various functions of the metering equipment.

Step 2 and 3 are specified in the Green Book,DLMS UA 1000-2 Ed. 9. It specifies communication profiles for various communication media and the protocol layers of these communication profiles. The top layer in any profile is the DLMS/COSEM application layer. It provides services to establish a logical connection between the client and the server(s). It also provides the xDLMS messaging services to access attributes and methods of the COSEM interface objects. The lower, communication profile specific protocol layers transport the information.

Rules for conformance testing are specified in the "Yellow Book", DLMS UA 1001-1 "DLMS/COSEM Conformance Test Process".

Terms are explained in the "White book" DLMS UA 1002, "COSEM Glossary of Terms".

2 Referenced documents

Reference	Title
DLMS UA 1000-2 Ed. 9	*DLMS/COSEM Architecture and Protocols, the "Green Book" Edition 9*
DLMS UA 1001-1	*DLMS/COSEM Conformance test and certification process, the "Yellow Book"*
DLMS UA 1002	*COSEM Glossary of terms, the "White Book"*
IEC TR 61000-2-8:2002	*Electromagnetic compatibility (EMC) – Part 2-8: Environment - Voltage dips and short interruptions on public electric power supply systems with statistical measurement results*
IEC 61334-4-32:1996	*Distribution automation using distribution line carrier systems – Part 4: Data communication protocols – Section 32: Data link layer – Logical link control (LLC)*
IEC 61334-4-41:1996	*Distribution automation using distribution line carrier systems – Part 4: Data communication protocols – Section 41: Application protocols – Distribution line message specification*
IEC 61334-4-511:2000	*Distribution automation using distribution line carrier systems – Part 4-511: Data communication protocols – Systems management – CIASE protocol*
IEC 61334-4-512:2001	*Distribution automation using distribution line carrier systems – Part 4-512: Data communication protocols – System management using profile 61334-5-1 – Management Information Base (MIB)*
IEC 61334-5-1:2001	*Distribution automation using distribution line carrier systems – Part 5-1: Lower layer profiles – The spread frequency shift keying (S-FSK) profile*
IEC 62053-23:2003	Electricity metering equipment (a.c.) – Particular requirements – Part 23: Static meters for reactive energy (classes 2 and 3)
IEC TR 62055-21:2005	*Technical report Electricity metering - Payment systems- Part 21: Framework for standardization. 2005-8*
IEC 62056-21:2002	Electricity metering *– Data exchange for meter reading, tariff and load control – Part 21: Direct local data exchange*
IEC 62056-31:1999	*Electricity metering – Data exchange for meter reading, tariff and load control – Part 31: Using local area networks on twisted pair with carrier signalling* NOTE This Edition is referenced in the interface class "IEC twisted pair (1) setup" (class_id: 24, version: 0)
IEC 62056-3-1:2013	*Electricity metering data exchange – The DLMS/COSEM suite – Part 3-1: Use of local area networks on twisted pair with carrier signalling* NOTE This Edition is referenced in the interface class "IEC twisted pair (1) setup" (class_id: 24, version: 1)
IEC 62056-8-6: 2017	*13/1652/CDV, ELECTRICITY METERING DATA EXCHANGE – THE DLMS/COSEM SUITE – Part 8-6: High speed PLC ISO/IEC 12139-1 profile for neighbourhood networks*
ISO/IEC 8802-2:1998	*IEEE Standard for Information technology – Telecommunications and information exchange between systems – Local and metropolitan area networks – Specific requirements – Part 2: Logical Link Control*
ISO/IEC 12139-1:2009	*Information technology —Telecommunications and information exchange between systems — Powerline communication (PLC) — High speed PLC medium access control (MAC) and physical layer (PHY) — Part 1: General requirements*
ISO/IEC/IEEE 60559:2011	*Information technology – Microprocessor Systems – Floating-Point arithmetic*
ISO 4217	*Codes for the representation of currencies and funds*
ITU-T E.212 (05.2008)	*SERIES E: OVERALL NETWORK OPERATION,TELEPHONE SERVICE, SERVICE OPERATION AND HUMAN FACTORS - International operation – Maritime mobile service and public land mobile service - The international identification plan for public networks and subscriptions*
3GPP TS 24.301 V13.4.0 (2016-01)	*Technical Specification Group Core Network and Terminals; Non-Access-Stratum (NAS) protocol for Evolved Packet System (EPS); Stage 3*
ITU-T G.9903 Amd. 1:2013	*SERIES G: TRANSMISSION SYSTEMS AND MEDIA, DIGITAL SYSTEMS AND NETWORKS – Access networks – In premises networks – Narrow-band orthogonal frequency division multiplexing power line communication transceivers for G3-PLC networks* NOTE This Recommendation is referenced in version 0 of the G3-PLC setup classes.

Reference	Title
ITU-T G.9903:2014	*SERIES G: TRANSMISSION SYSTEMS AND MEDIA, DIGITAL SYSTEMS AND NETWORKS – Access networks – In premises networks –* *Narrow-band orthogonal frequency division multiplexing power line communication transceivers for G3-PLC networks* NOTE This Recommendation is referenced in version 1 of the G3-PLC setup classes.
ITU-T G.9903:2017	*SERIES G: TRANSMISSION SYSTEMS AND MEDIA, DIGITAL SYSTEMS AND NETWORKS - Access networks – In premises networks - Narrowband orthogonal frequency division multiplexing power line communication transceivers for G3-PLC networks* NOTE This Recommendation is referenced in current version of the G3-PLC setup classes.
ITU-T G.9904:2012	*SERIES G: TRANSMISSION SYSTEMS AND MEDIA, DIGITAL SYSTEMS AND NETWORKS – Access networks – In premises networks – Narrow-band orthogonal frequency division multiplexing power line communication transceivers for PRIME networks*
EN 834:1994	*Heat cost allocators for the determination of the consumption of room heating radiators – Appliances with electrical energy supply*
EN 1434-1:2015	*Heat meters – Part 1: General requirements*
EN 1434-2:2015	*Heat meters – Part 2: Constructional requirements*
EN 13757-1:2014	*Communication system for meters – Part 1: Data exchange*
EN 13757-2	*Communication systems for meters and remote reading of meters – Part 2: Physical and link layer*
EN 13757-3:2004	*Communication systems for and remote reading of meters – Part 3: Dedicated application layer* NOTE This standard is referenced in the “M-Bus client setup” interface class version 0.
EN 13757-3:2018	*Communication systems for meters – Part 3: Dedicated application layer* NOTE This standard is referenced in the M-Bus client setup interface class version 1.
EN 13757-4:2013	*Communication system for and remote reading of meters – Part 4: Wireless meter (Radio meter reading for operation in SRD bands)*
EN 13757-5:2015	*Communication systems for meters – Part 5: Wireless M-Bus relaying*
EN 13757-7:2018	*Communication system for meters – Part 7: Transport and security services*
IEEE 802.15.4: 2006 also available as ISO/IEC/IEEE 8802-15-4 Ed 1.0	*IEEE 802.15.4-2006 Standard for Information technology – Telecommunications and information exchange between systems – Local and metropolitan area networks – Specific requirements – Part 15.4: Wireless Medium Access Control (MAC) and Physical Layer (PHY) Specifications for Low-Rate Wireless Personal Area Networks (WPANs) – September 2006.*
ETSI GSM 05.08	*Digital cellular telecommunications system (Phase 2+); Radio subsystem link control*
ANSI C12.19:2012	*American National Standard For Utility Industry End Device Data Tables*
ZigBee® 053474	*ZigBee® Specification.* The specification can be downloaded free of charge from https://www.zigbee.org/zigbee-for-developers/zigbee-pro/
The following RFCs are available online from the Internet Engineering Task Force (IETF): ***http://www.ietf.org/rfc/std-index.txt, http://www.ietf.org/rfc/***	
IETF STD 51	*The Point-to-Point Protocol (PPP), 1994. (Also RFC 1661, RFC 1662)*
RFC 791	*Internet Protocol (Also: IETF STD 0005)*, 1981
RFC 1144	*Compressing TCP/IP Headers for Low-Speed Serial Links*, 1990
RFC 1332	*The PPP Internet Protocol Control Protocol (IPCP)*, 1992, Updated by: RFC 3241. Obsoletes: RFC 1172
RFC 1570	*PPP LCP Extensions, 1994*
IETF STD 51 / RFC 1661	*The Point-to-Point Protocol (PPP) (Also: IETF STD 0051)*, 1994, Updated by: RFC 2153, Obsoletes: RFC 1548
IETF STD 51 / RFC 1662	*PPP in HDLC-like Framing, (Also: IETF STD 0051)*, 1994, Obsoletes: RFC 1549

Reference	Title
RFC 1994	*PPP Challenge Handshake Authentication Protocol (CHAP),* 1996. Obsoletes: RFC
RFC 2433	*PPP CHAP Extension,* 1998
RFC 2474	*Definition of the Differentiated Services Field (DS Field) in the IPv4 and IPv6 Headers,* 1998
RFC 2507	*IP Header Compression,* 1999
RFC 2508	*Compressing IP/UDP/RTP Headers for Low-Speed Serial Links,* 1999
RFC 2759	*Microsoft PPP CHAP Extensions, Version 2,* 2000
RFC 2986	PKCS #10 v1.7: *Certification Request Syntax Standard*
RFC 3095	*RObust Header Compression (ROHC): Framework and four profiles: RTP, UDP, ESP, and uncompressed,* 2001
RFC 3241	*Robust Header Compression (ROHC) over PPP,* 2002. Updates: RFC1332
RFC 3513	*Internet Protocol Version 6 (IPv6) Addressing Architecture,* 2003
RFC 3544	*IP Header Compression over PPP,* 2003
RFC 3748	*Extensible Authentication Protocol (EAP),* 2004
RFC 4861	*Neighbor Discovery for IP version 6 (IPv6),* 2007
RFC 4944	*Internet Engineering Task Force (IETF). RFC 4944: Transmission of IPv6 Packets over IEEE 802.15.4 Networks [online]. Edited by G. Montenegro, N. Kushalnagar and D. Culler. September 2007*
RFC 5280	*Internet X.509 Public Key Infrastructure Certificate and Certificate Revocation List (CRL) Profile, 2008*
RFC 5905	*Network Time Protocol Version 4: Protocol and Algorithms Specification, 2010.*
RFC 6282	*Internet Engineering Task Force (IETF). RFC 6282: Compression Format for IPv6 Datagrams over IEEE 802.15.4-Based Networks [online]. Edited by J. Hui, Ed. September 2011*
RFC 6775	*Neighbor Discovery Optimization for IPv6 over Low-Power Wireless Personal Area Networks (6LoWPANs), 2012*
	Point-to-Point (PPP) Protocol Field Assignments. Online database. Available from: http://www.iana.org/assignments/ppp-numbers/ppp-numbers.xhtml

3 Terms, definitions and abbreviated terms

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 Terms and definitions related to the Image transfer process (see 4.4.6)

Term	Definition
Image	binary data of a specified size Note 1 to entry: An Image can be seen as a container. It may consist of one or multiple elements (image_to_activate) which are transferred, verified and activated together.
ImageSize	size of the whole Image to be transferred Note 1 to entry: ImageSize is expressed in octets.
ImageBlock	part of the Image of size ImageBlockSize Note 1 to entry: The Image is transferred in ImageBlocks. Each block is identified by its ImageBlockNumber.
ImageBlockSize	size of ImageBlock expressed in octets
ImageBlockNumber	identifier of an ImageBlock. ImageBlocks are numbered sequentially, starting from 0.

The meaning of the definitions above is illustrated in Figure 2.

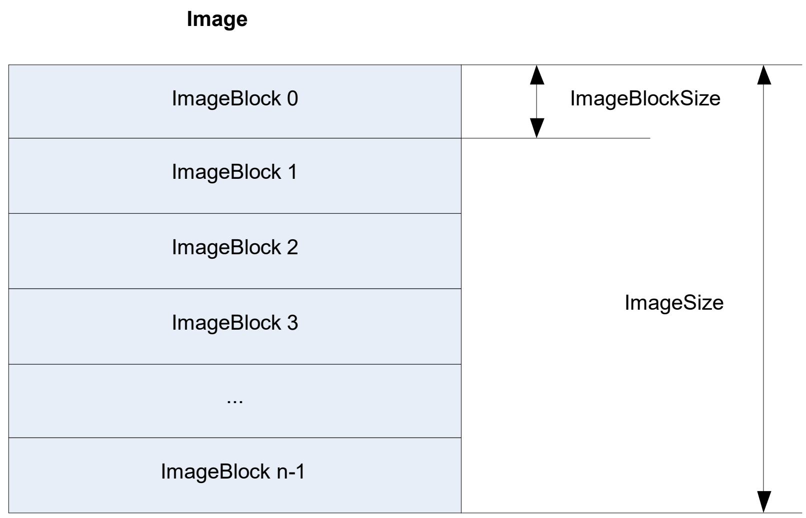


Figure 2 – The meaning of the definitions concerning the Image

3.2 Terms and definitions related to the S-FSK PLC setup ICs (see 4.10)

Term	Definition
initiator	user-element of a client System Management Application Entity (SMAE) Note. The initiator uses the CIASE and xDLMS ASE and is identified by its system title. [SOURCE: IEC 61334-4-511:2000, 3.8.1]
active initiator	initiator which issues or has last issued a CIASE Register request when the server is in the unconfigured state [SOURCE: IEC 61334-4-511:2000, 3.9.1]
new system	server system which is in the unconfigured state: its MAC address equals "NEW-address" [SOURCE: IEC 61334-4-511:2000, 3.9.3]
new system title	system-title of a new system Note This is the system title of a system, which is in the new state. [SOURCE: IEC 61334-4-511:2000 3.9.4]
registered system	server system which has an individual valid MAC address (therefore, different from "NEW Address", see IEC 61334-5-1:2001: Medium Access Control) [SOURCE: IEC 61334-4-511:2000 3.9.5]
reporting system	server system which issues a DiscoverReport [SOURCE: IEC 61334-4-511:2000 3.9.6 modified to correct an error in IEC 61334-4-511.]
sub-slot	time needed to transmit two bytes by the physical layer Note 1 to entry: Timeslots are divided to sub-slots in the RepeaterCall mode of the physical layer.
timeslot	time needed to transmit a physical frame Note 1 to entry: As specified in IEC 61334-5-1, 3.3.1, a physical frame comprises 2 bytes preamble, 2 bytes start subframe delimiter, 38 bytes PSDU and 3 bytes pause.

3.3 Terms and definitions related to the PRIME NB OFDM PLC setup ICs (see 4.12)

Term	**Definition**
	Definitions related to the physical layer
base node	the master node, which controls and manages the resources of a subnetwork [SOURCE: ITU-T G.9904:2012, 3.2.1]
beacon slot	the location of the beacon PDU within a frame [SOURCE: ITU-T G.9904:2012, 3.2.2]
node	any one element of a subnetwork, which is able to transmit to and receive from other subnetwork elements [SOURCE: ITU-T G.9904:2012, 3.2.9]
registration	the process by which a service node is accepted as member of the subnetwork and allocated a LNID [SOURCE: ITU-T G.9904:2012, 3.2.12]
service node	any one node of a subnetwork, which is not a base node [SOURCE: ITU-T G.9904:2012, 3.2.13]
subnetwork	a set of elements that can communicate by complying with this specification and share a single base node [SOURCE: ITU-T G.9904:2012, 3.2.15]
	Definitions related to the MAC layer
disconnected state <of a service node>	this is the initial functional state for all service nodes. When disconnected, a service node is not able to communicate data or switch other nodes' data; its main function is to search for a subnetwork within its reach and try to register on it [SOURCE: ITU-T G.9904:2012 8.1]
terminal state <of a service node>	when in this functional state a service node is able to establish connections and communicate data, but it is not able to switch other nodes' data [SOURCE: ITU-T G.9904:2012 8.1]

switch state <of a service node>	when in this functional state a service node is able to perform all Terminal functions. Additionally, it is able to forward data to and from other nodes in the same subnetwork. It is a branch point on the tree structure [SOURCE: ITU-T G.9904:2012 8.1]
promotion	the process by which a service node is qualified to switch (repeat, forward) data traffic from other nodes and act as a branch point on the subnetwork tree structure. A successful promotion represents the transition between Terminal and Switch state. When a service node is in the Disconnected state, it cannot directly transition to Switch state [SOURCE: ITU-T G.9904:2012 8.1]
demotion	the process by which a service node ceases to be a branch point on the subnetwork tree structure. A successful demotion represents the transition between Switch and Terminal state [SOURCE: ITU-T G.9904:2012 8.1]

3.4 Terms and definitions related to ZigBee® (see 4.15)

NOTE Terms marked with * are from the ZigBee® Specification.

Term	Definition
CAD	Consumer Access Device; a ZigBee® gateway device that acts like an IHD within the ZigBee® network, but has an additional connection to a different network (i.e. WiFi)
IHD	in Home Display; a device that has a screen for the displaying of Energy information to the consumer
install code	a Hashed (via MMO) Pre-Configured Linked Key (PCLK) that is provided to a Trust Center via out-of-band communications. A new device wishing to join the network would need to send this install code to the Trust Center, which would allow the Trust Center to execute the joining process, using this install code as part of the security information
link key *	this is a key that is shared exclusively between two, and only two, peer application-layer entities within a PAN
MAC address/IEEE address	these are used synonymously to represent the EUI-64 code allocated to the ZigBee® Radio
ZigBee®	ZigBee® is a specification for a suite of high level communication protocols used to create personal area networks built from small, low-power digital radios. ZigBee® is based on an IEEE 802.15 standard. Though low-powered, ZigBee® devices often transmit data over longer distances by passing data through intermediate devices to reach more distant ones, creating a mesh network
ZigBee® client	this is similar to the role of the DLMS/COSEM Client. For a greater understanding of the interaction between the client and server the ZigBee® PRO specification should be read
ZigBee® coordinator *	an IEEE 802.15.4-2003 PAN coordinator that is the principal controller of an IEEE 802.15.4-2003-based network that is responsible for network formation. The PAN coordinator must be a full function device (FFD)
ZigBee® cluster	a set of message types related to a certain device function (e.g. metering, ballast control)
ZigBee® mirror	a device which echoes data being published by a battery operated ZigBee® device, allowing other network actors to obtain data while the battery operated device is unavailable due to power saving
ZigBee® PRO	an alternative name for the ZigBee® 2007 protocol. ZigBee® 2007, now the current stack release, contains two stack profiles, stack profile 1 (simply called ZigBee®), for home and light commercial use, and stack profile 2 (called ZigBee® PRO). ZigBee® PRO offers more features, such as multi-casting, many-to-one routing and high security with Symmetric-Key Key Exchange (SKKE), while ZigBee® (stack profile 1) offers a smaller footprint in RAM and flash. Both offer full mesh networking and work with all ZigBee® application profiles
ZigBee® router *	an IEEE 802.15.4-2003 FFD participating in a ZigBee® network, which is not the ZigBee® coordinator but may act as an IEEE 802.15.4-2003 coordinator within its personal operating space, that is capable of routing messages between devices and supporting associations

ZigBee® server	this is similar to the role of the DLMS/COSEM Server. Note 1 to entry: For a greater understanding of the interaction between the client and server the ZigBee® PRO specification should be read.
ZigBee® Trust Center *	the device trusted by devices within a ZigBee® network to distribute keys for the purpose of network and end-to-end application configuration management

3.5 Terms and definitions related to Payment metering ICs (see 4.6)

Term	definition
account	statement of the credits and charges of an individual with reference to a contractual relationship between the said individual and another party; in this case a utility service provider
available	(credit), total value that may be decremented by charges without further action
charge	representation of a financial liability on an account Note 1 to entry: Within this specification charges are modelled in the form of "Charge" objects that define the amount due, collection mechanism, collection periodicity, collection amount and other relevant variables. Note 2 to entry: There may be one or more instalments payable and their size may be determined explicitly or in terms of a rate of payment per unit of time or of consumption. Note 3 to entry: Charges may also be levied as a fixed amount per vend.
credit mode	mode of operation of a meter in a payment system that does not require payment for the consumption in advance
collect	take payment of an instalment of a charge, accounting for the collection amount determined by the *unit_charge_active* attribute of the "Charge" object
commodity	utility product delivered to a consumer at a service point on their premises under a contract of supply such as electricity, gas, water, and heat
enabled	when used in the context of "Credit" or "Charge" types; means that the "Credit" or "Charge" type appears in the *credit_reference_list* or *charge_reference_list* respectively of the "Account" object
emergency credit	amount of credit administered in a payment metering system working in prepayment mode, representing a short term loan to the consumer Note1 to entry: This is a feature of some payment metering systems in which the consumer is able to obtain a limited amount of credit as a short-term loan, often mediated locally by the prepayment unit itself. The word "emergency" indicates urgent need rather than disaster.
Enterprise Resource Planning (ERP) system - Back Office System	computer system carrying out the business processing of an organisation (such as an energy supplier), as distinct from the communications system. See also Head End System.
friendly credit	period of time with a configurable start and end point, where the meter will not disconnect supply regardless of the status of the *available_credit*. Also known as non-disconnect period Note 1 to entry: This function is used in circumstances where it would be inconvenient to obtain needed credit (for example, at night or in the case of a frail elderly consumer).
Head End System (HES)	computer system, connected by a communications network to a population of intelligent devices, whose job is the control and coordination of information flows to and from those devices, typically on behalf of a separate ERP ("back office") system
Home Area Network (HAN)	communications network constructed with the principal aim of connecting devices in one premises
in use	state of a "Credit" object that, at the point of query, has a positive *current_credit_amount* and that Credit is being consumed by some active Charges represented by "Charge" objects Note 1 to entry: When the current_credit_amount reaches zero, the credit status becomes exhausted.
load limiting	mode of operation of some payment metering systems (not necessarily in prepayment mode) in which the consumer is able to draw on a supply provided they do not exceed a configured level of demand Note 1 to entry: The implied purpose is for management of the consumer's finances: where demand is subject to limitation for the benefit of the generation or distribution system the term "load management" is more often used.

local communications	mechanism of communicating with the meter over some media, within the vicinity of that meter such as over a HAN or optical port
manual entry	entering of a token to the payment metering installation via means of a manual process
managed payment mode	specialisation of credit mode that allows operation of an Account, Credit and possibly Charges in a meter where the payment for the service is received by the utility after the service has been consumed Note 1 to entry: When in managed payment mode tokens are not normally used, however the credit is adjusted using the methods in the “Credit” object. Note 2 to entry: The meter is allowed to go into an allowable amount of debt before being credited from the client in line with a received cash payment by the utility. Note 3 to entry: In this example cash is used as a generic term for a real life payment of currency to the utility which could be executed as legal tender, automated electronic transfer etc.
payment metering installation	set of payment metering equipment installed and ready for use at a consumer’s premise Note 1 to entry: This includes mounting the equipment as appropriate, and where a multi-device installation is involved, the connection of each unit of equipment as appropriate. It also includes the connection of utility supply network to each supply interface, the connection of the consumer’s load interface, and the commissioning of the equipment into an operational state as a payment metering installation.
prepayment mode	mode of operation of a meter in a payment system, whereby the consumer pays for service in advance of consumption
post-payment	method of operation of a payment system whereby a consumer may consume service before paying for it Note 1 to entry: This term can be used interchangeably with the term Credit mode when used in the context of operational modes. Note 2 to entry: This term is usually used in conjunction with a system description whereas Credit mode is used when referring to the operational mode of a meter or account.
remote communications	transportation of a token or other message from a client to a server running a payment metering application process via some form of WAN and access network. This could be point to point, mesh radio, fibre optic connection etc. and may travel through multiple devices and over multiple protocols before reaching the meter
repayable	credit_types such as emergency credit where an amount added to *current_credit_amount* of a “Credit” object has to be repaid before the Credit is selectable again
reserved credit	amount of credit that is held in reserve in the account of a payment meter, for use at a later time, at the discretion of the consumer Note 1 to entry: The mechanism for reserving this credit may be subject to agreement between the utility supplier and the consumer. For example a proportion of every token may be added to the reserve Credit or the supplier might give the consumer an allowance every month, but these arrangements will be project specific.
selectable	specific state of a “Credit” object where the consumer’s immediate confirmation is needed before it can be brought into use Note 1 to entry: For example, Emergency Credit has the nature of a short-term loan and should therefore only be deployed with the consumer’s agreement. The term refers respectively to the need to get agreement and to the fact of having received agreement. Only a ”Credit” made (1) Selectable can be (2) Selected / Invoked. Not all Credits need to be selected by an external trigger, as in most cases the meter application automatically performs this action.
selected/invoked	specific state of a “Credit” object where the value of *current_credit_amount* is included in the calculation of *available_credit* in the related “Account”.Note 1 to entry: This is the state of a Credit before becoming In use and is considered in the available_credit attribute of the “Account”, but is not yet being consumed by any Charge (due to a higher priority Credit being In use.
service	provision of a commodity (such as water, electricity gas or heat)
social credit	credit that is given free of payment for reasons such as the relief of poverty Note 1 to entry: Typically such a credit is given at fixed times (e.g. monthly) in limited amounts. This particular type of credit could also be consumption based, such that that the consumer must keep consumption below a limiting threshold in order to use the social credit. This could be controlled by the consumer being disconnected if the limit is breached. Note 2 to entry: Social credits are modelled of “Credit” objects of type emergency_credit, time_based_credit, consumption_based_credit.

temporary debt	transient liability to the meter that accrues when *Charges* are collected at a time when all credits are exhausted Note1 to entry: This temporary debt amount is accumulated in amount_to_clear in the “Account” object.
token	self-contained package of data related to the purchase of credit or to other system functions, embodied in a token carrier (q.v.). The token forms a link between source and destination of the transaction. The token contents may reflect money, energy, time, etc., in harmony with the currency declared in the meter Note 1 to entry: Defined in IEC TR 62055-21:2005 as ““<Equipment-related definition>[sic] information content including an instruction issued on a token carrier by a vending or management system that is capable of subsequent transfer to and acceptance by a specific payment meter, or one of a group of meters, with appropriate security”.
token carrier	means of transferring a token from one system element to another, typically in material “physical” or electronic “virtual” form Note 1 to entry: In a general sense, the token refers to the instruction and information being transferred, while the token carrier refers to the physical device being used to carry the instruction and information, or to the communications medium in the case of a virtual token carrier.
token carrier interface	interface between the token carrier and the payment metering installation Note 1 to entry: For example, it may be a keypad for numeric tokens, or a physical token carrier acceptor, or a communications connection to a local or remote machine for a virtual token carrier interface. Note 2 to entry: The token carrier interface may also be used to pass additional information to or from the payment meter, such as for the purposes of payment system management.
top-up - credit token	credit purchased by the consumer and capable of being delivered in the form of a token (as well as by other means) in a physical or virtual token carrier
transient device communications	transportation of a token within a payment metering installation through some electronic communication mechanism involving a transient device. This could be done by local radio, galvanic connection, optical connection etc. from various devices e.g. HHT, mobile phone Note 1 to entry: In Home Displays are not classed as transient devices despite the fact that they may operate in a transient manner as far as the network is concerned. Transient devices shall be considered as devices that join the network for a short time and only very rarely. In home displays are considered to be on the network for long periods and only absent for very short periods in comparison to the life of the network.
vend	operation or transaction resulting in the available credit held on a payment meter to be increased by use of a credit token Note 1 to entry: Vend would normally relate to a transaction in conjunction with a vending system at a point of sale, resulting in the creation of a token that can be transported by means of a physical or virtual token carrier.

3.6 Terms and definitions related to the Arbitrator IC (see 4.5.12)

Term	Definition
action	operation that can be requested locally or remotely from the server
actor	entity requesting an action Note 1 to entry: It can be the local application process or a client.
arbitrator	function modelled in COSEM that can determine, based on pre-configured rules, which action is carried out when multiple actors request potentially conflicting actions to control the same resource

3.7 Abbreviated terms

Abbreviation	Explanation
3GPP	3rd Generation Partnership Project
6LoWPAN	IPv6 over Low-Power Wireless Personal Area Network
AA	Application Association
AARE	A-Associate Response – an APDU of the ACSE

Abbreviation	Explanation
AARQ	A-Associate Request – an APDU of the ACSE
ACSE	Association Control Service Element
ADP	Primary Station Address
ADS	Secondary Station Address
AGA	American Gas Association
AGA 8	Method for calculation of compressibility (Gas metering)
AGC	Automatic Gain Control
AL	Application layer
AP	Application process
APDU	Application Protocol Data Unit
APS	Application Support Sublayer (ZigBee® term)
ARFCN	Absolute radio-frequency channel number
ASE	Application Service Element
A-XDR	Adapted Extended Data Representation (IEC 61334-6)
base_name	The short_name corresponding to the first attribute (“logical_name”) of a COSEM object
BCD	Binary Coded Decimal
BER	Bit Error Rate
CBCP	CallBack Control Protocol (PPP)
CC	Current Credit (S-FSK PLC profile)
CDMA	Code Division Multiple Access
CENELEC	European Committee for Electrotechnical Standardization
CHAP	Challenge Handshake Authentication Protocol
CIASE	Configuration Initiation Application Service Element (S-FSK PLC profile)
class_id	Interface class identification code
CLI	Calling Line Identity
COSEM	Companion Specification for Energy Metering
COSEM object	An instance of a COSEM interface class
CPAS	Common Part Adaptation Sublayer
CRC	Cyclic Redundancy Check
CSD	Circuit Switched Data
CSMA	Carrier Sense Multiple Access
CtoS	Client to Server challenge
CU	Currently Unused
DC	Delta credit (S-FSK PLC profile)
DHCP	Dynamic Host Configuration Protocol
DIB	Data Information Block (M-Bus)
DIF	Data Information Field (M-Bus)
DL	Data Link
DLMS	Device Language Message Specification
DLMS UA	DLMS User Association

Abbreviation	Explanation
DNS	Domain Name Server
DSCP	Differentiated Services Code Point
DSSID	Direct Switch ID
EAP	Extensible Authentication Protocol
eARFCN	Enhanced Absolute radio-frequency channel number
EDGE	Enhanced Data rates for GSM Evolution
EMC	Emergency Credit (Payment metering)
ERP	Enterprise Resource Planning
EUI-48	48-bit Extended Unique Identifier
EUI-64	64-bit Extended Unique Identifier
E-UTRA	Evolved UMTS Terrestrial Radio Access
FCC	Federal Communications Commission
FFD	Full-Function Device
FIFO	First-In-First-Out
FTP	File Transfer Protocol
GCM	Galois/Counter Mode, an algorithm for authenticated encryption with associated data
GMT	Greenwich Mean Time. Replaced by Coordinated Universal Time (UTC).
GPRS	General Packet Radio Service
GPS	Global Positioning System
GSM	Global System for Mobile Communications
HAN	Home Area Network
HART	Highway Addressable Remote Transducer; see http://www.hartcomm.org/ (in relation with the Sensor manager interface class)
HDLC	High-level Data Link Control
HES	Head End System
HHT	Hand Held Terminal
HLS	High Level Security Authentication
HSDPA	High-Speed Downlink Packet Access
HS-PLC	High-Speed Power Line Carrier
IANA	Internet Assigned Numbers Authority
IB	Information Base
IC	Interface Class (COSEM)
IC	Initial credit (S-FSK PLC profile)
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers
IETF	Internet Engineering Task Force
IPCP	Internet Protocol Control Protocol
IPv4	Internet Protocol version 4
IPv6	Internet Protocol version 6
ISO	International Organization for Standardization
ISP	Internet Service Provider
IT	Information Technology
ITU-T	International Telecommunication Union – Telecommunication

Abbreviation	Explanation
KEK	Key Encryption Key
LA	Local Area
LAC	Local Area Code
LAN	Local Area Network
LCID	Local Connection Identifier
LCP	Link Control Protocol
LDN	Logical Device Name
LBD	(6)LoWPAN Bootstrapping Device
LLC	Logical Link Control (sublayer)
LLS	Low Level Security
LN	Logical Name
LNID	Local Node Identifier
LOADng	6LoWPAN Ad Hoc On-Demand Distance Vector Routing Next Generation (LOADng)
LQI	Link Quality Indicator (ZigBee ® term)
LSB	Least Significant Bit
LSID	Local Switch Identifier
LTE	Long Term Evolution (Wireless communication)
m	mandatory
M2M	Machine to Machine
MAC	Medium Access Control
M-Bus	Meter Bus
MCC	Mobile Country Code
MD5	Message Digest Algorithm 5
MIB	Management Information Base (S-FSK PLC profile)
MID	Measuring Instruments Directive 2004/22/EC of the European Parliament and of the Council
MMO	Matyas-Meyer-Oseas hash (ZigBee ® term)
MNC	Mobile Network Code
MPAN	(UK term) Meter Point Access Number – reference of the location of the Electricity meter on the electricity distribution network.
MPDU	MAC Protocol Data Unit
MSB	Most Significant Bit
MSDU	MAC Service Data Unit
MT	Mobile Termination
NB	Narrow-band
ND	Neighbour Discovery
NTP	Network Time Protocol
o	optional
OBIS	Object Identification System
OFDM	Orthogonal Frequency Division Multiplexing
OTA	Over the Air – Refers to Firmware Upgrade using ZigBee ®
PAN	Personal Area Network (Term used in relation to G3-PLC [1]) and ZigBee ®

Abbreviation	Explanation
Pad	Padding
PAP	Password Authentication Protocol
PCLK	Pre-Configured Link Key (ZigBee® term)
PDU	Protocol Data Unit
PhL, PHY	Physical Layer
PIB	PLC Information Base
PIN	Personal Identity Number
PLC	Power Line Carrier
PLMN	Public Land Mobile Network
PNPDU	Promotion Needed PDU
POS	Personal Operating Space (ZigBee ®)
POS	Point Of Sale (Payment metering)
PPDU	Physical Protocol Data Unit
PPP	Point-to-Point Protocol
PSTN	Public Switched Telephone Network
QoS	Quality of Service
RB	Radio Band
REJ PDU	Reject Protocol Data Unit
RFC	Request for Comments; a document published by the Internet Engineering Task Force
RFD	Reduced Function Device
ROHC	Robust Header Compression
RREP	Route Reply
RREQ	Route Request
RRER	Route Error
RSRQ	Reference Signal Received Quality
RSRP	Reference Signal Received Power
RSSI	Received Signal Strength Indication (ZigBee® term)
SAP	Service Access Point
SAS	Startup Attribute Set (ZigBee® term)
SCP	Shared Contention Period
SE	Smart Energy
SEP	Smart Energy Profile (ZigBee® term)
S-FSK	Spread – Frequency Shift Keying
SGERG88	Method for calculation of compressibility (Gas metering)
SHA	Secure Hash Algorithm
SI	International System of Units (*Système International d'Unités)*
SID	Switch identifier
SMS	Short Message Service
SMTP	Simple Mail Transfer Protocol
SN	Short Name
SNA	Subnetwork Address
SSAS	Service Specific Adaptation Sublayer

Abbreviation	Explanation
SSCS	Service Specific Convergence Layer
StoC	Server to Client Challenge
TAB	In the case of the EURIDIS profiles without DLMS and without DLMS/COSEM: data code. In the case of profiles using DLMS or DLMS/COSEM: value at which the equipment is programmed for Discovery
TABi	List of TAB field
TCC	Transmission Control Code (IPv4)
TCP	Transmission Control Protocol
TFTP	Trivial File Transfer Protocol
TOU	Time of use
TTL	Time To Live
UDP	User Datagram Protocol
UMTS	Universal Mobile Telecommunications System
UNC	Unconfigured (S-FSK PLC profile)
UTC	Coordinated Universal Time
VIB	Value Information Block (M-Bus)
VIF	Value Information Field (M-Bus)
VZ	Billing period counter (Form *Vorwertzähler* in German, see DIN 43863-3)
wake-up	trigger the meter to connect to the communication network to be available to a client (e.g. HES)
WAN	Wide Area Network
wM-Bus	Wireless M-Bus
ZTC	ZigBee® Trust Center
[1)] In the case of the G3-PLC technology, PAN may be defined as PLC Area Network.	

4 The COSEM interface classes

4.1 Basic principles

4.1.1 General

This Clause 4 describes the basic principles on which the COSEM interface classes (ICs) are built. It also gives a short overview on how interface objects – instantiations of the ICs – are used for communication purposes. Data collection systems and metering equipment from different vendors, following these specifications, can exchange data in an interoperable way.

For specification purposes, this document uses the technique of object modelling.

An object is a collection of attributes and methods. Attributes represent the characteristics of an object. The value of an attribute may affect the behaviour of an object. The first attribute of any object is the *logical_name*. It is one part of the identification of the object. An object may offer a number of methods to either examine or modify the values of the attributes.

Objects that share common characteristics are generalized as an interface class, identified with a class_id. Within a specific IC, the common characteristics (attributes and methods) are described once for all objects. Instantiations of ICs are called COSEM interface objects.

Manufacturers may add proprietary methods and attributes to any object; see 4.1.2.

Figure 3 illustrates these terms by means of an example:

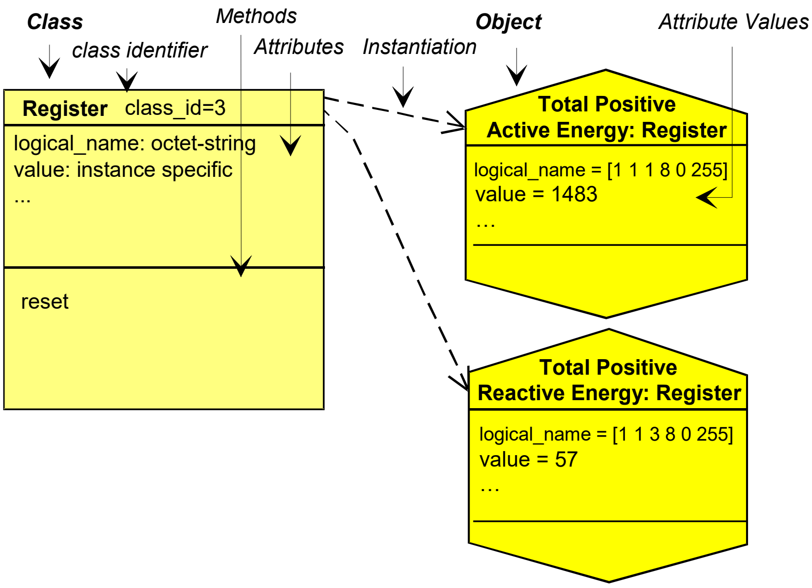


Figure 3 – An interface class and its instances

The IC "Register" is formed by combining the features necessary to model the behaviour of a generic register (containing measured or static information) as seen from the client (data collection system, hand held terminal). The contents of the register are identified by the attribute *logical_name*. The *logical_name* contains an OBIS identifier (see Clause 7). The actual (dynamic) content of the register is carried by its *value* attribute.

Defining a specific meter means defining several specific objects. In the example of Figure 3, the meter contains two registers; i.e. two specific instances of the IC "Register" are instantiated. Through the instantiation, one COSEM object becomes a "total, positive, active energy register" whereas the other becomes a "total, positive, reactive energy register".

NOTE The COSEM interface objects (instances of COSEM ICs) represent the behaviour of the meter as seen from the "outside". Therefore, modifying the value of an attribute – for example resetting the *value* attribute of a register

– is always initiated from the outside. Internally initiated changes of the attributes – for example updating the *value* attribute of a register – are not described in this model.

4.1.2 Referencing methods

Attributes and methods of COSEM objects can be referenced in two different ways:

Using logical names (LN referencing): In this case, the attributes and methods are referenced via the identifier of the COSEM object instance to which they belong.

The reference for an attribute is: class_id, value of the *logical_name* attribute, attribute_index.

The reference for a method is: class_id, value of the *logical_name* attribute, method_index, where:

- attribute_index is used as the identifier of the attribute required. Attribute indexes are specified in the definition of each IC. They are positive numbers starting with 1. Proprietary attributes may be added: these shall be identified with negative numbers;
- method_index is used as the identifier of the method required. Method indexes are specified in the definition of each IC. They are positive numbers starting with 1. Proprietary methods may be added: these shall be identified with negative numbers.

Using short names (SN referencing): This kind of referencing is intended for use in simple devices. In this case, each attribute and method of a COSEM object is identified with a 13-bit integer. The syntax for the short name is the same as the syntax of the name of a DLMS named variable. See IEC 61334-4-41:1996 and DLMS UA 1000-2 Ed. 9, 9.5.

4.1.3 Reserved base_names for special COSEM objects

In order to facilitate access to devices using SN referencing, some short_names are reserved as base_names for special COSEM objects. The range for reserved base_names is from 0xFA00 to 0xFFF8. The following specific base_names are defined, see Table 1.

Table 1 – Reserved base_names for SN referencing

Base_name (objectName)	COSEM object
0xFA00	Association SN
0xFB00	Script table (instantiation: Broadcast “Script table”)
0xFC00	SAP assignment
0xFD00	“Data” or “Register” object containing the “COSEM logical device name” in the attribute “value”

4.1.4 Class description notation

This subclause describes the notation used to define the ICs.

A short text describes the functionality and application of the IC. A table gives an overview of the IC including the class name, the attributes, and the methods. Each attribute and method shall be described in detail. The template is shown below.

Class name		**Cardinality**	**class_id, version**			
Attributes		***Data type***	***Min.***	***Max.***	***Def.***	**Short name**
1. logical_name	(static)	octet-string				x
2. …	(…)	…				x + 0x…
3. …	(…)	…				x + 0x…
Specific methods (if required)		***m/o***				
1.		…				x + 0x…
2.		…				x + 0x…
3.		…				x + 0x…

Class name	Describes the interface class (e.g. "Register", "Clock", "Profile generic"...). NOTE 1 Interface classes names are mentioned in quotation marks.
Cardinality	Specifies the number of instances of the IC within a logical device (see 4.1.8). *value* The IC shall be instantiated exactly "value" times. *Min...max.* The IC shall be instantiated at least "min." times and at most "max." times. If min. is zero (0) then the IC is optional, otherwise (min. > 0) "min." instantiations of the IC are mandatory.
class_id	Identification code of the IC (range 0 to 65 535). The class_id of each object is retrieved together with the logical name by reading the *object_list* attribute of an "Association LN" / "Association SN" object. - class_id-s from 0 to 8 191 are reserved to be specified by the DLMS UA. - class_id-s from 8 192 to 32 767 are reserved for manufacturer specific ICs. - class_id-s from 32 768 to 65 535 are reserved for user group specific ICs. The DLMS UA reserves the right to assign ranges to individual manufacturers or user groups.
version	Identification code of the version of the IC. The version of each object is retrieved together with the class_id and the logical name by reading the *object_list* attribute of an "Association LN" / "Association SN" object. **Within one logical device, all instances of a certain IC shall be of the same version.** Version numbers are to be allocated by the DLMS User Association.
Attributes	Specifies the attributes that belong to the IC. *(dyn.)* Classifies an attribute that carries a process value, which is updated by the meter itself. *(static)* Classifies an attribute, which is not updated by the meter itself (for example configuration data). There are some attributes which may be either static or dynamic depending on the application. In these cases this property is not indicated. NOTE 2 Attribute names use the underscore notation. When mentioned in the text they are in *italic*. Example: *logical_name*

logical_ name	octet-string	It is always the first attribute of an IC. It identifies the instantiation (COSEM object) of this IC. The value of the *logical_name* conforms to OBIS; see Clauses 6 and 7.
Data type	Defines the data type of an attribute; see 4.1.5.	
Min.	Specifies if the attribute has a minimum value. *X* The attribute has a minimum value. <*empty*> The attribute has no minimum value.	
Max.	Defines if the attribute has a maximum value. *X* The attribute has a maximum value. <*empty*> The attribute has no maximum value.	
Def.	Specifies if the attribute has a default value. This is the value of the attribute after reset. *X* The attribute has a default value. <*empty*> The default value is not defined by the IC specification.	
Short name	When Short Name (SN) referencing is used, each attribute and method of object instances has to be mapped to short names. The base_name x of each object instance is the DLMS named variable the logical name attribute is mapped to. It is selected in the implementation phase. The IC definition specifies the offsets for the other attributes and for the methods.	
Specific methods	Provides a list of the specific methods that belong to the object. Method Name () The method has to be described in the subsection “Method description”. NOTE 3 Method names use the underscore notation. When mentioned in the text they are in *italic*. Example: *add_object.*	
m/o	Defines if the method is mandatory or optional. *m (mandatory)* The method is mandatory. *o (optional)* The method is optional.	

Attribute description

Describes each attribute with its data type (if the data type is not simple), its data format and its properties (minimum, maximum and default values).

Method description

Describes each method and the invoked behaviour of the COSEM object(s) instantiated.

NOTE Services for accessing attributes or methods by the protocol are specified in DLMS UA 1000-2 Ed. 9, Clause 9.

Selective access

The xDLMS attribute-related services typically reference the entire attribute. However, for certain attributes selective access to just a part of the attribute may be provided. The part of the attribute is identified by specific selective access parameters. These are defined as part of the attribute specification.

Selective access is available with the following interface class attributes and methods:

- “Profile generic” objects, buffer attribute;

- “Association SN” objects, object_list and access_rights_list attribute;
- “Association LN” objects, object_list attribute;
- “Compact data”, objects, compact_buffer attribute;
- “Push” objects, push_object_list attribute;
- “Data protection” objects, protection_object_list attribute get_protected_attributes method and set_protected_attributes method.

4.1.5 Common data types

Table 2 contains the list of data types usable for attributes of COSEM objects.

Table 2 – Common data types

Type description	Tag [a]	Definition	Value range
-- simple data types			
null-data	[0]		
boolean	[3]	boolean	TRUE or FALSE
bit-string	[4]	An ordered sequence of boolean values	
double-long	[5]	Integer32	-2 147 483 648… 2 147 483 647
double-long-unsigned	[6]	Unsigned32	0…4 294 967 295
	[7]	Tag of the “floating-point” type in IEC 61334-4-41:1996, not usable in DLMS/COSEM. See tags [23] and [24]	
octet-string	[9]	An ordered sequence of octets (8 bit bytes)	
visible-string	[10]	An ordered sequence of ASCII characters	
	[11]	Tag of the “time” type in IEC 61334-4-41:1996, not usable in DLMS/COSEM. See tag [27]	
utf8-string	[12]	An ordered sequence of characters encoded as UTF-8	
bcd	[13]	binary coded decimal	
integer	[15]	Integer8	-128…127
long	[16]	Integer16	-32 768…32 767
unsigned	[17]	Unsigned8	0…255
long-unsigned	[18]	Unsigned16	0…65 535
long64	[20]	Integer64	- 2^{63}…2^{63}-1
long64-unsigned	[21]	Unsigned64	0…2^{64}-1
enum	[22]	The elements of the enumeration type are defined in the *Attribute description* or *Method description* section of a COSEM IC specification.	0…255
float32	[23]	OCTET STRING (SIZE(4))	For formatting, see 4.1.6.2.
float64	[24]	OCTET STRING (SIZE(8))	
date-time[b]	[25]	OCTET STRING SIZE(12))	For formatting, see 4.1.6.1.
date	[26]	OCTET STRING (SIZE(5))	
time	[27]	OCTET STRING (SIZE(4))	
-- complex data types			
array	[1]	The elements of the array are defined in the *Attribute* or *Method description* section of a COSEM IC specification.	
structure	[2]	The elements of the structure are defined in the *Attribute or Method description* section of a COSEM IC specification.	
Compact array	[19]	Provides an alternative, compact encoding of complex data.	
-- CHOICE		For some COSEM interface objects attributes, the data type may be chosen at instantiation, in the implementation phase of the COSEM server. The server always shall send back the data type and the value of each attribute, so that together with the logical name an unambiguous interpretation is ensured. The list of possible data types is defined in the “Attribute description” section of a COSEM IC specification.	
[a] The tags are as defined inDLMS UA 1000-2 Ed. 9, 9.5.			
[b] The type-description for date-time has been harmonised as date-time throughout the document.			

4.1.6 Data formats

4.1.6.1 Date and time formats

Date and time information may be represented using the data type *octet-string*.

NOTE 1 In this case the encoding includes the tag of the data type *octet-string*, the length of the octet-string and the elements of *date*, *time* and /or *date-time* as applicable.

Date and time information may be also represented using the data types *date, time* and *date-time*.

NOTE 2 In these cases, the encoding includes only the tag of the data types date, time or date-time as applicable and the elements of date, time or date-time.

NOTE 3 The (SIZE ( )) specifications are applicable only when date, time or date time are represented by the data types date, time or date-time.

<table>
<tr><td>date</td><td>OCTET STRING (SIZE(5))
{
year highbyte,
year lowbyte,
month,
day of month,
day of week
}
Where:
year: interpreted as long-unsigned
range 0…big
0xFFFF = not specified
year highbyte and year lowbyte represent the 2 bytes of the long-unsigned

month: interpreted as unsigned
range 1…12, 0xFD, 0xFE, 0xFF
1 is January
0xFD = daylight_savings_end
0xFE = daylight_savings_begin
0xFF = not specified

dayOfMonth: interpreted as unsigned
range 1…31, 0xFD, 0xFE, 0xFF
0xFD = 2nd last day of month
0xFE = last day of month
0xE0 to 0xFC = reserved
0xFF = not specified

dayOfWeek: interpreted as unsigned
range 1…7, 0xFF
1 is Monday
0xFF = not specified

For repetitive dates, the unused parts shall be set to “not specified”.

For countries not using the Gregorian calendar, Month 1 is the starting month of the calendar and the range of dayOfMonth may be different.</td></tr>
<tr><td colspan="2">The elements dayOfMonth and dayOfWeek shall be interpreted together:

- if last dayOfMonth is specified (0xFE) and dayOfWeek is wildcard, this specifies the last calendar day of the month;</td></tr>
</table>

<table>
<tr><td colspan="2">
- if last dayOfMonth is specified (0xFE) and an explicit dayOfWeek is specified (for example 7, Sunday) then it is the last occurrence of the weekday specified in the month, i.e. the last Sunday;
- if the year is not specified (0xFFFF), and dayOfMonth and dayOfWeek are both explicitly specified, this shall be interpreted as the dayOfWeek on, or following dayOfMonth;
- if the year and month are specified, and both the dayOfMonth and dayOfWeek are explicitly specified but the values are not consistent it shall be considered as an error.
</td></tr>
<tr><td colspan="2">
Examples:
1) year = 0xFFFF, month =0x FF, dayOfMonth = 0xFE, dayofWeek = 0xFF: last day of the month in every year and month;
2) year = 0xFFFF, month =0x FF, dayOfMonth = 0xFE, dayofWeek = 0x07: last Sunday in every year and month;
3) year = 0xFFFF, month = 0x03, dayOfMonth = 0xFE, dayofWeek = 0x07: last Sunday in March in every year;
4) year = 0xFFFF, month = 0x03, dayOfMonth = 0x01, dayofWeek = 0x07: first Sunday in March in every year;
5) year = 0xFFFF, month = 0x03, dayOfMonth = 0x16, dayofWeek = 0x05: fourth Friday in March in every year;
6) year = 0xFFFF, month = 0x0A, dayOfMonth = 0x16, dayofWeek = 0x07: fourth Sunday in October in every year;
7) year = 0x07DE, month = 0x08, dayOfMonth = 0x13, (2014.08.13, Wednesday) dayofWeek = 0x02 (Tuesday): error, as the dayOfMonth and dayOfWeek in the given year and month do not match.
</td></tr>
<tr><td>time</td><td>
OCTET STRING (SIZE(4))
{
hour,
minute,
second,
hundredths
}
Where:
hour: interpreted as unsigned range 0…23, 0xFF,
minute: interpreted as unsigned range 0…59, 0xFF,
second: interpreted as unsigned range 0…59, 0xFF,
hundredths: interpreted as unsigned range 0…99, 0xFF

For hour, minute, second and hundredths: 0xFF = not specified.

For repetitive times the unused parts shall be set to “not specified”.
</td></tr>
<tr><td>date-time</td><td>
OCTET STRING (SIZE(12))
{
year highbyte,
year lowbyte,
month,
day of month,
day of week,
hour,
minute,
second,
hundredths of second,
deviation highbyte,
deviation lowbyte,
clock status
}

The elements of date and time are encoded as defined above. Some may be set to “not specified” as defined above.

In addition:
</td></tr>
</table>

	deviation: interpreted as long range -720…+720 in minutes of local time to UTC 0x8000 = not specified Deviation highbyte and deviation lowbyte represent the 2 bytes of the long. Clock_status interpreted as unsigned. The bits are defined as follows: bit 0 (LSB): invalid [a] value, bit 1: doubtful [b] value, bit 2: different clock base [c], bit 3: invalid clock status [d], bit 4: reserved, bit 5: reserved, bit 6: reserved, bit 7 (MSB): daylight saving active [e] 0xFF = not specified

[a] Time could not be recovered after an incident. Detailed conditions are manufacturer specific (for example after the power to the clock has been interrupted). For a valid status, bit 0 shall not be set if bit 1 is set.

[b] Time could be recovered after an incident but the value cannot be guaranteed. Detailed conditions are manufacturer specific. For a valid status, bit 1 shall not be set if bit 0 is set.

[c] Bit is set if the basic timing information for the clock at the actual moment is taken from a timing source different from the source specified in clock_base.

[d] This bit indicates that at least one bit of the clock status is invalid. Some bits may be correct. The exact meaning shall be explained in the manufacturer's documentation.

[e] Flag set to true: the transmitted time contains the daylight saving deviation (summer time).
Flag set to false: the transmitted time does not contain daylight saving deviation (normal time).

4.1.6.2 Floating point number formats

Floating point number formats are defined in ISO/IEC/IEEE 60559:2011.

The single format is:

1	8	23	…widths
s	*e*	*F*	
	msb *lsb*	*msb* *lsb*	*…order*

Where:
- *s* is the sign bit;
- *e* is the exponent; it is 8 bits wide and the exponent bias is +127;
- *f* is the fraction, it is 23 bits.

With this, the value is (if 0 < e < 255):

$$\upsilon = (-1)^s \cdot 2^{e-127} \cdot (1.f)$$

The double format is:

1	11	52	…widths
s	*e*	*F*	
	msb *lsb*	*msb* *lsb*	*…order*

Where:

- *s* is the sign bit;
- *e* is the exponent; it is 11 bits wide and the exponent bias is +1 023;
- *f* is the fraction, it is 52 bits.

With this, the value is (if 0 < e < 2 047):

$$\upsilon = (-1)^s \cdot 2^{e-1023} \cdot (1.f)$$

For details, see ISO/IEC/IEEE 60559:2011.

Floating-point numbers shall be represented as a fixed length octet-string, containing the 4 bytes (float32) of the single format or the 8 bytes (float64) of the double format floating-point number as specified above, most significant byte first.

EXAMPLE 1 The decimal value “1” represented in single floating-point format is:

Bit 31 Sign bit **0** 0: + 1: -	Bits 30-23 Exponent field: **01111111** Decimal value of exponent field and exponent: **127**-127 = 0	Bits 22-0 Significand 1.**00000000000000000000000** Decimal value of the significand: 1.0000000

NOTE The significand is the binary number 1 followed by the radix point followed by the binary bits of the fraction.

The encoding, including the tag of the data type is (all values are hexadecimal): 17 3F 80 00 00.

EXAMPLE 2 The decimal value “1” represented in double floating-point format is:

Bit 63 Sign bit **0** 0: + 1: -	Bits 62-52 Exponent field: **01111111111** Decimal value of exponent field and exponent: **1023**-1023 = 0	Bits 51-0 Significand 1.**0000000000000000000000000000000000000000000000000000** Decimal value of the significand: 1.0000000000000000

The encoding, including the tag of the data type is (all values are hexadecimal): 18 3F F0 00 00 00 00 00 00.

EXAMPLE 3 The decimal value “62056” represented in single floating-point format is:

Bit 31 Sign bit **0** 0: + 1: -	Bits 30-23 Exponent field: **10001110** Decimal value of exponent field and exponent: **142**-127 = 15	Bits 22-0 Significand 1.**11100100110100000000000** Decimal value of the significand: 1.8937988

The encoding, including the tag of the data type is (all values are hexadecimal): 17 47 72 68 00.

EXAMPLE 4 The decimal value “62056” represented in double floating-point format is:

Bit 63 Sign bit **0** 0: + 1: -	Bits 62-52 Exponent field: **10000001110** Decimal value of exponent field and exponent: **1038**-1023 = 15	Bits 51-0 Significand 1.**1110010011010000000000000000000000000000000000000000** Decimal value of the significand: 1.8937988281250000

The encoding, including the tag of the data type is (all values are hexadecimal): 18 40 EE 4D 00 00 00 00 00.

4.1.7 The COSEM server model

The COSEM server is structured into three hierarchical levels as shown in Figure 4:

Level 1: Physical device
Level 2: Logical device
Level 3: Accessible COSEM objects

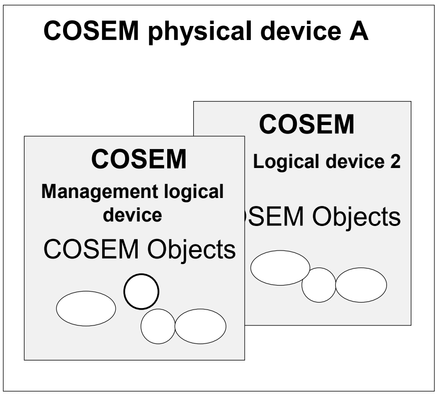


Figure 4 – The COSEM server model

The example in Figure 5 shows how a combined metering device can be structured using the COSEM server model.

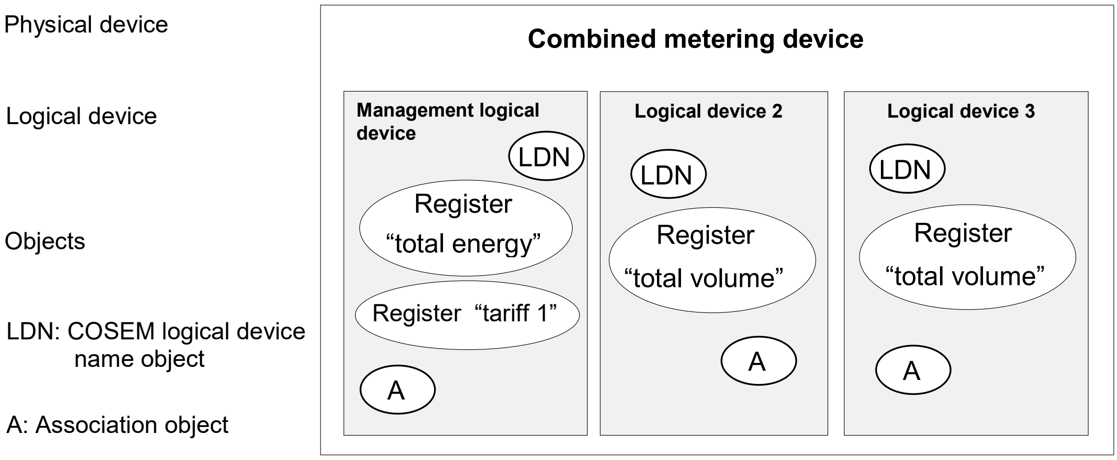


Figure 5 – Combined metering device

4.1.8 COSEM logical device

4.1.8.1 General

A COSEM logical device contains a set of COSEM objects. Each physical device shall contain a "Management logical device".

The addressing of COSEM logical devices shall be provided by the addressing scheme of the lower layers of the protocol stack used.

4.1.8.2 COSEM logical device name (LDN)

Each COSEM logical device can be identified by its unique COSEM LDN. This name can be retrieved from an instance of IC "SAP assignment" (see 4.4.5), or from a COSEM object "COSEM logical device name" (see 6.2.32).

The LDN is defined as an octet-string of up to 16 octets. The first three octets shall carry the manufacturer identifier [1]. The manufacturer shall ensure that the LDN, starting with the three octets identifying the manufacturer and followed by up to 13 octets, is unique for each and every LD manufactured.

4.1.8.3 The "association view" of the logical device

In order to access COSEM objects in the server, an application association (AA) shall first be established with a client. AAs identify the partners and characterize the context within which the associated server and client applications will communicate. The major parts of this context are:

- the application context;
- in the case of explicitly established AAs, the authentication mechanism;
- the xDLMS context.

AAs are modelled by special COSEM objects:

- instances of the IC "Association SN" – see 4.4.3 – are used with short name referencing;
- instances of the IC "Association LN" – see 4.4.4 – are used with logical name referencing.

Depending on the AA established between the client and the server, different access rights may be granted by the server. Access rights concern a set of COSEM objects – the visible objects – that can be accessed ('seen') within the given AA. In addition, access to attributes and methods of these COSEM objects may also be restricted within the AA (for example a certain type of client can only read a particular attribute of a COSEM object, but cannot write it). Access right may also stipulate required cryptographic protection.

The list of the visible COSEM objects – the "association view" – can be obtained by the client by reading the *object_list* attribute of the appropriate association object.

4.1.8.4 Mandatory contents of a COSEM logical device

The following objects shall be present in each COSEM logical device. They shall be accessible for GET/Read in all AAs with this logical device:

- COSEM logical device name object;
- current "Association" (LN or SN) object.

If the "SAP Assignment" object is present, then the COSEM logical device name object does not have to be present.

For identifying the firmware the following objects are mandatory:

- an active firmware identifier object that holds the identifier of the currently active firmware;
- an active firmware signature object that holds the digital signature of the currently active firmware.

  Note : The digital signature algorithm is not specified here.

If a Logical Device has multiple firmwares then an active firmware identifier object and an active firmware signature object shall be present for each firmware.

————————

[1] Administered by the DLMS User Association, in cooperation with the FLAG Association.

The following objects may be optionally present:

- one or more active firmware version object(s) that hold(s) the version of the currently active firmware.

4.1.8.5 Management logical device

As specified in 4.1.8.1, the management logical device is a mandatory element of any physical device. It has a reserved address. It shall support an AA to a public client with the lowest level security (no security) authentication. Its role is to support revealing the internal structure of the physical device and to support notification of events in the server.

In addition to the “Association” object modelling the AA with the public client, the management logical device shall contain a “SAP assignment” object, giving its Service Access Point (SAP) and the SAPs of all other logical devices within the physical device. The SAP assignment object shall be readable at least by the public client.

If there is only one logical device within the physical device, the “SAP assignment” object may be omitted.

4.1.9 Information security

DLMS/COSEM provides several information security features for accessing and transporting data:

- data access security controls access rights to the data held by a DLMS/COSEM server;
- data transport security allows the sending party to apply cryptographic protection to the xDLMS APDUs sent. This requires ciphered APDUs. The receiving party can check or remove this protection;
- COSEM data security allows protecting COSEM attribute values, as well as method invocation and return parameters.

On the COSEM object level, information security is supported / managed by the following objects:

- “Association SN”, see 4.4.3;
- “Association LN”, see 4.4.4;
- “Security setup”, see 4.4.7; and
- “Data protection”, see 4.4.9.

Information security on the DLMS/COSEM Application layer level is described in DLMS UA 1000-2 Ed. 9, 9.2.

4.2 Overview of the COSEM interface classes

The ICs defined currently and the relations between them are shown in Figure 6 and Figure 7.

NOTE 1 The IC “base” itself is not specified explicitly. It contains only one attribute *logical_name*.

NOTE 2 In the description of the “Demand register”, “Clock” and “Profile generic” ICs, the 2nd attributes are labelled differently from that of the 2nd attribute of the “Data” IC, namely *current_average_value*, *time* and *buffer* vs. *value*. This is to emphasize the specific nature of the *value*.

NOTE 3 On these Figures the interface classes are presented in each group by increasing class_id. In the clauses specifying the various groups of interface classes, the new interface classes are put at the end of the relevant clause.

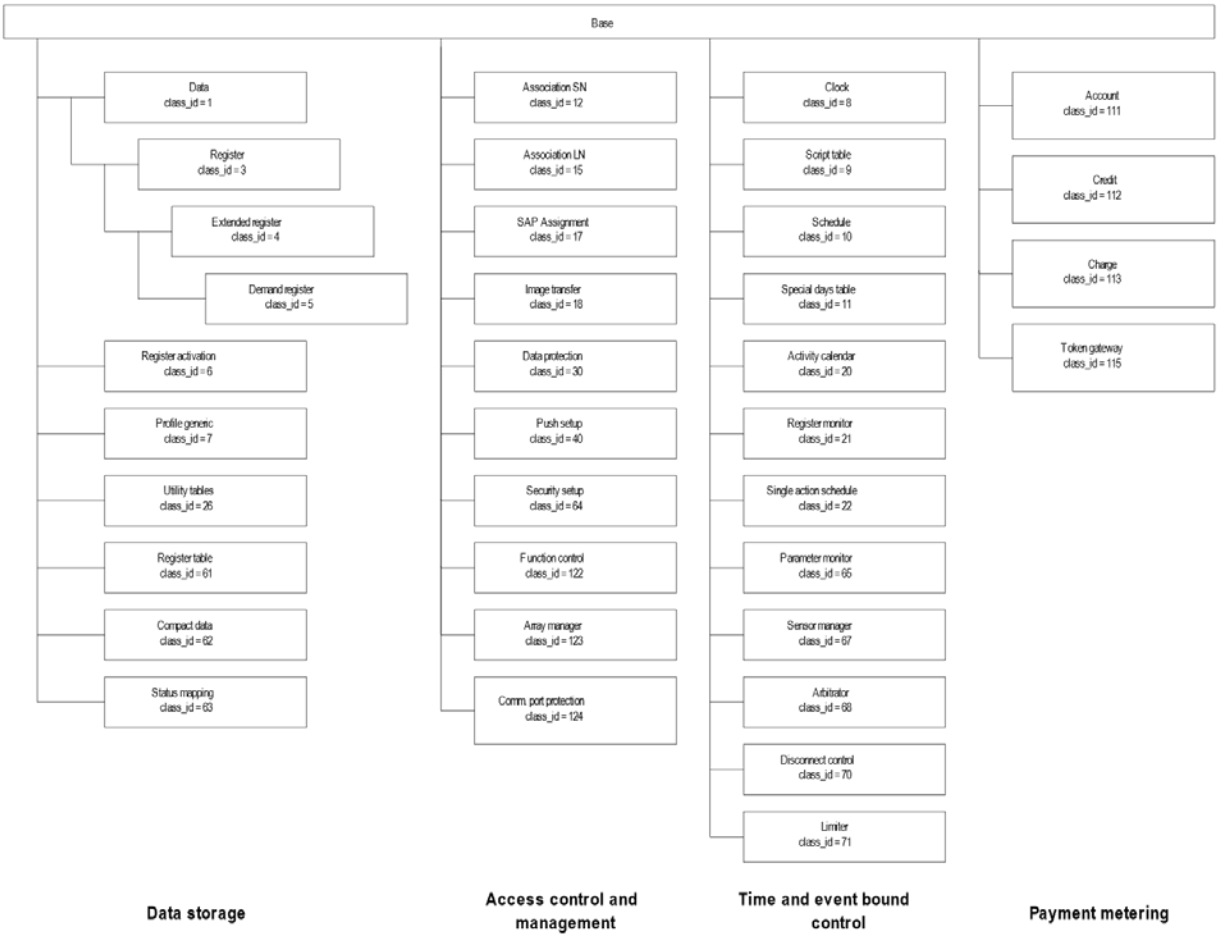


Figure 6 – Overview of the interface classes – Part 1

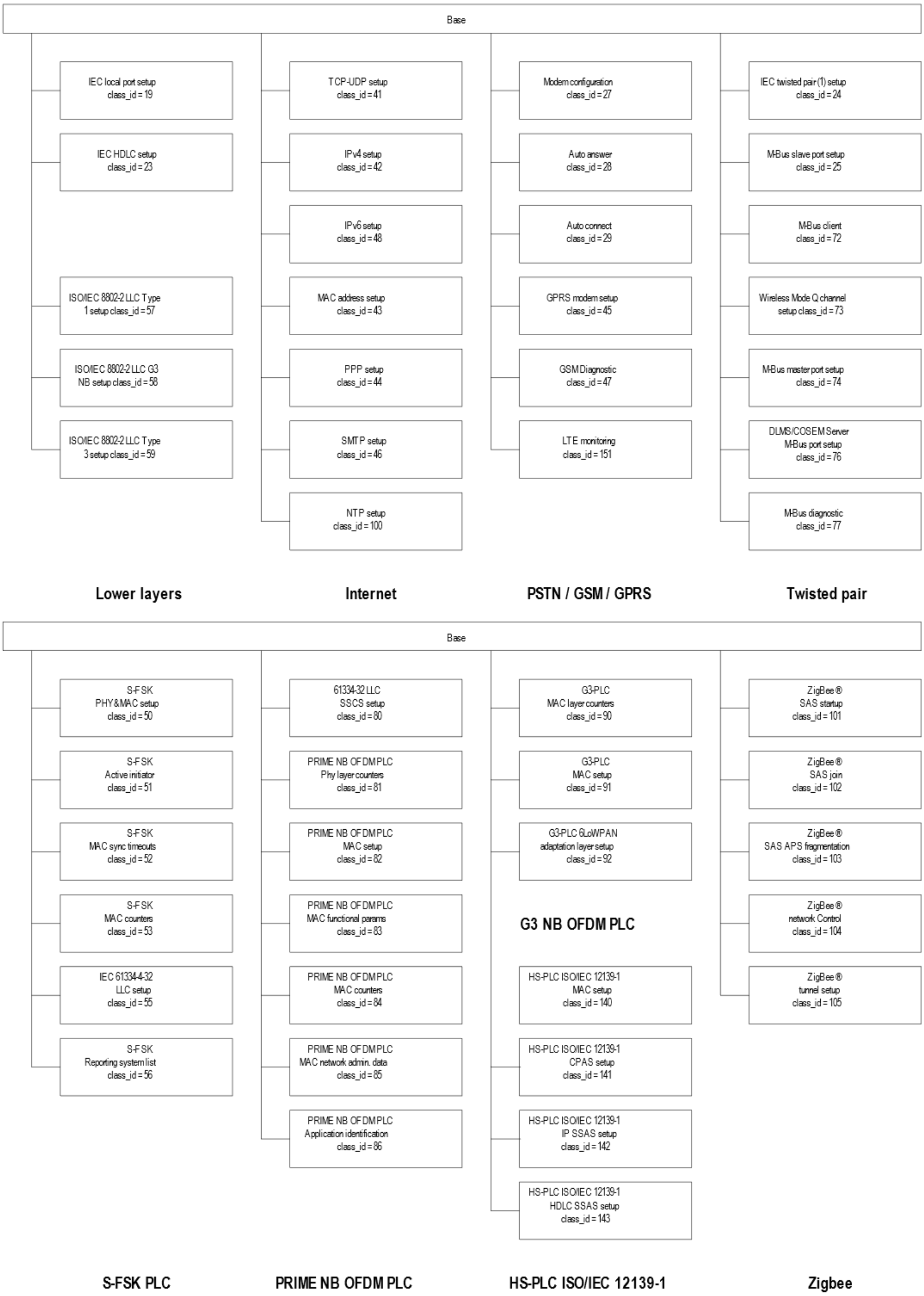


Figure 7 – Overview of the interface classes – Part 2

Table 3 lists the interface classes by class_id.

Table 3 – List of interface classes by class_id

Interface class name	class_id	version(s)	Clause
Data	1	0	4.3.1
Register	3	0	4.3.2
Extended register	4	0	4.3.3
Demand register	5	0	4.3.4
Register activation	6	0	4.3.5
Profile generic	7	1 0	4.3.6
Clock	8	0	4.5.1
Script table	9	0	4.5.2
Schedule	10	0	4.5.3
Special days table	11	0	4.5.4
Association SN	12	4 3 2 1 0	4.4.3
Association LN	15	3 2 1 0	4.4.4
SAP Assignment	17	0	4.4.5
Image transfer	18	0	4.4.6
IEC local port setup	19	1 0	4.7.1
Activity calendar	20	0	4.5.5
Register monitor	21	0	4.5.6
Single action schedule	22	0	4.5.7
IEC HDLC setup	23	1 0	4.7.2
IEC twisted pair (1) setup	24	1 0	4.7.3
M-BUS slave port setup	25	0	4.8.2
Utility tables	26	0	4.3.7
Modem configuration PSTN modem configuration	27	1 0	4.7.4
Auto answer Note The use of version 1 is not allowed.	28	2 1 0	4.7.5
Auto connect PSTN Auto dial	29	2 1 0	4.7.6
Data protection	30	0	4.4.9

Interface class name	class_id	version(s)	Clause
Push setup	40	1 0	4.4.8.2
TCP-UDP setup	41	0	4.9.1
IPv4 setup	42	0	4.9.2
MAC address setup (Ethernet setup)	43	0	4.9.4, 4.12.10
PPP setup	44	0	4.9.5
GPRS modem setup	45	0	4.7.7
SMTP setup	46	0	4.9.6
GSM diagnostic	47	1 0	4.7.8
IPv6 setup	48	0	4.9.3
S-FSK Phy&MAC setup	50	1 0	4.10.3
S-FSK Active initiator	51	0	4.10.4
S-FSK MAC synchronization timeouts	52	0	4.10.5
S-FSK MAC counters	53	0	4.10.6
IEC 61334-4-32 LLC setup S-FSK IEC 61334-4-32 LLC setup	55	1 0	4.10.7
S-FSK Reporting system list	56	0	4.10.8
ISO/IEC 8802-2 LLC Type 1 setup	57	0	4.11.2
ISO/IEC 8802-2 LLC Type 2 setup	58	0	4.11.3
ISO/IEC 8802-2 LLC Type 3 setup	59	0	4.11.4
Register table	61	0	4.3.8
Compact data	62	1 0	4.3.10
Status mapping	63	0	4.3.9
Security setup	64	1 0	4.4.7
Parameter monitor	65	0	4.5.10
Sensor manager	67	0	4.5.11
Arbitrator	68	0	4.5.12.2
Disconnect control	70	0	4.5.8
Limiter	71	0	4.5.9
M-Bus client	72	1 0	4.8.3
Wireless Mode Q channel	73	0	4.8.4
M-Bus master port setup	74	0	4.8.5
DLMS/COSEM server M-Bus port setup	76	0	4.8.6
M-Bus diagnostic	77	0	4.8.7
61334-4-32 LLC SSCS setup	80	0	4.12.3
PRIME NB OFDM PLC Physical layer counters	81	0	4.12.5
PRIME NB OFDM PLC MAC setup	82	0	4.12.6

Interface class name	class_id	version(s)	Clause
PRIME NB OFDM PLC MAC functional parameters	83	0	4.12.7
PRIME NB OFDM PLC MAC counters	84	0	4.12.8
PRIME NB OFDM PLC MAC network administration data	85	0	4.12.9
PRIME NB OFDM PLC Application identification	86	0	4.12.11
G3-PLC MAC layer counters G3 NB OFDM PLC MAC layer counters	90	1 0	4.13.3
G3-PLC MAC setup G3-PLC MAC setup G3 NB OFDM PLC MAC setup	91	2 1 0	4.13.4
G3-PLC 6LoWPAN adaptation layer setup G3-PLC 6LoWPAN adaptation layer setup G3 NB OFDM PLC 6LoWPAN adaptation layer setup	92	2 1 0	4.13.5
ZigBee® SAS startup	101	0	4.15.2
ZigBee® SAS join	102	0	4.15.3
ZigBee® SAS APS fragmentation	103	0	4.15.4
ZigBee® network control	104	0	4.15.5
ZigBee® tunnel setup	105	0	4.15.6
NTP Setup	100	0	4.9.7
Account	111	0	4.6.2
Credit	112	0	4.6.3.4
Charge	113	0	4.6.4
Token gateway	115	0	4.6.5
Function control	122	0	4.4.10
Array manager	123	0	4.4.11
Communication port protection	124	0	4.4.12
HS-PLC ISO/IEC 12139-1 MAC setup	140	0	4.14.2
HS-PLC ISO/IEC 12139-1 CPAS setup	141	0	4.14.3
HS-PLC ISO/IEC 12139-1 IP SSAS setup	142	0	4.14.4
HS-PLC ISO/IEC 12139-1 HDLC SSAS setup	143	0	4.14.5
LTE monitoring	151	0	4.7.9

4.3 Interface classes for parameters and measurement data

4.3.1 Data (class_id = 1, version = 0)

This IC allows modelling various data, such as configuration data and parameters. The data are identified by the attribute *logical_name*.

Data		**0...n**	**class_id = 1, version = 0**			
Attributes		***Data type***	***Min.***	***Max.***	***Def.***	**Short name**
1. logical_name	(static)	octet-string				x
2. value		CHOICE				x + 0x08
Specific methods		**m/o**				

Attribute description

logical_name	Identifies the "Data" object instance. See Clauses 6 and 7.
value	Contains the data.

```
CHOICE
{
        -- simple data types
        null-data               [0],
        boolean                 [3],
        bit-string              [4],
        double-long             [5],
        double-long-unsigned    [6],
        octet-string            [9],
        visible-string          [10],
        utf8-string             [12],
        bcd                     [13],
        integer                 [15],
        long                    [16],
        unsigned                [17],
        long-unsigned           [18],
        long64                  [20],
        long64-unsigned         [21],
        enum                    [22],
        float32                 [23],
        float64                 [24],
        date-time               [25],
        date                    [26],
        time                    [27],

        -- complex data types
        array                   [1],
        structure               [2],
        compact-array           [19]
}
```

The data type depends on the instantiation defined by the *logical_name* and possibly from the manufacturer. It has to be chosen so, that together with the *logical_name*, an unambiguous interpretation is possible. Any simple and complex data types listed in 4.1.5 can be used, unless the choice is restricted in Clause 6.

4.3.2 Register (class_id = 3, version = 0)

This IC allows modelling a process or a status value with its associated scaler and unit. “Register” objects know the nature of the process or status value. It is identified by the attribute *logical_name*.

Register		0...n	class_id = 3, version = 0			
Attributes		***Data type***	***Min.***	***Max.***	***Def.***	**Short name**
1. logical_name	(static)	octet-string				x
2. value		CHOICE				x + 0x08
3. scaler_unit	(static)	scal_unit_type				x + 0x10
Specific methods		**m/o**				
1. reset (data)		o				x + 0x28

Attribute description	
logical_name	Identifies the “Register” object instance. See Clauses 6 and 7.
value	Contains the current process or status value.

```
CHOICE
{
    -- simple data types
    null-data               [0],
    bit-string              [4],
    double-long             [5],
    double-long-unsigned    [6],
    octet-string            [9],
    visible-string          [10],
    utf8-string             [12],
    integer                 [15],
    long                    [16],
    unsigned                [17],
    long-unsigned           [18],
    long64                  [20],
    long64-unsigned         [21],
    enum                    [22],
    float32                 [23],
    float64                 [24],
}
```

The data type of the value depends on the instantiation defined by *logical_name* and possibly on the choice of the manufacturer. It has to be chosen so that, together with the *logical_name*, an unambiguous interpretation of the value is possible.

When, instead of a “Data” object, a “Register” object is used, (with the *scaler_unit* attribute not used or with scaler = 0, unit = 255) then the data types allowed for the *value* attribute of the “Data” IC are allowed.

scaler_unit

Provides information on the unit and the scaler of the value.

```
scal_unit_type ::= structure
{
    scaler,
    unit
}
```

scaler: integer

This is the exponent (to the base of 10) of the multiplication factor.

REMARK If the value is not numerical, then the scaler shall be set to 0.

unit: enum

Enumeration defining the physical unit; for details see Table 4 below.

Method description	
reset (data)	Forces a reset of the object. By invoking this method, the value is set to the default value. The default value is an instance specific constant. data ::= integer (0)

Table 4 – Enumerated values for physical units

unit ::= enum	Unit	Quantity	Unit name	SI definition (comment)
		SI units		
(1)	a	time	year	
(2)	mo	time	month	
(3)	wk	time	week	7*24*60*60 s
(4)	d	time	day	24*60*60 s
(5)	h	time	hour	60*60 s
(6)	min	time	minute	60 s
(7)	s	time (t)	second	s
(8)	°	(phase) angle	degree	rad*180/π
(9)	°C	temperature (T)	degree-celsius	K-273.15
(10)	currency	(local) currency		
(11)	m	length (l)	metre	m
(12)	m/s	speed (v)	metre per second	ms^{-1}
(13)	m^3	volume (V) r_V , meter constant or pulse value (volume)	cubic metre	m^3
(14)	m^3	corrected volume [a]	cubic metre	m^3
(15)	m^3/h	volume flux	cubic metre per hour	$m^3s^{-1}/(60*60)$
(16)	m^3/h	corrected volume flux [a]	cubic metre per hour	$m^3s^{-1}/(60*60)$
(17)	m^3/d	volume flux	cubic metre per day	$m^3s^{-1}/(24*60*60)$
(18)	m^3/d	corrected volume flux [a]	cubic metre per day	$m^3s^{-1}/(60*60)$
(19)	l	volume	litre	10^{-3} m^3
(20)	kg	mass (m)	kilogram	
(21)	N	force (F)	newton	$N = kg{\cdot}m{\cdot}s^{-2}$
(22)	Nm	energy	newton meter	J = Nm = Ws
(23)	Pa	pressure (p)	pascal	N/m^2
(24)	bar	pressure (p)	bar	10^5 Nm^{-2}
(25)	J	energy	joule	J = Nm = Ws
(26)	J/h	thermal power, rate of change	joule per hour	$Js^{-1}/(60*60)$
(27)	W	active power (P)	watt	$W = Js^{-1}$
(28)	VA	apparent power (S)	volt-ampere	
(29)	var	reactive power (Q)	var	
(30)	Wh	active energy r_W , active energy meter constant or pulse value	watt-hour	Ws*(60*60)
(31)	VAh	apparent energy r_S , apparent energy meter constant or pulse value	volt-ampere-hour	VAs*(60*60)
(32)	varh	reactive energy r_B , reactive energy meter constant or pulse value	var-hour	var s *(60*60s

unit ::= enum	Unit	Quantity	Unit name	SI definition (comment)
(33)	A	current (I)	ampere	A
(34)	C	electrical charge (Q)	coulomb	C = As
(35)	V	voltage (U)	volt	V
(36)	V/m	electric field strength (E)	volt per metre	Vm^{-1}
(37)	F	capacitance (C)	farad	$CV^{-1} = AsV^{-1}$
(38)	Ω	resistance (R)	ohm	$\Omega = VA^{-1}$
(39)	$\Omega m^2/m$	resistivity (ρ)		Ωm
(40)	Wb	magnetic flux (Φ)	weber	Wb = Vs
(41)	T	magnetic flux density (B)	tesla	Wbm^{-2}
(42)	A/m	magnetic field strength (H)	ampere per metre	Am^{-1}
(43)	H	inductance (L)	henry	$H = WbA^{-1}$
(44)	Hz	frequency (f, ω)	hertz	s^{-1}
(45)	1/(Wh)	R_W , active energy meter constant or pulse value		
(46)	1/(varh)	R_B , reactive energy meter constant or pulse value		
(47)	1/(VAh)	R_S , apparent energy meter constant or pulse value		
(48)	V^2h	volt-squared hour, r_{U2h} , volt-squared hour meter constant or pulse value	volt-squared-hours	V^2s^{-1} /(60*60)
(49)	A^2h	ampere-squared hour, r_{I2h} , ampere-squared hour meter constant or pulse value	ampere-squared-hours	A^2 s^{-1} /(60*60)
(50)	kg/s	mass flux	kilogram per second	kg s^{-1}
(51)	S, mho	conductance	siemens	Ω^{-1}
(52)	K	temperature (T)	kelvin	
(53)	$1/(V^2h)$	R_{U2h} , volt-squared hour meter constant or pulse value		
(54)	$1/(A^2h)$	R_{I2h} , ampere-squared hour meter constant or pulse value		
(55)	$1/m^3$	R_V , meter constant or pulse value (volume)		
(56)		percentage	%	
(57)	Ah	ampere-hours	Ampere-hour	
(58),(59)		reserved		
(60)	Wh/m^3	energy per volume	$3{,}6*10^3$ J/m^3	
(61)	J/m^3	calorific value, wobbe		
(62)	Mol %	molar fraction of gas composition	mole percent	(Basic gas composition unit)
(63)	g/m^3	mass density, quantity of material		(Gas analysis, accompanying elements)
(64)	Pa s	dynamic viscosity	pascal second	(Characteristic of gas stream)
(65)	J/kg	specific energy NOTE The amount of energy per unit of mass of a substance	Joule / kilogram	$m^2 \cdot kg \cdot s^{-2}$ / kg = $m^2 \cdot s^{-2}$
(66)	g/cm^2	pressure	gram per square centimeter	98,066 5 Pa
(67)	atm	pressure	atmosphere	$101{,}325*10^3$ Pa
(68),(69)		reserved		
(70)	dBm	signal strength, dB milliwatt (e.g. of GSM radio systems)		
(71)	dbμV	signal strength, dB microvolt		
(72)	dB	logarithmic unit that expresses the ratio between two values of a physical quantity		

unit ::= enum	Unit	Quantity	Unit name	SI definition (comment)
(73)..(127)		reserved		
		Non – SI Units		
(128)	in	length (l)	inch	
(129)	ft	length (l)	foot	
(130)	lb	mass (m)	pound	
(131)	°F	temperature	degree Fahrenheit	
(132)	°R	temperature	degree Rankine	
(133)	sq. in	area	square inch	
(134)	sq ft	area	square foot	
(135)	ac	area	acre	
(136)	cu in	volume	cubic inch	
(137)	cu ft	volume	cubic foot	
(138)	ac ft	volume	acre-foot	
(139)	gal (imp)	volume	gallon (imperial)	
(140)	gal (US)	volume	gallon (US)	
(141)	lbf	force	pound force	
(142)	psi	pressure (p)	Pound force per square inch	
(143)	lb/cu ft	density	pound per cubic foot	
(144)	lb/(ft .s)	dynamic viscosity	pound per (foot . second)	
(145)	sq ft/s	kinematic viscosity	square foot per second	
(146)	Btu	energy	British thermal unit	
(147)	thm(EC)	energy	Therm(EU)	
(148)	thm(US)	energy	Therm(US)	
(149)	Btu/lb	calorific value of mass, enthalpy	British thermal unit per pound	
(150)	Btu/cu ft	calorific value of volume, wobbe	British thermal unit per cubic foot	
(151)	cu ft	volume (V) rv, meter constant or pulse value (volume)	cubic feet	
(152)	ft/s	speed (v)	foot per second	
(153)	cu ft/s	volume flux	cubic foot per second	
(154)	cu ft/min	volume flux	cubic foot per min	
(155)	cu ft/h	volume flux	cubic foot per hour	
(156)	cu ft/d	volume flux	cubic foot per day	
(157)	ac ft/s	volume flux	acre foot per second	
(158)	ac ft/min	volume flux	acre foot per min	
(159)	ac ft/h	volume flux	acre foot per hour	
(160)	ac ft/d	volume flux	acre foot per day	
(161)	gal (imp)	volume (V) rv, meter constant or pulse value (volume)	imperial gallon	
(162)	gal (imp) / s	volume flux	imperial gallon per second	
(163)	gal (imp) / min	volume flux	imperial gallon per min	

unit ::= enum	Unit	Quantity	Unit name	SI definition (comment)
(164)	gal (imp) / h	volume flux	imperial gallon per hour	
(165)	gal (imp) / d	volume flux	imperial gallon per day	
(166)	gal (US)	volume (V) rv, meter constant or pulse value (volume)	US gallon	
(167)	gal (US) / s	volume flux	US gallon per second	
(168)	gal (US) / min	volume flux	US gallon per min	
(169)	gal (US) / h	volume flux	US gallon per hour	
(170)	gal (US) / d	volume flux	US gallon per day	
(171)	Btu/s	energy flow, heat, power, change rate	British thermal unit per second	
(172)	Btu/min	energy flow, heat, power, change rate	British thermal unit per minute	
(173)	Btu/h	energy flow, heat, power, change rate	British thermal unit per hour	
(174)	Btu/d	energy flow, heat, power, change rate	British thermal unit per day	
(175) .. (252)		reserved		
(253)		extended table of units		
(254)	other	other unit		
(255)	count	no unit, unitless, count		
[a] Usage of these units (16 & 18) is deprecated as OBIS codes specify a corrected volume (flux). This is to avoid contradiction of units associated with selected OBIS codes.				

Some examples are shown in Table 5 below.

Table 5 – Examples for scaler_unit

Value	Scaler	Unit	Data
263788	-3	m^3	263,788 m^3
593	3	Wh	593 kWh
3467	-1	V	346,7
3467	0	V	3467 V
3467	1	V	34 670 V

4.3.3 Extended register (class_id = 4, version = 0)

This IC allows modelling a process value with its associated scaler, unit, status and capture time information. “Extended register” objects know the nature of the process value. It is described by the attribute *logical_name*.

For more information see the complete Blue Book.

4.3.4 Demand register (class_id = 5, version = 0)

This IC allows modelling a demand value with its associated scaler, unit, status and time information. A "Demand register" object measures and computes a *current_average_value* periodically and it stores a *last_average_value.* The time interval *T* over which the demand is calculated is defined by specifying *number_of_periods* and *period*. See Figure 8.

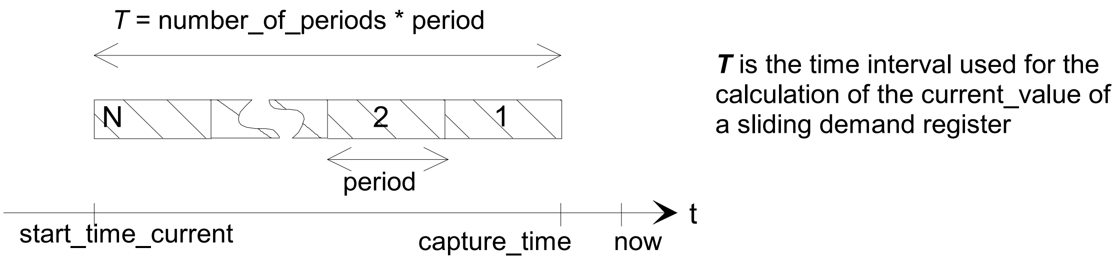


Figure 8 – The time attributes when measuring sliding demand

The demand register delivers two types of demand: *current_average_value* and *last_average_value* (see Figure 9 and Figure 10).

"Demand register" objects know the nature the of process value, which is described by the attribute *logical_name*.

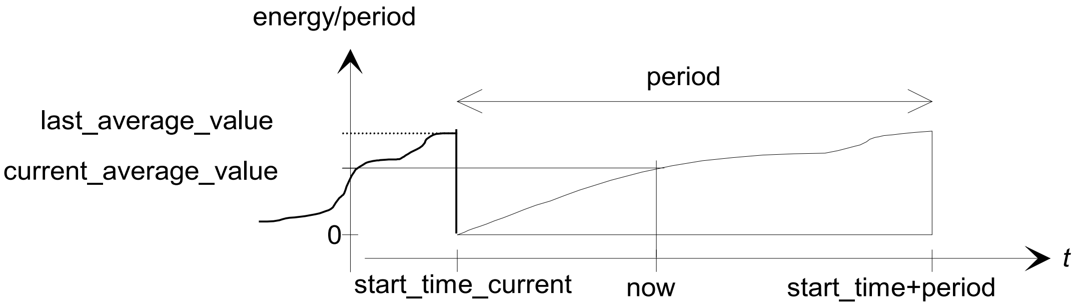


Figure 9 – The attributes in the case of block demand

For more information see the complete Blue Book.

4.3.5 Register activation (class_id = 6, version = 0)

This IC allows modelling the handling of different tariffication structures. To each "Register activation" object, groups of "Register", "Extended register" or "Demand register" objects, modelling different kind of quantities (for example active energy, active demand, reactive energy, etc.) are assigned. Subgroups of these registers, defined by the *activation masks* define different tariff structures (for example day tariff, night tariff). One of these activation masks, the *active_mask*, defines which subset of the registers, assigned to the "Register activation" object instance is active. Registers not included in the *register_assignment* attribute of any "Register activation" object are always enabled by default.

For more information see the complete Blue Book.

4.3.6 Profile generic (class_id = 7, version = 1)

This IC provides a generalized concept allowing to store, sort and access data groups or data series, called *capture_objects*. Capture objects are appropriate attributes or elements of (an) attribute(s) of COSEM objects. The capture objects are collected periodically or occasionally.

A profile has a *buffer* to store the captured data. To retrieve only a part of the buffer, either a value range or an entry range may be specified, asking to retrieve all entries that fall within the range specified.

The list of *capture objects* defines the values to be stored in the *buffer* (using auto capture or the method *capture*). The list is defined statically to ensure homogenous buffer entries (all entries have the same size and structure). If the list of capture objects is modified, the *buffer* is cleared. If the buffer is captured by other "Profile generic" objects, their *buffer* is cleared as well, to guarantee the homogeneity of their *buffer* entries.

The *buffer* may be defined as sorted by one of the *capture objects*, e.g. the clock, or the entries are stacked in a "last in first out" order. For example, it is very easy to build a "maximum demand register" with a one entry deep sorted profile capturing and sorted by a "Demand register" *last_average_value* attribute. It is just as simple to define a profile retaining the three largest values of some period.

For more information see the complete Blue Book.

4.3.7 Utility tables (class_id = 26, version = 0)

This IC allows encapsulating ANSI C12.19 table data. Each "table" is represented by an instance of this IC, identified by its *logical name*.

For more information see the complete Blue Book.

4.3.8 Register table (class_id = 61, version = 0)

This IC allows to group homogenous entries, identical attributes of multiple objects, which are all instances of the same IC, and in their *logical_name* (OBIS code) the value in value groups A to D and F is identical. The possible values in value group E are defined in Clause 7 in a tabular form: the table header defines the common part of the OBIS code and each table cell defines one possible value of value group E. A "Register table" object may capture attributes of some or all of those objects.

For more information see the complete Blue Book.

4.3.9 Status mapping (class_id = 63, version = 0)

This IC allows modelling the mapping of bits in a status word to entries in a reference table.

For more information see the complete Blue Book.

4.3.10 Compact data (class_id = 62, version = 1)

4.3.10.1 Compact data interface class specification

NOTE This version 1 supports both relative and absolute selective access.

Instances of the "Compact data" IC allow capturing the values of COSEM object attributes as determined by the *capture_objects* attribute. Capturing can take place:

- on an external trigger (explicit capturing); or
- upon reading the compact_buffer attribute (implicit capturing)

as determined by the *capture_method* attribute.

The values are stored in the *compact_buffer* attribute as an octet-string.

The set of data types is identified by the *template_id* attribute. The data type of each attribute captured is held by the *template_description* attribute.

The client can reconstruct the data in the uncompacted form – i.e. including the COSEM attribute descriptor, the data type and the data values – using the *capture_objects*, *template_id* and *template_description* attributes.

For more information see the complete Blue Book.

4.3.10.2 Examples for using compact data

4.3.10.2.1 Example Daily billing data

Table 6 shows the daily billing data that are captured – together with the mandatory *template_id* – to the *compact_buffer* attribute of a "Compact data" object.

Table 6 – Example daily billing data captured to *compact_buffer*

Data	class _id	Logical name	attribute_ id	data_ index	Size (bytes)	Type	Value
1	2	3	4	5	6	7	8
Template Id	62	0-0:66.0.0.255	4	0	1	unsigned	0
Unix time	1	0-0:1.1.0.255	2	0	4	double-long-unsigned	1374573317
Operating status	1	0-0:96.5.0.255	2	0	1	unsigned	0x29
Error register	1	0-0:97.97.0.255	2	0	1	unsigned	0x18
Total index	3	7-0:13.83.1.255	2	0	4	double-long-unsigned	6422483
Index F1	3	7-0:13.83.1.255	2	0	4	double-long-unsigned	865234
Index F2	3	7-0:13.83.1.255	2	0	4	double-long-unsigned	1234567
Index F3	3	7-0:13.83.1.255	2	0	4	double-long-unsigned	2345678
Activity calendar name	20	0-0:13.0.0.255	2	0	6	octet-string	"ABCDEF"
Event counter	1	0-0:96.15.1.255	2	0	2	long-unsigned	7890

Table 7 shows the attributes of the "Compact data" object.

Table 7 – "Compact data" object attributes – Daily billing data example

capture_objects (array)	For the elements of the array, see columns 2, 3, 4 and 5 of Table 6.
template_id (unsigned)	0
template_description (octet-string)	-- For the data types, see column 7 of Table 6. 02 0A 11 06 11 11 06 06 06 06 09 12
compact_buffer (octet-string) 32 bytes)	-- For the values see column 8 of Table 6. 00 51EE5305 29 18 0061FFD3 000D33D2 0012D687 0023CACE 06414243444546 1ED2

For comparison, the A-XDR encoding of the same data as if they were accessed using a GET-WITH-LIST service is shown in Table 8. Only the encoding of the result (SEQUENCE OF Get-Data-Result) is shown.

Table 8 - Example daily billing data read using GET-WITH LIST

Encoding	Explanation	Length
09	**SEQUENCE** of 9 elements	1
00 06 51EE5305	double-long-unsigned	6
00 11 29	unsigned	3
00 11 18	unsigned	3
00 06 0061FFD3	double-long-unsigned	6
00 06 000D33D2	double-long-unsigned	6
00 06 0012D687	double-long-unsigned	6
00 06 0023CACE	double-long-unsigned	6
00 09 06 414243444546	octet-string of length 6	9
00 12 1ED2	long-unsigned	4
	Total	50 bytes
NOTE The leading 00-s in each element are there to indicate the CHOICE “Data” in Get-Data-Result.		

4.3.10.2.2 Diagnostic and Alarm data

Table 9 shows the diagnostic and alarm data that are captured – together with the mandatory *template_id* – to the *compact_buffer* attribute of a “Compact data” object.

Table 9 – Example diagnostic and alarm data captured to *compact_buffer*

Data	class _id	Logical name	attribute _id	data_ index	Size (bytes)	Type	Value
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Template Id	62	0-0:66.0.0.255	4	0	1	unsigned	1
Current Diagnostic	3	7-0:96.5.1.255	2	0	2	long-unsigned	0x4200
Daily Diagnostic	3	7-1:96.5.1.255	2	0	2	long-unsigned	0x4108
Billing Period Diagnostic	1	7-2:96.5.1.255	2	0	2	long-unsigned	0x4308
Synchronization event counter	1	0-0:96.15.2.255	2	0	2	long-unsigned	763
Metrological firmware version	1	7-0:0.2.1.255	2	0	8	octet-string	“ABCDEFGH”
Metrological event counter	1	0-0:96.15.1.255	2	0	2	long-unsigned	1532
Non-metrological firmware version	1	7-1:0.2.1.255	2	0	8	octet-string	“DEFGHIJK”

Table 10 shows the attributes of the “Compact data“ object.

Table 10 – "Compact data" object attributes – Diagnostic and Alarm data example

capture_objects (array)	For the elements of the array, see columns 2, 3, 4 and 5 of Table 9.
template_id (unsigned)	1
template_description (octet-string)	-- For the data types, see column 7 of Table 9. 02 08 11 12 12 12 12 09 12 09
compact_buffer (octet-string) 29 bytes	-- For the values, see column 8 of Table 9. 01 4200 4108 4308 02FB 0841424344454647 48 05FC 0844454647 48494A4B

For comparison, the A-XDR encoding of the data as if they were read from the *buffer* attribute of a "Profile generic" object is shown in Table 11 (only the Data is shown).

Table 11 – Example diagnostic and alarm data read from "Profile generic" *buffer*

Encoding	Explanation	Length
01 01	array of one element	2
02 07	structure of 7 elements	2
12 4200	long-unsigned	3
12 4108	long-unsigned	3
12 4308	long-unsigned	3
12 02FB	long-unsigned	3
09 08 4142434445464748	octet-string of length 8	10
12 05FC	long-unsigned	3
09 08 4445464748494A4B	octet-string of length 8	10
	Total	39 bytes

4.3.10.2.3 Logbook reading

In this example, the data to be compacted is the *buffer* attribute of a Logbook held by a "Profile generic" object capturing 2 elements, as shown in Table 12.

Table 12 – Example logbook data entries in "Profile generic" *buffer*

Data	class_id	Logical name	Attribute_id	data_index	Size (bytes)	Type	Value
1	2	3	4	5	6	7	8
Unix time	1	0-0:1.1.0.255	2	0	4	double-long-unsigned	See Note
Event code	1	0-0:96.11.2.255	2	0	1	unsigned	
NOTE: For this example, the following values are assumed: - UNIX timestamp: 1374573317D, - status: 0x29, - for simplicity of the example, the values are the same for all entries, - there are 50 entries in the buffer.							

Table 13 shows the data to be captured by the "Compact data" object.

Table 13 – Example logbook data captured to *compact_buffer*

Data	class _id	Logical name	attribute _id	Data index	Size (bytes)	Type	Value
1	2	3	4	5	6	7	8
Template Id	62	0-0:66.0.0.255	4	0	1	unsigned	2
Logbook buffer [1]	7	0-0:99.98.0.255	2	0	dyn. [2]	array of structure	2

[1] See Table 12.
[2] The size is dynamic and depends on the number of entries captured.

Table 14 shows the attributes of the “Compact data” object.

Table 14 – “Compact data“ object attributes – Logbook data example

capture_objects (array)	For the elements of the array, see columns 2, 3, 4 and 5 of Table 13. The capture object has only 2 elements: the Template_id and the *buffer* attribute of the Logbook.
template_id (unsigned)	2
template-description (octet-string)	-- For the data types, see column 7 of Table 13. 02 02 11 01 02 02 06 11 Meaning: 02 02 - a structure of 2 elements 11 - first element is an unsigned 01 02 02- second element is an array of structure with two elements in the structure 06 first one is a double-long-unsigned 11 second one is an unsigned
compact_buffer (octet-string)	-- For the values, see column 8 of Table 13. 02 -- value of the template-id 32 -- number of the elements in the array and 50*5 = 250 bytes (for 50 elements in the log book) 252 bytes in total

For comparison, the A-XDR encoding of the same data when read from the *buffer* attribute of a “Profile generic” object is shown in Table 15.

Table 15 – Example logbook data read from “Profile generic” *buffer*

Encoding	Explanation	Length
01 32	array of 50 elements	2
02 02	structure of 2 elements	2
06 51EE5305	double-long-unsigned	5
11 29	unsigned	2
02 02	structure of 2 elements	2
06 51EE5305	double-long-unsigned	5
11 29	unsigned	2
02 02	structure of 2 elements	2
06 51EE5305	double-long-unsigned	5
11 29	unsigned	2
….	…	…
	Total	**452 bytes**

4.4 Interface classes for access control and management

4.4.1 Overview

Interface classes in this category model the logical structure of the DLMS/COSEM server, allow configuring and managing access to its resources, updating the firmware and managing security:

- the "Association SN" class – see 4.4.3 – and the "Association LN" class – see 4.4.4 – model AAs. Their instances, the Association objects provide the list of objects accessible in each AA, manage and control access rights to their attributes and methods. They also manage the authentication of the communicating partners;
- the "SAP Assignment" class – see 4.4.5 – models the logical structure of the server;
- the "Image transfer" class – see 4.4.6 – models the firmware update process;
- the "Security setup" class – see 4.4.7 – models the elements of the security context. "Security setup" objects are referenced from the "Association" objects and allow configuring security suites and security policies and managing security material;
- the "Push setup" class – see 4.4.8 – models the push operation of the server;
- the "Data protection" class – see 4.4.9 – specifies the necessary elements to apply cryptographic protection to COSEM object attribute values as well as to method invocation and return parameters;
- the "Function control" class – see 4.4.10 – allows enabling and disabling functions in the server;
- the "Array manager" class – see 4.4.11 – allows managing attributes of type array of other interface objects;
- the "Communication port protection" class – see 4.4.12 – allows protection of ports against unauthorised attempts at communication.

4.4.2 Client user identification

This feature enables the server to distinguish between different users from the client side and to log their activities accessing the meter but it is not applicable to pre-established AAs.

Each AA established between a client and a server can be used by several users on the client side. The properties of the AA are configured in the server, using the "Association" and the "Security setup" objects. All users of an AA on the client side use these same properties.

The security keys are known by the client and the server but they need not be known by the users of the client.

The list of users – identified by their user_id and user_name – is known both by the client and the server. In the server it is held by the *user_list* attribute of the "Association" objects.

NOTE 1 The way a client authenticates a user to log into a client system is outside the scope of this specification.

During AA establishment, the user_id – belonging to the user_name – is carried by the calling-AE-invocation-id field of the AARQ APDU.

NOTE 2 For this reason, this feature is not available with pre-established AAs.

If the user_id provided is on the *user_list*, the AA can be established – provided that all other conditions are met – and the *current_user* attribute is updated. The value of this attribute can be logged.

If the server does not "know" the user, the AA shall not be established. The server may silently discard the request to establish the AA or it may send back an appropriate error message.

The user identification process is optional: if the *user_list* is empty – i.e. it is an array of 0 elements – the function is disabled.

4.4.3 Association SN class (class_id = 12, version 4)

COSEM logical devices able to establish AAs within a COSEM context using SN referencing, model the AAs using instances of the “Association SN” IC. A COSEM logical device may have one instance of this IC for each AA the device is able to support.

The **short_name** of the “Association SN” object itself is fixed within the COSEM context. See 4.1.3.

For more information see the complete Blue Book.

4.4.4 Association LN class (class_id = 15, version 3)

COSEM logical devices able to establish AAs within a COSEM context using LN referencing, model the AAs through instances of the “Association LN” IC. A COSEM logical device has one instance of this IC for each AA the device is able to support.

For more information see the complete Blue Book.

4.4.5 SAP assignment (class_id = 17, version = 0)

This IC allows modelling the logical structure of physical devices, by providing information on the assignment of the logical devices to their SAP-s. See DLMS UA 1000-2 Ed. 9, Clause 10.

For more information see the complete Blue Book.

4.4.6 Image transfer (class_id = 18, version = 0)

4.4.6.1 General

Instances of the Image transfer IC model the process of transferring binary files, called Images to COSEM servers.

NOTE This specification includes some improvements and precisions to the text. The main changes are:

- The description of the Image transfer process is given as an example only. The text and the flow chart are updated;
- Data exchange between the client and a conceptual Image server is out of Scope;
- A clear distinction is made between the Image transferred and the Images to activate;
- Steps 1 and 6 are optional now;
- Size of the *image_transferred_blocks_status* bit-string may be dynamic;
- It is specified now that setting the value of the *image_transfer_enabled* attribute to FALSE disables the image transfer process;
- It is specified now that re-initiating the image transfer process resets the whole process;
- Some precisions have been added to the effect of invoking the methods;
- See also the highlighted parts of the text.

4.4.6.2 The steps of the image transfer process

The Image transfer usually takes place in several steps:

- Step 1: (Optional): Get ImageBlockSize;
- Step 2: Client initiates Image transfer;

- Step 3: Client transfers ImageBlocks;
- Step 4: Client checks completeness of the Image;
- Step 5: Server verifies the Image (Initiated by the client or on its own);
- Step 6 (Optional): Client checks the information on the images to activate;
- Step 7: Server activates the Image(s) (Initiated by the client or on its own).

For an example with more detailed explanations, see 4.4.6.4.

4.4.6.3 Image transfer interface class specification

For more information see the complete Blue Book.

4.4.7 Security setup (class_id = 64, version = 1)

Instances of the "Security setup" IC contain the necessary information on the security suite in use and the security policy applicable between the server and a client and/or third party indentified by their respective system titles. They also provide methods to increase the level of security and to manage symmetric keys, asymmetric key pairs and certificates.

For more information see the complete Blue Book.

4.4.8 Push interface class (class_id = 40, version = 1)

4.4.8.1 Overview

There are several occasions on which DLMS messages can be 'pushed' to a destination without being explicitly requested, e.g.:

- if a scheduled time is reached;
- if a value being locally monitored exceeds a threshold;
- on triggering by a local event (e.g. power-up/down, push button pressed, meter cover opened).

The DLMS/COSEM push mechanism follows the publish/subscribe pattern:

> *Publish/subscribe is a messaging pattern where senders (publishers) of messages do not program the messages to be sent directly to specific receivers (subscribers). Rather, published messages are characterized into classes, without knowledge of what, if any, subscribers there may be. Subscribers express interest in one or more classes, and only receive messages that are of interest, without knowledge of what, if any, publishers there are. [Wikipedia]*

In DLMS/COSEM, publishing is modelled by the *object_list* attribute of "Association" objects providing the list of COSEM objects and their attributes accessible in a given AA. Subscription is modelled by writing the appropriate attributes of "Push setup" objects. The required data are sent – upon the trigger specified – using the xDLMS DataNotification service.

The COSEM model of the Push operation is shown in Figure 12.

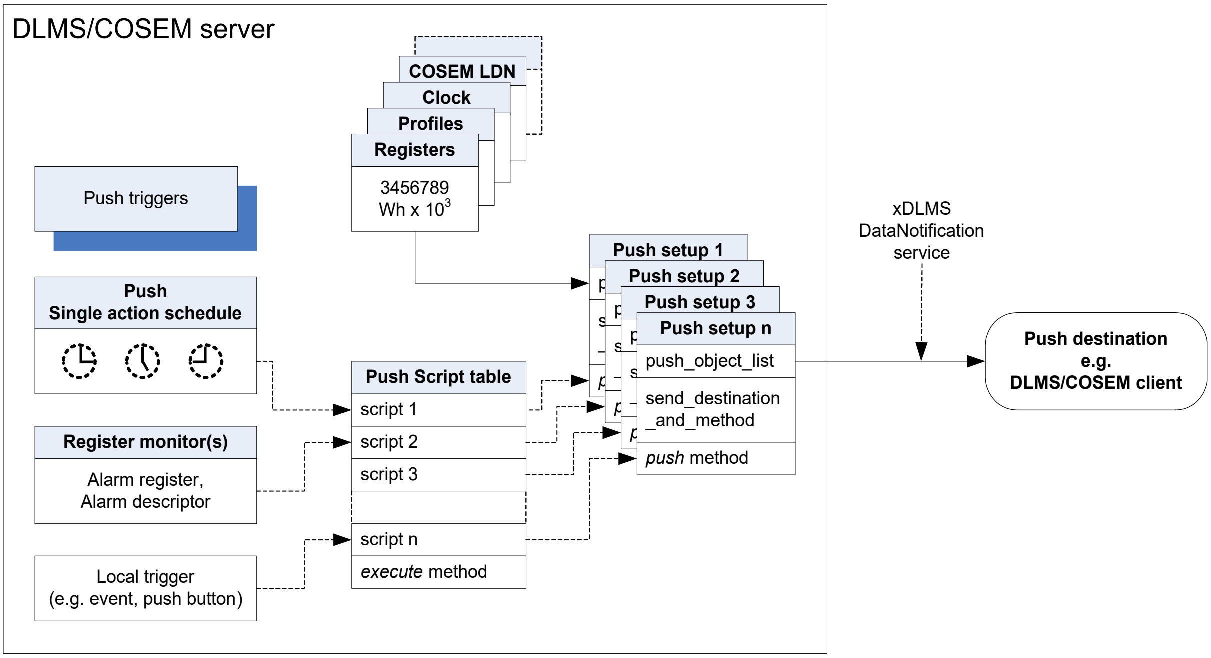


Figure 10 – COSEM model of push operation

The core element of modelling the push operation is the "Push setup" IC. The *push_object_list* attribute contains a list of references to COSEM object attributes to be pushed.

When push uses a gateway, then the version of the gateway protocol for end devices without WAN/NN knowledge is to be applied. This is described in the Green Book Edition 9, 10.7.4.3.

The various triggers (e.g. schedulers, monitors, local triggers etc.) call a script entry in a Push "Script table" object (instances of the "Script table" IC) which invokes then the *push* method of the related "Push setup" object. The destination, the communication media, the protocol, the encoding, the timing as well as any retries of the push operation are determined by the other attributes of the "Push setup" object.

Each trigger can cause the data to be sent to a dedicated destination. Therefore, for every trigger or a group of triggers an individual "Push setup" object is available defining the content and the destination of the push message as well as the communication medium used.

For the purposes of pushing data when an alarm occurs, Alarm monitor objects (instances of the "Register monitor" IC) are available.

The alarms are held by *Alarm register* or *Alarm descriptor* objects, see 6.2.59.

NOTE 1 The structure of the *Alarm descriptor* as well as the alarm conditions need to be defined in a project specific companion specification.

Alarm descriptor objects are monitored by Alarm "Register monitor" objects, see 6.2.13. The *actions* attribute provides the link to the action_up and maybe the action_down scripts in the Push "Script table" object – see 6.2.7 – which invoke then the *push* method of the desired "Push setup" object. When an alarm occurs, the predefined set of data – that may include among other data the *Alarm register* and *Alarm descriptor* objects – are pushed.

The push data is sent – when the conditions for pushing are met – using the unsolicited, non-client/server type xDLMS service, the DataNotification service. When the data pushed is long, it can be sent in blocks.

The push process takes place within the application context of the AA which is referenced by the *push_client_SAP* attribute of the "Push setup" object. The security context is determined by the "Security setup" object referenced from the "Association" object. The necessary data protection parameters are defined in attribute *push_protection_parameters* which offers the same options as defined in the "Data Protection" IC.

All information necessary to process the data received by the client shall be either:

- retrieved by the client e.g. by reading the *push_object_list attribute*; or
- shall be part of the data pushed; or
- shall be predefined in the client application.

4.4.8.2 Push setup (class_id = 40, version = 1)

The "Push setup" interface class contains a list of references to COSEM object attributes to be pushed. It also contains the push destination and method as well as the communication time windows and the handling of retries.

In version 1 the possibility of data protection has been added offering the same options as defined in the "Data protection" IC.

This version of the interface class is intended to facilitate the use of relative and absolute data selection. It would be common practice to use an instance of the Push setup IC with relative data selection for routine data push, and an instance of the Push setup IC with absolute data for special cases.

The push takes place upon invoking the push method, triggered by a Push "Single action schedule" object, by an Alarm "Register monitor" object, by a dedicated internal event or externally. After the push operation has been triggered, it is executed according to the settings made in the given "Push setup" object. Depending on the communication window settings, the push is executed immediately or as soon as a communication window becomes active, after a random delay. If the push was not successful, retries are made. Push windows, delays and retries are shown in Figure 13.

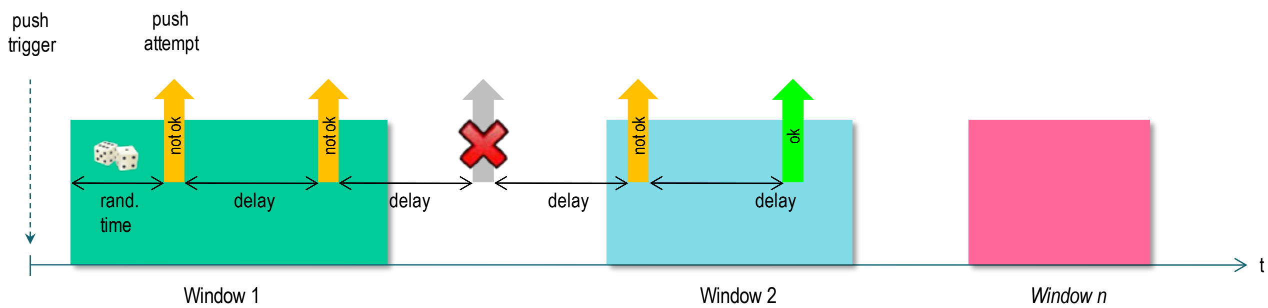


Figure 11 - Push windows and delays

For more information see the complete Blue Book.

4.4.9 COSEM data protection (class_id = 30, version = 0)

4.4.9.1 Overview

Instances of this IC allow applying cryptographic protection on COSEM data i.e. on attribute values and method invocation and return parameters. This is achieved by accessing attributes and/or methods of other COSEM objects indirectly through instances of the "Data protection" interface class that provide the necessary mechanisms and parameters to apply / verify / remove protection on COSEM data.

NOTE 1 "Accessing" includes reading / writing / capturing / pushing COSEM object attributes or invoking methods.

NOTE 2 When attributes and methods of COSEM objects are accessed directly, protection can be provided by protecting the xDLMS APDUs as stipulated by the relevant security policy and the access rights.

NOTE 3 For definitions and abbreviations related to cryptographic security see DLMS UA 1000-2 Ed. 9, Clause 3.

Protection on COSEM data is aligned with and complements protection on xDLMS APDUs as defined in DLMS UA 1000-2 Ed. 9, Clause 9.

The use cases for COSEM data protection include, but are not limited to:

- reading or writing a pre-defined set of protected attribute values;
- storing a pre-defined set of protected attribute values in "Profile generic" objects for later retrieval;
- pushing a pre-defined set of protected attribute values;
- reading or writing selected attributes of other COSEM objects with protection;
- invoking a method of another COSEM object with protected method invocation and return parameters.

Protection may comprise any combination of authentication, encryption and digital signature and can be applied in a layered manner. The parties applying and removing the protection are the DLMS/COSEM server and another identified party, which may be a DLMS/COSEM client or a third party.

Applying data protection between a DLMS/COSEM server and a third party allows keeping critical / sensitive data confidential towards the client through which the third party accesses the server. Signing COSEM data by a third party supports non-repudiation.

For end-to-end protection between third parties and servers, see also DLMS UA 1000-2 Ed. 9, 4.7 and 9.2.2.5.

The protection parameters are always controlled by the client with some elements filled in by the server as appropriate.

The security suite is determined by the "Security setup" object referenced from the current "Association SN" / "Association LN" object.

Figure 14 shows the COSEM model of data protection and the relationship of a "Data protection" object with other COSEM objects.

For accessing attributes of other COSEM objects with protected data, there are two mechanisms available:

- reading or writing the *protection_buffer* attribute. The *protection_buffer* can be also captured in "Profile generic" objects or pushed using "Push setup" objects;
- invoking the get_protected_attributes / set_protected_attributes method.

For accessing a method of another COSEM object with protected data, the *invoke_protected_method* method is available.

APDUs carrying service invocations to access attributes and methods of "Data protection" objects are protected as stipulated by access rights to these attributes and methods, and by "Security setup" *security_suite* and *security_policy.*

The master key and Certificates – as required by the security suite – are held by “Security setup”.

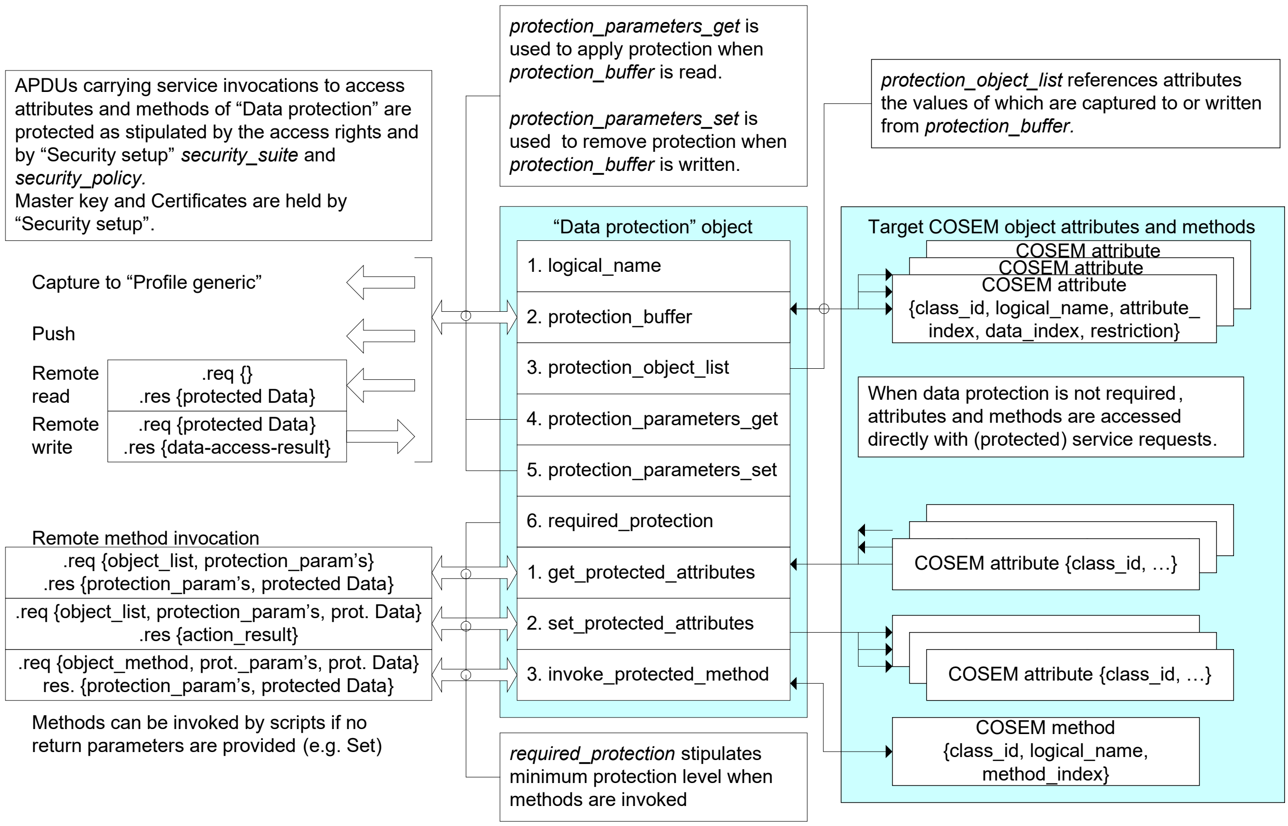


Figure 12 – COSEM model of data protection

Protection on COSEM data is applied and removed in the various cases as follows:

1) When the *protection_buffer* attribute is read / captured in a “Profile generic” object / pushed:
   - attributes determined by *protection_object_list* are captured;
   - protection according to *protection_parameters_get* is applied on the set of attributes and the result is put to *protection_buffer*;
   - the value of *protection_buffer* is returned / captured in the “Profile generic” *buffer* / pushed using “Push setup” objects.
2) When the *protection_buffer* is written:
   - protected Data are written to *protection_buffer;* and
   - protection according to *protection_parameters_set* is removed and the resulting attribute values are written to the attributes specified by *protection_object_list.*
3) When the *get_protected_attributes* method is invoked:
   - attributes determined by the object_list element of get_protected_attributes_request are captured;
   - protection according to the *required_protection* attribute and response protection_parameters is applied. If protection_parameters do not satisfy required_protection then the method invocation fails;

- the protected attribute values are returned.

4) When the *set_protected_attributes* method is invoked:
   - protection on protected_attributes is verified and removed using the protection_parameters that must meet *required_protection*;
   - the resulting attribute values are put in the attributes specified by the object_list element;
5) When the *invoke_protected_method* method is invoked:
   - protection from protected method invocation parameters is removed using the protection parameters in the request that must meet *required_protection*;
   - the method specified by the object_method element of invoke_protected_method_request is invoked with this method invocation parameter;
   - on the return parameters, the protection using the response protection parameters that must meet *required_protection* is applied. If protection_parameters do not satisfy required_protection then the method invocation fails;
   - the protected method return parameters are returned.

Figure 15 shows, as an example, how protected Data in *protection_buffer* is constructed from the attributes determined by *protection_object_list* according to the *protection_parameters_get.* See also DLMS UA 1000-2 Ed. 9, Figure 81.

When the *protection_buffer* attribute is read the following steps are performed:

6) prerequisites: *protection_object_list*, *protection_parameters_get*, master key, key agreement and digital signature certificates as needed;
7) capture COSEM object attributes determined by *protection_object_list* and create Data, a structure containing the individual Data of the attributes captured;
8) protect Data according to *protection_parameters_get.*

   NOTE 4 In the example shown in Figure 15 two layers of protection are applied:

   - the first layer is a combination of compression / encryption / authentication as determined by the Security control byte SC, resulting (C)Data,
   - the second layer is digital signature applied to (C)Data.

9) put the protected data, of data type octet-string, into *protection_buffer*;
10) return the value of *protection_buffer*.

It may be necessary to read also *protection_parameters_get* to obtain the protection parameters to verify / remove protection by the recipient.

The invocation counter used when protection is applied / removed is related to the key used. When the protection is applied the corresponding invocation counter is incremented. When the key is changed the invocation counter shall be reset to 0.

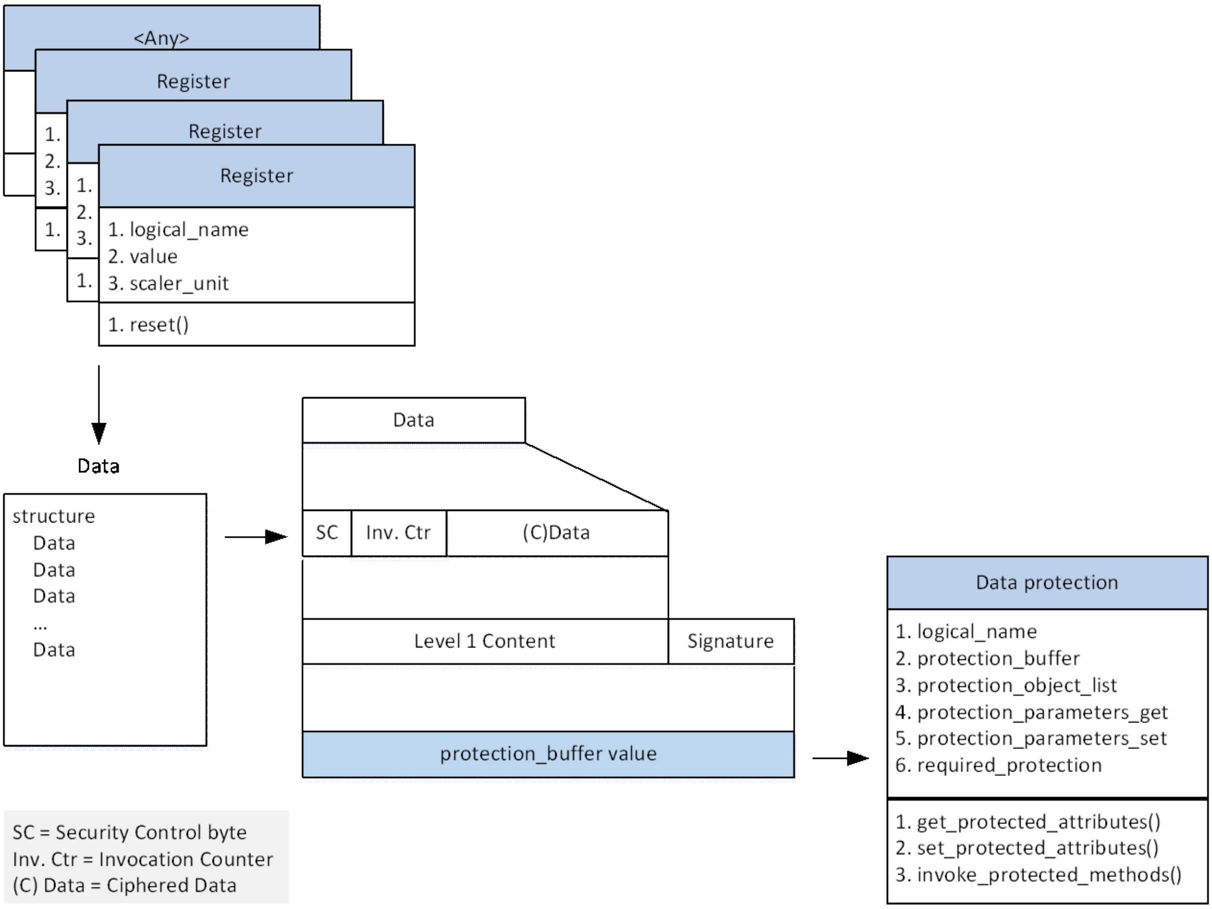


Figure 13 – Example: Read *protection_buffer* attribute

4.4.9.2 Data protection interface class specification (class_id = 30, version = 0)

Data protection	**0...n**	**class_id = 30, version = 0**			
Attributes	***Data type***	***Min.***	***Max.***	***Def.***	**Short name**
1. logical_name (static)	octet-string				x
2. protection_buffer (dyn.)	octet-string				x + 0x08
3. protection_object_list (static)	array				x + 0x10
4. protection_parameters_get (static)	array				x + 0x18
5. protection_parameters_set (static)	array				x + 0x20
6. required_protection (static)	enum				x + 0x28
Specific methods	***m/o***				
1. get_protected_attributes (data)	m				x + 0x30
2. set_protected_attributes (data)	m				x + 0x38
3. invoke_protected_method (data)	m				x + 0x40

For more information see the complete Blue Book.

4.4.10 Function control (class_id: 122, version: 0)

Instances of the IC “Function control” allow enabling and disabling functions in the server. Each function that can be enabled / disabled is identified by a name and is defined by a particular set of object identifiers referenced.

To allow enabling and disabling of functions controlled by time, “Single action schedule” and “Script table” objects are also specified.

For more information see the complete Blue Book.

4.4.11 Array manager (class_id = 123, version = 0)

Instances of the “Array manager” IC allow managing attributes of type *array* of other interface objects, i.e.:

- retrieving the number of entries;
- selectively reading a range of entries;
- inserting a new entry or updating an existing entry;
- removing a range of entries.

Each instance allows managing several attributes of type *array* assigned to it.

An example of the application is shown in Figure 16.

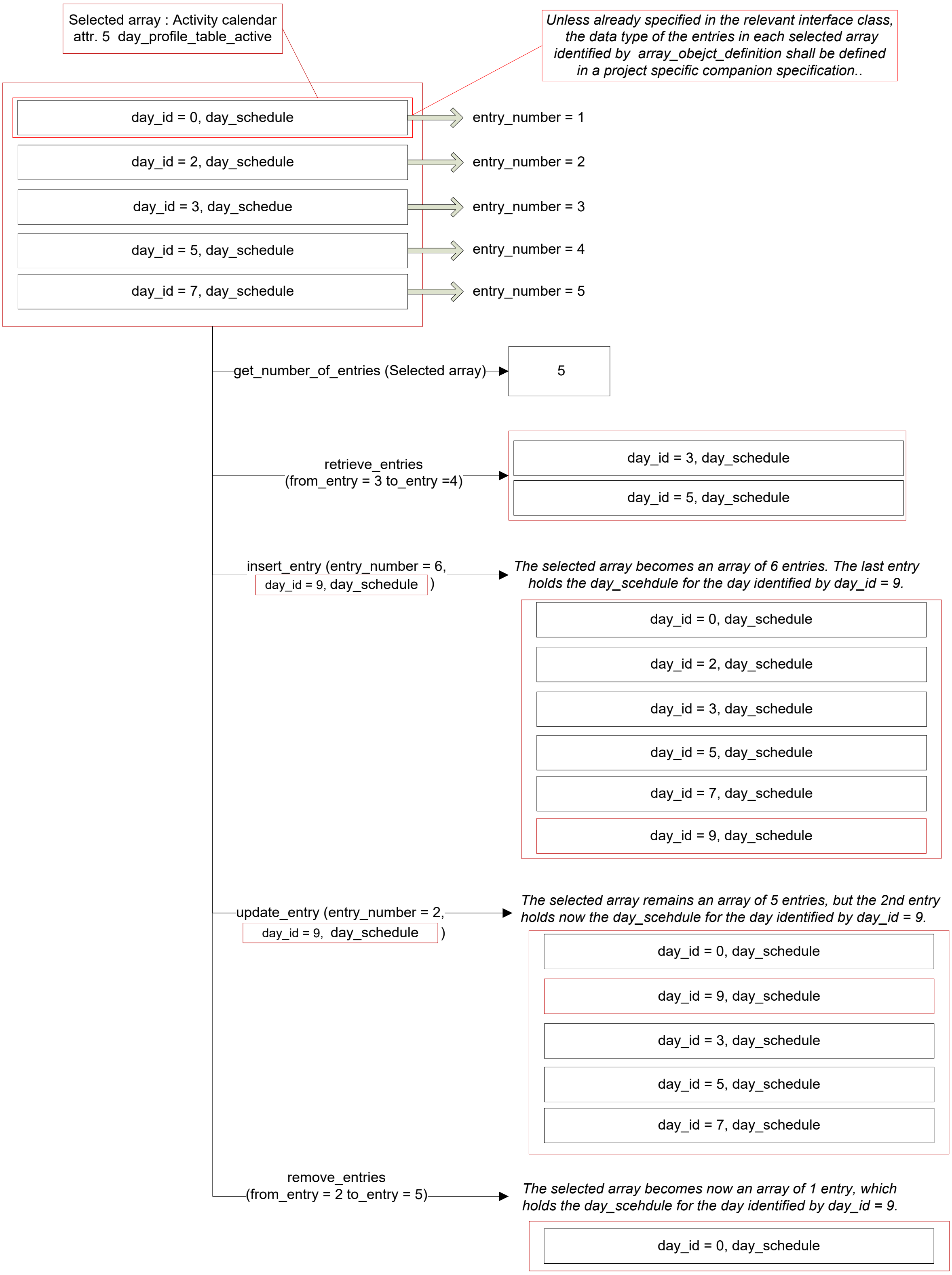


Figure 14 – Example of managing an array

For more information see the complete Blue Book.

4.4.12 Communication port protection (class_id = 124, version = 0)

Instances of the "Communication port protection" IC can be used to protect communication ports of DLMS/COSEM servers against possibly malicious communication attempts, in particular to prevent brute force attacks by reducing the possible number of attempts.

Each instance references a single communication port by its logical name (OBIS code). If an acceptable number of failed attempts is exceeded then the communication port is temporarily locked. The lockout time may increase with each failed attempt, until a maximum lockout time is reached.

A failed attempt is one that leads to discarding the APDU carrying a service request. The criteria for detecting a failed attempt are out of the Scope of this document.

The objects count both the number of failed attempts between two resets and the cumulative number of failed attempts.

It is possible to configure the communication ports such that they are locked to all attempts or unlocked to all attempts.

Communication port protection		**0...n**	**class_id = 124, version = 0**			
Attributes		***Data type***	***Min.***	***Max.***	***Def.***	***Short name***
1. logical_name	(static)	octet-string				x
2. protection_mode	(static)	enum			1	x + 0x08
3. allowed_failed_attempts	(static)	long-unsigned				x + 0x10
4. initial_lockout_time	(static)	double-long-unsigned				x + 0x18
5. steepness_factor	(static)	unsigned			1	x + 0x20
6. max_lockout_time	(static)	double-long-unsigned				x + 0x28
7. port_reference	(static)	octet-string				x + 0x30
8. protection_status	(dyn.)	enum				x + 0x38
9. failed_attempts	(dyn.)	double-long-unsigned				x + 0x40
10. cumulative_failed_attempts	(dyn.)	double-long-unsigned				x + 0x48
Specific methods	***m/o***					
1. reset(data)	o	o				x + 0x50

For more information see the complete Blue Book.

4.5 Interface classes for time- and event bound control

4.5.1 Clock (class_id = 8, version = 0)

This IC models the device clock, managing all information related to date and time including deviations of the local time to a generalized time reference (UTC) due to time zones and daylight saving time schemes. The IC also offers various methods to adjust the clock.

The *date* information includes the elements year, month, day of month and day of week. The *time* information includes the elements hour, minutes, seconds, hundredths of seconds, and the deviation of the local time from UTC. The daylight saving time function modifies the deviation of local time to UTC depending on the attributes; see Figure 17. The start and end point of that function is normally set once. An internal algorithm calculates the real switch point depending on these settings.

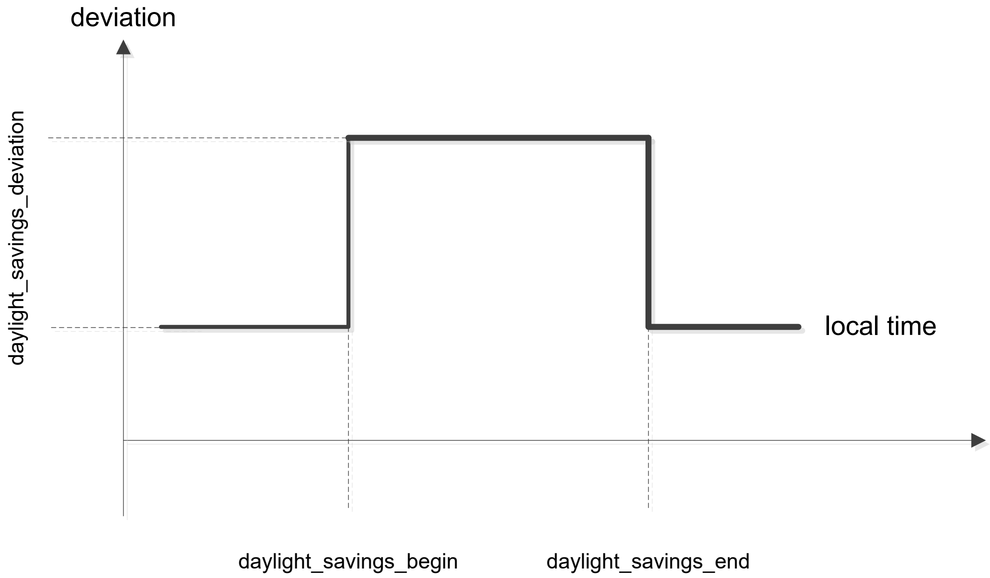


Figure 15 – The generalized time concept

For more information see the complete Blue Book.

4.5.2 Script table (class_id = 9, version = 0)

This IC allows modelling the triggering of a series of actions by executing scripts using the *execute* (data) method.

“Script table” objects contain a table of script entries. Each entry consists of a script identifier and a series of action specifications. An action specification activates a method or modifies an attribute of a COSEM object within the logical device.

A certain script may be activated by other COSEM objects within the same logical device or from the outside.

If two scripts have to be executed at the same time instance, then the one with the smaller index is executed first.

For more information see the complete Blue Book.

4.5.3 Schedule (class_id = 10, version = 0)

This IC, together with the IC “Special days”, allows modelling time- and date-driven activities within a device. Table 23 and Table 24 provide an overview and show the interactions between the two ICs.

Table 16 – Schedule

Index	enable	action (script)	Switch _time	validity_ window	exec_weekdays							exec_specdays					date range	
					Mo	Tu	We	Th	Fr	Sa	Su	S1	S2	…	S8	S9	begin_ date	end_ date
120	Yes	xxxx:yy	06:00	0xFFFF	x	x	x	x	x	x							xx-04-01	xx-09-30
121	Yes	xxxx:yy	22:00	15	x	x	x	x	x								xx-04-01	xx-09-30
122	Yes	xxxx:yy	12:00	0						x							xx-04-01	xx-09-30
200	No	xxxx:yy	06:30		x	x	x	x	x	x							xx-04-01	xx-09-30
201	No	xxxx:yy	21:30		x	x	x	x	x								xx-04-01	xx-09-30
202	No	xxxx:yy	11:00							x							xx-04-01	xx-09-30

Table 17 – Special days table

Index	special_day_date	day_id
12	xx-12-24	S1
33	xx-12-25	S3
77	97-03-31	S3

For more information see the complete Blue Book.

4.5.4 Special days table (class_id = 11, version = 0)

This IC allows defining special dates. On such dates, a special switching behaviour overrides the normal one. The IC works in conjunction with the class "Schedule" or "Activity calendar". The linking data item is *day_id*.

For more information see the complete Blue Book.

4.5.5 Activity calendar (class_id = 20, version = 0)

This IC allows modelling the handling of various tariff structures in the meter. The IC provides a list of scheduled actions, following the classical way of calendar based schedules by defining seasons, weeks…

An "Activity calendar" object may coexist with the more general "Schedule" object and it can even overlap with it. If actions in a "Schedule" object are scheduled for the same activation time as in an "Activity calendar" object, the actions triggered by the "Schedule" object are executed first.

After a power failure, only the "last action" missed from the object "Activity calendar" is executed (delayed). This is to ensure proper tariffication after power up. If a "Schedule" object is present, then the missed "last action" of the "Activity calendar" shall be executed at the correct time within the sequence of actions requested by the "Schedule" object.

The "Activity calendar" object defines the activation of certain scripts, which can perform different activities inside the logical device. The interface to the IC "Script table" is the same as for the IC "Schedule" (see 4.5.3).

If an instance of the IC "Special days table" (see 4.5.4) is available, relevant entries there take precedence over the "Activity calendar" object driven selection of a day profile. The day profile referenced in the "Special days table" activates the day_schedule of the *day_profile_table* in the "Activity calendar" object by referencing through the day_id.

For more information see the complete Blue Book.

4.5.6 Register monitor (class_id = 21, version = 0)

This IC allows modelling the function of monitoring of values modelled by “Data”, “Register”, “Extended register” or “Demand register” objects. It allows specifying thresholds, the value monitored, and a set of scripts (see 4.5.2) that are executed when the value monitored crosses a threshold.

The IC “Register monitor” requires an instantiation of the IC “Script table” in the same logical device.

For more information see the complete Blue Book.

4.5.7 Single action schedule (class_id = 22, version = 0)

This IC allows modelling the execution of periodic actions within a meter. Such actions are not necessarily linked to tariffication (see “Activity calendar” or “Schedule”).

For more information see the complete Blue Book.

4.5.8 Disconnect control (class_id = 70, version = 0)

Instances of the “Disconnect control” IC manage an internal or external disconnect unit of the meter (e.g. electricity breaker, gas valve) in order to connect or disconnect – partly or entirely – the premises of the consumer to / from the supply. The state diagram and the possible state transitions are shown in Figure 18.

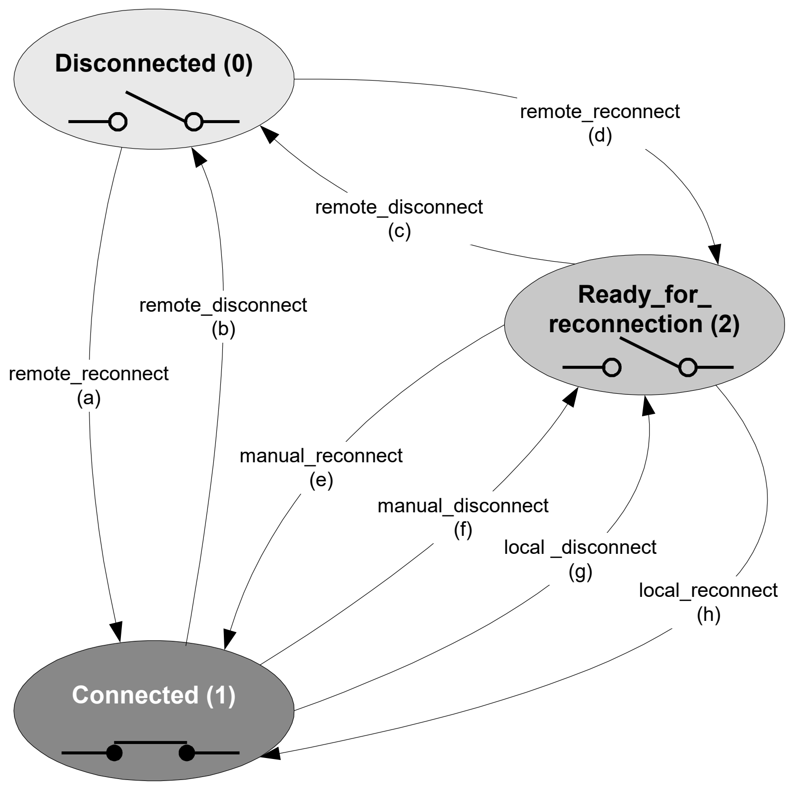


Figure 16 – State diagram of the Disconnect control IC

Disconnect and reconnect can be requested:

- Remotely, via a communication channel: remote_disconnect, remote_reconnect;
- Manually, using e.g. a push button: manual_disconnect, manual_reconnect;
- Locally, by a function of the meter, e.g. limiter, prepayment: local_disconnect, local_reconnect.

The states and state transitions of the Disconnect control IC are shown in Table 25. The possible state transitions depend on the control mode. The Disconnect control object doesn't feature a memory, i.e. any commands are executed immediately.

To define the behaviour of the disconnect control object for each trigger, the control mode shall be set.

Table 18 – Disconnect control IC – states and state transitions

States		
State number	**State name**	**State description**
0	Disconnected	The *output_state* is set to FALSE and the consumer is disconnected.
1	Connected	The *output_state* is set to TRUE and the consumer is connected.
2	Ready_for_reconnection	The *output_state* is set to FALSE and the consumer is disconnected.
State transitions		
Transition	**Transition name**	**State description**
a	remote_reconnect	Moves the “Disconnect control” object from the Disconnected (0) state directly to the Connected (1) state without manual intervention.
b	remote_disconnect	Moves the “Disconnect control” object from the Connected (1) state to the Disconnected (0) state.
c	remote_disconnect	Moves the “Disconnect control” object from the Ready_for_reconnection (2) state to the Disconnected (0) state.
d	remote_reconnect	Moves the “Disconnect control” object from the Disconnected (0) state to the Ready_for_reconnection (2) state. From this state, it is possible to move to the Connected (2) state via the manual_reconnect transition (e) or local_reconnect transition (h).
e	manual_reconnect	Moves the “Disconnect control” object from the Ready_for_connection (2) state to the Connected (1) state.
f	manual_disconnect	Moves the “Disconnect control” object from the Connected (1) state to the Ready_for_connection (2) state. From this state, it is possible to move back to the Connected (2) state via the manual_reconnect transition (e) or local_reconnect transition (h).
g	local_disconnect	Moves the “Disconnect control” object from the Connected (1) state to the Ready_for_connection (2) state. From this state, it is possible to move back to the Connected (2) state via the manual_reconnect transition (e) or local_reconnect transition (h). NOTE 1 Transitions f) and g) are essentially the same, but their trigger is different.
h	local_reconnect	Moves the “Disconnect control” object from the Ready_for_connection (2) state to the Connected (1) state NOTE 2 Transitions e) and h) are essentially the same, but their trigger is different.

For more information see the complete Blue Book.

4.5.9 Limiter (class_id = 71, version = 0)

Instances of the "Limiter" IC allow defining a set of actions that are executed when the value of a *value* attribute of a monitored object "Data", "Register", "Extended Register", "Demand Register", etc. crosses the threshold value for at least minimal duration time.

The threshold value can be normal or emergency threshold. The *emergency threshold* is activated via the *emergency_profile* defined by *emergency profile id*, *emergency activation time*, and *emergency duration*. The *emergency profile id* element is matched to an *emergency profile group id*: this mechanism enables the activation of the emergency threshold only for a specific emergency group.

For more information see the complete Blue Book.

4.5.10 Parameter monitor (class_id = 65, version = 0)

Instances of the "Parameter monitor" IC monitor a list of COSEM object attributes holding parameters.

The parameters can be changed as usual. If the value of an attribute changes and this attribute is present in the *parameter_list* attribute, the identifier and the value of that attribute is automatically captured to the *changed_parameter* attribute. The time when the change of the parameter occurred is captured in the *capture_time* attribute. These attributes may be captured then by a "Profile generic" object. In this way, a log of all parameter changes can be built. For the OBIS code of the Parameter monitor log objects, see 7.4.5.

NOTE 1 In the case of simultaneous or quasi simultaneous parameter changes the order of capturing and logging the changed parameters has to be managed by the application.

Several "Parameter monitor" objects and corresponding "Profile generic" objects can be instantiated to manage a number of parameter groups. The link between the "Parameter monitor" object and the corresponding "Profile generic" object is via the *capture_object* attribute of the "Profile generic" object.

NOTE 2 As the various parameters may be of different type and length, the entries in the profile column holding the parameters will be also of different type and length. This can be managed for example by capturing different kind of parameters into different Parameter list "Profile generic" objects and parameter logs.

NOTE 3 The "Profile generic" object holding the parameter change log may capture other suitable object attributes, like the *time* attribute of the "Clock" object, and any other relevant values.

For more information see the complete Blue Book.

4.5.11 Sensor manager interface class (class_id = 67, version = 0)

4.5.11.1 General

Most measuring instruments under the scope of the MID operate with dedicated sensors (transducers and transmitters) connected to the processing unit. These sensors have to be permanently supervised concerning their functioning and limits to fulfil the metrological requirements for subsequent calculation of monetary values.

In addition, the measured values have to be monitored. These values may be related to a physical quantity – raw values of voltage, current, resistance, frequency, digital output – provided by the sensor, and the measured quantities resulting from the processing of the information provided by the sensor.

It is necessary to monitor and often to log the relevant values in order to obtain diagnostic information that allows:

- the identification of the sensor device;
- the connection and the sealing status of the sensor;
- the configuration of the sensors;
- the monitoring of the operation of the sensors;
- the monitoring of the result of the processing.

The "Sensor manager" interface class allows managing detailed information related to a sensor by a single object.

For simpler sensors / devices, already existing COSEM objects – identifying the sensors, holding measurement values and monitoring those measurement values – can be used.

4.5.11.2 Sensor manager interface class specification (class_id = 67, version = 0)

Instances of the "Sensor manager" IC manage complex information related to sensors. They also allow monitoring the raw data and the processed value, derived by processing the raw-data using appropriate algorithms as required by the particular application. This IC includes a number of functions:

- nameplate data of the sensor and site information (attributes 2 to 6);
- an "Extended register" function for the *raw-value* (attributes 7 to 10);
- a "Register monitor" function for the *raw-value* (attributes 11-12);

NOTE 1 Not every raw data (e.g. the voltage output of a pressure sensor) has its own OBIS code / object. This is the reason to include raw data in the Sensor manager class.

- a "Register monitor" function for the *processed_value* (attributes 13 to 15).

NOTE 2 Not all "modules" are necessarily present. The attributes not used are possibly not implemented or not accessible.

For more information see the complete Blue Book.

4.5.11.3 Example for absolute pressure sensor

Figure 19 illustrates the definition of relevant upper and lower thresholds.

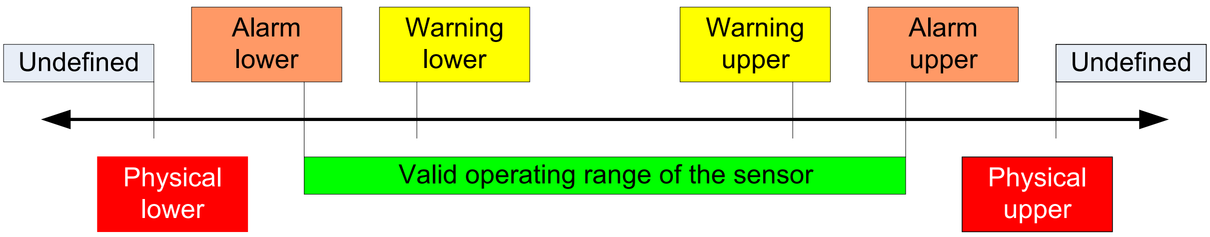


Figure 17 – Definition of upper and lower thresholds

Table 26 and Table 27 show examples of the various thresholds and the actions performed when the thresholds are crossed.

Table 19 – Explicit presentation of threshold value arrays

Threshold	Physical lower	Physical upper	Alarm lower	Alarm upper	Warning lower	Warning upper
Value	1,0	5,5	1,2	5,0	1,4	4,8
scaler_unit	1, Volt	1, Volt	1, bar	1, bar	1, bar	1, bar

Table 20 – Explicit presentation of action_sets

action_set	Physical lower	Physical upper	Alarm lower	Alarm upper	Warning lower	Warning upper
action_up	clr_phy_ alarm_bit	set_phy_ alarm_bit	clear_ alarm_bit	set_ alarm_bit	clear_ warn_bit	set_ warn_bit
action_down	set_phy_ alarm_bit	clr_phy_ alarm_bit	set_ alarm_bit	clear_ alarm_bit	set_ warn_bit	clear_ warn_bit

4.5.12 Arbitrator (class_id = 68, version = 0)

4.5.12.1 Overview

Instances of the "Arbitrator" IC allow determining, based on pre-configured rules comprising permissions and weightings, which action is carried out when multiple actors may request potentially conflicting actions to control the same resource. Generally, there is one "Arbitrator" object instantiated for each resource for which competing action requests need to be handled.

The "Arbitrator" IC allows:

- configuring the possible, potentially conflicting actions that can be requested;
- configuring the permissions for each actor to request the possible actions;
- configuring the weighting for each actor for each possible request.

NOTE 1 Examples for a resource are the supply control switch or a gas valve of the meter. Examples for possible actions are disconnect supply, enable reconnection, reconnect supply, prevent disconnection, prevent reconnection.

The actions that can be requested are held in the *actions* attribute as an array of script identifiers. The scripts – held by separate "Script table" objects – allow performing a wide range of functions. There may be actions designed to inhibit the execution of other actions: these are modelled as null-scripts, i.e. pointing to a script_identifier (0) of a "Script table" object.

NOTE 2 The "Arbitrator" objects do not contain the names of the actions, but their purpose and effect can be deduced by looking at the relevant "Script table" objects.

The permissions are held in the *permissions_table* attribute as an array of bit-strings: each element in the array represents one actor and each bit in the bit-string represents one action from the *actions* array.

The weightings are held in the *weightings_table* attribute as a two-dimensional array: each line represents one actor and there is one weight allocated to each possible action for that actor. For actions designed to inhibit other actions a very high weight may be allocated compared to the weight of the action that is to be inhibited.

Actions are requested by invoking the *request_action* method. The method invocation parameters contain:

- the identifier of the actor. This element, an unsigned number, points to a line in the *permissions_table, weightings_table* and *most_recent_requests_table* attributes;

  NOTE 3 Names of the actors may be specified in project specific companion specifications.

- the list of actions requested, in the form of a bit-string. Each bit corresponds to one element of the *actions* array: for the actions requested the bit is set to 1, for the actions not requested (inactions) the bit is set to 0. An actor may request none, one, several or all actions in a single request in one invocation. The reason to allow requesting multiple actions in a single request is to allow the actor to request an action, and at the same time to prevent another actor reversing that action.

  NOTE 4 For example, an actor may request disconnecting the supply and preventing another actor to reconnect it.

  NOTE 5 An earlier action request by an actor can be cleared by not requesting the same action (i.e. by requesting an inaction) in another invocation of the *request_action* method by the same actor. With this, a request for inhibiting an action is lifted.

The *most_recent_requests_table* attribute holds the list of the most recent request of each actor, in the form of an array of bit-strings: each element in the array represents the last request of an actor, and each bit in the bit-string represents one action / inaction requested.

When the *request_action* method is invoked by an actor the AP carries out the following activities:

- it checks the *permissions_table* attribute entry for the given actor to see if the actions requested are permitted or not;
- it updates the *most_recent_requests_table* attribute by setting or clearing the bit in the bit-string for that actor for each action requested that is also permitted (bit is set); or not requested / not permitted (bit is cleared;
- it applies the *weightings_table* for the *most_recent_requests_table:* for each bit set in the *most_recent_requests_table* the corresponding weight of each actor is applied;
- for each action, the weights are summed; and then
- if there is a unique highest total weight for an action, this value is written to the *last_outcome* attribute and the corresponding script is executed. If there is no highest unique total weight, nothing happens.

4.5.12.2 Arbitrator interface class specification (class_id = 68, version = 0)

For more information see the complete Blue Book.

4.5.13 Modelling examples: tariffication and billing

Figure 20 shows an example of modelling tariff parametrization and management using COSEM objects.

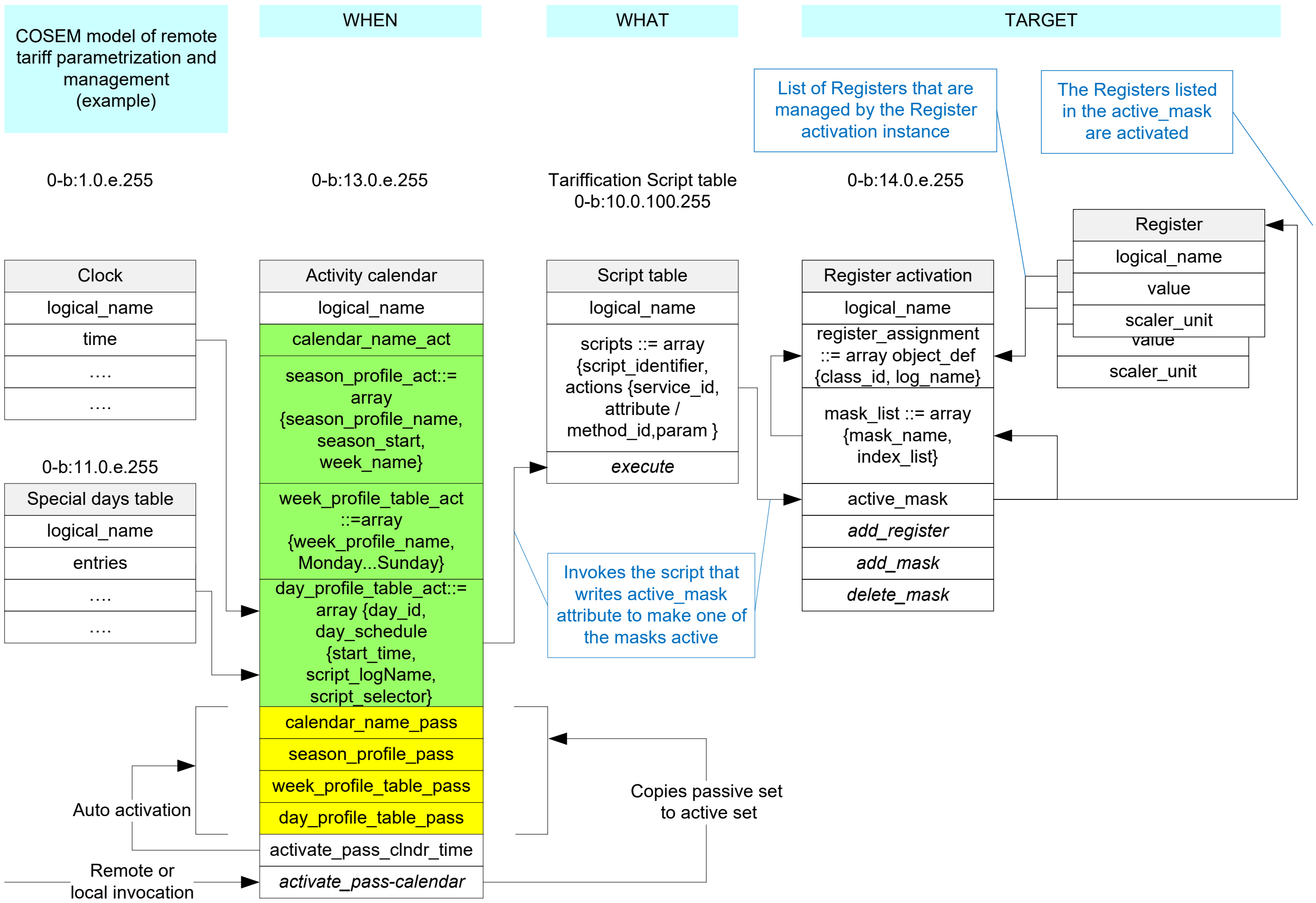


Figure 18 – COSEM tariffication model (example)

Figure 21 shows an example of modelling parametrization and management of billing using COSEM objects.

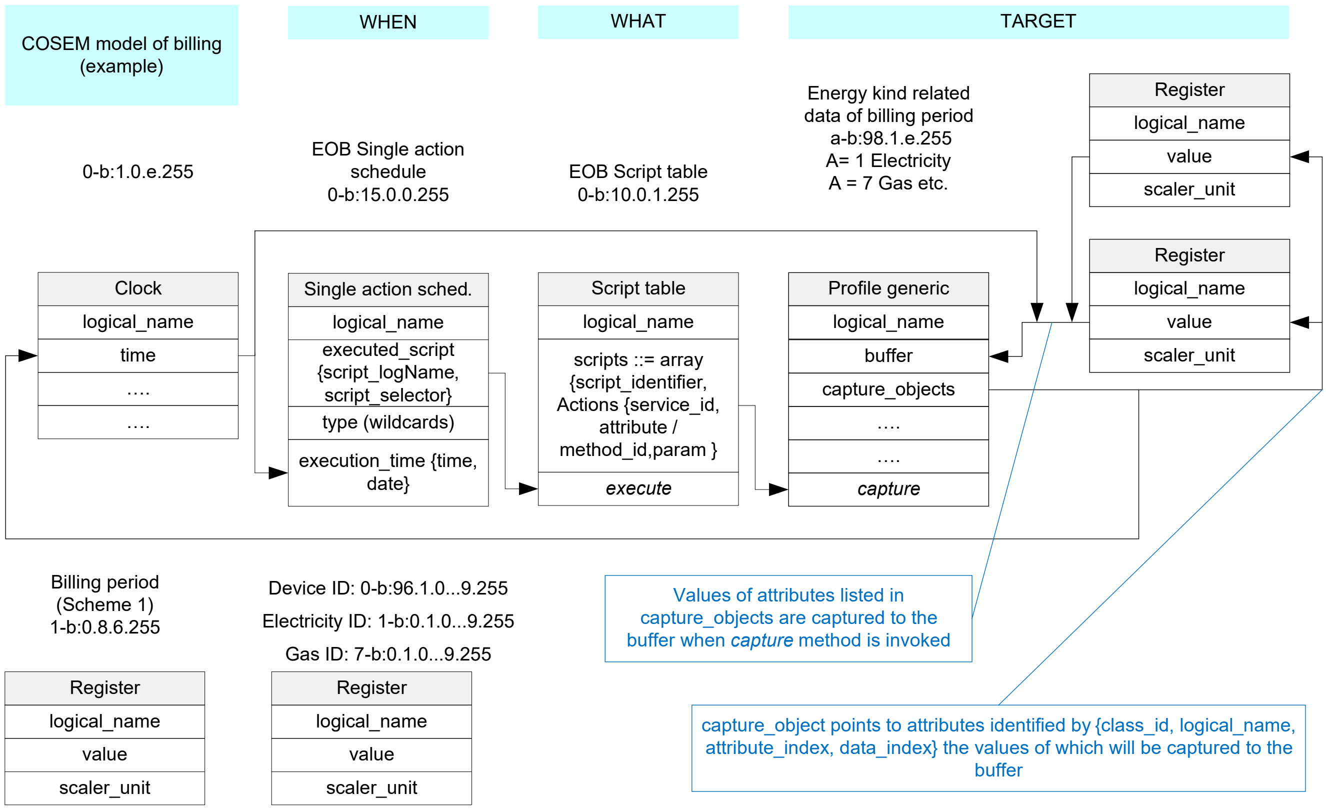


Figure 19 – COSEM billing model (example)

4.6 Payment metering related interface classes

4.6.1 Overview of the COSEM accounting model

The COSEM accounting model contains four interlinked interface classes: “Account”, “Credit”, “Charge” and the “Token gateway” IC. These classes are concerned with accounting for energy, not with delivery of that energy. The “Account” is linked to it’s associated “Credit”, “Charge” and “Token gateway” objects by use of the value group D and B field such that an “Account” with D=0 should be linked to a “Token gateway” with D=40 and have a “Credit” objects with D=10 and “Charge” objects with D=20. Whereas an “Account” with D=1 should have “token gateway” with D=41, “Credit” objects with D=11 and “Charge” objects with D=21 etc. Multiple “Token gateway”, “Credit” and “Charge” objects related to the same “Account” are identified using different values in the value group E field.

An “Account” object contains summary information and coordinates information pertaining to Credits and Charges. There is a single “Account” object per supply, for example, electricity import has one “Account” object, but a system that also has micro-generation could have a second “Account” to deal with the export of generated electricity; the second “Account” might or might not be accessible via the same Application Association (AA) as the first.

A “Credit” object contains detailed information about one source of funds. There is one or (usually) more “Credit” object(s) associated with an “Account”: for example, one object for token credit and one object for emergency credit. Both of these objects can receive credit amounts from tokens, but emergency credit can only receive credit amounts when it has been consumed (entirely or partially) and when *credit_configuration* has bit 2 (Requires the credit amount to be paid back) set.

There are several types of credit listed in IEC TR 62055-21:2005, and these are the types supported by the ”Credit” IC. There can be zero or more instances of each type of Credit.

- token_credit**:** Credit that is transferred to a meter operating in prepayment mode, normally in the form of Credit Tokens;

  NOTE 1 In a meter operating in credit mode or managed payment mode, a “Credit” object configured with type token_credit is used for recording the amount of credit used since last synchronised with a client.

  NOTE 2 The content of the token is not defined by this document and may be an amount of money or another quantity that can be accounted in a way that is equivalent to the currency used by the meter.

- reserved_credit**:** Credit that is held in reserve, which is released under specific conditions;
- emergency_credit**:** Accounting functions that deal with the calculation and transacting of credit that is released only under emergency situations. Usually the amount of emergency credit used is recovered from subsequently purchased credit token

  NOTE 3 Emergency above refers to a time when a consumer does not have any token credit, and not to any safety related situation.

- time_based_credit**:** Credit that is released on a scheduled time basis;
- consumption_based_credit**:** Credit that is released on the basis of a schedule of consumption levels. For example if a consumer keeps their consumption below a threshold, the system may release a predefined amount of credit.

A “Charge” object contains detailed information about one sink of expenditure, that is, one way in which credit is being used up. There can be one or (usually) more “Charge” objects associated with an “Account” for instance, one for energy usage, one for standing charge, and possibly one paying off a debt such as an installation charge.

There are several types of charge listed in IEC TR 62055-21:2005, but the following types, distinguished by the trigger for collection, are the ones most useful in the COSEM accounting model. There can be zero or more instances of each type of ”Charge” IC.

- consumption_based_collection: describes charges that are collected according to the amount of consumption that has occurred in a tariff. A price per unit is assigned to each tariff register of the energy consumed

NOTE 4 Tariffs cannot be applied when currency is in time or energy units.

- time_based_collection: describes charges that are collected regularly according to the passage of time, independent of consumption in that period. This may be used to collect standing charges, or debt charge to be paid off over a period of time;
- payment_event_based_collection: describes charges that are collected from every top-up that is received, typically for debt repayment. These may be expressed as amount-based, where a fixed amount is taken from each top-up credit received (for example, the consumer pays £2 out of every vend regardless of the vend amount), or percentage_based_collection where a proportion of the amount of top-up credit received is taken (for example, with every vend the consumer pays 20% of the vend amount). Bit 0 (Percentage based collection) of the *charge_configuration* attribute of the "Charge" object specifies the method of *event_based_collection*. Figure 22 gives a general view of the account model.

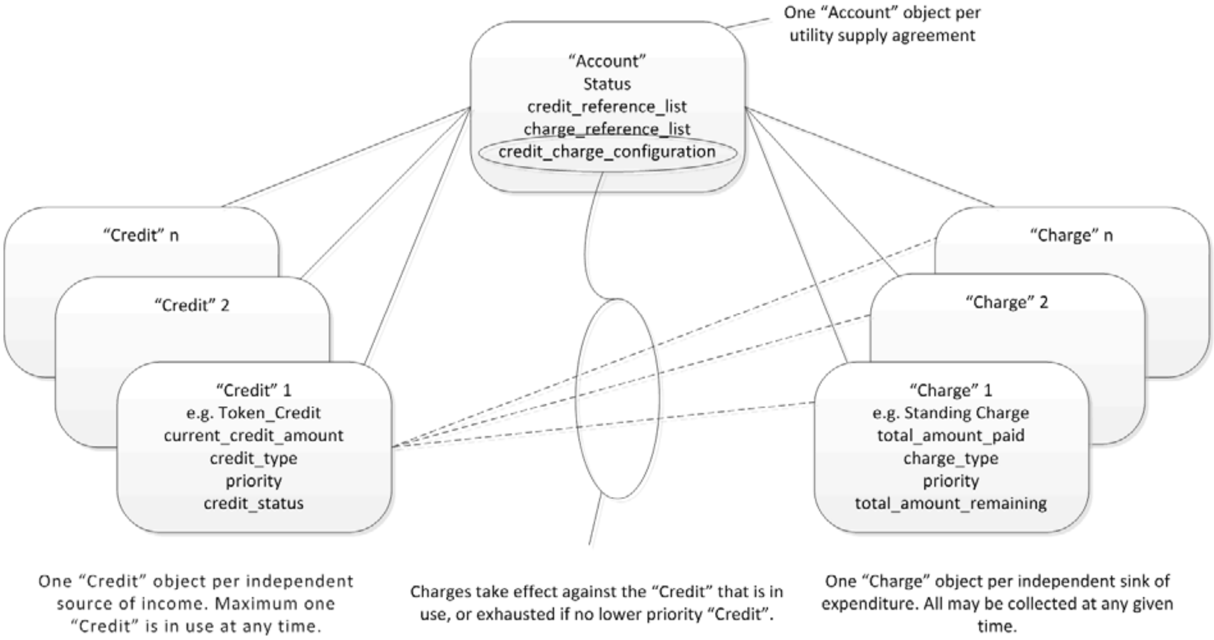


Figure 20 – Outline Account model

Figure 23 shows instances of "Account", "Credit" and "Charge" interface classes with some of their attributes and the relationships between those attributes. In this example:

a) There is one "Account", two "Credit" and two "Charge" objects configured;

b) "Credit" 1 is of type *token_credit* and the *low_credit_threshold* and *limit* attributes are configured to be 0;

c) Interaction between multiple classes is covered in this diagram. Detailed configuration of individual "Credit" and "Charge" objects is not shown.

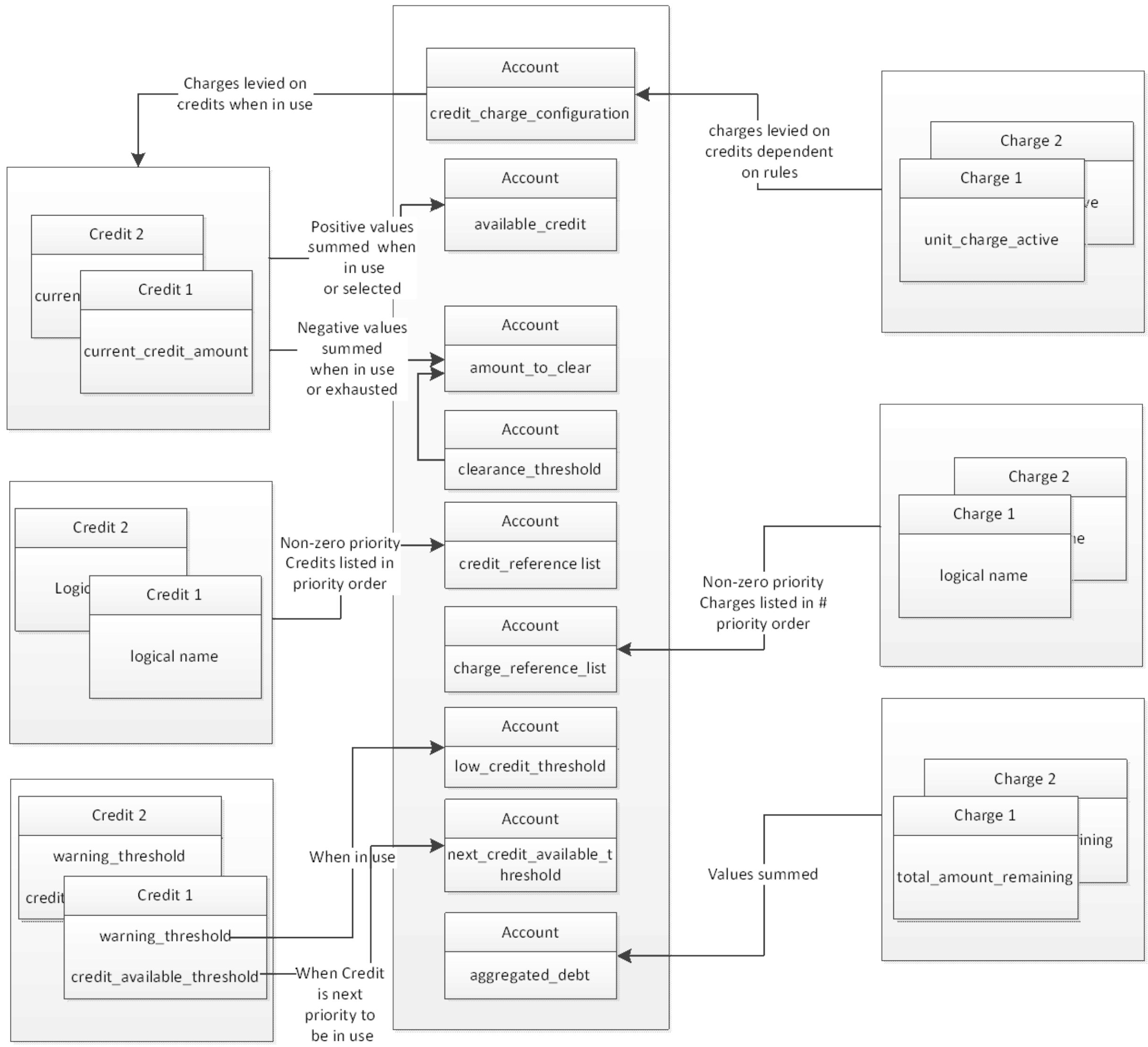


Figure 21 – Diagram of attribute relationships

4.6.2 Account (class_id = 111, version = 0)

Instances of the “Account” IC manage all the necessary elements related to the supervision of the “Credit” objects and the “Charge” objects referenced by a particular instance of the “Account” IC.

The operation of the payment metering function will be defined within the configuration of “Charge”, “Credit”, and “Account” objects and disconnection rules.

NOTE 1 Disconnection rules are either application specific or can be modelled using an instance of the “Arbitrator” IC, see 4.5.12.2.

If explicitly specified for a particular project, it is permissible for accounting to switch from credit to prepayment mode, or from prepayment to credit mode, once an accounting configuration has been correctly set up and the “Account” object has been activated. In the absence of any such specification the operating mode should remain fixed for any particular “Account” once it has been made active.

For more information see the complete Blue Book.

4.6.3 Credit interface class (class_id = 112, version = 0)

4.6.3.1 General

Instances of the “Credit” IC allow the management of a credit that can be consumed by charges. There are several different credit types; each “Credit” object characterizes itself by the values of its attributes.

All “Credits” associated with one supply are listed in the *credit_reference_list* attribute of the “Account” object. “Credits” move between states by:

- top-ups;
- the adjustment of current_credit_amount by method invocation; or
- the decrement of credit by charges.

This is explained in the state diagram in 4.6.3.2. 4.6.1 lists “Credit” types as defined in IEC TR 62055-21:2005.

4.6.3.2 Credit states

The credit states only have meaning when *priority* is non-zero. They are shown in Table 28 and Figure 24. The state transitions are shown in Table 29.

Table 21 – Credit states

Priority	Credit state	Meaning
0	Any	The instance of the “Credit” object is inactive. NOTE When a “Credit” has a non-zero priority, but does not appear in any *credit_reference_list* then it has the same behaviour as if it had a zero priority.
>0	(0) Enabled	Reference to the “Credit” appears in the *credit_reference_list* of an active “Account” with a non-zero priority.
>0	(1) Selectable	The “Credit” requires some additional interaction before it can be *In use*. A credit is selectable only when it is the next priority credit, it is not exhausted and when bit 1 (Requires confirmation) of “Credit” *credit_configuration* is set.
>0	(2) Selected/Invoked	The “Credit” that was selectable has now been selected but it may not yet be *In use* (it could be that some of the higher priority ”Credit” is still being used i.e. in the case of EMC). Alternatively a “Credit” that was Enabled and did not require selection may arrive here directly if the higher priority credit has become *Exhausted*.
>0	(3) In use	The “Credit” is being used to pay *Charge*s within the meter.
>0	(4) Exhausted	The “Credit” has run out.

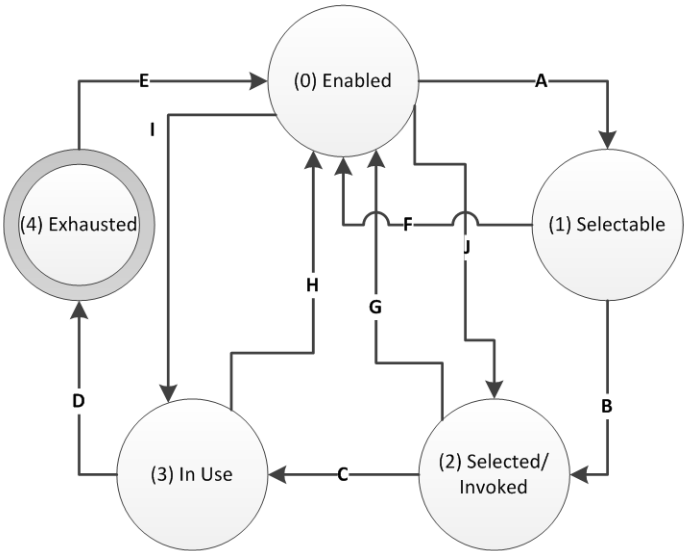


Figure 22 – Credit States when priority >0

For more information see the complete Blue Book.

4.6.4 Charge (class_id = 113, version = 0)

Instances of the "Charge" IC allow the management of a single Charge. Depending on the attributes configured such as amount per price and the period, the Charge is taken at appropriate times from the "Credit" object *In use*.

NOTE 1 The details of the collection (charge-taking) cycle may be project dependent, and thus they are subject to project specific companion specifications since they affect third-party estimates of current values.

Each "Charge" object characterises itself by the values of its attributes.

All "Charges" associated with one supply are referenced in the *charge_ reference_list* attribute of the related "Account" object.

For more information see the complete Blue Book.

4.6.5 Token gateway (class_id = 115, version = 0)

An instance of the "Token gateway" IC implements the Token Carrier Interface.

NOTE 1 A single instance of the "Token gateway" object is instantiated for each "Account" object and hence each supply contract.

For more information see the complete Blue Book.

4.7 Interface classes for setting up data exchange via local ports and modems

4.7.1 IEC local port setup (class_id = 19, version = 1)

This IC allows modelling the configuration of communication ports using the protocols specified in IEC 62056-21:2002. Several ports can be configured.

For more information see the complete Blue Book.

4.7.2 IEC HDLC setup (class_id = 23, version = 1)

This IC allows modelling and configuring communication channels according to DLMS UA 1000-2 Ed. 9 Clause 8. Several communication channels can be configured.

For more information see the complete Blue Book.

4.7.3 IEC twisted pair (1) setup (class_id = 24, version = 1)

4.7.3.1 General

The communication medium *twisted pair with carrier signalling* is widely used in metering. The main advantages of using this medium are the ease of installation and the reliability of communications due to carrier signalling. This medium can be used:

- between Local Network Access Points (LNAPs) and metering end devices (M interface);
- between Local Network Access Points (LNAPs) and Neighbourhood Network Access Points (NNAPs); and
- for direct connection between a HHU and the metering end device.

IEC 62056-3-1:2013 specifies three communication profiles using the medium twisted pair with carrier signalling:

- without DLMS;
- with DLMS; and
- with DLMS/COSEM.

IEC 62056-31:1999 supports only the first two profiles.

The new, DLMS/COSEM profile introduces a Support Manager Layer entity performing the initialisation of the bus, discovery management, alarm management and communication speed negotiation. It also allows higher baud rates up to 9 600 Bd. The Transport Layer supports segmentation and reassembly.

The IC “IEC Twisted pair (1) set up” (class_id = 24, version = 0) supports the first two communication profiles specified in IEC 62056-31:1999.

The new version 1 supports the DLMS/COSEM profile. With its introduction, the use of version 0 is deprecated.

The use of the communication profiles specified in IEC 62056-3-1:2013 requires using the registration services provided by the Euridis Association: www.euridis.org.

The following COSEM interface objects are necessary to set up data exchange over the medium *Twisted pair with carrier signalling:*

- “IEC Twisted pair (1) setup”: class_id = 24, version = 1;

- “MAC address”: class_id = 43, version = 0;
- “Data”: class_id = 1, version = 0.

For OBIS codes, see 6.2.21.

4.7.3.2 IEC twisted pair (1) setup (class_id = 24, version = 1)

Instances of this IC allow setting up data exchange over the medium *twisted pair with carrier signalling* as specified in IEC 62056-3-1:2013. Several communication channels can be configured.

For more information see the complete Blue Book.

4.7.3.3 Fatal error register

Each device implementing the DLMS/COSEM communication profile specified in IEC 62056-3-1:2013 shall provide an error register holding the result of the last communication with the primary station. The structure of the fatal error register shall be as specified inTable 22.

Table 22 – Fatal error register

Ref	Name	Description
Bit 0	EP-3F	Transmission error. The time out TOE is elapsed without the byte being sent, leading to a non-ability to send the remaining part of the frame.
Bit 1	EP-4F	Reception error. The number of bytes received is higher than the maximum expected.
Bit 2	EP-5F	Expiry of TARSO wake-up while receiving an RSO frame. Not relevant for secondary station (server); concerns the primary station (client) only.
Bit 3	EL-1F	Alarm indication received during an association. No relevant. Concern the primary station (client) only.
Bit 4	EL-2F	Incorrect response from the Secondary Station after MaxRetry repeated transmissions of a request.
Bit 5	EA-1F	Incorrect TAB from the server. Not relevant for secondary station (server); concerns the primary station (client) only.
Bit 6	EA-2F	Authentication error on the data received from the server. Not relevant for secondary station (server); concerns the primary station (client) only.
Bit 7	EA-3F	Authentication error detected by the secondary station.

4.7.4 Modem configuration (class_id = 27, version = 1)

This IC allows modelling the configuration and initialisation of modems used for data transfer from/to a device. Several modems can be configured.

For more information see the complete Blue Book.

4.7.5 Auto answer (class_id = 28, version = 2)

Version 0 of the Auto answer class models how the device handles incoming calls to request the connection of the modem.

NOTE 1 Version 1 of the Auto answer class was an interim version.

In version 2, new capabilities are added to manage wake-up requests that may be in the form of a wake-up call or a wake-up message e.g. an (empty) SMS message. After a successful wake-up request, the device connects to the network. See also Annex A.

For both functions, additional security is provided by adding the possibility of checking the calling number: calls or messages are accepted only from a pre-defined list of callers. This feature requires the presence of a calling line identification (CLI) service in the communication network used.

NOTE 2 The wake-up process is fully decoupled from AL services, i.e. a wake-up message cannot contain any xDLMS service requests. This is to avoid creating a backdoor. xDLMS messages may be exchanged in SMS messages once the wake-up process is completed.

For more information see the complete Blue Book.

4.7.6 Auto connect (class_id = 29, version = 2)

Version 1 of the "Auto connect" class models how the device performs auto dialling or sends messages using various services.

In version 2 new capabilities are added to model the connection of the device to a communication network. Network connection may be permanent, within a time window or on invocation of the connect method.

For more information see the complete Blue Book.

4.7.7 GPRS modem setup (class_id = 45, version = 0)

This IC allows setting up GPRS modems, by handling all data necessary data for modem management.

For more information see the complete Blue Book.

4.7.8 GSM diagnostic (class_id: 47, version: 1)

The cellular network is undergoing constant changes in terms of registration status, signal quality etc. It is necessary to monitor and log the relevant parameters in order to obtain diagnostic information that allows identifying communication problems in the network.

An instance of the "GSM diagnostic" class stores parameters of the GSM/GPRS, UMTS, CDMA or LTE network necessary for analysing the operation of the network.

A GSM diagnostic "Profile generic" object is also available to capture the attributes of the GSM diagnostic object, see 7.4.5.

For more information see the complete Blue Book.

4.7.9 LTE monitoring (class_id: 151, version: 0)

Instances of the 'LTE monitoring" IC allow monitoring LTE modems by handling all data necessary data for this purpose.

For more information see the complete Blue Book.

4.8 Interface classes for setting up data exchange via M-Bus

4.8.1 Overview

The M-Bus related interface classes specified in this subclause 4.8.1 are used in two different scenarios:

a) a DLMS/COSEM server hosted by a M-Bus master and exchanging dedicated M-Bus APDUs with M-Bus slaves;

b) a DLMS/COSEM client hosted by a M-Bus master and exchanging DLMS/COSEM APDUs with DLMS/COSEM servers hosted by M-Bus slaves;

In case a) instances of the following M-Bus interface classes are used to set up and manage the M-Bus media in the DLMS/COSEM server:

- M-Bus client (class_id = 72), see 4.8.3;
- M-Bus master port setup (class_id = 74), see 4.8.5;
- M-Bus diagnostic (class_id = 77, version = 0), see 4.8.7.

In case b) instances of the following M-Bus interface classes are used in the DLMS/COSEM server:

- DLMS/COSEM server M-Bus port setup (class_id = 76), see 4.8.6;
- M-Bus slave port setup (class_id = 25), see 4.8.2; and/or
- Wireless Mode Q channel (class_id = 73), see 4.8.4;
- M-Bus diagnostic (class_id = 77, version = 0), see 4.8.7.

4.8.2 M-Bus slave port setup (class_id = 25, version = 0)

NOTE 1 The name of this IC has been changed from “M-BUS port setup” to “M-Bus slave port setup”, to indicate that it serves to set up data exchange when a COSEM server communicates with a COSEM client using wired M-Bus.

This IC allows modelling and configuring communication channels according to EN 13757-2. Several communication channels can be configured.

For more information see the complete Blue Book.

4.8.3 M-Bus client (class_id = 72, version = 1)

Instances of the “M-Bus client” allow setting up M-Bus slave devices using wired M-Bus and to exchange data with them. Each “M-Bus client” object controls one M-Bus slave device. For details on the M-Bus dedicated application layer, see EN 13757-3.

NOTE 1 Version 1 of the “M-Bus client” IC is in line with EN 13757-3:2013.

The M-Bus client device may have one or more physical M-Bus interfaces, which can be configured using instances of the “M-Bus master port setup” IC, see 4.8.5.

An M-Bus slave device is identified with its Primary Address, Identification Number, Manufacturer ID etc. as defined in EN 13757-3:2013, Clause 5, Variable Data Send and Variable Data respond. These parameters are carried by the respective attributes of the M-Bus client IC.

Values to be captured from an M-Bus slave device are identified by the *capture_definition* attribute, containing a list of data identifiers (DIB, VIB) for the M-Bus slave device. The data are captured periodically or on an appropriate trigger. Each data element is stored in an M-Bus value object, of IC “Extended register”. M-Bus value objects may be captured in M-Bus “Profile generic” objects, eventually along with other, non M-Bus specific objects. If the data type used by M-Bus is not a data type specified in COSEM, then a data type conversion has to take place. The conversion process is specified in EN13757-3:2018 Annex H.

Using the methods of “M-Bus client” objects, M-Bus slave devices can be installed and de-installed.

It is also possible to send data to M-Bus slave devices and to perform operations like resetting alarms, synchronizing the clock, transferring an encryption key etc.

Configuration field as defined in EN 13757-3:2013, 5.12 provides information about the encryption mode and number of encrypted bytes.

Encryption key status provides information if encryption key has been set, transferred to M-Bus slave device and is in use with M-Bus slave device.

For more information see the complete Blue Book.

4.8.4 Wireless Mode Q channel (class_id = 73, version = 1)

Instances of this IC define the operational parameters for communication using the mode Q interfaces. See also EN 13757-5:2015.

For more information see the complete Blue Book.

4.8.5 M-Bus master port setup (class_id = 74, version = 0)

Instances of this IC define the operational parameters for communication using the EN 13757-2 interfaces if the device acts as an M-bus master.

For more information see the complete Blue Book.

4.8.6 DLMS/COSEM server M-Bus port setup (class_id = 76, version = 0)

Instances of the “DLMS/COSEM server M-Bus port setup” are used in DLMS/COSEM servers hosted by M-Bus slave devices, using the DLMS/COSEM wired or wireless M-Bus (wM-Bus) communication profile.

For more information see the complete Blue Book.

4.8.7 M-Bus diagnostic (class_id = 77, version = 0)

Instances of the IC “M-Bus diagnostic” hold information related to the operation of the M-Bus network, like current signal strength, channel identifier, link status to the M-Bus network and counters related to the frame exchange, transmission and frame reception quality.

For more information see the complete Blue Book.

4.9 Interface classes for setting up data exchange over the Internet

4.9.1 TCP-UDP setup (class_id = 41, version = 0)

This IC allows modelling the setup of the TCP or UDP sub-layer of the COSEM TCP or UDP based transport layer of a TCP-UDP/IP based communication profile.

In TCP-UDP/IP based communication profiles, all AAs between a physical device hosting one or more COSEM client application processes and a physical device hosting one or more COSEM server APs rely on a single TCP or UDP connection. The TCP or UDP entity is wrapped in the COSEM TCP-UDP based transport layer. Within a physical device, each AP – client AP or server logical device – is bound to a Wrapper Port (WPort). The binding is done with the help of the SAP Assignment object. See 4.4.5.

On the other hand, a COSEM TCP or UDP based transport layer may be capable to support more than one TCP or UDP connections, between a physical device and several peer physical devices hosting COSEM APs.

When a COSEM physical device supports various data link layers – for example Ethernet and PPP – an instance of the TCP-UDP setup object is necessary for each of them.

For more information see the complete Blue Book.

4.9.2 IPv4 setup (class_id = 42, version = 0)

NOTE 1 Compared to earlier editions of the Blue Book, this specification provides improvements in presenting the attributes. As this does not constitute technical changes, the version of the IC remains 0.

This IC allows modelling the setup of the IPv4 layer, handling all information related to the IP Address settings associated to a given device and to a lower layer connection on which these settings are used.

There shall be an instance of this IC in a device for each different network interface implemented. For example, if a device has two interfaces (using the TCP-UDP/IPv4 profile on both of them), there shall be two instances of the IPv4 setup IC in that device: one for each of these interfaces.

For more information see the complete Blue Book.

4.9.3 IPv6 setup (class_id = 48, version = 0)

NOTE 1 See also Annex C.

The IPv6 setup IC allows modelling the setup of the IPv6 layer, handling all information related to the IPv6 address settings associated to a given device and to a lower layer connection on which these settings are used.

There shall be an instance of this IC in a device for each different network interface implemented. For example, if a device has two interfaces (using the UDP/IP and/or TCP/IP profile on both of them), there shall be two instances of the IPv6 setup IC in that device: one for each of these interfaces.

For more information see the complete Blue Book.

4.9.4 MAC address setup (class_id = 43, version = 0)

NOTE 1 The name and the use of this interface class has been changed in Edition 10 of the Blue Book from “Ethernet setup” to “MAC address setup” to allow a more general use, without changing the version.

Instances of this IC hold the MAC address of the physical device (or, more generally, a device or software.) There shall be an instance of this IC for each network interface of a physical device.

NOTE 2 In the case of the three-layer HDLC based communication profile, the MAC address (lower HDLC address) is carried by an IEC HDLC setup object.

NOTE 3 In the case of the S-FSK PLC communication profile, the MAC address is carried by a S-FSK Phy&MAC setup object.

For more information see the complete Blue Book.

4.9.5 PPP setup (class_id = 44, version = 0)

NOTE 1 Compared to earlier editions of the Blue Book, this specification provides improvements in presenting the attributes. As this does not constitute technical changes, the version of the IC remains 0.

This IC allows modelling the setup of interfaces using the PPP protocol, by handling all information related to PPP settings associated to a given physical device and to a lower layer connection on which these settings are used. There shall be an instance of this IC for each network interface of a physical device.

For more information see the complete Blue Book.

4.9.6 SMTP setup (class_id = 46, version = 0)

This IC allows setting up data exchange using the SMTP protocol.

For more information see the complete Blue Book.

4.9.7 NTP setup (class_id = 100, version = 0)

Instances of the “NTP setup” IC allow setting up time synchronisation using the NTP protocol as specified in RFC 5905. One or several instances may be configured to support multiple time servers.

For more information see the complete Blue Book.

4.10 Interface classes for setting up data exchange using S-FSK PLC

4.10.1 General

This subclause specifies COSEM interface classes to set up and manage the protocol layers of DLMS/COSEM S-FSK PLC communication profile:

- the S-FSK Physical layer and the MAC sub-layer as defined in IEC 61334-5-1:2001 and IEC 61334-4-512:2001;
- the LLC sub-layer as specified in IEC 61334-4-32:1996.

The MIB variables / logical link parameters specified in IEC 61334-4-512:2001, IEC 61334-5-1:2001, IEC 61334-4-32:1996 and ISO/IEC 8802-2:1998 respectively have been mapped to attributes and/or methods of COSEM ICs. The specification of these elements has been taken from the above standards and the text has been adapted to the DLMS/COSEM environment.

NOTE IEC 61334-4-512:2001 also specifies some management variables to be used on the Client side. However, the Client side object model is not covered in this document.

For definitions related to S-FSK PLC profile see 3.2.

4.10.2 Overview

COSEM objects for setting up the S-FSK PLC channel and the LLC layer, if implemented, shall be located in the Management Logical Device of COSEM servers.

Figure 27 shows an example with a COSEM physical device comprising three logical devices. Each logical device shall contain a Logical Device Name (LDN) object. Each logical device contains one or more Association objects, one for each client supported.

NOTE As in this example there is more than one logical device, the mandatory Management Logical Device contains a SAP Assignment object instead of a Logical Device Name object.

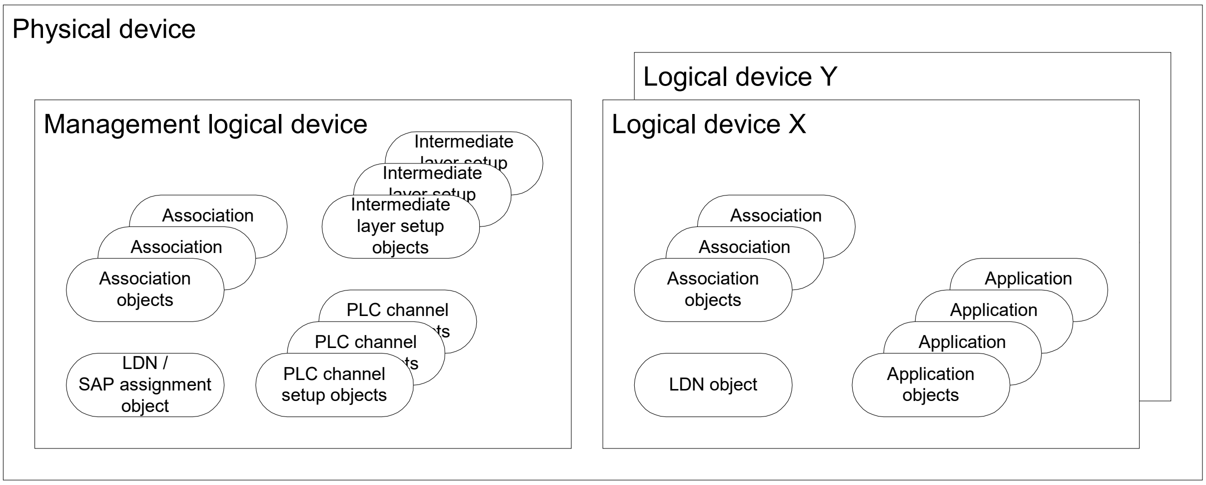


Figure 23 – Object model of DLMS/COSEM servers

The management logical device contains the setup objects of the physical and MAC layers of the PLC channel, as well as setup objects for the intermediate layer(s). It may contain further application objects.

The other logical devices, in addition to the Association and Logical Device Name objects mentioned above, contain further application objects, holding parameters and measurement values.

IEC 61334-4-512:2001 uses DLMS named variables to model the MIB objects and specifies their DLMS name in the range 8…184. For compatibility with existing implementations, the short names 8…400 [sic] are reserved for devices using the IEC 61334-5-1:2001 S-FSK PLC profiles without COSEM. Therefore, when mapping the attributes and methods of the COSEM objects specified in this document to DLMS named variables (SN mapping) this range shall not be used.

Table 23 shows the mapping of MIB variables to attributes and/or methods of COSEM ICs.

Note that on the one hand, not all MIB variables specified in IEC 61334-4-512:2001 have been mapped to attributes and methods of COSEM ICs. On the other hand, some new management variables are specified in this document.

Table 23 – Mapping IEC 61334-4-512:2001 MIB variables to COSEM IC attributes / methods

Name	Reference (unless otherwise indicated)	Interface class	class_id / attribute / method
S-FSK Physical layer management			
delta-electrical-phase	variable 1		50 / Attr. 3

Name	Reference (unless otherwise indicated)	Interface class	class_id / attribute / method
max-receiving-gain	variable 2	S-FSK Phy&MAC set-up (class_id = 50, version = 1)	50 / Attr. 4
max-transmitting-gain	–		50 / Attr. 5
search-initiator-threshold	–		50 / Attr. 6
frequencies	–		50 / Attr. 7
transmission-speed	–		50 / Attr. 15
MAC layer management			
mac-address	variable 3	S-FSK Phy&MAC set-up (class_id = 50, version = 1)	50 / Attr. 8
mac-group-addresses	variable 4		50 / Attr. 9
repeater	variable 5		50 / Attr. 10
repeater-status	–		50 / Attr. 11
search-initiator time-out	–	S-FSK MAC synchronization timeouts (class_id = 52, version = 0)	52 / Attr. 2
synchronization-confirmation-time-out	variable 6		52 / Attr. 3
time-out-not-addressed	variable 7		52 / Attr. 4
time-out-frame-not-OK	variable 8		52 / Attr. 5
min-delta-credit	variable 9	S-FSK Phy&MAC set-up (class_id = 50, version = 1)	50 / Attr. 12
initiator-mac-address	IEC 61334-5-1:2001, 4.3.7.6		50 / Attr. 13
synchronization-locked	variable 10		50 / Attr. 14
IEC 61334-4-32 LLC layer management			
max-frame-length	IEC 61334-4-32:1996,5.1.4	IEC 61334-4-32 LLC setup (class_id = 55, version = 1)	55 / Attr. 2
reply-status-list	variable 11		55 / Attr. 3
broadcast-list	variable 12	–	–
L-SAP-list	variable 13	NOTE In DLMS/COSEM, L-SAPs of logical devices are held by a SAP Assignment object	
ACSE management			
application-context-list	variable 14	NOTE In DLMS/COSEM the Association objects play a similar role.	
Application management			
active-initiator	variable 15	S-FSK Active initiator (class_id = 51, version = 0)	51 / Attr. 2
MIB system objects			
reporting-system-list	variable 16	S-FSK Reporting system list (class_id = 56, version = 0)	56 / Attr. 2
Other MIB objects			
reset-NEW-not-synchronized	variable 17	S-FSK Active initiator (class_id = 51, version = 0)	51 / Method 1
new-synchronization	IEC 61334-5-1:2001, 4.3.7.6	–	
initiator-electrical-phase	variable 18		50 / Attr. 2

Name	Reference (unless otherwise indicated)	Interface class	class_id / attribute / method
broadcast-frames-counter	variable 19	S-FSK MAC counters (class_id = 53, version = 0)	53 / Attr. 4
repetitions-counter	variable 20		53 / Attr. 5
transmissions-counter	variable 21		53 / Attr. 6
CRC-OK-frames-counter	variable 22		53 / Attr. 7
CRC-NOK-frames-counter	–		53 / Attr. 8
synchronization-register	variable 23		53 / Attr. 2
desynchronization-listing	variable 24		53 / Attr. 3

4.10.3 S-FSK Phy&MAC set-up (class_id = 50, version = 1)

NOTE 1 The use of version 0 of this interface class is deprecated.

An instance of the “S-FSK Phy&MAC set-up” class stores the data necessary to set up and manage the physical and the MAC layer of the PLC S-FSK lower layer profile.

For more information see the complete Blue Book.

4.10.4 S-FSK Active initiator (class_id = 51, version = 0)

An instance of the “S-FSK Active initiator” IC stores the data of the active initiator. The active initiator is the client system, which has last registered the server system with a CIASE Register request. See IEC 61334-4-511:2000, 7.2.

For more information see the complete Blue Book.

4.10.5 S-FSK MAC synchronization timeouts (class_id = 52, version = 0)

An instance of the “S-FSK MAC synchronization timeouts” IC stores the timeouts related to the synchronization process.

For more information see the complete Blue Book.

4.10.6 S-FSK MAC counters (class_id = 53, version = 0)

An instance of the “S-FSK MAC counters” IC stores counters related to the frame exchange, transmission and repetition phases.

For more information see the complete Blue Book.

4.10.7 IEC 61334-4-32 LLC setup (class_id = 55, version = 1)

An instance of the “IEC 61334-4-32 LLC setup” IC holds parameters necessary to set up and manage the LLC layer as specified in IEC 61334-4-32.

For more information see the complete Blue Book.

4.10.8 S-FSK Reporting system list (class_id = 56, version = 0)

An instance of the "S-FSK Reporting system list" IC holds the list of reporting systems.

For more information see the complete Blue Book.

4.11 Interface classes for setting up the LLC layer for ISO/IEC 8802-2

4.11.1 General

This subclause specifies the ICs available for setting up the ISO/IEC 8802-2 LLC layer, used in some DLMS/COSEM communication profiles, in the various types of operation.

For definitions related to the ISO/IEEE 8802-2 LLC layer see ISO/IEC 8802-2:1998, 1.4.2.

4.11.2 ISO/IEC 8802-2 LLC Type 1 setup (class_id = 57, version = 0)

An instance of the "ISO/IEC 8802-2 LLC Type 1 setup" IC holds the parameters necessary to set up the ISO/IEC 8802-2 LLC layer in Type 1 operation.

For more information see the complete Blue Book.

4.11.3 ISO/IEC 8802-2 LLC Type 2 setup (class_id = 58, version = 0)

An instance of the "ISO/IEC 8802-2 LLC Type 2 setup" IC holds the parameters necessary to set up the ISO/IEC 8802-2 LLC layer in Type 2 operation.

For more information see the complete Blue Book.

4.11.4 ISO/IEC 8802-2 LLC Type 3 setup (class_id = 59, version = 0)

An instance of the "ISO/IEC 8802-2 LLC Type 3 setup" IC holds the parameters necessary to set up the ISO/IEC 8802-2 LLC layer in Type 3 operation.

For more information see the complete Blue Book.

4.12 Interface classes for setting up and managing DLMS/COSEM narrowband OFDM PLC profile for PRIME networks

4.12.1 Overview

COSEM objects for data exchange using narrowband OFDM PLC profile for PRIME networks, if implemented, shall be located in the Management Logical Device of COSEM servers.

Figure 28 shows an example with a COSEM physical device comprising three logical devices.

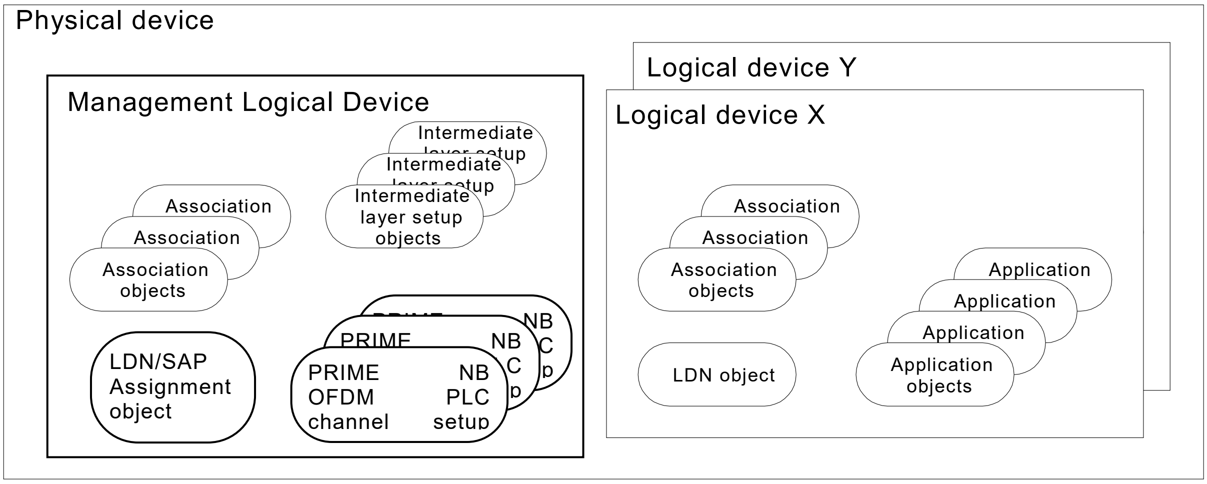


Figure 24 – Object model of DLMS/COSEM servers

Each logical device shall contain a Logical Device Name (LDN) object.

NOTE As in this example there is more than one logical device, the mandatory Management logical device contains a "SAP Assignment" object instead of a Logical Device object.

Each logical device contains one or more "Association" objects, one for each client supported.

The management logical device contains the setup objects of the physical and MAC layers of narrowband OFDM PLC profile for PRIME networks as well as setup objects for the intermediate layer(s). It may contain further application objects.

The other logical devices, in addition to the "Association" and Logical Device Name objects mentioned above, contain further application objects, holding parameters and measurement values.

To set up and manage the 61334-4-32 LLC SSCS, one IC is specified:

- "61334-4-32 LLC SSCS setup", see 4.12.3.

To manage the PRIME NB OFDM PLC physical layer (PhL), one IC is specified:

- "PRIME NB OFDM PLC Physical layer counters", see 4.12.5;

To set up and manage the PLC PRIME OFDM MAC layer, four ICs are specified:

- "PRIME NB OFDM PLC MAC setup": see 4.12.6;
- "PRIME NB OFDM PLC MAC functional parameters": see 4.12.7;
- "PRIME NB OFDM PLC MAC counters": see 4.12.8;
- "PRIME NB OFDM PLC MAC network administration data": see 4.12.9.

For application identification, one IC is specified:

- "PRIME NB OFDM PLC Application identification", see 4.12.11.

4.12.2 Mapping of PRIME NB OFDM PLC PIB attributes to COSEM IC attributes

ITU-T G.9904:2012 defines variables in Table 10-1 and Table 10-2 for PHY PIB attributes, Table 10-3 to Table 10-8 for MAC PIB attributes and Table 10-9 for Applications PIB attributes.

Table 24 shows the mapping of PRIME NB OFDM PLC PIB attributes to attributes of COSEM ICs. Only variables related to the switch and Terminal nodes are mapped. Variables relevant for the base node are not mapped, because the base node acts as a client regarding the distribution network.

Table 24 – Mapping of PRIME NB OFDM PLC PIB attributes to COSEM IC attributes

Name	Identifier	Interface class	class_id / attribute
PHY PIB attributes – PHY read-only variable that provide statistical information [1]			
phyStatsCRCIncorrectCount	0x00A0	PRIME NB OFDM PLC Physical layer counters (class_id = 81, version = 0)	81 / Attr. 2
PhyStatsCRCFailCount	0x00A1		81 / Attr. 3
phyStatsTxDropCount	0x00A2		81 / Attr. 4
phyStatsRxDropCount	0x00A3		81 / Attr. 5
phyStatsRxTotalCount	0x00A4		Not modelled
phyStatsBlkAvgEvm	0x00A5		Not modelled
phyEmaSmoothing	0x00A8		Not modelled

For more information see the complete Blue Book.

4.12.3 61334-4-32 LLC SSCS setup (class_id = 80, version = 0)

An instance of the “61334-4-32 LLC SSCS” (Service Specific Convergence Sublayer, 432 CL) setup IC holds addresses that are provided by the base node during the opening of the convergence layer, as a response to the establish request of the service node. They allow the service node to be part of the network managed by the base node.

For more information see the complete Blue Book.

4.12.4 PRIME NB OFDM PLC Physical layer parameters

The physical layer parameters are not modelled.

4.12.5 PRIME NB OFDM PLC Physical layer counters (class_id = 81, version = 0)

An instance of the “PRIME NB OFDM PLC Physical layer counters” IC stores counters related to the physical layers exchanges. The objective of these counters is to provide statistical information for management purposes.

The attributes of instances of this IC shall be read only. They can be reset using the reset method.

For more information see the complete Blue Book.

4.12.6 PRIME NB OFDM PLC MAC setup (class_id = 82, version = 0)

An instance of the “PRIME NB OFDM PLC MAC setup” IC holds the necessary parameters to set up and manage the PRIME NB OFDM PLC MAC layer.

These attributes influence the functional behaviour of an implementation. These attributes may be defined external to the MAC, typically by the management entity and implementations may allow changes to their values during normal running, i.e. even after the device start-up sequence has been executed.

For more information see the complete Blue Book.

4.12.7 PRIME NB OFDM PLC MAC functional parameters (class_id = 83 version = 0)

The attributes of an instance of the “PRIME NB OFDM PLC MAC functional parameters” IC belong to the functional behaviour of MAC. They provide information on specific aspects.

The attributes of instances of this IC shall be read only.

For more information see the complete Blue Book.

4.12.8 PRIME NB OFDM PLC MAC counters (class_id = 84, version = 0)

An instance of the “PRIME NB OFDM PLC MAC counters” IC stores statistical information on the operation of the MAC layer for management purposes. The attributes of instances of this IC shall be read only. They can be reset using the reset method.

For more information see the complete Blue Book.

4.12.9 PRIME NB OFDM PLC MAC network administration data (class_id = 85, version = 0)

This IC holds the parameters related to the management of the devices connected to the network.

For more information see the complete Blue Book.

4.12.10 PRIME NB OFDM PLC MAC address setup (class_id = 43, version = 0)

An instance of the MAC address setup IC holds the EUI-48 MAC address of the device. The size of this octet string is 6 due to the fact that this address is a EUI-48 and is unique. See also 4.9.4 and 6.2.26.

4.12.11 PRIME NB OFDM PLC Application identification (class_id = 86, version = 0)

An instance of the “PRIME NB OFDM PLC Application identification IC” holds identification information related to administration and maintenance of PRIME NB OFDM PLC devices. They are not communication parameters but allow the device management.

For more information see the complete Blue Book.

4.13 Interface classes for setting up and managing the DLMS/COSEM narrowband OFDM PLC profile for G3-PLC networks

4.13.1 Overview

This subclause 4.13 specifies interface classes for setting up and managing the MAC and 6LoWPAN Adaptation layers of the DLMS/COSEM G3-PLC profile, based ITU-T G.9903:2017.

NOTE 1 ITU-T G.9903:2013 was supported using the version 0 of these interface classes which are retained in the full Blue Book.

NOTE 2 ITU-T G.9903:2014 was supported using version 1 of the G3-PLC MAC layer counters in section 4.13.3, version 1 of the G3-PLC MAC setup which is retained in the full Blue Book, and G3-PLC 6LoWPAN adaptation layer setup version 1 which is retained in the full Blue Book.

For this purpose, the elements of the PAN Information Base (PIB) have been mapped to attributes of COSEM ICs.

COSEM objects for data exchange using G3-PLC, if implemented, shall be located in the Management Logical Device of COSEM servers.

To set up and manage the DLMS/COSEM G3-PLC profile layers (including PHY, IEEE 802.15.4 MAC and 6LoWPAN), three ICs are specified:

- "G3-PLC MAC layer counters", see 4.13.3;
- "G3-PLC MAC setup", see 4.13.4;
- "G3-PLC 6LoWPAN adaptation layer setup", see 4.13.5.

An instance of the existing COSEM interface class "MAC address" (class_id = 43, version = 0) is needed to indicate the EUI-48 MAC address of the G3-PLC modem (corresponding to aExtendedAddress constant in IEEE 802.15.4).

IPv6 configuration is provided by an instance of "IPv6 setup" class.

NOTE 3 The PHY layer of ITU-T G.9903:2014 is out of scope of the G3-PLC setup ICs.

4.13.2 Mapping of G3-PLC IB attributes to COSEM IC attributes

In terms of IEEE 802.15.4, a meter is a Reduced Function Device (RFD) while a concentrator / Neighbourhood Network Access Point (NNAP) is a Full Function Device (FFD) / PAN coordinator. In terms of DLMS/COSEM the meter is the server and the concentrator / NNAP is the client (or an agent for a client).

As COSEM models only the server and not the client, the G3-PLC setup classes concern only the RFD (Reduced Function Device) and not the PAN coordinator.

For more information see the complete Blue Book.

4.13.3 G3-PLC MAC layer counters (class_id = 90, version = 1)

An instance of the "G3-PLC MAC layer counters" IC stores counters related to the MAC layer exchanges. The objective of these counters is to provide statistical information for management purposes.

The attributes of instances of this IC shall be read only. They can be reset using the reset method.

For more information see the complete Blue Book.

4.13.4 G3-PLC MAC setup (class_id = 91, version = 2)

An instance of the “G3-PLC MAC setup” IC holds the necessary parameters to set up and manage the G3-PLC IEEE 802.15.4 MAC sub-layer.

These attributes influence the functional behaviour of an implementation. Implementations may allow changes to the attributes during normal running, i.e. even after the device start-up sequence has been executed.

G3-PLC MAC setup		0...n	class_id = 91, version = 2			
Attributes		***Data type***	***Min.***	***Max.***	***Def.***	**Short name**
1. logical_name	(static)	octet-string				X
2. mac_short_address	(dyn.)	long-unsigned	0x0000	0xFFFF	0xFFFF	x + 0x08
3. mac_RC_coord	(dyn.)	long-unsigned	0x0000	0xFFFF	0xFFFF	x + 0x10
4. mac_PAN_id	(dyn.)	long-unsigned	0x0000	0xFFFF	0xFFFF	x + 0x18
5. mac_key_table	(dyn.)	array			Empty	x + 0x20
6. mac_frame_counter	(dyn.)	double-long-unsigned	0	4 294 967 295	0	x + 0x28
7. mac_tone_mask	(static)	bit-string			'FFFFFFFFF0 00000000'H for CENELEC-A bandplan; 'FFFFFFFFFF FFFFFFFF'H for FCC bandplan	x + 0x30
8. mac_TMR_TTL	(static)	unsigned	0	255	10	x + 0x38
9. mac_max_frame_retries	(static)	unsigned	0	10	5	x + 0x40
10. mac_POS_table_entry_TTL	(static)	unsigned	0	255	255	x + 0x48
11. mac_neighbour_table	(dyn.)	array				x + 0x50
12. mac_high_priority_window_size	(static)	unsigned	1	7	7	x + 0x58
13. mac_CSMA_fairness_limit	(static)	unsigned	See below	255	25	x + 0x60
14. mac_beacon_randomization _window_length	(static)	unsigned	1	254	12	x + 0x68
15. mac_A	(static)	unsigned	3	20	8	x + 0x70
16. mac_K	(static)	unsigned	1	See below	5	x + 0x78
17. mac_min_CW_attempts	(static)	unsigned	0	255	10	x + 0x80
18. mac_cenelec_legacy_mode	(static)	unsigned	0	255	1	x + 0x88
19. mac_FCC_legacy_mode	(static)	unsigned	0	255	1	x + 0x90
20. mac_max_BE	(static)	unsigned	0	20	8	x + 0x98
21. mac_max_CSMA_backoff	(static)	unsigned	0	255	50	x + 0xA0
22. mac_min_BE	(static)	unsigned	0	20	3	x + 0xA8
23. mac_broadcast_max_CW _enabled	(static)	boolean			FALSE	x + 0xB0
24. mac_transmit_atten	(static)	unsigned	0	25	0	x + 0xB8
25. mac_POS_table	(dyn)	array				x + 0xC0
Specific methods		***m/o***				
1. mac_get_neighbour_table _entry(data)		O				x + 0xE0

For more information see the complete Blue Book.

4.13.5 G3-PLC 6LoWPAN adaptation layer setup (class_id = 92, version = 2)

An instance of the "G3-PLC 6LoWPAN adaptation layer setup" IC holds the necessary parameters to set up and manage the G3-PLC 6LoWPAN Adaptation layer.

These attributes influence the functional behaviour of an implementation. Implementations may allow changes to their values during normal running, i.e. even after the device start-up sequence has been executed.

G3-PLC 6LoWPAN adaptation layer setup		0...n	class_id = 92, version = 2			
Attribute (s)		***Data type***	***Min.***	***Max.***	***Def.***	**Short name**
1. logical_name	(static)	octet-string				x
2. adp_max_hops	(static)	unsigned	1	14	8	x + 0x08
3. adp_weak_LQI_value	(static)	unsigned	0	255	52	x + 0x10
4. adp_security_level	(static)	unsigned	0	5	5	x + 0x18
5. adp_prefix_table	(dyn)	array				x + 0x20
6. adp_routing_configuration	(static)	array				x + 0x28
7. adp_broadcast_log_table _entry_TTL	(static)	long- unsigned	0	65535	2	x + 0x30
8. adp_routing_table	(dyn)	array				x + 0x38
9. adp_context_information _table	(dyn)	array				x + 0x40
10. adp_blacklist_table	(dyn)	array				x + 0x48
11. adp_broadcast_log_table	(dyn)	array				x + 0x50
12. adp_group_table	(dyn)	array				x + 0x58
13. adp_max_join_wait_time	(static)	long- unsigned	0	1023	20	x + 0x60
14. adp_path_discovery_time	(static)	unsigned	0	255	40	x + 0x68
15. adp_active_key_index	(static)	unsigned	0	1	0	x + 0x70
16. adp_metric_type	(static)	unsigned	0x00	0x0F	0x0F	x + 0x78
17. adp_coord_short_address	(static)	long- unsigned	0x0000	0x7FFF	0x0000	x + 0x80
18. adp_disable_default_routing	(static)	boolean			FALSE	x + 0x88
19. adp_device_type	(static)	enum	0	2	2	x + 0x90
20. adp_default_coord_route _enabled	(static)	boolean			FALSE	x + 0x98
21. adp_destination_address _set	(dyn)	array				x + 0xA0
Specific methods		***m/o***				

For more information see the complete Blue Book.

4.14 Interface classes for setting up and managing DLMS/COSEM HS-PLC ISO/IEC 12139-1 neighbourhood networks

4.14.1 Overview

COSEM objects for data exchange using DLMS/COSEM HS-PLC ISO/IEC 12139-1 neighbourhood networks, if implemented, shall be located in the Management Logical Device of COSEM servers.

For setting up and managing DLMS/COSEM HS-PLC ISO/IEC 12139-1 neighbourhood networks the following ICs are specified:

- HS-PLC ISO/IEC 12139-1 MAC setup, see 4.14.2;
- HS-PLC ISO/IEC 12139-1 CPAS setup, see 4.14.3;
- HS-PLC ISO/IEC 12139-1 IP SSAS setup, see 4.14.4;
- HS-PLC ISO/IEC 12139-1 HDLC SSAS setup, see 4.14.5.

4.14.2 HS-PLC ISO/IEC 12139-1 MAC setup (class_id = 140, version = 0)

Instances of the "HS-PLC ISO/IEC 12139-1 MAC setup" IC hold parameters necessary to set up and manage the MAC layer of the HS-PLC ISO/IEC 12139-1 profile.

For more information see the complete Blue Book.

4.14.3 HS-PLC ISO/IEC 12139-1 CPAS setup (class_id = 141, version = 0)

Instances of the "HS-PLC ISO/IEC 12139-1 CPAS setup" IC hold parameters necessary to set up and manage the CPAS layer of the HS-PLC ISO/IEC 12139-1 profile.

For more information see the complete Blue Book.

4.14.4 HS-PLC ISO/IEC 12139-1 IP SSAS setup (class_id = 142, version = 0)

Instances of the "HS-PLC ISO/IEC 12139-1 IP SSAS setup" IC hold parameters necessary to set up and manage the IP SSAS of the HS-PLC ISO/IEC 12139-1 profile.

For more information see the complete Blue Book.

4.14.5 HS-PLC ISO/IEC 12139-1 HDLC SSAS setup (class_id = 143, version = 0)

Instances of the "HS-PLC ISO/IEC 12139-1 HDLC SSAS setup" IC hold parameters necessary to set up and manage the HDLC SSAS of the HS-PLC ISO/IEC 12139-1 profile.

For more information see the complete Blue Book.

4.15 ZigBee® setup classes

4.15.1 Overview

This subclause specifies COSEM interface classes required for the external configuration and management of a ZigBee® network to allow interfacing with a multi-part installation that internally uses ZigBee® communications. ZigBee® is a low-power radio communications technology and open standard that is operated by the ZigBee® Alliance, see www.zigbee.org.

ZigBee® is a registered trademark of the ZigBee® Alliance.

NOTE 1 A multi-part installation is one where the meter provides information and/or services to the householder on behalf of the utility. For example, the meter interacts with an in home display, and/or an external load control switch, and/or a smart appliance, to inform the customer of their usage in real time, to control heating devices, and possibly to disconnect peak loads when supply is constrained. While it is possible that the consumer will control the ZigBee® network, in normal operations the utility will control the radio system. This is to ensure that security is maintained for PAN, so that ZigBee® devices such as load switches controlled by the utility operate in a secure manner.

ZigBee® defines a local network of devices linked by radio, with routing and forwarding of messages and with encryption for privacy at network-level.

NOTE 2 Such a local network is known as a PAN – a Personal Area Network. This name is used in the ZigBee® community as ZigBee® is underpinned by the IEEE 802.15.4 standard, which uses the term PAN. This is broadly equivalent to a HAN (Home Area Network – name used in the context of smart metering in the UK) or PAN.

Each PAN has one device designated as ZigBee® coordinator, which has responsibility for creating and managing the network, and which normally acts also as a ZigBee® Trust Center for the management of ZigBee® network, PCLK's and APS Link keys.

There is a process of PAN creation (and corresponding destruction) which is performed by the coordinator; this declares the existence of the network without any devices apart from the coordinator forming part of it. Other ZigBee® devices can join a network created with cooperation of the coordinator, and equally can choose to leave, or can be invited to leave by the coordinator (this is not currently enforceable). Normally devices are members of the network indefinitely; they do not repeatedly join and leave. To create a PAN the coordinator has to receive an external trigger and needs to have setup information including:

- extended PAN ID;
- link keys or install code (for initial communication with new devices);
- radio channel information.

During the process of creating the PAN, the coordinator scans for nearby radio devices, "exchanges" keys, chooses the short addresses, and confirms use of radio channels. Details of the information available from the ZigBee® servers on each device are also exchanged.

NOTE 3 Full details of the joining process are documented in ZigBee® 053474, the ZigBee® specification. More information on ZigBee® technology can be sought at http://www.zigbee.org/.

Figure 29 shows an example architecture with a Comms hub on the left, that comprises a DLMS/COSEM server as well as the ZigBee® coordinator. The DLMS/COSEM server has interface objects needed to set up and control the ZigBee® network and may have other COSEM objects to support a metering application. Further, there are two native ZigBee® devices and another DLMS/COSEM server – an electricity meter or another meter type – on the right which is also a "normal" ZigBee® network device.

Any ZigBee® device can be "joined" to the network by remote control.

It is assumed that the Comms hub will also have a further network connection to the WAN, and it is assumed that this is managed by existing DLMS structures – e.g. PSTN, GSM/3G, PLC etc. – but this is out of scope of this document.

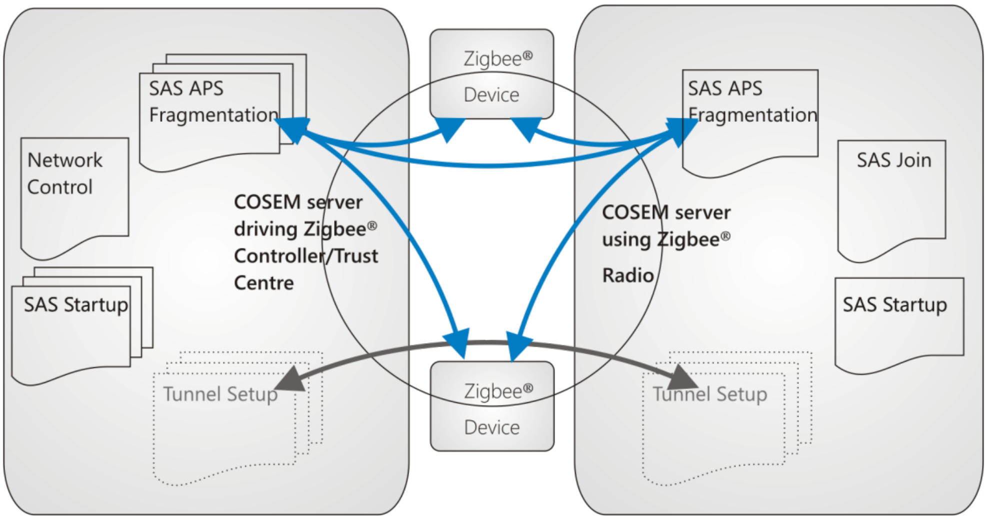


Figure 25 – Example of a ZigBee® network

The role of COSEM interface objects in the process of creating / destructing the PAN is to set up ZigBee® parameters and allow a DLMS/COSEM client to trigger actions, typically when commissioning the installation, in a system where WAN communications between a central system and a smart meter installation is by means of DLMS.

Operation of the ZigBee® network is not the responsibility of DLMS/COSEM. The DLMS/COSEM server is merely the vehicle for controlling the ZigBee® network by an external manager (DLMS/COSEM Client).

The use of ZigBee® setup classes in the ZigBee® coordinator and other DLMS/COSEM ZigBee® devices is shown in Table 25.

Table 25 – Use of ZigBee® setup COSEM interface classes

ZigBee® coordinator	Other DLMS/COSEM ZigBee® devices	Reference
ZigBee® SAS startup	ZigBee® SAS startup	4.15.2
–	ZigBee® SAS join	4.15.3
ZigBee® SAS APS fragmentation	ZigBee® SAS APS fragmentation	4.15.4
ZigBee® network control	–	4.15.5
Optionally: ZigBee® tunnel setup	Optionally: ZigBee® tunnel setup	4.15.6

This set of COSEM ICs supports the ZigBee® 2007 and ZigBee® PRO protocol stacks. The ZigBee® IP protocol stack is not supported at this time.

NOTE 4 In the specification of the ZigBee® COSEM ICs, the length of the octet-strings is indicated for information.

4.15.2 ZigBee® SAS startup (class_id = 101, version = 0)

Instances of this IC are used to configure a ZigBee® PRO device with information necessary to create or join the network. The functionality that is driven by this object and the effect on the network depends on whether the object is located in a ZigBee® coordinator or in another ZigBee® device.

For more information see the complete Blue Book.

4.15.3 ZigBee® SAS join (class_id = 102, version = 0)

Instances of this IC configure the behaviour of a ZigBee® PRO device on joining or loss of connection to the network. “ZigBee® SAS join” objects are present in all devices where a DLMS/COSEM server controls the ZigBee® Radio behaviour, but it is not used when a device is acting as coordinator (as the coordinator device creates rather than joins a network). “ZigBee® SAS join” objects can be factory configured, or configured using another communications technique – e.g. an optical port.

For more information see the complete Blue Book.

4.15.4 ZigBee® SAS APS fragmentation (class_id = 103, version = 0)

Instances of this IC configure the fragmentation feature of ZigBee® PRO transport layer. This fragmentation is not of concern to COSEM; the object merely allows configuration of the fragmentation function by an external manager (DLMS/COSEM client).

Instances of this IC are present in all devices where a DLMS/COSEM server controls the ZigBee® Radio behaviour.

For more information see the complete Blue Book.

4.15.5 ZigBee® network control (class_id = 104, version = 0)

There will be a single instance of the “ZigBee® network control” IC in any device that can act as a ZigBee® coordinator controlled by the DLMS/COSEM client. This class allows interaction between a DLMS/COSEM client (head-end system) and a ZigBee® coordinator at times such as when the installation is commissioned.

For more information see the complete Blue Book.

4.15.6 ZigBee® tunnel setup (class_id = 105, version = 0)

A ZigBee® tunnel is established between two ZigBee® PRO devices to allow DLMS APDUs to be transferred between them. The tunnel in effect extends WAN connectivity to ZigBee® devices not connected to the WAN through a ZigBee® device connected to the same ZigBee® network and connected to the WAN.

The ZigBee® tunnel setup objects would be present on the coordinator and on all other DLMS/COSEM devices that are not connected to the WAN.

Creation of the tunnel is managed on demand and invisibly from the point of view of the DLMS/COSEM client. The target device is implicitly identified by the COSEM addressing information.

For more information see the complete Blue Book.

5 Maintenance of the interface classes

5.1 General

5.1.1 New versions of interface classes

Any modification of an existing IC affecting the transmission of service requests or responses results in a new version (version ::= version+1) and shall be documented accordingly.

NOTE Previous versions of this Technical Report had additional text that applied a rule on the re-use and modification of attribute and method enumerators. This rule is no longer required as it placed an unnecessary constraint on interface classes with large numbers of attributes and/or methods.

Any modification of ICs will be recorded by moving the old version of an IC into the relevant clause below.

5.1.2 New interface classes

The DLMS UA reserves the right to be the exclusive administrator of interface classes.

5.1.3 Removal of interface classes

Besides one association object and the logical device name object no instantiation of an IC is mandatory within a meter. Therefore, even unused ICs will not be removed from the standard. They will be kept to ensure compatibility with possibly existing implementations.

5.2 Previous versions of interface classes – general

The subsequent subclauses list those IC specifications which were included in previous editions of this document. The previous IC versions differ from the current versions by at least one attribute and/or method and by the version number.

For new implementations in metering devices, only the current versions should be used.

Communication drivers at the client side should also support previous versions.

For more information see the complete Blue Book.

6 Relation to OBIS

6.1 General

This Clause 6 specifies the use of COSEM interface objects to model various data items.

It also specifies the logical names of the objects. The naming system is based on OBIS, the Object Identification System: each logical name is an OBIS code.

The following rules for object instantiations are applicable with interface classes:

- if the use of IC "Data" is specified but it is not available in a given implementation, "Register" or "Extended register" (with scaler = 0, unit = 255) may be used;
- when, instead of a "Data" object, a "Register" or "Extended register" object is used, then the data types allowed for the value attribute of the "Data" IC are allowed.

OBIS codes are specified in the following subclauses:

- 6.2 specifies the use and the logical names of abstract COSEM objects, i.e. objects not related to an energy type;
- 6.3 specifies the use and logical names for electricity related COSEM objects;
- 6.4 specifies the use and logical names for heat cost allocator (HCA) related COSEM objects;
- 6.5 specifies the use and logical names for thermal energy related COSEM objects;
- 6.6 specifies the use and logical names for gas related COSEM objects;
- 6.7 specifies the use and logical names for water related COSEM objects;

  NOTE The use and the logical names of COSEM objects related to other media / energy types are under consideration.
- the detailed OBIS code allocations – for all media / energy types – are specified in Clause 7.

Unless otherwise specified the use of value group B shall be:

- if just one object is instantiated, the value in value group B shall be 0;
- if more than one object is instantiated in the same physical device, the value group B shall number the measurement or communication channels as appropriate, from 1…64. This is indicated by the letter "*b*".

Unless otherwise specified the use of value group E shall be:

- if just one object is instantiated, value in value group E shall be 0;
- if more than one object is instantiated in the same physical device, the value group E shall number the instantiations from zero to the maximum value needed. This is indicated by the letter "*e*". For the values allocated, see Clause 7.

All codes, which are not explicitly listed, but which are outside the manufacturer, utility or consortia specific ranges are reserved for future use.

6.2 Abstract COSEM objects

6.2.1 Use of value group C

Table 26 shows the use of value group C for abstract objects in the COSEM context. See also Table 42.

Table 26 – Use of value group C for abstract objects in the COSEM context

Value group C Abstract objects (A = 0)	
0	General purpose COSEM objects
1	Instances of IC "Clock"
2	Instances of IC “Modem configuration” and related IC-s
10	Instances of IC "Script table"
11	Instances of IC "Special days table"
12	Instances of IC "Schedule"
13	Instances of IC "Activity calendar"
14	Instances of IC “Register activation”
15	Instances of IC "Single action schedule"
16	Instances of IC “Register monitor”, “Parameter monitor”
17	Instances of IC “Limiter”
18	Instances of IC “Array manager”
19	COSEM objects related to payment metering: “Account”, “Credit”, “Charge”, “Token gateway”
20	Instances of IC "IEC local port setup"
21	Standard readout definitions
22	Instances of IC “IEC HDLC setup”
23	Instances of IC "IEC twisted pair (1) setup"
24	COSEM objects related to M-Bus
25	Instances of IC “TCP-UDP setup”, “IPv4 setup”, “IPv6 setup”, “MAC address setup”, “PPP setup”, “GPRS modem setup”, “SMTP setup”, “GSM diagnostic”, “FTP setup”, “NTP setup”, “LTE monitoring” Instances of “Push setup”,
26	COSEM objects for data exchange using S-FSK PLC networks
27	COSEM objects for ISO/IEC 8802-2 LLC layer setup
28	COSEM objects for data exchange using narrow-band OFDM PLC for PRIME networks
29	COSEM objects for data exchange using narrow-band OFDM PLC for G3-PLC networks
30	COSEM objects for data exchange using ZigBee®
31	Instances of IC “Wireless Mode Q” (M-Bus)
33	COSEM objects for data exchange using HS-PLC ISO/IEC 12139-1 networks
40	Instances of IC “Association SN/LN”
41	Instances of IC “SAP assignment”
42	COSEM logical device name

Value group C Abstract objects (A = 0)	
43	COSEM objects related to security: Instances of IC "Security setup" and "Data protection"
44	Instances of IC "Image transfer", "Function control" and "Communication port protection" objects
65	Instances of IC "Utility tables"
66	Instances of "Compact data"
128...199	Manufacturer specific COSEM related abstract objects
All other	Reserved

6.2.2 Data of historical billing periods

COSEM provides three mechanisms to represent values of historical billing periods. These may be applicable to abstract and media specific objects.

The mechanisms are shown in Figure 26 and are described below:

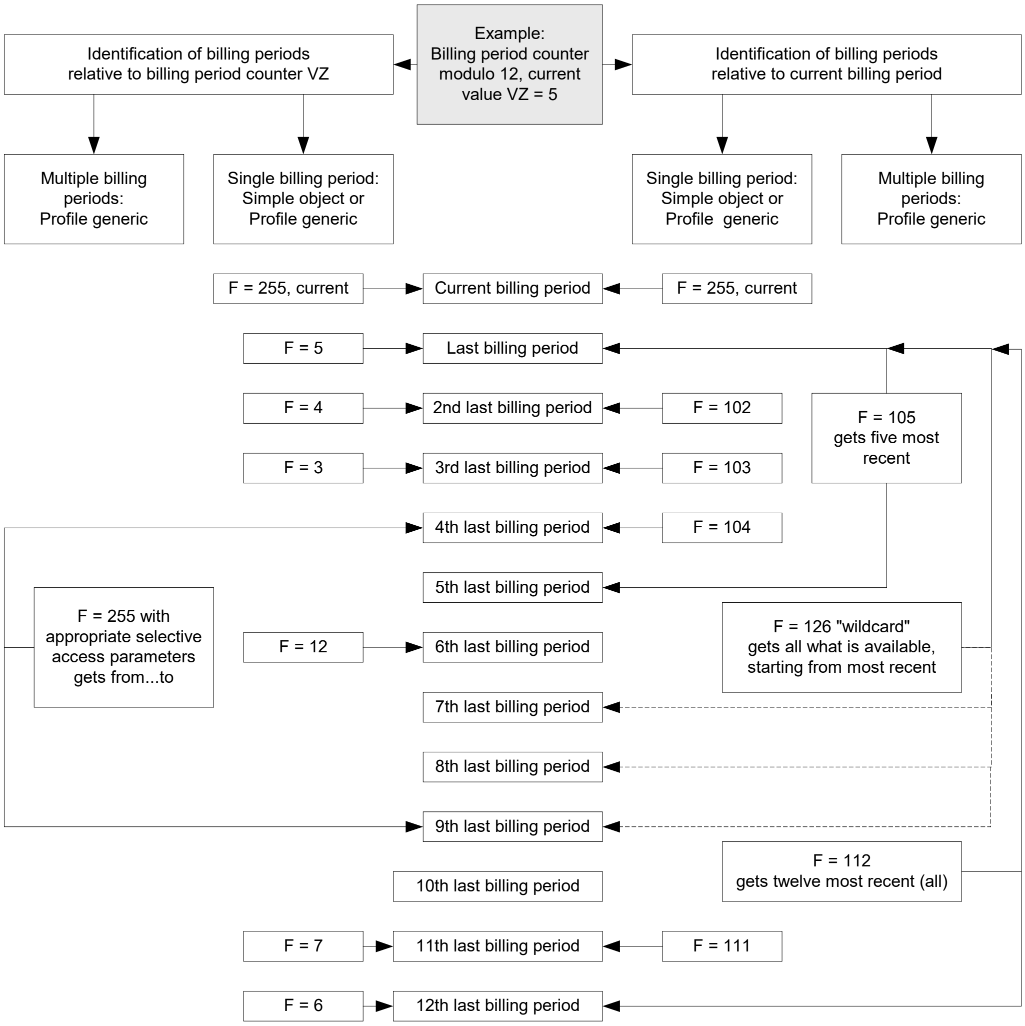


Figure 26 – Data of historical billing periods – example with module 12, VZ = 5

- a value of a single historical billing period may be represented using the same IC as used for representing the value of the current billing period. With F = 0…99, the billing period is identified by the value of the billing period counter VZ. F = VZ identifies the youngest value, F = VZ-1 identifies the second youngest value etc. F = 101…125 identifies the last, second last …25th last billing period. (F = 255 identifies the current billing period). Simple objects can only be used to represent values of historical billing periods, if “Profile generic” objects are not implemented;
- a value of a single historical billing period may also be represented by “Profile generic” objects, which are one entry deep, and contain the historical value itself and the time stamp of the storage. With F = 0…99, the billing period is identified by the value of the billing period counter VZ. F = VZ identifies the youngest value, F = VZ-1 identifies the second youngest value etc. F=101 identifies the most recent billing period;
- values of multiple historical billing periods are represented with “Profile generic” objects, with suitable controlling attributes. With F = 102…125 the two last, …25 last values can be reached. F = 126 identifies an unspecified number of historical values;
- when values of historical billing periods are represented by “Profile generic” objects, more than one billing periods schemes may be used. The billing period scheme is identified by the billing period counter object captured in the profile.

6.2.3 Billing period values / reset counter entries

These values are represented by instances of the IC "Data”.

For billing period / reset counters and for number of available billing periods the data type shall be *unsigned*, *long-unsigned* or *double-long-unsigned*. For time stamps of billing periods, the data type shall be *double-long-unsigned* (in the case of UNIX time), *octet-string* or *date-time* formatted as specified in 4.1.6.1.

These objects may be related to energy type – see also 6.3.3 and 6.4.3 – and channels.

When the values of historical periods are represented by “Profile generic” objects, the time stamp of the billing period objects shall be part of the captured objects.

Billing period values / reset counter entries	**IC**	**OBIS code**					
		A	**B**	**C**	**D**	**E**	**F**
For item names and OBIS codes see Table 56.	1, Data	0	*b*	0	1	*e*	255

6.2.4 Other abstract general purpose OBIS codes

Program entries shall be represented by instances of the IC "Data" with data type *unsigned, long-unsigned* or *octet-string*.

For identifying the firmware the following objects are available:

- Active firmware identifier objects hold the identifier of the currently active firmware;
- Active firmware version objects hold the version of the currently active firmware;

NOTE *Firmware version* can be used to distinguish between different releases of a firmware identified by the same *Firmware identifier*.

- Active firmware signature objects hold the digital signature of the currently active firmware. The digital signature algorithm is not specified here.

These three elements are inextricably linked to the currently active firmware.

Firmware identifiers may be also energy type and channel related.

Time entry values shall be represented by instances of IC “Data”, “Register” or “Extended register” with the data type of the value attribute octet-string, formatted as *date-time* in 4.1.6.1.

For detailed OBIS codes, see Table 56.

Abstract general purpose OBIS codes	**IC**	**OBIS code**					
		A	**B**	**C**	**D**	**E**	**F**
Program entries	1, Data	0	*b*	0	2	*e*	255
Time entries	1, Data	0	*b*	0	9	*e*	255

6.2.5 Clock objects (class_id = 8)

Instances of the IC “Clock” – see 4.5.1 – control the system clock of the physical device.

“UNIX clock” objects are instances of the Interface class “Data”, with data type *double-long-unsigned*. They hold the number of seconds since 1970-01-01 00:00:00.

“High resolution clock” objects are instances of the Interface class “Data”, with data type *long64-unsigned*. They hold the number of microseconds since 1970-01-01 00:00:00.

Clock objects	**IC**	**OBIS code**					
		A	**B**	**C**	**D**	**E**	**F**
Clock	8, Clock	0	*b*	1	0	*e*	255
UNIX clock	1, Data	0	*b*	1	1	*e*	255
High resolution clock	1, Data	0	*b*	1	2	*e*	255

6.2.6 Modem configuration and related objects

In this group, the following objects are available:

- Instances of the IC “Modem configuration” – see 4.7.4 – define and control the behaviour of the device regarding the communication through a modem;
- Instances of the IC “Auto connect” – see 4.7.6 – define the necessary parameters for the management of sending information from the metering device to one or more destinations and for connection to the network;
- Instances of the IC “Auto answer" – see 4.7.5 – define and control the behaviour of the device regarding the auto answering function using a modem and handling wake-up calls and messages.

Modem configuration and related objects	**IC**	**OBIS code**					
		A	**B**	**C**	**D**	**E**	**F**
Modem configuration	27, Modem configuration	0	*b*	2	0	0	255
Auto connect	29, Auto connect	0	*b*	2	1	0	255
Auto answer	28, Auto answer	0	*b*	2	2	0	255

6.2.7 Script table objects (class_id = 9)

Instances of the IC “Script table” – see 4.5.2 – control the behaviour of the device.

Several instances are predefined and normally available as hidden scripts only with access to the *execute* () method. The following table contains only the identifiers for the "standard" instances of the listed scripts. Implementation specific instances of these scripts should use values different from zero in value group D.

- *MDI reset / End of billing period* "Script table" objects define the actions to be performed at the end of the billing period, for example the reset of maximum demand indicator registers and archiving data. If there are several billing period schemes available, then there shall be one script present in the array of scripts for each billing period scheme;
- *Tariffication* "Script table" objects define the entry point into tariffication by standardizing utility-wide how to invoke the activation of certain tariff conditions;
- *Disconnect control* "Script table" objects hold the scripts to invoke the methods of "Disconnect control" objects;
- *Image activation* "Script table" objects are is used to locally activate an Image transferred to the server, at the date and time held by an Image activation "Single action schedule" object;
- *Push* "Script table" objects hold scripts to activate the push operation. Normally every entry in the array of scripts calls the push method of one "Push setup" object instance;
- *Load profile control* "Script table" allow to change attributes of "Profile generic" objects e.g. to change the capture period and thus allow extended time control;
- *M-Bus profile control* "Script table" allow to change attributes of M-Bus related "Profile generic" objects e.g. to change the capture period and thus allow extended time control;
- *Function control* "Script table" objects allow making changes to "Function control" objects;
- *Broadcast* "Script table" objects allow standardising utility wide the entry point into regularly needed functionality.

Script table objects	**IC**	**OBIS code**					
		A	**B**	**C**	**D**	**E**	**F**
Global meter reset [a] Script table	9, Script table	0	*b*	10	0	0	255
MDI reset / End of billing period [a] Script table		0	*b*	10	0	1	255
Tariffication Script table		0	*b*	10	0	100	255
Activate test mode [a] Script table		0	*b*	10	0	101	255
Activate normal mode [a] Script table		0	*b*	10	0	102	255
Set output signals Script table		0	*b*	10	0	103	255
Switch optical test output [b, c] Script table		0	*b*	10	0	104	255
Power quality measurement management Script table		0	*b*	10	0	105	255
Disconnect control Script table		0	*b*	10	0	106	255
Image activation Script table		0	*b*	10	0	107	255
Push Script table		0	*b*	10	0	108	255
Load profile control Script table		0	*b*	10	0	109	255
M-Bus profile control Script table		0	*b*	10	0	110	255
Function control Script table		0	*b*	10	0	111	255
Broadcast Script table		0	*b*	10	0	125	255

[a] The activation of these scripts is performed by calling the execute() method to the script identifier 1 of the corresponding script object.

[b] The optical test output is switched to measuring quantity Y and the test mode is activated by calling the execute method of the script table object 0.x.10.0.104.255 using Y as parameter; where Y is given by Clause 7.5.1, Table 50. The default value of A is 1 (Electricity).

EXAMPLE In the case of electricity meters, A = 1, default, execute (21) switches the test output to display the active power + of phase 1.

[c] The optical test output is also switched back to its default value when this script is activated.

6.2.8 Special days table objects (class_id = 11)

Instances of the IC "Special days table" – see 4.5.4 – define and control the behaviour of the device regarding calendar functions on special days for clock control.

Special days table objects	IC	OBIS code					
		A	B	C	D	E	F
Special days table	11, Special days table	0	*b*	11	0	*e*	255

6.2.9 Schedule objects (class_id = 10)

Instances of the IC "Schedule" – see 4.5.3 – define and control the behaviour of the device in a sequenced way.

Schedule objects	IC	OBIS code					
		A	B	C	D	E	F
Schedule	10, Schedule	0	*b*	12	0	*e*	255

6.2.10 Activity calendar objects (class_id = 20)

Instances of the IC "Activity calendar" – see 4.5.5 – define and control the behaviour of the device in a calendar-based way.

Activity calendar objects	IC	OBIS code					
		A	B	C	D	E	F
Activity calendar	20, Activity calendar	0	*b*	13	0	*e*	255

6.2.11 Register activation objects (class_id = 6)

Instances of the IC "Register activation"– see 4.3.5 – are used to handle different tariffication structures.

Register activation objects	IC	OBIS code					
		A	B	C	D	E	F
Register activation	6, Register activation	0	*b*	14	0	*e*	255

6.2.12 Single action schedule objects (class_id = 22)

Instances of the IC "Single action schedule" – see 4.5.7 – control the behaviour of the device. Implementation specific instances should use values different from zero in value group D.

Instances of Push “Single action schedule” objects activate scripts in Push “Script table” objects, which invoke the push method of the appropriate “Push setup” objects.

Load profile control “Single action schedule” objects activate scripts in Load profile control “Script table” objects and thus allow extended time control.

M-Bus profile control “Single action schedule” objects activate scripts in M-Bus profile control “Script table” objects and thus allow extended time control.

Function control “Single action schedule” objects activate scripts in Function control “Script table” objects.

Single action schedule objects	**IC**	**OBIS code**					
		A	**B**	**C**	**D**	**E**	**F**
End of billing period Single action schedule	22, Single action schedule	0	*b*	15	0	0	255
Disconnect control Single action schedule		0	*b*	15	0	1	255
Image activation Single action schedule		0	*b*	15	0	2	255
Output control Single action schedule		0	*b*	15	0	3	255
Push Single action schedule		0	*b*	15	0	4	255
Load profile control Single action schedule		0	*b*	15	0	5	255
M-Bus profile control Single action schedule		0	*b*	15	0	6	255
Function control Single action schedule		0	*b*	15	0	7	255

6.2.13 Register monitor and alarm monitor objects (class_id = 21)

Instances of the IC “Register monitor” – see 4.5.6 – control the register monitoring and alarm monitoring function of the device. They define the value to be monitored, the set of thresholds to which the value is compared, and the actions to be performed when a threshold is crossed.

In general, the logical name(s) shown in the table below shall be used. See also 6.3.9 and 6.3.10.

Alarm monitor objects monitor *Alarm register* or *Alarm descriptor* objects.

Register monitor objects	**IC**	**OBIS code**					
		A	**B**	**C**	**D**	**E**	**F**
Register monitor	21, Register monitor	0	*b*	16	0	*e*	255
Alarm monitor		0	*b*	16	1	0…9	255

6.2.14 Parameter monitor objects (class_id = 65)

Instances of the IC “Parameter monitor” – see 4.5.10 – control the Parameter monitoring function of the device. They define the list of parameters to be monitored and hold the identifier and the value of the last parameter changed, as well as the *capture_time*.

Parameter monitor objects	**IC**	**OBIS code**					
		A	**B**	**C**	**D**	**E**	**F**
Parameter monitor	65, Parameter monitor	0	*b*	16	2	*e*	255

6.2.15 Limiter objects (class_id = 71)

Instances of the IC "Limiter" handle the monitoring of values in normal and emergency conditions. See also 4.5.9.

Limiter objects	IC	OBIS code					
		A	B	C	D	E	F
Limiter	71, Limiter	0	*b*	17	0	*e*	255

6.2.16 Array manager objects (class_id = 123)

Instances of the IC "Array manager" – see 4.4.11 – allow managing COSEM interface object attributes of type *array*.

Array manager objects	IC	OBIS code					
		A	B	C	D	E	F
Array manager	123	0	*b*	18	0	*e*	255

6.2.17 Payment metering related objects

Payment accounting can be applied to any commodity.

An instance of the "Account" – see 4.6.2 – IC holds the summary information for a given contract and lists the "Credit" and "Charge" objects used by that "Account". If more than one "Account" is for any reason required in a given context then field D should be other than 0.

One or several instances of the "Credit" IC – see 4.6.3.4 – represent the different credit sources.

One or several instances of the "Charge" IC – see 4.6.4 – represent the different charges applicable.

One or more instances of the "Token gateway" IC – see 4.6.5 – are available to enter tokens. If only a single gateway is defined in a single "Account" then field E of the OBIS code shall be zero. If more than one "Token gateway" object is for any reason required in a single "Account" then field E should be other than 0.

The "Account" is linked to it's associated "Credit", "Charge" and "Token gateway" objects by use of the value group D and B field such that an "Account" with D=0 should be linked to a "Token gateway" with D=40 and have a "Credit" objects with D=10 and "Charge" objects with D=20. Whereas an "Account" with D=1 should have "token gateway" with D=41, "Credit" objects with D=11 and "Charge" objects with D=21 etc. Multiple "Credit" and "Charge" objects are identified using different values in the value group E field. See also Additional Notes there describing the "Max credit_limit" and „Max vend limit" objects there.

Instances of "Profile Generic" IC hold the history of the token credit and of the charge collections with a "Parameter Monitor" interface class monitoring a value used to trigger capture.

Payment metering related objects	IC	OBIS code					
		A	B	C	D	E	F
Account	111, Account	0	*b*	19	0..9	0	255
Credit	112, Credit	0	*b*	19	10..19	e	255
Charge	113, Charge	0	*b*	19	20..29	e	255
Token gateway	115, Token gateway	0	*b*	19	40…49	*e*	255
Configurable limit objects							
Max credit limit	01, Data	0	*b*	19	50…59	1	255
Max vend limit	01, Data	0	*b*	19	50…59	2	255

6.2.18 IEC local port setup objects (class_id = 19)

These objects define and control the behaviour of local ports using the protocol specified in IEC 62056-21:2002. See also 4.7.1.

IEC local port setup objects	IC	OBIS code					
		A	B	C	D	E	F
IEC optical port setup	19, IEC local port setup	0	*b*	20	0	0	255
IEC electrical port setup		0	*b*	20	0	1	255

6.2.19 Standard readout profile objects (class_id = 7)

A set of objects is defined to carry the standard readout as it would appear with IEC 62056-21:2002 (modes A to D). See also 4.3.6.

Standard readout objects	IC	OBIS code					
		A	B	C	D	E	F
General local port readout	7, Profile generic	0	*b*	21	0	0	255
General display readout		0	*b*	21	0	1	255
Alternate display readout		0	*b*	21	0	2	255
Service display readout		0	*b*	21	0	3	255
List of configurable meter data		0	*b*	21	0	4	255
Additional readout profile 1		0	*b*	21	0	5	255
…………..							
Additional readout profile *n*		0	*b*	21	0	N	255

For the parametrization of the standard readout “Data” objects can be used.

Standard readout parametrization objects	IC	OBIS code					
		A	B	C	D	E	F
Standard readout parametrization	1, Data	0	*b*	21	0	*e*	255

6.2.20 IEC HDLC setup objects (class_id = 23)

Instances of the IC "IEC HDLC setup" – see 4.7.2 – hold the parameters of the HDLC based data link layer.

IEC HDLC setup objects	IC	OBIS code					
		A	B	C	D	E	F
IEC HDLC setup	23, IEC HDLC setup	0	*b*	22	0	0	255

6.2.21 IEC twisted pair (1) setup objects (class_id = 24 etc.)

An instance of the IC "IEC twisted pair (1) set up" IC – see 4.7.3 – stores the parameters necessary to manage a communication profile specified in IEC 62056-3-1:2013.

An instance of the IC "MAC address set up" IC stores the Secondary Station Address ADS.

An instance of the "Data" stores the Fatal Error register.

Instances of the IC "Profile generic" IC instances allow the configuration of IEC 62056-3-1 readout lists.

IEC twisted pair (1) setup and related objects	IC	OBIS code					
		A	B	C	D	E	F
IEC twisted pair (1) setup	24, IEC twisted pair (1) setup	0	*b*	23	0	0	255
IEC twisted pair (1) MAC address setup	43, MAC address setup	0	*b*	23	1	0	255
IEC twisted pair (1) Fatal Error register	1, Data	0	b	23	2	0	255
IEC 62056-3-1 Short readout	7, Profile generic	0	*b*	23	3	0	255
IEC 62056-3-1 Long readout		0	*b*	23	3	1	255
IEC 62056-3-1 Alternate readout profile 0		0	b	23	3	2	255
IEC 62056-3-1 Additional readout profile 1		0	b	23	3	3	255
IEC 62056-3-1 Additional readout profile 2		0	b	23	3	4	255
IEC 62056-3-1 Additional readout profile 7		0	b	23	3	9	255

For the parametrization of the IEC 62056-3-1 readout "Data" objects can be used.

Standard readout parametrization objects	IC	OBIS code					
		A	B	C	D	E	F
IEC 62056-3-1 readout parametrization	1, Data	0	*b*	23	3	*e*	255

6.2.22 Objects related to data exchange over M-Bus

The following objects are available to model and control data exchange using the M-Bus protocol specified in the EN 13757 series:

- instances of the IC "M-Bus slave port setup" define and control the behaviour of M-Bus slave ports of a DLMS/COSEM device. See 4.8.2;
- instances of the IC "M-Bus client" are used to configure DLMS/COSEM devices as M-Bus clients. There is one "M-Bus client" object for each M-Bus slave. Value group B identifies the M-Bus channels. See 4.8.3;
- M-Bus value objects, instances of the IC "Extended register", hold the values captured from M-Bus slave devices on the relevant channel. The link between the M-Bus client setup objects and the M-Bus value objects is provided by the channel number.
- M-Bus "Profile generic" objects capture M-Bus value objects possibly along with other, not M-Bus specific objects;
- M-Bus "Disconnect control" objects control disconnect devices of M-Bus devices (e.g. gas valves);
- instances of the IC "Wireless mode Q" define and control the behaviour of the device regarding the communication parameters according to mode Q of EN 13757-5:2015. A node having more than one network address, i.e. a multi-homed node, will have multiple objects of these types. See 4.8.4;
- M-Bus control log objects are instances of the IC "Profile generic". They log the changes of the state of the disconnect devices;
- instances of the IC "M-Bus master port setup" define and control the behaviour of M-Bus master ports of DLMS/COSEM devices, allowing to exchange data with M-Bus slaves. See 4.8.5;
- instances of the IC "DLMS/COSEM server M-Bus port setup" are used in DLMS/COSEM servers hosted by M-Bus slave devices, using the DLMS/COSEM wired or wireless M-Bus communication profile. See 4.8.6;
- instances of the IC "M-Bus diagnostic" hold information related to the operation of the M-Bus network. See 4.8.7.

Objects related to data exchange over M-Bus	**IC**	**OBIS code**					
		A	**B**	**C**	**D**	**E**	**F**
M-Bus slave port setup	25, M-Bus slave port setup	0	*b*	24	0	0	255
M-Bus client	72, M-Bus client	0	*b*	24	1	0	255
M-Bus value	4, Extended register	0	*b*	24	2	e [a]	255
M-Bus profile generic	7, Profile generic	0	*b*	24	3	e	255
M-Bus disconnect control	70, Disconnect control	0	*b*	24	4	0	255
M-Bus control log	7, Profile generic	0	*b*	24	5	0	255
M-Bus master port setup	74, M-Bus master port setup	0	*b*	24	6	0	255
Wireless Mode Q channel	73, Wireless Mode Q channel	0	*b*	31	0	0	255
DLMS/COSEM server M-Bus port setup	76, DLMS/COSEM server M-Bus port setup	0	*b*	24	8	e [b]	255
M-Bus diagnostic	77, M-Bus diagnostic	0	*b*	24	9	e [b]	255

[a] "e" is equal to the index of the captured value in accordance to index of capture_definition_element in the *capture_definition* attribute of the M-Bus client object.

[b] If there is more than one M-Bus network interface present then there may be one object instantiated for each interface. For example, if a device has two interfaces (one wired M-Bus and one wireless M-Bus) and uses the DLMS/COSEM M-Bus communication profiles on both, there shall be one instance for each interface.

6.2.23 Objects to set up data exchange over the Internet

In this group, the following objects are available:

- Instances of the IC "TCP-UDP setup" – see 4.9.1 – handle all information related to the setup of the TCP and UDP layer of the Internet based communication profile(s), and point to the IP setup object(s) handling the setup of the IP layer on which the TCP-UDP connection(s) is (are) used;
- Instances of the IC "IPv4 setup" – see 4.9.2 – handle all information related to the setup of the IPv4 layer of the Internet based communication profile(s) and point to the data link layer setup object(s) handling the setup of the data link layer on which the IP connections is (are) used;
- Instances of the IC "IPv6 setup" – see 4.9.3 – handle all information related to the setup of the IPv6 layer of the Internet based communication profile(s) and point to the data link layer setup object(s) handling the setup of the data link layer on which the IP connections is (are) used;
- Instances of the IC "MAC address setup" – see 4.9.4 – handle all information related to the setup of the Ethernet data link layer of the Internet based communication profile(s);
- Instances of the IC "PPP setup" – see 4.9.5 – handle all information related to the setup of the PPP data link layer of the Internet based communication profiles;
- Instances of the IC "GPRS modem setup" – see 4.7.7 – handle all information related to the setup of the GPRS modem;
- Instances of the IC "SMTP setup" – see 4.9.6 – handle all information related to the setup of the SMTP service.

NOTE The following objects have internet related OBIS codes, although they are not strictly related to use over the internet only.

- Instances of the IC "GSM diagnostic" – see 4.7.8 – handle all diagnostic information related to the GSM/GPRS network.
- Instances of the IC "NTP setup" – see 4.9.7 – handle all information related to the setup of the NTP time synchronisation service;
- Instances of the IC "LTE monitoring " – see 4.7.9 – allow monitoring LTE modems.

Objects to set up data exchange over the Internet	**IC**	**OBIS code**					
		A	**B**	**C**	**D**	**E**	**F**
TCP-UDP setup	41, TCP-UDP setup	0	*b*	25	0	0	255
IPv4 setup	42, IPv4 setup	0	*b*	25	1	0	255
MAC address setup	43, MAC address setup	0	*b*	25	2	0	255
PPP setup	44, PPP setup	0	*b*	25	3	0	255
GPRS modem setup	45, GPRS modem setup	0	*b*	25	4	0	255
SMTP setup	46, SMTP setup	0	*b*	25	5	0	255
GSM diagnostic	47, GSM diagnostic	0	*b*	25	6	0	255
IPv6 setup	48, IPv6 setup	0	*b*	25	7	0	255
Reserved for FTP setup							
NTP setup	100, NTP setup	0	*b*	25	10	0	255
LTE monitoring	151, LTE monitoring	0	*b*	25	11	0	255

6.2.24 Objects to set up Push Setup (class_id = 40)

Instances of the IC "Push setup" – see 4.4.8 – handle all information about the data to be pushed, the push destination and the method by which the data should be pushed.

Push Setup	IC	OBIS code					
		A	B	C	D	E	F
Push setup	40, Push setup	0	*b*	25	9	0	255

6.2.25 Objects for setting up data exchange using S-FSK PLC

In this group, the following objects are available:

- Instances of the IC "S-FSK Phy&MAC setup" – see 4.10.3 – handle all information related to setting up the PLC S-FSK lower layer profile specified in IEC 61334-5-1:2001;
- Instances of the IC "S-FSK Active initiator" – see 4.10.4 – handle all information related to the active initiator in the PLC S-FSK lower layer profile specified in IEC 61334-5-1:2001;
- Instances of the IC "S-FSK MAC synchronization timeouts" – see 4.10.5 – manage all timeouts related to the synchronization process of devices using the PLC S-FSK lower layer profile specified in IEC 61334-5-1:2001;
- Instances of the IC "S-FSK MAC counters" – see 4.10.6 – store counters related to the frame exchange, transmission and repetition phases in the PLC S-FSK lower layer profile specified in IEC 61334-5-1:2001;
- Instances of the IC "IEC 61334-4-32 LLC setup" – see 4.10.7 – handle all information related to the LLC layer specified in IEC 61334-4-32:1996;
- Instances of the IC "S-FSK Reporting system list" – see 4.10.8 – hold information on reporting systems in the PLC S-FSK lower layer profile specified in IEC 61334-5-1:2001.

Objects to set up data exchange using S-FSK PLC	IC	OBIS code					
		A	B	C	D	E	F
S-FSK Phy&MAC setup	50, S-FSK Phy&MAC setup	0	*b*	26	0	0	255
S-FSK Active initiator	51, S-FSK Active initiator	0	*b*	26	1	0	255
S-FSK MAC synchronization timeouts	52, S-FSK MAC synchronization	0	*b*	26	2	0	255
S-FSK MAC counters	53, S-FSK MAC counters	0	*b*	26	3	0	255
NOTE This is a placeholder for a Monitoring IC to be specified.							
IEC 61334-4-32 LLC setup	55, IEC 61334-4-32 LLC setup	0	*b*	26	5	0	255
S-FSK Reporting system list	56, S-FSK Reporting system list	0	*b*	26	6	0	255

6.2.26 Objects for setting up the ISO/IEC 8802-2 LLC layer

In this group, the following objects are available:

- Instances of the IC "ISO/IEC 8802-2 LLC Type 1 setup" – see 4.11.2 – handle all information related to the LLC layer specified in ISO/IEC 8802-2:1998 in Type 1 operation;
- Instances of the IC "ISO/IEC 8802-2 LLC Type 2 setup" – see 4.11.3 – handle all information related to the LLC layer specified in ISO/IEC 8802-2:1998 in Type 2 operation;
- Instances of the IC "ISO/IEC 8802-2 LLC Type 3 setup" – see 4.11.4 – handle all information related to the LLC layer specified in ISO/IEC 8802-2:1998 in Type 3 operation.

Objects to set up the ISO/IEC 8802-2 LLC layer	**IC**	**OBIS code**					
		A	**B**	**C**	**D**	**E**	**F**
ISO/IEC 8802-2 LLC Type 1 setup	57, ISO/IEC 8802-2 LLC Type 1 setup	0	*b*	27	0	0	255
ISO/IEC 8802-2 LLC Type 2 setup	58, ISO/IEC 8802-2 LLC Type 2 setup	0	*b*	27	1	0	255
ISO/IEC 8802-2 LLC Type 3 setup	59, ISO/IEC 8802-2 LLC Type 3 setup	0	*b*	27	2	0	255

6.2.27 Objects for data exchange using narrowband OFDM PLC for PRIME networks

For setting up and managing data exchange using narrowband OFDM PLC for PRIME networks one instance of each following classes shall be implemented for each interface:

- an instance of the 61334-4-32 LLC SSCS setup – see 4.12.3 – holds the addresses related to the CL_432 layer;
- an instance of the IC "PRIME NB OFDM PLC Physical layer counters" – see 4.12.5 – stores counters related to the physical layers exchanges;
- an instance of the IC "PRIME NB OFDM PLC MAC setup" – see 4.12.6 – holds the necessary parameters to set up the PRIME NB OFDM PLC MAC layer;
- an instance of the IC "PRIME NB OFDM PLC MAC functional parameters" – see 4.12.7 – provides information on specific aspects concerning the functional behaviour of the MAC layer;
- an instance of the IC "PRIME NB OFDM PLC MAC counters" – see 4.12.8 – stores statistical information on the operation of the MAC layer for management purposes;
- an instance of the IC "PRIME NB OFDM PLC MAC network administration data" – see 4.12.9 – holds the parameters related to the management of the devices connected to the network;
- an instance of the IC "MAC address setup" – holds the MAC address of the device. See 4.12.10;
- an instance of the IC "PRIME NB OFDM PLC Application identification" – see 4.12.11 – holds identification information related to administration and maintenance of PRIME NB OFDM PLC devices.

Objects for data exchange using PRIME NB OFDM PLC	**IC**	**OBIS code**					
		A	**B**	**C**	**D**	**E**	**F**
61334-4-32 LLC SSCS setup	80, 61334-4-32 LLC SSCS setup	0	*b*	28	0	0	255

Objects for data exchange using PRIME NB OFDM PLC	IC	OBIS code					
		A	B	C	D	E	F
PRIME NB OFDM PLC Physical layer counters	81, PRIME NB OFDM PLC Physical layer counters	0	*b*	28	1	0	255
PRIME NB OFDM PLC MAC setup	82, PRIME NB OFDM PLC MAC setup	0	*b*	28	2	0	255
PRIME NB OFDM PLC MAC functional parameters	83, PRIME NB OFDM PLC MAC functional parameters	0	*b*	28	3	0	255
PRIME NB OFDM PLC MAC counters	84, PRIME NB OFDM PLC MAC counters	0	*b*	28	4	0	255
PRIME NB OFDM PLC MAC network administration data	85, PRIME NB OFDM PLC MAC network administration data	0	*b*	28	5	0	255
PRIME NB OFDM PLC MAC address setup	43, MAC address setup	0	*b*	28	6	0	255
PRIME NB OFDM PLC Application identification	86, PRIME NB OFDM PLC Application identification	0	*b*	28	7	0	255

6.2.28 Objects for data exchange using narrow-band OFDM PLC for G3-PLC networks

For setting up and managing data exchange using G3-PLC profile, one instance of each following classes shall be implemented for each interface:

- an instance of the IC “G3-PLC MAC layer counters” – see 4.13.3 – to store counters related to the MAC layer exchanges;
- an instance of the IC “G3-PLC MAC setup” – see 4.13.4 – to hold the necessary parameters to set up the G3-PLC MAC IEEE 802.15.4 layer;
- an instance of the IC “G3-PLC 6LoWPAN adaptation layer setup” – see 4.13.5 – to hold the necessary parameters to set up the Adaptation layer.

Objects for data exchange using G3-PLC	IC	OBIS code					
		A	B	C	D	E	F
G3-PLC MAC layer counters	90, G3-PLC MAC layers counters	0	*b*	29	0	0	255
G3-PLC MAC setup	91, G3-PLC MAC setup	0	*b*	29	1	0	255
G3-PLC 6LoWPAN adaptation layer setup	92, G3-PLC 6LoWPAN adaptation layer setup	0	*b*	29	2	0	255

6.2.29 ZigBee® setup objects

The following objects are available for setting up and managing a ZigBee® network; see also 4.14.

Objects set up and manage ZigBee® networks	IC	OBIS code					
		A	B	C	D	E	F
ZigBee® SAS startup	101, ZigBee® SAS Startup	0	*b*	30	0	e	255
ZigBee® SAS join	102, ZigBee® SAS join	0	*b*	30	1	e	255
ZigBee® SAS APS fragmentation	103, ZigBee® SAS APS fragmentation	0	*b*	30	2	e	255
ZigBee® network control	104, ZigBee® network control	0	*b*	30	3	e	255
ZigBee® tunnel setup	105 ,ZigBee® tunnel setup	0	*b*	30	4	e	255

6.2.30 Objects for data exchange using HS-PLC ISO/IEC 12139-1 ISO/EC 12139-1 networks

For setting up and managing data exchange using HS-PLC ISO/IEC 12139-1 networks one instance of each following classes shall be implemented for each interface:

- an instance of the IC "HS-PLC ISO/IEC 12139-1 MAC setup" – see 4.14.2 – holds the necessary parameters for setting up the MAC layer;
- an instance of the IC "HS-PLC ISO/IEC 12139-1 CPAS setup" – see 4.14.3 – holds the necessary parameters for setting up the CPAS;
- an instance of the IC "HS-PLC ISO/IEC 12139-1 IP SSAS setup" – see 4.14.4 – holds the necessary parameters for setting up the IP SSAS;
- an instance of the IC "HS-PLC ISO/IEC 12139-1 HDLC SSAS setup" – see 4.14.5 – holds the necessary parameters for setting up the HDLC SSAS.

Objects for data exchange using HS-PLC ISO/IEC 12139-1	IC	OBIS code					
		A	B	C	D	E	F
HS-PLC ISO/IEC 12139-1 MAC setup	140, HS-PLC ISO/IEC 12139-1 MAC setup	0	*b*	33	0	0	255
HS-PLC ISO/IEC 12139-1 CPAS setup	141, HS-PLC ISO/IEC 12139-1 CPAS setup	0	*b*	33	1	0	255
HS-PLC ISO/IEC 12139-1 IP SSAS setup	142, HS-PLC ISO/IEC 12139-1 IP SSAS setup	0	*b*	33	2	0	255
HS-PLC ISO/IEC 12139-1 HDLC SSAS setup	143, HS-PLC ISO/IEC 12139-1 HDLC SSAS setup	0	*b*	33	3	0	255

6.2.31 Association objects (class_id = 12, 15)

A series of Association SN / LN objects – see 4.4.3 – are available to model application associations between a DLMS/COSEM client and server.

Association objects	IC	OBIS code					
		A	B	C	D	E	F
Current association	12, Association SN 15, Association LN	0	0	40	0	0	255
Association, instance 1		0	0	40	0	1	255
....							
Association, instance *n*		0	0	40	0	n	255

6.2.32 SAP assignment object (class_id = 17)

An instance of the IC "SAP assignment" – see 4.4.5 – holds information about the addresses (Service Access Points, SAPs) of logical devices within a physical device.

SAP Assignment object	IC	OBIS code					
		A	B	C	D	E	F
SAP assignment of current physical device	17, SAP assignment	0	0	41	0	0	255

6.2.33 COSEM logical device name object

Each COSEM logical device shall be identified by its Logical Device Name, unique worldwide. See 4.1.8.2. It is held by the *value* attribute of a "Data" object, with data type *octet-string* or *visible-string*. For short name referencing, the base_name of the object is fixed. See 4.1.3.

COSEM logical device name object	IC	OBIS code					
		A	B	C	D	E	F
COSEM logical device name	1, Data [a]	0	0	42	0	0	255
[a] If the IC "Data" is not available, "Register" (with scaler = 0, unit = 255) may be used.							

6.2.34 Information security related objects (class_id = 64 etc.)

Instances of the IC "Security setup" – see 4.4.7 – are used to set up the message security features. For each Association object, there is one Security setup object managing security within that AA. See 5.4.4 and 5.4.5. Value group E numbers the instances.

Security setup objects	IC	OBIS code					
		A	B	C	D	E	F
Security setup	64, Security setup	0	0	43	0	*e*	255

Invocation counter objects hold the invocation counter element of the initialization vector. They are instances of the IC "Data". The value in value group B identifies the communication channel.

NOTE The same client may use different communication channels e.g. a remote port and a local port. The invocation counter on the different channels may be different.

The value in value group E shall be the same as in the logical name of the corresponding "Security setup" object.

Invocation counter objects	IC	OBIS code					
		A	B	C	D	E	F
Invocation counter	1, Data [a]	0	*b*	43	1	*e*	255
NOTE In earlier version of the Blue Book, these objects were called Frame counter objects.							
[a] If the IC "Data" is not available, "Register" (with scaler = 0, unit = 255) may be used.							

Instances of the IC "Data protection" – see 4.4.9 – are used to apply / remove protection on COSEM data, i.e. sets of attributes values, method invocation and return parameters. Value group E numbers the instances.

Data protection objects	IC	OBIS code					
		A	B	C	D	E	F
Data protection	30, Data protection	0	0	43	2	*e*	255

6.2.35 Image transfer objects (class_id = 18)

Instances of the IC "Image transfer" – see 4.4.6 – control the Image transfer process.

Image transfer related objects	IC	OBIS code					
		A	B	C	D	E	F
Image transfer	18, Image transfer	0	0	44	0	*e*	255

6.2.36 Function control objects (class_id = 122)

Instances of the IC "Function control" – see 4.4.10 – allow enabling and disabling functions in the server.

Function control related objects	IC	OBIS code					
		A	B	C	D	E	F
Function control	122, Function control	0	0	44	1	*e*	255

6.2.37 Communication port protection objects (class_id = 124)

Instances of the "Communication port protection" IC – see 4.4.12 – control the communication port protection mechanism.

Communication port protection objects	IC	OBIS code					
		A	B	C	D	E	F
Communication port protection objects	124	0	*b*	44	2	*e*	255

6.2.38 Utility table objects (class_id = 26)

Instances of the IC "Utility tables" – see 4.3.7 – allow representing ANSI utility tables. The Utility table IDs are mapped to OBIS codes as follows:

- value group A: use value of 0 to specify abstract object;
- value group B: instance of table set;
- value group C: use value 65 – signifies utility tables specific definitions;
- value group D: table group selector;
- value group E: table number within group;
- value group F: use value 0xFF for data of current billing period.

Utility table objects	IC	OBIS code					
		A	B	C	D	E	F
Standard tables 0-127	26, Utility tables	0	*b*	65	0	*e*	255
Standard tables 128-255		0	*b*	65	1	*e*	255
…							
Standard tables 1920-2047		0	*b*	65	15	*e*	255

Utility table objects	IC	OBIS code					
		A	B	C	D	E	F
Manufacturer tables 0-127		0	*b*	65	16	*e*	255
Manufacturer tables 128-255		0	*b*	65	17	*e*	255
…							
Manufacturer tables 1920-2047		0	*b*	65	31	*e*	255
Std pending tables 0-127		0	*b*	65	32	*e*	255
Std pending tables 128-255		0	*b*	65	33	*e*	255
…							
Std pending tables 1920-2047		0	*b*	65	47	*e*	255
Mfg pending tables 0-127		0	*b*	65	48	*e*	255
Mfg pending tables 128-255		0	*b*	65	49	*e*	255
…							
Mfg pending tables 1920-2047		0	*b*	65	63	*e*	255

6.2.39 Compact data objects (class_id = 62)

"Compact data" objects – see 4.3.10 – store data and metadata separated, thus they allow reducing overhead.

Compact data objects	IC	OBIS code					
		A	B	C	D	E	F
Compact data	62, Compact data	0	*b*	66	0	e	255

6.2.40 Device ID objects

A series of objects are used to hold ID numbers of the device. These ID numbers can be defined by the manufacturer (e.g. manufacturing number) or by the user.

They are held by the *value* attribute of "Data" objects, with data type *double-long-unsigned*, *octet-string*, *visible-string, utf8-string*, *unsigned, long-unsigned.* If more than one of those is used, it is allowed to combine them into a "Profile generic" object. In this case, the captured objects are *value* attributes of the device ID "Data" objects, the capture period is 1 to have just actual values, the sort method is FIFO and the profile entries are limited to 1. Alternatively, a "Register table" object – see 4.3.8 – can be used. See also Table 56.

Device ID objects	IC	OBIS code					
		A	B	C	D	E	F
Device ID 1…10 object (manufacturing number)	1, Data	0	*b*	96	1	0…9	255
Device ID-s object	7, Profile generic	0	*b*	96	1	255	255
Device ID-s object	61, Register table	0	*b*	96	1	255	255

6.2.41 Metering point ID objects

One object is available to store a media type independent metering point ID. It is held by the *value* attribute of a "Data" object, with data type *double-long-unsigned*, *octet-string*, *visible-string, utf8-string*, *unsigned, long-unsigned.*

Metering point ID objects	IC	OBIS code					
		A	B	C	D	E	F
Metering point ID	1, Data	0	*b*	96	1	10	255

6.2.42 Parameter changes and calibration objects

A set of simple COSEM objects describes the history of the configuration of the device. All values are modelled by instances of the IC "Data".

Parameter changes objects	IC	OBIS code					
		A	B	C	D	E	F
For names and OBIS codes see Table 56.	1, Data	0	*b*	96	2	*e*	255

6.2.43 I/O control signal objects

A series of objects are available to define and control the status of I/O lines of the physical metering equipment.

The status is held by the *value* attribute of a "Data" object, with data type *octet-string, boolean* or *bit-string.* Alternatively, the status is held by a "Status mapping" object, see 4.3.9, which holds both the status word and the mapping of its bits to the reference table. If there are several I/O control status objects used, it is allowed to combine them into an instance of the IC "Profile generic" or "Register table", using the OBIS code of the global state of I/O control signals object. See also Table 56.

I/O control signal objects	IC	OBIS code					
		A	B	C	D	E	F
I/O control signal objects, contents manufacturer specific	1, Data	0	*b*	96	3	0…4	255
I/O control signal objects, contents mapped to a reference table	63, Status mapping	0	*b*	96	3	0…4	255
I/O control signal objects, global	7, Profile generic or 61, Register table	0	*b*	96	3	0	255

6.2.44 Disconnect control objects (class_id = 70)

Instances of the IC "Disconnect control" – see 4.5.8 – manage internal or external disconnect units (e.g. electricity breaker, gas valve) in order to connect or disconnect – partly or entirely – the premises of the consumer to / from the supply. See also 6.2.22.

Disconnect control objects	IC	OBIS code					
		A	B	C	D	E	F
Disconnect control	70, Disconnect control	0	b	96	3	10	255

6.2.45 Arbitrator objects (class_id = 68)

Instances of the IC "Arbitrator" – see 4.5.12 – are used

Arbitrator Objects	IC	OBIS code					
		A	B	C	D	E	F
General-purpose Arbitrator	68, Arbitrator	0	*b*	96	3	*20… 29*	255

6.2.46 Status of internal control signals objects

A series of objects are available to hold the status of internal control signals.

The status carries binary information from a bitmap, and it shall be held by the *value* attribute of a "Data" object, with data type *boolean, bit-string, unsigned, long-unsigned, double-long-unsigned, long64-unsigned or octet-string.* Alternatively, the status is held by a "Status mapping" object, see 4.3.9, which holds both the status word and the mapping of its bits to the reference table. If there are several status of internal control signals objects used, it is allowed to combine them into an instance of the IC "Profile generic" or "Register table", using the OBIS code of the global "Internal control signals" object. See also Table 56.

Internal control signals objects	IC	OBIS code					
		A	B	C	D	E	F
Internal control signals, contents manufacturer specific	1, Data	0	*b*	96	4	0…4	255
Internal control signals, contents mapped to a reference table	63, Status mapping	0	*b*	96	4	0…4	255
Internal control signals, global	7, Profile generic or 61, Register table	0	*b*	96	4	0	255

6.2.47 Internal operating status objects

A series of objects are available to hold internal operating statuses.

The status carries binary information from a bitmap, and it shall be held by the value attribute of a "Data" object, with data type *boolean*, *bit-string, unsigned, long-unsigned, double-long-unsigned, long64-unsigned or octet-string.* Alternatively, the status is held by a "Status mapping" object, see 4.3.9, which holds both the status word and the mapping of its bits to the reference table. If there are several status of internal control signals objects used, it is allowed to combine them into an instance of the IC "Profile generic" or "Register table", using the OBIS code of the global "Internal operating status" object. See also Table 56.

Internal operating status objects	IC	OBIS code					
		A	B	C	D	E	F
Internal operating status objects, contents manufacturer specific	1, Data	0	*b*	96	5	0…4	255
Internal operating status objects, contents mapped to a reference table	63, Status mapping	0	*b*	96	5	0…4	255
Internal operating status objects, global	7, Profile generic or 61, Register table	0	*b*	96	5	0	255

Internal operating status objects can also be related to an energy type. See 6.3.7.

6.2.48 Battery entries objects

A series of objects are available for holding information relative to the battery of the device. These objects are instances of IC "Data", "Register" or "Extended register" as appropriate.

Battery entries objects	IC	OBIS code					
		A	B	C	D	E	F
For names and OBIS codes see Table 56.	1, Data, 3, Register or 4, Extended register	0	*b*	96	6	0…6	255

6.2.49 Power failure monitoring objects

A series of objects are available for power failure monitoring:

- For simple power failure monitoring, it is possible to count the number of power failure events affecting all three phases, one of the three phases, any of the phases, and the auxiliary supply;
- For advanced power failure monitoring, it is possible to define a time threshold to make a distinction between short and long power failure events. It is possible to count the number of such long power failure events separately from the short ones, as well as to store their time of occurrence and duration (time from power down to power up) in all three phases, in one of the three phases and in any of the phases;
- The number of power failure events objects are represented by instances of the IC "Data", "Register" or "Extended register" with data types *unsigned*, *long-unsigned*, *double-long-unsigned* or *long64-unsigned*;
- The power failure duration, time and time threshold data are represented by instances of the IC "Data", "Register" or "Extended register" with appropriate data types;
- If power failure duration objects are represented by instances of the IC "Data", then the default scaler shall be 0, and the default unit shall be the second.

Power failure monitoring objects	IC	OBIS code					
		A	B	C	D	E	F
For names and OBIS codes see Table 56.	1, Data, 3, Register or 4, Extended register	0	*b*	96	7	0… 21	255

These objects may be collected in a "Power failure event log" object. See Table 71.

6.2.50 Operating time objects

A series of objects are available for holding the cumulated operating time and the various tariff registers of the device. These objects are instances of the IC "Data", "Register" or "Extended register". The data type shall be *unsigned*, *long-unsigned* or *double-long-unsigned* with appropriate scaler and unit. If the IC "Data" is used, the unit shall be the second by default.

Operating time objects	IC	OBIS code					
		A	B	C	D	E	F
For names and OBIS codes see Table 56.	1, Data, 3, Register or 4, Extended register	0	*b*	96	8	0… 63	255

6.2.51 Environment related parameters objects

A series of objects are available to store environmental related parameters. They are held by the *value* attribute of instances of the IC "Register" or "Extended register", with appropriate data types.

Environment related parameters objects	IC	OBIS code					
		A	B	C	D	E	F
For names and OBIS codes see Table 56.	3, Register or 4, Extended register	0	*b*	96	9	0…2	255

6.2.52 Status register objects

A series of objects are available to hold statuses that can be captured in load profiles. See also Table 56.

Status register objects	IC	OBIS code					
		A	B	C	D	E	F
Status register, contents manufacturer specific	1, Data	0	*b*	96	10	1… 10	255
Status register, contents mapped to reference table	63, Status mapping	0	*b*	96	10	1… 10	255

The status register is held by the value attribute of a "Data" object, with data type *bit-string, unsigned, long-unsigned, double-long-unsigned, long64-unsigned or octet-string.* It carries binary information from a bitmap. It's contents is not specified.

Alternatively, the status register may be held by the *status_word* attribute of a "Status mapping" object, see 4.3.9. The *mapping_table* attribute holds mapping information between the bits of the status word and entries of a reference table.

6.2.53 Event code objects

In the meter or in its environment, various events may be generated. A series of objects are available to hold an identifier of a most recent event (event code). Different instances of event code objects may be captured in different instances of event logs; see 6.2.61.

NOTE The definition of event identifiers is out of the Scope of this document.

Event code objects	IC	OBIS code					
		A	B	C	D	E	F
For names and OBIS codes see Table 56.	1, Data, 3, Register, or 4, Extended register	0	*b*	96	11	0… 99	255

Events may also set flags in error registers and alarm registers. See also 6.2.59.

6.2.54 Communication port log parameter objects

A series of objects are available to hold various communication log parameters. They are represented by instances of IC "Data", "Register" or "Extended register".

Communication port log parameter objects	IC	OBIS code					
		A	B	C	D	E	F
For names and OBIS codes see Table 56.	1, Data, 3, Register, or 4, Extended register	0	*b*	96	12	0…6	255

6.2.55 Consumer message objects

A series of objects are available to store information sent to the energy end-user. The information may appear on the display of the meter and / or on a consumer information port.

Consumer message objects	IC	OBIS code					
		A	B	C	D	E	F
For names and OBIS codes see Table 56.	1, Data, 3, Register, or 4, Extended register	0	*b*	96	13	0, 1	255

6.2.56 Currently active tariff objects

A series of objects are available to hold the identifier of the currently active tariff. They carry the same information as the *active_mask* attribute of the corresponding “Register activation” object.

Currently active tariff objects	IC	OBIS code					
		A	B	C	D	E	F
For names and OBIS codes see Table 56.	1, Data, 3, Register, or 4, Extended register	0	*b*	96	14	0… 15	255

6.2.57 Event counter objects

A series of objects are available to count events. The number of the events is held by the value attribute.

Event counter objects	IC	OBIS code					
		A	B	C	D	E	F
For names and OBIS codes see Table 56.	1, Data, 3, Register, or 4, Extended register	0	*b*	96	15	0… 99	255

6.2.58 Profile entry digital signature objects

Instances of “Data”, “Register” or “Extended register” objects hold digital signatures of “Profile generic” object buffer entries. If the *capture_object* attribute of a “Profile generic” object contains a reference to a “Profile entry digital signature” object, then the digital signature is calculated and captured together with the other attribute values.

The security context is determined by the “Security setup” object which is which is visible in the same AA (object_list).

NOTE The digital signature may be generated when the entry is captured or “on the fly”, when an entry is accessed.

Profile entry digital signature objects	IC	OBIS code					
		A	B	C	D	E	F
For names and OBIS codes see Table 56.	1, Data, 3, Register, or 4, Extended register	0	*b*	96	16	0…9	255

6.2.59 Meter tamper event related objects

A series of objects are available to register characteristics of various meter tamper events. These objects are instances of the IC "Data", Register" or "Extended register". The data type shall be *unsigned*, *long-unsigned or double-long-unsigned* with appropriate scaler and unit. For time stamps, the data type shall be *double-long-unsigned* (in the case of UNIX time), *octet-string* or *date-time* formatted as specified in 4.1.6.1.

- Meter open events are related to cases when the meter case is open;
- Terminal cover open events are related to cases when a terminal cover is removed (open);
- Tilt events are related to cases when the meter is not in its normal operation position;
- Strong DC magnetic field events are related to cases when the presence of a strong DC magnetic field is detected;
- Metrology tamper events are related to cases when an anomaly in the operation of the metrology is detected due to a perceived tamper;
- Communication tamper events are related to cases when an anomaly in the operation of the communication interfaces is detected due to a perceived tamper.

The method of detecting the various tampers is out of the Scope of this document.

Meter tamper event related objects	**IC**	**OBIS code**					
		A	**B**	**C**	**D**	**E**	**F**
For names and OBIS codes see Table 56.	1, Data, 3, Register, or 4, Extended register	0	*b*	96	20	*e*	255

6.2.60 Error register objects

A series of objects are used to communicate error indications of the device. The different error registers are held by the *value* attribute of "Data" objects, with data type or *bit-string*, *octet-string, unsigned, long-unsigned, double-long-unsigned* or *long64-unsigned.*

The individual bits of the error register may be set and cleared by a pre-defined selection of events – see 6.2.51. Depending on the type of the error, some errors may clear themselves when the reason setting the error flag disappears.

If more than one of those objects is used, it is allowed to combine them into one instance of the IC "Profile generic". In this case, the captured objects are the *value* attributes "Data" objects, the capture period is 1 to have just actual values, the sort method is FIFO, the profile entries are limited to 1. Alternatively, an instance of the IC "Register table" can be used.

Error register objects can also be related to an energy type and to a channel. See 7.4.2, 7.5.5.2, 7.6.4.2, 7.7.4.2, 7.9.4.2.

Error register objects	**IC**	**OBIS code**					
		A	**B**	**C**	**D**	**E**	**F**
Error register 1…10 object	1, Data	0	b	97	97	0…9	255
Error profile object	7, Profile generic	0	b	97	97	255	255
Error table object	61, Register table	0	b	97	97	255	255

6.2.61 Alarm register, Alarm filter and Alarm descriptor objects

A number of objects are available to hold alarm registers. The different alarm registers are held by the value attribute of "Data" objects, with data type *bit-string*, *octet-string*, *unsigned*, *long-unsigned*, *double-long-unsigned* or *long64-unsigned*. When selected events occur, they set the corresponding flag and the device may raise an alarm. Depending on the type of alarm, some alarms may clear themselves when the reason setting the alarm flag disappears.

If more than one of those objects is used, it is also allowed to combine them into one instance of the IC "Profile generic". In this case, the captured objects are the *value* attributes of "Data" objects, the capture period is 1 to have just actual values, the sort method is FIFO, and the profile entries are limited to 1. Alternatively, an instance of the IC "Register table" can be used.

Alarm filter objects are available to define if an event is to be handled as an alarm when it appears. The different alarm filters are held by the value attribute of "Data" objects, with data type *bit-string, octet-string, unsigned, long-unsigned, double-long-unsigned* or *long64-unsigned*. The bit mask has the same structure as the corresponding alarm register object. If a bit in the alarm filter is set, then the corresponding alarm is enabled, otherwise it is disabled. *Alarm filter* objects act on *Alarm register* and *Alarm descriptor* objects the same way.

Alarm descriptor objects are available to persistently hold the occurrence of alarms. The different alarm descriptors are of the same type as the corresponding *Alarm register*. When a selected event occurs, the corresponding flag is set in the *Alarm register* as well as in the *Alarm descriptor* objects. An alarm descriptor flag remains set even if the corresponding alarm condition has disappeared. Alarm descriptor flags do not reset themselves; they can be reset by writing the value attribute only.

NOTE The alarm conditions, the structure of the *Alarm register / Alarm filter / Alarm descriptor* objects are subject to a project specific companion specification.

Alarm register, Alarm filter and Alarm descriptor objects	IC	OBIS code					
		A	B	C	D	E	F
Alarm register objects 1…10	1, Data	0	b	97	98	0…9	255
Alarm register profile object	7, Profile generic	0	b	97	98	255	255
Alarm register table object	61, Register table	0	b	97	98	255	255
Alarm filter objects 1…10	1, Data	0	b	97	98	10…19	255
Alarm descriptor objects 1…10	1, Data	0	b	97	98	20…29	255

6.2.62 General list objects

Instances of the IC "Profile generic" are used to model lists of any kind of data, for example measurement values, constants, statuses, events. They are modelled by "Profile generic" objects. One standard object per billing period scheme is defined.

List objects may be also related to an energy type and to a channel.

General list objects	IC	OBIS code					
		A	B	C	D	E	F
For names and OBIS codes see 7.4.3.	7, Profile generic	0	*b*	98	*d*	*e*	255[a]

ᵃ F = 255 means a wildcard here. See 7.11.3.

6.2.63 Event log objects (class_id = 7)

Instances of the IC "Profile generic" are used to store Event logs. Event logs may be also media related. In this case, the value of value group A shall be the relevant media identifier. See also 7.4.5, 7.5.5.4, 7.8.6.4.

Event log objects	**IC**	**OBIS code**					
		A	**B**	**C**	**D**	**E**	**F**
Event log	7, Profile generic	*a*	*b*	99	98	*e*	255 [a]
[a] F = 255 means a wildcard here. See 7.11.3.							
NOTE 1 Event logs may capture for example the time of occurrence of the event, the event code and other relevant data. NOTE 2 Project specific companion specifications may specify a more precise meaning of the instances of the different event logs, i.e. the data captured and the number of events captured.							

6.2.64 Inactive objects

Inactive objects are objects, which are present in the meter, but which do not have an assigned functionality. Inactive instances of any IC may be present. See also 7.3.3.2.

Inactive objects	**IC**	**OBIS code**					
		A	**B**	**C**	**D**	**E**	**F**
Inactive objects	Any	0	*b*	127	0	*e*	255

6.3 Electricity related COSEM objects

6.3.1 Value group D definitions

The different ways of processing measurement values as defined by value group D – see 7.5.2.1 – are modelled as shown in Table 27.

Table 27 – Representation of various values by appropriate ICs

Type of value	Represented by
cumulative values	Instances of IC "Register" or “Extended register”.
maximum and minimum values	Instances of IC "Profile generic" with sorting method *maximum* or *minimum*, depth according to implementation and captured objects according to implementation. A single maximum value or minimum value can alternatively be represented by an instance of the IC “Register” or "Extended register”.
current and last average values	Instances of IC “Demand register”. The logical name is the OBIS code of the current average value (D = 4, 14 or 24). For display purposes: Instances of IC “Register” or “Demand register”. The logical name is the OBIS code of current average (D = 4, 14 or 24) or last average (D= 5, 15 or 25) as appropriate.
instantaneous values	Instances of IC "Register”.
time integral values	Instances of IC "Register" or “Extended register”.
occurrence counters	Instances of IC “Data” or "Register".
contracted values	Instances of IC "Register" or “Extended register”.
Under/Over limit thresholds	Instances of IC "Register" or “Extended register”.
Over/Under limit occurrence counters	Instances of IC "Register" or “Extended register”.
Under/Over limit durations	Instances of IC "Register" or “Extended register”.
Over/Under limit magnitudes	Instances of IC "Register" or “Extended register”.

6.3.2 ID numbers – Electricity

The different electricity ID numbers are held by instances of the IC "Data”, with data type *unsigned, long-unsigned, double-long-unsigned, octet-string* or *visible-string.*

If more than one of those is used, it is allowed to combine them into a "Profile generic" object. In this case, the captured objects are *value* attributes of electricity ID “Data” objects, the capture period is 1 to have just actual values, the sort method is FIFO, the profile entries are limited to 1. Alternatively, a “Register table” object can be used. See also Table 57.

ID objects – Electricity	IC	OBIS code					
		A	B	C	D	E	F
Electricity ID 1…10 object	1, Data	1	*b*	0	0	0…9	255
Electricity ID-s object	7, Profile generic	1	*b*	0	0	255	255
Electricity ID-s object	61, Register table	1	*b*	0	0	255	255

6.3.3 Billing period values / reset counter entries

These values are represented by instances of the IC "Data".

For billing period / reset counters and for number of available billing periods the data type shall be *unsigned*, *long-unsigned* or *double-long-unsigned*. For time stamps of billing periods, the data type shall be *double-long-unsigned* (in the case of UNIX time), *octet-string* or *date-time* formatted as specified in 4.1.6.1.

These objects may be related to channels.

When the values of historical periods are represented by “Profile generic” objects, the time stamp of the billing period objects shall be part of the captured objects.

Billing period values / reset counter entries	**IC**	**OBIS code**					
		A	**B**	**C**	**D**	**E**	**F**
For item names and OBIS codes see Table 57.	1, Data	1	*b*	0	1	*e*	255

6.3.4 Other electricity related general purpose objects

Program entries shall be represented by instances of the IC "Data" with data type *unsigned, long-unsigned, octet-string* or *visible-string.* For “Meter connection diagram ID” objects data type *enumerated* can be used as well. Program entries can also be related to a channel.

Output pulse constant, reading factor, CT/VT ratio, nominal value, input pulse constant, transformer and line loss coefficient values shall be represented by instances of the IC “Data”, "Register" or “Extended register”. For the *value* attribute, only simple data types are allowed.

Measurement period, recording interval and billing period duration values shall be represented by instances of IC “Data”, “Register” or “Extended register” with the data type of the *value* attribute *unsigned, long-unsigned* or *double-long-unsigned.* The default unit is the second.

Time entry values shall be represented by instances of IC “Data”, “Register” or “Extended register” with the data type of the *value* attribute *octet-string*, formatted as *date-time* in 4.1.6.1. The data types *unsigned, integer, long-unsigned double-long-unsigned* or *long64-unsigned* can also be used where appropriate.

The *Clock synchronization method* shall be represented by an instance of an IC “Data” with data type *enum*.

Synchronization method enum:
- (0) no synchronization,
- (1) adjust to quarter,
- (2) adjust to measuring period,
- (3) adjust to minute,
- (4) reserved,
- (5) adjust to preset time,
- (6) shift time

For the detailed OBIS codes, see Table 57.

Electricity related general purpose objects	IC	OBIS code					
		A	B	C	D	E	F
Program entries	1, Data	1	*b*	0	2	*e*	255
Output pulse values or constants	1, Data 3, Register 4, Extended Register	1	*b*	0	3	*e*	255
Reading factor and CT/VT ratio		1	*b*	0	4	*e*	255
Nominal values	3, Register 4, Extended Register	1	*b*	0	6	*e*	255
Input pulse values or constants	1, Data 3, Register 4, Extended Register	1	*b*	0	7	*e*	255
Measurement period- / recording interval- / billing period duration	1, Data 3, Register 4, Extended Register	1	*b*	0	8	*e*	255
Time entries		1	*b*	0	9	*e*	255
Transformer and line loss coefficients	3, Register 4, Extended Register	1	*b*	0	10	*e*	255

6.3.5 Measurement algorithm

These values are represented by instances of the IC “Data”, with data type *enum*.

Measurement algorithm objects	IC	OBIS code					
		A	B	C	D	E	F
Measuring algorithm for active power	1, Data	1	*b*	0	11	1	255
Measurement algorithm for active energy		1	*b*	0	11	2	255
Measurement algorithm for reactive power		1	*b*	0	11	3	255
Measurement algorithm for reactive energy		1	*b*	0	11	4	255
Measurement algorithm for apparent power		1	*b*	0	11	5	255
Measurement algorithm for apparent energy		1	*b*	0	11	6	255
Measurement algorithm for power factor calculation		1	*b*	0	11	7	255

The enumerated values are specified in Table 28:

Table 28 – Measuring algorithms – enumerated values

Measuring algorithm for active power and energy	
(0)	not specified
(1)	only the fundamentals of voltage and current are used
(2)	all harmonics of voltage and current are used
(3)	only the DC part of voltage and current is used
(4)	all harmonics and the DC part of voltage and current are used
Measuring algorithm for reactive power and energy	
(0)	not specified

(1)	(sum of) reactive power of each phase, calculated from the fundamental of the per phase voltage and the per phase current
(2)	polyphase reactive power calculated from polyphase apparent power and polyphase active power
(3)	(sum of) reactive power calculated from per phase apparent power and per phase active power
Measurement algorithm for apparent power and energy	
(0)	not specified
(1)	$S = U \times I$, with voltage: only fundamental, and current: only fundamental
(2)	$S = U \times I$, with voltage: only fundamental, and current: all harmonics
(3)	$S = U \times I$, with voltage: only fundamental, and current: all harmonics and DC part
(4)	$S = U \times I$, with voltage: all harmonics, and current: only fundamental
(5)	$S = U \times I$, with voltage: all harmonics, and current: all harmonics
(6)	$S = U \times I$, with voltage: all harmonics, and current: all harmonics and DC part
(7)	$S = U \times I$, with voltage: all harmonics and DC part, and current: only fundamental
(8)	$S = U \times I$, with voltage: all harmonics and DC part, and current: all harmonics
(9)	$S = U \times I$, with voltage: all harmonics and DC part, and current: all harmonics and DC part
(10)	$S = \sqrt{P^2 + Q^2}$, with P: only fundamental in U and I, and Q: only fundamental in U and I, where P and Q are polyphase quantities
(11)	$S = \sqrt{P^2 + Q^2}$, with P: all harmonics in U and I, and Q: only fundamental in U and I where P and Q are polyphase quantities
(12)	$S = \sqrt{P^2 + Q^2}$, with P: all harmonics and DC part in U and I, and Q: only fundamental in U and I where P and Q are polyphase quantities
(13)	$S = \Sigma\sqrt{P^2 + Q^2}$, with P: only fundamental in U and I, and Q: only fundamental in U and I where P and Q are single phase quantities
(14)	$S = \Sigma\sqrt{P^2 + Q^2}$, with P: all harmonics in U and I, and Q: only fundamental in U and I where P and Q are single phase quantities
(15)	$S = \Sigma\sqrt{P^2 + Q^2}$, with P: all harmonics and DC part in U and I, and Q: only fundamental in U and I where P and Q are single-phase quantities
Measurement algorithm for power factor calculation	
(0)	not specified
(1)	displacement power factor: the displacement between fundamental voltage and current vectors, which can be calculated directly from fundamental active power and apparent power, or another appropriate algorithm,
(2)	true power factor, the power factor produced by the voltage and current, including their harmonics . It may be calculated from apparent power and active power, including the harmonics.

6.3.6 Metering point ID (electricity related)

A series of objects are available to hold electricity related metering point IDs. They are held by the *value* attribute of "Data" objects, with data type *unsigned, long-unsigned, double-long unsigned*, *octet-string* or *visible-string.* If more than one of those is used, it is allowed to combine them into one instance of the IC "Profile generic". In this case, the captured objects are the *value* attributes of the electricity related metering point ID “Data” objects, the capture period is 1 to have just actual values, the sort method is FIFO, the profile entries are limited to 1. Alternatively, an instance of the IC “Register table” can be used. For detailed OBIS codes, see Table 57.

Metering point ID objects	**IC**	**OBIS code**					
		A	**B**	**C**	**D**	**E**	**F**
Metering point ID 1…10 (electricity related)	1, Data [a]	1	*b*	96	1	0…9	255
Metering point ID-s object	7, Profile generic	1	*b*	96	1	255	255
Metering point ID-s object	64, Register table	1	*b*	96	1	255	255
[a] If the IC “Data” is not available, “Register” (with scaler = 0, unit = 255) may be used.							

6.3.7 Electricity related status objects

A number of electricity related objects are available to hold information about the internal operating status, the starting of the meter and the status of voltage and current circuits.

The status is held by the value attribute of a “Data” object, with data type *boolean, bit-string, unsigned, long-unsigned, double-long-unsigned, long64-unsigned or octet-string.*

Alternatively, the status is held by a “Status mapping” object, which holds both the status word and the mapping of its bits to the reference table.

If there are several electricity related internal operating status objects used, it is allowed to combine them into an instance of the IC “Profile generic” or “Register table”, using the OBIS code of the global internal operating status. For detailed OBIS codes, see Table 57.

Electricity related status objects	**IC**	**OBIS code**					
		A	**B**	**C**	**D**	**E**	**F**
Internal operating status signals, electricity related, contents manufacturer specific	1, Data	1	*b*	96	5	0…5	255
Internal operating status signals, electricity related, contents mapped to reference table	63, Status mapping	1	*b*	96	5	0…5	255
Electricity related status data, contents manufacturer specific	1, Data	1	*b*	96	10	0…3	255
Electricity related status data, contents mapped to reference table	63, Status mapping	1	*b*	96	10	0…3	255

6.3.8 List objects – Electricity (class_id = 7)

These COSEM objects are used to model lists of any kind of data, for example measurement values, constants, statuses, events. They are modelled by “Profile generic” objects.

One standard object per billing period scheme is defined. See also 7.5.5.3.

List objects – Electricity	IC	OBIS code					
		A	B	C	D	E	F
For names and OBIS codes see Table 59.	7, Profile generic	1	*b*	98	*d*	*e*	255[a]

[a] F = 255 means a wildcard here. See 7.11.3.

6.3.9 Threshold values

A number of objects are available for representing thresholds for instantaneous quantities. The thresholds may be “under limit”, “over limit”, “missing” and “time thresholds”. Time thresholds are used to detect “under limit”, “over limit” and “missing” conditions.

Objects are also available to represent the number of occurrences when these thresholds are exceeded, the duration of such events and the magnitude of the quantity during such events.

These values are represented by instances of IC “Data”, “Register” or “Extended register”.

All these quantities may be related to tariffs.

As defined in 7.5.4.2, value group F may be used to identify multiple thresholds.

For OBIS codes, see Table 29 below and Table 51.

Table 29 – Threshold objects, electricity

<table>
<tr><th rowspan="2">Threshold objects</th><th rowspan="2">IC</th><th colspan="6">OBIS code</th></tr>
<tr><th>A</th><th>B</th><th>C</th><th>D</th><th>E</th><th>F</th></tr>
<tr><td>Threshold objects for instantaneous values</td><td rowspan="2">1, Data,
3, Register,
4, Extended register</td><td>1</td><td>b</td><td>1…10, 13, 14, 16…20, 21…30, 33, 34, 36…40, 41…50, 53, 54, 56…60, 61…70, 73, 74, 76…80, 82, 84…89</td><td rowspan="2">31…34, 35…38, 39…42, 43…45</td><td>0…63</td><td rowspan="2">0…99, 255</td></tr>
<tr><td>Threshold objects for harmonics of voltage, current and active power</td><td>1</td><td>b</td><td>11, 12, 15, 31, 32, 35, 51, 52, 55, 71, 72, 75, 90…92</td><td>0…120, 124…127</td></tr>
</table>

For monitoring the supply voltage, a more sophisticated functionality is also available, that allows counting the number of occurrences classified by the duration of the event and the depth of the voltage dip. For OBIS codes, see 7.5.3.6, Table 57.

6.3.10 Register monitor objects (class_id = 21)

Further to 6.2.13, the following definitions apply:

- for monitoring thresholds of instantaneous values, the logical name of the “Register monitor” object may be the OBIS identifier of the threshold;
- for monitoring current average and last average values, the logical name of the “Register monitor” object may be the OBIS identifier of the demand value monitored.

See Table 30.

Table 30 – Register monitor objects, electricity

<table>
<tr><th rowspan="2">Register monitor objects</th><th rowspan="2">IC</th><th colspan="6">OBIS code</th></tr>
<tr><th>A</th><th>B</th><th>C</th><th>D</th><th>E</th><th>F</th></tr>
<tr><td rowspan="2">Instantaneous values, under limit / over limit / missing</td><td rowspan="4">21, Register monitor</td><td>1</td><td>b</td><td>c1</td><td rowspan="2">31, 35, 39</td><td>0-63</td><td rowspan="4">0-99, 255</td></tr>
<tr><td>1</td><td>b</td><td>c2</td><td>0-120, 124-127</td></tr>
<tr><td rowspan="2">Current average and last average values</td><td>1</td><td>b</td><td>c1</td><td rowspan="2">4, 5, 14, 15, 24, 25</td><td>0-63</td></tr>
<tr><td>1</td><td>b</td><td>c2</td><td>0-120, 124-127</td></tr>
<tr><td colspan="8">c1 = 1-10, 13,14, 16-20, 21-30, 33,34, 36-40, 41-50, 53,54, 56-60, 61-70, 73,74, 76-80, 82, 84-89.
c2 = 11, 12, 15, 31, 32, 35, 51, 52, 55, 71, 72, 75, 90-92.</td></tr>
</table>

For the use of value group D, see Table 51.

For the use of value group E, see Table 52 and Table 53.

For the use of value group F, see 7.5.4.2.

6.4 HCA related COSEM objects

6.4.1 General

The use of interface classes to represent various data is described in the following tables.

Grouping the data by major categories supports the link between the data and the OBIS value groups associated with them.

6.4.2 ID numbers – HCA

The different HCA ID numbers are held by instances of the IC "Data", with data type *unsigned, long-unsigned, double-long-unsigned, long64-unsigned, octet-string* or *visible-string*.

If more than one of those is used, it is allowed to combine them into a "Profile generic" object. In this case, the captured objects are *value* attributes of the HCA ID data objects, the capture period is 1 to have just actual values, the sort method is FIFO, the profile entries are limited to 1. Alternatively, an instance of the IC “Register table” can be used. See also Table 65.

HCA ID	**3IC**	**OBIS code**					
		A	**B**	**C**	**D**	**E**	**F**
HCA ID 1…10 object	1, Data	4	*b*	0	0	0…9	255
HCA ID-s object	7, Profile generic	4	*b*	0	0	255	255
HCA ID-s object	61, Register table	4	*b*	0	0	255	255

6.4.3 Billing period values / reset counter entries - HCA

These values are represented by instances of the IC "Data”.

For billing period / reset counters and for number of available billing periods the data type shall be *unsigned*, *long-unsigned* or *double-long-unsigned*. For time stamps of billing periods, the data type shall be *double-long-unsigned* (in the case of UNIX time), *octet-string, date* or *date-time* formatted as specified in 4.1.6.1. These objects may be related to channels.

When the values of historical periods are represented by “Profile generic” objects, the time stamp of the billing period objects shall be part of the captured objects.

Billing period values / reset counter entries objects “Storage information”	**IC**	**OBIS code**					
		A	**B**	**C**	**D**	**E**	**F**
For item names and OBIS codes see See Table 65.	1, Data	4	*b*	0	1	1,2, 10, 11	255

6.4.4 General purpose objects – HCA

The use of ICs shall be as specified below:

- *Configuration entries* are represented by instances of the IC "Data" with data type *unsigned, long-unsigned* or *octet-string* or *enumerated*. Configuration entries can also be related to a channel;
- *Device measuring principle* values are represented by instances of the IC “Data” with data type *unsigned* or *enumerated* for the *value* attribute;

Enum	Value
(0)	Single sensor
(1)	Single sensor + start sensor
(2)	Dual sensor
(3)	Triple sensor
Other	reserved

- *Conversion factor* values are represented by instances of the IC “Data”, "Register" or “Extended register”. For the *value* attribute, only simple data types are allowed;
- *Threshold values* are represented by instances of the IC "Register" or “Extended register”. For the *value* attribute, only simple data types are allowed;
- *Period values* are represented by instances of IC “Data”, “Register” or “Extended register” with the data type of the *value* attribute *unsigned*, *long-unsigned* or *double-long-unsigned*;
- *Time entry* values are represented by instances of IC “Data”, “Register” or “Extended register” with the data type of the *value* attribute *double-long-unsigned* (in the case of UNIX time), *octet-string, date* or *date-time* formatted as specified in 4.1.6.1.

General purpose objects – HCA related [a]	**IC**	**OBIS code**					
		A	**B**	**C**	**D**	**E**	**F**
Configuration objects	1, Data	4	*b*	0	2	0-2	255
Device measuring principle	1, Data	4	*b*	0	2	3	255
Conversion factors	1, Data or 3, Register or 4, Extended register	4	*b*	0	4	0-6	255
Threshold values	3, Register or 4, Extended register	4	*b*	0	5	10-11	255
Period information	1, Data or 3, Register or 4, Extended register	4	*b*	0	8	0,4,6	255
Time entries	1, Data or 3, Register or 4, Extended register	4	*b*	0	9	1-3	255
[a] For item names and OBIS codes see Table 65.							

6.4.5 Measured Values – HCA

6.4.5.1 Consumption – HCA

The use of ICs shall be as specified below:

Consumption values are represented by instances of the IC "Register", "Extended register" or "Profile generic" with data types *double-long,double-long-unsigned, octet-string, visible-string, integer, long,unsigned, long-unsigned, long64, long64-unsigned, float32* or *float64*.

Consumption	IC	OBIS code					
		A	B	C [a]	D [b]	E [c]	F
Integral value, current	3, Register or 4, Extended register	4	*b*	1, 2	0	0	255
Integral value over measurement periods (periodical value)					1		0…99 101… 125, 255
Integral value relative to billing periods (Set date value, Billing date value)					2,3		
Minimum, Maximum of integral value over billing periods	4, Extended register or 7, Profile generic				4,5		
Integral test value	3, Register, 4, Extended register, or 7, Profile generic				6		255

[a] See Table 62– Value group C codes - HCA
[b] See Table 63– Value group D codes – HCA
[c] No further classification in value group E is made. Therefore, E shall be 0.

6.4.5.2 Temperature Values – HCA

The use of ICs shall be as specified below:

The objects are used to represent temperature information as measurand values.

Temperature values are represented by instances of the IC "Register", "Extended register" or "Profile generic".

Temperature	IC	OBIS code					
		A	B	C [a]	D [b]	E [c]	F
Temperature value, current	3, Register or 4, Extended register	4	*b*	3..7	0	255	255
Minimum, Maximum of temperature	4, Extended register, or 7, Profile generic				4,5		
Temperature test value	3, Register, 4, Extended register, or 7, Profile generic				6		

[a] See Table 62– Value group C codes – HCA
[b] See Table 63– Value group D codes – HCA
[c] Value group E not used. Therefore, E shall be 255.

6.4.6 Error register objects – HCA

A series of objects are used to communicate error indications of the device. See also Table 69.

The different error registers are held by the *value* attribute of "Data", "Register" or "Extended register" objects, with data type *bit-string*, *octet-string, unsigned, long-unsigned, double-long-unsigned* or *long64-unsigned.*

Error register objects - HCA	IC	OBIS code					
		A	B	C	D	E	F
Error register objects	1, Data or 3, Register or 4, Extended register	4	*b*	97	97	e	255

6.4.7 List objects – HCA

The use of ICs shall be as specified below:

These COSEM objects are used to model lists of any kind of data, for example measurement values, constants, statuses, events. They are modelled by "Profile generic" objects. Examples are present in 7.6.5.3.

List objects – HCA	IC	OBIS code					
		A	B	C	D	E	F
For names and OBIS codes see XX	7, Profile generic	4	*b*	98	*d*	*e*	255[a]
[a] F = 255 means a wildcard here. See 7.6.							

6.4.8 Data profile objects – HCA

The use of ICs shall be as specified below:

HCA related data profiles – identified with one single OBIS code – are used to hold a series of measurement values of one or more similar quantities and/or to group various data. See also 7.6.4.4.

Data profile objects - HCA	IC	OBIS code					
		A	B	C	D	E	F
Data profile objects	7, Profile generic	4	*b*	99	1	e	255

6.5 Thermal energy meter related COSEM objects

6.5.1 General

The use of interface classes to represent various data is described in the following tables.

Grouping the data by major categories supports the link between the data and the OBIS value groups associated with them.

6.5.2 ID numbers – Thermal energy meter

The different thermal energy meter ID numbers are held by instances of the IC "Data", with data type *unsigned, long-unsigned, double-long-unsigned, long64-unsigned, octet-string* or *visible-string*.

If more than one of those is used, it is allowed to combine them into a "Profile generic" object. In this case, the captured objects are *value* attributes of the thermal meter ID data objects, the capture period is 1 to have just actual values, the sort method is FIFO, the profile entries are limited to 1. Alternatively, an instance of the IC “Register table” can be used. See also Table 73

Thermal energy meter ID	**IC**	**OBIS code**					
		A	**B**	**C**	**D**	**E**	**F**
Thermal energy meter ID 1…10 object	1, Data	5/6	*b*	0	0	0…9	255
Thermal energy meter ID-s object	7, Profile generic	5/6	*b*	0	0	255	255
Thermal energy meter ID-s object	61, Register table	5/6	*b*	0	0	255	255

6.5.3 Billing period values / reset counter entries - Thermal energy meter

These values are represented by instances of the IC "Data”.

For billing period / reset counters and for number of available billing periods the data type shall be *unsigned*, *long-unsigned* or *double-long-unsigned*. For time stamps of billing periods, the data type shall be *double-long-unsigned* (in the case of UNIX time), *octet-string* or *date-time* formatted as specified in 4.1.6.1.

These objects may be related to channels.

When the values of historical periods are represented by “Profile generic” objects, the time stamp of the billing period objects shall be part of the captured objects.

Billing period values / reset counter entries objects “Storage information”	**IC**	**OBIS code**					
		A	**B**	**C**	**D**	**E**	**F**
For item names and OBIS codes see Table 73.	1, Data	5/6	*b*	0	1	1,2, 10, 11	1,2, 255

6.5.4 General purpose objects – Thermal energy meter

The use of ICs shall be as specified below:

- *Configuration entries* are represented by instances of the IC "Data" with data type *unsigned, long-unsigned* or *octet-string*. Configuration entries can also be related to a channel;
- *Conversion factor* values are represented by instances of the IC “Data”, "Register" or “Extended register”. For the *value* attribute, only simple data types are allowed;
- *Threshold values* are represented by instances of the IC "Register" or “Extended register”. For the *value* attribute, only simple data types are allowed;
- *Timing information for averaging, measurement, billing periods and recording interval is* presented by instances of IC “Data”, “Register” or “Extended register” with the data type of the *value* attribute *unsigned*, *long-unsigned* or *double-long-unsigned*;
- *Time entry* values are represented by instances of IC “Data”, “Register” or “Extended register” with the data type of the *value* attribute *double-long-unsigned* (in the case of UNIX time), *octet-string* or *date-time* formatted as specified in 4.1.6.1.

General purpose objects – Thermal energy meter related [a]	**IC**	**OBIS code**					
		A	**B**	**C**	**D**	**E**	**F**
Configuration objects	1, Data	5/6	*b*	0	2	0-4, 10 -13	255
Conversion factors	1, Data	5/6	*b*	0	4	1-3	255
Threshold values	3, Register or 4, Extended register	5/6	*b*	0	5	1-9, 21-24	255
Timing information	1, Data	5/6	*b*	0	8	0-7, 11-14, 21-25, 31-34	255
Time entries	1, Data	5/6	*b*	0	9	1-3	255

[a] For item names and OBIS codes see Table 73.

6.5.5 Measured values - Thermal energy meter

6.5.5.1 Consumption – Thermal energy meter

The use of ICs shall be as specified below:

Consumption values are represented by instances of the IC "Register", “Extended register” or “Profile generic” with data types *double-long,double-long-unsigned, octet-string, visible-string, integer, long,unsigned, long-unsigned, long64, long64-unsigned, float32* or *float64*.

<table>
<tr><th rowspan="2">Consumption</th><th rowspan="2">IC</th><th colspan="6">OBIS code</th></tr>
<tr><th>A</th><th>B</th><th>C[a]</th><th>D[b]</th><th>E[c]</th><th>F</th></tr>
<tr><td>Energy, volume, mass values</td><td>3, Register or
4, Extended register,
or 7, Profile generic</td><td rowspan="6">5/6</td><td rowspan="6">b</td><td rowspan="6">1…7</td><td>0…3, 7</td><td rowspan="5">0,
1…9</td><td>255</td></tr>
<tr><td>Integral value relative to billing periods</td><td>3, Register or
4, Extended register,
or 7, Profile generic</td><td>3, 8, 9</td><td>0…99,
101…125,
255</td></tr>
<tr><td>Periodical value</td><td>3, Register or
4, Extended register,
or 7, Profile generic</td><td>1,12,13</td><td rowspan="3">0…99,
101…125</td></tr>
<tr><td>Set date value</td><td>3, Register or
4, Extended register,
or 7, Profile generic</td><td>2</td></tr>
<tr><td>Minimum, Maximum of integral value over billing periods</td><td>3, Register or
4, Extended register,
or 7, Profile generic</td><td>4, 5, 14, 15</td></tr>
<tr><td>Integral test value</td><td>3, Register,
4, Extended register</td><td>6</td><td>255</td><td>255</td></tr>
<tr><td colspan="8">[a] See Table 70– Value group C codes – thermal energy meters
[b] See Table 71– Value group D codes - thermal energy meters
[c] All other values reserved for further use (tariff rate E=0 means Total)</td></tr>
</table>

6.5.5.2 Monitoring values – Thermal energy meter

The use of ICs shall be as specified below:

The objects are to be used to represent information as monitored values.

Monitoring values are held by the *value* attribute of “Register” or “Extended register“ objects with data types *double-long,double-long-unsigned, octet-string, visible-string, integer, long,unsigned, long-unsigned, long64, long64-unsigned, float32* or *float64*.

<table>
<tr><th rowspan="2">Monitoring values</th><th rowspan="2">IC</th><th colspan="6">OBIS code</th></tr>
<tr><th>A</th><th>B</th><th>C[a]</th><th>D[b]</th><th>E[c]</th><th>F</th></tr>
<tr><td>Energy, volume, mass
Maximum of integral value</td><td>4, Extended register, or
7, Profile generic</td><td rowspan="8">5/6</td><td rowspan="8">b</td><td>1…7</td><td>5,15</td><td rowspan="8">0,
1..9</td><td rowspan="2">0…99,
101…125
, 255</td></tr>
<tr><td>Power or flow rate values</td><td>3, Register, or
4, Extended register, or
7, Profile generic</td><td>8,9</td><td>1, 4, 5,
12…15</td></tr>
<tr><td>Temperature or pressure value, current</td><td>3, Register or
4, Extended register, or
7, Profile generic</td><td rowspan="4">10… 13</td><td>0</td><td>255</td></tr>
<tr><td>Minimum, Maximum of temperature or pressure</td><td>4, Extended register, or
7, Profile generic</td><td>4, 5, 14, 15</td><td>0…99,
101…125</td></tr>
<tr><td>Temperature or pressure test, instantaneous value</td><td>3, Register, or
4, Extended register</td><td>6,7</td><td rowspan="4">255</td></tr>
<tr><td>Average values of temperature or pressure</td><td>5, Demand register, or
7, Profile generic</td><td>10,11</td></tr>
<tr><td>Occurrence counters</td><td>3, Register, or
4, Extended register, or
7, Profile generic</td><td rowspan="2">1…13</td><td>20, 22, 24</td></tr>
<tr><td>Occurrence durations</td><td>3, Register, or
4, Extended register, or
7, Profile generic</td><td>21, 23, 25</td></tr>
<tr><td colspan="8">[a] See Table 70 – Value group C codes – Thermal energy meter
[b] See Table 71 – Value group D codes - Thermal energy meter
[c] All other values reserved for further use (tariff rate E=0 means Total)</td></tr>
</table>

6.5.6 Error register objects – Thermal energy meter

A series of objects are used to communicate error indications of the device. See also Table 74.

The different error registers are held by the value attribute of "Data", "Register" or "Extended register" objects, with data type *bit-string, octet-string, unsigned, long-unsigned, double-long-unsigned* or *long64-unsigned.*

– Error register objects – Thermal energy meters	**IC**	**OBIS code**					
		A	**B**	**C**	**D**	**E**	**F**
Overall error status [a]	1, Data or 3, Register or 4, Extended register	5/6	*b*	97	97	0	255
Subsystem where error has occurred [b]		5/6	*b*	97	97	1	255
Duration of error condition [c]		5/6	*b*	97	97	2	255
a	This object is a 'mirror' of the object 0.x.97.97.0.						
b	A further subdivision of error information.						
c	This is the time during which the meter has not been able to calculate energy.						

6.5.7 List objects – Thermal energy meter

These COSEM objects are used to model lists of any kind of data, for example measurement values, constants, statuses, events. They are modelled by "Profile generic" objects.

List objects – Thermal energy meter	**IC**	**OBIS code**					
		A	**B**	**C**	**D**	**E**	**F**
For names and OBIS codes see XX	7, Profile generic	5/6	*b*	98	*d*	*e*	255[a]
[a] F = 255 means a wildcard here. Also note 7.7.4.3.							

6.5.8 Data profile objects – Thermal energy meter

Thermal energy meter related data profiles – identified with one single OBIS code – are used to hold a series of measurement values of one or more similar quantities and/or to group various data.

Data profile objects – Thermal energy meters	**IC**	**OBIS code**					
		A	**B**	**C**	**D**	**E**	**F**
Data profile objects. For names and OBIS codes see Table 77.	7, Profile generic	5/6	*b*	99	1	1-3	255
					2	1-3	
					3	1	
					99	e	

6.6 Gas related COSEM objects

NOTE The reader is advised to refer to 7.8.1, General introduction to gas measurement before reading this section.

6.6.1 General

The use of interface classes to represent various data is described in the following tables.

Grouping the data by major categories supports the link between the data and the OBIS value groups associated with them.

6.6.2 ID numbers – Gas

The different gas ID numbers are represented by instances of the IC "Data", with data type *unsigned, long-unsigned, double-long-unsigned, octet-string or visible-string.*

If more than one of those is used, it is allowed to combine them into a "Profile generic" object. In this case, the captured objects are *value* attributes of the gas ID data objects, the capture period is 1 to have just actual values, the sort method is FIFO, the profile entries are limited to 1. Alternatively, an instance of the IC "Register table" can be used. See also Table 89.

Gas ID	IC	OBIS code					
		A	B	C	D	E	F
Gas ID 1…10 object	1, Data	7	*b*	0	0	0…9	255
Gas ID-s object	7, Profile generic	7	*b*	0	0	255	255
Gas ID-s object	61, Register table	7	*b*	0	0	255	255

6.6.3 Billing period values / reset counter entries – Gas

Billing period values are represented by instances of the IC "Data".

For billing period / reset counters and for number of available billing periods the data type shall be *unsigned*, *long-unsigned* or *double-long-unsigned*. For time stamps of billing periods, the data type shall be *double-long-unsigned* (in the case of UNIX time), *octet-string* or *date-time* formatted as specified in 4.1.6.1.

These objects may be related to channels.

When the values of historical periods are represented by "Profile generic" objects, the time stamp of the billing period objects shall be part of the captured objects.

Billing period values / reset counter entries objects	IC	OBIS code					
		A	B	C	D	E	F
For item names and OBIS codes see Table 89	1, Data	7	*b*	0	1	*e*	255

6.6.4 Other general purpose objects – Gas

Configuration entries are represented by instances of the IC "Data" with data type *unsigned, long-unsigned* or *octet-string* or *enumerated*. Configuration entries can also be related to a channel.

For the digital and analogue output configuration objects the enumerated values are specified in Table 31 below.

Table 31 – Digital / Analogue output configurations – enumerated values

Digital output configuration	
(0)	Output switched off (transistor blocking, "switch open")
(1)	Volume pulse output, logic active
(2)	Status output, logic active (signalling active => output switched on)
(3)	Time-synchronised output, logic active
(4)	Output switched on (transistor conducting, "switch closed")
(5)	Volume pulse output, logic inactive
(6)	Status output, logic inactive (signalling active => output switched off)
(7)	Time-synchronised output, logic inactive
(8)	High frequency pulse output
(9)	Event output, logic active (message active => output switched on)
(10)	Event output, logic inactive (message active => output switched off)
(99)	Continuous pulse (for test purposes)
Analogue output configuration	
(0)	inactive
(1)	1= 4–20 mA
(2)	2= 0–20 mA
(3)	3= Voltage output

The use of ICs shall be as specified below:

- Output pulse constant values are represented by instances of the IC “Data”, "Register" or “Extended register”. For the *value* attribute, only simple data types are allowed;
- Conversion factor values are represented by instances of the IC “Data”, "Register" or “Extended register”. For the *value* attribute, only simple data types are allowed;
- Threshold values are represented by instances of the IC "Register" or “Extended register”. For the *value* attribute, only simple data types are allowed;
- Nominal values of volume sensors are represented by instances of the IC "Register" or “Extended register”. For the *value* attribute, only simple data types are allowed;
- Input pulse constant values are represented by instances of the IC “Data”, "Register" or “Extended register”. For the *value* attribute, only simple data types are allowed;
- Interval and period values are represented by instances of IC “Data”, “Register” or “Extended register” with the data type of the *value* attribute *unsigned*, *long-unsigned* or *double-long-unsigned*;
- Time entry values are represented by instances of IC “Data”, “Register” or “Extended register” with the data type of the *value* attribute *octet-string*, formatted as *date-time* in 4.1.6.1. The data types *unsigned*, *integer*, *long-unsigned* or *double-long-unsigned* can also be used where appropriate;
- Station management information values are represented by instances of the IC "Register" or “Extended register”. For the *value* attribute, only simple data types are allowed;
- Gas parameters for volume conversion currently used in compressibility calculation values are represented by instances of the IC “Data”, "Register" or “Extended register”. For the *value* attribute, only simple data types are allowed;

- Gas measuring method specific parameters, including gas parameters for Venturi measurement and for density measurement are represented by instances of the IC “Data”, "Register" or “Extended register”. For the *value* attribute, only simple data types are allowed.
- “Sensor manager” objects – see 4.5.11 – manage complex information related to sensors. See 4.5.11. This interface class will be used by the following (metrological) sensors e.g. in gas applications:
  - absolute temperature;
  - absolute pressure;
  - velocity of sound;
  - density of gas;
  - relative density;
  - gauge pressure;
  - differential pressure;
  - density of air.

  Value group E of the OBIS code can be mapped to the value group C codes, identifying the various physical quantities, see Table 79. The possible values are 41, 42, 44, 45...49.

  EXAMPLE Absolute pressure sensor manager object OBIS code 7.0.0.15.42.255.

  If there is more than one sensor for the same physical quantity, then value group B shall be used to identify the sensors.

For detailed item names and OBIS codes see Table 89.

Gas related general purpose objects	IC	OBIS code					
		A	B	C	D	E	F
Configuration objects	1, Data	7	*b*	0	2	*e*	255
Output pulse constants converted / unconverted	1, Data	7	*b*	0	3	*e*	255
Conversion factors	1, Data	7	*b*	0	4	*e*	255
Threshold values	3, Register or 4, Extended register	7	*b*	0	5	*e*	255
Nominal values volume sensor	3, Register or 4, Extended register	7	*b*	0	6	*e*	255
Input pulse constants	1, Data	7	*b*	0	7	*e*	255
Intervals and periods	1, Data	7	*b*	0	8	*e*	255
Time entries	1, Data	7	*b*	0	9	*e*	255
Station management information	3, Register or 4, Extended register	7	*b*	0	10, 11	*e*	255
Gas parameters for volume conversion, currently used in compressibility calculation	1, Data, 3, Register or 4, Extended register	7	*b*	0	12	*e*	255
Gas measuring method specific parameters	1, Data, 3, Register or 4, Extended register	7	*b*	0	13, 14	*e*	255
Sensor manager objects	67, Sensor manager	7	*b*	0	15	*e*	255

6.6.5 Internal operating status objects – Gas

A number of gas related objects are available to hold information about the *internal operating status.* The status is held by the *value* attribute of a "Data" object, with data type *unsigned, long-unsigned, double-long-unsigned, long64-unsigned, octet-string, boolean or bit-string.* Alternatively, the status is held by a "Status mapping" object, which holds both the status word and the mapping of its bits to the reference table. If there are several gas related internal operating status objects used, it is allowed to combine them into an instance of the IC "Profile generic" or "Register table", using the OBIS code of the global internal operating status.

Gas related internal operating status objects	IC	OBIS code					
		A	B	C	D	E	F
Internal operating status signals, gas related, content manufacturer specific	1, Data	7	*b*	96	5	0…9	255
Internal operating status signals, gas related, content mapped to reference table	63, Status mapping	7	*b*	96	5	0…9	255

6.6.6 Measured values – Gas

6.6.6.1 Indexes and index differences – Gas

Table 32 shows the objects to be used to represent indexes and index differences of volume, mass and energy.

Table 32 – Indexes and index differences

<table>
<tr><th rowspan="2">Indexes and index differences</th><th rowspan="2">IC</th><th colspan="6">OBIS code</th></tr>
<tr><th>A</th><th>B</th><th>C[a]</th><th>D[b]</th><th>E[c]</th><th>F</th></tr>
<tr><td>Index</td><td rowspan="4">Register or Extended register</td><td></td><td></td><td></td><td>0…3</td><td></td><td>255</td></tr>
<tr><td>Index relative to billing periods</td><td rowspan="4">7</td><td rowspan="4">b</td><td rowspan="4">1…8, 11…16, 21…26, 31…36, 61…66</td><td>24…26
42…44
63…65
81…83</td><td rowspan="4">0, 1…63</td><td>0…99
101…126</td></tr>
<tr><td>Index difference over measurement periods</td><td>6….23</td><td>255</td></tr>
<tr><td>Index difference over billing periods</td><td>27…32, 45…50, 66…71, 84…89</td><td>255</td></tr>
<tr><td>Maximum of index differences over billing periods</td><td>Extended register, or Profile generic</td><td>33…41, 51…62, 72…80, 90…98</td><td>0…99
101…126, 255</td></tr>
<tr><td colspan="8">[a] See Table 79 – Value group C codes – Gas
[b] See Table 80 – Value group D codes – Gas – Indexes and index differences
[c] See Table 85 – Value group E codes – Gas – Indexes and index differences – Tariff rates</td></tr>
</table>

6.6.6.2 Flow rate – Gas

Table 33 shows the objects to be used to represent flow rate values.

Table 33 – Flow rate

Flow rate	IC	OBIS code					
		A	B	C[a]	D[b]	E	F
Flow rate, instantaneous values	Register or Extended register	7	*b*	43	0, 1, 2, 13,	0	255
Flow rate current average and last average values over averaging periods	Register, Extended register or Demand register				15…18, 19…22, 35…38, 39…42, 55…58, 59…62, 63…66, 67…70	0	255
Maximum of last averages of flow rates relative to measuring period	Extended register or Profile generic				23…26, 27…30, 43…46, 47…50		255
Maximum of last averages of flow rates relative to billing period 1	Extended register or Profile generic				31…34, 51…54	0	0…99, 101…126, 255

[a] See Table 79 – Value group C codes – Gas
[b] See Table 81 – Value group D codes – Gas – Flow rate

6.6.6.3 Process values – Gas

Table 34 shows the objects to be used to represent process values.

Table 34 – Process values

Process values	IC	OBIS code					
		A	B	C[a]	D[b]	E	F
Measurands of the gas process in different conditions, average values, minima and maxima relative to different process intervals	Register or Extended register	7	*b*	41, 42, 44…49	0, 2, 3, 10, 11, 13, 15…92	0	255

[a] See Table 79 – Value group C codes – Gas
[b] See Table 82 – Value group D codes – Gas – Process values

6.6.7 Conversion related factors and coefficients – Gas

Table 35 shows the objects available to represent correction, conversion, Compressibility, Superior calorific value and gas law deviation coefficient values. Various OBIS code allocations are made taking into consideration the specifics of the measuring process.

Table 35 – Conversion related factors and coefficients

Conversion related factors and coefficients	IC	OBIS code					
		A	B	C[a]	D[b]	E[c]	F
Process independent current value or weighted value	Register or Extended register	7	*b*	51…55	0, 2, 3, 10, 11	0,1	255
Current average and last average values						11…28	

[a] See Table 79 – Value group C codes – Gas
[b] See Table 83 – Value group D codes – Gas – Conversion related factors and coefficients
[c] See Table 86 – Value group E codes – Gas – Conversion related factors and coefficients

6.6.8 Calculation methods – Gas

Table 36 shows the OBIS codes of the objects used to identify calculation methods for correction, compression and compressibility calculation as well as for superior calorific value and gas law deviation coefficient.

Only one calculation method per calculation process can be in use, but gas measurement devices may have the capability to support various calculation methods. The choice of the methods may depend on regulation, national or company requirements etc. The use of these objects should be part of project specific companion specifications. The contents of the calculation methods listed are not defined in this document.

The calculation method is held by the *value* attribute with data types *octet-string*, *visible-string*, *unsigned*, *long-unsigned* or *enumerated*.

NOTE Calculation methods for compressibility factor Z can be found for example in ISO 12213-3, EN 12405-1, EN 12405-2 and AGA 8. EN 12405-1 also offers methods for volume conversion and EN 12405-2 for energy conversion.

Table 36 – Calculation methods

Calculation methods	IC	OBIS code					
		A	B	C[a]	D[b]	E[c]	F
Calculation methods	Data, Register or Extended register	7	*b*	51…55	12	0…20	255

[a] See Table 79 – Value group C codes – Gas
[b] See Table 83 – Value group D codes – Gas – Conversion related factors and coefficients
[c] See Table 87 – Value group E codes – Gas – Calculation methods – Value group E codes – Gas – Calculation methods

6.6.9 Natural gas analysis

Table 37 shows the objects to be used to represent values of natural gas analysis.

Table 37 – Natural gas analysis

Natural gas analysis	IC	OBIS code					
		A	**B**	**C[a]**	**D[b]**	**E[c]**	**F**
Reference values of gas analysis process	Register or Extended register	7	*b*	70	8,9	0	255
Gas characteristics Process independent current value, and weighted value	Register or Extended register	7	*b*	70	10…20, 60…84	0,1	255
Gas characteristics Average values for current and last intervals	Register or Extended register	7	*b*	70	10…20, 60…84	11…28	255

[a] See Table 79 – Value group C codes – Gas
[b] See Table 84 – Value group D codes – Gas – Natural gas analysis values
[c] See Table 88 – Value group E codes – Gas – Natural gas analysis values – Averages

6.6.10 List objects – Gas

These COSEM objects are used to model lists of any kind of data, for example measurement values, constants, statuses, events. They are modelled by "Profile generic" objects. See also 7.8.6.3.

One standard object per billing period scheme is defined. See also 7.8.6.3.

List objects - Gas	IC	OBIS code					
		A	**B**	**C**	**D**	**E**	**F**
For names and OBIS codes see Table 91 – OBIS codes for list objects – Gas.	7, Profile generic	7	*b*	98	*d*	*e*	255[a]

[a] F = 255 means a wildcard here. See 7.11.3.

6.7 Water meter related COSEM objects

6.7.1 General

The use of interface classes to represent various data is described in the following subclauses.

Grouping the data by major categories supports the link between the data and the OBIS value groups associated with them.

6.7.2 ID numbers – water meter

The different water meter ID numbers are instances of the IC "Data", with data type *unsigned, long-unsigned, double-long-unsigned, long64-unsigned, octet-string* or *visible-string.*

If more than one of those is used, it is allowed to combine them into a "Profile generic" object. In this case, the captured objects are *value* attributes of the water meter ID data objects, the capture period is 1 to have just actual values, the sort method is FIFO, the profile entries are limited to 1. Alternatively, an instance of the IC “Register table” can be used. See also Table 96.

Water meter ID	IC	OBIS code					
		A	B	C	D	E	F
Water meter ID 1…10 object	1, Data	8/9	*b*	0	0	0…9	255
Water meter ID-s object	7, Profile generic	8/9	*b*	0	0	255	255
Water meter ID-s object	61, Register table	8/9	*b*	0	0	255	255

6.7.3 Billing period values / reset counter entries – water meter

These values are represented by instances of the IC "Data”.

For billing period / reset counters and for number of available billing periods the data type shall be *unsigned*, *long-unsigned* or *double-long-unsigned*. For time stamps of billing periods, the data type shall be *double-long-unsigned* (in the case of UNIX time), *octet-string* or *date-time* formatted as specified in 4.1.6.1. These objects may be related to channels.

When the values of historical periods are represented by “Profile generic” objects, the time stamp of the billing period objects shall be part of the captured objects.

Billing period values / reset counter entries objects “Storage information”	IC	OBIS code					
		A	B	C	D	E	F
For item names and OBIS codes see Table 96.	1, Data	8/9	*b*	0	1	1,2, 10.. 12	255

6.7.4 General purpose objects – water meter

The use of ICs shall be as specified below:

- *Program entries* are represented by instances of the IC "Data" with data type *unsigned, long-unsigned* or *octet-string.* Program entries can also be related to a channel;
- *Threshold values* are represented by instances of the IC "Register" or "Extended register".
- *Input pulse constants* are represented by instances of the IC "Data", "Register" or "Extended register" with data type *unsigned, long-unsigned* or *octet-string. Input pulse constants* entries can also be related to a channel;
- *Timing information for measurement and registration periods is* presented by instances of IC "Data", "Register" or "Extended register" with the data type of the *value* attribute *unsigned*, *long-unsigned* or *double-long-unsigned*;
- *Time entry* values are represented by instances of IC "Data", "Register" or "Extended register" with the data type of the *value* attribute *double-long-unsigned* (in the case of UNIX time), *octet-string* or *date-time* formatted as specified in 4.1.6.1.

General purpose objects – Water meter related [a]	**IC**	**OBIS code**					
		A	**B**	**C**	**D**	**E**	**F**
Program entries	1, Data	8/9	*b*	0	2	0,3	255
Threshold values	3, Register or 4, Extended register	8/9	*b*	0	5	1	255
Input pulse constants	3, Register or 4, Extended register	8/9	*b*	0	7	1	255
Measurement-/registration period duration	1, Data 3, Register or 4, Extended register	8/9	*b*	0	8	1,6	255
Time entries	1, Data 3, Register or 4, Extended register	8/9	*b*	0	9	1-3	255

[a] For item names and OBIS codes see Table 96.

6.7.5 Measured values – water meter

6.7.5.1 Consumption – water meter

The use of ICs shall be as specified below:

Consumption values are held by the value attribute of “Register” or “Extended register“ objects with data types double-long,double-long-unsigned, octet-string, visible-string, integer, long, unsigned, long-unsigned, long64, long64-unsigned, float32 or float64.

Consumption	IC	OBIS code					
		A	B	C[a]	D[b]	E[c]	F
Accumulated volume	3, Register or 4, Extended register	8/9	*b*	1	0-3	0-12	255
					1-3		0-99, 101-125
Minimum, Maximum of integral value over billing periods	4, Extended register, or 7, Profile generic				4,5		
Integral test value	3, Register, 4, Extended register, or 7, Profile generic				6		255

[a] See. Table 93– Value group C codes - water meters
[b] See. Table 94 – Value group D codes - water meters
[c] All other values reserved for further use (tariff rate E=0 means Total)

6.7.5.2 Monitoring values – water meter

The use of ICs shall be as specified below:

Monitoring values are held by the *value* attribute of “Register” or “Extended register“ objects with data types *double-long,double-long-unsigned, octet-string, visible-string, integer, long,unsigned, long-unsigned, long64, long64-unsigned, float32* and *float64*.

Monitoring values	IC	OBIS code					
		A	B	C[a]	D[b]	E[c]	F
Flow rate values	3, Register or 4, Extended register	8/9	*b*	2	0-3	0-12	255
					1-3		0-99, 101-125
Minimum, Maximum of Flow rate	4, Extended register, or 7, Profile generic				4,5		
Flow rate test value	3, Register, 4, Extended register, or 7, Profile generic				6		255

Monitoring values	IC	OBIS code					
		A	B	C[a]	D[b]	E[c]	F
Temperature values	3, Register or 4, Extended register	8/9	*b*	3	0-3	0-12	255
					1-3		0..99, 101-125
Minimum, Maximum of temperature	4, Extended register, or 7, Profile generic				4,5		
Temperature test value	3, Register, 4, Extended register, or 7, Profile generic				6		255

[a] See Table 93 – Value group C codes - water meters
[b] See Table 94 – Value group D codes - water meters
[c] All other values reserved for further use (tariff rate E=0 means Total)

6.7.6 Error register objects – water meter

A series of objects are used to communicate error indications of the device. See also Table 97.

The different error registers are held by the *value* attribute of "Data", "Register" or "Extended register" objects, with data type *bit-string*, *octet-string, unsigned, long-unsigned, double-long-unsigned* or *long64-unsigned.*

Error register objects – Water meters –	IC	OBIS code					
		A	B	C	D	E	F
Error register objects	1, Data or 3, Register or 4, Extended register	8/9	*b*	97	97	e	255

6.7.7 List objects – water meter

These COSEM objects are used to model lists of any kind of data, for example measurement values, constants, statuses, events. They are modelled by "Profile generic" objects

List objects – Water meters	IC	OBIS code					
		A	B	C	D	E	F
List objects – water	7, Profile generic	8/9	*b*	98	*d*	*e*	255[a]

[a] F = 255 means a wildcard here.

6.7.8 Data profile objects – water meter

Water meter related data profiles – identified with one single OBIS code – are used to hold a series of measurement values of one or more similar quantities and/or to group various data.

Data profile objects – Water meters	IC	OBIS code					
		A	B	C	D	E	F
Data profile objects	7, Profile generic	8/9	*b*	99	1	*e*	255

6.8 Coding of OBIS identifications

To identify different instances of the same IC, their logical_name shall be different. In COSEM, the logical_name is taken from the OBIS definition (see 6.2, 6.3, 6.4, 6.5, 6.6, 6.7 and Clause 7).

OBIS codes are used within the COSEM environment as an *octet-string [6].* Each octet contains the unsigned value of the corresponding OBIS value group, coded without tags.

If a data item is identified by less than six value groups, all unused value groups shall be filled with 255.

Octet 1 contains the binary coded value of A (A = 0, 1, 2 ...9) in the four rightmost bits. The four leftmost bits contain the information on the identification system. The four leftmost bits set to zero indicate that the OBIS identification system (version 1) is used as *logical_name*.

Identification system used	Four leftmost bits of octet 1 (MSB left)
OBIS, see Clause 7.	0 0 0 0
Reserved for future use	0 0 0 1 … 1 1 1 1

Within all value groups, the usage of a certain selection is fully defined; others are reserved for future use. If in the value groups B to F a value belonging to the manufacturer specific range (see 7.2.2) is used, then the whole OBIS code shall be considered as manufacturer specific, and the value of the other groups does not necessarily carry a meaning defined neither by Clause 4 nor Clause 7 of this Technical Report.

7 COSEM Object Identification System (OBIS)

7.1 Scope

The OBject Identification System (OBIS) defines the identification codes for commonly used data items in metering equipment. This Clause 7 specifies the overall structure of the identification system and the mapping of all data items to their identification codes.

OBIS provides a unique identifier for all data within the metering equipment, including not only measurement values, but also abstract values used for configuration or obtaining information about the behaviour of the metering equipment. The ID codes defined in this document are used for the identification of:

- logical names of the instances of the ICs, the objects, as defined in Clauses 4 and 6;
- data transmitted through communication lines, see 7.11.1;
- data displayed on the metering equipment, see 7.11.2.

This document applies to all types of metering equipment, such as fully integrated meters, modular meters, tariff attachments, data concentrators etc.

To cover metering equipment measuring energy types other than electricity, combined metering equipment measuring more than one type of energy or metering equipment with several physical measurement channels, the concepts of medium and channels are introduced. This allows meter data originating from different sources to be identified.

7.2 OBIS code structure

7.2.1 Value groups and their use

OBIS codes identify data items used in energy metering equipment, in a hierarchical structure using six value groups A to F, see Table 38.

Table 38 – OBIS code structure and use of value groups

Value group	Use of the value group
A	Identifies the media (energy type) to which the metering is related. Non-media related information is handled as abstract data.
B	Generally, identifies the measurement channel number, i.e. the number of the input of a metering equipment having several inputs for the measurement of energy of the same or different types (for example in data concentrators, registration units). Data from different sources can thus be identified. It may also identify the communication channel, and in some cases it may identify other elements. The definitions for this value group are independent from the value group A.
C	Identifies abstract or physical data items related to the information source concerned, for example current, voltage, power, volume, temperature. The definitions depend on the value in the value group A. Further processing, classification and storage methods are defined by value groups D, E and F. For abstract data, value groups D to F provide further classification of data identified by value groups A to C.
D	Identifies types, or the result of the processing of physical quantities identified by values in value groups A and C, according to various specific algorithms. The algorithms can deliver energy and demand quantities as well as other physical quantities.
E	Identifies further processing or classification of quantities identified by values in value groups A to D.
F	Identifies historical values of data, identified by values in value groups A to E, according to different billing periods. Where this is not relevant, this value group can be used for further classification.

7.2.2 Manufacturer specific codes

In value groups B to F, the following ranges are available for manufacturer-specific purposes:

- group B: 128…199;
- group C: 128…199, 240;
- group D: 128…254;
- group E: 128…254;
- group F: 128…254.

If any of these value groups contain a value in the manufacturer specific range, then the whole OBIS code shall be considered as manufacturer specific, and the value of the other groups does not necessarily carry a meaning defined in Clause 6 or 7.

In addition, manufacturer specific ranges are defined in Table 45 with A = 0, C = 96, in Table 57 with A = 1, C = 96, in Table 65 with A = 4, C = 96, in Table 73 with A = 5/6, C = 96, in Table 89 with A = 7, C = 96 and in Table 96 with A = 8/9, C = 96.

7.2.3 Reserved ranges

By default, all codes not allocated are reserved. [2]

7.2.4 Summary of rules for manufacturer, utility, consortia and country specific codes

Table 39 summarizes the rules for manufacturer specific codes specified in 7.2.2, utility specific codes specified in 7.3.2, consortia specific codes specified in 7.3.4.2 and country specific codes specified in 7.3.4.3.

Table 39 – Rules for manufacturer, utility, consortia and country specific codes

Code type	Value group					
	A	B	C	D	E	F
Manufacturer specific [1]	0, 1, 4…9, F	128…199	*c*	*d*	*e*	*f*
		b	128… 199, 240	*d*	*e*	*f*
		b	*c*	128…254	*e*	*f*
		b	*c*	*d*	128…254	*f*
		b	*c*	*d*	*e*	128…254
Manufacturer specific abstract [2]	0	0…64	96	50…99	0…255	0…255
Manufacturer specific, media related general purpose [2]	1, 4…9, F	0…64	96	50…99	0…255	0…255
Utility specific [3]	0, 1, 4…9, F	65…127	0…255	0…255	0…255	0…255
Consortia specific [4]	0, 1, 4…9, F	0…64	93	See Table 43.		
Country specific [5]		0…64	94	See Table 44.		

[2] Administered by the DLMS User Association (see Foreword).

NOTE 1	“b”, “c”, “d”, “e”, “f” means any value in the relevant value group.
NOTE 2	The range D = 50…99 is available for identifying objects, which are not represented by another defined code, but need representation on the display as well. If this is not required, the range D = 128…254 should be used.
NOTE 3	If the value in value group B is 65…127, the whole OBIS code should be considered as utility specific and the value of other groups does not necessarily carry a meaning defined neither in Clause 6 nor Clause 7.
NOTE 4	The usage of value group E and F are defined in consortia specific documents.
NOTE 5	The usage of value group E and F are defined in country specific documents.

Objects for which this Technical Report defines standard identifiers shall not be re-identified by manufacturer, utility, consortia or country specific identifiers.

On the other hand, an object previously identified by a manufacturer-, utility-, consortia- or country- specific identifier may receive a standard identifier in the future, if its use is of common interest for the users of this document.

7.2.5 Standard object codes

Standard object codes are meaningful combinations of defined values of the six value groups.

Notation: In the following tables, in the various value groups, *“b”, “c”, ”d”, “e”, “f”* signifies any value in the respective value group. If only one object is instantiated, the value shall be 0. If a value group is shaded, then this value group is not used.

NOTE The DLMS UA maintains a list of standard COSEM object definitions at www.dlms.com. The validity of the combination of OBIS codes and class_id-s as well as the data types of the attributes are tested during conformance testing.

7.3 Value group definitions – overview

7.3.1 Value group A

The range for value group A is 0 to 15; see Table 40.

Table 40 – Value group A codes

Value group A	
0	Abstract objects
1	Electricity related objects
…	
4	Heat cost allocator related objects
5, 6	Thermal energy related objects
7	Gas related objects
8	Cold water related objects
9	Hot water related objects
…	
15	Other media
All other	Reserved

The following subclauses contain value group definitions B to F common for all values of value group A.

7.3.2 Value group B

The range for value group B is 0 to 255; see Table 41.

Table 41 – Value group B codes

Value group B	
0	No channel specified
1…64	Channel 1..64
65…127	Utility specific codes
128…199	Manufacturer specific codes
200…255	Reserved

If channel information is not essential, the value 0 shall be assigned.

The range 65…127 is available for utility specific use. If the value of value group B is in this range, the whole OBIS code shall be considered as utility specific and the value of other groups does not necessarily carry a meaning defined neither in Clause 4 nor in Clause 7.

7.3.3 Value group C

7.3.3.1 General

The range for value group C is 0 to 255. The definitions depend on the value in value group A. The codes for abstract objects are specified in 7.3.3.2. See also:

- electricity related codes specified in 7.5.1;
- heat cost allocator related codes specified in 7.6.2;
- thermal energy related codes specified in 7.7.2;
- gas related codes specified in 7.8.2;
- water related codes specified in 7.9.2;
- other media related codes specified in 7.10.2.

7.3.3.2 Abstract objects

Abstract objects are data items, which are not related to a certain type of physical quantity. See Table 42.

Table 42 – Value group C codes – Abstract objects

Value group C Abstract objects (A = 0)	
0…89	Context specific identifiers [a]
93	Consortia specific identifiers (See 7.3.4.2).
94	Country specific identifiers (See 7.3.4.3)
96	General and service entry objects – Abstract (See 7.4.1)
97	Error register objects – Abstract (See 7.4.2)
98	List objects – Abstract (See 7.4.3, 7.4.4)
99	Data profile objects – Abstract (See 7.4.5)

…	
127	Inactive objects [b]
128…199, 240	Manufacturer specific codes
All other	Reserved
a	Context specific identifiers identify objects specific to a certain protocol and/or application. For the COSEM context, the identifiers are defined in 6.2.
b	An inactive object is an object, which is defined and present in a meter, but which has no assigned functionality.

7.3.4 Value group D

7.3.4.1 General

The range for value group D is 0 to 255.

7.3.4.2 Consortia specific identifiers

Table 43 specifies the use of value group D for consortia specific applications. In this table, there are no reserved ranges for manufacturer specific codes. The usage of value group E and F are defined in consortia specific documents.

Objects that are already identified in this document shall not be re-identified by consortia specific identifiers.

Table 43 – Value group D codes – Consortia specific identifiers

Value group D Consortia specific identifiers (A = any, C = 93)	
All values	Reserved
NOTE At the time of the publication of this document, no consortia specific identifiers are allocated.	

7.3.4.3 Country specific identifiers

Table 44 specifies the use of value group D for country specific applications. Wherever possible, the country calling codes are used. In this table, there are no reserved ranges for manufacturer specific codes. The usage of value group E and F are defined in country specific documents.

Objects that are already identified in this document shall not be re-identified by country specific identifiers.

Table 44 – Value group D codes – Country specific identifiers

Value group D Country specific identifiers [a] (A = any, C = 94)			
00	Finland (Country calling code = 358)	**50**	
01	USA (= Country calling code)	**51**	Peru (= Country calling code)
02	Canada (Country calling code = 1)	**52**	South Korea (Country calling code = 82)
03	Serbia (Country calling code = 381)	**53**	Cuba (= Country calling code)
04		**54**	Argentina (= Country calling code)
05		**55**	Brazil (= Country calling code)

Value group D Country specific identifiers [a] (A = any, C = 94)			
06		**56**	Chile (= Country calling code)
07	Russia (Country calling code = 7)	**57**	Colombia (= Country calling code)
08		**58**	Venezuela (= Country calling code)
09		**59**	
10	Czech Republic (Country calling code = 420)	**60**	Malaysia (= Country calling code)
11	Bulgaria (Country calling code = 359)	**61**	Australia (= Country calling code)
12	Croatia (Country calling code = 385)	**62**	Indonesia (= Country calling code)
13	Ireland (Country calling code = 353)	**63**	Philippines (= Country calling code)
14	Israel (Country calling code = 972)	**64**	New Zealand (= Country calling code)
15	Ukraine (Country calling code = 380)	**65**	Singapore (= Country calling code)
16	Yugoslavia [a]	**66**	Thailand (= Country calling code)
17		**67**	
18		**68**	
19		**69**	
20	Egypt (= Country calling code)	**70**	
21		**71**	Latvia (Country calling code = 371)
22		**72**	
23		**73**	Moldova (Country calling code = 373)
24		**74**	
25		**75**	Belarus (Country calling code = 375)
26		**76**	
27	South Africa (= Country calling code)	**77**	
28		**78**	
29		**79**	
30	Greece (= Country calling code)	**80**	
31	Netherlands (= Country calling code)	**81**	Japan (= Country calling code)
32	Belgium (= Country calling code)	**82**	Mexico
33	France (= Country calling code)	**83**	
34	Spain (= Country calling code)	**84**	
35	Portugal (Country calling code = 351)	**85**	Hong Kong (Country calling code = 852)
36	Hungary (= Country calling code)	**86**	China (= Country calling code)
37	Lithuania (Country calling code = 370)	**87**	Bosnia and Herzegovina (Country calling code = 387)
38	Slovenia (Country calling code = 386)	**88**	
39	Italy (= Country calling code)	**89**	
40	Romania (= Country calling code)	**90**	Turkey (= Country calling code)
41	Switzerland (= Country calling code)	**91**	India (= Country calling code)
42	Slovakia (Country calling code = 421)	**92**	Pakistan (= Country calling code)
43	Austria (= Country calling code)	**93**	
44	United Kingdom (= Country calling code)	**94**	
45	Denmark (= Country calling code)	**95**	
46	Sweden (= Country calling code)	**96**	Saudi Arabia (Country calling code = 966)
47	Norway (= Country calling code)	**97**	United Arab Emirates (Country calling code = 971)
48	Poland (= Country calling code)	**98**	Iran (= Country calling code)
49	Germany (= Country calling code)	**99**	
	All other codes are reserved		
[a]	With the dissolution of the former Yugoslavia into separate nations, country code 38 was decommissioned.		

7.3.4.4 Identification of general and service entry objects

For the use of value group D to identify:

- abstract general and service entry objects, see 7.4, Table 45;
- electricity related general and service entry objects, see Table 57;
- HCA related general and service entry objects, see Table 65;
- thermal energy related general and service entry objects, see Table 73;
- gas related general and service entry objects, see Table 89;
- water related general and service entry objects, see Table 96.

7.3.5 Value group E

The range for value group E is 0 to 255. It can be used for identifying further classification or processing of values defined by values in value groups A to D, as specified in the relevant energy type specific clauses. The various classifications and processing methods are exclusive.

For the use of value group E to identify:

- abstract general and service entry objects, see 7.4, Table 45;
- electricity related general and service entry objects, see Table 57;
- HCA related general and service entry objects, see Table 65;
- thermal energy related general and service entry objects, see Table 73;
- gas related general and service entry objects, see Table 89;
- water related general and service entry objects, see Table 96.

7.3.6 Value group F

7.3.6.1 General

The range for value group F is 0 to 255. In all cases, if value group F is not used, it is set to 255.

7.3.6.2 Identification of billing periods

Value group F specifies the allocation to different billing periods (sets of historical values) for the objects defined by value groups A to E, where storage of historical values is relevant. A billing period scheme is identified with its billing period counter, number of available billing periods, time stamp of the billing period and billing period length. Several billing period schemes may be possible. For more, see 6.2.2 and 7.11.3.

7.4 Abstract objects (Value group A = 0)

7.4.1 General and service entry objects – Abstract

Table 45 specifies OBIS codes for abstract objects. See also Table 26.

Table 45 – OBIS codes for general and service entry objects

General and service entry objects	OBIS code					
	A	B	C	D	E	F
Billing period values/reset counter entries (First billing period scheme if there are two)						
Billing period counter (1)	0	*b*	0	1	0	VZ or 255
Number of available billing periods (1)	0	*b*	0	1	1	
Time stamp of the most recent billing period (1)	0	*b*	0	1	2	
Time stamp of the billing period (1) VZ (last reset)	0	*b*	0	1	2	VZ
Time stamp of the billing period (1) VZ_{-1}	0	*b*	0	1	2	VZ_{-1}
…	…	…	…	…	…	…
Time stamp of the billing period (1) VZ_{-n}	0	*b*	0	1	2	VZ_{-n}
Billing period values/reset counter entries (Second billing period scheme)						
Billing period counter (2)	0	*b*	0	1	3	VZ or 255
Number of available billing periods (2)	0	*b*	0	1	4	
Time stamp of the most recent billing period (2)	0	*b*	0	1	5	
Time stamp of the billing period (2) VZ (last reset)	0	*b*	0	1	5	VZ
Time stamp of the billing period (2) VZ_{-1}	0	*b*	0	1	5	VZ_{-1}
…	…	…	…	…	…	…
Time stamp of the billing period (2) VZ_{-n}	0	*b*	0	1	5	VZ_{-n}
Program entries						
Active firmware identifier	0	*b*	0	2	0	
Active firmware version	0	*b*	0	2	1	
Active firmware signature	0	*b*	0	2	8	
Time entries						
Local time	0	*b*	0	9	1	
Local date	0	*b*	0	9	2	
Device IDs						
Complete device ID	0	*b*	96	1		
Device ID # 1 (manufacturing number)	0	*b*	96	1	0	
…			…	…	…	
Device ID # 10	0	*b*	96	1	9	
Metering point ID (abstract)	0	0	96	1	10	
Parameter changes, calibration and access						
Number of configuration program changes	0	*b*	96	2	0	
Date [a] of last configuration program change	0	*b*	96	2	1	
Date [a] of last time switch program change	0	*b*	96	2	2	
Date [a] of last ripple control receiver program change	0	*b*	96	2	3	
Status of security switches	0	*b*	96	2	4	
Date [a] of last calibration	0	*b*	96	2	5	
Date [a] of next configuration program change	0	*b*	96	2	6	

General and service entry objects	OBIS code					
	A	B	C	D	E	F
Date [a] of activation of the passive calendar	0	*b*	96	2	7	
Number of protected configuration program changes [b]	0	*b*	96	2	10	
Date [a] of last protected configuration program change [b]	0	*b*	96	2	11	
Date [a] (corrected) of last clock synchronization/setting	0	*b*	96	2	12	
Date of last firmware activation	0	*b*	96	2	13	
Input/output control signals						
State of input/output control signals, global [c]	0	*b*	96	3	0	
State of input control signals (status word 1)	0	*b*	96	3	1	
State of output control signals (status word 2)	0	*b*	96	3	2	
State of input/output control signals (status word 3)	0	*b*	96	3	3	
State of input/output control signals (status word 4)	0	*b*	96	3	4	
Disconnect control	0	*b*	96	3	10	
Arbitrator	0	*b*	96	3	20.. 29	
Internal control signals						
Internal control signals, global [c]	0	*b*	96	4	0	
Internal control signals (status word 1)	0	*b*	96	4	1	
Internal control signals (status word 2)	0	*b*	96	4	2	
Internal control signals (status word 3)	0	*b*	96	4	3	
Internal control signals (status word 4)	0	*b*	96	4	4	
Internal operating status						
Internal operating status, global [c]	0	*b*	96	5	0	
Internal operating status (status word 1)	0	*b*	96	5	1	
Internal operating status (status word 2)	0	*b*	96	5	2	
Internal operating status (status word 3)	0	*b*	96	5	3	
Internal operating status (status word 4)	0	*b*	96	5	4	
Battery entries						
Battery use time counter	0	*b*	96	6	0	
Battery charge display	0	*b*	96	6	1	
Date of next battery change	0	*b*	96	6	2	
Battery voltage	0	*b*	96	6	3	
Battery initial capacity	0	*b*	96	6	4	
Battery installation date and time	0	*b*	96	6	5	
Battery estimated remaining use time	0	*b*	96	6	6	
Aux. supply use time counter	0	*b*	96	6	10	
Aux. voltage (measured)	0	*b*	96	6	11	
Power failure monitoring						
Number of power failures						
In all three phases	0	0	96	7	0	
In phase L1	0	0	96	7	1	
In phase L2	0	0	96	7	2	
In phase L3	0	0	96	7	3	
In any phase [sic]	0	0	96	7	21	
Auxiliary supply	0	0	96	7	4	
Number of long power failures						
In all three phases	0	0	96	7	5	
In phase L1	0	0	96	7	6	

General and service entry objects	OBIS code					
	A	B	C	D	E	F
In phase L2	0	0	96	7	7	
In phase L3	0	0	96	7	8	
In any phase	0	0	96	7	9	
Time of power failure [d]						
In all three phases	0	0	96	7	10	
In phase L1	0	0	96	7	11	
In phase L2	0	0	96	7	12	
In phase L3	0	0	96	7	13	
In any phase	0	0	96	7	14	
Duration of long power failure [e]						
In all three phases	0	0	96	7	15	
In phase L1	0	0	96	7	16	
In phase L2	0	0	96	7	17	
In phase L3	0	0	96	7	18	
In any phase	0	0	96	7	19	
Time threshold for long power failure						
Time threshold for long power failure	0	0	96	7	20	
NOTE 1 See *Number of power failures in any phase* above	*0*	*b*	*96*	*7*	*21*	
Operating time						
Time of operation	0	b	96	8	0	
Time of operation rate 1…rate 63	0	b	96	8	1…63	
Environment related parameters						
Ambient temperature	0	*b*	96	9	0	
Ambient pressure	0	*b*	96	9	1	
Relative humidity	0	*b*	96	9	2	
Status register						
Status register (Status register 1 if several status registers are used)	0	*b*	96	10	1	
Status register 2	0	*b*	96	10	2	
…	0	*b*	96	10	…	
Status register 10	0	*b*	96	10	10	
Event code						
Event code objects # 1…#100	0	*b*	96	11	0…99	
Communication port log parameters						
Reserved	0	*b*	96	12	0	
Number of connections	0	*b*	96	12	1	
Reserved	0	*b*	96	12	2	
Reserved	0	*b*	96	12	3	
Communication port parameter 1	0	*b*	96	12	4	
GSM field strength	0	*b*	96	12	5	
Telephone number / Communication address of the physical device	0	*b*	96	12	6	
Consumer messages						
Consumer message via local consumer information port	0	*b*	96	13	0	
Consumer message via the meter display and / or via consumer information port	0	*b*	96	13	1	
Currently active tariff						

General and service entry objects	OBIS code					
	A	B	C	D	E	F
Currently active tariff objects # 1…#16 NOTE 2 Object #16 (E = 15) carries the name of register with the lowest tariff (default tariff register)	0	*b*	96	14	0… 15	
Event counter objects						
Event counter objects #1…#100	0	*b*	96	15	0… 99	
Profile entry digital signature objects						
Profile entry digital signature objects #1…#10	0	*b*	96	16	0… 9	
Meter tamper event related objects						
Meter open event counter	0	*b*	96	20	0	
Meter open event, time stamp of current event occurrence	0	*b*	96	20	1	
Meter open event, duration of current event	0	*b*	96	20	2	
Meter open event, cumulative duration	0	*b*	96	20	3	
Reserved	0	*b*	96	20	4	
Terminal cover open event counter	0	*b*	96	20	5	
Terminal cover open event, time stamp of current event occurrence	0	*b*	96	20	6	
Terminal cover open event, duration of current event	0	*b*	96	20	7	
Terminal cover open event, cumulative duration	0	*b*	96	20	8	
Reserved	0	*b*	96	20	9	
Tilt event counter	0	*b*	96	20	10	
Tilt event, time stamp of current event occurrence	0	*b*	96	20	11	
Tilt event, duration of current event	0	*b*	96	20	12	
Tilt event, cumulative duration	0	*b*	96	20	13	
Reserved	0	*b*	96	20	14	
Strong DC magnetic field event counter	0	*b*	96	20	15	
Strong DC magnetic field event, time stamp of current event occurrence	0	*b*	96	20	16	
Strong DC magnetic field event, duration of current event	0	*b*	96	20	17	
Strong DC magnetic field event, cumulative duration	0	*b*	96	20	18	
Reserved	0	*b*	96	20	19	
Supply control switch / valve tamper event counter	0	*b*	96	20	20	
Supply control switch / valve tamper event, time stamp of current event occurrence	0	*b*	96	20	21	
Supply control switch / valve tamper event, duration of current event	0	*b*	96	20	22	
Supply control switch / valve tamper event, cumulative duration	0	*b*	96	20	23	
Reserved	0	*b*	96	20	24	
Metrology tamper event counter	0	*b*	96	20	25	
Metrology tamper event, time stamp of current event occurrence	0	*b*	96	20	26	
Metrology tamper event, duration of current event	0	*b*	96	20	27	
Metrology tamper event, cumulative duration	0	*b*	96	20	28	
Reserved	0	*b*	96	20	29	
Communication tamper event counter	0	*b*	96	20	30	
Communication tamper event, time stamp of current event occurrence	0	*b*	96	20	31	
Communication tamper event, duration of current event	0	*b*	96	20	32	
Communication tamper event, cumulative duration	0	*b*	96	20	33	
Reserved	0	*b*	96	20	34	

General and service entry objects	OBIS code					
	A	B	C	D	E	F
Manufacturer specific [f] … Manufacturer specific	0 0	*b* *b*	96 96	50 99	*e* *e*	*f* *f*
All other codes are reserved						

a	Date of the event may contain the date only, the time only or both, encoded as specified in 4.1.6.1.
b	Protected configuration is characterized by the need to open the main meter cover to modify it, or to break a metrological seal.
c	Global status words with E = 0 contain the individual status words E = 1…4. The contents of the status words are not defined in this document.
d	Time of power failure is recorded when either a short or long power failure occurs.
e	Duration of long power failure holds the duration of the last long power failure.
f	The range D = 50…99 is available for identifying objects, which are not represented by another defined code, but need representation on the display as well. If this is not required, the range D = 128…254 should be used.

7.4.2 Error registers, alarm registers / filters / descriptor objects – Abstract

The OBIS codes for abstract error registers, alarm registers and alarm filters are shown in Table 46.

Table 46 – OBIS codes for error registers, alarm registers and alarm filters – Abstract

Error register, alarm register and alarm filter objects – Abstract	OBIS code					
	A	B	C	D	E	F
Error register objects 1…10	0	*b*	97	97	0…9	
Alarm register objects 1…10	0	*b*	97	98	0…9	
Alarm filter objects 1…10	0	*b*	97	98	10…19	
Alarm descriptor objects 1…10	0	*b*	97	98	20…29	
NOTE The information to be included in the error objects is not defined in this document.						

7.4.3 List objects – Abstract

Lists – identified with a single OBIS code – are defined as a series of any kind of data (for example measurement value, constants, status, events). See Table 47.

Table 47 – OBIS codes for list objects – Abstract

List objects – Abstract	OBIS code					
	A	B	C	D	E	F
Data of billing period (with billing period scheme 1 if there are more than one schemes available)	0	*b*	98	1	*e*	255 [a]
Data of billing period (with billing period scheme 2)	0	*b*	98	2	*e*	255 [a]
[a] F = 255 means a wildcard here. See 7.11.3.						

7.4.4 Register table objects – Abstract

Register tables are defined to hold a number of values of the same type. See Table 48.

Table 48 – OBIS codes for Register table objects – Abstract

Register table objects – Abstract	OBIS code					
	A	B	C	D	E	F
General use, abstract	0	*b*	98	10	*e*	

7.4.5 Data profile objects – Abstract

Abstract data profiles – instances of the "Profile generic IC" and identified with one single OBIS code as specified inTable 49 – are used to hold a series of measurement values of one or more similar quantities and/or to group various data.

Table 49 – OBIS codes for data profile objects – Abstract

Data profile objects – Abstract	OBIS code					
	A	B	C	D	E	F
Load profile with recording period 1 [a]	0	*b*	99	1	*e*	
Load profile with recording period 2 [a]	0	*b*	99	2	*e*	
Load profile during test [a]	0	*b*	99	3	0	
Connection profile	0	*b*	99	12	*e*	
GSM diagnostic profile	0	*b*	99	13	*e*	
Charge collection history (Payment metering)	0	*b*	99	14	e	
Token credit history (Payment metering)	0	*b*	99	15	e	
Parameter monitor log	0	*b*	99	16	*e*	
Token transfer log (Payment metering)	0	*b*	99	17	*e*	
LTE monitoring profile	0	*b*	99	18	*e*	
Event log [a]	0	*b*	99	98	*e*	
[a] These objects should be used if they (also) hold data not specific to the energy type.						

7.5 Electricity (Value group A = 1)

7.5.1 Value group C codes – Electricity

Table 50 specifies the use of value group C for electricity related objects.

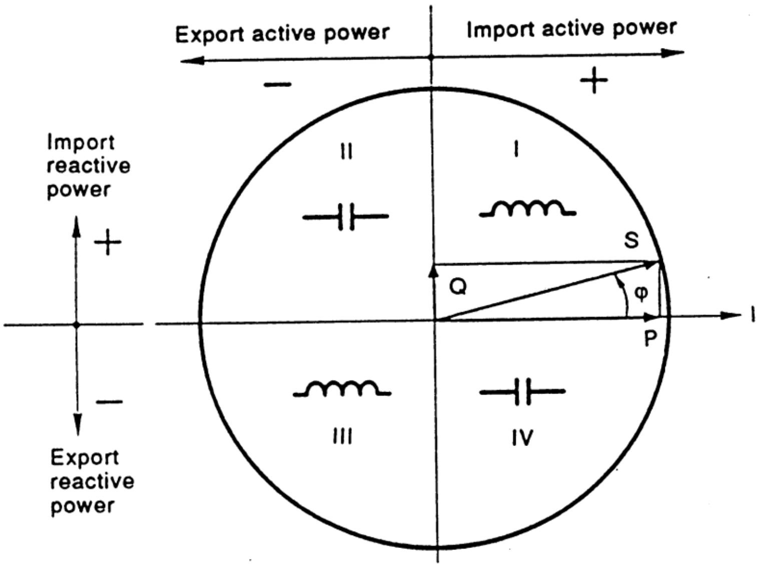
The quadrant definitions for active and reactive power ar shown in Figure 27.

Table 50 – Value group C codes – Electricity

Value group C codes – Electricity (A = 1)				
0	General purpose objects (See 7.5.5.1)			
ΣL_i	**L_1**	**L_2**	**L_3**	(See also Note 2)
1	**21**	**41**	**61**	Active power+ (QI+QIV)
2	**22**	**42**	**62**	Active power– (QII+QIII)
3	**23**	**43**	**63**	Reactive power+ (QI+QII)
4	**24**	**44**	**64**	Reactive power– (QIII+QIV)
5	**25**	**45**	**65**	Reactive power QI
6	**26**	**46**	**66**	Reactive power QII
7	**27**	**47**	**67**	Reactive power QIII
8	**28**	**48**	**68**	Reactive power QIV
9	**29**	**49**	**69**	Apparent power+ (QI+QIV) (See also Note 3)
10	**30**	**50**	**70**	Apparent power– (QII+QIII)
11	**31**	**51**	**71**	Current: any phase (C = 11) / L_i phase [a] (C= 31, 51, 71)
12	**32**	**52**	**72**	Voltage: any phase (C = 12) / L_i phase [a] (C= 32, 52, 72)
13	**33**	**53**	**73**	Power factor (See also Note 4)
14	**34**	**54**	**74**	Supply frequency
15	**35**	**55**	**75**	Active power (abs(QI+QIV)+(abs(QII+QIII)) [a]
16	**36**	**56**	**76**	Active power (abs(QI+QIV)-abs(QII+QIII))
17	**37**	**57** [d]	**77**	Active power QI
18	**38**	**58**	**78**	Active power QII
19	**39**	**59**	**79**	Active power QIII
20	**40**	**60**	**80**	Active power QIV
….				
81	Angles [b]			
82	Unitless quantity (pulses or pieces)			
83	Transformer and line loss quantities [c]			
84	ΣL_i Power factor– (See also Note 4)			
85	L_1 Power factor–			
86	L_2 Power factor–			
87	L_3 Power factor–			
88	ΣL_i Ampere-squared hours (QI+QII+QIII+QIV)			
89	ΣL_i Volt-squared hours (QI+QII+QIII+QIV)			
90	ΣL_i current (algebraic sum of the – unsigned – value of the currents in all phases)			
91	L_0 current (neutral) [a]			
92	L_0 voltage (neutral) [a]			
93	Consortia specific identifiers (See 7.3.4.2)			

Value group C codes – Electricity (A = 1)				
94	Country specific identifiers (See 7.3.4.3)			
96	General and service entry objects – Electricity (See 7.5.5.1)			
97	Error register objects – Electricity (See 7.5.5.2)			
98	List objects – Electricity (See 7.5.5.3)			
99	Data profile objects – Electricity (See 7.5.5.4)			
ΣL_i	**L_1**	**L_2**	**L_3**	(See also Note 2)
100	**101**	**102**	**103**	Reactive power inductive (QI+QIII)
104	**105**	**106**	**107**	Reactive power capacitive (QII+QIV)
108..123	Reserved			
124	$L_1 - L_2$ line voltage			
125	$L_2 - L_3$ line voltage			
126	$L_3 - L_1$ line voltage			
127	Reserved			
128...199, 240	Manufacturer specific codes			
All other	Reserved			
NOTE 1	L_i *Quantity* is the value (to be measured) of a measurement system connected between the phase *i* and a reference point. In 3-phase 4-wire systems, the reference point is the neutral. In 3-phase 3-wire systems, the reference point is the phase L_2.			
NOTE 2	ΣL_i *Quantity* is the total measurement value across all systems.			
NOTE 3	If just one apparent energy/demand value is calculated over the four quadrants, C = 9 shall be used.			
NOTE 4	Power factor quantities with C = 13, 33, 53, 73 are calculated either as PF = Active power+ (C = 1, 21, 41, 61) / Apparent power+ (C = 9, 29, 49, 69) or PF = Active power– (C = 2, 22, 42, 62) / Apparent power- (C = 10, 30, 50, 70). In the first case, the sign is positive (no sign), it means power factor in the import direction (PF+). In the second case, the sign is negative, it means power factor in the export direction (PF–). Power factor quantities C = 84, 85, 86 and 87 are always calculated as PF– = Active power– / Apparent power–. This quantity is the power factor in the export direction; it has no sign.			

[a] For details of extended codes, see 7.5.3.3.
[b] For details of extended codes, see 7.5.3.4.
[c] For details of extended codes, see 7.5.3.5.
[d] This was recorded erroneously as 58 in Blue Book 12.2 and earlier versions.



NOTE The quadrant definitions are according to IEC 62053-23:2003, Figure C1.

Figure 27 – Quadrant definitions for active and reactive power

7.5.2 Value group D codes – Electricity

7.5.2.1 Processing of measurement values

Table 51 specifies the use of value group D for electricity related objects.

Table 51 – Value group D codes – Electricity

Value group D codes – Electricity (A = 1, C <> 0, 93, 94, 96, 97, 98, 99)	
0	Billing period average (since last reset)
1	Cumulative minimum 1
2	Cumulative maximum 1
3	Minimum 1
4	Current average 1
5	Last average 1
6	Maximum 1
7	Instantaneous value
8	Time integral 1
9	Time integral 2
10	Time integral 3
11	Cumulative minimum 2
12	Cumulative maximum 2
13	Minimum 2
14	Current average 2
15	Last average 2
16	Maximum 2
17	Time integral 7
18	Time integral 8

Value group D codes – Electricity (A = 1, C <> 0, 93, 94, 96, 97, 98, 99)	
19	Time integral 9
20	Time integral 10
21	Cumulative minimum 3
22	Cumulative maximum 3
23	Minimum 3
24	Current average 3
25	Last average 3
26	Maximum 3
27	Current average 5
28	Current average 6
29	Time integral 5
30	Time integral 6
31	Under limit threshold
32	Under limit occurrence counter
33	Under limit duration
34	Under limit magnitude
35	Over limit threshold
36	Over limit occurrence counter
37	Over limit duration
38	Over limit magnitude
39	Missing threshold
40	Missing occurrence counter
41	Missing duration
42	Missing magnitude
43	Time threshold for under limit
44	Time threshold for over limit
45	Time threshold for missing magnitude
46	Contracted value
49	Average value for recording interval 1
50	Average value for recording interval 2
51	Minimum for recording interval 1
52	Minimum for recording interval 2
53	Maximum for recording interval 1
54	Maximum for recording interval 2
55	Test average
56	Current average 4 for harmonics measurement

Value group D codes – Electricity (A = 1, C <> 0, 93, 94, 96, 97, 98, 99)	
58	Time integral 4
128...254	Manufacturer specific codes
All other	Reserved
NOTES	
Averaging scheme 1	Controlled by measurement period 1 (see Table 57), a set of registers is calculated by a metering device (codes 1…6). The typical usage is for billing purposes.
Averaging scheme 2	Controlled by measurement period 2, a set of registers is calculated by a metering device (codes 11…16). The typical usage is for billing purposes.
Averaging scheme 3	Controlled by measurement period 3, a set of registers is calculated by a metering device (codes 21…26). The typical usage is for instantaneous values.
Averaging scheme 4	Controlled by measurement period 4, a test average value (code 55) is calculated by the metering device.
Current average 1, 2, 3	See the definition of the “Demand register” IC in 4.3.4. The value is calculated using measurement period 1, 2 and/or 3 respectively.
Last average 1,2,3	See the definition of the “Demand register” IC in 4.3.4. The value is calculated using measurement period 1, 2 or 3 respectively.
Minimum	The smallest of last average values during a billing period, see Table 57.
Maximum	The largest of last average values during a billing period.
Cumulative min.	The cumulative sum of minimum values over all the past billing periods.
Cumulative max.	The cumulative sum of maximum values over all the past billing periods.
Current average 4	For harmonics measurement
Current average 5	See the definition of the “Demand register” IC in 4.3.4. The value is calculated using recording interval 1; see Table 57.
Current average 6	See the definition of the “Demand register” IC in 4.3.4. The value is calculated using recording interval 2.
Time integral 1	For a current billing period (F= 255): Time integral of the quantity calculated from the origin (first start of measurement) to the instantaneous time point. For a historical billing period (F= 0…99): Time integral of the quantity calculated from the origin to the end of the billing period given by the billing period code.
Time integral 2	For a current billing period (F = 255): Time integral of the quantity calculated from the beginning of the current billing period to the instantaneous time point. For a historical billing period (F = 0…99): Time integral of the quantity calculated over the billing period given by the billing period code.
Time integral 3	Time integral of the positive difference between the quantity and a prescribed threshold value.
Time integral 4 ("Test time integral")	Time integral of the quantity calculated over a time specific to the device or determined by test equipment.
Time integral 5	Used as a base for load profile recording: Time integral of the quantity calculated from the beginning of the current recording interval to the instantaneous time point for recording period 1, see Table 57.
Time integral 6	Used as a base for load profile recording: Time integral of the quantity calculated from the beginning of the current recording interval to the instantaneous time point for recording period 2, see Table 57.
Time integral 7	Time integral of the quantity calculated from the origin (first start of measurement) up to the end of the last recording period with recording period 1, see Table 57.
Time integral 8	Time integral of the quantity calculated from the origin (first start of measurement) up to the end of the last recording period with recording period 2, see Table 57.
Time integral 9	Time integral of the quantity calculated from the beginning of the current billing period up to the end of the last recording period with recording period 1, see Table 57.
Time integral 10	Time integral of the quantity calculated from the beginning of the current billing period up to the end of the last recording period with recording period 2, see Table 57.
Under limit values	Values under a certain threshold (for example dips).
Over limit values	Values above a certain threshold (for example swells).
Missing values	Values considered as missing (for example interruptions).

7.5.2.2 Use of value group D for identification of other objects

For identifiers of electricity related general purpose objects see 7.5.5.1.

7.5.3 Value group E codes – Electricity

7.5.3.1 General

The following clauses define the use of value group E for identifying further classification or processing the measurement quantities defined by values in value groups A to D. The various classifications and processing methods are exclusive.

7.5.3.2 Tariff rates

Table 52 shows the use of value group E for identification of tariff rates typically used for energy (consumption) and demand quantities.

Table 52 – Value group E codes – Electricity – Tariff rates

Value group E codes – Electricity – Tariff rates (A = 1)	
0	Total
1	Rate 1
2	Rate 2
3	Rate 3
…	…
63	Rate 63
128…254	Manufacturer specific codes
All other	Reserved

7.5.3.3 Harmonics

Table 53 shows the use of value group E for the identification of harmonics of instantaneous values of voltage, current or active power.

Table 53 – Value group E codes – Electricity – Harmonics

Value group E codes – Electricity – Measurement of harmonics of voltage, current or active power (A = 1, C = 12, 32, 52, 72, 92, 11, 31, 51, 71, 90, 91, 15, 35, 55, 75, D = 7, 24, 56)	
0	Total (fundamental + all harmonics)
1	1st harmonic (fundamental)
2	2nd harmonic
…	*n*th harmonic
120	120th harmonic
124	Total Harmonic Distortion (THD) [a]
125	Total Demand Distortion (TDD) [b]

Value group E codes – Electricity – Measurement of harmonics of voltage, current or active power (A = 1, C = 12, 32, 52, 72, 92, 11, 31, 51, 71, 90, 91, 15, 35, 55, 75, D = 7, 24, 56)	
126	All harmonics [c]
127	All harmonics to nominal value ratio [d]
128…254	Manufacturer specific codes
All other	Reserved
[a]	THD is calculated as the ratio of the square root of the sum of the squares of each harmonic to the value of the fundamental quantity, expressed as a percent of the value of the fundamental.
[b]	TDD is calculated as the ratio of the square root of the sum of the squares of each harmonic to the maximum value of the fundamental quantity, expressed as percent of the maximum value of the fundamental.
[c]	Calculated as the square root of the sum of the squares of each harmonic.
[d]	This is calculated as ratio of the square root of the sum of the squares of each harmonic, to the nominal value of the fundamental quantity, expressed as percent of the nominal value of the fundamental.

7.5.3.4 Phase angles

Table 54 shows the use of value group E for identification of phase angles.

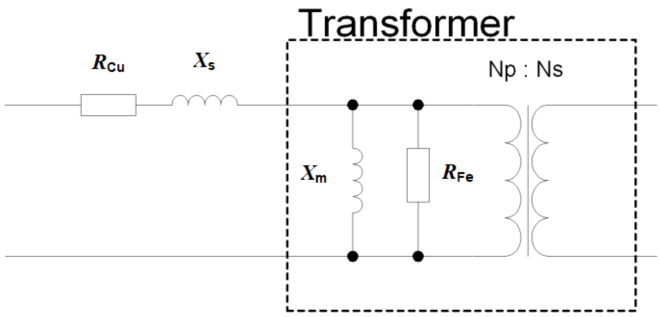
Table 54 – Value group E codes – Electricity – Extended phase angle measurement

Value group E codes – Electricity – Extended phase angle measurement (A = 1, C = 81; D = 7)								
Angle	**U(L1)**	**U(L2)**	**U(L3)**	**I(L1)**	**I(L2)**	**I(L3)**	**I(L0)**	**<= From**
U(L1)	(00)	01	02	04	05	06	07	
U(L2)	10	(11)	12	14	15	16	17	
U(L3)	20	21	(22)	24	25	26	27	
I(L1)	40	41	42	(44)	45	46	47	
I(L2)	50	51	52	54	(55)	56	57	
I(L3)	60	61	62	64	65	(66)	67	
I(L0)	70	71	72	74	75	76	(77)	
^ To (reference)								

7.5.3.5 Transformer and line loss quantities

Table 55 shows the meaning of value group E for the identification of transformer and line loss quantities. The use of value group D shall be according to Table 51, the use of value group F shall be according to Table 103. For these quantities, no tariffication is available.

The model of the line and the transformer used for loss calculation is shown on Figure 28.



Legend:

- R_{Cu} Line resistance losses, OBIS code 1.x.0.10.2.VZ
- X_s Line reactance losses, OBIS code 1.x.0.10.3.VZ
- X_m Transformer magnetic losses, OBIS code 1.x.0.10.0.VZ
- R_{Fe} Transformer iron losses, OBIS code 1.x.0.10.1.VZ
- N_p Number of turns on the primary side of the transformer
- N_s Number of turns on the secondary side of the transformer

NOTE Serial elements of the transformer are normally low compared to that of the line, therefore they are not considered here.

Figure 28 – Model of the line and the transformer for calculation of loss quantities

Table 55 – Value group E codes – Electricity – Transformer and line losses

Value group E codes – Electricity – Transformer and line losses (A = 1, C = 83)			
E=	**Quantity**	**Formula**	**Quadrant / comment**
1	ΣL_i Active line losses+	On Load Active, positive OLA+ = (CuA_1+) + (CuA_2+) + (CuA_3+)	QI+QIV
2	ΣL_i Active line losses–	On Load Active, negative OLA– = (CuA_1–) + (CuA_2–) + (CuA_3–)	QII+QIII
3	ΣL_i Active line losses	On Load Active OLA = (CuA_1) + (CuA_2) + (CuA_3)	QI+QII+QIII+QIV
4	ΣL_i Active transformer losses+	No Load Active, positive NLA+ = (FeA_1+) + (FeA_2+) + (FeA_3+)	QI+QIV
5	ΣL_i Active transformer losses–	No Load active, negative NLA– = (FeA_1–) + (FeA_2–) + (FeA_3–)	QII+QIII
6	ΣL_i Active transformer losses	No Load Active NLA = (FeA_1) + (FeA_2) + (FeA_3)	QI+QII+QIII+QIV
7	ΣL_i Active losses+	Total Losses Active, positive TLA+ = (OLA+) + (NLA+)	QI+QIV
8	ΣL_i Active losses–	Total Losses Active, negative TLA– = (OLA–) + (NLA–)	QII+QIII
9	ΣL_i Active losses	Total Losses Active TLA = OLA + NLA = TLA_1 + TLA_2 + TLA_3	QI+QII+QIII+QIV
10	ΣL_i Reactive line losses+	On Load Reactive, positive OLR+ = (CuR_1+) + (CuR_2+) + (CuR_3+)	QI+QII
11	ΣL_i Reactive line losses–	On Load Reactive, negative OLR– = (CuR_1–) + (CuR_2–) + (CuR_3–)	QIII+QIV

Value group E codes – Electricity – Transformer and line losses (A = 1, C = 83)			
E=	**Quantity**	**Formula**	**Quadrant / comment**
12	ΣL_i Reactive line losses	On Load Reactive OLR = (CuR_1) + (CuR_2) + (CuR_3)	QI+QII+QIII+QIV
13	ΣL_i Reactive transformer losses+	No Load reactive, positive NLR+ = (FeR_1+) + (FeR_2+) + (FeR_3+)	QI+QII
14	ΣL_i Reactive transformer losses–	No Load Reactive, negative NLR– = (FeR_1–) + (FeR_2–) + (FeR_3–)	QIII+QIV
15	ΣL_i Reactive transformer losses	No Load Reactive NLR = (FeR_1) + (FeR_2) + (FeR_3)	QI+QII+QIII+QIV
16	ΣL_i Reactive losses+	Total Losses Reactive, positive TLR+ = (OLR+) + (NLR+)	QI+QII
17	ΣL_i Reactive losses–	Total Losses Reactive, negative TLR– = (OLR–) + (NLR–)	QIII+QIV
18	ΣL_i Reactive losses	Total Losses Reactive TLR = OLR + NLR = TLR_1 + TLR_2 + TLR_3	QI+QII+QIII+QIV
19	Total transformer losses with normalized R_{Fe} = 1 MΩ	U^2h $1/R_{Fe}$ x (U^2h_{L1}+U^2h_{L2}+U^2h_{L3})	QI+QII+QIII+QIV
20	Total line losses with normalized R_{Cu} = 1 Ω	I^2h R_{Cu} x (I^2h_{L1} + I^2h_{L2} + I^2h_{L3})	QI+QII+QIII+QIV
21	Compensated active gross+	CA+ = (A+) + (TLA+)	QI+QIV; A+ is the quantity A = 1, C = 1
22	Compensated active net+	CA+ = (A+) - (TLA+)	QI+QIV
23	Compensated active gross–	CA– = (A–) + (TLA–)	QII+QIII, A– is the quantity A = 1, C = 2
24	Compensated active net–	CA – = (A–) - (TLA–)	QII+QIII
25	Compensated reactive gross+	CR+ = (R+) + (TLR+)	QI+QII; R+ is the quantity A = 1, C = 3
26	Compensated reactive net+	CR+ = (R+) - (TLR+)	QI+QII
27	Compensated reactive gross–	CR– = (R–) + (TLR–)	QIII+QIV;R– is the quantity A = 1, C = 4
28	Compensated reactive net–	CR– = (R–) - (TLR–)	QIII+QIV
29	Reserved		
30	Reserved		
31	L_1 Active line losses+	CuA_1+ = I^2h_{L1} x R_{Cu}	QI+QIV R_{Cu} is the serial resistive element of the line loss, OBIS code 1.x.0.10.2.VZ
32	L_1 Active line losses–	CuA_1– = I^2h_{L1} x R_{Cu}	QII+QIII
33	L_1 Active line losses	CuA_1 = I^2h_{L1} x R_{Cu}	QI+QII+QIII+QIV
34	L_1 Active transformer losses+	FeA_1+ = U^2h_{L1}/R_{Fe}	QI+QIV R_{Fe} is the parallel resistive element of the transformer loss, OBIS code 1.x.0.10.1.VZ
35	L_1 Active transformer losses–	FeA_1– = U^2h_{L1}/R_{Fe}	QII+QIII
36	L_1 Active transformer losses	FeA_1 = U^2h_{L1}/R_{Fe}	QI+QII+QIII+QIV
37	L_1 Active losses+	TLA_1+ = (CuA_1+) + (FeA_1+)	QI+QIV
38	L_1 Active losses–	TLA_1– = (CuA_1–) + (FeA_1–)	QII+QIII
39	L_1 Active losses	TLA_1 = CuA_1 + FeA_1	QI+QII+QIII+QIV
40	L_1 Reactive line losses+	CuR_1+ = I^2hL_1 x X_s	QI+QII X_s is the serial reactive element of

Value group E codes – Electricity – Transformer and line losses (A = 1, C = 83)			
E=	**Quantity**	**Formula**	**Quadrant / comment**
			the line loss, OBIS code 1.x.0.10.3.VZ
41	L_1 Reactive line losses–	$CuR_1– = I^2h_{L1}$ x X_s	QIII+QIV
42	L_1 Reactive line losses	$CuR_1 = I^2h_{L1}$ x X_s	QI+QII+QIII+QIV
43	L_1 Reactive transformer losses+	$FeR_1+ = U^2h_{L1}/X_m$	QI+QII X_m is the parallel reactive element of the transformer loss, OBIS code 1.x.0.10.0.VZ
44	L_1 Reactive transformer losses–	$FeR_1– = U^2h_{L1}/X_m$	QIII+QIV
45	L_1 Reactive transformer losses	$FeR_1 = U^2h_{L1}/X_m$	QI+QII+QIII+QIV
46	L_1 Reactive losses+	$TLR_1+ = (CuR_1+) + (FeR_1+)$	QI+QII
47	L_1 Reactive losses–	$TLR_1– = (CuR_1–) + (FeR_1–)$	QIII+QIV
48	L_1 Reactive losses	$TLR_1 = CuR_1 + FeR_1$	QI+QII+QIII+QIV
49	L_1 Ampere-squared hours	A^2h_{L1}	QI+QII+QIII+QIV
50	L_1 Volt-squared hours	V^2h_{L1}	QI+QII+QIII+QIV
51	L_2 Active line losses+	$CuA_2+ = I^2h_{L2}$ x R_{Cu}	QI+QIV R_{Cu} is the serial resistive element of the line loss, OBIS code 1.x.0.10.2.VZ
52	L_2 Active line losses–	$CuA_2– = I^2h_{L2}$ x R_{Cu}	QII+QIII
53…70	L_2 quantities, (See 33…48)		
71	L_3 Active line losses +	$CuA_3+ = I^2h_{L3}$ x R_{Cu}	QI+QIV R_{Cu} is the serial resistive element of the line loss, OBIS code 1.x.0.10.2.VZ
72	L_3 Active line losses -	$CuA_3– = I^2h_{L3}$ x R_{Cu}	QII+QIII
73…90	L_3 quantities (See 33…48)		
91… 255	Reserved		
NOTE In this table, no manufacturer specific range is available.			

7.5.3.6 UNIPEDE voltage dips

Table 56 shows the use of value group E for the identification of voltage dips according to the UNIPEDE classification.

Table 56 – Value group E codes – Electricity – UNIPEDE voltage dips

Value group E codes – Electricity – UNIPEDE voltage dips measurement (A = 1, C = 12, 32, 52, 72, D = 32)							
Depth in % of U_n	Residual voltage U in % of U_n	Duration Δt s					
		0,01 < Δt ≤ 0,1	0,1 < Δt ≤ 0,5	0,5 < Δt ≤ 1	1 < Δt ≤ 3	3 < Δt ≤ 20	20 < Δt ≤ 60
10%…<15%	90 > U ≥ 85	00	01	02	03	04	05
15%…<30%	85 > U ≥ 70	10	11	12	13	14	15
30%…<60%	70 > U ≥ 40	20	21	22	23	24	25
60%…<90%	40 > U ≥ 10	30	31	32	33	34	35
90%…<100%	10 > U ≥ 0	40	41	42	43	44	45
NOTE These *dip classes* form a subset of the classes defined in IEC TR 61000-2-8, Table 2.							

7.5.3.7 Use of value group E for the identification of other objects

For identifiers of electricity related general purpose objects see 7.5.5.1.

7.5.4 Value group F codes – Electricity

7.5.4.1 Billing periods

Value group F specifies the allocation to different billing periods (sets of historical values) for the objects with following codes:

- value group A: 1;
- value group C: as defined in Table 50;
- value group D:
  - 0: Billing period average (since last reset);
  - 1, 2, 3, 6: (Cumulative) minimum / maximum 1;
  - 8, 9, 10: Time integral 1 / 2 / 3;
  - 11, 12, 13, 16: (Cumulative) minimum / maximum 2;
  - 21, 22, 23, 26: (Cumulative) minimum / maximum 3;

There are two billing period schemes available (for example to store weekly and monthly values). For each billing period scheme, the following general purpose objects are available:

- billing period counter;
- number of available billing periods;
- time stamp of most recent and historical billing periods;
- billing period length.

For OBIS codes see Table 57. For additional information, see 6.2.2 and 7.11.3.

7.5.4.2 Multiple thresholds

Value group F is also used to identify several thresholds for the same quantity, identified with the following codes:

- value group A = 1;
- value group C = 1…20, 21…40, 41…60, 61…80, 82, 84…89, 90… 92;
- value group D = 31, 35, 39 (under limit, over limit and missing thresholds);
- value group F = 0…99.

NOTE All quantities monitored are instantaneous values: D = 7 or D = 24.

When multiple thresholds are identified by value group F, then the Under limit / Over limit / Missing Occurrence counter / Duration / Magnitude quantities relative to a threshold are identified with the same value in value group F. In this case, value group F cannot be used to identify values relative to billing period. However, such values can be held by “Profile generic” objects.

Example:

- Over limit threshold #1 for current in any phase is identified with OBIS code 1-0:11.35.0*0;
- Over limit duration above threshold # 1 for current in any phase is identified with OBIS code 1-0:11.37.0*0.

To avoid ambiguity, value group F cannot be used to identify historical values of Under limit / Over limit / Missing Occurrence counter / Duration / Magnitude quantities. For historical values of these quantities “Profile generic” objects can be used and values related to previous billing periods can be accessed using selective access.

7.5.5 OBIS codes – Electricity

7.5.5.1 General and service entry objects – Electricity

Table 57 specifies the OBIS codes for electricity related general and service entry objects.

Table 57 – OBIS codes for general and service entry objects – Electricity

General and service entry objects – Electricity	OBIS code					
	A	B	C	D	E	F
Free ID-numbers for utilities						
Complete combined electricity ID	1	*b*	0	0		
Electricity ID 1	1	*b*	0	0	0	
…	…	…	…	…	…	
Electricity ID 10	1	*b*	0	0	9	
Billing period values/reset counter entries (First billing period scheme if there are more than one)						
Billing period counter (1)	1	*b*	0	1	0	VZ or 255
Number of available billing periods (1)	1	*b*	0	1	1	
Time stamp of the most recent billing period (1)	1	*b*	0	1	2	
Time stamp of the billing period (1) VZ (last reset)	1	*b*	0	1	2	VZ
Time stamp of the billing period (1) VZ_{-1}	1	*b*	0	1	2	VZ_{-1}
…	…	…	…	…	…	…
Time stamp of the billing period (1) VZ_{-n}	1	*b*	0	1	2	VZ_{-n}
Billing period values/reset counter entries (Second billing period scheme)						

General and service entry objects – Electricity	OBIS code					
	A	B	C	D	E	F
Billing period counter (2)	1	*b*	0	1	3	VZ or 255
Number of available billing periods (2)	1	*b*	0	1	4	
Time stamp of the most recent billing period (2)	1	*b*	0	1	5	
Time stamp of the billing period (2) VZ (last reset)	1	*b*	0	1	5	VZ
Time stamp of the billing period (2) VZ_{-1}	1	*b*	0	1	5	VZ_{-1}
…	…	…	…	…	…	…
Time stamp of the billing period (2) VZ_{-n}	1	*b*	0	1	5	VZ_{-n}
Program entries						
Active firmware identifier (Previously: Configuration program version number)	1	*b*	0	2	0	
Parameter record number	1	*b*	0	2	1	
Parameter record number, line 1	1	*b*	0	2	1	1
Reserved for future use	1	*b*	0	2	1	2… 127
Manufacturer specific	1	*b*	0	2	1	128… 254
Time switch program number	1	*b*	0	2	2	
RCR program number	1	*b*	0	2	3	
Meter connection diagram ID	1	*b*	0	2	4	
Passive calendar name	1	*b*	0	2	7	
Active firmware signature	1	*b*	0	2	8	
Output pulse values or constants NOTE For units, see 4.3.2.						
Active energy, metrological LED	1	*b*	0	3	0	
Reactive energy, metrological LED	1	*b*	0	3	1	
Apparent energy, metrological LED	1	*b*	0	3	2	
Active energy, output pulse	1	*b*	0	3	3	
Reactive energy, output pulse	1	*b*	0	3	4	
Apparent energy, output pulse	1	*b*	0	3	5	
Volt-squared hours, metrological LED	1	*b*	0	3	6	
Ampere-squared hours, metrological LED	1	*b*	0	3	7	
Volt-squared hours, output pulse	1	*b*	0	3	8	
Ampere-squared hours, output pulse	1	*b*	0	3	9	
Ratios						
Reading factor for power	1	*b*	0	4	0	
Reading factor for energy	1	*b*	0	4	1	
Transformer ratio – current (numerator) [a]	1	*b*	0	4	2	VZ
Transformer ratio – voltage (numerator) [a]	1	*b*	0	4	3	VZ
Overall transformer ratio (numerator) [a]	1	*b*	0	4	4	VZ
Transformer ratio – current (denominator) [a]	1	*b*	0	4	5	VZ
Transformer ratio – voltage (denominator) [a]	1	*b*	0	4	6	VZ
Overall transformer ratio (denominator) [a]	1	*b*	0	4	7	VZ
Demand limits for excess consumption metering						
Reserved for Germany	1	*b*	0	5		
Nominal values						
Voltage	1	*b*	0	6	0	
Basic/nominal current	1	*b*	0	6	1	
Frequency	1	*b*	0	6	2	
Maximum current	1	*b*	0	6	3	

General and service entry objects – Electricity	OBIS code					
	A	B	C	D	E	F
Reference voltage for power quality measurement	1	*b*	0	6	4	VZ
Reference voltage for aux. power supply	1	*b*	0	6	5	
Input pulse values or constants [b] NOTE For units, see 4.3.2.						
Active energy	1	*b*	0	7	0	
Reactive energy	1	*b*	0	7	1	
Apparent energy	1	*b*	0	7	2	
Volt-squared hours	1	*b*	0	7	3	
Ampere-squared hours	1	*b*	0	7	4	
Unitless quantities	1	*b*	0	7	5	
Active energy, export	1	*b*	0	7	10	
Reactive energy, export	1	*b*	0	7	11	
Apparent energy, export	1	*b*	0	7	12	
Measurement period- / recording interval- / billing period duration						
Measurement period 1, for averaging scheme 1	1	*b*	0	8	0	VZ
Measurement period 2, for averaging scheme 2	1	*b*	0	8	1	VZ
Measurement period 3, for instantaneous value	1	*b*	0	8	2	VZ
Measurement period 4, for test value	1	*b*	0	8	3	VZ
Recording interval 1, for load profile	1	*b*	0	8	4	VZ
Recording interval 2, for load profile	1	*b*	0	8	5	VZ
Billing period (Billing period 1 if there are two billing period schemes)	1	*b*	0	8	6	VZ
Billing period 2	1	*b*	0	8	7	VZ
Measurement period 4, for harmonics measurement	1	*b*	0	8	8	VZ
Time entries						
Time expired since last end of billing period (First billing period scheme if there are more than one)	1	*b*	0	9	0	
Local time	1	*b*	0	9	1	
Local date	1	*b*	0	9	2	
Reserved for Germany	1	*b*	0	9	3	
Reserved for Germany	1	*b*	0	9	4	
Week day (0…7)	1	*b*	0	9	5	
Time of last reset (First billing period scheme if there are more than one)	1	*b*	0	9	6	
Date of last reset (First billing period scheme if there are more than one)	1	*b*	0	9	7	
Output pulse duration	1	*b*	0	9	8	
Clock synchronization window	1	*b*	0	9	9	
Clock synchronization method	1	*b*	0	9	10	
Clock time shift limit (default value: s)	1	*b*	0	9	11	
Billing period reset lockout time (First billing period scheme if there are more than one)	1	*b*	0	9	12	
Second billing period scheme						
Time expired since last end of billing period	1	*b*	0	9	13	
Time of last reset	1	*b*	0	9	14	
Date of last reset	1	*b*	0	9	15	
Billing period reset lockout time	1	*b*	0	9	16	
Coefficients						

General and service entry objects – Electricity	OBIS code					
	A	B	C	D	E	F
Transformer magnetic losses, X_m	1	*b*	0	10	0	VZ
Transformer iron losses, R_{Fe}	1	*b*	0	10	1	VZ
Line resistance losses, R_{Cu}	1	*b*	0	10	2	VZ
Line reactance losses, X_s	1	*b*	0	10	3	VZ
Measurement methods						
Algorithm for active power measurement	1	*b*	0	11	1	
Algorithm for active energy measurement	1	*b*	0	11	2	
Algorithm for reactive power measurement	1	*b*	0	11	3	
Algorithm for reactive energy measurement	1	*b*	0	11	4	
Algorithm for apparent power measurement	1	*b*	0	11	5	
Algorithm for apparent energy measurement	1	*b*	0	11	6	
Algorithm for power factor calculation	1	*b*	0	11	7	
Metering point ID (electricity related)						
Metering point ID 1 (electricity related)	1	0	96	1	0	
………						
Metering point ID 10 (electricity related)	1	0	96	1	9	
Internal operating status, electricity related						
Internal operating status, global [c]	1	*b*	96	5	0	
Internal operating status (status word 1)	1	*b*	96	5	1	
Internal operating status (status word 2)	1	*b*	96	5	2	
Internal operating status (status word 3)	1	*b*	96	5	3	
Internal operating status (status word 4)	1	*b*	96	5	4	
Meter started status flag	1	*b*	96	5	5	
Electricity related status data						
Status information missing voltage	1	0	96	10	0	
Status information missing current	1	0	96	10	1	
Status information current without voltage	1	0	96	10	2	
Status information auxiliary power supply	1	0	96	10	3	
Manufacturer specific [d]	1	*b*	96	50	*e*	*f*
…………………	…	…	…	…	…	…
Manufacturer specific	1	*b*	96	99	*e*	*f*

a	If a transformer ratio is expressed as a fraction the ratio is numerator, divided by denominator. If the transformer ratio is expressed by an integer or real figure, only the numerator is used.
b	The codes for export active, reactive and apparent energy shall be used only if meters measuring import energy and meters measuring export energy are connected to the pulse inputs.
c	Global status words with E = 0 contain the individual status words E = 1…5. The contents of the status words are not defined In this Technical Report.
d	The range D = 50…99 is available for identifying objects, which are not represented by another defined code, but need representation on the display as well. If this is not required, the range D = 128…254 should be used.

It should be noted, that some of the codes above are normally used for display purposes only, as the related data items are attributes of objects having their own OBIS name. See Clause 4.

7.5.5.2 Error register objects – Electricity

Table 58 specifies the OBIS codes for electricity related error register objects.

Table 58 – OBIS codes for error register objects – Electricity

Error register objects – Electricity	OBIS code					
	A	B	C	D	E	F
Error register	1	*b*	97	97	*e*	
NOTE The information to be included in the error objects is not defined in this document.						

7.5.5.3 List objects – Electricity

Table 59 specifies the OBIS codes for electricity related list objects.

Table 59 – OBIS codes for list objects – Electricity

List objects – Electricity	OBIS code					
	A	B	C	D	E	F
Electricity related data of billing period (with billing period scheme 1 if there are two schemes available)	1	*b*	98	1	*e*	255 [a]
Electricity related data of billing period (with billing period scheme 2)	1	*b*	98	2	*e*	255 [a]
[a] F = 255 means a wildcard here. See 7.11.3.						

7.5.5.4 Data profile objects – Electricity

Electricity related data profiles – identified with one single OBIS code – are used to hold a series of measurement values of one or more similar quantities and/or to group various data. The OBIS codes are specified in Table 60.

Table 60 – OBIS codes for data profile objects – Electricity

Data profile objects – Electricity	OBIS code					
	A	B	C	D	E	F
Load profile with recording period 1	1	*b*	99	1	*e*	
Load profile with recording period 2	1	*b*	99	2	*e*	
Load profile during test	1	*b*	99	3	0	
Dips voltage profile	1	*b*	99	10	1	
Swells voltage profile	1	*b*	99	10	2	
Cuts voltage profile	1	*b*	99	10	3	
Voltage harmonic profile	1	*b*	99	11	n^{th}	
Current harmonic profile	1	*b*	99	12	n^{th}	
Voltage unbalance profile	1	*b*	99	13	0	
Power quality	1	*b*	99	14	0	
Power failure event log	1	*b*	99	97	*e*	
Event log	1	*b*	99	98	*e*	
Certification data log	1	*b*	99	99	*e*	

7.5.5.5 Register table objects – Electricity

Register tables - identified with a single OBIS code - are defined to hold a number of values of the same type. The OBIS codes are specified in Table 61.

Table 61 – OBIS codes for Register table objects – Electricity

Register table objects – Electricity	OBIS code					
	A	B	C	D	E	F
UNIPEDE voltage dips, any phase	1	*b*	12	32		
UNIPEDE voltage dips, L_1	1	*b*	32	32		
UNIPEDE voltage dips, L_2	1	*b*	52	32		
UNIPEDE voltage dips, L_3	1	*b*	72	32		
Extended angle measurement	1	*b*	81	7		
General use, electricity related	1	*b*	98	10	*e*	

7.6 Heat Cost Allocators (Value group A = 4)

7.6.1 General

NOTE The following introductory text is from EN 13757-1:2014, 11.3.2.1.

Heat Cost Allocators (HCAs) are mounted on radiators in the area to be monitored. The HCA should be mounted with in free air and radiators should not be enclosed. There will normally also be multiple HCAs, even for a single customer. This makes at, the present, direct connection to all HCAs using a two way connections an infeasible solution. It is nevertheless important, that data coming from a (number of) HCAs (via a concentrator) can be handled in the same way as data from other meters for remote reading.

This subclause 7.6 describes the naming of objects carrying HCA information in a COSEM environment. The words used in this clause are those used in EN 834:1994, the corresponding media standard.

The output from an HCA is "the temperature integral with respect to time", and it is only a relative sum. The main parameter from a HCA is this integral. Time series of this integral may be stored in the HCA for later readout. Other media related information available from a HCA are temperature and rating factors.

7.6.2 Value group C codes – HCA

The name of the different objects in the table for HCA objects corresponds to the name used in the relevant standard, EN 834:1994. The OBIS codes are specified in Table 62.

Table 62 – Value group C codes – HCA

Value group C codes – HCA (A = 4)	
0	General purpose objects [a]
1	Unrated integral [b]
2	Rated integral [c]
3	Radiator surface temperature [d]
4	Heating medium temperature, t_m
5	Flow (forward) temperature, t_V
6	Return temperature, t_R
7	Room temperature, t_L
93	Consortia specific identifiers, see Table 43.
94	Country specific identifiers, see Table 44.
96	General and service entry objects– HCA (See 7.6.4.1).
97	Error register objects – HCA (See 7.6.4.2).
98	List objects – HCA
99	Data profile objects – HCA (See 7.6.4.3)
128...199, 240	Manufacturer specific codes
All other	Reserved
[a]	Settings like time constant, thresholds etc. See the table of object codes in EN 13757-1:2014, 11.3.2.2.

Value group C codes – HCA (A = 4)	
b	Readout prior to compensation as specified in EN 834:1994.
c	Readout after compensation as specified in EN 834:1994.
d	Temperature measured prior to any rating
NOTE 1	The radiator surface (C = 3) temperature and the heating media (C=4) temperature are mutually exclusive.
NOTE 2	The forward flow (C = 5) and reverse flow (C = 6) temperatures are exclusive to the radiator surface (C = 3) temperature.
NOTE 3	The room temperature measurement (C = 7) is always be accompanied by either a radiator surface (C = 3) temperature, a heating media (C = 4) temperature or a pair of forward / return flow (C = 5 / C = 6) temperatures.

7.6.3 Value group D codes – HCA

This value group specifies the result of processing a *Quantity* according to a specific algorithm for Heat Cost Allocator related values. The OBIS codes are specified inTable 63.

Table 63 – Value group D codes – HCA

Value group D codes – HCA (A = 4, C <> 0, 96...99)	
0	Current value
1	Integral value over measurement periods (Periodical value) [a]
2	Integral value relative to billing periods: Set date value
3	Integral value relative to billing periods: Billing date value
4	Minimum of value
5	Maximum of value
6	Test value [b]
All other	Reserved
a	A set of values periodically stored (this may be once or twice a month)
b	A value specially processed for test purpose. This may be due to an increased precision of the data, or to a faster (but less precise) processing of data.

7.6.4 Value group E codes – HCA

Table 64 shows the use of value group E for identification of tariff rates typically used for energy (consumption) and demand quantities.

Table 64 – Value group E codes – HCA

Value group E codes – HCA	
0	Total
1	Rate 1
2	Rate 2
3	Rate 3
…	…
9	Rate 9

128…254	Manufacturer specific codes
All other	Reserved

7.6.5 OBIS codes – HCA

7.6.5.1 General and service entry objects – HCA

Table 65 specifies OBIS codes for heat cost allocator related general and service entry objects.

Table 65 – OBIS codes for general and service entry objects – HCA

General and service entry objects – HCA	OBIS code					
	A	**B**	**C**	**D**	**E**	**F**
Free ID-numbers for utilities						
Complete combined ID	4	*b*	0	0		
ID 1	4	*b*	0	0	0	
…			…	…	…	
ID 10	4	*b*	0	0	9	
Storage information						
Status (VZ) of the historical value counter	4	*b*	0	1	1	
Number of available historical values	4	*b*	0	1	2	
Set date (target date)	4	*b*	0	1	10	
Billing date	4	*b*	0	1	11	
Configuration						
Program version no.	4	*b*	0	2	0	
Firmware version no.	4	*b*	0	2	1	
Software version no.	4	*b*	0	2	2	
Device measuring principle						
Device measuring principle [a]	4	*b*	0	2	3	
Conversion factors						
Resulting rating factor, K	4	*b*	0	4	0	
Thermal output rating factor, K_Q	4	*b*	0	4	1	
Thermal coupling rating factor overall, K_C	4	*b*	0	4	2	
Thermal coupling rating factor room side, K_{CR}	4	*b*	0	4	3	
Thermal coupling rating factor heater side, K_{CH}	4	*b*	0	4	4	
Low temperature rating factor, K_T	4	*b*	0	4	5	
Display output scaling factor	4	*b*	0	4	6	
Threshold values						
Start temperature threshold	4	*b*	0	5	10	
Difference temperature threshold	4	*b*	0	5	11	
Period information						
Measuring period for average value	4	*b*	0	8	0	
Recording interval for consumption profile	4	*b*	0	8	4	

General and service entry objects – HCA	OBIS code					
	A	B	C	D	E	F
Billing period	4	*b*	0	8	6	
Time entries						
Local time	4	*b*	0	9	1	
Local date	4	*b*	0	9	2	
Time stamp (local time) of the most recent billing period [b]	4	*b*	0	9	3	
Manufacturer specific [c]	4	*b*	96	50	*e*	*f*
…………………						
Manufacturer specific	4	*b*	96	99	*e*	*f*

[a] This is an object of the type 'Data' enumerated, (0) single sensor, (1) single sensor + start sensor, (2) dual sensor, (3) triple sensor.

[b] In case of billing period schemes absence or event triggered, commonly calculated from local date and local time information.

[c] The range D = 50…99 is available for identifying objects, which are not represented by another defined code, but need representation on the display as well. If this is not required, the range D = 128…254 should be used.

7.6.5.2 Error register objects – HCA

Table 66 specifies OBIS codes for HCA related error register objects.

Table 66 – OBIS codes for error register objects – HCA

Error register objects – HCA	OBIS code					
	A	B	C	D	E	F
Error registers	4	*b*	97	97	*e*	

7.6.5.3 List objects - HCA

Table 67 specifies the OBIS codes for HCA related list objects.

Table 67 – OBIS codes for list objects – HCA

List objects – HCA	OBIS code					
	A	B	C	D	E	F
HCA related data of billing period (with billing period scheme 1 if there are two schemes available)	4	*b*	98	1	*e*	255 [a]
HCA related data of billing period (with billing period scheme 2)	4	*b*	98	2	*e*	255 [a]

[a] F = 255 means a wildcard here. See 7.11.3.

7.6.5.4 Data profile objects – HCA

HCA related data profiles – identified with one single OBIS code – are used to hold a series of measurement values of one or more similar quantities and/or to group various data. The OBIS codes are specified in Table 68.

Table 68 – OBIS codes for data profile objects – HCA

Data profile objects – HCA	OBIS code					
	A	B	C	D	E	F
Data profile objects	4	*b*	99	1	*e*	

7.6.5.5 OBIS codes for HCA related objects (examples)

Table 69 specifies examples for OBIS codes of HCA related objects.

Table 69 – OBIS codes for HCA related objects (examples)

HCA related objects	OBIS code					
	A	B	C	D	E	F
Consumption						
Current unrated integral	4	*b*	1	0	0	
Current rated integral	4	*b*	2	0	0	
Rated integral, last set date	4	*b*	2	2	0	V_Z
Unrated integral, previous billing date	4	*b*	1	3	0	V_{Z-1}
Rated integral, two most recent periodical values	4	*b*	2	1	0	102
Monitoring values						
Radiator temperature, current value	4	*b*	3	0		
Radiator temperature, minimum value	4	*b*	3	4		
Radiator temperature, maximum value	4	*b*	3	5		
Flow temperature, test value	4	*b*	5	6		
Room temperature, current value	4	*b*	7	0		
Room temperature, minimum value	4	*b*	7	4		
Room temperature, maximum value	4	*b*	7	5		

7.7 Thermal energy (Value group A = 5 or A = 6)

7.7.1 General

This section describes the naming of objects carrying Thermal energy meter information in a COSEM environment. It covers the handling of heat, as well as cooling. The media specific terms used in this clause are those used in EN 1434-1:2015, EN 1434-2:2015 and parts of the corresponding media standard. The output from a Thermal energy meter is "the integral of power, i.e. the enthalpy difference times the mass flow-rate, with respect to time".

Thermal energy meters can be used for measurement in heating (A=6) or cooling (A=5) systems.

Value group A = 5 has been set aside for metering of cooling specific objects and value group A = 6 for the metering of heat specific objects. The other value groups are identical for heating and cooling.

7.7.2 Value group C codes – Thermal energy

The name of the different objects in the table for heat metering and cooling metering objects corresponds to the name used in EN 1434-1:2015. The OBIS codes are specified in Table 70.

Table 70 – Value group C codes – Thermal energy

Value group C codes – Thermal energy related objects (A = 5 or A = 6)	
0	General and service entry objects – Thermal energy (See 7.7.4.1)
1	Energy
2	Volume
3	Mass [b]
4	Inlet (Flow) volume [a]
5	Inlet (Flow) mass [a]
6	Outlet (Return) volume [a]
7	Outlet (Return) mass [a]
8	Power
9	Flow rate
10	Inlet (Flow) temperature [a]
11	Outlet (Return) temperature [a]
12	Temperature difference [c]
13	Pressure [d]
93	Consortia specific identifiers, see Table 43
94	Country specific identifiers, see Table 44
96	General and service entry objects – Thermal energy (See 7.7.4.1)
97	Error register objects – Thermal energy (See 7.7.4.2)
98	List objects – Thermal energy
99	Data profile objects – Thermal energy (See 7.7.4.3)
128...199, 240	Manufacturer specific codes
All other	Reserved
[a]	In a heating system the term “flow” is equivalent to “inlet” and the term “return” is equivalent to “outlet”

Value group C codes – Thermal energy related objects (A = 5 or A = 6)	
b	Used when metering steam.
c	Will often be available with a higher precision and accuracy than inlet (flow) and outlet (return) temperature.
d	Pressure of the media, if measured. Pressure can be retrieved as backup value from a general and service entry object (C=0), if incapable of measurement.

7.7.3 Value group D codes – Thermal energy

This value group specifies the result of processing a *Quantity* according to a specific algorithm for heat or cooling related values. See Table 71.

Table 71 – Value group D codes – Thermal energy

Value group D codes – Thermal energy (A = 5 or A = 6), (C <> 0, 96...99)	
0	Current value
1	Periodical value 1[a]
2	Set date value
3	Billing date value
4	Minimum of value 1
5	Maximum of value 1
6	Test value [b]
7	Instantaneous value [c]
8	Time integral 1 [d]
9	Time integral 2 [e]
10	Current average [f]
11	Last average [g]
12	Periodical value 2 [a]
13	Periodical value 3 [a]
14	Minimum of value 2
15	Maximum of value 2
20	Under limit occurrence counter
21	Under limit duration
22	Over limit occurrence counter
23	Over limit duration
24	Missing data occurrence counter [h]
25	Missing data duration [h]
All other	Reserved
a	A set of data that is collected periodically. Recording of data in this way is directly supported by 'profiles'.
b	A value specially processed for test purpose. This may be due to an increased precision of the data, or to a faster (but less precise) processing of data.
c	An immediate readout from the system, typically with a shorter measuring time than the current value.

Value group D codes – Thermal energy (A = 5 or A = 6), (C <> 0, 96...99)	
d	For a current billing period (F = 255): Time integral of the *quantity* calculated from the origin (first start of measurement) to the instantaneous time point. For a historical billing period (F = 0…99): Time integral of the *quantity* calculated from the origin to the end of the billing period given by the billing period code.
e	For a current billing period (F = 255): Time integral of the *quantity* calculated from the beginning of the current billing period to the instantaneous time point. For a historical billing period (F = 0…99): Time integral of the *quantity* calculated over the billing period given by the billing period code.
f	The value of a current demand register.
g	The value of a demand register at the end of the last measurement period.
h	Values considered as missing (for instance due to sensor failure).

7.7.4 Value group E codes – Thermal energy

Table 72 shows the use of value group E for identification of tariff rates typically used for energy (consumption) and demand quantities.

Table 72 – Value group E codes – Thermal Energy – Tariff rates

Value group E codes – Thermal Energy	
0	Total
1	Rate 1
2	Rate 2
3	Rate 3
...	…
9	Rate 9
128...254	Manufacturer specific codes
All other	Reserved

7.7.5 OBIS codes – Thermal energy

7.7.5.1 General and service entry objects – Thermal energy

Table 73 specifies OBIS codes for thermal energy related general and service entry objects.

Table 73 – OBIS codes for general and service entry objects – Thermal energy

General and service entry objects – Thermal energy	OBIS code					
	A	B	C	D	E	F
Free ID-numbers for utilities						
Complete combined ID	5/6	*b*	0	0		
ID 1	5/6	*b*	0	0	0	
…			…	…	…	
ID 10	5/6	*b*	0	0	9	

General and service entry objects – Thermal energy	OBIS code					
	A	B	C	D	E	F
Storage information						
Status (VZ) of the historical /periodical value counter	5/6	*b*	0	1	1	[f]
Status (VZ) of the periodical value counter, period 1	5/6	*b*	0	1	1	1 [f]
Number of available historical / periodical values	5/6	*b*	0	1	2	[f]
Number of available periodical values for period 2	5/6	*b*	0	1	2	2 [f]
Set date	5/6	*b*	0	1	10	
Billing date	5/6	*b*	0	1	11	
Configuration						
Program version	5/6	*b*	0	2	0	
Firmware version	5/6	*b*	0	2	1	
Software version	5/6	*b*	0	2	2	
Meter location (flow or return) [a]	5/6	*b*	0	2	3	
Device version	5/6	*b*	0	2	4	
Serial number of inlet (flow) temperature transducer	5/6	*b*	0	2	10	
Serial number of outlet (return) temperature transducer	5/6	*b*	0	2	11	
Serial number of forward flow transducer	5/6	*b*	0	2	12	
Serial number of return flow transducer	5/6	b	0	2	13	
Conversion factors						
Heat coefficient, k	5/6	*b*	0	4	1	
Pressure (backup value) [b]	5/6	*b*	0	4	2	
Enthalpy [c]	5/6	*b*	0	4	3	
Threshold values						
Threshold value limit for rate 1 [d]	5/6	*b*	0	5	1	
…			…	…	…	
Threshold value limit for rate 9 [d]	5/6	*b*	0	5	9	
Maximum contracted flow rate [e]	5/6	*b*	0	5	21	
Maximum contracted power [e]	5/6	*b*	0	5	22	
Maximum contracted $\Delta\theta$ [e]	5/6	*b*	0	5	23	
Minimum contracted return temperature [e]	5/6	*b*	0	5	24	
Timing information						
Averaging period for measurements, generic	5/6	*b*	0	8	0	
Averaging period for instantaneous measurements	5/6	*b*	0	8	1	
Averaging period for volume / flow measurements	5/6	*b*	0	8	2	
Averaging period for temperature measurements	5/6	*b*	0	8	3	
Averaging period for pressure measurements	5/6	*b*	0	8	4	
Averaging period, power	5/6	*b*	0	8	5	
Averaging period, flow rate	5/6	*b*	0	8	6	
Averaging period, test values	5/6	*b*	0	8	7	
Measurement period, peak values, period 1(short) [g]	5/6	*b*	0	8	11	
Measurement period, peak values, period 2 [g]	5/6	*b*	0	8	12	

General and service entry objects – Thermal energy	OBIS code					
	A	B	C	D	E	F
Measurement period, peak values, period 3 [g]	5/6	*b*	0	8	13	
Measurement period, peak values, period 4 [g]	5/6	*b*	0	8	14	
Measurement period, periodical values, period 1(short) [g]	5/6	*b*	0	8	21	
Measurement period, periodical values, period 2 [g]	5/6	*b*	0	8	22	
Measurement period, periodical values, period 3 [g]	5/6	*b*	0	8	23	
Measurement period, periodical values, period 4 [g]	5/6	*b*	0	8	24	
Measurement period, test values	5/6	*b*	0	8	25	
Recording interval 1 for profiles [h]	5/6	*b*	0	8	31	
Recording interval 2 for profiles [h]	5/6	*b*	0	8	32	
Recording interval 3 for profiles [h]	5/6	*b*	0	8	33	
Billing period	5/6	*b*	0	8	34	
Time entries						
Local time	5/6	*b*	0	9	1	
Local date	5/6	*b*	0	9	2	
Time stamp (local time) of the most recent billing period [i]	5/6	*b*	0	9	3	
Manufacturer specific [j] ………………… Manufacturer specific	5/6 5/6	*b* *b*	96 96	50 99	*e* *e*	*f* *f*

[a] Information about where the (single) flow meter is inserted. A non-zero value is used when the flow meter is located in the flow path.

[b] Defines the pressure of the media, if not measured. The default value is 16 bar according to EN 1434-2:2015.

[c] The enthalpy of the thermal conveying liquid. This will be necessary when using media other than pure water. The enthalpy is a part of the calculations when converting from mass to power.

[d] Part of the contract between the customer and the supplier. The threshold defines when to switch rate, and can be used for diagnostic purposes, or to control limiting valves as well.

[e] Part of the contract between the customer and the supplier. The threshold may be used to set a 'flag', for diagnostic purposes, or to control limiting valves.

[f] Value group 'F' may be left unused, if there is only one set of historical / periodical values in the meter.

[g] The instantiation of periods in a meter shall always start at period 1.

[h] If only one recording interval is implemented, then it shall be recording interval 1. If multiple recording intervals are implemented, the recording interval 1 shall be the interval with the shorter period.

[i] In case of billing period schemes absence or event triggered, commonly calculated from local date and local time information

[j] The range D = 50…99 is available for identifying objects, which are not represented by another defined code, but need representation on the display as well. If this is not required, the range D = 128…254 should be used.

7.7.5.2 Error register objects – Thermal energy

Table 74 specifies OBIS codes for thermal energy related error register objects.

Table 74 – OBIS codes for error register objects – Thermal energy

Error register objects – Thermal energy	OBIS code					
	A	B	C	D	E	F
Error registers	5/6	*b*	97	97	*e*	

NOTE The information to be included in the error objects is not defined in this document.

7.7.5.3 List objects – Thermal Energy Meters

Table 75 specifies the OBIS codes for Thermal Energy Meters related list objects. .

Table 75 – OBIS codes for list objects – Thermal Energy Meters

List objects – Thermal Energy Meters	OBIS code					
	A	B	C	D	E	F
Thermal energy related data of billing period (with billing period scheme 1 if there are two schemes available)	5/6	*b*	98	1	*e*	255 [a]
Thermal energy related data of billing period (with billing period scheme 2)	5/6	*b*	98	2	*e*	255 [a]
[a] F = 255 means a wildcard here. See 7.11.3.						

7.7.5.4 Data profile objects – Thermal energy

Thermal energy related data profiles – identified with one single OBIS code – are used to hold a series of measurement values of one or more similar quantities and/or to group various data. The OBIS codes are specified in Table 76.

Table 76 – OBIS codes for data profile objects – Thermal energy

Data profile objects – Thermal energy	OBIS code					
	A	B	C	D	E	F
Consumption / load profile with recording interval 1	5/6	*b*	99	1	1	
Consumption / load profile with recording interval 2	5/6	*b*	99	1	2	
Consumption / load profile with recording interval 3	5/6	*b*	99	1	3	
Profile of maxima with recording interval 1	5/6	*b*	99	2	1	
Profile of maxima with recording interval 2	5/6	*b*	99	2	2	
Profile of maxima with recording interval 3	5/6	*b*	99	2	3	
Consumption / load profile during test	5/6	*b*	99	3	1	
Certification data log	5/6	*b*	99	99	*e*	

7.7.5.5 OBIS codes for Thermal energy related objects (examples)

Table 77 shows examples for OBIS codes of Thermal energy related objects.

Table 77 – OBIS codes for Thermal energy related objects (examples)

Thermal energy related objects (examples)	OBIS code					
	A	B	C	D	E	F
Consumption						

Thermal energy related objects (examples)	OBIS code					
	A	B	C	D	E	F
Energy, current value, total	5/6	*b*	1	0	0	
Energy, current value, rate 1	5/6	*b*	1	0	1	
Energy, periodical, total, the second last storage	5/6	*b*	1	1	0	102
Energy, billing date value, total, last storage, rate 1	5/6	*b*	1	3	1	V_Z
Monitoring values						
Energy, maximum value (current period)	5/6	*b*	1	5		
Flow rate, Period value 2, previous storage	5/6	*b*	9	12		V_{Z-1}
Power, Max value, previous period	5/6	*b*	8	5		V_{Z-1}
Energy, Missing duration c	5/6	*b*	1	25		
Differential temperature, Test value	5/6	*b*	12	6		
Flow path, temperature transducers serial no.	5/6	*b*	0	2	10	
Error handling						
Overall error status [a]	5/6	*b*	97	97	0	
Subsystem where error has occurred [b]	5/6	*b*	97	97	1	
Duration of error condition [c]	5/6	*b*	97	97	2	

a	This object is a 'mirror' of the object 0.x.97.97.0.
b	This is the time during which the meter has not been able to calculate energy.
c	A further subdivision of error information.

7.8 Gas (Value group A = 7)

7.8.1 General introduction to gas measurement

7.8.1.1 Overview

Measurement of the energy supplied in the form of gas to customers is a complex process. It has to take into account the characteristics of the measuring site, the gas measurement technology, the conditions and the properties of the gas and the characteristics of the billing process.

Energy measurement is generally a multi-step process:

- The first step is to measure either the amount of the volume or the mass of gas based on various measuring principles, like volume, flow, density or mass measurement. Accuracy can be improved by correcting the measurement error of the meter;
- In the case of volume measurement, the next step is to convert the volume measured at metering conditions to volume at base conditions;
- In the final step, the energy is calculated from the volume at base conditions or the mass, and the calorific value. The calorific value – either per volume unit or per mass unit – is determined using gas analysis techniques.

The measurement technology and the implementation of the volume conversion and energy calculation process depend on the application segment.

Conversion and calculation steps can take place at the measuring site by electronic devices, or in the IT system.

For measurement of larger volumes, there are several devices involved in the process, depending on installation and hazardous area requirements. Not only the final results, but also interim values in the conversion and calculation process are of interest for checking and controlling purposes.

7.8.1.2 Typical gas metering installations

7.8.1.2.1 Residential application

A typical residential gas metering installation is shown in Figure 29.

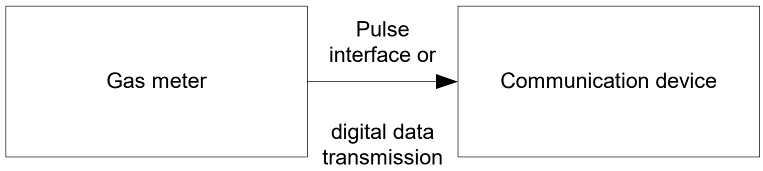


Figure 29 – Residential gas metering installation

The meter is typically a diaphragm (positive displacement) meter, which may perform mechanical temperature correction.

The information from the gas meter to the communication device may be transferred in the form of pulses. Alternatively, the meter may be equipped with a digital interface, e.g. an encoder turning the index reading to digital information.

Volume conversion and energy calculation takes place in the IT system.

7.8.1.2.2 Industrial application

A typical industrial gas metering installation is shown in Figure 30.

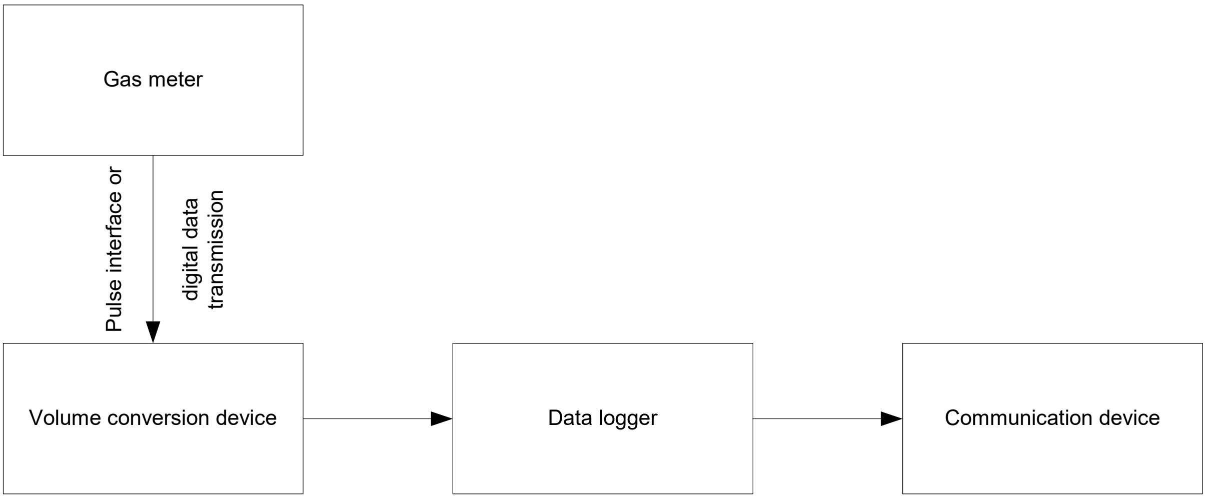


Figure 30 – Industrial gas metering installation (single stream)

In industrial applications, typically more functions are implemented at the measuring site than in residential applications. This may include the calculation of the volume at base conditions, and, if the calorific value is available (e.g. via remote communication), the calculation of the energy.

The data logger stores data relevant for billing, data validation and process control.

The functions may be integrated in fewer devices, depending on the hazardous zone restrictions and the level of integration of electronics.

7.8.1.2.3 Gas transport application

A typical gas transport metering “city gate” installation – also used for very large consumers – is shown in Figure 31.

Such gas stations are equipped with more than one pipe for the gas flow (multi stream).Typically, volume conversion devices are installed on each pipe, because the measurement is closely pipe related. Generally, there is one data logger and a device used to determine the calorific value (e.g. gas chromatograph).

All devices are connected via a bus system.

Depending on the design of these devices, selected functions may be implemented in a single cabinet or physical device.

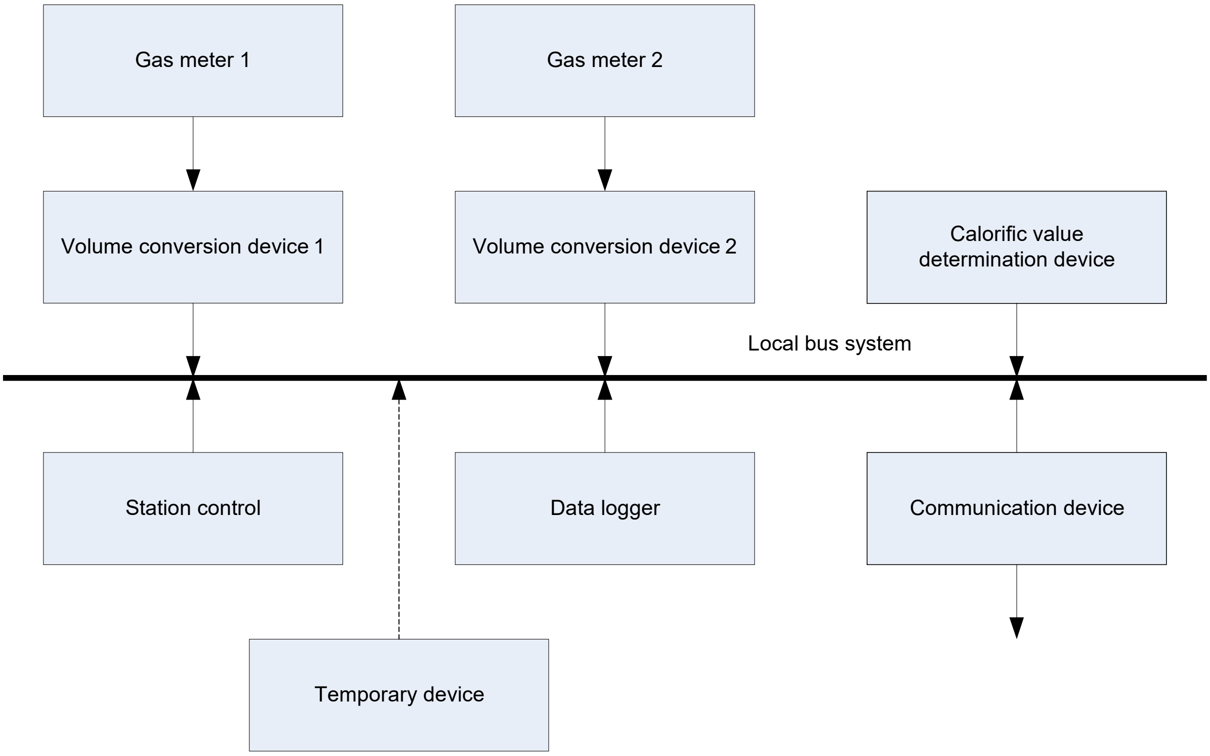


Figure 31 – City gate or border crossing installation (multi stream)

7.8.1.3 Gas volume conversion

7.8.1.3.1 General

The gas volume conversion process needs the following inputs:

- the volume information from a gas meter;
- the temperature of the gas measured;
- the pressure of the gas measured: this may be replaced by a constant;
- the compressibility, this may be replaced by a constant.

When the process is implemented in a gas conversion device, it is assumed to be capable of:

- performing error correction (optionally);
- measuring the temperature;
- measuring the pressure of the gas (optionally); and
- calculating the compressibility according to agreed algorithms, in function of temperature, pressure and gas composition (optionally).

The volume conversion device may handle bidirectional gas flows. The main direction of flow is *forward*.

It may be equipped with *disturbance registers* used when the value of temperature, pressure or compressibility is outside permissible metrological limits of plausibility, leading to an *alert condition*. When such alert condition occurs, the gas conversion process switches to store results in disturbance registers, until the alert conditions disappears.

7.8.1.3.2 Step 1: Error correction (optional)

The error curve of the gas meter is corrected by a correction factor:

$$V_c = C_f * V_m$$

where:

- V_c is the corrected volume;
- C_f is the correction factor given by an equation Cf = f(q) or Cf = f(Re); where q is the flow and Re is the Reynolds number;
- V_m is the volume at metering conditions.

The error correction method depends on station construction and operating conditions and its selection is made generally by manufacturer, utility or market specific.

7.8.1.3.3 Step 2: Volume conversion to base conditions

Volume at base conditions is calculated using the equation:

$$V_b = C \text{ x } V$$

Where:

- V_b is the volume at base conditions,
- V may be V_m or V_c (Volume at metering conditions or corrected volume);
- C is the conversion factor given by the relationship:

$$C = (P / P_b) \text{ x } (T_b / T) \text{ x } (Z_b / Z)$$

where Z is the compressibility factor allowing to take into account the difference in compressibility between the gas measured and the ideal gas. It is a function of the pressure and the temperature:

$$Z = \text{f } (P, T)$$

Settable gas properties and components are used for the compressibility calculation, combined into one of several existing calculation methods. If the compressibility factor is not calculated, it may be included as a fixed value in the calculation of the conversion factor. Below 1,5 bar, the value of Z is usually set to 1.

If the pressure is not measured, it may be included as a fixed value in the calculation of the conversion factor.

7.8.1.3.4 Step 3: Energy conversion

The final step is to calculate the energy, using the equation:

$$E = \text{CalValue x } V_b$$

where CalValue is the calorific value, expressed in J/m^3. Typically, it is measured by calorimeter or gas chromatograph devices.

7.8.1.3.5 Model of data flow for volume conversion and energy calculation

The model of data flow for volume conversion and energy calculation is shown in Figure 32.

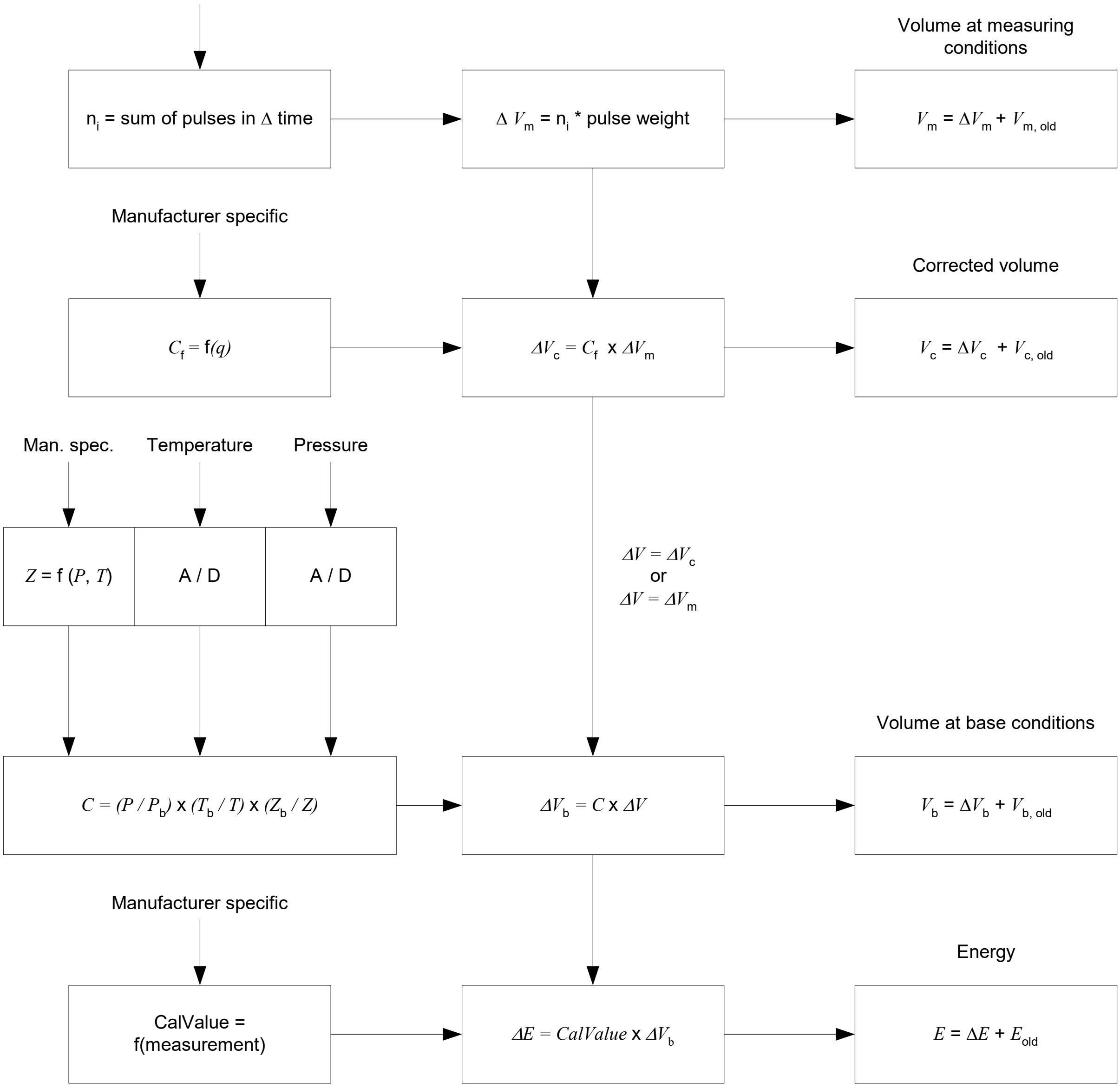


Figure 32 – Data flow of volume conversion and energy calculation

The OBIS codes of the main objects in the data flow are shown in Table 78, with the following assumptions:

- the conversion process passes through all four functions from metering to energy;
- the device has one single channel;
- the direction of the gas flow is forward;
- energy is the result of the conversion process from volume at base conditions to energy, by applying the calorific value as factor;
- the data of interest are current values of absolute indexes and the gas process data.

Table 78 – OBIS codes of the main objects in the gas conversion process data flow

Name	Symbol	OBIS code
Indexes		
Forward absolute meter volume, index, at metering conditions	V_m	7.0.3.0.0.255
Forward absolute converter volume, index, at metering conditions	V_m	7.0.13.0.0.255
Forward absolute converter volume, index, corrected value	V_c	7.0.13.1.0.255
Forward absolute converter volume, index, at base conditions	V_b	7.0.13.2.0.255
Forward absolute energy, index, at base conditions	E	7.0.33.2.0.255
Compressibility, correction and conversion values		
Correction factor [a]	C_f	7.0.51.0.0.255
Conversion factor [b]	C	7.0.52.0.0.255
Compressibility factor, current value at metering conditions [c]	Z	7.0.53.0.0.255
Compressibility factor, current value at base conditions [c]	Z_b	7.0.53.2.0.255
Compressibility factor, preset value [c]	Z_b	7.0.53.11.0.255
Compressibility factor, calculation method [c]		7.0.53.12.0.255
Superior calorific value [d]	CalVal	7.0.54.0.0.255
Metering site condition information		
Gas temperature (absolute), value at metering conditions [e]	T	7.0.41.0.0.255
Gas temperature (absolute), value at base conditions [e]	T_b	7.0.41.2.0.255
Gas temperature (absolute), backup value [e]	T	7.0.41.3.0.255
Gas pressure (absolute), value at metering conditions [f]	P	7.0.42.0.0.255
Gas pressure (absolute), value at base conditions [f]	P_b	7.0.42.2.0.255
Gas pressure (absolute), backup value [f]	P	7.0.42.3.0.255

a	A fixed value used to correct a scalar error on a meter: for example, if a meter under-registers volume by 0,5 %, then a correction factor value of 1,005 will compensate for the error.
b	See 7.8.1.3.3.
c	Compressibility, Z: effectively, the "difference" in compressibility between the gas being measured and "noble" gas. For example, EN 12405, SGERG-88, AGA 8 give full information on this, though below 1,5 Bar (a) this is usually set to 1.
d	The superior (or gross) calorific value can be seen as a conversion factor for converting volume to energy although it is also used for the conversion algorithm.
e	Temperature of the gas, expressed in Kelvin. Volume conversion depends on Kelvin temperature measurement. This may represent a measured value or a base condition, or a backup value, used if the temperature sensor fails, as identified by the value of value group D.
f	Pressure of the gas, expressed in a suitable unit, in absolute terms, for example Bar (a). This means that the value is referenced to a perfect vacuum, as opposed to "Gauge" pressure, which is referenced to current atmospheric conditions. This may represent a measured value or a base condition, or a backup value, used if the pressure sensor fails, as identified by the value of value group D.

7.8.1.4 Data logging

7.8.1.4.1 General

The data logging process captures, generates and makes available the data necessary for billing, as well as the data necessary for managing the measurement process and the gas grid.

7.8.1.4.2 Time bound processing

Quantities measured by the gas meter, calculated in the data logger or in the IT system may be:

- indexes, index differences and maxima of index differences; and
- average, minimum and maximum values

related to various intervals and periods. A distinction is made between:

- recording intervals for profiles;
- measurement periods for average values;
- process intervals;
- measurement periods for index differences;
- billing periods for indexes, index differences and maxima of index differences;
- averaging periods.

Some of these periods and intervals may have a default length, or otherwise their length can be held by specific objects. See 7.8.6.1, Table 89.

The processing methods depend on the kind of the quantity:

- indexes and index differences; see 7.8.3.2;
- flow rate, see 7.8.3.3;
- process values, see 7.8.3.4;
- conversion related factors and coefficients, see 7.8.3.5; and
- natural gas analysis, see 7.8.3.6.

7.8.1.4.3 Gas day

One specific element in gas metering is that the start of a gas day may be different from the start of a calendar day.

NOTE 1 For example the gas day starts at 6:00 in Germany.

NOTE 2 In some countries, the gas day start time retains its value when DST starts and ends, causing a 25 hour and 23 hour day in each year.

Therefore, taking the example above, a gas month lasts from 6:00 of the first day of a calendar month to 6:00 of the first day of the next calendar month. Similarly, a gas year starts at 6:00 on 1st of January and ends at 6:00 on 1st January of the next year.

7.8.1.4.4 Data profiles

COSEM “Profile generic” objects may capture one or several values – attributes of COSEM objects – in their buffer.

For gas metering, both *general purpose* and *dedicated* profiles are available:

- a general purpose “Profile generic” object captures one or several values. Such objects have a general OBIS code / logical name that do not provide specific information on the values captured. These profiles are also available with some fixed recording intervals;
- a dedicated “Profile generic” object captures only one value. The OBIS code / logical name of such a dedicated ”Profile generic” object is “self-explanatory”, i.e. it reflects the OBIS code of the object the value attribute of which is captured.

NOTE A time stamp and a status attribute may be captured in addition to the value(s) of interest.

In any case, the values captured are identified by the capture_objects attribute. See 7.8.6.4.

7.8.2 Value group C codes – Gas

The allocations in the value group C – see Table 79 – take into account the different combinations of measuring and calculating devices located at a metering point, to allow identifying the source where the data are generated.

For the purposes of volume / mass / energy measurement, value group C identifies:

- the location of the device in the measurement chain: meter (encoder), converter, logger;
- the direction of the gas flow: forward or reverse;
- the qualifier of the measurement: undisturbed, disturbed, or absolute, where absolute value is the sum of the values calculated under undisturbed and disturbed conditions.
- Value group C is also used for identifying process data.

For the purposes of gas analysis, a distinction is made between measured values generated by gas analysing systems (C = 70) and parameters used for calculation (C = 0, D = 12).

Table 79 – Value group C codes – Gas

Value group C codes – Gas (A = 7)	
0	General purpose objects
1	Forward undisturbed meter volume
2	Forward disturbed meter volume
3	Forward absolute meter volume
4	Reverse undisturbed meter volume
5	Reverse disturbed meter volume
6	Reverse absolute meter volume
7	Forward absolute meter volume (encoder)
8	Reverse absolute meter volume (encoder)
11	Forward undisturbed converter volume
12	Forward disturbed converter volume
13	Forward absolute converter volume
14	Reverse undisturbed converter volume
15	Reverse disturbed converter volume
16	Reverse absolute converter volume
21	Forward undisturbed logger volume
22	Forward disturbed logger volume
23	Forward absolute logger volume
24	Reverse undisturbed logger volume
25	Reverse disturbed logger volume
26	Reverse absolute logger volume

Value group C codes – Gas (A = 7)	
31	Forward undisturbed energy
32	Forward disturbed energy
33	Forward absolute energy
34	Reverse undisturbed energy
35	Reverse disturbed energy
36	Reverse absolute energy
41	Absolute temperature
42	Absolute pressure
43	Flow rate
44	Velocity of sound
45	Density (of gas)
46	Relative density
47	Gauge pressure
48	Differential pressure
49	Density of air
51	Correction factor
52	Conversion factor
53	Compressibility factor
54	Superior calorific value [a]
55	Gas law deviation coefficient (= compressibility factor ratio)
61	Forward undisturbed mass
62	Forward disturbed mass
63	Forward absolute mass
64	Reverse undisturbed mass
65	Reverse disturbed mass
66	Reverse absolute mass
70	Natural gas analysis
93	Consortia specific identifiers
94	Country specific identifiers
96	General and service entry objects – Gas (See 7.8.6.1)
97	Error register objects – Gas (See 7.8.6.2)
98	List objects – Gas (See 7.8.6.3)
99	Data profiles – Gas (See 7.8.6.4)
128...199, 240	Manufacturer specific codes

Value group C codes – Gas (A = 7)	
All other	Reserved
Notes	
[a] The superior (or gross) caloric value can be seen as a conversion factor for converting volume to energy although it is also used for the conversion algorithm.	

7.8.3 Value group D codes – Gas

7.8.3.1 General

Allocations in value group D allow to further classify quantities identified by codes in value group A to C. The allocations depend on the kind of quantity:

- indexes and index differences; see 7.8.3.2;
- flow rate, see 7.8.3.3;
- process values, see 7.8.3.4;
- conversion related factors and coefficients, see 7.8.3.5; and
- natural gas analysis values, see 7.8.3.6.

7.8.3.2 Gas indexes and index differences

The allocations allow identifying the various volume, mass and energy quantities measured along the measuring chain and the gas volume conversion process, relative to various measurement and billing periods:

- indexes: current values and historical values relative to various billing periods;
- index differences: current and last values relative to measurement periods and billing periods;

NOTE Index difference over a certain measurement or billing period is also known as consumption. For consumption, thresholds may be defined, see Table 89.

- maximum of index differences over various measurement periods, relative to various billing periods;

A distinction is made between *value at metering conditions*, *corrected value* and *value at base conditions (converted value)*. The applicability of these qualifiers depends on the location in the measuring chain and in the gas volume conversion process.

Three measurement periods are available:

- measurement period 1: default value 15 min;
- measurement period 2: default value 1 hour;
- measurement period 3: no default value specified.

Four billing periods are available:

- billing period 1: default value 1 day;
- billing period 2: default value 1 month;
- billing period 3: default value 1 year;
- billing period 4: no default value specified.

The default values specified reflect the most common applications. If other values are used, they may be held by COSEM objects specified for this purpose; see 6.4.4 and Table 89.

In addition to the current values of the indexes, the following values are available:

For measurement periods 1 to 3:

- index differences for the current and the last measurement period (6 values each).

For billing periods 1, 3 and 4:

- historical indexes (3 values each);
- index differences for the current and the last billing period (6 values each);
- maximum of index differences over measurement periods 1, 2 and 3 (9 values each);
- in total, 18 values each.

For billing period 2:

- historical indexes (3 values);
- index differences for the current and the last billing period (6 values);
- maximum of index differences over measurement periods 1, 2 and 3, as well as over billing period 1 (12 values);
- in total, 21 values.

For all these values, tariffs may be applied. See 7.8.4.2.

Table 80 specifies the use of value group D to identify gas related indexes and index differences.

Table 80 – Value group D codes – Gas – Indexes and index differences

Value group D codes – Gas – Indexes and index differences (A= 7, C = 1…8, 11…16, 21…26, 31…36, 61…66)			
	Quantity	**Qualifier**	**Period**
0	Index	Value at metering conditions	Current [c)]
1	Index	Corrected value [a]	Current [c)]
2	Index	Value at base conditions / “Converted value”	Current [c)]
3	Index	Current redundant value at metering conditions [b]	Current [c)]
Values relative to measurement period 1 (default value = 15 minutes)			
6	Index difference	Value at metering conditions	Current
7	Index difference	Corrected value	Current
8	Index difference	Value at base conditions	Current
9	Index difference	Value at metering conditions	Last
10	Index difference	Corrected value	Last
11	Index difference	Value at base conditions	Last
Values relative to measurement period 2 (default value = 1 hour)			
12	Index difference	Value at metering conditions	Current
13	Index difference	Corrected value	Current
14	Index difference	Value at base conditions	Current
15	Index difference	Value at metering conditions	Last
16	Index difference	Corrected value	Last

Value group D codes – Gas – Indexes and index differences (A= 7, C = 1…8, 11…16, 21…26, 31…36, 61…66)			
	Quantity	**Qualifier**	**Period**
17	Index difference	Value at base conditions	Last
Values relative to measurement period 3 (no default value)			
18	Index difference	Value at metering conditions	Current
19	Index difference	Corrected value	Current
20	Index difference	Value at base conditions	Current
21	Index difference	Value at metering conditions	Last
22	Index difference	Corrected value	Last
23	Index difference	Value at base conditions	Last
Values relative to billing period 1 (default value = 1 day)			
24	Index	Value at metering conditions	Historical [c]
25	Index	Corrected value	Historical [c]
26	Index	Value at base conditions	Historical [c]
27	Index difference	Value at metering conditions	Current
28	Index difference	Corrected value	Current
29	Index difference	Value at base conditions	Current
30	Index difference	Value at metering conditions	Last
31	Index difference	Corrected value	Last
32	Index difference	Value at base conditions	Last
33	Maximum of Index differences over measurement period 1 [c]	Value at metering conditions	
34	Maximum of Index differences over measurement period 1 [c]	Corrected value	
35	Maximum of Index differences over measurement period 1 [c]	Value at base conditions	
36	Maximum of Index differences over measurement period 2 [c]	Value at metering conditions	
37	Maximum of Index differences over measurement period 2 [c]	Corrected value	
38	Maximum of Index differences over measurement period 2 [c]	Value at base conditions	
39	Maximum of Index differences over measurement period 3 [c]	Value at metering conditions	
40	Maximum of Index differences over measurement period 3 [c]	Corrected value	
41	Maximum of Index differences over measurement period 3 [c]	Value at base conditions	
Values relative to billing period 2 (default value = 1 month)			
42	Index	Value at metering conditions	Historical [c]
43	Index	Corrected value	Historical [c]
44	Index	Value at base conditions	Historical [c]
45	Index difference	Value at metering conditions	Current
46	Index difference	Corrected value	Current
47	Index difference	Value at base conditions	Current
48	Index difference	Value at metering conditions	Last
49	Index difference	Corrected value	Last

Value group D codes – Gas – Indexes and index differences (A= 7, C = 1…8, 11…16, 21…26, 31…36, 61…66)			
	Quantity	**Qualifier**	**Period**
50	Index difference	Value at base conditions	Last
51	Maximum of Index differences over measurement period 1 [c]	Value at metering conditions	
52	Maximum of Index differences over measurement period 1 [c]	Corrected value	
53	Maximum of Index differences over measurement period 1 [c]	Value at base conditions	
54	Maximum of Index differences over measurement period 2 [c]	Value at metering conditions	
55	Maximum of Index differences over measurement period 2 [c]	Corrected value	
56	Maximum of Index differences over measurement period 2 [c]	Value at base conditions	
57	Maximum of Index differences over measurement period 3 [c]	Value at metering conditions	
58	Maximum of Index differences over measurement period 3 [c]	Corrected value	
59	Maximum of Index differences over measurement period 3 [c]	Value at base conditions	
60	Maximum of Index differences over billing period 1 [c]	Value at metering conditions	
61	Maximum of Index differences over billing period 1 [c]	Corrected value	
62	Maximum of Index differences over billing period 1 [c]	Value at base conditions	
Values relative to billing period 3 (default value = 1 year)			
63	Index	Value at metering conditions	Historical [c]
64	Index	Corrected value	Historical [c]
65	Index	Value at base conditions	Historical [c]
66	Index difference	Value at metering conditions	Current
67	Index difference	Corrected value	Current
68	Index difference	Value at base conditions	Current
69	Index difference	Value at metering conditions	Last
70	Index difference	Corrected value	Last
71	Index difference	Value at base conditions	Last
72	Maximum of Index differences over measurement period 1 [c]	Value at metering conditions	
73	Maximum of Index differences over measurement period 1 [c]	Corrected value	
74	Maximum of Index differences over measurement period 1 [c]	Value at base conditions	
75	Maximum of Index differences over measurement period 2 [c]	Value at metering conditions	
76	Maximum of Index differences over measurement period 2 [c]	Corrected value	
77	Maximum of Index differences over measurement period 2 [c]	Value at base conditions	
78	Maximum of Index differences over measurement period 3 [c]	Value at metering conditions	

Value group D codes – Gas – Indexes and index differences (A= 7, C = 1…8, 11…16, 21…26, 31…36, 61…66)			
	Quantity	**Qualifier**	**Period**
79	Maximum of Index differences over measurement period 3 [c]	Corrected value	
80	Maximum of Index differences over measurement period 3 [c]	Value at base conditions	
Values relative to billing period 4 (no default value)			
81	Index	Value at metering conditions	Historical [c]
82	Index	Corrected value	Historical [c]
83	Index	Value at base conditions	Historical [c]
84	Index difference	Value at metering conditions	Current
85	Index difference	Corrected value	Current
86	Index difference	Value at base conditions	Current
87	Index difference	Value at metering conditions	Last
88	Index difference	Corrected value	Last
89	Index difference	Value at base conditions	Last
90	Maximum of Index differences over measurement period 1 [c]	Value at metering conditions	
91	Maximum of Index differences over measurement period 1 [c]	Corrected value	
92	Maximum of Index differences over measurement period 1 [c]	Value at base conditions	
93	Maximum of Index differences over measurement period 2 [c]	Value at metering conditions	
94	Maximum of Index differences over measurement period 2 [c]	Corrected value	
95	Maximum of Index differences over measurement period 2 [c]	Value at base conditions	
96	Maximum of Index differences over measurement period 3 [c]	Value at metering conditions	
97	Maximum of Index differences over measurement period 3 [c]	Corrected value	
98	Maximum of Index differences over measurement period 3 [c]	Value at base conditions	
All other	Reserved		
[a]	Error correction of meter curves can be allocated to meters (e.g. temperature compensation of a diaphragm gas meter) or subsequent connected devices (e.g. high pressure correction curve of a turbine meter implemented in an associated volume conversion device).		
[b]	From data logger (parallel recording) for use in case of a measurement device fails.		
[c]	Current value: F = 255 Historical values (F ≠ 255): - With F = 1…12, 0…99 value(s) of (a) previous billing period, relative to the billing period counter. - With F = 101…126 value(s) of (a) previous billing period(s) relative to the current billing period.		

7.8.3.3 Flow rate

The allocations allow identifying values associated with the flow rate of the gas. The flow rate is a process information. It is not linked to a physical device. No tariffication is applicable.

A distinction is made between:

- current average, last average, and maximum of last average values measured over various averaging periods, relative to various measurement and billing periods. Measurement period 2 and 3 shall be multiple of the averaging period of block demand / sliding demand measurement.
- values at metering conditions, corrected value, value at base conditions (converted value) and value at standard conditions;

  NOTE Standard conditions refer to national regulations, which may differ from ISO standards reference values for base conditions.

  EXAMPLE Gas reference temperature at standard conditions is 0 °C, gas reference temperature at base conditions is +15 °C.

For averaging period 2, block demand (default) or sliding demand is available. In the case of sliding demand, the averaging period is split to sub-periods. The number of sub-periods is carried by the object 7.b.0.8.35.255; see Table 89.

The last average values of the various flow rate quantities can be captured to load profiles, with self-explanatory OBIS codes, see 7.8.6.4.

Table 81 specifies the use of value group D to identify gas related flow rate values.

Table 81 – Value group D codes – Gas – Flow rate

Value group D codes – Gas – Flow rate (A = 7, C = 43)		
	Quantity	**Qualifier**
0	Instantaneous	Current value at metering conditions
1	Instantaneous	Corrected value
2	Instantaneous	Value at base conditions / “Converted value”
13	Instantaneous	Value at standard conditions
Averaging period 1, default value = 5 minutes		
15	Current average for averaging period 1	Value at metering conditions
16		Corrected value
17		Value at base conditions
18		Value at standard conditions
19	Last average for averaging period 1	Value at metering conditions
20		Corrected value
21		Value at base conditions
22		Value at standard conditions
23	Maximum of last averages for averaging period 1 relative to measurement period 2 (default value = 1 hour)	Value at metering conditions
24		Corrected value
25		Value at base conditions
26		Value at standard conditions
27	Maximum of last averages for averaging period 1 relative to measurement period 3 (no default value)	Value at metering conditions
28		Corrected value

Value group D codes – Gas – Flow rate (A = 7, C = 43)		
29		Value at base conditions
30		Value at standard conditions
31	Maximum of last averages for averaging period 1 relative to billing period 1 (default value = 1 day)	Value at metering conditions
32		Corrected value
33		Value at base conditions
34		Value at standard conditions
Averaging period 2, default value = 15 minutes (block demand or sliding demand)		
35	Current average for averaging period 2	Value at metering conditions
35		Corrected value
37		Value at base conditions
38		Value at standard conditions
39	Last average for averaging period 2	Value at metering conditions
40		Corrected value
41		Value at base conditions
42		Value at standard conditions
43	Maximum of last averages for averaging period 2 relative to measurement period 2 (default value = 1 hour)	Value at metering conditions
44		Corrected value
45		Value at base conditions
46		Value at standard conditions
47	Maximum of last averages for averaging period 2 relative to measurement period 3 (no default value)	Value at metering conditions
48		Corrected value
49		Value at base conditions
50		Value at standard conditions
51	Maximum of last averages for averaging period 2 relative to billing period 1 (default value = 1 day)	Value at metering conditions
52		Corrected value
53		Value at base conditions
54		Value at standard conditions
Averaging period 3, default value = 1 hour		
55	Current average for averaging period 3	Value at metering conditions
56		Corrected value
57		Value at base conditions
58		Value at standard conditions
59	Last average for averaging period 3	Value at metering conditions
60		Corrected value
61		Value at base conditions
62		Value at standard conditions

Value group D codes – Gas – Flow rate (A = 7, C = 43)		
Averaging period 4, (no default value)		
63	Current average for averaging period 4	Value at metering conditions
64		Corrected value
65		Value at base conditions
66		Value at standard conditions
67	Last average for averaging period 4	Value at metering conditions
68		Corrected value
69		Value at base conditions
70		Value at standard conditions
All other	Reserved	

7.8.3.4 Process values

For process values, a distinction is made between:

- instantaneous values;
- average, minimum and maximum values over various process intervals;
- value at metering conditions, value at base conditions; and value at standard conditions;

  NOTE Standard conditions refer to national regulations, which may differ from ISO standards reference values for base conditions.

  EXAMPLE Gas reference temperature at standard conditions is 0 °C, gas reference temperature at base conditions is +15 °C.
- for some quantities, backup, actual and preset values are available.

Table 82 specifies the use of value group D to identify gas related process values.

Table 82 – Value group D codes – Gas – Process values

Value group D codes – Gas – Process values (A = 7, C = 41, 42, 44…49)		
	Quantity	**Qualifier**
0	Instantaneous	Current value at metering conditions [a]
2	Instantaneous	Value at base conditions / "Converted value" [b]
3	Instantaneous	Backup value
10	Instantaneous	Actual value
11	Instantaneous	Preset value
13	Instantaneous	Value at standard conditions
Process interval 1 (default value = 15 minutes)		
15	Average, current interval, process interval 1	Value at metering conditions
16		Value at base conditions
17		Value at standard conditions

Value group D codes – Gas – Process values (A = 7, C = 41, 42, 44...49)		
18	Minimum, current interval, process interval 1	Value at metering conditions
19		Value at base conditions
20		Value at standard conditions
21	Maximum, current interval, process interval 1	Value at metering conditions
22		Value at base conditions
23		Value at standard conditions
24	Average, last interval, process interval 1	Value at metering conditions
25		Value at base conditions
26		Value at standard conditions
27	Minimum, last interval, process interval 1	Value at metering conditions
28		Value at base conditions
29		Value at standard conditions
30	Maximum, last interval, process interval 1	Value at metering conditions
31		Value at base conditions
32		Value at standard conditions
Process interval 2 (default value = 1 hour)		
33	Average, current interval, process interval 2	Value at metering conditions
34		Value at base conditions
35		Value at standard conditions
36	Minimum, current interval, process interval 2	Value at metering conditions
37		Value at base conditions
38		Value at standard conditions
39	Maximum, current interval, process interval 2	Value at metering conditions
40		Value at base conditions
41		Value at standard conditions
42	Average, last interval, process interval 2	Value at metering conditions
43		Value at base conditions
44		Value at standard conditions
45	Minimum, last interval, process interval 2	Value at metering conditions
46		Value at base conditions
47		Value at standard conditions
48	Maximum, last interval, process interval 2	Value at metering conditions
49		Value at base conditions
50		Value at standard conditions

Value group D codes – Gas – Process values (A = 7, C = 41, 42, 44…49)		
Process interval 3 (default value = 1 day)		
51	Average, current interval, process interval 3	Value at metering conditions
52		Value at base conditions
53		Value at standard conditions
54	Minimum, current interval, process interval 3	Value at metering conditions
55		Value at base conditions
56		Value at standard conditions
57	Maximum, current interval, process interval 3	Value at metering conditions
58		Value at base conditions
59		Value at standard conditions
60	Average, last interval, process interval 3	Value at metering conditions
61		Value at base conditions
62		Value at standard conditions
63	Minimum, last interval, process interval 3	Value at metering conditions
64		Value at base conditions
65		Value at standard conditions
66	Maximum, last interval, process interval 3	Value at metering conditions
67		Value at base conditions
68		Value at standard conditions
Process interval 4 (default value = 1 month)		
69	Average, current interval, process interval 4	Value at metering conditions
70		Value at base conditions
71		Value at standard conditions
72	Minimum, current interval, process interval 4	Value at metering conditions
73		Value at base conditions
74		Value at standard conditions
75	Maximum, current interval, process interval 4	Value at metering conditions
76		Value at base conditions
77		Value at standard conditions
78	Average, last interval, process interval 4	Value at metering conditions
79		Value at base conditions
80		Value at standard conditions
81	Minimum, last interval, process interval 4	Value at metering conditions
82		Value at base conditions
83		Value at standard conditions

Value group D codes – Gas – Process values (A = 7, C = 41, 42, 44…49)		
84	Maximum, last interval, process interval 4	Value at metering conditions
85		Value at base conditions
86		Value at standard conditions
Process interval 5, since last event		
87	Average, process interval 5, interval since last event	Value at metering conditions
88		Value at base conditions
89		Value at standard conditions
90	Average, process interval 6, interval between last two events	Value at metering conditions
91		Value at base conditions
92		Value at standard conditions
All other	Reserved	
[a]	To be used for e.g. velocity of sound.	
[b]	Value of the base conditions is associated with reference values for volume conversion: C = 41, 42.	

7.8.3.5 Conversion related factors and coefficients

For correction, conversion, compressibility, superior calorific value and gas law deviation coefficient values, various OBIS code allocations are made taking into consideration the specifics of the measuring process. See Table 83.

For these values, average values over various averaging periods are also defined; see 7.8.4.5.

Table 83 specifies the use of value group D to identify gas conversion related factors and coefficients values.

Table 83 – Value group D codes – Gas – Conversion related factors and coefficients

Value group D codes – Gas – Conversion related factors and coefficients (A = 7, C = 51…55)	
0	Current value at metering conditions
2	Current value at base conditions / “Converted Value”
3	Backup
10	Actual
11	Preset
12	Method
All other	Reserved

7.8.3.6 Natural gas analysis values

For natural gas analysis, allocations in value group D identify the key parameters and the components of the natural gas. For these values, average values over various averaging periods are also defined; see 7.8.4.6. Table 84 specifies the use of value group D to identify natural gas analysis values.

Table 84 – Value group D codes – Gas – Natural gas analysis values

Value group D codes – Gas – Natural gas analysis values (A = 7, C = 70)	
8	Reference pressure of gas analysis
9	Reference temperature of gas analysis
10	Superior [a] Wobbe index 0 °C
11	Inferior [b] Wobbe index 0 °C
12	Methane number
13	Total sulphur
14	Hydrogen sulphide H_2S
15	Mercaptans
16	Water dew point (DP H_2O)
17	Water (H_2O) dew point outlet / normalised
18	Hydrocarbon dew point (DP C_XH_Y)
19	Inferior [c] calorific value $H_{i,n}$
20	Water H_2O
60	Nitrogen N_2
61	Hydrogen H_2
62	Oxygen O_2
63	Helium He
64	Argon Ar
65	Carbon monoxide CO
66	Carbon dioxide CO_2
67	Methane CH_4
68	Ethene C_2H_4
69	Ethane C_2H_6
70	Propene C_3H_6
71	Propane C_3H_8
72	i-butane i-C_4H_{10}
73	n-butane n-C_4H_{10}
74	neo-pentane neo-C_5H_{12}
75	i-pentane i-C_5H_{12}
76	n-pentane n-C_5H_{12}
77	Hexane C_6H_{14}
78	Hexane share higher hydrocarbons C_6H_{14} %
79	Hexane+ C_6H_{14}+

Value group D codes – Gas – Natural gas analysis values (A = 7, C = 70)	
80	Heptane C_7H_{16}
81	Octane C_8H_{18}
82	Nonane C_9H_{20}
83	Decane $C_{10}H_{22}$
84	Tetrahydrothiophene C_4H_8S
All other	Reserved
[a]	Superior (gross) Wobbe index
[b]	Inferior (net) Wobbe index
[c]	Inferior (net) calorific value

7.8.4 Value group E codes – Gas

7.8.4.1 General

The following clauses define the use of value group E for identifying further classification or processing the measurement quantities defined by value groups A to D. The various classifications and processing methods are exclusive.

7.8.4.2 Indexes and index differences – Tariff rates

Table 85 shows the use of value group E for identification of tariff rates typically used for indexes and index differences of volume, mass and energy, specified in Table 80.

Table 85 – Value group E codes – Gas – Indexes and index differences – Tariff rates

Value group E codes – Gas – Indexes and index differences – Tariff rates (A = 7, C = 1…8, 11…16, 21…26, 31…36, 61…66, D = 0…3, 6…98)	
0	Total
1	Rate 1
…	
63	Rate 63
128…254	Manufacturer specific codes
All other	Reserved

7.8.4.3 Flow rate

No further classification in value group E are made. Therefore E shall be 0.

7.8.4.4 Process values

No further classification in value group E is made. Therefore, E shall be 0.

7.8.4.5 Conversion related factors and coefficients – Averages

Table 86 shows the use of value group E for the identification of average values of conversion related factors and coefficients – as specified in 7.8.3.5 – over various averaging periods.

Table 86 – Value group E codes – Gas – Conversion related factors and coefficients

	Value group E codes – Gas – Conversion related factors and coefficients– Averages (A = 7, C = 51...55, D = 0, 2, 3, 10, 11)
0	Process independent current value[a]
1	Weighted value (e.g. Superior calorific value)[b]
11	Average, current interval, averaging period 1 (default 5 minutes)
12	Average, last interval, averaging period 1 (default 5 minutes)
13	Average, current interval, averaging period 2 (default 15 minutes)
14	Average, last interval, averaging period 2 (default 15 minutes)
15	Average, current interval, averaging period 3 (default 1 hour)
16	Average, last interval, averaging period 3 (default 1 hour)
17	Average, current interval, averaging period 4 (no default value)
18	Average, last interval, averaging period 4 (no default value)
19	Average, current interval, averaging period 5 (default 1 day)
20	Average, last interval, averaging period 5 (default 1 day)
21	Average, current interval, averaging period 6 (default 1 month)
22	Average, last interval, averaging period 6 (default 1 month)
23	Average, current interval, averaging period 7 (default 1 year)
24	Average, last interval, averaging period 7 (default 1 year)
25	Average, current interval, averaging period 8 (no default value)
26	Average, last interval, averaging period 8 (no default value)
27	Average, averaging period 9, interval since last event
28	Average, averaging period 10, interval between last two events
All other	Reserved
a	Process independent current value is a gas analysis technology independent value, which is generated asynchronous to processing cycles, but used for further calculations.
b	Weighted value is the result of specific algorithms taking into account different values by weighting their influence on the algorithm result.

7.8.4.6 Calculation methods

Table 87 – Value group E codes – Gas – Calculation methods shows the use of value group E for the identification of calculation methods. See also 6.4.8.

Table 87 – Value group E codes – Gas – Calculation methods

	Value group E codes – Calculation methods (A = 7, C = 51…55, D = 12)
0	Calculation method in use
1	Calculation method 1 supported
…	…
20	Calculation method 20 supported
All other	Reserved

7.8.4.7 Natural gas analysis values – Averages

Table 88 shows the use of value group E for the identification of natural gas analysis values – as specified in 7.8.3.6 – over various averaging periods.

Table 88 – Value group E codes – Gas – Natural gas analysis values – Averages

Value group E codes – Gas – Natural gas analysis values – Averages (A = 7, C = 70, D = 8…20, 60…84)	
0	Process independent current value [a]
1	Weighted value (e.g. CO_2 in [GJ / t]) [b]
11	Average, current interval, averaging period 1 (default 5 minutes)
12	Average, last interval, averaging period 1 (default 5 minutes)
13	Average, current interval, averaging period 2 (default 15 minutes)
14	Average, last interval, averaging period 2 (default 15 minutes)
15	Average, current interval, averaging period 3 (default 1 hour)
16	Average, last interval, averaging period 3 (default 1 hour)
17	Average, current interval, averaging period 4 (no default value)
18	Average, last interval, averaging period 4 (no default value)
19	Average, current interval, averaging period 5 (default 1 day)
20	Average, last interval, averaging period 5 (default 1 day)
21	Average, current interval, averaging period 6 (default 1 month)
22	Average, last interval, averaging period 6 (default 1 month)
23	Average, current interval, averaging period 7 (default 1 year)
24	Average, last interval, averaging period 7 (default 1 year)
25	Average, current interval, averaging period 8 (no default value)
26	Average, last interval, averaging period 8 (no default value)
27	Average, averaging period 9, interval since last event
28	Average, averaging period 10, interval between last two events
All other	Reserved
a	Process independent current value is a gas analysis technology independent value, which is generated asynchronous to processing cycles, but used for further calculations.
b	Weighted value is the result of specific algorithms taking into account different values by weighting their influence on the algorithm result.

7.8.5 Value group F codes – Gas

Value group F identifies current (with F = 255) or historical values of quantities identified by value groups A to E, where appropriate.

There are four billing period schemes available (for example to store daily, monthly, yearly and weekly values). For each billing period scheme, the following general purpose objects are available:

- billing period counter;
- number of available billing periods;
- time stamp of most recent and historical billing periods;
- billing period length.

For OBIS codes see Table 89. For additional information, see 6.2.2 and 7.11.3.

7.8.6 OBIS codes – Gas

7.8.6.1 General and service entry objects – Gas

Table 89 specifies the OBIS codes for gas related general and service entry objects.

Table 89 – OBIS codes for general and service entry objects – Gas

General and shows service entry objects – Gas	OBIS code					
	A	B	C	D	E	F
Free ID-numbers for utilities						
Complete combined gas ID	7	*b*	0	0		
Gas ID 1	7	*b*	0	0	0	
…	…	…	…	…	…	
Gas ID 10	7	*b*	0	0	9	
Billing period values / reset counter entries (First billing period scheme if there are more than one)						
Billing period counter (1)	7	*b*	0	1	0	VZ or 255
Number of available billing periods (1)	7	*b*	0	1	1	
Time stamp of the most recent billing period (1)	7	*b*	0	1	2	
Time stamp of the billing period (1) VZ (last reset)	7	*b*	0	1	2	VZ
Time stamp of the billing period (1) VZ-1	7	*b*	0	1	2	VZ_{-1}
…			…	…	…	
Time stamp of the billing period (1) VZ-n	7	*b*	0	1	2	VZ_{-n}
Billing period values / reset counter entries (Second billing period scheme)						
Billing period counter (2)	7	*b*	0	1	3	VZ or 255
Number of available billing periods (2)	7	*b*	0	1	4	
Time stamp of the most recent billing period (2)	7	*b*	0	1	5	
Time stamp of the billing period (2) VZ (last reset)	7	*b*	0	1	5	VZ
Time stamp of the billing period (2) VZ-1	7	*b*	0	1	5	VZ_{-1}

General and shows service entry objects – Gas	OBIS code					
	A	B	C	D	E	F
…			…	…	…	
Time stamp of the billing period (2) VZ-n	7	*b*	0	1	5	VZ_{-n}
Billing period values / reset counter entries (Third billing period scheme)						
Billing period counter (3)	7	*b*	0	1	6	VZ or 255
Number of available billing periods (3)	7	*b*	0	1	7	
Time stamp of the most recent billing period (3)	7	*b*	0	1	8	
Time stamp of the billing period (3) VZ (last reset)	7	*b*	0	1	8	VZ
Time stamp of the billing period (3) VZ-1	7	*b*	0	1	8	VZ_{-1}
…			…	…	…	
Time stamp of the billing period (3) VZ-n	7	b	0	1	8	VZ_{-n}
Billing period values / reset counter entries (Fourth billing period scheme)						
Billing period counter (4)	7	*b*	0	1	9	VZ or 255
Number of available billing periods (4)	7	*b*	0	1	10	
Time stamp of the most recent billing period (4)	7	*b*	0	1	11	
Time stamp of the billing period (4) VZ (last reset)	7	*b*	0	1	11	VZ
Time stamp of the billing period (4) VZ-1	7	*b*	0	1	11	VZ_{-1}
…			…	…	…	
Time stamp of the billing period (4) VZ-n	7	*b*	0	1	11	VZ_{-n}
Configuration						
Program version	7	*b*	0	2	0	
Firmware version	7	*b*	0	2	1	
Software version	7	*b*	0	2	2	
Device version	7	*b*	0	2	3	
Active firmware signature	7	*b*	0	2	8	
Number of device channels	7	*b*	0	2	10	
Pressure sensor, serial no.	7	*b*	0	2	11	
Temperature sensor, serial no.	7	*b*	0	2	12	
Calculator, serial no.	7	*b*	0	2	13	
Volume sensor [a], serial no.	7	*b*	0	2	14	
Density sensor, serial no.	7	b	0	2	15	
Sensor (medium irrespective), serial no.	7	*b*	0	2	16	
Digital output configuration	7	*b*	0	2	17	
Analogue output configuration	7	*b*	0	2	18	
Output pulse constants converted / unconverted						
Volume forward at metering conditions	7	*b*	0	3	0	
Volume reverse at metering conditions	7	*b*	0	3	1	
Volume absolute [b] at metering conditions	7	*b*	0	3	2	
Volume forward at base conditions	7	*b*	0	3	3	
Volume reverse at base conditions	7	*b*	0	3	4	

General and shows service entry objects – Gas	OBIS code					
	A	B	C	D	E	F
Volume absolute [b] at base conditions	7	*b*	0	3	5	
Conversion factors						
{This area is to be used for polynomials, constants for conversion, and similar} …	7 7 7 7 7	*b* *b* *b* *b* *b*	0 0 0 0 0	4 4 4 4 4	0 1 2 3 4	
Threshold values						
Threshold power for over-consumption relative to measurement period 2 for indexes and index differences						
limit 1	7	*b*	0	5	1	1
…			…	…	…	…
limit 4	7	*b*	0	5	1	4
Threshold power for over-consumption relative to measurement period 3 for indexes and index differences						
limit 1	7	*b*	0	5	1	11
…			…	…	…	…
limit 4	7	*b*	0	5	1	14
Threshold limit for rate 1 for over-consumption relative to measurement period 2 for indexes and index differences	7	*b*	0	5	2	1
…			…	…	…	…
limit for rate 9	7	*b*	0	5	2	9
Threshold limit for rate 1 for over-consumption relative to measurement period 3 for indexes and index differences	7	*b*	0	5	2	11
…			…	…	…	…
limit for rate 9	7	*b*	0	5	2	19
Maximum contracted consumption for rec. interval 1	7	*b*	0	5	3	
Maximum contracted consumption for rec. interval 2	7	*b*	0	5	4	
Absolute temperature, minimum limit setting [c]	7	*b*	0	5	11	
Absolute temperature, maximum limit setting [c]	7	*b*	0	5	12	
Absolute pressure, minimum limit setting [c]	7	*b*	0	5	13	
Absolute pressure, maximum limit setting [c]	7	*b*	0	5	14	
Nominal values volume sensor						
Pressure	7	*b*	0	6	1	
Temperature	7	*b*	0	6	2	
Q_{min}	7	*b*	0	6	3	
Q_{max}	7	*b*	0	6	4	
Input pulse constants						
Volume forward at metering conditions	7	*b*	0	7	0	
Volume reverse metering conditions	7	*b*	0	7	1	

General and shows service entry objects – Gas	OBIS code					
	A	B	C	D	E	F
Volume absolute [b] at metering conditions	7	*b*	0	7	2	
Volume forward at base conditions	7	*b*	0	7	3	
Volume reverse at base conditions	7	*b*	0	7	4	
Volume absolute [b] at base conditions	7	*b*	0	7	5	
Intervals and periods						
Recording interval 1, for profile [d]	7	*b*	0	8	1	
Recording interval 2, for profile [d]	7	*b*	0	8	2	
Measurement period 1, for average value 1	7	*b*	0	8	3	
Measurement period 2, for average value 2	7	*b*	0	8	4	
Measurement period 3, for instantaneous value	7	*b*	0	8	5	
Measurement period 4, for test value	7	*b*	0	8	6	
Billing period	7	*b*	0	8	10	
NOTE Codes 7.b.0.8.11...35 are newly defined in Blue Book Edition 9.						
Process interval 1, default value 15 minutes	7	*b*	0	8	11	
Process interval 2, default value 1 hour	7	*b*	0	8	12	
Process interval 3, default value 1 day	7	*b*	0	8	13	
Process interval 4, default value 1 month	7	*b*	0	8	14	
Process interval 5, for process value, since last event	7	*b*	0	8	15	
Process interval 6, between last two events	7	*b*	0	8	16	
Measurement period 1, for indexes and index differences, default value 15 minutes	7	*b*	0	8	17	
Measurement period 2, for indexes and index differences, default value 1 hour	7	*b*	0	8	18	
Measurement period 3, for indexes and index differences, no default value	7	*b*	0	8	19	
Billing period 1, for indexes and index differences, default value 1 day	7	*b*	0	8	20	
Billing period 2, for indexes and index differences, default value 1 month	7	*b*	0	8	21	
Billing period 3, for indexes and index differences, default value 1 year,	7	*b*	0	8	22	
Billing period 4, for indexes and index differences, no default value	7	*b*	0	8	23	
Averaging period 1, default value 5 minutes	7	*b*	0	8	25	
Averaging period 2, default value 15 minutes	7	*b*	0	8	26	
Averaging period 3, default value 1 hour	7	*b*	0	8	27	
Averaging period 4, no default value	7	*b*	0	8	28	
Averaging period 5, default value 1 day	7	*b*	0	8	29	
Averaging period 6, default value 1 month	7	*b*	0	8	30	
Averaging period 7, default value 1 year	7	*b*	0	8	31	
Averaging period 8, no default value	7	*b*	0	8	32	
Averaging period 9, since last event	7	*b*	0	8	33	
Averaging period 10, between two last events	7	*b*	0	8	34	
Number of sub-periods for averaging period 2	7	*b*	0	8	35	
Time entries						

General and shows service entry objects – Gas	**OBIS code**					
	A	**B**	**C**	**D**	**E**	**F**
Number of days (time expired) since last reset (First billing period scheme if there are more than one)	7	*b*	0	9	0	
Local time	7	*b*	0	9	1	
Local date	7	*b*	0	9	2	
Start of conventional gas day	7	*b*	0	9	3	
Residual time shift [e]	7	*b*	0	9	4	
Time of last reset (First billing period scheme if there are more than one)	7	*b*	0	9	6	
Date of last reset (First billing period scheme if there are more than one)	7	*b*	0	9	7	
Clock time shift limit	7	*b*	0	9	11	
First billing period scheme						
Number of days (time expired) since last reset (end of billing period)	*See above.*					
Time of last reset	*See above.*					
Date of last reset	See above.					
Billing period reset lockout time (First billing period scheme if there are more than one)	7	*b*	0	9	12	
Second billing period scheme						
Number of days (time expired) since last end of billing period	7	*b*	0	9	13	
Time of last reset	7	*b*	0	9	14	
Date of last reset	7	*b*	0	9	15	
Billing period reset lockout time	7	*b*	0	9	16	
Third billing period scheme						
Number of days (Time expired) since last end of billing period	7	*b*	0	9	17	
Time of last reset	7	*b*	0	9	18	
Date of last reset	7	*b*	0	9	19	
Billing period reset lockout time	7	*b*	0	9	20	
Fourth billing period scheme						
Number of days (time expired) since last end of billing period	7	*b*	0	9	21	
Time of last reset	7	*b*	0	9	22	
Date of last reset	7	*b*	0	9	23	
Billing period reset lockout time	7	*b*	0	9	24	
Station management information objects						
Heating temperature [f], current value	7	*b*	0	10	0	
Heating temperature, average 15 minutes	7	*b*	0	10	1	
Heating temperature, average 60 minutes	7	*b*	0	10	11	
Heating temperature, average day	7	*b*	0	10	21	
Heating temperature, average month	7	*b*	0	10	31	
Ambient device temperature [g], current value	7	*b*	0	11	0	

General and shows service entry objects – Gas	OBIS code					
	A	B	C	D	E	F
Ambient device temperature, average 15 minutes	7	*b*	0	11	1	
Ambient device temperature, average 60 minutes	7	*b*	0	11	11	
Ambient device temperature, average day	7	*b*	0	11	21	
Ambient device temperature, average month	7	*b*	0	11	31	
Gas parameters for volume conversion, currently used in compressibility calculation						
Reference pressure of gas analysis	7	*b*	0	12	8	
Reference temperature of gas analysis	7	*b*	0	12	9	
Superior Wobbe number 0 °C	7	*b*	0	12	10	
Inferior Wobbe number 0 °C	7	*b*	0	12	11	
Methane number	7	*b*	0	12	12	
Total sulphur	7	*b*	0	12	13	
Hydrogen sulphide H_2S	7	*b*	0	12	14	
Mercaptans	7	*b*	0	12	15	
Water dew point (DP H_2O)	7	*b*	0	12	16	
Water (H_2O) dew point outlet / normalised	7	*b*	0	12	17	
Hydrocarbon dew point (DP C_XH_Y)	7	*b*	0	12	18	
Inferior calorific value $H_{i,n}$	7	*b*	0	12	19	
Water H_2O	7	*b*	0	12	20	
Density (of gas), base conditions	7	*b*	0	12	45	
Relative density	7	*b*	0	12	46	
Superior calorific value $H_{s,n}$	7	*b*	0	12	54	
Nitrogen N_2	7	*b*	0	12	60	
Hydrogen H_2	7	*b*	0	12	61	
Oxygen O_2	7	*b*	0	12	62	
Helium He	7	*b*	0	12	63	
Argon Ar	7	*b*	0	12	64	
Carbon monoxide CO	7	*b*	0	12	65	
Carbon dioxide CO_2	7	*b*	0	12	66	
Methane CH_4	7	*b*	0	12	67	
Ethene C_2H_4	7	*b*	0	12	68	
Ethane C_2H_6	7	*b*	0	12	69	
Propene C_3H_6	7	*b*	0	12	70	
Propane C_3H_8	7	*b*	0	12	71	
i-butane i-C_4H_{10}	7	*b*	0	12	72	
n-butane n-C_4H_{10}	7	*b*	0	12	73	
neo-pentane neo-C_5H_{12}	7	*b*	0	12	74	
i-pentane i-C_5H_{12}	7	*b*	0	12	75	
n-pentane n-C_5H_{12}	7	*b*	0	12	76	
Hexane C_6H_{14}	7	*b*	0	12	77	
Hexane share higher hydrocarbons C_6H_{14} %	7	*b*	0	12	78	
Hexane+ C_6 H_{14}+	7	*b*	0	12	79	
Heptane C_7H_{16}	7	*b*	0	12	80	

General and shows service entry objects – Gas	OBIS code					
	A	B	C	D	E	F
Octane C_8H_{18}	7	*b*	0	12	81	
Nonane C_9H_{20}	7	*b*	0	12	82	
Decane $C_{10}H_{22}$	7	*b*	0	12	83	
Tetrahydrothiophene	7	*b*	0	12	84	
Gas parameters for Venturi measurement						
Internal pipe diameter	7	*b*	0	13	1	
Orifice diameter	7	*b*	0	13	2	
Pressure type (orifice fitting)	7	*b*	0	13	3	
Flow coefficient (alfa)	7	*b*	0	13	4	
Expansion coefficient (epsilon)	7	*b*	0	13	5	
Reflux coefficient	7	*b*	0	13	6	
Isoentropic coefficient	7	*b*	0	13	7	
Dynamic viscosity	7	*b*	0	13	8	
Differential pressure dp for cut off	7	*b*	0	13	9	
Reynold number	7	*b*	0	13	10	
Gas parameters for density measurement						
K0 Densimeter Coefficient	7	*b*	0	14	1	
K2 Densimeter Coefficient	7	*b*	0	14	2	
Densimeter period for instantaneous measurement	7	*b*	0	14	10	
Densimeter period for measurement period 15 minutes	7	*b*	0	14	11	
Sensor manager						
Sensor manager objects	7	*b*	0	15	*e*	
Internal operating status, gas related						
Internal operating status, global [h]	7	*b*	96	5	0	
Internal operating status (status word 1) [h]	7	*b*	96	5	1	
Internal operating status (status word 2) [h]	7	*b*	96	5	2	
Internal operating status (status word 3) [h]	7	*b*	96	5	3	
Internal operating status (status word 4) [h]	7	*b*	96	5	4	
Internal operating status (status word 5) [h]	7	*b*	96	5	5	
Internal operating status (status word 6) [h]	7	*b*	96	5	6	
Internal operating status (status word 7) [h]	7	*b*	96	5	7	
Internal operating status (status word 8) [h]	7	*b*	96	5	8	
Internal operating status (status word 9) [h]	7	*b*	96	5	9	
Manufacturer specific [i)]	7	*b*	96	50	e	
…………………						
Manufacturer specific	7	*b*	96	99	e	

a	A volume sensor could be an external mechanical meter / encoder / electronic index.
b	Absolute in the sense that negative volume is summed as positive ABS().
c	An absolute temperature or absolute pressure outside these limits may affect the error status of the device.

General and shows service entry objects – Gas	OBIS code					
	A	B	C	D	E	F
[d]	If multiple recording intervals are implemented, then recording interval 1 shall be the shorter.					
[e]	This value indicates the remaining time interval for soft time setting, where the clock is corrected in small steps (equivalent to Clock object method 6).					
[f]	Temperature heating is applied by stations with gas heating systems.					
[g]	Application for control of battery environment or volume conversion device environmental control.					
[h]	Status words referring to a status table with fix status words or to any status table bits using mapped status (class_id = 63).					
[i]	The range D = 50…99 is available for identifying objects, which are not represented by another defined code, but need representation on the display as well. If this is not required, the range D = 128…254 should be used.					

7.8.6.2 Error register objects – Gas

Table 90 – OBIS codes for error register specifies the OBIS codes for gas related error register objects.

Table 90 – OBIS codes for error register objects – Gas

Error register objects – Gas	OBIS code					
	A	B	C	D	E	F
Error registers	7	*b*	97	97	*e*	
NOTE The information to be included in the error objects is not defined in this document.						

7.8.6.3 List objects – Gas

Table 91 – OBIS codes for list objects – Gas specifies the OBIS codes for gas related list objects.

Table 91 – OBIS codes for list objects – Gas

List objects – Gas	OBIS code					
	A	B	C	D	E	F
Gas related data of billing period (with billing period scheme 1 if there are more than one schemes available)	7	*b*	98	1	*e*	255 [a]
Gas related data of billing period (with billing period scheme 2)	7	*b*	98	2	*e*	255 [a]
Gas related data of billing period (with billing period scheme 3)	7	*b*	98	3	*e*	255 [a]
Gas related data of billing period (with billing period scheme 4)	7	*b*	98	4	*e*	255 [a]
Gas related data of event triggered billing profile [b]	7	*b*	98	11	*e*	255 [a]
[a]	F = 255 means a wildcard here. See 7.11.3.					
[b]	Event triggered means the termination of a billing period by events, e.g. by commands. (Therefore, the profile entries are not equidistant in time).					

7.8.6.4 Data profile objects – Gas

Gas related data profiles – identified with one single OBIS code – are used to hold a series of measurement values of one or more similar quantities and/or to group various data. The OBIS codes are specified in Table 92.

Table 92 – OBIS codes for data profile objects – Gas

Data profile objects – Gas	**OBIS code**					
	A	**B**	**C**	**D**	**E**	**F**
Load profile with recording interval 1	7	*b*	99	1	4 [a]	
Load profile with recording interval 2	7	*b*	99	2	4 [a]	
Profile of maxima with recording interval 1	7	*b*	99	3	4 [a]	
Profile of maxima with recording interval 2	7	*b*	99	4	4 [a]	
Load profiles for indexes and index differences of volume, mass and energy [b]	7	*b*	99	*d* [c]	*e* [d]	
Load profiles for process values	7	*b*	99	*d* [e]	*e* [f]	
Load profiles for flow rate	7	*b*	99	43	*e* [g]	
Power failure event log	7	*b*	99	97	*e*	
Event log	7	*b*	99	98	*e*	
Certification data log	7	*b*	99	99	0	
Load profile with recording interval 15 minutes	7	*b*	99	99	1	
Load profile with recording interval 60 minutes	7	*b*	99	99	2	
Load profile with recording interval day	7	*b*	99	99	3	
Load profile with recording interval month	7	*b*	99	99	4	

a	The value in value group E has been changed from 0 to 4 to avoid overlaps with the self-descriptive profile OBIS codes. The use of the value 0 is deprecated.
b	Value group D and E identify the value captured in these profiles. Value group D and E of the OBIS code of the load profile is mapped to value group C and D of the OBIS code identifying the value captured. The value captured in the buffer is always attribute 2 (value) of the respective Register / Extended register object.
c	The possible values are 1…8, 11…16, 21…26, 31…36, 61…66. See Table 79.
d	The possible values are 0…3, 6…98. See Table 80. EXAMPLE A load profile with OBIS code 7.b.99.11.17.255 contains the logged values from a volume conversion device: Forward undisturbed converter volume, index difference, value at base conditions, relative to measurement period 2. The values are captured at the end of each measurement period (last values).
e	The possible values are 41, 42, 44…49. See Table 79.
f	The possible values are 0, 2, 13, 24…32, 42…50, 60…68, 78…86, 90…92. See Table 86. EXAMPLE A load profile with OBIS code 7.b.99.41.43.255 contains the logged values of absolute gas temperature, average, last interval, (relative to) process interval 2.
g	The possible values are 0, 1, 2, 13, 19…22, 39…42, 59…62, 67…70. See Table 81. EXAMPLE A load profile with OBIS code 7.b.99.43.19.255 contains the logged values of the flow rate, last average for averaging period 1, value at metering conditions.

7.9 Water (Value group A = 8 and A = 9)

7.9.1 General

This subclause 7.9 specifies the naming of objects carrying water meter information in a COSEM environment. It covers the handling of hot, as well as the handling of cold water.

7.9.2 Value group C codes – Water

Table 93 specifies the use of value group C for hot and cold water.

Table 93 – Value group C codes – Water

Value group C codes – Water (A=8 or A=9)	
0	General purpose objects
1	Accumulated volume
2	Flow rate
3	Temperature
93	Consortia specific identifiers, see Table 54.
94	Country specific identifiers, see Table 55.
96	General and service entry objects – Water (See 7.9.4.1)
97	Error register objects – Water (See 7.9.4.2)
98	List objects – Water
99	Data profile objects – Water (See 7.9.4.3)
128...199, 240	Manufacturer specific codes
All other	Reserved

7.9.3 Value group D codes – Water

This value group specifies the result of processing a *Quantity* according to a specific algorithm for water related values. See Table 94.

Table 94 – Value group D codes – Water

Value group D codes – Water (A = 8 or A = 9, C <> 0, 96...99)	
0	Current value
1	Periodical value
2	Set date value
3	Billing date value
4	Minimum of value
5	Maximum of value
6	Test value
All other	Reserved

7.9.4 Value group E codes – Water

Table 95 shows the use of value group E for identification of tariff rates typically used for consumption and demand quantities.

Table 95 – Value group E codes – Water

Value group E codes – Water	
0	Total
1	Rate 1
2	Rate 2
3	Rate 3
…	…
9	Rate 9
128...254	Manufacturer specific codes
All other	Reserved

7.9.5 OBIS codes – Water

7.9.5.1 General and service entry objects – Water

Table 96 specifies the OBIS codes for water related general and service entry objects.

Table 96 – OBIS codes for general and service entry objects – Water

General and service entry objects – Water	OBIS code					
	A	B	C	D	E	F
Free ID-numbers for utilities						
Complete combined ID	8/9	*b*	0	0		
ID 1	8/9	*b*	0	0	0	
…			…	…	…	
ID 10	8/9	*b*	0	0	9	
Storage information						
Status (VZ) of the historical value counter	8/9	*b*	0	1	1	
Number of available historical values	8/9	*b*	0	1	2	
Due date	8/9	*b*	0	1	10	
Billing date	8/9	*b*	0	1	11	
Billing date period	8/9	*b*	0	1	12	
Program entries						
Program version no.	8/9	*b*	0	2	0	
Device version no.	8/9	*b*	0	2	3	
Threshold values						
Contracted maximum consumption	8/9	*b*	0	5	1	
Input pulse constants						
Volume forward	8/9	*b*	0	7	1	

General and service entry objects – Water	OBIS code					
	A	B	C	D	E	F
Measurement / registration-period duration						
Recording interval for load profile	8/9	*b*	0	8	1	
Time integral, averaging period for actual flow rate value	8/9	*b*	0	8	6	
Time entries						
Local time	8/9	*b*	0	9	1	
Local date	8/9	*b*	0	9	2	
Time stamp (local time) of the most recent billing period [a]	8/9	*b*	0	9	3	
Manufacturer specific [b]	8/9	b	96	50	*e*	*f*
…………………						
Manufacturer specific	8/9	*b*	96	99	*e*	*f*

[a] In case of billing period schemes absence or event triggered, commonly calculated from local date and local time information.

[b] The range D = 50…99 is available for identifying objects, which are not represented by another defined code, but need representation on the display as well. If this is not required, the range D = 128…254 should be used.

7.9.5.2 Error register objects – Water

Table 97 specifies the OBIS codes for water related error register objects.

Table 97 – OBIS codes for error register objects – Water

Error register objects – Water	OBIS code					
	A	B	C	D	E	F
Error registers	8/9	*b*	97	97	*e*	

NOTE The information to be included in the error objects is not defined in this document.

7.9.5.3 List objects – water meters

Table 98 specifies the OBIS codes for Water meter related list objects.

Table 98 – OBIS codes for list objects – Water Meters

List objects – Water Meters	OBIS code					
	A	B	C	D	E	F
Water Meter related data of billing period (with billing period scheme 1 if there are two schemes available)	8/9	*b*	98	1	*e*	255 [a]
Water Meter related data of billing period (with billing period scheme 2)	8/9	*b*	98	2	*e*	255 [a]

[a] F = 255 means a wildcard.

7.9.5.4 Data profile objects – Water

Water related data profiles – identified with one single OBIS code – are used to hold a series of measurement values of one or more similar quantities and/or to group various data. The OBIS codes are specified in Table 99.

Table 99 – OBIS codes for data profile objects – Water

Data profile objects – Water	OBIS code					
	A	B	C	D	E	F
Consumption/load profile	8/9	*b*	99	1	*e*	

7.9.5.5 OBIS codes for water related objects (examples)

Table 100 – OBIS codes for water related objects (examples) specifies examples for OBIS codes of water related objects.

Table 100 – OBIS codes for water related objects (examples)

Water related objects	OBIS code					
	A	B	C	D	E	F
Consumption						
Current index, total	8/9	*b*	1	0	0	
Current index, tariff 1	8/9	*b*	1	0	1	
Current index, periodical, total, the two last periods	8/9	*b*	1	1	0	102
Monitoring values						
Flow rate, maximum value, previous period	8/9	*b*	2	5	0	V_{Z-1}
Forward temperature, billing date value, last billing period	8/9	*b*	3	3	0	101

7.10 Other media (Value group A= 15)

7.10.1 General

This subclause 7.10 specifies naming of objects related to other media than what is defined with values A = 1, 4…9. Typical application is distributed energy generation using renewable energy sources.

NOTE The details of OBIS codes will be specified as application of DLMS/COSEM in this area grows.

7.10.2 Value group C codes – Other media

Table 101 specifies the use of value group C for other media.

Table 101 – Value group C codes – Other media

Value group C codes – Other media	
0	General purpose objects
1…10	Solar
11…20	Wind
128…254	Manufacturer specific codes
All other	Reserved

7.10.3 Value group D codes – Other media

To be specified later.

7.10.4 Value group E codes – Other media

To be specified later.

7.10.5 Value group F codes – Other media

To be specified later.

7.11 Code presentation

7.11.1 Reduced ID codes (e.g. for IEC 62056-21)

To comply with the syntax defined for protocol modes A to D of IEC 62056-21:2002, the range of ID codes is reduced to fulfil the limitations which usually apply to the number of digits and their ASCII representation. Values in all value groups are limited to a range of 0…99 and within that range, to the values specified in the clauses specifying the use of the value groups.

Some value groups may be suppressed, if they are not relevant to an application:

- optional value groups: A, B, E, F;
- mandatory value groups: C, D.

To allow the interpretation of shortened codes delimiters are inserted between all value groups, see Figure 33:

A -	B :	C .	D	. E	* F

IEC 304/02

Figure 33 – Reduced ID code presentation

The delimiter between value groups E and F can be modified to carry some information about the source of a reset (& instead of * if the reset was performed manually).

The manufacturer shall ensure that the combination of the OBIS code and the class_id (see Clause 4) uniquely identifies each COSEM object.

7.11.2 Display

The usage of OBIS codes to display values is normally limited in a similar way as for data transfer, for example according to IEC 62056-21:2002.

Some codes in value group C and D may be replaced by letters to clearly indicate the differences from other data items; see Table 102.

Table 102 – Example of display code replacement

Value group C and D	
OBIS code	**Display code**
96	C
97	F
98	L
99	P
NOTE The letter codes may also be used in protocol modes A to D.	

7.11.3 Special handling of value group F

Unless otherwise specified, the value group F is used for the identification of values of billing periods.

The billing periods can be identified relative to the status of the billing period counter or relative to the current billing period.

For electricity, there are two billing period schemes available in Table 57, each scheme defined by the length of the billing period, the billing period counter, the number of available billing periods and the time stamps of the billing period. See also 6.2.2 and 7.5.4.1.

For gas, there are four billing period schemes available, see Table 89.

With $0 \le F \le 99$, a single billing period is identified relative to the value of the billing period counter, VZ. If the value of the value group of any OBIS code is equal to VZ, this identifies the most recent (youngest) billing period. VZ_{-1} identifies the second youngest, etc. The billing period counter may have different operating modes, for example modulo-12 or modulo-100. The value after reaching the limit of the billing period counter is 0 for the operating mode modulo-100 and 1 for other operating modes (for example modulo-12).

With $101 \le F \le 125$, a single billing period or a set of billing periods are identified relative to the current billing period. F=101 identifies the last billing period, F = 102 the second last / two last billing periods, etc., F = 125 identifies the 25th last / 25 last billing periods.

F = 126 identifies an unspecified number of last billing periods, therefore it can be used as a wildcard.

F=255 means that the value group F is not used, or identifies the current billing period value(s).

For use of ICs for representing values of historical billing periods, see 6.2.2 and Table 103.

Table 103 – Value group F – Billing periods

Value group F	
VZ	Most recent value
VZ_{-1}	Second most recent value
VZ_{-2}	Third most recent value
VZ_{-3}	Fourth most recent value
VZ_{-4}	…
etc.	
101	Last value
102	Second / two last value(s)
….	
125	25th/25 last value(s)
126	Unspecified number of last values

7.11.4 COSEM

The usage of OBIS codes in the COSEM environment shall be as defined in Clause 6.

Annex A
(Informative)
Additional information on Auto answer and Auto connect ICs

NOTE This information is related to the “Auto answer” (class_id = 28, version = 2, see 4.7.5) and “Auto connect” (class_id = 29, version = 2, see 4.7.6) interface classes.

Since the capabilities (e.g. connection time, number of parallel connections) of communication networks (e.g. GPRS) are limited, devices e.g. meters are not permanently connected to the communication network.

Devices may connect to the network in regular intervals or on special events either to send unsolicited data or just to become accessible.

If a DLMS/COSEM client e.g. a Head End System needs to access a server e.g. a meter that is not connected to the communication network a wake-up request can be sent. This may be a wake-up call or a wake-up message, e.g. an SMS message. After successfully processing the wake-up request the device connects to network.

Figure A. 1 below shows an example for a GSM/GPRS communication network. Please note that the dashed lines represent the network services, the solid lines refer to possible application layer services.

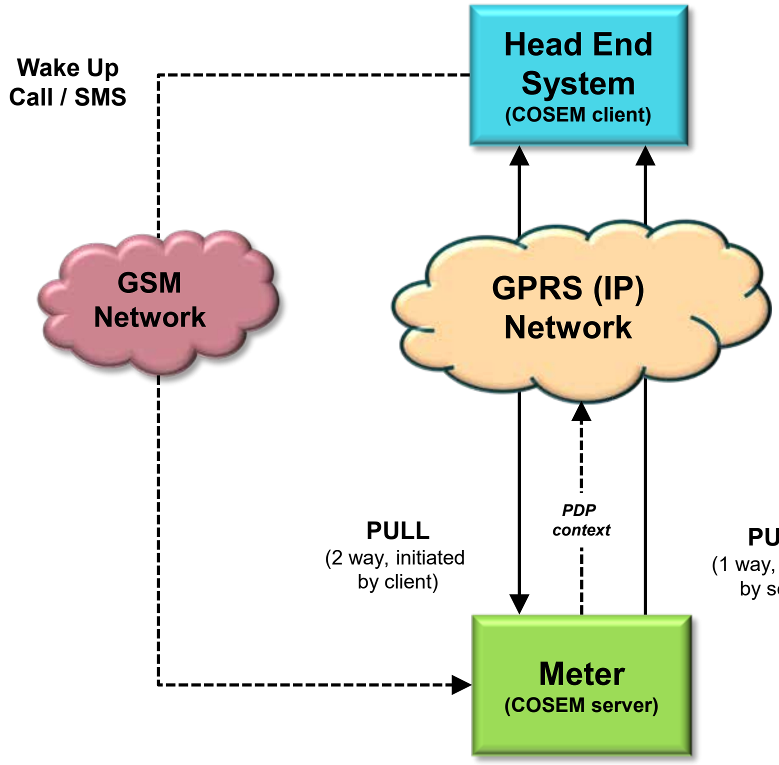


Figure A. 1 – Network connectivity example for a GSM/GPRS network

The basic network connectivity in the case of a mobile network (GPRS or equivalent service) is modelled by the “Auto connect” IC. Depending on the mode the connection can be 'always on', 'always on in a time window' or 'only on after a wake-up'.

For more information see the complete Blue Book.

Annex B
(Informative)
Additional information to M-Bus client (class_id = 72, version 1)

State transitions of the *encryption_key_status* attribute for different use cases are shown in Figure B. 1.

Figure B. 1 – Encryption key status diagram

For more information see the complete Blue Book.

Annex C
(Informative)
Additional information on IPv6 setup class (class_id = 48, version = 0)

C.1 General

In most regards, IPv6 is a conservative extension of IPv4. Most transport and application-layer protocols need little or no change to operate over IPv6; exceptions are application protocols that embed internet-layer addresses, such as FTP or NTPv3.

IPv6 specifies a new packet format, designed to minimize packet-header processing. Since the headers of IPv4 packets and IPv6 packets are significantly different, the two protocols are not interoperable.

C.2 IPv6 addressing

The most important feature of IPv6 is a much larger address space than that of IPv4: addresses in IPv6 are 128 bits long, compared to 32-bit addresses in IPv4. Furthermore, compared to IPv4, IPv6 supports multi-addressing on one physical interface (global, unique or link local IPv6 addresses).

IPv6 addresses are typically composed of two logical parts: a 64-bit (sub-)network prefix used for routing, and a 64-bit host part used to identify a host within the network.

The formats allowed for an IPv6 address are shown in Figure C. 1 (see http://www.iana.org/assignments/ipv6-address-space/). Note that to facilitate the IPv6 address writing, a specific notation defined in RFC 4291 has been specified by IETF (e.g. FF00::/8).

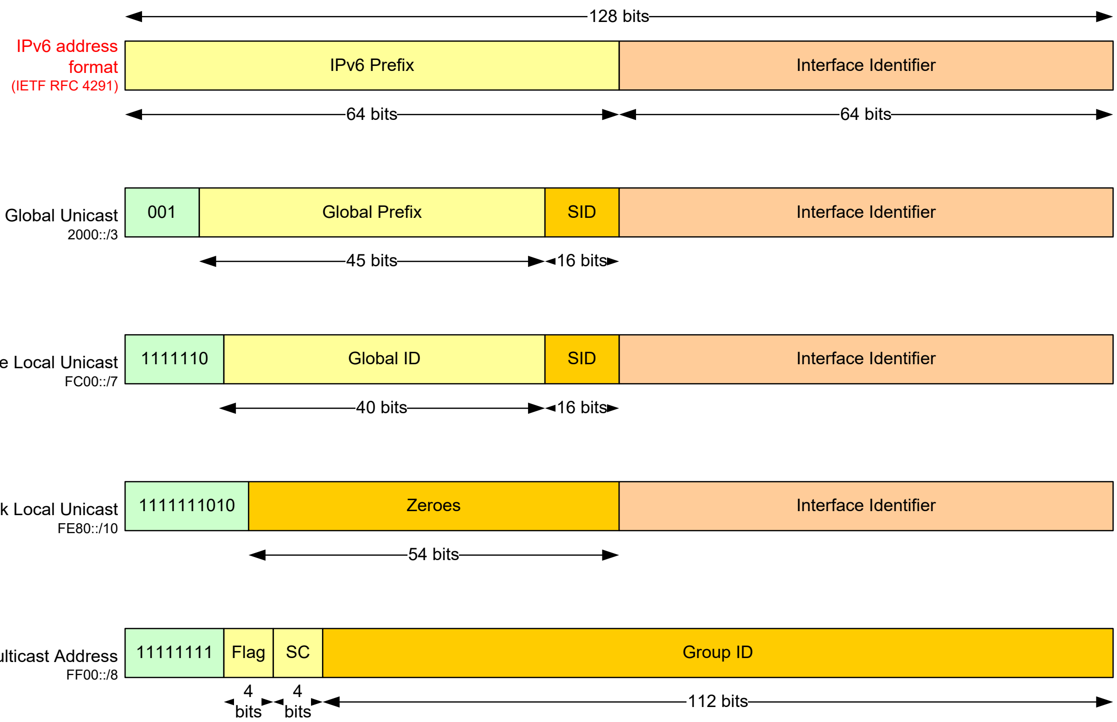


Figure C. 1 – IPv6 address formats

Where:

- *Global Unicast* is a routable address in the whole internet network and is composed as follows:
  - Global prefix assigned by IANA (see http://www.iana.org/assignments/ipv6-unicast-address-assignments/);
  - Subnet ID (SID) allocated by the network administrator; and
  - Interface Identifier either generated from the interface's MAC address (using modified EUI-64 format), or obtained from a DHCPv6 server, or assigned manually;
- *Unique Local Unicast* is an address only applicable to local network. This type of address is not routable outside the local network. The Global ID and the Subnet ID (SID) are allocated by the network administrator;
- *Link Local Unicast* is a unicast address allowed for a link local (without router). This type of address is not routable outside a local link;
- *Multicast* is an address assigned to different devices of the network. Following the scope (SC) of the address, the multicast group may be either Interface-local, Link-local, Admin-local, Site-local, Organization-local or global. For more information about Flag and SC (scope) parameters, see RFC 4291, 2.7.

It is important to note that there is no broadcast address defined in IPv6.

For more information see the complete Blue Book.

Annex D (Informative)
Overview of the narrow-band OFDM PLC technology for PRIME networks

For the specification of the PRIME narrow-band OFDM PLC setup classes, see 4.12.

NOTE This technology is supported by the PRIME Alliance, http://www.prime-alliance.org.

ITU-T G.9904:2012 specifies a physical layer, a medium access control layer and convergence layers for cost-effective narrowband (<200 kbps) data transmission over electrical power lines, intended for use in smart metering and smart grid applications. It is based on Orthogonal Frequency Division Multiplexing (OFDM).

The specification currently describes the following:

- a low-cost PHY capable of achieving rates of encoded 128 kbps;
- a Master-Slave MAC optimised for the power line environment;
- a convergence layer for the LLC layer specified in IEC 61334-4-32;
- a convergence layer for IPv4;
- a convergence layer for IPv6;

IEC 62056-8-4 specifies the DLMS/COSEM narrowband OFDM PLC profile for PRIME networks.

Annex E
(informative)
Overview of the narrow-band OFDM PLC technology for G3-PLC networks

For the specification of the G3 narrow-band OFDM PLC setup classes, see 4.13.

NOTE This specification is supported by the G3-PLC Alliance, http://www.G3-PLC.com.

ITU-T G.9903 specifies the physical, MAC and 6LoWPAN Adaptation layers of the G3-PLC technology while ITU-T G.9901 deals with frequency bandplan allocation and associated transmission level limitations.

Power line communication has been used for many decades, but a variety of new services and applications require more reliability and higher data rates. However, the power line channel is very hostile. Channel characteristics and parameters vary with frequency, location, time and the type of equipment connected to it. The lower frequency regions from 10 kHz to 200 kHz are especially susceptible to interference. Furthermore, the power line is a very frequency selective channel. Besides background noise, it is subject to impulsive noise often occurring at 50/60 Hz and group delays up to several hundred microseconds.

G3-PLC uses advanced modulation and channel coding techniques, which enables efficient use of the limited bandwidth of the CENELEC bands and facilitates communication over the power line channel. This combination enables a very robust communication in the presence of narrow-band interference, impulsive noise, and frequency selective attenuation. The specification addresses the following main objectives:

- provide robust communication on extremely harsh power line channels;
- provide a minimum of 20 kbps effective data rate in the normal mode of operation;
- ability to notch selected frequencies, to allow the cohabitation with other Narrow-band PLC communication technologies (e.g. IEC 61334-5-1:2001 S-FSK) or to be compliant with specific regulatory requirements;
- dynamic tone adaptation capability to select frequencies on the channel that do not have major interference, thereby ensuring a robust communication;
- access control, authentication, confidentiality and integrity to ensure high level of security.

To this end, the G3-PLC protocol stack aggregates several layers and sub-layers that form the G3-PLC profile:

- a robust high-performance PHY layer based on OFDM and adapted to the narrow-band PLC environment;
- a MAC layer of the IEEE 802.15.4 type (extended), well suited to low data rates;
- IPv6, the new generation of IP (Internet Protocol), which widely opens the range of potential applications and services; and
- to allow good IPv6 and MAC interoperability, an Adaptation sublayer taken from the Internet world (IETF) and called 6LoWPAN (RFC 4944 extended and RFC 6282). The adaptation sub layer also embeds the LOADng routing algorithm to allow multi-hop mesh connectivity.

For more information about the extensions of IEEE 802.15.4, RFC 4944 and RFC 6282 (AKA 6LoWPAN) standards, and LOADng, see ITU-T G.9903:2014.

IEC 62056-8-5 specifies the DLMS/COSEM narrowband OFDM PLC profile for G3-PLC networks.

Annex F
(informative)
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