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Functions concerned Fonctions concernées ☐ Safety / Sécurité ☐ EMC / CEM ☐ Environment / Environnement ☐ Quality assurance / Assurance de la qualité		

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Title

Communication networks and systems in substations - Part 7-3: Basic communication structure for substation and feeder equipment - Common data classes

Titre

ATTENTION
VOTE PARALLÈLE
CEI – CENELEC

L'attention des Comités nationaux de la CEI, membres du CENELEC, est attirée sur le fait que ce projet final de Norme internationale est soumis au vote parallèle. Un bulletin de vote séparé pour le vote CENELEC leur sera envoyé par le Secrétariat Central du CENELEC.

ATTENTION
IEC – CENELEC
PARALLEL VOTING

The attention of IEC National Committees, members of CENELEC, is drawn to the fact that this final Draft International Standard (DIS) is submitted for parallel voting. A separate form for CENELEC voting will be sent to them by the CENELEC Central Secretariat.

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

COMMUNICATION NETWORKS AND SYSTEMS IN SUBSTATIONS –

Part 7-3: Basic communication structure for substation and feeder equipment – Common data classes

FOREWORD

1) The IEC (International Electrotechnical Commission) is a worldwide organisation for standardisation comprising all national electrotechnical committees (IEC National Committees). The object of the IEC is to promote international co-operation on all questions concerning standardisation in the electrical and electronic fields. To this end and in addition to other activities, the IEC publishes International Standards. Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organisations liaising with the IEC also participate in this preparation. The IEC collaborates closely with the International Organisation for Standardisation (ISO) in accordance with conditions determined by agreement between the two organisations.
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International Standard IEC 61850-7-3 has been prepared by IEC technical committee 57: Power system control and associated communications.

The text of this standard is based on the following documents:

FDIS	Report on voting
57/XX/FDIS	57/XX/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

IEC 61850 consists of the following parts, under the general title *Communication networks and systems in substations*.

Part 1: Basic principles [1]

Part 2: Glossary [2]

Part 3: General requirements

Part 4: System and project management

Part 5: Communication requirements for functions and device models [1]

Part 6: Configuration description language for communication in electrical substations related to IEDs [2]

Part 7-1: Basic communication structure for substation and feeder equipment – Principles and models [1]

Part 7-2: Basic communication structure for substation and feeder equipment – Abstract communication service interface (ACSI) [1]

Part 7-3: Basic communication structure for substation and feeder equipment – Common data classes [1]

Part 7-4: Basic communication structure for substation and feeder equipment – Compatible logical node classes and data classes [1]

Part 8-1: Specific communication service mapping (SCSM) – Mappings to MMS (ISO/IEC 9506-1 and ISO/IEC 9506-2) and to ISO/IEC 8802-3 [2]

Part 9-1: Specific communication service mapping (SCSM) – Sampled values over serial unidirectional multidrop point to point link [1]

Part 9-2: Specific communication service mapping (SCSM) – Sampled values over ISO/IEC 8802-3 [2]

Part 10: Conformance testing [2]

The content of this part of IEC 61850 is based on existing or emerging standards and applications. In particular the definitions are based upon:

- the specific data types defined in IEC 60870-5-101 and IEC 60870-5-103.
- the common class definitions from the *Utility Communication Architecture 2.0: Generic Object Models for Substation & Feeder Equipment (GOMSFE) (IEEE TR 1550).*

The committee has decided that the contents of this publication will remain unchanged until 2005. At this date, the publication will be

- reconfirmed;
- withdrawn;
- replaced by a revised edition, or
- amended.

A bilingual version of this standard may be issued at a later date.

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1 To be published.

2 Under consideration.

INTRODUCTION

This document is part of a set of specifications, which details layered substation communication architecture. This architecture has been chosen to provide abstract definitions of classes and services such that the specifications are independent of specific protocol stacks and objects. The mapping of these abstract classes and services to communication stacks is outside the scope of IEC 61850-7-x and may be found in IEC 61850-8-x (station bus) and IEC 61850-9-x (process bus).

IEC 61850-7-1 gives an overview of this communication architecture. This part of IEC 61850 defines common attribute types and common data classes related to substation applications. These common data classes are used in IEC 61850-7-4. To define compatible data classes, the attributes of the instances of data shall be accessed using services defined in IEC 61850-7-2.

This part is used to specify the **abstract common data class** definitions. These abstract definitions shall be mapped into concrete object definitions that are to be used for a particular protocol (for example MMS, ISO 9506).

COMMUNICATION NETWORKS AND SYSTEMS IN SUBSTATIONS –

Part 7-3: Basic communication structure for substation and feeder equipment – Common data classes

1 Scope

This part of IEC 61850 specifies common attribute types and common data classes related to substation applications. In particular it specifies:

- common data classes for **status information**,
- common data classes for **measured information**,
- common data classes for **controllable status information**,
- common data classes for **controllable analogue set point information**,
- common data classes for **status settings**,
- common data classes for **analogue settings** and
- **attribute types** used in these common data classes.

This international standard is applicable to the description of device models and functions of substations and feeder equipment.

This international standard may also be applied, for example, to describe device models and functions for:

- substation to substation information exchange,
- substation to control centre information exchange,
- power plant to control centre information exchange,
- information exchange for distributed generation, or
- information exchange for metering.

2 Normative references

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

IEC 61850-2, *Communication networks and systems in substations – Part 2: Glossary* [3]

IEC 61850-7-1, *Communication networks and systems in substations – Part 7-1: Basic communication structure for substation and feeder equipment – Principles and models* [4]

IEC 61850-7-2, *Communication networks and systems in substations – Part 7-2: Basic communication structure for substation and feeder equipment – Abstract communication service interface (ACSI)* [4]

IEC 61850-7-4, *Communication networks and systems in substations – Part 7-4: Basic communication structure for substation and feeder equipment – Compatible logical node classes and data classes* [4]

ISO 1000, SI units and recommendations for the use of their multiples and of certain other units

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[3] Under consideration.

[4] To be published.

3 Terms and definitions

Fur the purposes of this International Standard, the terms and definitions given in IEC 61850-2[5] and 61850-7-2 apply.

4 Abbreviated terms

CDC	Common Data Class
dchg	Trigger option for data-change
dupd	Trigger option for data-update
FC	Functional Constraint
qchg	Trigger option for quality-change
TrgOp	trigger option

NOTE Abbreviations used for the identification of the common data classes and as names of the attributes are specified in the specific Clauses of this document and are not repeated here.

5 Conditions for attribute inclusion

This Clause lists general conditions that specify the presence of an attribute.

Abbreviation	Condition
M	Attribute is mandatory.
O	Attribute is optional.
PICS_SUBST	Attribute is mandatory, if substitution is supported (for substitution, see IEC 61850-7-2).
GC_1	At least one of the attributes shall be present for a given instance of DATA.
GC_2 (n)	All or none of the data attributes belonging to the same group (n) shall be present for a given instance of DATA.
GC_CON	A configuration data attribute shall only be present, if the (optional) specific data attributes to which this configuration relates, is also present.
AC_EXT	The attribute shall be present, if the common data class is extended with private attributes. Otherwise, the attribute shall not be present.
AC_LN0_M	Applies to ldNs in CDC LPL only, ldNs shall always be present if the data object belongs to logical node LLN0, otherwise not.
AC_DLD_M	Applies to lnNs in CDC LPL only, lnNs shall be present if the name space of the LN deviates from the name space defined in ldNs.
AC_DLN_M	Applies to dataNs in all CDCs, dataNs shall be present if the name space of the DATA deviates from the name space defined in ldNs/lnNs.
AC_DLNDA_M	The attribute shall be present, if the name space of the CDC deviates from either the name space defined in ldNs/lnNs or the name space defined in dataNs, or both.
AC_SCAV	The presence of the configuration data attribute depends on the presence of i and f of the Analog Value of the data attribute to which this configuration attribute relates. For a given data object, that attribute 1) shall be present, if both i and f are present, 2) shall be optional if only i is present and 3) is not required if only f is present NOTE If only i is present in a device without floating point capabilities, the configuration parameter may be exchanged offline.

[5] Under consideration.

Abbreviation	Condition
AC_ST	The attribute is mandatory, if the controllable status class supports status information.
AC_CO_M	The attribute is mandatory, if the controllable status class supports control.
AC_CO_O	The attribute is optional, if the controllable status class supports control.
AC_SG_M	The attribute is mandatory, if setting group is supported.
AC_SG_O	The attribute is optional, if setting group is supported.
AC_NSG_M	The attribute is mandatory, if setting group is not supported.
AC_NSG_O	The attribute is optional, if setting group is not supported.
AC_RMS_M	The attribute is mandatory when the harmonics reference type is rms.

6 Common data attribute types

6.1 General

Common data attribute types are defined for the use in common data classes (**CDC**) in Clause 7.

IEC 61850-7-1 provides an overview of all IEC 61850-7 documents (IEC 61850-7-2, IEC 61850-7-3, and IEC 61850-7-4). IEC 61850-7-1 also describes the basic notation used in IEC 61850-7-3 and the description of the relations between the IEC 61850-7 documents.

NOTE The common data attribute type "TimeStamp" is specified in IEC 61850-7-2.

6.2 Quality

6.2.1 Overview

Quality type shall be as defined in Table 1.

Table 1 – Quality

Quality Type Definition			
Attribute Name	**Attribute Type**	**Value/Value Range**	**M/O/C**
	PACKED LIST		
validity	CODED ENUM	good | invalid | reserved | questionable	M
detailQual	PACKED LIST		M
overflow	BOOLEAN		M
outOfRange	BOOLEAN		M
badReference	BOOLEAN		M
oscillatory	BOOLEAN		M
failure	BOOLEAN		M
oldData	BOOLEAN		M
inconsistent	BOOLEAN		M
inaccurate	BOOLEAN		M
source	CODED ENUM	process | substituted DEFAULT process	M
test	BOOLEAN	DEFAULT FALSE	M
operatorBlocked	BOOLEAN	DEFAULT FALSE	M

The DEFAULT value shall be applied, if the functionality of the related attribute is not supported. The mapping may specify to exclude the attribute from the message, if it is not supported or if the DEFAULT value applies.

Quality shall be an attribute that contains information on the quality of the information from the server. The different quality identifiers are not independent. Basically, there are the following quality identifiers:

- validity;
- source;
- test;
- operatorBlocked.

NOTE The quality, as used within the scope of 61850, is related to the quality of the information from the **server**. There may be a requirement that the client uses additional quality information within its local database. This is a local issue and not part of the scope of IEC 61850. However, the quality of a client may have an impact on the quality supplied by a server of a client – server relationship at a higher level (see Figure 3).

6.2.2 Validity

Validity shall be good, questionable or invalid.

good: The value shall be marked good if no abnormal condition of the acquisition function or the information source is detected.

invalid: The value shall be marked invalid when an abnormal condition of the acquisition function or the information source (missing or non-operating updating devices) is detected. The value shall not be defined under this condition. The mark invalid shall be used to indicate to the client that the value may be incorrect and shall not be used.

EXAMPLE If an input unit detects an oscillation of one input it will mark the related information as invalid.

questionable: The value shall be marked questionable if a supervision function detects an abnormal behaviour, however the value could still be valid. The client shall be responsible for determining whether or not values marked "questionable" should be used.

6.2.3 Detail quality

The reason for an invalid or questionable value of an attribute may be specified in more detail with further quality identifiers. If one of these identifiers is set then validity shall be set to invalid or questionable. The following Table shows the relation of the detailed quality identifiers with invalid or questionable quality.

DetailQual	Invalid	Questionable
Overflow	X	
Out of Range	X	X
Bad Reference	X	X
Oscillatory	X	X
Failure	X	
Old data		X
Inconsistent		X
Inaccurate		X

overflow: this identifier shall indicate a quality issue that the value of the attribute to which the quality has been associated is beyond the capability of being represented properly (used for measurand information only).

EXAMPLE A measured value may exceed the range that may be represented by the selected data type, for example the data type is a 16-bit unsigned integer and the value exceeds 65535.

outOfRange: this identifier shall indicate a quality issue that the attribute to which the quality has been associated is beyond a predefined range of values. The server shall decide if validity shall be set to invalid or questionable (used for measurand information only).

EXAMPLE A measured value may exceed a predefined range, however the selected data type can still represent the value, for example the data type is a 16-bit unsigned integer, the predefined range is 0 to 40 000, if the value is between 40001 and 65535 it is considered to be out of range.

badReference: this identifier shall indicate that the value may not be a correct value due to a reference being out of calibration. The server shall decide if validity shall be set to invalid or questionable (used for measurand information and binary counter information only).

oscillatory: to prevent overloading of event driven communication channels, it is desirable to detect and suppress oscillating (fast changing) binary inputs. If a signal changes in a defined time (t_{osc}) twice in the same direction (from 0 to 1 or from 1 to 0) then it shall be defined as an oscillation and the detail quality identifier “oscillatory” shall be set. If a configured numbers of transient changes is detected, they shall be suppressed. In this time, the validity status "questionable” shall be set. If the signal is still in the oscillating state after the defined number of changes, the value shall be left in the state it was in when the oscillatory flag was set. In this case, the validity status "questionable” shall be reset and “invalid” shall be set as long as the signal is oscillating. If the configuration is such that all transient changes should be suppressed, the validity status “invalid” shall be set immediately in addition to the detail quality identifier “oscillatory” (used for status information only).

failure: this identifier shall indicate that a supervision function has detected an internal or external failure.

oldData: a value shall be oldData if an update is not made during a specific time interval. The value may be an old value that may have changed in the meantime. This specific time interval may be defined by an allowed-age attribute.

NOTE "Fail silent" errors, where the equipment stops sending data will cause a oldData condition. In this case, the last received information was correct.

inconsistent: this identifier shall indicate that an evaluation function has detected an inconsistency.

inaccurate: this identifier shall indicate that the value does not meet the stated accuracy of the source.

EXAMPLE The measured value of power factor may be noisy (inaccurate) when the current is very small.

6.2.4 Source

Source shall give information related to the origin of a value. The value may be acquired from the process or be a substituted value.

process: the value is provided by an input function from the process I/O or is calculated from some application function.

substituted: the value is provided by input of an operator or by an automatic source.

NOTE 1 Substitution may be done locally or via the communication services. In the second case, specific attributes with a FC SV are used.

NOTE 2 There are various means to clear a substitution. As an example, a substitution that was done following an invalid condition may be cleared automatically if the invalid condition is cleared. However, this is a local issue and therefore not in the scope of this standard.

6.2.5 Test

Test shall be an additional identifier that may be used to classify a value being a test value and not to be used for operational purposes. The processing of the test quality in the client shall be a local issue. The bit shall be completely independent from the other bits within the quality descriptor.

The test identifier should normally be propagated through all hierarchical levels.

6.2.6 Blocked by operator

operatorBlocked: this identifier shall be set if further update of the value has been blocked by an operator. The value shall be the information that was acquired before blocking. If this identifier is set then the identifier oldData of detailQual shall also be set.

NOTE Both an operator as well as an automatic function may block communication updating as well as input updating. In both cases, detailQual.oldData will be set. If the blocking is done by an operator, then the identifier operatorBlocked is set additionally. In that case, an operator activity is required to clear the condition.

EXAMPLE An operator may block the update of an input, to save the old value, if the auxiliary supply is switched off.

6.2.7 Quality in the client server context

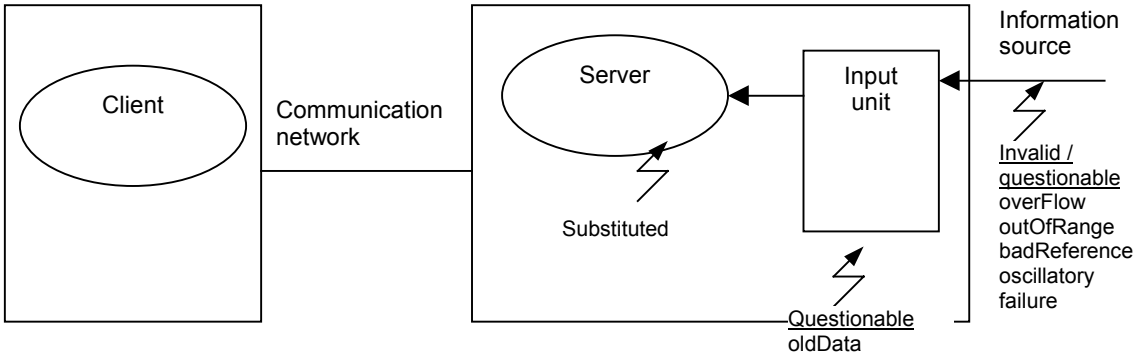


Figure 1 – Quality identifiers in a single client – server relationship

The quality identifier shall reflect the quality of the information in the server, as it is supplied to the client. Figure 1 shows potential sources that may influence the quality in a single client – server relationship. "Information Source" is the (hardwired) connection of the process information to the system. The information may be invalid or questionable as indicated in Figure 1. Further abnormal behaviour of the information source may be detected by the input unit. In that case, the input unit may keep the old data and flag it accordingly.

In a multiple client - server relationship, as shown in Figure 2, information may be acquired over a communication link (with Client B). If that communication link is broken, client B will detect that error situation and qualify the information as questionable/old data.

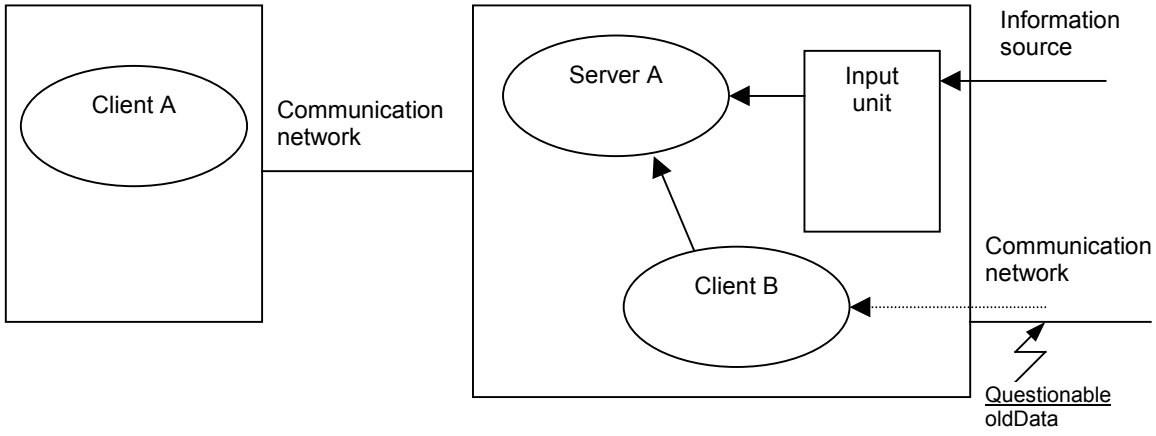


Figure 2 – Quality identifiers in a multiple client – server relationship

In the multiple client-server relationship, the quality of the server A shall reflect both the quality of the server B (acquired with client B) as well as its own quality. Therefore, handling of prioritisation of quality from different levels may require further specification beyond that included in this standard. For the identifier **validity**, the value invalid shall dominate over the value questionable, since this is the worst case. For the identifier **source**, the higher level of the multiple client – server relationship shall dominate over the lower level.

EXAMPLE Let A be the higher level and B the lower level. The quality from server B is invalid. If now the communication fails (questionable, oldData) between server B and client B, the quality will remain invalid and not become questionable, since the last information was not correct. Server A therefore will report the information as invalid.

6.2.8 Relation between quality identifiers

Validity and **source** have a prioritised relation. If source is in the “process” state, then validity shall determine the quality of the origin value. If source is in the “substitute” state, then validity shall be overruled by the definition of the substituted value. This is an important feature, since substitution is used to replace invalid values with substituted values that may be used by the client such as good values.

EXAMPLE 1 If both questionable and substituted are set, this means that the substituted value is questionable. This may happen if, in a hierarchical configuration, a substitution is performed at the lowest level and the communication fails on a higher level.

EXAMPLE 2 If an invalid value is substituted, the invalid field will be cleared and the substituted field will be set to indicate the substitution.

The quality identifier **operatorBlocked** is independent of the other quality identifiers.

EXAMPLE 3 An oscillating input may cause the invalid field to be set. Due to the continuing changes in the value many reports are generated, loading the communication network. An operator may block the update of the input. In this case the field operatorBlocked will also be set.

An example for the interaction between the quality identifiers and the impact of multiple client – server relation is shown in Figure 3. In this example, it is assumed that a bay level device acts as a client of the process level server and as a server to the station level client.

NOTE This is one example of a multiple client – server relationship; other multiple client - server relationships may exist, but the behaviour will not change.

In case A, the input is blocked, the quality of the information is marked as questionable and oldData.

In case B, a substitution is done at process level. Now, the quality of the information to the next higher level (the bay level) is marked as substituted (but good).

In case C, the communication between process and bay level fails. Between bay level and station level, the information is still marked as substituted. In addition, questionable and oldData is set to indicate that the (substituted) information may be old.

In case D, a new substitution is made at bay level. Now the quality of the information to the next higher level is marked as substituted (and good) and is independent from the first substitution.

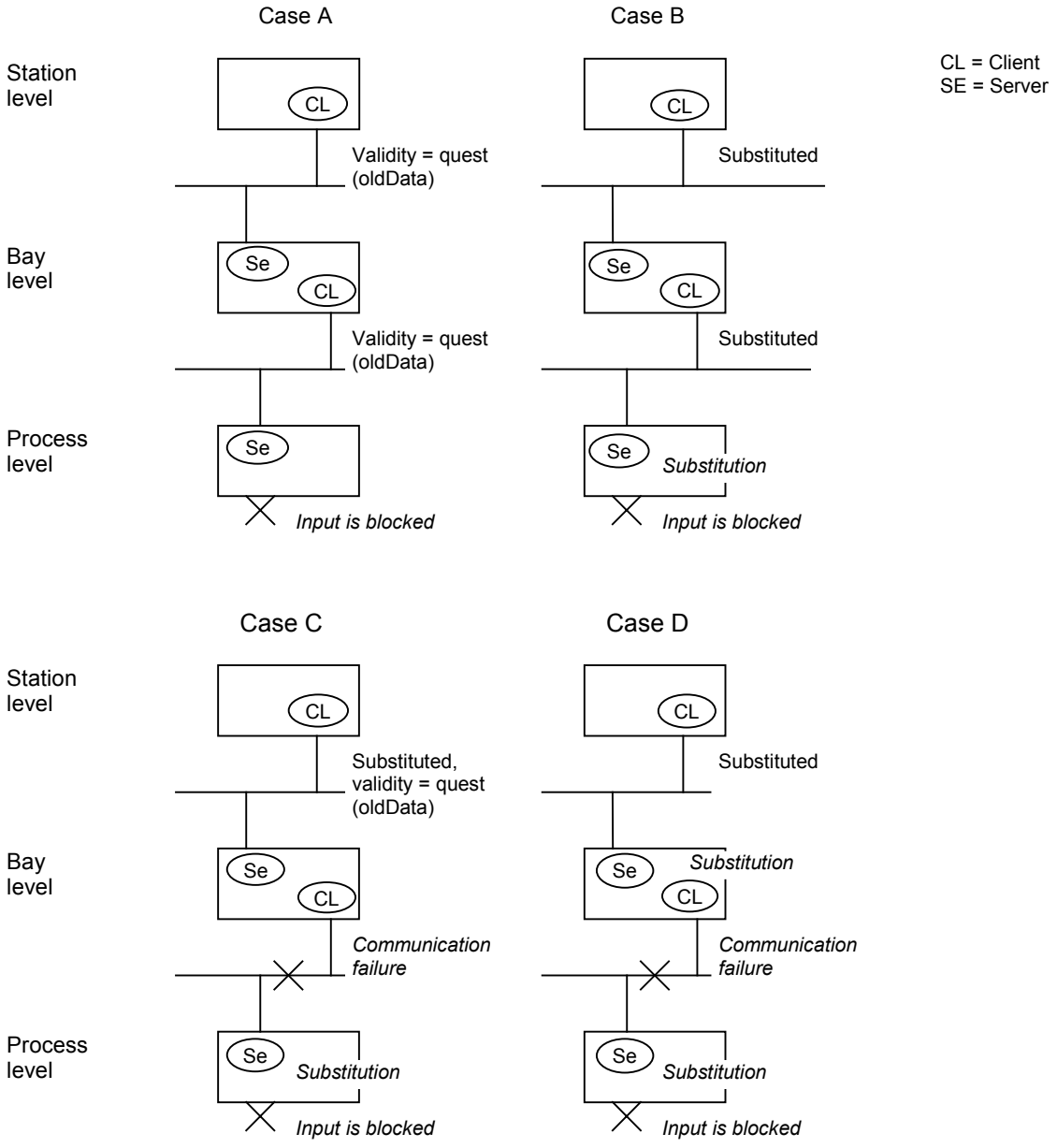


Figure 3 – Interaction of substitution and validity

6.3 Analogue value

Analogue value type shall be as defined in Table 2.

Table 2 – Analogue value

AnalogueValue Type Definition			
Attribute Name	**Attribute Type**	**Value/Value Range**	**M/O/C**
i	INT32	integer value	GC_1
f	FLOAT32	floating point value	GC_1

Analogue values may be represented as a basic data type INTEGER (attribute i) or as FLOATING POINT (attribute f). At least one of the attributes shall be used. If both i and f exist, the application has to insure that both values remain consistent. The latest value set by the communication service shall be used to update the other value. As an example, if xxx.f is written, the application shall update xxx.i accordingly.

***i*:** The value of i shall be an integer representation of the measured value. The formula to convert between i and f shall be:

$$f \times 10^{units.multiplier} = (i \times scaleFactor) + offset$$

It shall be true within acceptable error when *i*, scaleFactor, offset and *f* are all present.

***f*:** The value of f shall be the floating point representation of the measured value. *f* shall represent the technological value in SI units, see Annex A.

NOTE The reason for both integer and floating point representation is so that IEDs without FLOATING POINT capabilities shall be enabled to support analogue values. In this case, the scaleFactor and offset may be exchanged offline between clients and servers.

6.4 Configuration of analogue value

Configuration of analogue value type shall be as defined in Table 3.

Table 3 – Configuration of analogue value

ScaledValueConfig Type Definition			
Attribute Name	**Attribute Type**	**Value/Value Range**	**M/O/C**
scaleFactor	FLOAT32		M
offset	FLOAT32		M

This data attribute type shall be used to configure the INTEGER value representation of the analogue value. The formula for conversion between integer and floating point value is given in 6.3.

scaleFactor: the value of scaleFactor shall be the scaling factor.

offset: the value of offset shall be the offset.

6.5 Range configuration

Range configuration type is used to configure the limits that define the range of a measured value and shall be as defined in Table 4.

Table 4 – Range configuration

RangeConfig Type Definition			
Attribute Name	**Attribute Type**	**Value/Value Range**	**M/O/C**
hhLim	AnalogueValue		M
hLim	AnalogueValue		M
lLim	AnalogueValue		M
llLim	AnalogueValue		M
min	AnalogueValue		M
max	AnalogueValue		M

hhLim, hLim, lLim, llLim: These attributes shall be the configuration parameters used in the context with the range attribute as defined in 7.9.2.

min: the min (minimum) attribute shall represent the minimum process measurement for which values of *i* or *f* are considered within process limits. If the value is lower, q shall be set accordingly (validity = questionable, detailQual = outOfRange).

max: the max (maximum) attribute shall represent the maximum process measurement for which values of i or f are considered within process limits. If the value is higher, q shall be set accordingly (validity = questionable, detailQual = outOfRange).

6.6 Step position with transient indication

Step position with transient indication type is for example used to indicate the position of tap changers and shall be as defined in Table 5.

Table 5 – Step position with transient indication

ValWithTrans Type Definition			
Attribute Name	**Attribute Type**	**Value/Value Range**	**M/O/C**
posVal	INT8	–64 … 63	M
transInd	BOOLEAN		O

The **posVal** shall contain the step position, the **transInd** shall indicate that the equipment is in a transient state.

6.7 Pulse configuration

Pulse configuration type is used to configure the output pulse generated with a command and shall be as defined in Table 6.

Table 6 – Pulse configuration

PulseConfig Type Definition			
Attribute Name	**Attribute Type**	**Value/Value Range**	**M/O/C**
cmdQual	ENUMERATED	pulse | persistent	M
onDur	INT32U		M
offDur	INT32U		M
numPls	INT32U		M

cmdQual: this identifier shall define if the control output is a pulse output or if it is a persistent output. If it is set to pulse, then the duration of the pulse shall be defined with the identifiers onDur, offDur and numPls. If it is set to persistent, the deactivation of the output pulse is a local issue determined in the server; as an example, when a switch controlled by this control output has reached the end position, the local control logic in the in the device implementing the server will deactivate the output.

onDur, offDur, numPls: as the result of receiving an **Operate** service, a pulsed output may be generated to the **on** or **off** input of a switching device. The shape of this output is defined by onDur, offDur and numPls according to Figure 4. NumPls shall specify the number of pulses that are generated. onDur shall specify the on duration of the pulse, offDur specifies the duration between two pulses. onDur and offDur shall be specified in ms; a value of 0 ms shall specify that the duration is locally defined.

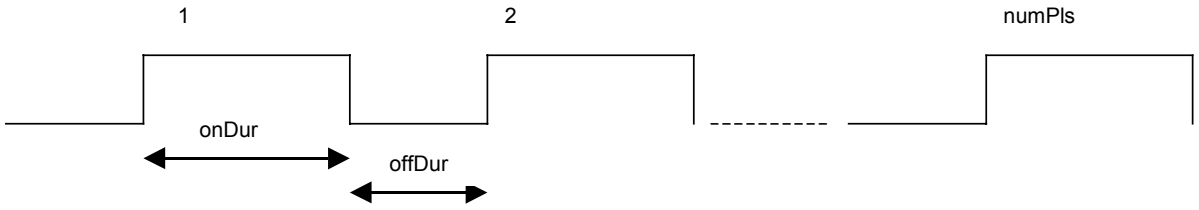


Figure 4 – Configuration of command output pulse

6.8 Originator

Originator type shall be as defined in Table .

Table 7 – Originator

Originator Type Definition			
Attribute Name	**Attribute Type**	**Value/Value Range**	**M/O/C**
orCat	ENUMERATED	not-supported | bay-control | station-control | remote-control | automatic-bay | automatic-station | automatic-remote | maintenance | process	M
orIdent	OCTET STRING64		M

Originator shall contain information related to the originator of the last change of the data attribute representing the value of a controllable data.

orCat: The originator category shall specify the category of the originator that caused a change of a value. An explanation of the values for orCat is given in Table 8.

Table 8 – Values for orCat

Value	Explanation
bay-control	Control operation issued from an operator using a client located at bay level
station-control	Control operation issued from an operator using a client located at station level
remote-control	Control operation from a remote operater outside the substation (for example network control center)
automatic-bay	Control operation issued from an automatic function at bay level
automatic-station	Control operation issued from an automatic function at station level
automatic-remote	Control operation issued from a automatic function outside of the substation
maintenance	Control operation issued from a maintenance/service tool
process	Status change occurred without control action (for example external trip of a circuit breaker or failure inside the breaker)

orIdent: the originator identification shall show the address of the originator who caused the change of the value. The value of NULL shall be reserved to indicate that the originator of a particular action is not known or is not reported.

NOTE The type of address stored (application address, IP address, link address, ...) is whatever the server can detect. This may depend on the specific mapping

6.9 Unit definition

Unit type shall be as defined in Table 9.

Table 9 – Unit

Unit Type Definition			
Attribute Name	**Attribute Type**	**Value/Value Range**	**M/O/C**
SIUnit	ENUMERATED	According to Tables A.1 to A.4 in Annex A	M
multiplier	ENUMERATED	According to Table A.5 in Annex A	O

SIUnit: shall define the SI unit according to Annex A.

multiplier: shall define the multiplier value according to Annex A. The default value is 0 (i.e. multiplier = 1).

6.10 Vector definition

Vector type shall be as defined in Table 10.

Table 10 – Vector

Vector Type Definition			
Attribute Name	**Attribute Type**	**Value/Value Range**	**M/O/C**
mag	AnalogueValue		M
ang	AnalogueValue		O

mag: the magnitude of the complex value.

ang: the angle of the complex value. The unit is degrees. The angle reference is defined in the context where the Vector type is used.

7 Common data class specifications

7.1 General

Common data classes are defined for use in part IEC 61850-7-4. Common data classes are composed of common data attribute types defined in Clause 6 of this part or of types defined in IEC 61850-7-2. IEC 61850-7-1 provides the basic notation used in this Clause.

7.2 Name spaces

Name spaces are defined to specify extensions to the present definitions of IEC 61850-7-3 and IEC 61850-7-4. The name space is based on a hierarchical structure from logical node zero **LLN0** at the top down to the common data class **CDC**. See Table 11.

Table 11 – Name space attributes

Attribute	Application	Scope of the standard specified with the attribute
ldNs	The DATA-ATTRIBUTE ldNs shall be included in the logical node LLN0 if the name space of the logical device deviates from "IEC 61850-7-4: 2003"	IEC 61850-7-4 (IEC 61850-7-3 by reference)
lnNs	The DATA-ATTRIBUTE lnNs shall be included if the name space of the LN deviates from the definition in the specification in which the LN is defined.	IEC 61850-7-4 (IEC 61850-7-3 by reference)
cdcNs	The DATA-ATTRIBUTE cdcNs shall be included if the definition of at least one DATA-ATTRIBUTE of the CDC deviates from the definition in the specification in which the CDC of the DATA is defined.	IEC 61850-7-3
dataNs	The DATA-ATTRIBUTE dataNs shall be included if the name space of the DATA deviates from the definition in the specification in which the LOGICAL-NODE and its DATA are defined.	IEC 61850-7-4 (IEC 61850-7-3 by reference)

7.3 Common data class specifications for status information

7.3.1 Basic status information template

Table 12 defines the basic status information template. In particular, it defines the inheritance and specialisation of services defined in IEC 61850-7-2.

Table 12 – Basic status information template

Basic status information template					
Attribute Name	**Attribute Type**	**FC**	**TrgOp**	**Value/Value Range**	**M/O/C**
DataName	Inherited from Data Class (see IEC 61850-7-2)				
DataAttribute					
status					
substitution					
configuration, description and extension					
Services (see IEC 61850-7-2)					
The following services are inherited from IEC 61850-7-2. They are specialised by restricting the service to attributes with a functional constraint as specified below.					

Service model of IEC 61850-7-2	**Service**	**Service applies to Attr with FC**	**Remark**
Data model	SetDataValues GetDataValues GetDataDefinition	DC, CF, SV ALL ALL	
Data set model	GetDataSetValues SetDataSetValues	ALL DC, CF, SV	
Reporting model	Report	ALL	as specified within the data set that is used to define the report content

7.3.2 Single point status (SPS)

Table 13 defines the common data class “single point status”.

Table 13 – Single point status common data class definition

SPS class					
Attribute Name	**Attribute Type**	**FC**	**TrgOp**	**Value/Value Range**	**M/O/C**
DataName	Inherited from Data Class (see IEC 61850-7-2)				
DataAttribute					
status					
stVal	BOOLEAN	ST	dchg	TRUE | FALSE	M
q	Quality	ST	qchg		M
t	TimeStamp	ST			M
substitution					
subEna	BOOLEAN	SV			PICS_SUBST
subVal	BOOLEAN	SV		TRUE | FALSE	PICS_SUBST
subQ	Quality	SV			PICS_SUBST
subID	VISIBLE STRING64	SV			PICS_SUBST
configuration, description and extension					
d	VISIBLE STRING255	DC		Text	O
dU	UNICODE STRING255	DC			O
cdcNs	VISIBLE STRING255	EX			AC_DLNDA_M
cdcName	VISIBLE STRING255	EX			AC_DLNDA_M
dataNs	VISIBLE STRING255	EX			AC_DLN_M
Services					
As defined in Table 12					

7.3.3 Double point status (DPS)

Table 14 defines the common data class “double point status”.

Table 14 – Double point status common data class specification

DPS class					
Attribute Name	**Attribute Type**	**FC**	**TrgOp**	**Value/Value Range**	**M/O/C**
DataName	Inherited from Data Class (see IEC 61850-7-2)				
DataAttribute					
status					
stVal	CODED ENUM	ST	dchg	intermediate-state | off | on | bad-state	M
q	Quality	ST	qchg		M
t	TimeStamp	ST			M
substitution					
subEna	BOOLEAN	SV			PICS_SUBST
subVal	CODED ENUM	SV		intermediate-state | off | on | bad-state	PICS_SUBST
subQ	Quality	SV			PICS_SUBST
subID	VISIBLE STRING64	SV			PICS_SUBST
configuration, description and extension					
d	VISIBLE STRING255	DC		Text	O
dU	UNICODE STRING255	DC			O
cdcNs	VISIBLE STRING255	EX			AC_DLNDA_M
cdcName	VISIBLE STRING255	EX			AC_DLNDA_M
dataNs	VISIBLE STRING255	EX			AC_DLN_M
Services					
As defined in Table 12					

7.3.4 Integer status (INS)

Table 15 defines the common data class “integer status”.

Table 15 – Integer status common data class specification

INS class					
Attribute Name	**Attribute Type**	**FC**	**TrgOp**	**Value/Value Range**	**M/O/C**
DataName	Inherited from Data Class (see IEC 61850-7-2)				
DataAttribute					
status					
stVal	INT32	ST	dchg		M
q	Quality	ST	qchg		M
t	TimeStamp	ST			M
substitution					
subEna	BOOLEAN	SV			PICS_SUBST
subVal	INT32	SV			PICS_SUBST
subQ	Quality	SV			PICS_SUBST
subID	VISIBLE STRING64	SV			PICS_SUBST
configuration, description and extension					
d	VISIBLE STRING255	DC		Text	O
dU	UNICODE STRING255	DC			O
cdcNs	VISIBLE STRING255	EX			AC_DLNDA_M
cdcName	VISIBLE STRING255	EX			AC_DLNDA_M
dataNs	VISIBLE STRING255	EX			AC_DLN_M
Services					
As defined in Table 12					

7.3.5 Protection activation information (ACT)

Table 16 defines the common data class “protection activation information”.

Table 16 – Protection activation information common data class specification

ACT class					
Attribute Name	**Attribute Type**	**FC**	**TrgOp**	**Value/Value Range**	**M/O/C**
DataName	Inherited from Data Class (see IEC 61850-7-2)				
DataAttribute					
status					
general	BOOLEAN	ST	dchg		M
phsA	BOOLEAN	ST	dchg		O
phsB	BOOLEAN	ST	dchg		O
phsC	BOOLEAN	ST	dchg		O
neut	BOOLEAN	ST	dchg		O
q	Quality	ST	qchg		M
t	TimeStamp	ST			M
configuration, description and extension					
operTm	TimeStamp	CF			O
d	VISIBLE STRING255	DC		Text	O
dU	UNICODE STRING255	DC			O
cdcNs	VISIBLE STRING255	EX			AC_DLNDA_M
cdcName	VISIBLE STRING255	EX			AC_DLNDA_M
dataNs	VISIBLE STRING255	EX			AC_DLN_M
Services					
As defined in Table 12					

7.3.6 Directional protection activation information (ACD)

Table 17 defines the common data class “directional protection activation information”.

Table 17 – Directional protection activation information common data class specification

ACD class					
Attribute Name	**Attribute Type**	**FC**	**TrgOp**	**Value/Value Range**	**M/O/C**
DataName	Inherited from Data Class (see IEC 61850-7-2)				
DataAttribute					
status					
general	BOOLEAN	ST	dchg		M
dirGeneral	ENUMERATED	ST	dchg	unknown | forward | backward | both	M
phsA	BOOLEAN	ST	dchg		GC_2 (1)
dirPhsA	ENUMERATED	ST	dchg	unknown | forward | backward	GC_2 (1)
phsB	BOOLEAN	ST	dchg		GC_2 (2)
dirPhsB	ENUMERATED	ST	dchg	unknown | forward | backward	GC_2 (2)
phsC	BOOLEAN	ST	dchg		GC_2 (3)
dirPhsC	ENUMERATED	ST	dchg	unknown | forward | backward	GC_2 (3)
neut	BOOLEAN	ST	dchg		GC_2 (4)
dirNeut	ENUMERATED	ST	dchg	unknown | forward | backward	GC_2 (4)
q	Quality	ST	qchg		M
t	TimeStamp	ST			M
configuration, description and extension					
d	VISIBLE STRING255	DC		Text	O
dU	UNICODE STRING255	DC			O
cdcNs	VISIBLE STRING255	EX			AC_DLNDA_M
cdcName	VISIBLE STRING255	EX			AC_DLNDA_M
dataNs	VISIBLE STRING255	EX			AC_DLN_M
Services					
As defined in Table 12					

7.3.7 Security violation counting (SEC)

Table 18 defines the common data class “security violation counting”.

Table 18 – Security violation counting common data class specification

SEC class					
Attribute Name	**Attribute Type**	**FC**	**TrgOp**	**Value/Value Range**	**M/O/C**
DataName	Inherited from Data Class (see IEC 61850-7-2)				
DataAttribute					
status					
cnt	INT32U	ST	dchg		M
sev	ENUMERATED	ST		unknown critical|major|minor|warning	M
t	TimeStamp	ST			M
addr	OCTET STRING64	ST			O
addInfo	VISIBLE STRING64	ST			O
configuration, description and extension					
d	VISIBLE STRING255	DC		Text	O
dU	UNICODE STRING255	DC			O
cdcNs	VISIBLE STRING255	EX			AC_DLNDA_M
cdcName	VISIBLE STRING255	EX			AC_DLNDA_M
dataNs	VISIBLE STRING255	EX			AC_DLN_M
Services					
As defined in Table 12					

7.3.8 Binary counter reading (BCR)

Table 19 defines the common data class “binary counter reading”.

Table 19 – Binary counter reading common data class specification

BCR class					
Attribute Name	**Attribute Type**	**FC**	**TrgOp**	**Value/Value Range**	**M/O/C**
DataName	Inherited from Data Class (see IEC 61850-7-2)				
DataAttribute					
status					
actVal	INT128	ST	dchg		M
frVal	INT128	ST	dupd		GC_2 (1)
frTm	TimeStamp	ST	dupd		GC_2 (1)
q	Quality	ST	qchg		M
t	TimeStamp	ST			M
configuration, description and extension					
units	Unit	CF		see Annex A	O
pulsQty	FLOAT32	CF			M
frEna	BOOLEAN	CF			GC_2 (1)
strTm	TimeStamp	CF			GC_2 (1)
frPd	INT32	CF			GC_2 (1)
frRs	BOOLEAN	CF			GC_2 (1)
d	VISIBLE STRING255	DC			O
dU	UNICODE STRING255	DC			O
cdcNs	VISIBLE STRING255	EX			AC_DLNDA_M
cdcName	VISIBLE STRING255	EX			AC_DLNDA_M
dataNs	VISIBLE STRING255	EX			AC_DLN_M
Services					
As defined in Table 12					

7.4 Common data class specifications for measurand information

7.4.1 Basic measurand information template

Table 20 defines the basic measurand information template. In particular, it defines the inheritance and specialisation of services defined in IEC 61850-7-2.

Table 20 – Basic measurand information template

Basic measurand information template					
Attribute Name	**Attribute Type**	**FC**	**TrgOp**	**Value/Value Range**	**M/O/C**
DataName	Inherited from Data Class (see IEC 61850-7-2)				
DataAttribute					
measured values					
substitution					
configuration, description and extension					
Services (see IEC 61850-7-2)					
The following services are inherited from IEC 61850-7-2. They are specialised by restricting the service to attributes with a functional constraint as specified below.					

Service model of IEC 61850-7-2	**Service**	**Service applies to Attr with FC**	**Remark**
Data model	SetDataValues GetDataValues GetDataDefinition	DC, CF, SV ALL ALL	
Data set model	GetDataSetValues SetDataSetValues	ALL DC, CF, SV	
Reporting model	Report	ALL	as specified within the data set that is used to define the report content

7.4.2 Measured value (MV)

Table 21 defines the common data class “measured value”.

Table 21 – Measured value

MV class					
Attribute Name	**Attribute Type**	**FC**	**TrgOp**	**Value/Value Range**	**M/O/C**
DataName	Inherited from Data Class (see IEC 61850-7-2)				
DataAttribute					
measured values					
instMag	AnalogueValue	MX			O
mag	AnalogueValue	MX	dchg		M
range	ENUMERATED	MX	dchg	normal | high | low | high-high | low-low |	O
q	Quality	MX	qchg		M
t	TimeStamp	MX			M
substitution					
subEna	BOOLEAN	SV			PICS_SUBST
subMag	AnalogueValue	SV			PICS_SUBST
subQ	Quality	SV			PICS_SUBST
subID	VISIBLE STRING64	SV			PICS_SUBST
configuration, description and extension					
units	Unit	CF		see Annex A	O
db	INT32U	CF		0 … 100 000	O
zeroDb	INT32U	CF		0 … 100 000	O
sVC	ScaledValueConfig	CF			AC_SCAV
rangeC	RangeConfig	CF			GC_CON
smpRate	INT32U	CF			O
d	VISIBLE STRING255	DC		Text	O
dU	UNICODE STRING255	DC			O
cdcNs	VISIBLE STRING255	EX			AC_DLNDA_M
cdcName	VISIBLE STRING255	EX			AC_DLNDA_M
dataNs	VISIBLE STRING255	EX			AC_DLN_M
Services					
As defined in Table 20					

7.4.3 Complex measured value (CMV)

Table 22 defines the common data class “complex measured value”.

Table 22 – Complex measured value

CMV class					
Attribute Name	**Attribute Type**	**FC**	**TrgOp**	**Value/Value Range**	**M/O/C**
DataName	Inherited from Data Class (see IEC 61850-7-2)				
DataAttribute					
measured values					
instCVal	Vector	MX			O
cVal	Vector	MX	dchg		M
range	ENUMERATED	MX	dchg	normal | high | low | high-high | low-low |	O
q	Quality	MX	qchg		M
t	TimeStamp	MX			M
substitution					
subEna	BOOLEAN	SV			PICS_SUBST
subCVal	Vector	SV			PICS_SUBST
subQ	Quality	SV			PICS_SUBST
subID	VISIBLE STRING64	SV			PICS_SUBST
configuration, description and extension					
units	Unit	CF		see Annex A	O
db	INT32U	CF		0 … 100 000	O
zeroDb	INT32U	CF		0 … 100 000	O
rangeC	RangeConfig	CF			GC_CON
magSVC	ScaledValueConfig	CF			AC_SCAV
angSVC	ScaledValueConfig	CF			AC_SCAV
angRef	ENUMERATED	CF		V | A | other …	O
smpRate	INT32U	CF			O
d	VISIBLE STRING255	DC		Text	O
dU	UNICODE STRING255	DC			O
cdcNs	VISIBLE STRING255	EX			AC_DLNDA_M
cdcName	VISIBLE STRING255	EX			AC_DLNDA_M
dataNs	VISIBLE STRING255	EX			AC_DLN_M
Services					
As defined in Table 20					

7.4.4 Sampled value (SAV)

Table 23 defines the common data class “sampled value”. This common data class is used to represent samples of instantaneous analogue values. The values are usually transmitted using the "transmission of sampled value model" as defined in IEC 61850-7-2.

Table 23 – Sampled value

SAV class					
Attribute Name	**Attribute Type**	**FC**	**TrgOp**	**Value/Value Range**	**M/O/C**
DataName	Inherited from Data Class (see IEC 61850-7-2)				
DataAttribute					
measured values					
instMag	AnalogueValue	MX			M
q	Quality	MX	qchg		M
t	TimeStamp	MX			O
configuration, description and extension					
units	Unit	CF		see Annex A	O
sVC	ScaledValueConfig	CF			AC_SCAV
min	AnalogueValue	CF			O
max	AnalogueValue	CF			O
d	VISIBLE STRING255	DC		Text	O
dU	UNICODE STRING255	DC			O
cdcNs	VISIBLE STRING255	EX			AC_DLNDA_M
cdcName	VISIBLE STRING255	EX			AC_DLNDA_M
dataNs	VISIBLE STRING255	EX			AC_DLN_M
Services					
As defined in Table 20					

7.4.5 WYE

Table 24 defines the common data class “WYE”. This class is a collection of simultaneous measurements of values in a three phase system that represent phase to ground values.

Table 24 – WYE

WYE class					
Attribute Name	**Attribute Type**	**FC**	**TrgOp**	**Value/Value Range**	**M/O/C**
DataName	Inherited from Data Class (see IEC 61850-7-2)				
Data					
phsA	CMV				GC_1
phsB	CMV				GC_1
phsC	CMV				GC_1
neut	CMV				GC_1
net	CMV				GC_1
res	CMV				GC_1
DataAttribute					
configuration, description and extension					
angRef	ENUMERATED	CF		Va | Vb | Vc | Aa | Ab | Ac | Vab | Vbc | Vca | Vother | Aother	O
d	VISIBLE STRING255	DC		Text	O
dU	UNICODE STRING255	DC			O
cdcNs	VISIBLE STRING255	EX			AC_DLNDA_M
cdcName	VISIBLE STRING255	EX			AC_DLNDA_M
dataNs	VISIBLE STRING255	EX			AC_DLN_M
Services					
As defined in Table 20					

With regard to data attributes of the CDC CMV, the following additional specifications apply:

- The data attribute angRef of phsA, phsB, phsC, neut, net and res shall not be used. Instead, the attribute angRef defined with the CDC WYE shall be used.
- The values of phsA.t, phsB.t, phsC.t, neut.t, net.t and res.t are identical. They specify the time at which the values for phsA, phsB, phsC and neut have been simultaneously acquired or determined.

7.4.6 Delta (DEL)

Table 25 defines the common data class “delta”. This class is a collection of measurements of values in a three phase system that represent phase to phase values.

Table 25 – Delta

DEL class					
Attribute Name	**Attribute Type**	**FC**	**TrgOp**	**Value/Value Range**	**M/O/C**
DataName	Inherited from Data Class (see IEC 61850-7-2)				
Data					
phsAB	CMV				GC_1
phsBC	CMV				GC_1
phsCA	CMV				GC_1
DataAttribute					
configuration, description and extension					
angRef	ENUMERATED	CF		Va | Vb | Vc | Aa | Ab | Ac | Vab | Vbc | Vca | Vother | Aother	O
d	VISIBLE STRING255	DC		Text	O
dU	UNICODE STRING255	DC			O
cdcNs	VISIBLE STRING255	EX			AC_DLNDA_M
cdcName	VISIBLE STRING255	EX			AC_DLNDA_M
dataNs	VISIBLE STRING255	EX			AC_DLN_M
Services					
As defined in Table 20					

With regard to data attributes of the CDC CMV, the following additional specifications apply:

- The data attribute angRef of phsAB, phsBC and phsCA shall not be used. Instead, the attribute angRef defined with the CDC DEL shall be used.
- The values of phsAB.t, phsBC.t and phsCA.t are identical. They specify the time at which the values for phsAB, phsBC and phsCA have been simultaneously acquired or determined.

7.4.7 Sequence (SEQ)

Table 26 defines the common data class “sequence”. This class is a collection of sequence components of a value.

Table 26 – Sequence

SEQ class					
Attribute Name	**Attribute Type**	**FC**	**TrgOp**	**Value/Value Range**	**M/O/C**
DataName	Inherited from Data Class (see IEC 61850-7-2)				
Data					
c1	CMV				M
c2	CMV				M
c3	CMV				M
DataAttribute					
measured values					
seqT	ENUMERATED	MX		pos-neg-zero | dir-quad-zero	M
configuration, description and extension					
phsRef	ENUMERATED	CF		A | B | C | …	O
d	VISIBLE STRING255	DC		Text	O
dU	UNICODE STRING255	DC			O
cdcNs	VISIBLE STRING255	EX			AC_DLNDA_M
cdcName	VISIBLE STRING255	EX			AC_DLNDA_M
dataNs	VISIBLE STRING255	EX			AC_DLN_M
Services					
As defined in Table 20					

With regard to data attributes of the CDC CMV, the following additional specifications apply:

- The values of c1.t, c2.t and c3.t are identical. They specify the time at which the values for c1, c2 and c3 have been calculated.

7.4.8 Harmonic Value (HMV)

Table 27 defines the common data class for non phase related harmonic values. This class is a collection of values that represent the harmonic or interharmonic content of a process value.

Table 27 – Harmonic value

HMV class					
Attribute Name	**Attribute Type**	**FC**	**TrgOp**	**Value/Value Range**	**M/O/C**
DataName	Inherited from Data Class (see IEC 61850-7-2)				
DataAttribute					
measured values					
basics					
q	Quality	MX	qchg		M
t	TimeStamp	MX			M
Harmonics and interharmonics					
har	ARRAY[0..numHar] OF Vector	MX	dchg, dupd		M
configuration, description and extension					
numHar	INT16U	CF		>1	M
numCycl	INT16U	CF		>0	M
evalTm	INT16U	CF			M
units	Unit	CF		see Annex A	O
smpRate	INT32U	CF			O
frequency	FLOAT32	CF		fundamental frequency	M
hvRef	ENUMERATED	CF		fundamental | rms | absolute	O
rmsTm	INT32U	CF			AC_RMS_M
d	VISIBLE STRING255	DC		Text	O
dU	UNICODE STRING255	DC			O
cdcNs	VISIBLE STRING255	EX			AC_DLNDA_M
cdcName	VISIBLE STRING255	EX			AC_DLNDA_M
dataNs	VISIBLE STRING255	EX			AC_DLN_M
Services					
As defined in Table 20					

NOTE Harmonics for a single circuit have phase angles (optional) but need no reference for the angle (angRef), since by convention the reference is always the fundamental frequency (index 1).

7.4.9 Harmonic value for WYE (HWYE)

Table 28 defines the common data class “harmonic value for WYE”. This class is a collection of simultaneous measurements (or evaluations) of values that represent the harmonic or interharmonic content of a process value in a three phase system with phase to ground values such as current.

Table 28 – Harmonic values for WYE

HWYE class					
Attribute Name	**Attribute Type**	**FC**	**TrgOp**	**Value/Value Range**	**M/O/C**
DataName	Inherited from Data Class (see IEC 61850-7-2)				
DataAttribute					
measured values					
basics					
q	Quality	MX	qchg		M
t	TimeStamp	MX			M
Harmonics and interharmonics					
phsAHar	ARRAY[0..numHar] OF Vector	MX	dchg, dupd		M
phsBHar	ARRAY[0..numHar] OF Vector	MX	dchg, dupd		O
phsCHar	ARRAY[0..numHar] OF Vector	MX	dchg, dupd		O
neutHar	ARRAY[0..numHar] OF Vector	MX	dchg, dupd		O
netHar	ARRAY[0..numHar] OF Vector	MX	dchg, dupd		O
resHar	ARRAY[0..numHar] OF Vector	MX	dchg, dupd		O
configuration, description and extension					
numHar	INT16U	CF		>1	M
numCycl	INT16U	CF		>0	M
evalTm	INT16U	CF			M
units	Unit	CF		see Annex A	O
angRef	ENUMERATED	CF		Va | Vb | Vc | Aa | Ab | Ac | Vab | Vbc | Vca | Vother | Aother	O
smpRate	INT32U	CF			O
frequency	FLOAT32	CF		fundamental frequency	M
hvRef	ENUMERATED	CF		fundamental | rms | absolute	O
rmsTm	INT32U	CF			AC_RMS_M
d	VISIBLE STRING255	DC		Text	O
dU	UNICODE STRING255	DC			O
cdcNs	VISIBLE STRING255	EX			AC_DLNDA_M
cdcName	VISIBLE STRING255	EX			AC_DLNDA_M
dataNs	VISIBLE STRING255	EX			AC_DLN_M
Services					
As defined in Table 20					

7.4.10 Harmonic value for DEL (HDEL)

Table 29 defines the common data class “harmonic value for delta”. This class is a collection of simultaneous measurements (or evaluations) of values that represent the harmonic or interharmonic content of a process value in a three phase system with phase to phase values.

Table 29 – Harmonic values for delta

HDEL class					
Attribute Name	**Attribute Type**	**FC**	**TrgOp**	**Value/Value Range**	**M/O/C**
DataName	Inherited from Data Class (see IEC 61850-7-2)				
DataAttribute					
measured values					
basics					
q	Quality	MX	qchg		M
t	TimeStamp	MX			M
Harmonics and interharmonics					
phsABHar	ARRAY[0..numHar] OF Vector	MX	dchg, dupd		M
phsBCHar	ARRAY[0..numHar] OF Vector	MX	dchg, dupd		O
phsCAHar	ARRAY[0..numHar] OF Vector	MX	dchg, dupd		O
configuration, description and extension					
numHar	INT16U	CF		>1	M
numCycl	INT16U	CF		>0	M
evalTm	INT16U	CF			M
units	Unit	CF		see Annex A	O
angRef	ENUMERATED	CF		Va | Vb | Vc | Aa | Ab | Ac | Vab | Vbc | Vca | Vother | Aother	O
smpRate	INT32U	CF			O
frequency	FLOAT32	CF		fundamental frequency	M
hvRef	ENUMERATED	CF		fundamental | rms | absolute	O
rmsTm	INT32U	CF			AC_RMS_M
d	VISIBLE STRING255	DC		Text	O
dU	UNICODE STRING255	DC			O
cdcNs	VISIBLE STRING255	EX			AC_DLNDA_M
cdcName	VISIBLE STRING255	EX			AC_DLNDA_M
dataNs	VISIBLE STRING255	EX			AC_DLN_M
Services					
As defined in Table 20					

7.5 Common data class specifications for controllable status information

7.5.1 Application of services

Table 30 defines the basic controllable status information template. In particular, it defines the inheritance and specialisation of services defined in IEC 61850-7-2.

Table 30 – Basic controllable status information template

Basic controllable status information template					
Attribute Name	**Attribute Type**	**FC**	**TrgOp**	**Value/Value Range**	**M/O/C**
DataName	Inherited from Data Class (see IEC 61850-7-2)				
DataAttribute					
control and status					
substitution					
configuration, description and extension					
Services (see IEC 61850-7-2)					
The following services are inherited from IEC 61850-7-2. They are specialised by restricting the service to attributes with a functional constraint as specified below.					

Service model of IEC 61850-7-2	**Service**	**Service applies to Attr with FC**	**Remark**
Data model	SetDataValues GetDataValues GetDataDefinition	DC, CF, SV ALL except CO ALL	
Data set model	GetDataSetValues SetDataSetValues	ALL except CO DC, CF, SV	
Reporting model	Report	ALL	as specified within the data set that is used to define the report content
Control model	Select SelectWithValue Cancel Operate CommandTermination Synchrocheck TimeActivatedOperate	CO CO CO CO CO CO CO	

All common data classes for control include the related status information.

7.5.2 Controllable single point (SPC)

Table 31 defines the common data class “controllable single point”.

Table 31 – Controllable single point

SPC class					
Attribute Name	**Attribute Type**	**FC**	**TrgOp**	**Value/Value Range**	**M/O/C**
DataName	Inherited from Data Class (see IEC 61850-7-2)				
DataAttribute					
control and status					
ctlVal	BOOLEAN	CO		off (FALSE) | on (TRUE)	AC_CO_M
operTm	TimeStamp	CO			AC_CO_O
origin	Originator	CO, ST			AC_CO_O
ctlNum	INT8U	CO, ST		0..255	AC_CO_O
stVal	BOOLEAN	ST	dchg	FALSE | TRUE	AC_ST
q	Quality	ST	qchg		AC_ST
t	TimeStamp	ST			AC_ST
stSeld	BOOLEAN	ST	dchg		AC_CO_O
substitution					
subEna	BOOLEAN	SV			PICS_SUBST
subVal	BOOLEAN	SV		FALSE | TRUE	PICS_SUBST
subQ	Quality	SV			PICS_SUBST
subID	VISIBLE STRING64	SV			PICS_SUBST
configuration, description and extension					
pulseConfig	PulseConfig	CF			AC_CO_O
ctlModel	ENUMERATED	CF		status-only | direct-with-normal-security | sbo-with-normal-security | direct-with-enhanced-security | sbo-with-enhanced-security	M
sboTimeout	INT32U	CF			AC_CO_O
sboClass	ENUMERATED	CF		operate-once | operate-many	AC_CO_O
d	VISIBLE STRING255	DC		Text	O
dU	UNICODE STRING255	DC			O
cdcNs	VISIBLE STRING255	EX			AC_DLNDA_M
cdcName	VISIBLE STRING255	EX			AC_DLNDA_M
dataNs	VISIBLE STRING255	EX			AC_DLN_M
Services					
As defined in Table 30					

7.5.3 Controllable double point (DPC)

Table 32 defines the common data class “controllable double point”.

Table 32 – Controllable double point

DPC class					
Attribute Name	**Attribute Type**	**FC**	**TrgOp**	**Value/Value Range**	**M/O/C**
DataName	Inherited from Data Class (see IEC 61850-7-2)				
DataAttribute					
control and status					
ctlVal	BOOLEAN	CO		off (FALSE) | on (TRUE)	AC_CO_M
operTm	TimeStamp	CO			AC_CO_O
origin	Originator	CO, ST			AC_CO_O
ctlNum	INT8U	CO, ST		0..255	AC_CO_O
stVal	CODED ENUM	ST	dchg	intermediate-state | off | on | bad-state	M
q	Quality	ST	qchg		M
t	TimeStamp	ST			M
stSeld	BOOLEAN	ST	dchg		AC_CO_O
substitution					
subEna	BOOLEAN	SV			PICS_SUBST
subVal	CODED ENUM	SV		intermediate-state | off | on | bad-state	PICS_SUBST
subQ	Quality	SV			PICS_SUBST
subID	VISIBLE STRING64	SV			PICS_SUBST
configuration, description and extension					
pulseConfig	PulseConfig	CF			AC_CO_O
ctlModel	ENUMERATED	CF		status-only | direct-with-normal-security | sbo-with-normal-security | direct-with-enhanced-security | sbo-with-enhanced-security	M
sboTimeout	INT32U	CF			AC_CO_O
sboClass	ENUMERATED	CF		operate-once | operate-many	AC_CO_O
d	VISIBLE STRING255	DC		Text	O
dU	UNICODE STRING255	DC			O
cdcNs	VISIBLE STRING255	EX			AC_DLNDA_M
cdcName	VISIBLE STRING255	EX			AC_DLNDA_M
dataNs	VISIBLE STRING255	EX			AC_DLN_M
Services					
As defined in Table 30					

7.5.4 Controllable integer status (INC)

Table 33 defines the common data class “controllable integer status”.

Table 33 – Controllable integer status

INC class					
Attribute Name	**Attribute Type**	**FC**	**TrgOp**	**Value/Value Range**	**M/O/C**
DataName	Inherited from Data Class (see IEC 61850-7-2)				
DataAttribute					
control and status					
ctlVal	INT32	CO			AC_CO_M
operTm	TimeStamp	CO			AC_CO_O
origin	Originator	CO, ST			AC_CO_O
ctlNum	INT8U	CO, ST		0..255	AC_CO_O
stVal	INT32	ST	dchg		M
q	Quality	ST	qchg		M
t	TimeStamp	ST			M
stSeld	BOOLEAN	ST	dchg		AC_CO_O
substitution					
subEna	BOOLEAN	SV			PICS_SUBST
subVal	INT32	SV			PICS_SUBST
subQ	Quality	SV			PICS_SUBST
subID	VISIBLE STRING64	SV			PICS_SUBST
configuration, description and extension					
ctlModel	ENUMERATED	CF		status-only | direct-with-normal-security | sbo-with-normal-security | direct-with-enhanced-security | sbo-with-enhanced-security	M
sboTimeout	INT32U	CF			AC_CO_O
sboClass	ENUMERATED	CF		operate-once | operate-many	AC_CO_O
minVal	INT32	CF			O
maxVal	INT32	CF			O
stepSize	INT32U	CF		1 … (maxVal – minVal)	O
d	VISIBLE STRING255	DC		Text	O
dU	UNICODE STRING255	DC			O
cdcNs	VISIBLE STRING255	EX			AC_DLNDA_M
cdcName	VISIBLE STRING255	EX			AC_DLNDA_M
dataNs	VISIBLE STRING255	EX			AC_DLN_M
Services					
As defined in Table 30					

7.5.5 Binary controlled step position information (BSC)

Table 34 defines the common data class “binary controlled step position information”.

Table 34 – Binary controlled step position information

BSC class					
Attribute Name	**Attribute Type**	**FC**	**TrgOp**	**Value/Value Range**	**M/O/C**
DataName	Inherited from Data Class (see IEC 61850-7-2)				
DataAttribute					
control and status					
ctlVal	CODED ENUM	CO		stop | lower | higher | reserved	AC_CO_M
operTm	TimeStamp	CO			AC_CO_O
origin	Originator	CO, ST			AC_CO_O
ctlNum	INT8U	CO, ST		0..255	AC_CO_O
valWTr	ValWithTrans	ST	dchg		AC_ST
q	Quality	ST	qchg		AC_ST
t	TimeStamp	ST			AC_ST
stSeld	BOOLEAN	ST	dchg		AC_CO_O
substitution					
subEna	BOOLEAN	SV			PICS_SUBST
subVal	ValWithTrans	SV			PICS_SUBST
subQ	Quality	SV			PICS_SUBST
subID	VISIBLE STRING64	SV			PICS_SUBST
configuration, description and extension					
persistent	BOOLEAN	CF			M
ctlModel	ENUMERATED	CF		status-only | direct-with-normal-security | sbo-with-normal-security | direct-with-enhanced-security | sbo-with-enhanced-security	M
sboTimeout	INT32U	CF			AC_CO_O
sboClass	ENUMERATED	CF		operate-once | operate-many	AC_CO_O
minVal	INT8	CF			O
maxVal	INT8	CF			O
stepSize	INT8U	CF		1 … (maxVal – minVal)	O
d	VISIBLE STRING255	DC		Text	O
dU	UNICODE STRING255	DC			O
cdcNs	VISIBLE STRING255	EX			AC_DLNDA_M
cdcName	VISIBLE STRING255	EX			AC_DLNDA_M
dataNs	VISIBLE STRING255	EX			AC_DLN_M
Services					
As defined in Table 30					

7.5.6 Integer controlled step position information (ISC)

Table 35 defines the common data class “integer controlled step position information”.

Table 35 – Integer controlled step position information

ISC class					
Attribute Name	**Attribute Type**	**FC**	**TrgOp**	**Value/Value Range**	**M/O/C**
DataName	Inherited from Data Class (see IEC 61850-7-2)				
DataAttribute					
control and status					
ctlVal	INT8	CO		–64 … 63	AC_CO_M
operTm	TimeStamp	CO			AC_CO_O
origin	Originator	CO, ST			AC_CO_O
ctlNum	INT8U	CO, ST		0..255	AC_CO_O
valWTr	ValWithTrans	ST	dchg		AC_ST
q	Quality	ST	qchg		AC_ST
t	TimeStamp	ST			AC_ST
stSeld	BOOLEAN	ST	dchg		AC_CO_O
substitution					
subEna	BOOLEAN	SV			PICS_SUBST
subVal	ValWithTrans	SV			PICS_SUBST
subQ	Quality	SV			PICS_SUBST
subID	VISIBLE STRING64	SV			PICS_SUBST
configuration, description and extension					
ctlModel	ENUMERATED	CF		status-only | direct-with-normal-security | sbo-with-normal-security | direct-with-enhanced-security | sbo-with-enhanced-security	M
sboTimeout	INT32U	CF			AC_CO_O
sboClass	ENUMERATED	CF		operate-once | operate-many	AC_CO_O
minVal	INT8	CF			O
maxVal	INT8	CF			O
stepSize	INT8U	CF		1 … (maxVal – minVal)	O
d	VISIBLE STRING255	DC		Text	O
dU	UNICODE STRING255	DC			O
cdcNs	VISIBLE STRING255	EX			AC_DLNDA_M
cdcName	VISIBLE STRING255	EX			AC_DLNDA_M
dataNs	VISIBLE STRING255	EX			AC_DLN_M
Services					
As defined in Table 30					

7.6 Common data class specifications for controllable analogue information

7.6.1 Application of services

Table 36 defines the basic controllable analogue information template. In particular, it defines the inheritance and specialisation of services defined in IEC 61850-7-2.

Table 36 – Basic controllable analogue information template

<table>
<tr><th colspan="6">Basic controllable analogue information template</th></tr>
<tr><th>Attribute Name</th><th>Attribute Type</th><th>FC</th><th>TrgOp</th><th>Value/Value Range</th><th>M/O/C</th></tr>
<tr><td>DataName</td><td colspan="4">Inherited from Data Class (see IEC 61850-7-2)</td><td></td></tr>
<tr><td colspan="6">DataAttribute</td></tr>
<tr><td colspan="6">setpoint and measured values</td></tr>
<tr><td colspan="6">configuration, description and extension</td></tr>
<tr><td colspan="6">Services (see IEC 61850-7-2)</td></tr>
<tr><td colspan="6">The following services are inherited from IEC 61850-7-2. They are specialised by restricting the service to attributes with a functional constraint as specified below.</td></tr>
<tr><td colspan="2">Service model of IEC 61850-7-2</td><td colspan="2">Service</td><td>Service applies to Attr with FC</td><td>Remark</td></tr>
<tr><td colspan="2">Data model</td><td colspan="2">SetDataValues
GetDataValues
GetDataDefinition</td><td>DC, CF
ALL
ALL</td><td></td></tr>
<tr><td colspan="2">Data set model</td><td colspan="2">GetDataSetValues
SetDataSetValues</td><td>ALL
DC, CF</td><td></td></tr>
<tr><td colspan="2">Reporting model</td><td colspan="2">Report</td><td>ALL</td><td>as specified within the data set that is used to define the report content</td></tr>
<tr><td colspan="2">Control model</td><td colspan="2">Operate
TimeActivatedOperate</td><td>SP
SP</td><td></td></tr>
</table>

All common data classes for set point shall include the related analogue information.

7.6.2 Controllable analogue set point information (APC)

Table 37 defines the common data class “controllable analogue set point information”.

Table 37 – Controllable analogue set point information

APC class					
Attribute Name	**Attribute Type**	**FC**	**TrgOp**	**Value/Value Range**	**M/O/C**
DataName	Inherited from Data Class (see IEC 61850-7-2)				
DataAttribute					
setpoint and measured values					
setMag	AnalogueValue	SP, MX	dchg		M
origin	Originator	SP, MX			O
operTm	TimeStamp	SP			O
q	Quality	ST	qchg		M
t	TimeStamp	ST			M
configuration, description and extension					
ctlModel	ENUMERATED	CF		direct-with-normal-security	M
units	Unit	CF		see Annex A	O
sVC	ScaledValueConfig	CF			AC_SCAV
minVal	AnalogueValue	CF			O
maxVal	AnalogueValue	CF			O
stepSize	AnalogueValue	CF		1 … (maxVal – minVal)	O
d	VISIBLE STRING255	DC		Text	O
dU	UNICODE STRING255	DC			O
cdcNs	VISIBLE STRING255	EX			AC_DLNDA_M
cdcName	VISIBLE STRING255	EX			AC_DLNDA_M
dataNs	VISIBLE STRING255	EX			AC_DLN_M
Services					
As defined in Table 36					

7.7 Common data class specifications for status settings

7.7.1 Application of services

Table 38 defines the basic controllable status settings template. In particular, it defines the inheritance and specialisation of services defined in IEC 61850-7-2.

Table 38 – Basic status setting template

Basic controllable status information template					
Attribute Name	**Attribute Type**	**FC**	**TrgOp**	**Value/Value Range**	**M/O/C**
DataName	Inherited from Data Class (see IEC 61850-7-2)				
DataAttribute					
setting					
configuration, description and extension					
Services (see IEC 61850-7-2)					
The following services are inherited from IEC 61850-7-2. They are specialised by restricting the service to attributes with a functional constraint as specified below.					

Service model of IEC 61850-7-2	**Service**	**Service applies to Attr with FC**	**Remark**
Data model	SetDataValues GetDataValues GetDataDefinition	DC, CF ALL ALL	
Data set model	GetDataSetValues SetDataSetValues	ALL DC, CF	
Reporting model	Report	ALL	as specified within the data set that is used to define the report content
Setting group control model	SetEditSGValues GetSGValues	SE SE, SG	

All common data classes for control include the related status information.

7.7.2 Single point setting (SPG)

Table 39 defines the common data class “single point setting”.

Table 39 – Single point setting

SPG class					
Attribute Name	**Attribute Type**	**FC**	**TrgOp**	**Value/Value Range**	**M/O/C**
DataName	Inherited from Data Class (see IEC 61850-7-2)				
DataAttribute					
setting					
setVal	BOOLEAN	SP		off (FALSE) | on (TRUE)	AC_NSG_M
setVal	BOOLEAN	SG, SE		off (FALSE) | on (TRUE)	AC_SG_M
configuration, description and extension					
d	VISIBLE STRING255	DC		Text	O
dU	UNICODE STRING255	DC			O
cdcNs	VISIBLE STRING255	EX			AC_DLNDA_M
cdcName	VISIBLE STRING255	EX			AC_DLNDA_M
dataNs	VISIBLE STRING255	EX			AC_DLN_M
Services					
As defined in Table 38					

7.7.3 Integer status setting (ING)

Table 40 defines the common data class “integer status setting”.

Table 40 – Integer status setting

ING class					
Attribute Name	**Attribute Type**	**FC**	**TrgOp**	**Value/Value Range**	**M/O/C**
DataName	Inherited from Data Class (see IEC 61850-7-2)				
DataAttribute					
setting					
setVal	INT32	SP			AC_NSG_M
setVal	INT32	SG, SE			AC_SG_M
configuration, description and extension					
minVal	INT32	CF			O
maxVal	INT32	CF			O
stepSize	INT32U	CF		1 ... (maxVal – minVal)	O
d	VISIBLE STRING255	DC		Text	O
dU	UNICODE STRING255	DC			O
cdcNs	VISIBLE STRING255	EX			AC_DLNDA_M
cdcName	VISIBLE STRING255	EX			AC_DLNDA_M
dataNs	VISIBLE STRING255	EX			AC_DLN_M
Services					
As defined in Table 38					

7.8 Common data class specifications for analogue settings

7.8.1 Application of services

Table 41 defines the basic controllable analogue information template. In particular, it defines the inheritance and specialisation of services defined in IEC 61850-7-2.

Table 41 – Basic analogue setting template

Basic controllable analogue information template					
Attribute Name	**Attribute Type**	**FC**	**TrgOp**	**Value/Value Range**	**M/O/C**
DataName	Inherited from Data Class (see IEC 61850-7-2)				
DataAttribute					
setting					
configuration, description and extension					
Services (see IEC 61850-7-2)					
The following services are inherited from IEC 61850-7-2. They are specialised by restricting the service to attributes with a functional constraint as specified below.					

Service model of IEC 61850-7-2	**Service**	**Service applies to Attr with FC**	**Remark**
Data model	SetDataValues GetDataValues GetDataDefinition	DC, CF ALL ALL	
Data set model	GetDataSetValues SetDataSetValues	ALL DC, CF	
Reporting model	Report	ALL	as specified within the data set that is used to define the report content
Setting group control model	SetEditSGValues GetSGValues	SE SE, SG	

All common data classes for set point shall include the related analogue information.

7.8.2 Analogue setting (ASG)

Table 42 defines the common data class “analogue setting”.

Table 42 – Analogue setting

ASG class					
Attribute Name	**Attribute Type**	**FC**	**TrgOp**	**Value/Value Range**	**M/O/C**
DataName	Inherited from Data Class (see IEC 61850-7-2)				
DataAttributS					
setting					
setMag	AnalogueValue	SP			AC_NSG_M
setMag	AnalogueValue	SG, SE			AC_SG_M
configuration, description and extension					
units	Unit	CF		see Annex A	O
sVC	ScaledValueConfig	CF			AC_SCAV
minVal	AnalogueValue	CF			O
maxVal	AnalogueValue	CF			O
stepSize	AnalogueValue	CF		1 … (maxVal – minVal)	O
d	VISIBLE STRING255	DC		Text	O
dU	UNICODE STRING255	DC			O
cdcNs	VISIBLE STRING255	EX			AC_DLNDA_M
cdcName	VISIBLE STRING255	EX			AC_DLNDA_M
dataNs	VISIBLE STRING255	EX			AC_DLN_M
Services					
As defined in Table 41					

7.8.3 Setting curve (CURVE)

Table 43 defines the common data class “setting curve”.

Table 43 – Setting curve

CURVE class					
Attribute Name	**Attribute Type**	**FC**	**TrgOp**	**Value/Value Range**	**M/O/C**
DataName	Inherited from Data Class (see IEC 61850-7-2)				
DataAttribute					
setting					
setCharact	ENUMERATED	SP			AC_NSG_M
setParA	FLOAT32	SP			AC_NSG_O
setParB	FLOAT32	SP			AC_NSG_O
setParC	FLOAT32	SP			AC_NSG_O
setParD	FLOAT32	SP			AC_NSG_O
setParE	FLOAT32	SP			AC_NSG_O
setParF	FLOAT32	SP			AC_NSG_O
setCharact	ENUMERATED	SG, SE			AC_SG_M
setParA	FLOAT32	SG, SE			AC_SG_O
setParB	FLOAT32	SG, SE			AC_SG_O
setParC	FLOAT32	SG, SE			AC_SG_O
setParD	FLOAT32	SG, SE			AC_SG_O
setParE	FLOAT32	SG, SE			AC_SG_O
setParF	FLOAT32	SG, SE			AC_SG_O
configuration, description and extension					
d	VISIBLE STRING255	DC		Text	O
dU	UNICODE STRING255	DC			O
cdcNs	VISIBLE STRING255	EX			AC_DLNDA_M
cdcName	VISIBLE STRING255	EX			AC_DLNDA_M
dataNs	VISIBLE STRING255	EX			AC_DLN_M
Services					
As defined in Table 41					

Data of this common data class shall be used to describe setting curves used in protection equipment. The resulting curve may be read from the device using a dedicated data of the CDC CSD as defined in 7.9.4.

7.9 Common data class specifications for description information

7.9.1 Basic description information template

Table 44 defines the basic description information template. In particular, it defines the inheritance and specialisation of services defined in IEC 61850-7-2.

Table 44 – Basic description information template

Basic description information template					
Attribute Name	**Attribute Type**	**FC**	**TrgOp**	**Value/Value Range**	**M/O/C**
DataName	Inherited from Data Class (see IEC 61850-7-2)				
DataAttribute					
configuration, description and extension					
Services (see IEC 61850-7-2)					
The following services are inherited from IEC 61850-7-2. They are specialised by restricting the service to attributes with a functional constraint as specified below.					

Service model of IEC 61850-7-2	**Service**	**Service applies to Attr with FC**	**Remark**
Data model	SetDataValues GetDataValues GetDataDefinition	DC ALL ALL	
Data set model	GetDataSetValues SetDataSetValues	ALL DC	
Reporting model	Report	ALL	as specified within the data set that is used to define the report content

7.9.2 Device name plate (DPL)

Table 45 defines the common data class “device name plate”. Data of this common data class are used to identify entities like primary equipment or physical devices.

Table 45 – Device name plate common data class specification

DPL class					
Attribute Name	**Attribute Type**	**FC**	**TrgOp**	**Value/Value Range**	**M/O/C**
DataName	Inherited from Data Class (see IEC 61850-7-2)				
DataAttribute					
configuration, description and extension					
vendor	VISIBLE STRING255	DC			M
hwRev	VISIBLE STRING255	DC			O
swRev	VISIBLE STRING255	DC			O
serNum	VISIBLE STRING255	DC			O
model	VISIBLE STRING255	DC			O
location	VISIBLE STRING255	DC			O
cdcNs	VISIBLE STRING255	EX			AC_DLNDA_M
cdcName	VISIBLE STRING255	EX			AC_DLNDA_M
dataNs	VISIBLE STRING255	EX			AC_DLN_M
Services					
As defined in Table 44					

7.9.3 Logical node name plate (LPL)

Table 46 defines the common data class “logical node name plate”. Data of this common data class are used to describe logical nodes.

Table 46 – Logical node name plate common data class specification

LPL class					
Attribute Name	**Attribute Type**	**FC**	**TrgOp**	**Value/Value Range**	**M/O/C**
DataName	Inherited from Data Class (see IEC 61850-7-2)				
DataAttribute					
configuration, description and extension					
vendor	VISIBLE STRING255	DC			M
swRev	VISIBLE STRING255	DC			M
d	VISIBLE STRING255	DC			M
dU	UNICODE STRING255	DC			O
configRev	VISIBLE STRING255	DC			AC_LN0_M
ldNs	VISIBLE STRING255	EX		shall be included in **LLN0** only; for example "IEC 61850-7-4:2003"	AC_LN0_M
lnNs	VISIBLE STRING255	EX			AC_DLD_M
cdcNs	VISIBLE STRING255	EX			AC_DLNDA_M
cdcName	VISIBLE STRING255	EX			AC_DLNDA_M
dataNs	VISIBLE STRING255	EX			AC_DLN_M
Services					
As defined in Table 44					

7.9.4 Curve shape description

Table 47 defines the common data class "curve shape description". Data of this common data class are used to read the shape of a curve as for example used with protection settings.

Table 47 – Curve shape description common data class specification

CSD class					
Attribute Name	**Attribute Type**	**FC**	**TrgOp**	**Value/Value Range**	**M/O/C**
DataName	Inherited from Data Class (see IEC 61850-7-2)				
DataAttribute					
configuration, description and extension					
xUnit	Unit	DC			M
xD	VISIBLE STRING255	DC			M
yUnit	Unit	DC			M
yD	VISIBLE STRING255	DC			M
numPts	INT16U	DC			M
crvPts	ARRAY[1..numPt] OF				M
xVal	FLOAT32	DC			
xVal	FLOAT32	DC			
d	VISIBLE STRING255	DC			M
dU	UNICODE STRING255	DC			O
cdcNs	VISIBLE STRING255	EX			AC_DLNDA_M
cdcName	VISIBLE STRING255	EX			AC_DLNDA_M
dataNs	VISIBLE STRING255	EX			AC_DLN_M
Services					
As defined in Table 44					

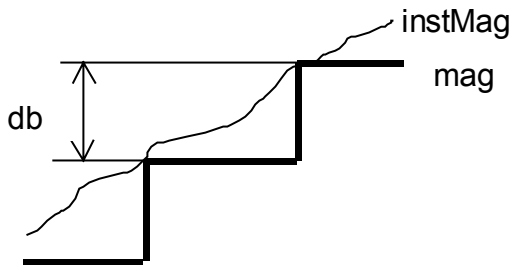
8 Data attribute semantic

The data attributes used in Clause 6 and 7 shall have semantics as defined in Table 48.

Table 48 – Semantics of data attributes

<table>
<tr><th>Data attribute name</th><th>Semantics</th></tr>
<tr><td>actVal</td><td>Binary counter status represented as an integer value.</td></tr>
<tr><td>addInfo</td><td>Additional information that may give further clarification as to the last detected violation.</td></tr>
<tr><td>addr</td><td>Address of the remote source that last caused the count to be incremented.
NOTE 1 The kind of address stored (application address, IP address, link address, ...) is whatever the server can detect. This may depend on the specific mapping.</td></tr>
<tr><td>angRef</td><td>Angle reference. Indicates the quantity that is used as reference for the phase angle. For the indicated quantity, the fundamental frequency (index = 1) is used as reference by convention.</td></tr>
<tr><td>angSVC</td><td>Scaled value configuration for angles. Shall be used to configure the scaled value representation of the angle in a vector.</td></tr>
<tr><td>c1</td><td>Sequence component 1. For the semantic meaning see seqT.</td></tr>
<tr><td>c2</td><td>Sequence component 2. For the semantic meaning see seqT.</td></tr>
<tr><td>c3</td><td>Sequence component 3. For the semantic meaning see seqT.</td></tr>
<tr><td>cdcName</td><td>Name of the common data class.</td></tr>
<tr><td>cdcNs</td><td>Common data class name space. The cdcNs shall unambiguously reference the specification in which the respective CDC is defined.
For devices conforming to IEC 61850-7-3:2003 the cdcNs shall be “IEC 61850-7-3:2003“.</td></tr>
<tr><td>cnt</td><td>Counter value of security violations.</td></tr>
<tr><td>configRev</td><td>Uniquely identifies the configuration of a logical device instance. The semantic and in particular the conditions for changing configRev are user defined.</td></tr>
<tr><td>crvPts</td><td>The array with the points specifying a curve shape</td></tr>
<tr><td>ctlModel</td><td>Specifies the control model of IEC 61850-7-2 that corresponds to the behaviour of the data.
<table>
<tr><th>Value</th><th>Explanation</th></tr>
<tr><td>status-only</td><td>The object is not controllable, only the services that apply to a status object are supported. The attribute ctlVal does not exist.</td></tr>
<tr><td>direct-with-normal-security</td><td>Direct control with normal security according to IEC 61850-7-2.</td></tr>
<tr><td>sbo-with-normal-security</td><td>SBO control with normal security according to IEC 61850-7-2.</td></tr>
<tr><td>direct-with-enhanced-security</td><td>Direct control with enhanced security according to IEC 61850-7-2.</td></tr>
<tr><td>sbo-with-enhanced-security</td><td>SBO control with enhanced security according to IEC 61850-7-2.</td></tr>
</table>
NOTE 2 If a data instance of a control class has no status information associated, then the attribute stVal does not exist. In that case, the value range for ctlModel is restricted to direct-with-normal-security and sbo-with-normal-security.</td></tr>
<tr><td>ctlNum</td><td>If the change of the status was caused by a control, the content shall show the control sequence number of the control service. All service primitives belonging to one control sequence shall be identified by the same control sequence number. The use of ctlNum is an issue of the client. The only thing that the server shall do with ctlNum is to include it in the responses to the control model and in the reports about a status change that is caused by a command.</td></tr>
<tr><td>ctlVal</td><td>Determines the control activity.
For the CDC INC, the integer value 0 shall be transmitted to reset the value.
For the CDC BSC, if the data attribute persistent is FALSE, higher and lower refer to one step in the data attribute posVal of the data attribute valWTr.
For the CDC ISC, the INTEGER value refers always to a dedicated position in the data attribute posVal of the data attribute valWTr which has to be reached directly.</td></tr>
</table>

Data attribute name	Semantics
cVal	Deadbanded complex value. Based on a deadband calculation from instCVal. The deadband calculation is done both on instCVal.mag as well as on instCVal.ang independently. For details on deadband calculation, see mag.
d	Textual description of the data. In case of the common data class LPL, the description refers to the logical node.
dataNs	Data name space. The dataNs shall unambiguously reference the specification in which the respective DATA class is defined. For devices conforming to IEC 61850-7-4:2003 the dataNs shall be "IEC 61850-7-4:2003". NOTE 3 The dataNs comprises the underlying class definition referenced in the dataNs (for example, IEC 61850-7-3 which is referenced in IEC 61850-7-4 for the CDCs used) if the underlying name space (cdcNs) is not included exclusively.
db	Deadband. Shall represent a configuration parameter used to calculate all deadbanded attributes (for example mag attribute in the CDC MV). The value shall represent the percentage of difference between max and min in units of 0,001 %. NOTE 4 If an integral calculation is used to determine the deadbanded value, the value shall be represented as 0,001 % s.
dirGeneral	General direction of the fault. If the faults of individual phases have different directions, this attribute shall be set to both.
dirNeut	Direction of the fault for neut.
dirPhsA	Direction of the fault for phase A.
dirPhsB	Direction of the fault for phase B.
dirPhsC	Direction of the fault for phase C.
dU	Textual description of the data using unicode characters. For further details, see d.
evalTm	Time window applied to interharmonic calculations. The value shall be represented in ms. For further details, see har.
frEna	BOOLEAN value, which controls the freeze, process. If TRUE, freezing shall occur as specified in strTm, frPd and frRs. If FALSE, no freezing shall occur.
frequency	Nominal frequency of the power system or some other fundamental frequency in Hz.
frPd	Time interval in ms between freeze operations. If frPd is 0, only a single freeze is performed at the time indicated in strTm.
frRs	Indicates that counter is to be automatically reset to zero after each freezing process.
frTm	Time of the last counter freeze.
frVal	Frozen binary counter status represented as an integer value.
general	Trip or start has happened. The attribute shall also be set if not all phases have a fault condition.
har	This array shall contain the harmonic and subharmonic or the interharmonic values. **harmonic and subharmonic values** (evalTm equal to the period of the power frequency) The first array element shall contain the dc components, the further array elements shall contain the values for the harmonics 1 .. numHar. If numCycl is larger than one, then the array shall contain both harmonics and subharmonics and their multiples. In that case, sequence entries with the number $n \times 2^{numCycl-1}$ are harmonics; all other ones are subharmonics or multiple of subharmonics. **interharmonic values** (evalTm not equal to the period of the power frequency) The first array element shall contain the dc components, the further array elements shall contain the values for the harmonics 1 .. numHar.
hvRef	Specifies the reference type (i.e. ratio of harmonic to fundamental, to RMS or to absolute), which the data attribute mag of the data attribute type Vector contain.
hwRev	HW-revision.
instCVal	Instant value of a vector type value.

Data attribute name	Semantics
instMag	Magnitude of a the instantaneous value of a measured value or harmonic value.
ldNs	Logical device name space. The ldNs shall unambiguously reference the specification in which the classes (used in the specification of a LOGICAL-DEVICE) are defined. For devices conforming to IEC 61850-7-4:2003 the ldNs shall be “IEC 61850-7-4:2003“. NOTE 5 The ldNs comprises all underlying class definitions referenced in the ldNs (for example, IEC 61850-7-3 which is referenced in IEC 61850-7-4 for the CDCs used) if the underlying name spaces (lnNs, dataNs, and cdcNs) are not included exclusively.
lnNs	Logical node name space. The lnNs shall unambiguously reference the specification in which the respective LN class is defined. For devices conforming to IEC 61850-7-4:2002 the lnNs shall be "IEC 61850-7-4:2002“. NOTE 6 The lnNs comprises all underlying class definitions referenced in the lnNs (for example, IEC 61850-7-3 which is referenced in IEC 61850-7-4 for the CDCs used) if the underlying name spaces (dataNs and cdcNs) are not included exclusively.
location	Location, where the equipment is installed.
mag	Deadbanded value. Shall be based on a dead band calculation from instMag as illustrated below. The value of mag shall be updated to the current value of instMag when the value has changed according the configuration parameter db.  NOTE 7 The figure above is an example. There may be other algorithms providing a comparable result; for example as an alternate solution, the dead band calculation may use the integral of the change of instMag. The algorithm used is a local issue. NOTE 8 This value mag is typically used to create reports for analogue values. Such a report sent "by exception" is not comparable to the transfer of sampled measured values as supported by the CDC SAV.
magSVC	Scaled value configuration for magnitude. Shall be used to configure the scaled value representation of the magnitude in a vector.
max	Maximum process measurement for which values of *i* or *f* are considered within process limits. If the value is higher, q shall be set accordingly (validity = questionable, detailQual = outOfRange).
maxVal	Defines together with minVal the setting range for ctlVal (CDC INC, BSC, ISC), setVal (CDC ING) or setMag (CDC APC, ASG).
min	Minimum process measurement for which values of *i* or *f* are considered within process limits. If the value is lower, q shall be set accordingly (validity = questionable, detailQual = outOfRange).
minVal	Defines together with maxVal the setting range for ctlVal (CDC INC, BSC, ISC), setVal (CDC ING) or setMag (CDC APC, ASG).
model	Vendor specific product name.
net	Net current. Net current is the algebraic sum of the instantaneous values of currents flowing through all live conductors (sum over phase currents) and neutral of a circuit at a point of the electrical installation.
netHar	This array shall contain the harmonic and subharmonics or interharmonic values related to net current. For further details see Har.
neut (WYE)	Value of phase neutral. For further details see phsA (WYE).
neut (ACT, ACD)	Start event with earth current.

Data attribute name	Semantics
neutHar	This array shall contain the harmonic and subharmonics or interharmonic values related to neutral. For further details see Har.
numCycl	Number of cycles of power frequency, which are used for harmonic, subharmonic and interharmonic calculation. For further details see har.
numHar	Number of harmonic and subharmonics or interharmonic values that are to be returned as the value attribute. The range of the value shall be greater than 0. The value 0 shall refer to the dc component. The maximal value for numHar may be calculated as follows: $numHar = \frac{1}{2} \times smpRate \times frequency \times evalTim \times 2^{numCycl-1} + 1$
numPts	Number of points used to define a curve.
operTm (control classes)	If the service TimeActivatedOperate is performed, then this attribute shall specify the absolute time when the command shall be executed.
operTm (ACT)	Operation Time. Is used for point on wave switching.
origin	Contains information related to the originator of the last change of the controllable value of the data.
persistent	Configures the control output. If set to FALSE, the **operate** service results in the change of exactly one step higher or lower as defined with ctlVal. If set to TRUE, the **operate** service initiates the persistent activation of the output. The output shall be deactivated by an operate service with the value stop or by a local timeout. A client may repeat sending the operate service in order to retrigger the output.
phsA (WYE)	Value of phase A. In the WYE class, values for phsA, phsB, phsC neut, net and res have been simultaneously acquired or determined. It shall be assumed that any jitter between the acquisition times dedicated for phsA, phsB, phsC neut, net and res is neglectable. The jitter for simultaneity shall be as indicated in the time quality field.
phsA (ACT, ACD)	Trip or start event of phase A.
phsAB	Value of phase A to phase B measurement. In the DEL class, values for phsAB, phsBC and phsCA have been simultaneously acquired or determined. It shall be assumed that any jitter between the acquisition times dedicated for phsAB, phsBC and phsCA is neglectable. The jitter for simultaneity shall be as indicated in the time quality field.
phsABHar	This array shall contain the harmonic and subharmonics or interharmonic values related to phase A to phase B. For further details see Har.
phsAHar	This array shall contain the harmonic and subharmonics or interharmonic values related to phase A. For further details see Har.
phsB (WYE)	Value of phase B. For further details see phsA (WYE).
phsB (ACT, ACD)	Trip or start event of phase B.
phsBC	Value of phase B to phase C measurement. For further details see phsAB.
phsBCHar	This array shall contain the harmonic and subharmonics or interharmonic values related to phase B to phase C. For further details see Har.
phsBHar	This array shall contain the harmonic and subharmonics or interharmonic values related to phase B. For further details see Har.
phsC (WYE)	Value of phase C. For further details see phsA (WYE).
phsC (ACT, ACD)	Trip or start event of phase C.
phsCA	Value of phase C to phase A measurement. For further details see phsAB.
phsCAHar	This array shall contain the harmonic and subharmonics or interharmonic values related to phase C to phase A. For further details see Har.
phsCHar	This array shall contain the harmonic and subharmonics or interharmonic values related to phase C. For further details see Har.
phsRef	Indicates which phase has been used as reference for the transformation of phase values to sequence values.

<table>
<tr><th>Data attribute name</th><th>Semantics</th></tr>
<tr><td>pulseConfig</td><td>Used to configure the output pulse generated with the command if applicable.</td></tr>
<tr><td>pulsQty</td><td>Magnitude of the counted value per count. actVal/frVal and pulsQty are used to calculate the value:

value = actVal × pulsQty
value = frVal × pulsQty</td></tr>
<tr><td>q</td><td>Quality of the attribute(s) representing the value of the data. For the different CDCs q applies to the following data attributes:
<table>
<tr><th>CDC</th><th>data attribute q applies to</th></tr>
<tr><td>SPS</td><td>stVal</td></tr>
<tr><td>DPS</td><td>stVal</td></tr>
<tr><td>INS</td><td>stVal</td></tr>
<tr><td>ACT</td><td>general, phsA, phsB, phsC, neut</td></tr>
<tr><td>ACD</td><td>general, dirGeneral, phsA, dirPhsA, phsB, dirPhsB, phsC, dirPhsC, neut, dirNeut</td></tr>
<tr><td>BCR</td><td>actVal, frVal</td></tr>
<tr><td>MV</td><td>instMag, Mag, range</td></tr>
<tr><td>CMV</td><td>instCMag, cMag, range</td></tr>
<tr><td>SAV</td><td>instMag</td></tr>
<tr><td>HMV</td><td>Har</td></tr>
<tr><td>HWYE</td><td>phsAHar, phsBHar, phsCHar, neutHar, netHar, resHar</td></tr>
<tr><td>HDEL</td><td>phsABHar, phsBCHar, phsCAHar</td></tr>
<tr><td>SPC</td><td>stVal</td></tr>
<tr><td>DPC</td><td>stVal</td></tr>
<tr><td>INC</td><td>stVal</td></tr>
<tr><td>BSC</td><td>valWTr</td></tr>
<tr><td>ISC</td><td>valWTr</td></tr>
<tr><td>APC</td><td>setMag</td></tr>
</table></td></tr>
<tr><td>range</td><td>Range in which the current value of instMag or instCVal.mag is. It may be used to issue an event if the current value changes and transitions to another range. Range shall be used in the context with configuration attributes like hhLim, hLim, lLim, llLim, min and max as shown below.
<table>
<tr><th></th><th>range</th><th>validity</th><th>detail-qual</th></tr>
<tr><td></td><td>high-high</td><td>questionable</td><td>outOfRange</td></tr>
<tr><td>max</td><td>high-high</td><td>good</td><td></td></tr>
<tr><td>hhLim</td><td>high</td><td>good</td><td></td></tr>
<tr><td>hLim</td><td>normal</td><td>good</td><td></td></tr>
<tr><td>lLim</td><td>low</td><td>good</td><td></td></tr>
<tr><td>llLim</td><td>low-low</td><td>good</td><td></td></tr>
<tr><td>min</td><td>low-low</td><td>questionable</td><td>outOfRange</td></tr>
</table>
NOTE 9 The use of algorithms to filter events based on transition from one range to another is a local issue.

NOTE 10 This value with the trigger option “data-change” as described in 61850-7-2 may be used to report an event to the client.</td></tr>
<tr><td>rangeC</td><td>Configuration parameters as used in the context with the range attribute.</td></tr>
<tr><td>res</td><td>Residual current. Residual current is the algebraic sum of the instantaneous values of currents flowing through all live conductors (i.e. sum over phase currents) of a circuit at a point of the electrical installation.</td></tr>
<tr><td>resHar</td><td>This array shall contain the harmonic and subharmonics or interharmonic values related to residual current. For further details, see Har.</td></tr>
<tr><td>rmsTm</td><td>Time window used for the calculation of rms values. The value shall be represented in ms.</td></tr>
</table>

<table>
<tr><th>Data attribute name</th><th>Semantics</th></tr>
<tr><td>sboClass</td><td>Specifies the SBO-class according to the control model of IEC 61850-7-2 that corresponds to the behaviour of the data. The following values are defined:
<table>
<tr><th>value</th><th></th></tr>
<tr><td>operate-once</td><td>Following an operate request, the control object shall return in the unselected state.</td></tr>
<tr><td>operate-many</td><td>Following an operate request, the control object shall remain in the ready state, as long as sboTimeout did not expire.</td></tr>
</table></td></tr>
<tr><td>sboTimeout</td><td>Specifies the timeout according to the control model of IEC 61850-7-2 that corresponds to the behaviour of the data. The value shall be in ms.</td></tr>
<tr><td>seqT</td><td>This attribute shall specify the type of the sequence. The following values are used:
<table>
<tr><th>value</th><th>c1</th><th>c2</th><th>c3</th></tr>
<tr><td>pos-neg-zero</td><td>pos</td><td>neg</td><td>zero</td></tr>
<tr><td>dir-quad-zero</td><td>dir</td><td>quad</td><td>zero</td></tr>
</table></td></tr>
<tr><td>serNum</td><td>Serial number.</td></tr>
<tr><td>setCharact</td><td>This attribute shall describe the curve characteristic. The values are defined below. Each curve is of the form x = f(y). There are three options to describe f(y):
1) characteristic = 1 ... 16: As a formula based on up to 6 parameters A, B, C, D, E and F. The formula is standardised by ANSI or IEC. ANSI and IEC also specify the values for A, B, C, D, E and F in that case, the corresponding attributes are read-only.
2) characteristic = 17 ... 32: As a definable formula based on up to 6 parameters A, B, C, D, E and F. In that case it may be possible, that the parameters may be modified. The specification of the formula is a local issue. The actual shape of the curve may be read out using a dedicated data of the CDC CSD.
3) characteristic = 33 ... 48: As a definable curve specified as an array of n (x,y) pairs. The specification of the array is a local issue. The actual shape of the curve may be read out using a dedicated data of the CDC CSD.
<table>
<tr><th>value</th><th>curve characteristic</th></tr>
<tr><td>1</td><td>ANSI Extremely Inverse</td></tr>
<tr><td>2</td><td>ANSI Very Inverse</td></tr>
<tr><td>3</td><td>ANSI Normal Inverse</td></tr>
<tr><td>4</td><td>ANSI Moderately Inverse</td></tr>
<tr><td>5</td><td>ANSI Definite Time (Definite Time Over Current = default)</td></tr>
<tr><td>6</td><td>Long-Time Extremely Inverse</td></tr>
<tr><td>7</td><td>Long-Time Very Inverse</td></tr>
<tr><td>8</td><td>Long-Time Inverse</td></tr>
<tr><td>9</td><td>IEC Normal Inverse</td></tr>
<tr><td>10</td><td>IEC Very Inverse</td></tr>
<tr><td>11</td><td>IEC Inverse</td></tr>
<tr><td>12</td><td>IEC Extremely Inverse</td></tr>
<tr><td>13</td><td>IEC Short-Time Inverse</td></tr>
<tr><td>14</td><td>IEC Long-Time Inverse</td></tr>
<tr><td>15</td><td>IEC Definite Time</td></tr>
<tr><td>16</td><td>Reserved</td></tr>
<tr><td>17</td><td>Definable curve 1 based on formula [x=f(y,A,B,C,D, E, F)]</td></tr>
<tr><td>...</td><td></td></tr>
<tr><td>32</td><td>Definable curve 16 based on formula [x=f(y,A,B,C,D, E, F)]</td></tr>
<tr><td>33</td><td>Vendor specific curve 1 defined by n pairs (x,y)</td></tr>
<tr><td>...</td><td></td></tr>
<tr><td>48</td><td>Vendor specific curve 1 defined by n pairs (x,y)</td></tr>
</table></td></tr>
<tr><td>setParA</td><td>Parameter used to specify the formula of the setting curve.</td></tr>
<tr><td>setParB</td><td>Parameter used to specify the formula of the setting curve.</td></tr>
<tr><td>setParC</td><td>Parameter used to specify the formula of the setting curve.</td></tr>
<tr><td>setParD</td><td>Parameter used to specify the formula of the setting curve.</td></tr>
</table>

<table>
<tr><th>Data attribute name</th><th>Semantics</th></tr>
<tr><td>setParE</td><td>Parameter used to specify the formula of the setting curve.</td></tr>
<tr><td>setParF</td><td>Parameter used to specify the formula of the setting curve.</td></tr>
<tr><td>setMag</td><td>The value of an analogue setting or set point.</td></tr>
<tr><td>setVal</td><td>The value of a status setting.</td></tr>
<tr><td>sev</td><td>Severity of the last violation detected. The values are:
<table>
<tr><th>value</th><th></th></tr>
<tr><td>unknown</td><td>Severity cannot be determined.</td></tr>
<tr><td>critical</td><td>Severity is critical in terms of safe operation or data considered critical and privileged access was attempted.</td></tr>
<tr><td>major</td><td>Severity is major in terms of safe operation or data considered of major importance and privileged access was attempted.</td></tr>
<tr><td>minor</td><td>Severity is minor in the sense that access control was denied to data considered privileged.</td></tr>
<tr><td>warning</td><td>Is less severe than minor.</td></tr>
</table></td></tr>
<tr><td>smpRate (HMV, HWYE, HDEL)</td><td>Determines according to the sampling theorem the highest possible harmonic or interharmonic detectable. The minimum is 2 × frequency. The value shall represent the number of samples per nominal period. In the case of a d.c. system, the value shall represent the number of samples per s.</td></tr>
<tr><td>smpRate (MV, CMV, WYE, DEL)</td><td>Sampling rate that has been used to determine the analogue values. The value shall represent the number of samples per nominal period. In the case of a d.c. system, the value shall represent the number of samples per s.</td></tr>
<tr><td>stepSize</td><td>Defines the step between individual values that ctlVal (CDC INC, BSC, ISC), setVal (CDC ING) or setMag (CDC APC, ASG) will accept.</td></tr>
<tr><td>strTm</td><td>Starting time of the freeze process. If the current time is later than the start time, the first freeze shall occur at the next freeze interval (frPd) expiration, computed from the start time setting.</td></tr>
<tr><td>stSeld</td><td>The controllable data is in the status "selected".</td></tr>
<tr><td>stVal</td><td>Status value of the data.</td></tr>
<tr><td>subCVal</td><td>Value used to substitute the data attribute instCVal.</td></tr>
<tr><td>subEna</td><td>Used to enable substitution. If this attribute is set to true, the attribute(s) representing the value of the data instance shall always be set to the same value as the attribute(s) used to store the substitution value of the data. If this attribute is set to false, the attribute(s) representing the value of the data instance shall be based on the process value. For the different CDCs subEna applies to the following data attributes:
<table>
<tr><th>CDC</th><th>data attribute subEna applies to</th></tr>
<tr><td>SPS</td><td>stVal and subVal, q and subQ</td></tr>
<tr><td>DPS</td><td>stVal and subVal, q and subQ</td></tr>
<tr><td>INS</td><td>stVal and subVal, q and subQ</td></tr>
<tr><td>MV</td><td>instMag and subMag, q and subQ</td></tr>
<tr><td>CMV</td><td>instCVal and subCVal, q and subQ</td></tr>
<tr><td>SPC</td><td>stVal and subVal, q and subQ</td></tr>
<tr><td>DPC</td><td>stVal and subVal, q and subQ</td></tr>
<tr><td>INC</td><td>stVal and subVal, q and subQ</td></tr>
<tr><td>BSC</td><td>valWTr and subVal, q and subQ</td></tr>
<tr><td>ISC</td><td>valWTr and subVal, q and subQ</td></tr>
</table>
It is the responsibility of the client application, in particular in the case of multiple attributes to be substituted, to set all relevant substitution values before enabling substitution. To prevent wrong operation in a specific mapping to one Get-Service request, the substitution is recommended to be mapped to two setDataValue services: the first one to set the substitution values and the second to set subEna to true.</td></tr>
<tr><td>subID</td><td>Shows the address of the device that made the substitution. The value of null shall be used if subEna is false or if the device is not known.</td></tr>
<tr><td>subMag</td><td>Value used to substitute the data attribute instMag.</td></tr>
</table>

<table>
<tr><th>Data attribute name</th><th>Semantics</th></tr>
<tr><td>subQ</td><td>Value used to substitute the data attribute q.</td></tr>
<tr><td>subVal</td><td>Value used to substitute the attribute representing the value of the data instance. For the different CDCs subVal is used to substitute the following data attributes:
<table>
<tr><th>CDC</th><th>data attribute subVal is used to substitute</th></tr>
<tr><td>SPS</td><td>stVal</td></tr>
<tr><td>DPS</td><td>stVal</td></tr>
<tr><td>INS</td><td>stVal</td></tr>
<tr><td>SPC</td><td>stVal</td></tr>
<tr><td>DPC</td><td>stVal</td></tr>
<tr><td>INC</td><td>stVal</td></tr>
<tr><td>BSC</td><td>valWTr</td></tr>
<tr><td>ISC</td><td>valWTr</td></tr>
</table></td></tr>
<tr><td>sVC</td><td>Scaled value configuration. Shall be used to configure the scaled value representation of instMag, mag, subMag or setMag.</td></tr>
<tr><td>swRev</td><td>SW-revision.</td></tr>
<tr><td>t</td><td>Timestamp of the last change in one of the attribute(s) representing the value of the data or in the q attribute. For the different CDCs t applies to the following data attributes:
<table>
<tr><th>CDC</th><th>data attribute t applies to</th></tr>
<tr><td>SPS</td><td>stVal</td></tr>
<tr><td>DPS</td><td>stVal</td></tr>
<tr><td>INS</td><td>stVal</td></tr>
<tr><td>ACT</td><td>general, phsA, phsB, phsC, neut</td></tr>
<tr><td>ACD</td><td>general, dirGeneral, phsA, dirPhsA, phsB, dirPhsB, phsC, dirPhsC, neut, dirNeut</td></tr>
<tr><td>SEC</td><td>cnt</td></tr>
<tr><td>BCR</td><td>actVal</td></tr>
<tr><td>MV</td><td>mag, range</td></tr>
<tr><td>CMV</td><td>cVal, range</td></tr>
<tr><td>SAV</td><td>instMag</td></tr>
<tr><td>HMV</td><td>Har</td></tr>
<tr><td>HWYE</td><td>phsAHar, phsBHar, phsCHar, neutHar, netHar, resHar</td></tr>
<tr><td>HDEL</td><td>phsABHar, phsBCHar, phsCAHar</td></tr>
<tr><td>SPC</td><td>stVal</td></tr>
<tr><td>DPC</td><td>stVal</td></tr>
<tr><td>INC</td><td>stVal</td></tr>
<tr><td>BSC</td><td>valWTr</td></tr>
<tr><td>ISC</td><td>valWTr</td></tr>
<tr><td>APC</td><td>setMag</td></tr>
</table></td></tr>
<tr><td>units</td><td>Units of the attribute(s) representing the value of the data. For the different CDCs units applies to the following data attributes:
<table>
<tr><th>CDC</th><th>data attribute units applies to</th></tr>
<tr><td>BCR</td><td>actVal, frVal</td></tr>
<tr><td>MV</td><td>instMag, mag</td></tr>
<tr><td>CMV</td><td>instCVal.Mag, cVal.Mag</td></tr>
<tr><td>SAV</td><td>instMag</td></tr>
<tr><td>HMV</td><td>har.Mag</td></tr>
<tr><td>HWYE</td><td>phsAHar.Mag, phsBHar.Mag, phsCHar.Mag, neutHar.Mag, netHar.Mag, resHar.Mmag</td></tr>
<tr><td>HDEL</td><td>phsAB.Mag, phsBC.Mag, phsCA.Mag</td></tr>
<tr><td>APC</td><td>setMag</td></tr>
<tr><td>ASG</td><td>setMag</td></tr>
</table></td></tr>
<tr><td>valWTr</td><td>Value with transient indication.</td></tr>
<tr><td>vendor</td><td>Name of the vendor.</td></tr>
<tr><td>xD</td><td>Description of the value of the x-axis of a curve.</td></tr>
<tr><td>xUnit</td><td>Unit of the x-axis of a curve.</td></tr>
</table>

<table>
<tr><th>Data attribute name</th><th>Semantics</th></tr>
<tr><td>xVal</td><td>The x-value of a curve point.</td></tr>
<tr><td>yD</td><td>Description of the value of the y-axis of a curve.</td></tr>
<tr><td>yUnit</td><td>Unit of the y-axis of a curve.</td></tr>
<tr><td>yVal</td><td>The y-value of a curve point.</td></tr>
<tr><td>zeroDb</td><td>Configuration parameter used to calculate the range around zero, where the analogue value will be forced to zero. The value shall represent the percentage of difference between max and min in units of 0,001 %. For the different CDCs zeroDb applies to the following data attributes:
<table>
<tr><th>CDC</th><th>data attribute zeroDb applies to</th></tr>
<tr><td>MV</td><td>mag</td></tr>
<tr><td>CMV</td><td>cVal.mag</td></tr>
</table>
</td></tr>
</table>

Annex A
(normative)

Value range for units and multiplier

The **units** shall be SI units, derived from ISO 1000, represented as an enumeration. The enumeration shall be as defined in Table A.1, Table A.2, Table A.3 and Table A.4. The multiplier shall be represented as an enumeration where the value of the enumeration equals the exponent of the multiplier value in base 10, as defined in Table A.5.

Table A.1 – SI units: base units

Value	Quantity	Unit name	Symbol
1	None	dimensionless	none
2	Length	meter	m
3	Mass	kilogram	kg
4	Time	second	s
5	Current	ampere	A
6	Temperature	Kelvin	K
7	Amount of substance	mole	mol
8	Luminous intensity	candela	cd

Table A.2 – SI units: derived units

Value	Quantity	Unit name	Symbol
9	Plane angle	degrees	deg
10	Plane angle	radian	rad
11	Solid angle	steradian	sr
21	Absorbed dose	Gray (J/Kg)	Gy
22	Activity	becquerel (l/s)	q
23	Relative temperature	degrees Celsius	°C
24	Dose equivalent	sievert (J/kg)	Sv
25	Electric capacitance	farad (C/V)	F
26	Electric charge	coulomb (AS)	C
27	Electric conductance	siemens (A/V)	S
28	Electric inductance	henry (Wb/A)	H
29	Electric potential	volt (W/A)	V
30	Electric resistance	ohm (VA)	Ω
31	Energy	joule (N m)	J
32	Force	newton (kg m/s^2)	N
33	Frequency	hertz (1/s)	Hz
34	Illuminance	lux (lm/m^2)	lx
35	Luminous flux	lumen (cd sr)	Lm
36	Magnetic flux	weber (V s)	Wb
37	Magnetic flux density	tesla (Wb/m^2)	T
38	Power	watt (J/s)	W
39	Pressure	pascal (N/m^2)	Pa

Table A.3 – SI units: extended units

Value	Quantity	Unit name	Symbol
41	Area	square meter (m^2)	m^2
42	Volume	cubic meter (m^3)	m^3
43	Velocity	meters per second (m/s)	ms^{-1}
44	Acceleration	meters per second^2 (m/s^2)	ms^{-2}
45	Volumetric flow rate	cubic meters per second (m^3/s)	m^3s^{-1}
46	Fuel efficiency	meters/cubic meter (m/m^3)	ms^3
47	Moment of mass	kilogram meter (kg m)	M
48	Density	kilogram/cubic meter (kg/m^3)	
49	Viscosity	meter square/second ($m^{2/}s$)	
50	Thermal conductivity	watt/meter Kelvin (W/m K)	
51	Heat capacity	joule/Kelvin (J/K)	
52	Concentration	parts per million	ppm
53	Rotational speed	rotations per second (1/s)	s^{-1}
54	Angular velocity	radian per second (rad/s)	$rads^{-1}$

Table A.4 – SI units: industry specific units

Value	Quantity	Unit name	Symbol
61	Apparent power	volt ampere (VA)	VA
62	Real power	watts (I^2R)	W
63	Reactive power	volt ampere reactive ($VISin\theta$)	VAr
64	Phase angle	degrees	θ
65	Power factor	(dimensionless)	$Cos\theta$
66	Volt seconds	volt seconds (Ws/A)	Vs
67	Volts squared	volt square (W^2/A^2)	V^2
68	Amp seconds	amp second (As)	As
69	Amps squared	amp square (A^2)	A^2
70	Amps squared time	amp square second (A^2s)	A^2t
71	Apparent energy	volt ampere hours	VAh
72	Real energy	watt hours	Wh
73	Reactive energy	volt ampere reactive hours	VArh
74	Magnetic flux	volts per hertz	V/Hz

Table A.5 – Multiplier

Value	Multiplier value	Name	Symbol
–24	10^{-24}	Yocto	y
–21	10^{-21}	Zepto	z
–18	10^{-18}	Atto	a
–15	10^{-15}	Femto	f
–12	10^{-12}	Pico	p
–9	10^{-9}	Nano	n
–6	10^{-6}	Micro	μ
–3	10^{-3}	Milli	m
–2	10^{-2}	Centi	c
–1	10^{-1}	Deci	d
1	10^{1}	Deca	da
2	10^{2}	Hecto	h
3	10^{3}	Kilo	k
6	10^{6}	Mega	M
9	10^{9}	Giga	G
12	10^{12}	Tera	T
15	10^{15}	Petra	P
18	10^{18}	Exa	E
21	10^{21}	Zetta	Z
24	10^{24}	Yotta	Y

Annex B
(informative)

Functional constraints

The functional constraints are defined in IEC 61850-7-2. Those that are relevant for this part of IEC 61850 are repeated here for better reading of the standard.

Table B.1 – Functional constraints

FC	Explanation
ST	Status information
MX	Measurands (analogue values)
CO	Control
SP	Setpoint
SG	Attribute used for active parameter group
SE	Attribute used for edit parameter group
SV	Attribute used for substitution
CF	Attribute used for configuration
DC	Attribute used for description
EX	Attribute used for extensions of common data classes

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