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COMMUNICATION NETWORKS AND SYSTEMS FOR UTILITY AUTOMATION –

Part 7-3: Basic communication structure – Common data classes

FOREWORD

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International Standard IEC 61850-7-3 has been prepared by IEC technical committee 57: Power system control and associated communications.

This CD of Edition 2 is based on the following documents:

IS	Report on voting
61850-7-3:2003	
CD	
57/779/CD	57/843/CC

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: Introduction and overview

Part 2: Glossary

Part 3: General requirements

Part 4: System and project management

Part 5: Communication requirements for functions and device models

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

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

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

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

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

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

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

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

Part 10: Conformance testing

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).*

TC57, WG10 is currently preparing the second edition of IEC 61850. During the recent WG meeting, it was decided to circulate in a first step the following parts as CD: Part 6, 7-2, 7-3, 7-4, 8-1 and 9-2. The purpose of these CDs is, to give the national committees a first possibility to comment on the principle direction of Edition 2. There may still be some missing elements in these CDs.

It is intended, to circulate by the end of 2007 a CDV of Edition 2. For that CDV, other parts, in particular part 1, 5 and 7-1 will be prepared as well.

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).

Compared to the published edition 1, this edition 2 of this standard:

- Defines new common data classes used for new standards defining object models for other domains based on IEC 61850 and for the representation of statistical and historical data.
- Provides clarifications and corrections to the published edition 1 of IEC 61850-7-3. Issues that require clarification are published in a database at www.tissue.iec61850.com.

This CD is based on Amendment 1 to IEC 61850-7-3, Ed 1 that has been circulated as 57/779/CD. Compared to the Amendment 1, this CD provides additional clarifications and it includes the following modifications:

- An extension of the CDC Nameplate as decided at the meeting in Charlotte in December 2005
- For the curve shape description, an option has been added to represent a curve in a three-dimensional space.
- A new CDC CSG to support the setting of a curve shape.
- A new CDC HST for histograms used in the power quality logical nodes.
- A new CDC TSG for time settings.

The numbering of figures and tables has been chosen such that the numbers from the first Edition remain the same. This helps to compare with the old document and since IEC has introduced manual numbering during the final editing of Edition 1, it helps to avoid introducing errors with references to figures and tables. For the publishing of the standard, the numbers will be updated.

COMMUNICATION NETWORKS AND SYSTEMS FOR UTILITY AUTOMATION –

Part 7-3: Basic communication structure – 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 **control**,
- 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*

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

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)*

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*

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

3 Terms and definitions

Fur the purposes of this International Standard, the terms and definitions given in IEC 61850-2 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

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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_LN0_M	The attribute shall be present if the data NamPlt belongs to LLN0; otherwise it may be optional.
AC_LN0_EX	The attribute shall be present only if the data NamPlt belongs to LLN0 (applies to ldNs in CDC LPL only).
AC_DLD_M	The attribute shall be present, if LN name space of this LN deviates from the LN name space referenced by ldNs of the logical device in which this LN is contained (applies to lnNs in CDC LPL only).
AC_DLN_M	The attribute shall be present, if data name space of this data deviates from the data name space referenced by either lnNs of the logical node in which the data is contained or ldNs of the logical device in which the data is contained (applies to dataNs in all CDCs only).
AC_DLNDA_M	The attribute shall be present, if CDC name space of this data deviates from the CDC name space referenced by either the dataNs of the data, the lnNs of the logical node in which the data is defined or ldNs of the logical device in which the data is contained (applies to cdcNs and cdcName in all CDCs only).
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.
AC_ST	The attribute is mandatory, if the controllable status class supports status information.
AC_CO_M	If the controllable status class supports control, this attribute is available and a mandatory attribute.
AC_CO_O	If the controllable status class supports control, this attribute is available and an optional attribute.
AC_CO_E	If the controllable status class supports control and if the control model supports the values "direct-with-enhanced-security" or "sbo-with-enhanced-security", that attribute shall be mandatory.

Abbreviation	Condition
AC_SG_M	The attribute is mandatory, if this data shall be member of a setting group.
AC_SG_O	The attribute is optional, if this data shall be member of a setting group.
AC_NSG_M	The attribute is mandatory, if this data shall be a setting outside a setting group.
AC_NSG_O	The attribute is optional, if this data shall be a setting outside a setting group.
AC_RMS_M	The attribute is mandatory when the harmonics reference type is rms.
AC_CLC_O	The attribute shall be optional, when the calculation type (according to data ClcTyp) for this LN is Max fundamental or RMS fundamental. The attribute shall not be available, if ClcTyp is TRUE 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	DEFAULT FALSE	M
outOfRange	BOOLEAN	DEFAULT FALSE	M
badReference	BOOLEAN	DEFAULT FALSE	M
oscillatory	BOOLEAN	DEFAULT FALSE	M
failure	BOOLEAN	DEFAULT FALSE	M
oldData	BOOLEAN	DEFAULT FALSE	M
inconsistent	BOOLEAN	DEFAULT FALSE	M
inaccurate	BOOLEAN	DEFAULT FALSE	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. Quality of the data is also related to the mode of a logical node. Further details can be found in IEC 61850-7-4. The different quality identifiers are not independent. Basically, there are the following quality identifiers:

- validity;
- detail quality;
- source;
- test;
- blocked by operator.

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.

Deleted: 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).¶

6.2.3 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

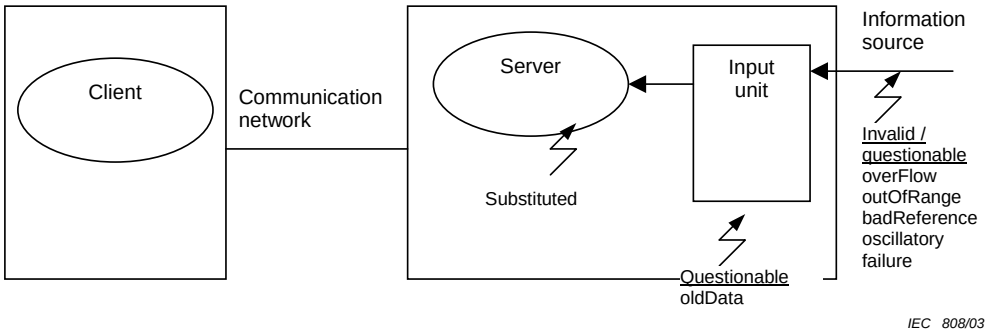

Figure 1 – Quality identifiers in a single client – server relationship

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.

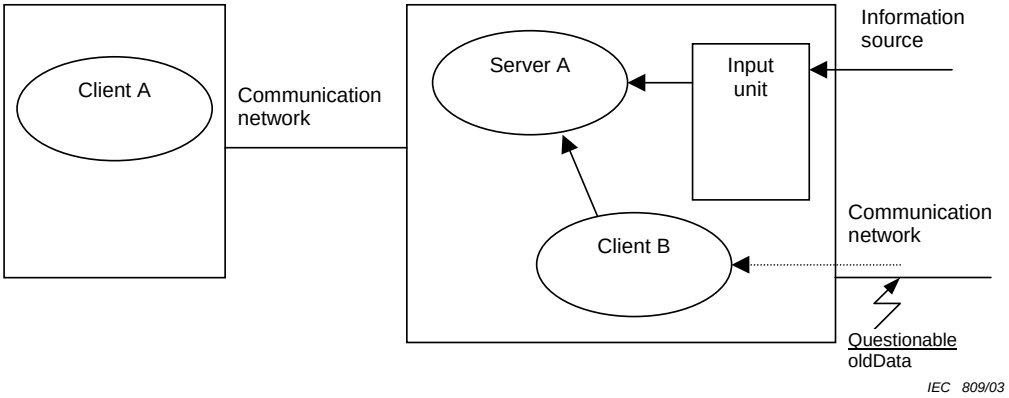

Figure 2 – Quality identifiers in a multiple client – server relationship

In the multiple client-server relationship, the quality of the data received from 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.

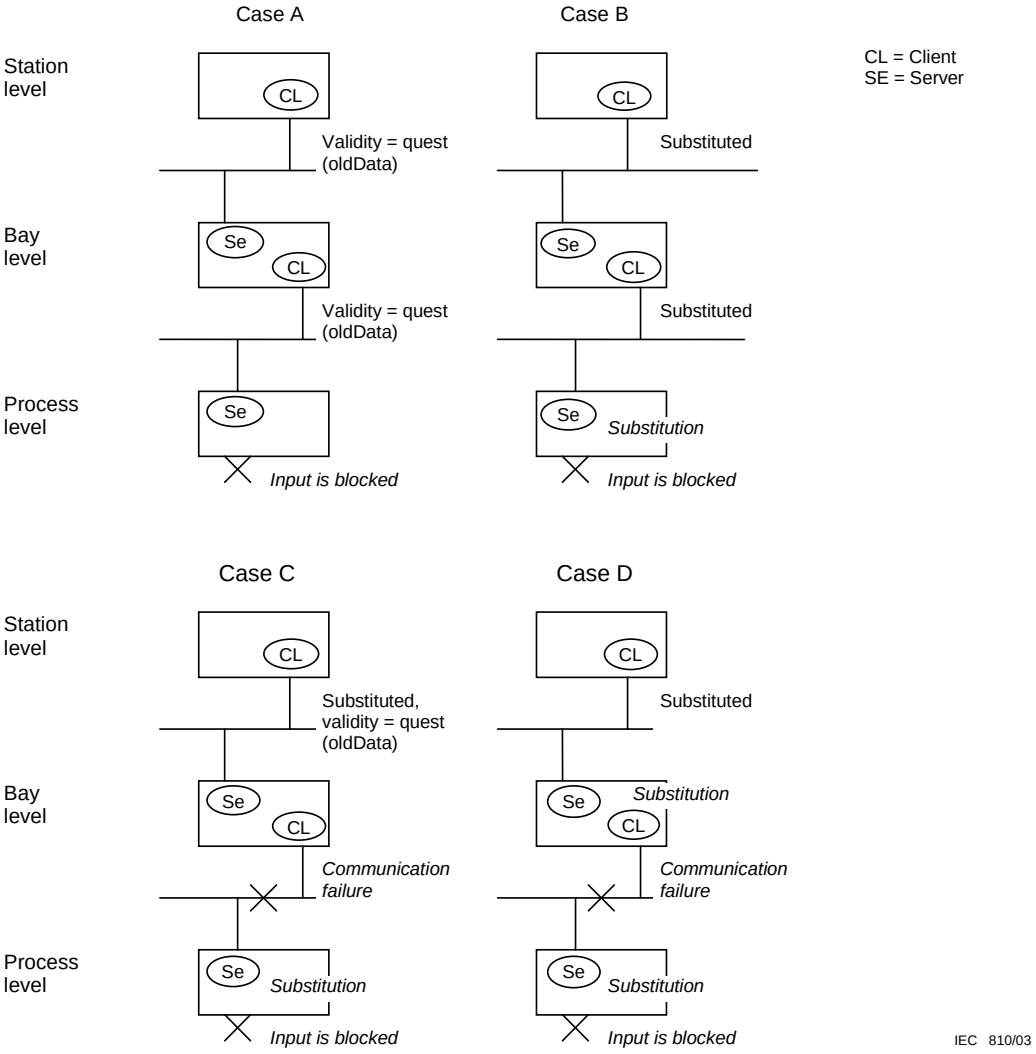

Figure 3 – Interaction of substitution and validity

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 in the server shall 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.

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***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.

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.

NOTE If a server does not support transmission of FLOAT32 values, the client may retrieve these values from the SCL file.

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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
limDb	INT32U	0 ... 100 000	O

hhLim, hLim, lLim, llLim: These attributes shall be the configuration parameters used in the context with the range attribute as defined in clause 8.

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).

limDb: The value is used to introduce a hysteresis in the calculation of range. Range is immediately set to the higher value, when a high limit has been crossed (to the lower value, when a low limit has been crossed). However, range is only set back to the lower value, when the value of the high limit minus limDb has been crossed (to the higher value when the value of the low limit plus limDb has been crossed). The value shall represent the percentage between max and min in units of 0.001%. If limDb is not present, no hysteresis calculation is made.

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.

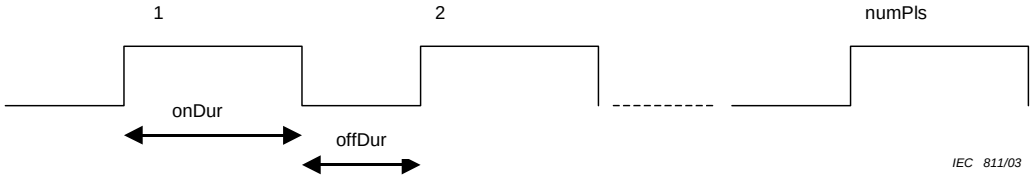

Figure 4 – Configuration of command output pulse

6.8 Originator

Originator type shall be as defined in Table 7.

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
not-supported	orCat is not supported
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	-180 ... +180	AC_CLC_O

mag: the magnitude of the complex value. The unit attribute of the common data class shall be applied to the mag value.

ang: the angle of the complex value. The SIunit shall be degrees and the unit multiplier is 1. The angle reference is defined in the context where the Vector type is used.

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6.11 Point definition

Point type shall be as defined in table 11.

Table 11 – Point

Point Type Definition			
Attribute Name	**Attribute Type**	**Value/Value Range**	**M/O/C**
xVal	FLOAT32		M
yVal	FLOAT32		M
zVal	FLOAT32		O

xVal: the x value of a curve point.

yVal: the y value of a curve point.

zVal: the z value of a curve point.

6.12 CtlModels definition

CtlModels type is defined as follows:

ENUMERATED (status-only | direct-with-normal-security | sbo-with-normal-security | direct-with-enhanced-security | sbo-with-enhanced-security)

6.13 SboClasses definition

SboClasses type is defined as follows:

ENUMERATED (operate-once | operate-many)

6.14 Cell

Comment [CB1]: For two dimensional Histograms

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Cell type is used to define a square area in a 2-dimensional environment and shall be defined as in table 11.1. Cell type can as well be used to describe a range within a one dimensional environment.

Table 11.1 – Cell

Cell Type Definition			
Attribute Name	**Attribute Type**	**Value/Value Range**	**M/O/C**
xStart	FLOAT32		M
xEnd	FLOAT32		O
yStart	FLOAT32		O
yEnd	FLOAT32		O

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xStart: the x value of the lower left corner of the square.

xEnd: the x value of the upper right corner of the square. That component shall not be present to indicate infinity in the direction of the x axis.

yStart: The y value of the lower left corner of the square. That component shall not be present, if only a one dimensional range needs to be described.

yEnd: The y value of the upper right corner of the square. That component shall not be present, if only a one dimensional range needs to be described or to indicate infinity in the direction of the y axis.

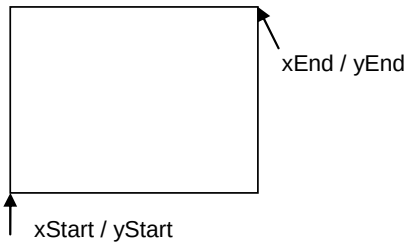

Figure 5 – Cell definition

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6.15 AddCause definition

AddCause type is used to identify the reason for failure of a control service. It is defined as follows:

ENUMERATED (ServiceError type | Blocked-by-switching-hierarchy | Select-failed | Invalid-position | Position-reached | Parameter-change-in-execution | Step-limit | Blocked-by-Mode | Blocked-by-process | Blocked-by-interlocking | Blocked-by-synchrocheck | Command-already-in-execution | Blocked-by-health | 1-of-n-control | Abortion-by-cancel | Time-limit-over | Abortion-by-trip | Object-not-selected)

The semantic interpretation of the values shall be as defined in table 11.1.

Table 11.1 – AddCause semantic

Value	Explanation
ServiceError type	All errors as defined in Table 5
Blocked-by-switching-hierarchy	Not successful since one of the downstream **Loc** switches like in **CSWI** has the value TRUE
Select-failed	Cancelled due to an unsuccessful selection (**select service**)
Invalid-position	Control action is aborted due to invalid switch position (**Pos** in **XCBR** or **XSWI**)
Position-reached	Switch is already in the intended position (**Pos** in **XCBR** or **XSWI**)
Parameter-change-in-execution	Control action is blocked due to running **parameter change**
Step-limit	Control action is blocked, because tap changer has reached the limit (**EndPosR** or **EndposL** in **YLTC**)
Blocked-by-Mode	Control action is blocked, because the LN (**CSWI** or **XCBR**/**XSWI**) is in a mode (**Mod**) which does not allow any switching

Value	Explanation
Blocked-by-process	Control action is blocked due to some external even at process level that prevents a successful operation, for example, blocking indication (**EEHealth** in **XCBR** or **XSWI**)
Blocked-by-interlocking	Control action is blocked due to interlocking of switching devices (in **CILO** attribute **EnaOpn.stVal="FALSE"** or **EnaCls.stVal="FALSE"**
Blocked-by-synchrocheck	Control action with synchrocheck is aborted due to the exceeding of the **time limit** and missing synchronism condition
Command-already-in-execution	Control service or cancel is rejected, because **control action** is already running
Blocked-by-health	Control action is blocked due to some internal event that prevents a successful operation (**Health**)
1-of-n-control	Control action is blocked, because another **control action** in a domain (for example, substation) is already **running** (in any **XCBR** or **XSWI**, the **DPC.stSeld**="**TRUE**").
Abortion-by-cancel	Control action is aborted due to **cancel service**
Time-limit-over	Control action is terminated due to exceed of some **time limit**
Abortion-by-trip	Control action is aborted due to a trip (**PTRC** with **ACT.general="TRUE"**)
Object-not-selected	Operation can not be executed, since object is not selected

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.

The semantic of the DataAttributes (Data) is defined in clause 8.

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 12.

Table 12 – 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	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 Application of services

Table 13 defines the basic status information template. In particular, it defines the inheritance and specialisation of services defined in IEC 61850-7-2.

Table 13 – 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 GetDataDirectory	DC, CF, SV ALL ALL ALL			
Data set model	GetDataSetValues SetDataSetValues	ALL DC, CF, SV			
Reporting model GSE model Sampled values model	Report SendGOOSEMessage SendGSSEMessage SendMSVMessage SendUSVMessage	ALL ST ST ST ST		as specified within the data set that is used to define the content of the message	

7.3.2 Single point status (SPS)

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

Table 14 – 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	dchg		PICS_SUBST
subVal	BOOLEAN	SV	dchg	TRUE | FALSE	PICS_SUBST
subQ	Quality	SV	dchg		PICS_SUBST
subID	VISIBLE STRING64	SV	dchg		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 13					

7.3.3 Double point status (DPS)

Table 15 defines the common data class “double point status”.

Table 15 – 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	dchg		PICS_SUBST
subVal	CODED ENUM	SV	dchg	intermediate-state | off | on | bad-state	PICS_SUBST
subQ	Quality	SV	dchg		PICS_SUBST
subID	VISIBLE STRING64	SV	dchg		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 13					

7.3.4 Integer status (INS)

Table 16 defines the common data class “integer status”.

Table 16 – 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	CtxInt	ST	dchg		M
q	Quality	ST	qchg		M
t	TimeStamp	ST			M
substitution					
subEna	BOOLEAN	SV	dchg		PICS_SUBST
subVal	CtxInt	SV	dchg		PICS_SUBST
subQ	Quality	SV	dchg		PICS_SUBST
subID	VISIBLE STRING64	SV	dchg		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 13					

7.3.5 Protection activation information (ACT)

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

Table 17 – 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
origin	Originator	ST			O
operTmPhsA	TimeStamp	ST			O
operTmPhsB	TimeStamp	ST			O
operTmPhsC	TimeStamp	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 13					

NOTE – the attribute origin may be used to identify the originator when a data of the CDC ACT is used to perform an operation. An example would be the data OpOpn of the LN CSWI being used to open a breaker (LN XCBR) through a GOOSE message. The LN XCBR receives the data CSWI.OpOpn including the originator as a GOOSE message. Once operated, the new status information in XCBR.Pos will include the originator information it received as part of the GOOSE message that triggered the operation.

7.3.6 Directional protection activation information (ACD)

Table 18 defines the common data class “directional protection activation information”.

Table 18 – 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 13					

7.3.7 Security violation counting (SEC)

Table 19 defines the common data class “security violation counting”.

Table 19 – 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 13					

7.3.8 Binary counter reading (BCR)

Table 20 defines the common data class “binary counter reading”.

Table 20 – 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	dchg	see Annex A	O
pulsQty	FLOAT32	CF	dchg		M
frEna	BOOLEAN	CF	dchg		GC_2 (1)
strTm	TimeStamp	CF	dchg		GC_2 (1)
frPd	INT32	CF	dchg		GC_2 (1)
frRs	BOOLEAN	CF	dchg		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 13					

7.3.9 Histogram (HST)

Table 20.1 defines the common data class "Histogram".

Table 20.1 – Histogram common data class specification

HST 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					
hstCnt	ARRAY 0..numPts-1 OF INT32	ST	dchg, dupd		M
q	Quality	ST	qchg		M
t	TimeStamp	ST			M
configuration, description and extension					
numPts	INT16U	CF		0 < numPts < number of Cells	M
hstRangeC	ARRAY 0..numPts-1 OF Cells	CF	dchg		M
xUnits	Unit	CF			M
yUnits	Unit	CF			O
xD	VISIBLE STRING255	DC			M
xDU	UNICODE STRING255	DC			O
yD	VISIBLE STRING255	DC			O
yDU	UNICODE STRING255	DC			O
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 13					

Deleted: numPts ... [1]

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7.4 Common data class specifications for measurand information

7.4.1 Application of services

Table 21 defines the basic measurand information template. In particular, it defines the inheritance and specialisation of services defined in IEC 61850-7-2.

NOTE Measured values as used in the following clauses may also be applied to calculated values.

Table 21 – 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)				
Data					
DataAttribute					
measured attributes					
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 GetDataDirectory	DC, CF, SV ALL ALL ALL	
Data set model	GetDataSetValues SetDataSetValues	ALL DC, CF, SV	
Reporting model GSE model Sampled values model	Report SendGOOSEMessage SendMSVMessage SendUSVMessage	ALL MX MX MX	as specified within the data set that is used to define the content of the message

7.4.2 Measured value (MV)

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

Table 22 – 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 attributes					
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	dchg		PICS_SUBST
subMag	AnalogueValue	SV	dchg		PICS_SUBST
subQ	Quality	SV	dchg		PICS_SUBST
subID	VISIBLE STRING64	SV	dchg		PICS_SUBST
configuration, description and extension					
units	Unit	CF	dchg	see Annex A	O
db	INT32U	CF	dchg	0 ... 100 000	O
zeroDb	INT32U	CF	dchg	0 ... 100 000	O
sVC	ScaledValueConfig	CF	dchg		AC_SCAV
rangeC	RangeConfig	CF	dchg		GC_CON
smpRate	INT32U	CF	dchg		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 21					

7.4.3 Complex measured value (CMV)

Table 23 defines the common data class “complex measured value”.

Table 23 – 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 attributes					
instCVal	Vector	MX			O
cVal	Vector	MX	dchg		M
range	ENUMERATED	MX	dchg	normal|high|low|high-high|low-low	O
rangeAng	ENUMERATED	MX	dchg	normal|high|low|high-high|low-low	O
q	Quality	MX	qchg		M
t	TimeStamp	MX			M
substitution					
subEna	BOOLEAN	SV	dchg		PICS_SUBST
subCVal	Vector	SV	dchg		PICS_SUBST
subQ	Quality	SV	dchg		PICS_SUBST
subID	VISIBLE STRING64	SV	dchg		PICS_SUBST
configuration, description and extension					
units	Unit	CF	dchg	see Annex A	O
db	INT32U	CF	dchg	0 ... 100 000	O
dbAng	INT32U	CF	dchg	0 ... 100 000	O
zeroDb	INT32U	CF	dchg	0 ... 100 000	O
rangeC	RangeConfig	CF	dchg		GC_CON
rangeAngC	RangeConfig	CF	dchg		GC_CON
magSVC	ScaledValueConfig	CF	dchg		AC_SCAV
angSVC	ScaledValueConfig	CF	dchg		AC_SCAV
angRef	ENUMERATED	CF	dchg	V | A | other ...	O
smpRate	INT32U	CF	dchg		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 21					

7.4.4 Sampled value (SAV)

Table 24 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 24 – 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 attributes					
instMag	AnalogueValue	MX			M
q	Quality	MX	qchg		M
t	TimeStamp	MX			O
configuration, description and extension					
units	Unit	CF	dchg	see Annex A	O
sVC	ScaledValueConfig	CF	dchg		AC_SCAV
min	AnalogueValue	CF	dchg		O
max	AnalogueValue	CF	dchg		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 21					

7.4.5 Phase to ground related measured values of a three phase system (WYE)

Table 25 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 25 – 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	dchg	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 21					

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 Phase to phase related measured values of a three phase system (DEL)

Table 26 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 26 – 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	dchg	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 21					

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

Table 27 – 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 attributes					
seqT	ENUMERATED	MX		pos-neg-zero | dir-quad-zero	M
configuration, description and extension					
phsRef	ENUMERATED	CF	dchg	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 21					

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 28 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 28 – 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)				
Data					
har	ARRAY 0..numHar OF CMV				M
DataAttribute					
configuration, description and extension					
numHar	INT16U	CF	dchg	>0	M
numCyc	INT16U	CF	dchg	>0	M
evalTm	INT16U	CF	dchg		M
smpRate	INT32U	CF	dchg		O
frequency	FLOAT32	CF	dchg	nominal frequency	M
hvRef	ENUMERATED	CF	dchg	fundamental | rms | absolute	O
rmsCyc	INT16U	CF	dchg		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 21					

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 29 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.

Table 29 – 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)				
Data					
phsAHar	ARRAY 0..numHar OF CMV				M
phsBHar	ARRAY 0..numHar OF CMV				O
phsCHar	ARRAY 0..numHar OF CMV				O
neutHar	ARRAY 0..numHar OF CMV				O
netHar	ARRAY 0..numHar OF CMV				O
resHar	ARRAY 0..numHar OF CMV				O
DataAttribute					
configuration, description and extension					
numHar	INT16U	CF	dchg	>0	M
numCyc	INT16U	CF	dchg	>0	M
evalTm	INT16U	CF	dchg		M
angRef	ENUMERATED	CF	dchg	Va | Vb | Vc | Aa | Ab | Ac | Vab | Vbc | Vca | Vother | Aother	O
smpRate	INT32U	CF	dchg		O
frequency	FLOAT32	CF	dchg	fundamental frequency	M
hvRef	ENUMERATED	CF	dchg	fundamental | rms | absolute	O
rmsCyc	INT16U	CF	dchg		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 21					

7.4.10 Harmonic value for DEL (HDEL)

Table 30 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 30 – 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)				
Data					
phsABHar	ARRAY 0..numHar OF CMV				M
phsBCHar	ARRAY 0..numHar OF CMV				O
phsCAHar	ARRAY 0..numHar OF CMV				O
DataAttribute					
configuration, description and extension					
numHar	INT16U	CF	dchg	>0	M
numCyc	INT16U	CF	dchg	>0	M
evalTm	INT16U	CF	dchg		M
units	Unit	CF	dchg	see Annex A	O
angRef	ENUMERATED	CF	dchg	Va | Vb | Vc | Aa | Ab | Ac | Vab | Vbc | Vca | Vother | Aother	O
smpRate	INT32U	CF	dchg		O
frequency	FLOAT32	CF	dchg	nominal frequency	M
hvRef	ENUMERATED	CF	dchg	fundamental | rms | absolute	O
rmsCyc	INT16U	CF	dchg		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 21					

7.5 Common data class specifications for controls

7.5.1 Application of services

Table 31 defines the basic controllable status information template. In particular, it defines the inheritance and specialisation of services defined in IEC 61850-7-2.

Table 31 – 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					
status / measured attributes					
substitution					
configuration, description and extension					
parameters for control services					
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 GetDataDirectory	DC, CF, SV ALL except CO, CR ALL ALL	
Data set model	GetDataSetValues SetDataSetValues	ALL except CO, CR DC, CF, SV	
Reporting model GSE model Sampled values model	Report SendGOOSEMessage SendGSSEMessage SendMSVMessage SendUSVMessage	ALL ST, MX ST ST, MX ST, MX	as specified within the data set that is used to define the content of the message
Control model	Select SelectWithValue Cancel Operate CommandTermination TimeActivatedOperate	CO CO CO CO CO CO	

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

7.5.2 Controllable single point (SPC)

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

Table 32 – 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					
status					
origin	Originator	ST			AC_CO_O
ctlNum	INT8U	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
rspNegCause	AddCause	CN	dchg		O
rspNegT	TimeStamp	CN			O
substitution					
subEna	BOOLEAN	SV	dchg		PICS_SUBST
subVal	BOOLEAN	SV	dchg	FALSE | TRUE	PICS_SUBST
subQ	Quality	SV	dchg		PICS_SUBST
subID	VISIBLE STRING64	SV	dchg		PICS_SUBST
configuration, description and extension					
pulseConfig	PulseConfig	CF	dchg		AC_CO_O
ctlModel	CtlModels	CF	dchg		M
sboTimeout	INT32U	CF	dchg		AC_CO_O
sboClass	SboClasses	CF	dchg		AC_CO_O
operTimeout	INT32U	CF	dchg		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
parameters for control services					
ctlVal	BOOLEAN	CO		off (FALSE) | on (TRUE)	AC_CO_M
operTm	TimeStamp	CO			AC_CO_O
origin	Originator	CO, CR			AC_CO_M
ctlNum	INT8U	CO, CR		0..255	AC_CO_M
T	TimeStamp	CO, CR			AC_CO_M
Test	BOOLEAN	CO, CR		No-test (FALSE) | test (TRUE)	AC_CO_M
Check	PACKED LIST	CO			AC_CO_M
synchrocheck	BOOLEAN			Perform synchrocheck (TRUE)	
interlock-check	BOOLEAN			Check for interlocking conditions (TRUE)	
rspNegCause	AddCause	CR			AC_CO_E
Services					
As defined in Table 31					

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7.5.3 Controllable double point (DPC)

Table 33 defines the common data class “controllable double point”.

Table 33 – 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					
status					
origin	Originator	ST			AC_CO_O
ctlNum	INT8U	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
rspNegCause	AddCause	CN	dchg		O
rspNegT	TimeStamp	CN			O
substitution					
subEna	BOOLEAN	SV	dchg		PICS_SUBST
subVal	CODED ENUM	SV	dchg	intermediate-state | off | on | bad-state	PICS_SUBST
subQ	Quality	SV	dchg		PICS_SUBST
subID	VISIBLE STRING64	SV	dchg		PICS_SUBST
configuration, description and extension					
pulseConfig	PulseConfig	CF	dchg		AC_CO_O
ctlModel	CtlModels	CF	dchg		M
sboTimeout	INT32U	CF	dchg		AC_CO_O
sboClass	SboClasses	CF	dchg		AC_CO_O
operTimeout	INT32U	CF	dchg		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
parameters for control services					
ctlVal	BOOLEAN	CO		off (FALSE) | on (TRUE)	AC_CO_M
operTm	TimeStamp	CO			AC_CO_O
origin	Originator	CO, CR			AC_CO_M
ctlNum	INT8U	CO, CR		0..255	AC_CO_M
T	TimeStamp	CO, CR			AC_CO_M
Test	BOOLEAN	CO, CR		No-test (FALSE) | test (TRUE)	AC_CO_M
Check	PACKED LIST	CO			AC_CO_M
synchrocheck	BOOLEAN			Perform synchrocheck (TRUE)	
interlock-check	BOOLEAN			Check for interlocking conditions (TRUE)	
rspNegCause	AddCause	CR			AC_CO_E
Services					
As defined in Table 31					

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7.5.4 Controllable integer status (INC)

Table 34 defines the common data class “controllable integer status”.

Table 34 – 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					
status					
origin	Originator	ST			AC_CO_O
ctlNum	INT8U	ST		0..255	AC_CO_O
stVal	CtxInt	ST	dchg		M
q	Quality	ST	qchg		M
t	TimeStamp	ST			M
stSeld	BOOLEAN	ST	dchg		AC_CO_O
rspNegCause	AddCause	CN	dchg		O
rspNegT	TimeStamp	CN			O
substitution					
subEna	BOOLEAN	SV	dchg		PICS_SUBST
subVal	CtxInt	SV	dchg		PICS_SUBST
subQ	Quality	SV	dchg		PICS_SUBST
subID	VISIBLE STRING64	SV	dchg		PICS_SUBST
configuration, description and extension					
ctlModel	CtlModels	CF	dchg		M
sboTimeout	INT32U	CF	dchg		AC_CO_O
sboClass	SboClasses	CF	dchg		AC_CO_O
minVal	INT32	CF	dchg		O
maxVal	INT32	CF	dchg		O
stepSize	INT32U	CF	dchg	1 ... (maxVal – minVal)	O
operTimeout	INT32U	CF	dchg		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
parameters for control services					
ctlVal	CtxInt	CO			AC_CO_M
operTm	TimeStamp	CO			AC_CO_O
origin	Originator	CO, CR			AC_CO_M
ctlNum	INT8U	CO, CR		0..255	AC_CO_M
T	TimeStamp	CO, CR			AC_CO_M
Test	BOOLEAN	CO, CR		No-test (FALSE) | test (TRUE)	AC_CO_M
Check	PACKED LIST	CO			AC_CO_M
synchrocheck	BOOLEAN			Perform synchrocheck (TRUE)	
interlock-check	BOOLEAN			Check for interlocking conditions (TRUE)	
rspNegCause	AddCause	CR			AC_CO_E
Services					
As defined in Table 31					

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7.5.5 Binary controlled step position information (BSC)

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

Table 35 – 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					
status					
origin	Originator	ST			AC_CO_O
ctlNum	INT8U	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
rspNegCause	AddCause	CN	dchg		O
rspNegT	TimeStamp	CN			O
substitution					
subEna	BOOLEAN	SV	dchg		PICS_SUBST
subVal	ValWithTrans	SV	dchg		PICS_SUBST
subQ	Quality	SV	dchg		PICS_SUBST
subID	VISIBLE STRING64	SV	dchg		PICS_SUBST
configuration, description and extension					
persistent	BOOLEAN	CF	dchg		M
ctlModel	CtlModels	CF	dchg		M
sboTimeout	INT32U	CF	dchg		AC_CO_O
sboClass	SboClasses	CF	dchg		AC_CO_O
minVal	INT8	CF	dchg		O
maxVal	INT8	CF	dchg		O
stepSize	INT8U	CF	dchg	1 ... (maxVal – minVal)	O
operTimeout	INT32U	CF	dchg		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
parameters for control services					
ctlVal	CODED ENUM	CO		stop | lower | higher | reserved	AC_CO_M
operTm	TimeStamp	CO			AC_CO_O
origin	Originator	CO, CR			AC_CO_M
ctlNum	INT8U	CO, CR		0..255	AC_CO_M
T	TimeStamp	CO, CR			AC_CO_M
Test	BOOLEAN	CO, CR		No-test (FALSE) | test (TRUE)	AC_CO_M
Check	PACKED LIST	CO			AC_CO_M
synchrocheck	BOOLEAN			Perform synchrocheck (TRUE)	
interlock-check	BOOLEAN			Check for interlocking conditions (TRUE)	
rspNegCause	AddCause	CR			AC_CO_E
Services					
As defined in Table 31					

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7.5.6 Integer controlled step position information (ISC)

Table 36 defines the common data class “integer controlled step position information”.

Table 36 – 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					
status					
origin	Originator	ST			AC_CO_O
ctlNum	INT8U	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
rspNegCause	AddCause	CN	dchg		O
rspNegT	TimeStamp	CN			O
substitution					
subEna	BOOLEAN	SV	dchg		PICS_SUBST
subVal	ValWithTrans	SV	dchg		PICS_SUBST
subQ	Quality	SV	dchg		PICS_SUBST
subID	VISIBLE STRING64	SV	dchg		PICS_SUBST
configuration, description and extension					
ctlModel	CtlModels	CF	dchg		M
sboTimeout	INT32U	CF	dchg		AC_CO_O
sboClass	SboClasses	CF	dchg		AC_CO_O
minVal	INT8	CF	dchg		O
maxVal	INT8	CF	dchg		O
stepSize	INT8U	CF	dchg	1 ... (maxVal – minVal)	O
operTimeout	INT32U	CF	dchg		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
parameters for control services					
ctlVal	INT8	CO		–64 ... 63	AC_CO_M
operTm	TimeStamp	CO			AC_CO_O
origin	Originator	CO, CR			AC_CO_M
ctlNum	INT8U	CO, CR		0..255	AC_CO_M
T	TimeStamp	CO, CR			AC_CO_M
Test	BOOLEAN	CO, CR		No-test (FALSE) | test (TRUE)	AC_CO_M
Check	PACKED LIST	CO			AC_CO_M
synchrocheck	BOOLEAN			Perform synchrocheck (TRUE)	
interlock-check	BOOLEAN			Check for interlocking conditions (TRUE)	
rspNegCause	AddCause	CR			AC_CO_E
Services					
As defined in Table 31					

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7.5.7 Controllable analogue process value (APC)

Table 38 defines the common data class “controllable analogue process value”.

Table 38– Controllable analogue process value

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					
measured attributes					
origin	Originator	MX			AC_CO_O
ctlNum	INT8U	MX		0..255	AC_CO_O
mxVal	AnalogueValue	MX	dchg		AC_ST
q	Quality	MX	qchg		AC_ST
t	TimeStamp	MX			AC_ST
stSeld	BOOLEAN	ST	dchg		AC_CO_O
rspNegCause	AddCause	CN	dchg		O
rspNegT	TimeStamp	CN			O
substitution					
subEna	BOOLEAN	SV	dchg		PICS_SUBST
subVal	AnalogueValue	SV	dchg		PICS_SUBST
subQ	Quality	SV	dchg		PICS_SUBST
subID	VISIBLE STRING64	SV	dchg		PICS_SUBST
configuration, description and extension					
ctlModel	CtlModels	CF	dchg		M
sboTimeout	INT32U	CF	dchg		AC_CO_O
sboClass	SboClasses	CF	dchg		AC_CO_O
units	Unit	CF	dchg	see Annex A	O
db	INT32U	CF	dchg	0 ... 100 000	O
sVC	ScaledValueConfig	CF	dchg		AC_SCAV
minVal	AnalogueValue	CF	dchg		O
maxVal	AnalogueValue	CF	dchg		O
stepSize	AnalogueValue	CF	dchg	0 ... (maxVal – minVal)	O
operTimeout	INT32U	CF	dchg		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
parameters for control services					
ctlVal	AnalogueValue	CO			AC_CO_M
operTm	TimeStamp	CO			AC_CO_O
origin	Originator	CO, CR			AC_CO_M
ctlNum	INT8U	CO, CR		0..255	AC_CO_M
T	TimeStamp	CO, CR			AC_CO_M
Test	BOOLEAN	CO, CR		No-test (FALSE) | test (TRUE)	AC_CO_M
Check	PACKED LIST	CO			AC_CO_M
synchrocheck	BOOLEAN			Perform synchrocheck (TRUE)	
interlock-check	BOOLEAN			Check for interlocking conditions (TRUE)	
rspNegCause	AddCause	CR			AC_CO_E
Services					
As defined in Table 31					

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7.5.8 Binary controlled analog process value (BAC)

Table 38.1 defines the common data class “binary controlled analog process value”.

Table 38.1 – Binary controlled analog process value

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					
Status					
origin	Originator	MX			AC_CO_O
ctlNum	INT8U	MX		0..255	AC_CO_O
mxVal	AnalogValue	MX	dchg		AC_ST
q	Quality	MX	qchg		AC_ST
t	TimeStamp	MX			AC_ST
stSeld	BOOLEAN	MX	dchg		AC_CO_O
rspNegCause	AddCause	CN	dChg		O
rspNegT	TimeSamp	CN			O
substitution					
subEna	BOOLEAN	SV	dchg		PICS_SUBST
subVal	AnlogValue	SV	dchg		PICS_SUBST
subQ	Quality	SV	dchg		PICS_SUBST
subID	VISIBLE STRING64	SV	dchg		PICS_SUBST
configuration, description and extension					
persistent	BOOLEAN	CF	dchg		M
ctlModel	CtlModels	CF	dchg		M
sboTimeout	INT32U	CF	dchg		AC_CO_O
sboClass	SboClasses	CF	dchg		AC_CO_O
minVal	AnalogValue	CF	dchg		O
maxVal	AnalogValue	CF	dchg		O
stepSize	AnalogValue	CF	dchg	1 ... (maxVal – minVal)	O
operTimeout	INT32U	CF	dchg		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
Parameters for control services					
ctlVal	AnalogValue	CO		stop | lower | higher | reserved	AC_CO_M
operTm	TimeStamp	CO			AC_CO_O
origin	Originator	CO, CR			AC_CO_M
ctlNum	INT8U	CO, CR		0..255	AC_CO_M
T	TimeStamp	CO, CR			AC_CO_M
Test	BOOLEAN	CO, CR		No-test (FALSE) | test (TRUE)	AC_CO_M
Check	PACKED LIST	CO			AC_CO_M
synchrocheck	BOOLEAN			Perform synchrocheck (TRUE)	
interlock-check	BOOLEAN			Check for interlocking conditions (TRUE)	
rspNegCause	AddCause	CR		0..255	AC_CO_E
Services					
As defined in Table 31					

7.6 Common data class specifications for status settings

7.6.1 Application of services

Table 39 defines the basic controllable status settings template. In particular, it defines the inheritance and specialisation of services defined in IEC 61850-7-2.

Table 39 – 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 GetDataDirectory	DC, CF, SP ALL ALL ALL			
Data set model	GetDataSetValues SetDataSetValues	ALL DC, CF			
Reporting model GSE model	Report SendGOOSEMessage	ALL SP		as specified within the data set that is used to define the content of the message	
Setting group control model	SetEditSGValues GetSGValues	SE SE, SG			

7.6.2 Single point setting (SPG)

Table 40 defines the common data class “single point setting”.

Table 40 – 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	dchg	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 39					

7.6.3 Integer status setting (ING)

Table 41 defines the common data class “integer status setting”.

Table 41 – 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	CtxInt	SP	dchg		AC_NSG_M
setVal	CtxInt	SG, SE			AC_SG_M
configuration, description and extension					
minVal	INT32	CF	dchg		O
maxVal	INT32	CF	dchg		O
stepSize	INT32U	CF	dchg	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 39					

7.6.4 Object reference setting group (ORG)

Table 41.1 defines the common data class “object reference setting group”.

NOTE This common data class is used to specify the object reference to the logical node of which the statistical data have been calculated. This CDC shall be used, i.e., for the DATA **CalcSrc** to be included in the “Optional Logical Node Information” of the Common Logical Node defined in IEC 61850-7-4:2003. The conceptual model of the statistical data model is defined in the first amendment to IEC 61850-7-1:2003.

Table 41.1 – Object reference setting group common data class specification

ORG 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					
setRef	VISIBLE STRING129	SP	dchg	Object Reference	AC_NSG_M
intAddr	VISIBLE STRING255	SP	dchg		AC_NSG_O
setRef	VISIBLE STRING129	SG, SE		Object Reference	AC_SG_M
intAddr	VISIBLE STRING255	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 39					

7.6.5 Time setting group (TSG)

Table 41.2 defines the common data class “Time setting group”.

Table 41.2 – Time setting group common data class specification

TSG 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					
setTm	TimeStamp	SP	dchg	Object Reference	AC_NSG_M
setTm	TimeStamp	SG, SE		Object Reference	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 39					

7.7 Common data class specifications for analogue settings

7.7.1 Application of services

Table 42 defines the basic controllable analogue information template. In particular, it defines the inheritance and specialisation of services defined in IEC 61850-7-2.

Table 42 – 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 GetDataDirectory	DC, CF, SP ALL ALL ALL			
Data set model	GetDataSetValues SetDataSetValues	ALL DC, CF			
Reporting model GSE model Sampled values model	Report SendGOOSEMessage SendGSSEMessage SendMSVMessage SendUSVMessage	ALL		as specified within the data set that is used to define the content of the message	
Setting group control model	SetEditSGValues GetSGValues	SE SE, SG			

7.7.2 Analogue setting (ASG)

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

Table 43 – 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)				
DataAttribute					
setting					
setMag	AnalogueValue	SP	dchg		AC_NSG_M
setMag	AnalogueValue	SG, SE			AC_SG_M
configuration, description and extension					
units	Unit	CF	dchg	see Annex A	O
sVC	ScaledValueConfig	CF	dchg		AC_SCAV
minVal	AnalogueValue	CF	dchg		O
maxVal	AnalogueValue	CF	dchg		O
stepSize	AnalogueValue	CF	dchg	0 ... (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 42					

7.7.3 Setting curve (CURVE)

Table 44 defines the common data class “setting curve”.

Table 44 – 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	dchg		AC_NSG_M
setParA	FLOAT32	SP	dchg		AC_NSG_O
setParB	FLOAT32	SP	dchg		AC_NSG_O
setParC	FLOAT32	SP	dchg		AC_NSG_O
setParD	FLOAT32	SP	dchg		AC_NSG_O
setParE	FLOAT32	SP	dchg		AC_NSG_O
setParF	FLOAT32	SP	dchg		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 42					

Data of this common data class shall be used to describe setting curves used in protection equipment. The CDC CURVE is used to select with the attribute setChar one of up to 48 predefined curve shapes. In some cases, in addition, parameters may be changed for the curves. The curve shapes are typically defined with formulas that use up to 6 parameters. Some of these formulas are standardised (value of setCharact between 1 and 16), other formulas may be user defined (value of setCharact between 17 and 32; the specification of the formula is a local issue). In some cases, the curve may be specified as an array of n (x,y) pairs (value of setChar between 33 and 48; the specification of the array of n(x,y) pairs is a local issue; a data of the CDC CSG may be used to specify each of the characteristics 33 to 48). The resulting curve may be read from the device using a dedicated data of the CDC CSD as defined in 7.9.4.

7.7.4 Curve shape setting (CSG)

Table 44.1 defines the common data class for curve shape setting.

Table 44.1 – Curve shape setting

CSG 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					
pointZ	FLOAT32	SP			AC_NSG_O
numPts	INT16U	SP		1 < numPts < maxPts-1	AC_NSG_M
crvPts	ARRAY 0..numPts-1 OF Point	SP			AC_NSG_M
pointZ	FLOAT32	SG, SE			AC_SG_O
numPts	INT16U	SG, SE		1 < numPts < maxPts-1	AC_SG_M
crvPts	ARRAY 0..numPts-1 OF Point	SG, SE			AC_SG_M
configuration, description and extension					
xUnit	Unit	CF			M
yUnit	Unit	CF			M
zUnit	Unit	CF			O
xD	VISIBLE STRING255	DC			M
xDU	UNICODE STRING255	DC			O
yD	VISIBLE STRING255	DC			M
yDU	UNICODE STRING255	DC			O
zD	VISIBLE STRING255	DC			O
zDU	UNICODE STRING255	DC			O
maxPts	INTEGER	CF			M
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 42					

The curve is created by the connection of crvPts[n] with crvPts[n+1] with 0<n<numPts.

A family of shape settings can be created by multiple instances of a data object with the CDC CSG. In that case, the common data attribute type Point used for crvPts shall not support the optional element z and the attribute pointZ is used to represent the value of the curve on the z Axis. The three dimensional shape is created by connecting the curves with each other.

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7.8 Common data class specifications for description information

7.8.1 Application of services

Table 45 defines the basic description information template. In particular, it defines the inheritance and specialisation of services defined in IEC 61850-7-2.

Table 45 – 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 GetDataDirectory	DC, CF ALL 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 content of the message	

7.8.2 Device name plate (DPL)

Table 46 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 46 – 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
owner	VISIBLE STRING255	DC			O
ePSName	VISIBLE STRING255	DC			O
role	VISIBLE STRING255	DC			O
primeOper	VISIBLE STRING255	DC			O
secondOper	VISIBLE STRING255	DC			O
latitude	FLOAT32	CF			O
longitude	FLOAT32	CF			O
altitude	FLOAT32	CF			O
tmOffset	INT16	CF			O
tmUseDT	BOOLEAN	CF			O
tmDT	BOOLEAN	ST	dchg		O
mrID	VISIBLE STRING255	CF			O
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 45					

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NOTE: the time related attributes are only of relevance for the physical name plate (not for the external equipment)

The change of the local time to daylight saving time can be a local issue. Optional, the change is possible through two settings: one with the UTC time of the next change to activate daylight saving time, one with the UTC time of the next change to deactivate daylight saving time.

7.8.3 Logical node name plate (LPL)

Table 47 defines the common data class “logical node name plate”. Data of this common data class are used to describe logical nodes.

Table 47 – 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
paramRev	INT32	ST	dchg		O
valueRev	INT32	ST	dchg		O
ldNs	VISIBLE STRING255	EX		shall be included in **LLN0** only; for example "IEC 61850-7-4:2003"	AC_LN0_EX
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 45					

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7.8.4 Curve shape description (CSD)

Table 48 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 48 – 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					
xUnits	Unit	DC			M
xD	VISIBLE STRING255	DC			M
xDU	UNICODE STRING255	DC			O
yUnits	Unit	DC			M
yD	VISIBLE STRING255	DC			M
yDU	UNICODE STRING255	DC			O
zUnits	Unit	DC			O
zD	VISIBLE STRING255	DC			O
zDU	UNICODE STRING255	DC			O
numPts	INT16U	DC		>1	M
crvPts	ARRAY 0..numPts-1 OF Point	DC			M
d	VISIBLE STRING255	DC			M
dU	UNICODE STRING255	DC			O
cdcNs	VISIBLE STRING255	EX			AC_DLNDA_M
cdcName	VISIBLE STRING255	EX			AC_DLNDA_M

Comment [CB11]: Correction of naming inconsistency (email CB 31.10.07)

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dataNs	VISIBLE STRING255	EX			AC_DLN_M
Services					
As defined in Table 45					

The curve is created by the connection of crvPts[n] with crvPts[n+1] with 0<n<numPts.

8 Data attribute semantic

The data attributes, controllable parameters and in some case data used in Clause 7 shall have semantics as defined in Table 49.

Table 49 – Semantics of data attributes and data

Data attribute name	Semantics
actVal	Binary counter status represented as an integer value.
addInfo	Additional information that may give further clarification as to the last detected violation.
addr	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.
altitude	Geographical position of device in WGS84 coordinates – altitude
angRef	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.
angSVC	Scaled value configuration for angles. Shall be used to configure the scaled value representation of the angle in a vector.
c1	Sequence component 1. For the semantic meaning see seqT.
c2	Sequence component 2. For the semantic meaning see seqT.
c3	Sequence component 3. For the semantic meaning see seqT.
cdcName	Name of the common data class. Used together with cdcNs, for details see IEC 61850-7-1.
cdcNs	Common data class name space. For details see IEC 61850-7-1.
Check	The parameter Check shall specify the kind of checks a control object shall perform before issuing a control operation. The parameter is applicable for the following services: SelVal (Request) Operate (Request) TimOper (Request) The parameter only needs to be considered if synchrocheck and interlock are used for the controlled item.
cnt	Counter value of security violations.
configRev	Uniquely identifies the configuration of a logical device instance. ConfigRev in LLN0 (at LD level) has to be changed at least on any semantic change of the data model of this LD related to the client functionality. How this is detected and performed is left to the user. Also the semantics of configRev concerning other LNs is left to the user. For further details see as well Annex C.
crvPts	The array with the points specifying a curve shape

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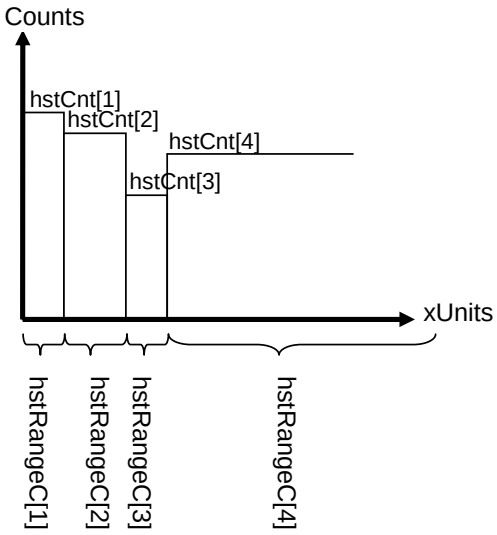
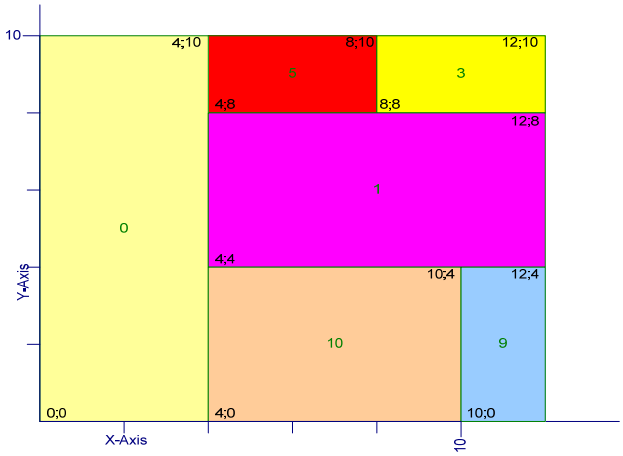
<table>
<tr><th>Data attribute name</th><th>Semantics</th></tr>
<tr><td>ctlModel</td><td>Specifies the control model of IEC 61850-7-2 that corresponds to the behaviour of the data.
<table>
<tr><th>Value</th><th>Explanation</th></tr>
<tr><td>status-only</td><td>The object is not controllable, only the 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 of the status attribute (FC=ST) ctlNum 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.
As a service parameter (FC=CO, CR), CtlNum is applicable for the following services:
SelVal (Request, Response+, Response-)
Operate (Request, Response+, Response-)
TimOper (Request, Response+, Response-)</td></tr>
<tr><td>ctlVal</td><td>Service parameter (FC=CO, CR) that 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.
The service parameter is applicable for the following services:
SelVal (Request, Response+, Response-)
Operate (Request, Response+, Response-)
TimOper (Request, Response+, Response-)</td></tr>
<tr><td>cVal</td><td>Deadbanded complex value. Based on a deadband calculation from instCVal. The deadband calculation is done both on instCVal.mag based on the configuration parameter db as well as on instCVal.ang based on the configuration parameter dbAng independently. For details on deadband calculation, see mag.</td></tr>
<tr><td>d</td><td>Textual description of the data. In case of the common data class LPL, the description refers to the logical node.</td></tr>
<tr><td>dataNs</td><td>Data name space. For details see IEC 61850-7-1.</td></tr>
<tr><td>db</td><td>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 %.
If an integral calculation is used to determine the deadbanded value, the value shall be represented as 0,001 % s.</td></tr>
<tr><td>dbAng</td><td>Deadband for angles. Shall represent a configuration parameter used to calculate deadbanded attributes for the angle in the case the data attribute is of the common data attribute type Vector (for example cVal attribute of the CDC CMV). The value shall represent the percentage of difference between max and min in units of 0,001 %.
If an integral calculation is used to determine the deadbanded value, the value shall be represented as 0,001 % s.</td></tr>
</table>

Comment [CB12]: Editor Meeting July 07

Data attribute name	Semantics
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.
ePSName	Name of electric power system the device is connected to
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	Logical "or" of the phase values, for example trip or start. 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.

<table>
<tr><th>Data attribute name</th><th>Semantics</th></tr>
<tr><td></td><td>This array shall contain the values for the histogram entries. A histogram can be calculated based on a onedimensional or a twodimensional range. Details of a one dimensional histogram representation are shown in the figure below.
 

A histogram evaluates a series of values and counts the appearance of a value in a certain range. The value range is configured with the configuration attribute hstRangeC. The attribute hstCnt[1] shall be the count of the appearance of the evaluated values in the range hstRangeC[1]. For a two dimensional histogram, the range can be as shown in the following figure. Each of the squares represents one range; there is no rule, how to order the ranges.
 

For that example, the values would be as follows:
<table>
<tr><td>index</td><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td></tr>
<tr><td>hstCnt</td><td>0</td><td>10</td><td>9</td><td>1</td><td>5</td><td>3</td></tr>
<tr><td>hstRangeC</td><td>0;0 / 4;10</td><td>4;0 / 10,4</td><td>10;0 / 12;4</td><td>4;4 / 12;8</td><td>4;8 / 8;10</td><td>8;8 / 12;10</td></tr>
</table></td></tr>
<tr><td>hstRangeC</td><td>This array shall contain the values for the configuration of the ranges for the histogram. For details see hstCnt.</td></tr>
<tr><td>hvRef</td><td>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.</td></tr>
</table>

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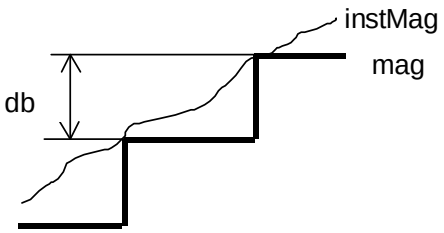
Deleted: hstRangeUnit ... [6]

Data attribute name	Semantics
hwRev	HW-revision.
intAddr	this value represents a manufacturer specific internal address
instCVal	Instant value of a vector type value.
instMag	Magnitude of the instantaneous value of a measured value. NOTE – The presence of the attribute instMag is optional, That only affects the visibility of that value to the communication. The instantaneous value may be required for the internal behaviour of the function, e.g. to perform the deadband calculation as explained with the attribute mag.
latitude	Geographical position of device in WGS84 coordinates – latitude
ldNs	Logical device name space. For details see IEC 61850-7-1.
lnNs	Logical node name space. For details see IEC 61850-7-1.
location	Location, where the equipment is installed.
longitude	Geographical position of device in WGS84 coordinates – longitude
mag	Deadbanded value. Shall be based on a dead band calculation from the instantaneous value (modelled as instMag) as illustrated below. The value of mag shall be updated to the current instantaneous value when the value has changed according the configuration parameter db. If db=0, the value of mag is identical to the value of instMag.  NOTE 3 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 4 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. NOTE – the data attribute mag explained here is not the same like the data attribute component mag of the common data attribute type vector. Therefore in particular the value instCVal.mag is NOT a deadbanded value.
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).
maxPts	The maximal number of points that is supported to be set as number of points for a given curve setting.
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.
mrID	Master resource ID – unique identification of an asset or device.
mxVal	Measured analogue process value. The return information with the current value of the controllable analogue process value. ~~The value can be dead banded for reporting.~~

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Comment [CB13]: May need to be revised??

Data attribute name	Semantics
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. For further details see phsA (WYE)
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 the measured phase neutral. If a direct measurement of this value is not available, it is acceptable to substitute an estimate computed by creating the algebraic sum of the instantaneous values of currents flowing through all live conductors. In that case, 'neut' is identical to 'res'. For further details see phsA (WYE).
neut (ACT, ACD)	Start event with earth current.
neutHar	This array shall contain the harmonic and subharmonics or interharmonic values related to neutral. For further details see Har.
numCyc	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 can be accessed. The range of the numHar value shall be 1 or greater. The array element "1" shall represent the first harmonic value. The value 0 shall refer to the dc component. The maximal value for numHar may be calculated as follows: $numHar = \frac{1}{2} \times smpRate \times frequency \times evalTm \times 2^{numCycl-1} + 1$
numPts	Number of points used to define a curve or a histogram.
operTimeout	This attribute specifies the timeout used to supervise an operation according the control model defined in IEC 61850-7-2. It applies to the control models with enhanced security and is the time after which a negative command termination is sent if an operation does not terminate successful with an indication of a new valid state. The value shall be in ms.
operTm	If the service TimeActivatedOperate is performed, then this attribute shall specify the absolute time when the command shall be executed. The service parameter is applicable for the following services: SelVal (Request, Response+, Response-) Operate (Request, Response+, Response-) TimOper (Request, Response+, Response-)
operTmPhsA	Operation Time for Phase A. Is used for point on wave switching.
operTmPhsB	Operation Time for Phase B. Is used for point on wave switching.
operTmPhsC	Operation Time for Phase C. Is used for point on wave switching.
origin	As a status attribute (FC=ST), this contains information related to the originator of the last change of the controllable value of the data. As a service parameter (FC=CO, CR), origin is applicable for the following services: SelVal (Request, Response+, Response-) Operate (Request, Response+, Response-) TimOper (Request, Response+, Response-)
owner	Owner of the device
paramRev	Uniquely identifies the parameter revision of a logical device or logical node instance. ParamRev has to be changed at least on any change of a parameter within this logical device or logical node. How this is detected and performed is left to the user. For further details see as well Annex C. The change of ParamRev shall be done with the following semantic: - if the parameter change is done in the IED only through communication services or through the local HMI, the value shall be increased by one - if the parameter change is done in the configuration file, the value shall be increased by 10'000.

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Data attribute name	Semantics
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.
pointZ	position of the curve on z-axis.
primeOper	Primary operator of device
pulseConfig	Used to configure the output pulse generated with the command if applicable.
pulsQty	Magnitude of the counted value per count. actVal/frVal and pulsQty are used to calculate the value: $value = actVal \times pulsQty$ $value = frVal \times pulsQty$

<table>
<tr><th>Data attribute name</th><th>Semantics</th></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>HST</td><td>hstCnt</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>mxVal</td></tr>
<tr><td>BAC</td><td>mxVal</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>max</td><td>high-high</td><td>questionable</td><td>outOfRange</td></tr>
<tr><td>hhLim</td><td>high-high</td><td>good</td><td></td></tr>
<tr><td>hLim</td><td>high</td><td>good</td><td></td></tr>
<tr><td>lLim</td><td>normal</td><td>good</td><td></td></tr>
<tr><td>llLim</td><td>low</td><td>good</td><td></td></tr>
<tr><td>min</td><td>low-low</td><td>good</td><td></td></tr>
<tr><td></td><td>low-low</td><td>questionable</td><td>outOfRange</td></tr>
</table>
NOTE 5 The use of algorithms to filter events based on transition from one range to another is a local issue.
NOTE 6 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>rangeAng</td><td>Range in which the current value of instCVal.ang is. For further details see range</td></tr>
<tr><td>rangeAngC</td><td>Configuration parameters as used in the context with the rangeAng attribute.</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. For further details see phsA (WYE)</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>rmsCyc</td><td>Number of cycles of power frequency, which are used for the calculation of rms values.</td></tr>
<tr><td>role</td><td>Role of the device</td></tr>
</table>

<table>
<tr><th>Data attribute name</th><th>Semantics</th></tr>
<tr><td>rspNegCause</td><td>The data attribute (FC=CN) contains the reason for a failure in the last negative response control service response

As a service parameter (FC=CR), rspNegCause can be applicable (depending on the control model associated to the controlled object; see condition AC_CO_E) for the following services:

SelVal (Response-)
Cancel (Response-)
Operate (Response-)
TimOper (Response-)
CmdTerm (Response-)</td></tr>
<tr><td>rspNegT</td><td>The data attribute contains the time stamp of the data attribute rspNegCause (i.e. the time stamp of the last negative response on a control service)</td></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 between a select and an operate command according to the control model of IEC 61850-7-2. The value shall be in ms.</td></tr>
<tr><td>secondOper</td><td>Secondary operator of device</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>
</table>

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<table>
<tr><th>Data attribute name</th><th>Semantics</th></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 (setParA, ..., set ParF) 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 can be performed using data of CDC = CSG where applicable. Otherwise it 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 16 defined by n pairs (x,y)</td></tr>
</table></td></tr>
<tr><td>setParA</td><td>Attribute used to set the parameter A of the setting curve (see detailed description under setCharact).</td></tr>
<tr><td>setParB</td><td>Attribute used to set the parameter B of the setting curve (see detailed description under setCharact).</td></tr>
<tr><td>setParC</td><td>Attribute used to set the parameter C of the setting curve (see detailed description under setCharact).</td></tr>
<tr><td>setParD</td><td>Attribute used to set the parameter D of the setting curve (see detailed description under setCharact).</td></tr>
<tr><td>setParE</td><td>Attribute used to set the parameter E of the setting curve (see detailed description under setCharact).</td></tr>
<tr><td>setParF</td><td>Attribute used to set the parameter F of the setting curve (see detailed description under setCharact).</td></tr>
<tr><td>setRef</td><td>The value of an object reference setting. The attribute may be used to reference a logical node instance.</td></tr>
<tr><td>setMag</td><td>The value of an analogue setting or set point.</td></tr>
<tr><td>setTm</td><td>The value of a time setting.</td></tr>
<tr><td>setVal</td><td>The value of a status setting.</td></tr>
</table>

<table>
<tr><th>Data attribute name</th><th>Semantics</th></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, APC, BAC), setVal (CDC ING) or setMag (CDC 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>
<tr><td>APC</td><td>mxVal and subVal; q and subQ</td></tr>
<tr><td>BAC</td><td>mxVal 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>
<tr><td>subQ</td><td>Value used to substitute the data attribute q.</td></tr>
</table>

Comment [CB16]: May need to be updated?

Deleted: APC,

<table>
<tr><th>Data attribute name</th><th>Semantics</th></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>
<tr><td>APC</td><td>mxVal</td></tr>
<tr><td>BAC</td><td>mxVal</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>T shall be the time, when the client sends the service request. The parameter is applicable for the following services:

SelVal (Request, Response+, Response-)
Cancel (Request, Response+, Response-)
Operate (Request, Response+, Response-)
CmdTerm (Response+, Response-)
TimOper (Request, Response+, Response-)</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>HST</td><td>hstCnt</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>mxVal</td></tr>
<tr><td>BAC</td><td>mxVal</td></tr>
</table></td></tr>
<tr><td>Test</td><td>The parameter shall define, whether the information exchange is for test or for normal operation. The parameter is applicable for the following services:

SelVal (Request, Response+, Response-)
Cancel (Request, Response+, Response-)
Operate (Request, Response+, Response-)
CmdTerm (Response+, Response-)
TimOper (Request, Response+, Response-)</td></tr>
<tr><td>tmOffset</td><td>Offset of local time from UTC in minutes</td></tr>
<tr><td>tmUseDT</td><td>Flag indicating if this location is using daylight saving time</td></tr>
<tr><td>tmDT</td><td>Flag indicating if for this location daylight saving time is in effect now</td></tr>
</table>

<table>
<tr><th>Data attribute name</th><th>Semantics</th></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>valRev</td><td>Uniquely identifies the revision of the preconfiguration of configuration values (FC= CF, FC=ST) in a logical device or logical node instance through a SCL file. ValRev has to be changed at least on any change of preconfigured values within an SCL file for this logical device or logical node. How this is detected and performed is left to the user. For further details see as well Annex C.
The change of ValueRev shall be done with the following semantic:
- if the value change is done in the IED only through communication services or through the local HMI, the value shall be increased by one
- if the value change is done in the configuration file, the value shall be increased by 10'000.</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>xDU</td><td>Description of the value of the x-axis of a curve in UNICODE.</td></tr>
<tr><td>xUnits</td><td>Unit of the x-axis of a curve.</td></tr>
<tr><td>yD</td><td>Description of the value of the y-axis of a curve.</td></tr>
<tr><td>yDU</td><td>Description of the value of the x-axis of a curve in UNICODE.</td></tr>
<tr><td>yUnits</td><td>Unit of the y-axis of a curve.</td></tr>
<tr><td>zD</td><td>Description of the value of the z-axis of a curve.</td></tr>
<tr><td>zDU</td><td>Description of the value of the x-axis of a curve in UNICODE.</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>
<tr><td>zUnits</td><td>Unit of the z-axis of a curve.</td></tr>
</table>

Comment [CB17]: Editor Meeting July 07

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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 (V/A)	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

Value	Quantity	Unit name	Symbol
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)	m/m^3
47	Moment of mass	kilogram meter (kg m)	M
48	Density	kilogram/cubic meter (kg/m^3)	kg/m^3
49	Viscosity	meter square/second (m^2/s)	m^2/s
50	Thermal conductivity	watt/meter Kelvin (W/m K)	W/m K
51	Heat capacity	joule/Kelvin (J/K)	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
75	Rate of change of frequency	hertz per second	Hz/s
76	Number of characters	characters	char
77	Baud	characters per second	char/s
78	Turbine inertia	kg square meter	kgm^2
79	Sound pressure level	dezibel	dB

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
0	1		
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}	Peta	P
18	10^{18}	Exa	E
21	10^{21}	Zetta	Z
24	10^{24}	Yotta	Y

NOTE – A value that is representing a percentage can use the unit 1 (dimensionless) and a multiplier -2.

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

Functional constraint (FC)					
	Semantic	**Services allowed**	**Initial values/storage/ explanation**	**D[a]**	**CB[b]**
ST	Status information	**DataAttribute** shall represent a status information whose value may be read, substituted, reported, and logged but shall not be written	Initial value of the **DataAttribute** shall be taken from the process	X	
MX	Measurands (analogue values)	**DataAttribute** shall represent a measurand information whose value may be read, substituted, reported, and logged but shall not be written	Initial value of the **DataAttribute** shall be taken from the process	X	
CO	Control	**DataAttribute** shall represent a control information whose value may be operated (control model) and read	N.a.	X	
CR		***Update with text from 7-2***			
CN		***Update with text from 7-2***			
SP	Setpoint	**DataAttribute** shall represent a set-point information whose value may be controlled (control model) and read. Values controlled shall become effective immediately	Initial value of the **DataAttribute** shall be as configured; value shall be non-volatile	X	X
SV	Substitution	**DataAttribute** shall represent a substitution information whose value may be written to substitute the value attribute and read	If the value of the **DataAttribute** is volatile then the initial value shall be FALSE, else the value should be as set or configured	X	
CF	Configuration	**DataAttribute** shall represent a configuration information whose value may be written and read. Values written may become effective immediately or deferred by reasons outside the scope of this standard	Initial value of the **DataAttribute** shall be as configured; value shall be non-volatile	X	
DC	Description	**DataAttribute** shall represent a description information whose value may be written and read	Initial value of the **DataAttribute** shall be as configured; value shall be non-volatile	X	
SG	Setting group	Logical devices that implement the **SGCB** class maintain multiple grouped values of all instances of **DataAttributes** with functional constraint SG. Each group contains one value for each **DataAttribute** with functional constraint SG which shall be the current active value (for details see 13). Values the of **DataAttributes** with **FC**=**SG** shall not be writeable	Initial value of the **DataAttribute** shall be as configured; value shall be non-volatile	X	
SE	Setting group editable	**DataAttribute** which can be edited by **SGCB** services	Value of the **DataAttribute** shall be as available after **SelectEditSG** service has been processed	X	
EX	Extended definition	**DataAttribute** shall represent an extension information providing a reference to a name space. Extensions are used in conjunction with extended definitions of **LNs**, **DATA**, and **DataAttributes** in 61850-7-3 and IEC 61850-7-4. Values the of **DataAttributes** with	Value of the **DataAttribute** shall be as configured; value shall be non-volatile	X	

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Functional constraint (FC)					
	Semantic	**Services allowed**	**Initial values/storage/ explanation**	**D[a]**	**CB[b]**
		FC=**EX** shall not be writeable			

Functional constraint (FC)					
	Semantic	**Services allowed**	**Initial values/storage/ explanation**	**D[a]**	**CB[b]**
BR	Buffered report [c]	**Attribute** shall represent a report control information of a **BRCB** whose value may be written and read	Initial value of the **Attribute** shall be as configured; value shall be non-volatile		X
RP	Unbuffered report [c]	**Attribute** shall represent a report control information of a **URCB** whose value may be written and read	Initial value of the **Attribute** shall be as configured; value shall be non-volatile		X
LG	Logging [c]	**Attribute** shall represent a log control information of a **LCB** whose value may be written and read	Initial value of the **Attribute** shall be as configured; value shall be non-volatile		X
GO	Goose control [c]	**Attribute** shall represent a goose control information of a **GoCB** whose value may be written and read	Initial value of the **Attribute** shall be as configured; value shall be non-volatile		X
GS	Gsse control [c]	**Attribute** shall represent a goose control information of a **GsCB** whose value may be written and read	Initial value of the **Attribute** shall be as configured; value shall be non-volatile		X
MS	Multicast sampled value control [c]	**Attribute** shall represent a sampled value control information of a **MSVCB** whose value may be written and read	Initial value of the **Attribute** shall be as configured; value shall be non-volatile		X
US	Unicast sampled value control [c]	**Attribute** shall represent a sampled value control information of an instance of a UNICAST-SVC whose value may be written and read	Initial value of the **Attribute** shall be as configured; value shall be non-volatile		X
XX	Representing all **DataAttributes** as a service parameter	Shall represent all **DataAttributes** of a **DATA** (of any **FC**) to be accessed, for example, to be written and read. The FC value "xx" shall only be used in the functionally constrained data (**FCD**); "XX" shall not be used as **FC** value in a **DataAttribute**	"XX" shall be used as a wildcard in services only		

NOTE The possibility to write an **Attribute** or a **DataAttribute** may be further constrained by a view or an implementation.

[a] Column D indicates the use of the **FC** in the definition of **DATA** (i.e. common **DATA** classes in IEC 61850-7-3).

[b] Column CB indicates the use of the **FC** in the definition of control blocks in this part of IEC 61850.

[c] Reserved for control classes in this part of IEC 61850.

Annex C
(normative)

Tracking of configuration revisions

		Issue	Impact / Comment	Where is the change made?		confRev	paramRev	valueRev	confRev
				in config file	in IED only				
Configuration	Data Model & Semantic	Semantic change within a logical device / logical node	A logical node gets a new semantic use; e.g. a instance of a LN CSWI is now serving a different physical switch or an instance of a logical node PDIS is now used for another zone A data gets a new semantic use; e.g. the use of GGIO.Alm1 changes from "Door open" to "Fire alarm"			x			
		Change of domain data model (Presence of LNs, Data, Data Attributes; Instance names)	available information identification of the information	Through IED configuration tool		x			
	Communication behaviour	Content of data sets; presence of data sets and control blocks	Subscribers of GOOSE or sampled value messages may be affected Preconfigured clients for reporting are affected	Through system or IED configuration tool	Communication services (where applicable) or local HMI				x
Operation / pre configuration		Enabling and disabling control blocks		Through system or IED configuration tool (Pre configuration)					
		changing selected values of control blocks (for details, see IEC 61850-7-2)	Message content may not be as expected (reference to data set may change) For sampled values, sample rate may be changed For sampled values, message structure may be changed						x
	Settings and setting groups	Editing values of setting groups (SE)		Through IED configuration tool (Pre configuration)			x		
		Change of a setting (SP)					x		
		Change of the active setting group (SG)	Preconfigured active setting group Change online of active SG through specific service						
	Configuration attributes	Change of the value of a CF attribute						x	
								x	

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Comment [CB18]: Changes done during Editor meeting July 07

Deleted: Message content may not be as expected (reference to data set may change)¶
For sampled values, sample rate may be changed¶
For sampled values, message structure may be changed

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Deleted: Preconfigured value¶
Changes online only through control services

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Change of the value of a ST attribute

Deleted: and status

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numPts	INT16U	ST		>1	M

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hstRangeUnits	Unit	CF	dchg		M

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controllable parameters

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xUnit	Unit	SP			AC_NSG_M
xD	VISIBLE STRING255	SP			AC_NSG_M
yUnit	Unit	SP			AC_NSG_M
yD	VISIBLE STRING255	SP			AC_NSG_M

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xUnit	Unit	SG, SE			AC_SG_M
xD	VISIBLE STRING255	SG, SE			AC_SG_M
yUnit	Unit	SG, SE			AC_SG_M
yD	VISIBLE STRING255	SG, SE			AC_SG_M

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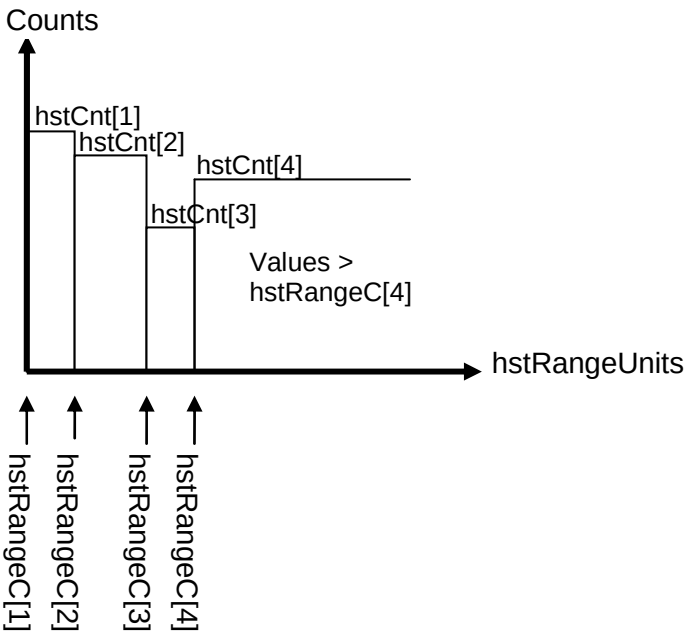
hstRangeUnit	This attribute shall represent the unit of the values that are evaluated with a histogram. For details see hst.
hstVal	This array shall contain the values for the histogram entries. Details of the histogram representation are shown in the figure below.  A histogram evaluates a series of values and counts the appearance of a value in a certain range. The value range is configured with the configuration attribute hstRangeC. The attribute hstCnt[1] shall be the count of the appearance of the evaluated values in the range between hstRangeC[1] and hstRangeC[2].