# 57/622/FDIS

**FINAL DRAFT INTERNATIONAL STANDARD**
**PROJET FINAL DE NORME INTERNATIONALE**

| | | |
|---|---|---|
| | Project number / Numéro de projet: **IEC 61850-7-4 Ed.1** | |
| | IEC/TC or SC CEI/CE ou SC **TC 57** | Secretariat / Secrétariat **Germany** |
| ☒ Submitted for parallel voting in CENELEC<br>Soumis au vote parallèle au CENELEC | Distributed on / Diffusé le **2003-01-17** | Voting terminates on / Vote clos le **2003-03-21** |

| | |
|---|---|
| Also of interest to the following committees<br>Intéresse également les comités suivants<br>TC 95 | Supersedes document<br>Remplace le document<br>57/520/CDV - 57/594/RVC |

Functions concerned
Fonctions concernées

| | | | |
|---|---|---|---|
| ☐ Safety<br>Sécurité | ☐ EMC<br>CEM | ☐ Environment<br>Environnement | ☐ Quality assurance<br>Assurance de la qualité |

INTERNATIONAL ELECTROTECHNICAL COMMISSION — COMMISSION ÉLECTROTECHNIQUE INTERNATIONALE

THIS DOCUMENT IS A DRAFT DISTRIBUTED FOR APPROVAL. IT MAY NOT BE REFERRED TO AS AN INTERNATIONAL STANDARD UNTIL PUBLISHED AS SUCH.

IN ADDITION TO THEIR EVALUATION AS BEING ACCEPTABLE FOR INDUSTRIAL, TECHNOLOGICAL, COMMERCIAL AND USER PURPOSES, FINAL DRAFT INTERNATIONAL STANDARDS MAY ON OCCASION HAVE TO BE CONSIDERED IN THE LIGHT OF THEIR POTENTIAL TO BECOME STANDARDS TO WHICH REFERENCE MAY BE MADE IN NATIONAL REGULATIONS.

CE DOCUMENT EST UN PROJET DIFFUSÉ POUR APPROBATION. IL NE PEUT ÊTRE CITÉ COMME NORME INTERNATIONALE AVANT SA PUBLICATION EN TANT QUE TELLE.

OUTRE LE FAIT D'ÊTRE EXAMINÉS POUR ÉTABLIR S'ILS SONT ACCEPTABLES À DES FINS INDUSTRIELLES, TECHNOLOGIQUES ET COMMERCIALES, AINSI QUE DU POINT DE VUE DES UTILISATEURS, LES PROJETS FINAUX DE NORMES INTERNATIONALES DOIVENT PARFOIS ÊTRE EXAMINÉS EN VUE DE LEUR POSSIBILITÉ DE DEVENIR DES NORMES POUVANT SERVIR DE RÉFÉRENCE DANS LES RÈGLEMENTATIONS NATIONALES.

Title

# Communication networks and systems in substations - Part 7-4: Basic communication structure for substation and feeder equipment - Compatible logical node classes and data classes

Titre

**ATTENTION**
**VOTE PARALLÈLE**
**CEI – CENELEC**

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

**ATTENTION**
**IEC – CENELEC**
**PARALLEL VOTING**

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

# CONTENTS

FOREWORD ... 4
INTRODUCTION ... 6

1 Scope ... 7
2 Normative references ... 8
3 Terms and definitions ... 9
4 Abbreviated terms ... 9
5 Logical node classes ... 13
5.1 Logical Node groups ... 13
5.2 Interpretation of Logical Node tables ... 14
5.3 System Logical Nodes LN Group: L ... 15
5.4 Logical Nodes for protection functions LN Group: P ... 17
5.5 Logical Nodes for protection related functions LN Group: R ... 33
5.6 Logical Nodes for control LN Group: C ... 40
5.7 Logical nodes for generic references LN Group: G ... 42
5.8 Logical Nodes for interfacing and archiving LN Group: I ... 44
5.9 Logical Nodes for automatic control LN Group: A ... 45
5.10 Logical Nodes for metering and measurement LN Group: M ... 47
5.11 Logical Nodes for sensors and monitoring LN Group: S ... 54
5.12 Logical Nodes for switchgear LN Group: X ... 56
5.13 Logical Nodes for instrument transformers LN Group: T ... 58
5.14 Logical Nodes for power transformers LN Group: Y ... 59
5.15 Logical Nodes for further power system equipment LN Group: Z ... 61
6 Data name semantics ... 66

Annex A (normative) Extension rules ... 87
A.1 The use of Logical Nodes and Data and its extensions ... 87
A.2 Multiple instances of LN classes for dedicated and complex functions ... 87
A.3 Specialisation of Data by use of the number extension ... 88
A.4 Rules for names of new Logical Nodes ... 88
A.5 Examples for new LNs ... 89
A.6 Rules for names of new Data ... 89
A.7 Example for new Data ... 89
A.8 Rules for new Common Data Classes (CDC) ... 90
Annex B (informative) Modelling examples ... 91
B.1 PTEF and PSDE ... 91
B.2 PSCH and PTRC ... 92
B.3 MDIF and PDIF ... 93
B.4 RDRE and Disturbance Recorder ... 94
B.5 PTRC ... 95
B.6 PDIR ... 96
B.7 RREC ... 97
B.8 PDIS ... 98
Annex C (informative) Relationship between this standard and IEC 61850-5 ... 100

Figure 1 – Overview of this standard ........ 8
Figure 2 – LN Relationships ........ 15
Figure B.1 – Fault current $I_F$ in a compensated network with earth fault ........ 91
Figure B.2 – Use of PSCH and PTRC ........ 92
Figure B.3 – Use of MDIF and PDIF ........ 93
Figure B.4 – Modelling of Disturbance Recorder ........ 94
Figure B.5 – Examples for allocation of Logical Nodes to IEDs ........ 95
Figure B.6 – Use of PDIR ........ 96
Figure B.7 – Use of RREC ........ 97

Table 1 – List of Logical Node Groups ........ 13
Table 2 – Interpretation of Logical Node tables ........ 14
Table 3 – Relation between IEC 61850-5 and IEC 61850-7-4 (this standard) for protection LNs ........ 18
Table 4 – Relation between IEC 61850-5 and IEC 61850-7-4 for protection related LNs ........ 33
Table 5 – Relation between IEC 61850-5 and IEC 61850-7-4 for control LNs ........ 40
Table 6 – Relation between IEC 61850-5 and IEC 61850-7-4 for automatic control LNs ........ 45
Table 7 – Relation between IEC 61850-5 and IEC 61850-7-4 for metering and measurement LNs ........ 47
Table 8 – Relation between IEC 61850-5 and IEC 61850-7-4 for sensors and monitoring LNs ........ 54
Table 9 – Description of Data ........ 66
Table C.1 – Relationship between IEC 61850-5 and this standard for some miscellaneous LNs ........ 100

INTERNATIONAL ELECTROTECHNICAL COMMISSION

# COMMUNICATION NETWORKS AND SYSTEMS IN SUBSTATIONS –

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

## FOREWORD

1) The IEC (International Electrotechnical Commission) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of the IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, the IEC publishes International Standards. Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. The IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
2) The formal decisions or agreements of the IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested National Committees.
3) The documents produced have the form of recommendations for international use and are published in the form of standards, technical specifications, technical reports or guides and they are accepted by the National Committees in that sense.
4) In order to promote international unification, IEC National Committees undertake to apply IEC International Standards transparently to the maximum extent possible in their national and regional standards. Any divergence between the IEC Standard and the corresponding national or regional standard shall be clearly indicated in the latter.
5) The IEC provides no marking procedure to indicate its approval and cannot be rendered responsible for any equipment declared to be in conformity with one of its standards.
6) Attention is drawn to the possibility that some of the elements of this International Standard may be the subject of patent rights. The IEC shall not be held responsible for identifying any or all such patent rights.

International Standard IEC 61850-7-4 has been prepared by IEC technical committee 57: Power system control and associated communications.

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

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

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

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

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

Part 1: Basic principles [2]

Part 2: Glossary [1]

Part 3: General requirements

Part 4: System and project management

Part 5: Communication requirements for functions and device models [2]

Part 6: Configuration description language for communication in electrical substations related to IEDs [1]

Part 7-1: Basic communication structure for substation and feeder equipment – Principles and models [2]

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

Part 7-3: Basic communication structure for substation and feeder equipment – Common data classes [2]

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 [1]

Part 9-1: Specific communication service mapping (SCSM) – Sampled values over serial unidirectional multidrop point to point link [2]

Part 9-2: Specific communication service mapping (SCSM) – Sampled values over ISO/IEC 8802-3 [1]

Part 10: Conformance testing [1]

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 and Feeder Equipment (GOMSFE) (IEEE TR 1550);
- CIGRE Report 34-03, Communication requirements in terms of data flow within substations, December 1996.

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

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

---

[1] Under consideration.

[2] To be published.

# INTRODUCTION

This part of IEC 61850 is a set of specifications. The complete set of specifications defines a 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, implementations, and operating systems. 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 and in IEC 61850-9-x.

IEC 61850-7-1 gives an overview of this communication architecture. IEC 61850-7-3 defines common attribute types and common data classes related to substation applications. The attributes of the common data classes may be accessed using services defined in IEC 61850-7-2. These common data classes are used in this part to define the compatible data classes.

To reach interoperability, all data to be exchanged need a strong definition with regard to syntax and semantics. The semantics of the data is mainly provided by names assigned to logical nodes and data they contain, as defined in this part. Interoperability is easiest if as much as possible of the data are defined as mandatory. Because of different philosophies and technical features, settings were declared as optional in this edition of the standard. After some experience has been gained with this standard, this decision may be reviewed in an amendment or in the next revision of this part.

It should be noted that data with full semantics is only one of the elements required to achieve interoperability. Since data and services are hosted by devices (IED), a proper device model is needed along with compatible, domain specific services (see IEC 61850-7-2).

The compatible logical node name and data name definitions found in this part and the associated semantics are fixed. The syntax of the type definitions of all data classes are abstract definitions provided in IEC 61850-7-2 and IEC 61850-7-3. Not all features of logical nodes are listed in this part for example data sets and logs are covered in IEC 61850-7-2.

# COMMUNICATION NETWORKS AND SYSTEMS IN SUBSTATIONS

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

## 1 Scope

This part of IEC 61850 specifies the information model of devices and functions related to substation applications. In particular, it specifies the compatible logical node names and data names for communication between Intelligent Electronic Devices (IED). This includes the relationship between Logical Nodes and Data.

The Logical Node Names and Data Names defined in this document are part of the class model introduced in IEC 61850-7-1 and defined in IEC 61850-7-2. The names defined in this document are used to build the hierarchical object references applied for communicating with IEDs in substations and on distribution feeders. The naming conventions of IEC 61850-7-2 are applied in this part.

To avoid private, incompatible extension rules this part specifies normative naming rules for multiple instances and private extensions of Logical Node (LN) Classes and Data Names.

In Annex A, all rules with examples are given for:

- multiple instances of logical node classes by use of a LN instance identification (ID);
- multiple instances of data by use of a data instance ID;
- selecting missing data out of the complete data name set;
- creating new logical node classes and data names.

In Annex B, examples are given for:

- the use of Logical Nodes in complex situations like line protection schemes;
- multiple instances of Logical Nodes with different levels of functionality.

This part does not provide tutorial material. It is recommended those parts IEC 61850-5 and IEC 61850-7-1 be read first, in conjunction with IEC 61850-7-3, and IEC 61850-7-2. This part does not discuss implementation issues. The relationship between this standard and IEC 61850-5 is outlined in Annex C.

This standard is applicable to describe device models and functions of substation and feeder equipment. The concepts defined in this standard may also be applied 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,
- information exchange for distributed automation, or
- information exchange for metering.

Figure 1 provides a general overview of this document.

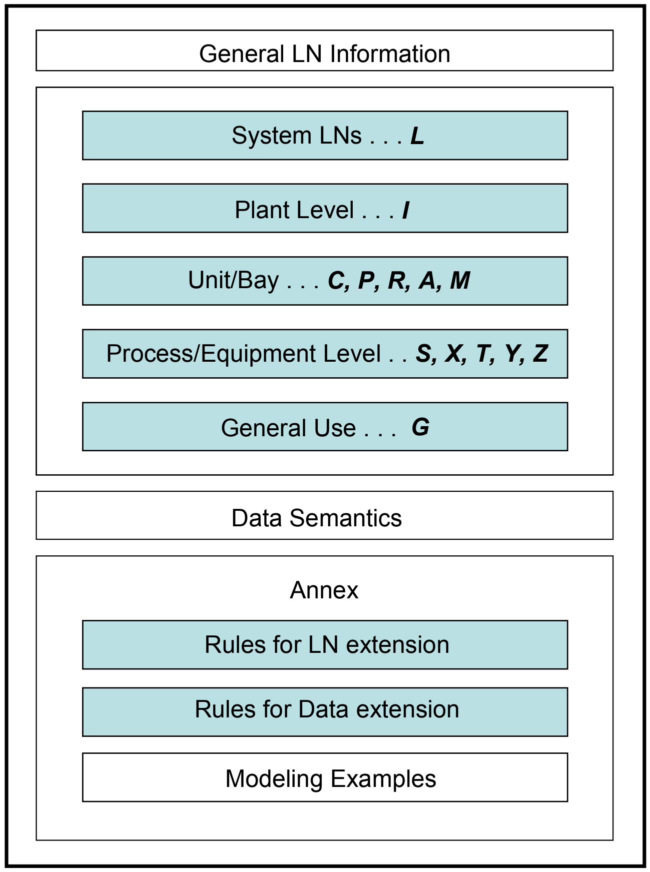



**Figure 1 – Overview of this standard**

## 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 61000-4-7, *Electromagnetic compatibility (EMC) – Part 4: Testing and measurement techniques – Section 7: General guide on harmonics and interharmonics measurements and instrumentation for power supply systems and equipment connected thereto*

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

IEC 61850-5, *Communication networks and systems in substations – Part 5: Communication requirements for functions and devices models* [3]

IEC 61850-7-1, *Communication networks and systems in substations – Part 7-1: Basic communication structure for substation and feeder equipment – Principles and models* [3]

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)* [3]

IEC 61850-7-3, *Communication networks and systems in substations – Part 7-3: Basic communication structure for substation and feeder equipment – Common data classes* [3]

[3] To be published.

IEEE 519:1992, *IEEE Recommended Practises and Requirements for Harmonic Control in Electrical Power Systems*

IEEE 1459:2000, *IEEE Trial Use Standard Definitions for the Measurement of Electric Power Quantities Under Sinusoidal, Nonsinusoidal, Balanced or Unbalanced Conditions*

IEEE C37.2:1996, *Electrical Power System Device Function Numbers and Contact Designation*

IEC 60255-24, *Electrical relays - Part 24: Common format for transient data exchange (COMTRADE) for power systems*

## 3 Terms and definitions

For the purpose of this international standard the terms and definitions given in IEC 61850-2[4] and IEC 61850-7-2 apply.

## 4 Abbreviated terms

The following terms are used to build concatenated Data Names. For example, ChNum is constructed by using two terms "Ch" which stands for channel and "Num" which stands for "Number". Thus the concatenaded name represents a "channel number".

| Term | Description |
|---|---|
| A | Current |
| Acs | Access |
| ACSI | Abstract Communication Service Interface |
| Acu | Acoustic |
| Age | Ageing |
| Alm | Alarm |
| Amp | Current non phase related |
| An | Analogue |
| Ang | Angle |
| Auth | Authorisation |
| Auto | Automatic |
| Aux | Auxiliary |
| Av | Average |
| B | Bushing |
| Bat | Battery |
| Beh | Behaviour |
| Bin | Binary |
| Blk | Block, blocked |
| Bnd | Band |
| Bo | Bottom |
| Cap | Capability |
| Car | Carrier |
| CB | Circuit Breaker |
| CDC | Common Data Class |
| CE | Cooling Equipment |
| Cf | Crest factor |
| Cfg | Configuration |
| CG | Core Ground |
| Ch | Channel |
| Cha | Charger |
| Chg | Change |
| Chk | Check |
| Chr | Characteristic |
| Cir | Circulating |
| Clc | Calculate |
| Clk | Clock, clockwise |
| Cls | Close |
| Cnt | Counter |
| Col | Coil |
| Cor | Correction |
| Crd | Coordination |
| Crv | Curve |
| CT | Current Transducer |
| Ctl | Control |
| Ctr | Center |
| Cyc | Cycle |
| Dea | Dead |
| Den | Density |

[4] Under consideration.

| Term | Description |
|---|---|
| Det | Detected |
| DEX | De-excitation |
| Diag | Diagnostics |
| Dif | Differential, difference |
| Dir | Direction |
| Dl | Delay |
| Dlt | Delete |
| Dmd | Demand |
| Dn | Down |
| DPCSO | Double point controllable status output |
| DQ0 | Direct, Quadrature, and zero axis quantities |
| Drag | Drag hand |
| Drv | Drive |
| DS | Device State |
| Dsch | Discharge |
| Dur | Duration |
| EC | Earth Coil |
| EF | Earth Fault |
| Ena | Enabled |
| Eq | Equalization, Equal |
| Ev | Evaluation |
| Ex | External |
| Exc | Exceeded |
| Excl | Exclusion |
| Ext | Excitation |
| FA | Fault Arc |
| Fact | Factor |
| FD | Fault Distance |
| Flt | Fault |
| Flw | Flow |
| FPF | Forward Power Flow |
| Fu | Fuse |
| Fwd | Forward |
| Gen | General |
| Gn | Generator |
| Gnd | Ground |
| Gr | Group |
| Grd | Guard |
| Gri | Grid |
| H | Harmonics (phase related) |
| H2 | Hydrogen |
| Ha | Harmonics (non phase related) |
| Hi | High, highest |
| HP | Hot point |
| Hz | Frequency |

| Term | Description |
|---|---|
| IEEE | Institute of Electrical and Electronic Engineers |
| Imb | Imbalance |
| Imp | Impedance non phase related |
| In | Input |
| Ina | Inactivity |
| Incr | Increment |
| Ind | Indication |
| Inh | Inhibit |
| Ins | Insulation |
| Int | Integer |
| ISCSO | Integer status controllable status output |
| IT | Current Time product |
| L | Lower |
| Ld | Lead |
| LD | Logical Device |
| LDC | Line Drop Compensation |
| LDCR | Line Drop Compensation Resistance |
| LDCX | Line Drop Compensation Reactance |
| LDCZ | Line Drop Compensation Impedance |
| LED | Light Emitting Diode |
| Len | Length |
| Lev | Level |
| Lg | Lag |
| Lim | Limit |
| Lin | Line |
| Liv | Live |
| LN | Logical Node |
| Lo | Low |
| LO | Lockout |
| Loc | Local |
| Lod | Load, loading |
| Lok | Locked |
| Los | Loss |
| Lst | List |
| LTC | Load Tap Changer |
| m | minutes |
| M/O | Data Object is Mandatory or Optional |
| Max | Maximum |
| Mem | Memory |
| Min | Minimum |
| Mod | Mode |
| Mot | Motor |
| Ms | Milliseconds |
| Mst | Moisture |
| MT | Main Tank |

| Term | Description |
|---|---|
| N | Neutral |
| Nam | Name |
| Net | Net sum |
| Ng | Negative |
| Nom | Nominal, Normalising |
| Num | Number |
| Ofs | Offset |
| Op | Operate, Operating |
| Opn | Open |
| Out | Output |
| Ov | Over, Override, Overflow |
| Pa | Partial |
| Par | Parallel |
| Pct | Percent |
| Per | Periodic |
| PF | Power Factor |
| Ph | Phase |
| Phy | Physical |
| Pls | Pulse |
| Plt | Plate |
| Pmp | Pump |
| Po | Polar |
| Pol | Polarizing |
| Pos | Position |
| POW | Point on wave switching |
| PP | Phase to phase |
| PPV | Phase to phase voltage |
| Pres | Pressure |
| Prg | Progress, in progress |
| Pri | Primary |
| Pro | Protection |
| Ps | Positive |
| Pst | Post |
| Pwr | Power |
| Qty | Quantity |
| R | Raise |
| R0 | Zero sequence resistance |
| R1 | Positive sequence resistance |
| Rat | Winding ratio |
| Rcd | Record, recording |
| Rch | Reach |
| Rcl | Reclaim |
| Re | Retry |
| React | Reactance; Reactive |
| Rec | Reclose |

| Term | Description |
|---|---|
| Red | Reduction |
| Rel | Release |
| Rem | Remote |
| Res | Residual |
| Ris | Resistance |
| Rl | Relation |
| Rms | Root mean square |
| Rot | Rotation, Rotor |
| RPF | Reverse Power Flow |
| Rs | Reset, Resetable |
| Rsl | Result |
| Rst | Restraint |
| Rsv | Reserve |
| Rte | Rate |
| Rtg | Rating |
| Rv | Reverse |
| Rx | Receive, received |
| S1 | Step one |
| S2 | Step two |
| Sch | Scheme |
| SCO | Supply change over |
| SCSM | Specific Communication Service Mapping |
| Sec | Security |
| Seq | Sequence |
| Set | Setting |
| Sh | Shunt |
| Sp | Speed |
| SP | Single Pole |
| SPCSO | Single point controllable status output |
| Src | Source |
| St | Status |
| Stat | Statistics |
| Std | Standard |
| Str | Start |
| Sts | Stress |
| Sup | Supply |
| Svc | Service |
| Sw | Switch |
| Swg | Swing |
| Syn | Synchronisation |
| Td | Total distortion |
| Tdf | Transformer derating factor |
| Thd | Total Harmonic Distortion |
| Thm | Thermal |
| TiF | Telephone influence factor |

| Term | Description |
|---|---|
| Tm | Time<br>Tmh = Time in h<br>Tmm = Time in min<br>Tms = Time in s<br>Tmms = Time in ms |
| Tmp | Temperature (°C) |
| To | Top |
| Tot | Total |
| TP | Three pole |
| Tr | Trip |
| Trg | Trigger |
| Ts | Total signed |
| Tu | Total unsigned |
| Tx | Transmit, transmitted |
| Typ | Type |
| Un | Under |
| V | Voltage |
| VA | Volt Amperes |
| Vac | Vacuum |
| Val | Value |
| VAr | Volt Amperes Reactive |
| Vlv | Valve |

| Term | Description |
|---|---|
| Vol | Voltage non phase related |
| VT | Voltage Transducer |
| W | Active Power |
| Wac | Watchdog |
| Watt | Active Power non phase related |
| Wei | Weak End Infeed |
| Wh | Watt hours |
| Wid | Width |
| Win | Window |
| Wrm | Warm |
| X0 | Zero sequence reactance |
| X1 | Positive sequence reactance |
| Z | Impedance |
| Z0 | Zero sequence impedance |
| Z1 | Positive sequence impedance |
| Zer | Zero |
| Zn | Zone |
| Zro | Zero sequence method |

# 5 Logical node classes

## 5.1 Logical Node groups

Logical nodes are grouped according to the Logical Node Groups listed in Table 1. The names of Logical Nodes shall begin with the character representing the group to which the Logical Node belongs. For modelling per phase (for example switches or instrument transformers), one instance per phase shall be created (see A.2.3 for example).

**Table 1 – List of Logical Node Groups**

| Group Indicator | Logical node groups |
|---|---|
| A | Automatic Control |
| C | Supervisory control |
| G | Generic Function References |
| I | Interfacing and Archiving |
| L | System Logical Nodes |
| M | Metering and Measurement |
| P | Protection Functions |
| R | Protection Related Functions |
| S [a)] | Sensors, Monitoring |
| T [a)] | Instrument Transformer |
| X [a)] | Switchgear |
| Y [a)] | Power Transformer and Related Functions |
| Z [a)] | Further (power system) Equipment |

[a)] LNs of this group exist in dedicated IEDs if a process bus is used. Without a process bus, LNs of this group are the I/Os in the hardwired IED one level higher (for example in a bay unit) representing the external device by its inputs and outputs (process image – see Figure B.5 for example).

## 5.2 Interpretation of Logical Node tables

The interpretation of the headings for the logical node tables is presented in Table 2.

**Table 2 – Interpretation of Logical Node tables**

| Column heading | Description |
|---|---|
| **Attribute Name** | **Name of the Data** |
| Attr. Type | Common Data Class that defines the structure of the data. See IEC 61850-7-3. |
| Explanation | Short explanation of the data and how it is used. |
| T | Transient Data – the status of data with this designation is momentary and must be logged or reported to provide evidence of their momentary state. Some T may be only valid on a modelling level. If no real time services are available (for example between CSWI and XCBR) and GSE messages (see IEC 61850-7-2) have been used instead, the implementation of this data shall be persistent at least until the related GSE message has finalized its repetitions. |
| M/O | Whether data, data sets, control blocks or services are mandatory (M) or optional (O) for the instantiation of a specific Logical Node.<br>NOTE The attributes for data that are instantiated may also be mandatory or optional based on the CDC (Attr. Type) definition in IEC 61850-7-3.<br>Where the letter C is used for “conditional”, at least one of the items of data labelled with C shall be used from each category where C occurs. |

All Attribute Names (Data Names) are listed alphabetically in Clause 6. The data in the Logical Nodes Classes are grouped into various categories (as described below) for the convenience of the reader. This grouping may result in some overlapping.

All Attribute Names (Data Names) are listed alphabetically in Clause 6. Despite some overlapping, the data in the Logical Nodes Classes are grouped for the convenience of the reader into some of the following categories.

*Common Logical Node Information*
is information independent of the dedicated function represented by the LN class. Mandatory data (M) are common to all LN classes; optional data (O) are valid for a reasonable subset of LN classes.

*Status Information*
is data which shows either the status of the process or of the function allocated to the LN class. This information is produced locally and cannot be changed remotely unless substitution is applicable. Data such as “start” or “trip” are listed in this category. Most of these data are mandatory.

*Settings*
are data which are needed for the function to operate. Since many settings are dependent on the implementation of the function, only a commonly agreed minimum is standardised. They may be changed remotely, but normally not very often.

*Measured values*
are analogue data measured from the process or calculated in the functions such as currents, voltages, power, etc. This information is produced locally and cannot be changed remotely unless substitution is applicable.

*Controls*
are data which are changed by commands such as switchgear state (ON/OFF), tap changer position or resetable counters. They are typically changed remotely, and are changed during operation much more than Settings.

## 5.3 System Logical Nodes LN Group: L

### 5.3.1 General

In this subclause, the system specific information is defined. This includes Common Logical Node Information (for example logical node mode control, nameplate information, operation counters) as well as information related to the physical device implementing the logical devices and logical nodes. These logical nodes are independent of the application domain. All other logical nodes are domain specific, but inherit mandatory and optional Data from these system logical nodes.

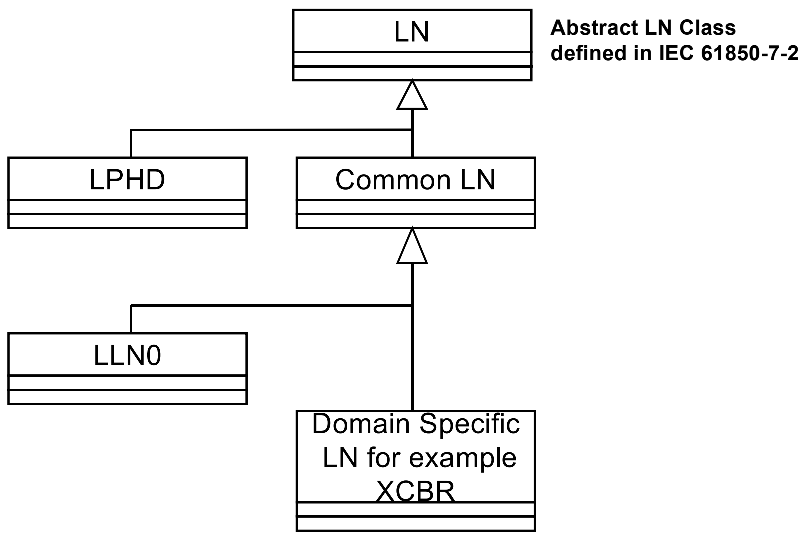



**Figure 2 – LN Relationships**

All logical node classes defined in this document inherit their structure from the abstract logical nodes class (LN, see Figure 2) defined in IEC 61850-7-2. Apart from the logical node class 'Physical Device Information' (LPHD) all logical node classes (LLN0 and domain specific LNs) defined in this document inherit at least the mandatory data of the common logical node (Common LN).

### 5.3.2 LN: Physical device information Name: LPHD

This LN is introduced in this part to model common issues for physical devices.

| LPHD class | | | | |
|---|---|---|---|---|
| **Attribute Name** | **Attr. Type** | **Explanation** | **T** | **M/O** |
| LNName | | Shall be inherited from Logical-Node Class (see IEC 61850-7-2) | | |
| **Data** | | | | |
| PhyName | DPL | Physical device name plate | | M |
| PhyHealth | INS | Physical device health | | M |
| OutOv | SPS | Output communications buffer overflow | | O |
| InOv | SPS | Input communications buffer overflow | | O |
| NumPwrUp | INS | Number of Power ups | | O |
| WrmStr | INS | Number of Warm Starts | | O |
| WacTrg | INS | Number of watchdog device resets detected | | O |
| PwrUp | SPS | Power Up detected | | O |
| PwrDn | SPS | Power Down detected | | O |
| PwrSupAlm | SPS | External power supply alarm | | O |
| RsStat | SPC | Reset device statistics | T | O |

### 5.3.3 Common Logical Node

The compatible logical nodes classes defined in this document are specialisations of this common logical node class.

| Common Logical Node class | | | | |
|---|---|---|---|---|
| **Attribute Name** | **Attr. Type** | **Explanation** | **T** | **M/O** |
| LNName | | Shall be inherited from Logical-Node Class (see IEC 61850-7-2) | | |
| **Data** | | | | |
| ***Mandatory Logical Node Information (Shall be inherited by ALL LN but LPHD)*** | | | | |
| Mod | INC | Mode | | M |
| Beh | INS | Behaviour | | M |
| Health | INS | Health | | M |
| NamPlt | LPL | Name plate | | M |
| ***Optional Logical Node Information*** | | | | |
| Loc | SPS | Local operation | | O |
| EEHealth | INS | External equipment health | | O |
| EEName | DPL | External equipment name plate | | O |
| OpCntRs | INC | Operation counter resetable | | O |
| OpCnt | INS | Operation counter | | O |
| OpTmh | INS | Operation time | | O |
| **Data Sets (see IEC 61850-7-2)** | | | | |
| Inherited and specialised from Logical Node class (see IEC 61850-7-2) | | | | |
| **Control Blocks (see IEC 61850-7-2)** | | | | |
| Inherited and specialised from Logical Node class (see IEC 61850-7-2) | | | | |
| **Services (see IEC 61850-7-2)** | | | | |
| Inherited and specialised from Logical Node class (see IEC 61850-7-2) | | | | |

A specialisation of this Common Logical Node class shall inherit all Data, Data Sets, Control Blocks and Services that are mandatory. For the optional data, there are three possibilities for specialisation:

- not to inherit these items;
- inherit these items and leave them as optional;
- inherit these items and define them as mandatory.

### 5.3.4 LN: Logical node zero Name: LLN0

This LN shall be used to address common issues for Logical Devices.

| LLNO class | | | | |
|---|---|---|---|---|
| **Attribute Name** | **Attr. Type** | **Explanation** | **T** | **M/O** |
| LNName | | Shall be inherited from Logical-Node Class (see IEC 61850-7-2) | | |
| **Data** | | | | |
| ***Common Logical Node Information*** | | | | |
| | | LN shall inherit all Mandatory Data from Common Logical Node Class | | M |
| OpTmh | INS | Operation time | | O |
| Diag | SPC | Run Diagnostics | | O |
| LEDRs | SPC | LED reset | T | O |
| Loc | SPS | Local operation for complete logical device | | O |

## 5.4 Logical Nodes for protection functions LN Group: P

### 5.4.1 Modelling remarks

This section refers to modelling of protection and protection related Logical Nodes and shows the relation (see Table 3) between IEC 61850-5 and the Logical Node class definitions according this document.

- If there are several stages to one function (i.e. for multi-zone relay), each stage shall be a separate instance of the LN. Examples are PDIS (n zones) or PTOV (2 stages).
- Multiple instances shall be used if LNs of the same LN class are operating with different setting groups in parallel.
- If different measuring principles such as phase or ground are required, each shall be represented by an instance of the same basic function. Examples are PTOC (used for phase or ground in dedicated instances).
- The logical nodes are defined in IEC 61850-5 from protection requirements, however for modelling purposes, some logical nodes have been split (see table below).
- Logical Nodes from IEC 61850-5 are modelled using combinations of the LNs defined in this part (see table below).
- Other logical nodes have been added to model complex protection devices and schemes (see the following clauses). As an example, line protection uses LN PSCH to combine the outputs from multiple protection LNs.
- The protection functions provide (if applicable) the data Str (Start) with direction information. In the case of a protection function which provides no direction information, the direction “unknown” shall be transmitted. The data Str is summarised by LN PTRC.
- If the fault direction is provided in Str (Start), the directional protection may be modelled without the Directional Element LN RDIR. If any of the settings provided by LN RDIR are needed, the LN RDIR shall be used.
- The protection functions provide (if applicable) the data Op (Operate) without direction information. The data Op is conditioned by LN PTRC resulting in the data Tr (Real Trip), i.e. between every protection LN and the circuit breaker node XCBR shall be a LN PTRC.

**Table 3 – Relation between IEC 61850-5 and IEC 61850-7-4 (this standard) for protection LNs**

| Functionality | IEEE C37.2 reference | Defined in IEC 61850-5 | Modelled in IEC 61850-7-4 | Comments |
|---|---|---|---|---|
| Transient earthfault | | PTEF | PTEF | Use shown in Annex B.1 |
| Zero speed and underspeed | 14 | PZSU | PZSU | |
| Distance | 21 | PDIS | PDIS<br>PSCH | Use one instance per zone.<br>To build line protection schemes |
| Volt per Hz | 24 | PVPH | PVPH | |
| (Time) Undervoltage | 27 | PTUV | PTUV | |
| Directional power /reverse power | 32 | PDPR | PDOP<br>or<br>PDUP | Directional over power<br>Directional under power<br>Reverse power modelled by PDOP plus directional mode “reverse” |
| Undercurrent/underpower | 37 | PUCP | PTUC<br>PDUP | Undercurrent<br>Underpower |
| Loss of field/Underexcitation | 40 | PUEX | PDUP | Directional under power |
| Reverse phase or phase balance current | 46 | PPBR | PTOC | Time overcurrent (PTOC) with three-phase information with sequence current as an input or even ratio of negative and positive sequence currents |
| Phase sequence voltage | 47 | PPBV | PTOV | Three-phase information and processing |
| Thermal overload | 49 | PTTR | PTTR | |
| Rotor thermal overload | 49R | PROL | PTTR | Thermal overload |
| Stator thermal overload | 49S | PSOL | PTTR | Thermal overload |
| Instantaneous overcurrent or rate of rise | 50 | PIOC | PIOC | |
| AC time overcurrent | 51 | PTOC | PTOC | |
| Voltage controlled/dependent time overcurrent | 51V | PVOC | PVOC | |
| Power factor | 55 | PPFR | POPF<br>PUPF | Over power factor<br>Under power factor |
| (Time) Overvoltage | 59 | PTOV | PTOV | |
| DC-overvoltage | 59DC | PDOV | PTOV | Both for DC and AC |
| Voltage or current balance | 60 | PVCB | PTOV<br>PTUV | Over voltage or Under voltage |
| Earth fault / Ground detection | 64 | PHIZ | PHIZ | |
| Rotor earth fault | 64R | PREF | PTOC | Time overcurrent |
| Stator earth fault | 64S | PSDE | PTOC | Time overcurrent |
| Interturn fault | 64W | PITF | PTOC | Time overcurrent |
| AC directional overcurrent | 67 | PDOC | PTOC | Time overcurrent |
| Directional earth fault | 67N | PDEF | PTOC | Time overcurrent |
| DC time overcurrent | 76 | PDCO | PTOC | Time overcurrent for AC and DC |
| Phase angle or out-of-step | 78 | PPAM | PPAM | |
| Frequency | 81 | PFRQ | PTOF<br>PTUF<br>PFRC | Over frequency<br>Under frequency<br>Rate of change of frequency |
| Differential | 87 | PDIF | PDIF | |
| Phase comparison | 87P | PPDF | PDIF | |

| Functionality | IEEE C37.2 reference | Defined in IEC 61850-5 | Modelled in IEC 61850-7-4 | Comments |
|---|---|---|---|---|
| Differential line | 87L | PLDF | PDIF | |
| Restricted earth fault | 87N | PNDF | PDIF | |
| Differential transformer | 87T | PTDF | PDIF<br>PHAR | Differential transformer<br>Harmonic restraint |
| Busbar | 87B | PBDF | PDIF or<br>PDIR | Busbar differential or<br>Fault direction comparison |
| Motor differential | 87M | PMDF | PDIF | |
| Generator differential | 87G | PGDF | PDIF | |
| Motor Startup | 49R, 66<br>48, 51LR | PMSU | PMRI<br>PMSS | Motor Restart Inhibition<br>Motor Starting Time Supervision |

### 5.4.2 LN: Differential Name: PDIF

See IEC 61850-5 (LNs PLDF, PNDF, PTDF, PBDF, PMDF, and PPDF). This LN shall be used for all kind of current differential protection. Proper current samples for the dedicated application shall be subscribed.

| PDIF class | | | | |
|---|---|---|---|---|
| **Attribute Name** | **Attr. Type** | **Explanation** | **T** | **M/O** |
| LNName | | Shall be inherited from Logical-Node Class (see IEC 61850-7-2) | | |
| **Data** | | | | |
| ***Common Logical Node Information*** | | | | |
| | | LN shall inherit all Mandatory Data from Common Logical Node Class | | M |
| OpCntRs | INC | Resetable operation counter | | O |
| ***Status Information*** | | | | |
| Str | ACD | Start | | O |
| Op | ACT | Operate | T | M |
| TmASt | CSD | Active curve characteristic | | O |
| ***Measured Values*** | | | | |
| DifAClc | WYE | Differential Current | | O |
| RstA | WYE | Restraint Current | | O |
| ***Settings*** | | | | |
| LoSet | ING | Low operate value, percentage of the nominal current | | O |
| HiSet | ING | High operate value, percentage of the nominal current | | O |
| MinOpTmms | ING | Minimum Operate Time | | O |
| MaxOpTmms | ING | Maximum Operate Time | | O |
| RstMod | ING | Restraint Mode | | O |
| RsDlTmms | ING | Reset Delay Time | | O |
| TmACrv | CURVE | Operating Curve Type | | O |

### 5.4.3 LN: Direction comparison Name: PDIR

For a description of this LN, see IEC 61850-5. The operate decision is based on an agreement on the fault direction signals from all directional fault sensors (for example directional relays) surrounding the fault. The directional comparison for lines is made with PSCH.

| PDIR class | | | | |
|---|---|---|---|---|
| **Attribute Name** | **Attr. Type** | **Explanation** | **T** | **M/O** |
| LNName | | Shall be inherited from Logical-Node Class (see IEC 61850-7-2) | | |
| **Data** | | | | |
| ***Common Logical Node Information*** | | | | |
| | | LN shall inherit all Mandatory Data from Common Logical Node Class | | M |
| OpCntRs | INC | Resetable operation counter | | O |
| ***Status Information*** | | | | |
| Str | ACD | Start (appearance of the first related fault direction) | | M |
| Op | ACT | Operate (decision from all sensors that the surrounded object is faulted) | T | M |
| ***Settings*** | | | | |
| RsDlTmms | ING | Reset Delay Time | | O |

### 5.4.4 LN: Distance Name: PDIS

For a description of this LN, see IEC 61850-5. The phase start value and ground start value are minimum thresholds to release the impedance measurements depending on the distance function characteristic given by the algorithm and defined by the settings. The settings replace the data curve as used for the characteristic on some other protection LNs.

| PDIS class | | | | |
|---|---|---|---|---|
| **Attribute Name** | **Attr. Type** | **Explanation** | **T** | **M/O** |
| LNName | | Shall be inherited from Logical-Node Class (see IEC 61850-7-2) | | |
| **Data** | | | | |
| ***Common Logical Node Information*** | | | | |
| | | LN shall inherit all Mandatory Data from Common Logical Node Class | | M |
| OpCntRs | INC | Resetable operation counter | | O |
| ***Status Information*** | | | | |
| Str | ACD | Start | | M |
| Op | ACT | Operate | T | M |
| ***Settings*** | | | | |
| PoRch | ASG | Polar Reach is the diameter of the Mho diagram | | O |
| PhStr | ASG | Phase Start Value | | O |
| GndStr | ASG | Ground Start Value | | O |
| DirMod | ING | Directional Mode | | O |
| PctRch | ASG | Percent Reach | | O |
| Ofs | ASG | Offset | | O |
| PctOfs | ASG | Percent Offset | | O |
| RisLod | ASG | Resistive reach for load area | | O |
| AngLod | ASG | Angle for load area | | O |
| TmDlMod | SPG | Operate Time Delay Mode | | O |
| OpDlTmms | ING | Operate Time Delay | | O |
| PhDlMod | SPG | Operate Time Delay Multiphase Mode | | O |
| PhDlTmms | ING | Operate Time Delay for Multiphase Faults | | O |
| GndDlMod | SPG | Operate Time Delay for Single Phase Ground Mode | | O |
| GndDlTmms | ING | Operate Time Delay for single phase ground faults | | O |
| X1 | ASG | Positive sequence line (reach) reactance | | O |
| LinAng | ASG | Line Angle | | O |
| RisGndRch | ASG | Resistive Ground Reach | | O |
| RisPhRch | ASG | Resistive Phase Reach | | O |

| PDIS class | | | | |
|---|---|---|---|---|
| **Attribute Name** | **Attr. Type** | **Explanation** | **T** | **M/O** |
| K0Fact | ASG | Residual Compensation Factor $K_0$ | | O |
| K0FactAng | ASG | Residual Compensation Factor Angle | | O |
| RsDlTmms | ING | Reset Time Delay | | O |

### 5.4.5 LN: Directional overpower Name: PDOP

For a description of this LN, see IEC 61850-5 (LN PDPR). This LN shall be used for the overpower part of PDPR. Additionally, PDOP is used to model a reverse overpower function (IEEE device function number 32R, from IEEE 32R.2,1996) when the DirMod is set to reverse.

| PDOP class | | | | |
|---|---|---|---|---|
| **Attribute Name** | **Attr. Type** | **Explanation** | **T** | **M/O** |
| LNName | | Shall be inherited from Logical-Node Class (see IEC 61850-7-2) | | |
| **Data** | | | | |
| ***Common Logical Node Information*** | | | | |
| | | LN shall inherit all Mandatory Data from Common Logical Node Class | | M |
| OpCntRs | INC | Resetable operation counter | | O |
| ***Status Information*** | | | | |
| Str | ACD | Start | | M |
| Op | ACT | Operate | T | M |
| ***Settings*** | | | | |
| DirMod | ING | Directional Mode | | O |
| StrVal | ASG | Start Value | | O |
| OpDlTmms | ING | Operate Delay Time | | O |
| RsDlTmms | ING | Reset Delay Time | | O |

### 5.4.6 LN: Directional underpower Name: PDUP

For a description of this LN, see IEC 61850-5 (LN PDPR). This LN shall be used for the underpower part of PDPR.

| PDUP class | | | | |
|---|---|---|---|---|
| **Attribute Name** | **Attr. Type** | **Explanation** | **T** | **M/O** |
| LNName | | Shall be inherited from Logical-Node Class (see IEC 61850-7-2) | | |
| **Data** | | | | |
| ***Common Logical Node Information*** | | | | |
| | | LN shall inherit all Mandatory Data from Common Logical Node Class | | M |
| OpCntRs | INC | Resetable operation counter | | O |
| ***Status Information*** | | | | |
| Str | ACD | Start | | M |
| Op | ACT | Operate | T | M |
| ***Settings*** | | | | |
| StrVal | ASG | Start Value | | O |
| OpDlTmms | ING | Operate Delay Time | | O |
| RsDlTmms | ING | Reset Delay Time | | O |
| DirMod | ING | Directional Mode | | O |

### 5.4.7 LN: Rate of change of frequency Name: PFRC

For a description of this LN, see IEC 61850-5 (LN PFRQ). This LN shall be used to model the rate of frequency change of PFRQ. One instance shall be used per stage.

| PFRC class | | | | |
|---|---|---|---|---|
| **Attribute Name** | **Attr. Type** | **Explanation** | **T** | **M/O** |
| LNName | | Shall be inherited from Logical-Node Class (see IEC 61850-7-2) | | |
| **Data** | | | | |
| ***Common Logical Node Information*** | | | | |
| | | LN shall inherit all Mandatory Data from Common Logical Node Class | | M |
| OpCntRs | INC | Resetable operation counter | | O |
| ***Status Information*** | | | | |
| Str | ACD | Start | | M |
| Op | ACT | Operate | T | M |
| BlkV | SPS | Blocked because of voltage | | O |
| ***Settings*** | | | | |
| StrVal | ASG | Start Value df/dt | | O |
| BlkVal | ASG | Voltage Block Value | | O |
| OpDlTmms | ING | Operate Delay Time | | O |
| RsDlTmms | ING | Reset Delay Time | | O |

### 5.4.8 LN: Harmonic restraint Name: PHAR

This LN shall be used to represent the harmonic restraint data of the transformer differential protection (see PDIF) in a dedicated node. There may be multiple instantiation of this LN with different settings, especially with different data HaRst.

| PHAR class | | | | |
|---|---|---|---|---|
| **Attribute Name** | **Attr. Type** | **Explanation** | **T** | **M/O** |
| LNName | | Shall be inherited from Logical-Node Class (see IEC 61850-7-2) | | |
| **Data** | | | | |
| ***Common Logical Node Information*** | | | | |
| | | LN shall inherit all Mandatory Data from Common Logical Node Class | | M |
| OpCntRs | INC | Resetable operation counter | | O |
| ***Status Information*** | | | | |
| Str | ACD | Start (active when restraint is needed) | | M |
| ***Settings*** | | | | |
| HaRst | ING | Number of harmonic restrained | | O |
| PhStr | ASG | Start Value | | O |
| PhStop | ASG | Stop Value | | O |
| OpDlTmms | ING | Operate Delay Time | | O |
| RsDlTmms | ING | Reset Delay Time | | O |

### 5.4.9 LN: Ground detector Name: PHIZ

For a description of this LN, see IEC 61850-5. This LN shall be used for high-impedance isolation faults only.

| PHIZ class | | | | |
|---|---|---|---|---|
| **Attribute Name** | **Attr. Type** | **Explanation** | **T** | **M/O** |
| LNName | | Shall be inherited from Logical-Node Class (see IEC 61850-7-2) | | |
| **Data** | | | | |
| ***Common Logical Node Information*** | | | | |
| | | LN shall inherit all Mandatory Data from Common Logical Node Class | | M |
| OpCntRs | INC | Resetable operation counter | | O |
| ***Status Information*** | | | | |
| Str | ACD | Start | | M |
| Op | ACT | Operate | T | M |
| ***Settings*** | | | | |
| AStr | ASG | Current Start Value | | O |
| VStr | ASG | Voltage Start Value | | O |
| HVStr | ASG | Third Harmonic Voltage Start Value | | O |
| OpDlTmms | ING | Operate Delay Time | | O |
| RsDlTmms | ING | Reset Delay Time | | O |

### 5.4.10 LN: Instantaneous overcurrent Name: PIOC

For a description of this LN, see IEC 61850-5. This LN shall be used for instantaneous overcurrent protection only.

| PIOC class | | | | |
|---|---|---|---|---|
| **Attribute Name** | **Attr. Type** | **Explanation** | **T** | **M/O** |
| LNName | | Shall be inherited from Logical-Node Class (see IEC 61850-7-2) | | |
| **Data** | | | | |
| ***Common Logical Node Information*** | | | | |
| | | LN shall inherit all Mandatory Data from Common Logical Node Class | | M |
| OpCntRs | INC | Resetable operation counter | | O |
| ***Status Information*** | | | | |
| Str | ACD | Start | | O |
| Op | ACT | Operate | T | M |
| ***Settings*** | | | | |
| StrVal | ASG | Start Value | | O |

### 5.4.11 LN: Motor restart inhibition Name: PMRI

For a description of this LN, see IEC 61850-5 (LN PMSU). This LN shall be used to model from LN PMSU the part which protects a motor against thermal overload during start-up in a dedicated LN.

| PMRI class | | | | |
|---|---|---|---|---|
| **Attribute Name** | **Attr. Type** | **Explanation** | **T** | **M/O** |
| LNName | | Shall be inherited from Logical-Node Class (see IEC 61850-7-2) | | |
| **Data** | | | | |
| ***Common Logical Node Information*** | | | | |
| | | LN shall inherit all Mandatory Data from Common Logical Node Class | | M |
| OpCntRs | INC | Resetable operation counter | | O |

| PMRI class | | | | |
|---|---|---|---|---|
| **Attribute Name** | **Attr. Type** | **Explanation** | **T** | **M/O** |
| ***Status Information*** | | | | |
| Op | ACT | Operate | T | O |
| StrInh | SPS | Restart inhibited | | O |
| StrInhTmm | INS | Restart Inhibition Time | | O |
| ***Settings*** | | | | |
| SetA | ASG | Current setting for motor start-up | | O |
| SetTms | ING | Time Setting for motor start-up | | O |
| MaxNumStr | ING | Maximum number of starts (also for cold starts) | | O |
| MaxWrmStr | ING | Maximum Warm Starts, permissible number of warm starts | | O |
| MaxStrTmm | ING | Time period for the maximum number of starts | | O |
| EqTmm | ING | Temperature Equalisation Time | | O |
| InhTmm | ING | Restart Inhibit Time | | O |

### 5.4.12 LN: Motor starting time supervision Name: PMSS

For a description of this LN, see IEC 61850-5 (LN PMSU). This LN shall be used to model from LN PMSU the part which protects a motor against excessive starting time/locked rotor during start-up in a dedicated LN.

| PMSS class | | | | |
|---|---|---|---|---|
| **Attribute Name** | **Attr. Type** | **Explanation** | **T** | **M/O** |
| LNName | | Shall be inherited from Logical-Node Class (see IEC 61850-7-2) | | |
| **Data** | | | | |
| ***Common Logical Node Information*** | | | | |
| | | LN shall inherit all Mandatory Data from Common Logical Node Class | | M |
| OpCntRs | INC | Resetable operation counter | | O |
| ***Status Information*** | | | | |
| Str | ACD | Start | | O |
| Op | ACT | Operate | T | O |
| ***Settings*** | | | | |
| SetA | ASG | Current setting for motor start-up | | O |
| SetTms | ING | Time Setting for motor start-up | | O |
| MotStr | ASG | I Motor Startup, (current pickup value of motor starting) | | O |
| LokRotTms | ING | Lock Rotor Time, permissible locked rotor time | | O |

### 5.4.13 LN: Over power factor Name: POPF

For a description of this LN, see IEC 61850-5 (LN PPFR). This LN shall be used for the over power factor part of PPFR.

| POPF class | | | | |
|---|---|---|---|---|
| **Attribute Name** | **Attr. Type** | **Explanation** | **T** | **M/O** |
| LNName | | Shall be inherited from Logical-Node Class (see IEC 61850-7-2) | | |
| **Data** | | | | |
| ***Common Logical Node Information*** | | | | |
| | | LN shall inherit all Mandatory Data from Common Logical Node Class | | M |
| OpCntRs | INC | Resetable operation counter | | O |

| POPF class | | | | |
|---|---|---|---|---|
| **Attribute Name** | **Attr. Type** | **Explanation** | **T** | **M/O** |
| ***Status Information*** | | | | |
| Str | ACD | Start | | M |
| Op | ACT | Operate | T | M |
| BlkA | SPS | Blocked below minimum operating current | | O |
| BlkV | SPS | Blocked below minimum operating voltage | | O |
| ***Settings*** | | | | |
| StrVal | ASG | Start Value | | O |
| OpDlTmms | ING | Operate Delay Time | | O |
| RsDlTmms | ING | Reset Delay Time | | O |
| BlkValA | ASG | Block Value (Minimum operating current) | | O |
| BlkValV | ASG | Block Value (Minimum operating voltage) | | O |

### 5.4.14 LN: Phase angle measuring Name: PPAM

For a description of this LN, see IEC 61850-5. This function shall be used to model "out-of-step" protection of generators.

| PPAM class | | | | |
|---|---|---|---|---|
| **Attribute Name** | **Attr. Type** | **Explanation** | **T** | **M/O** |
| LNName | | Shall be inherited from Logical-Node Class (see IEC 61850-7-2) | | |
| **Data** | | | | |
| ***Common Logical Node Information*** | | | | |
| | | LN shall inherit all Mandatory Data from Common Logical Node Class | | M |
| OpCntRs | INC | Resetable operation counter | | O |
| ***Status Information*** | | | | |
| Str | ACD | Start | | M |
| Op | ACT | Operate | T | M |
| ***Settings*** | | | | |
| StrVal | ASG | Start Value | | O |

### 5.4.15 LN: Protection scheme Name: PSCH

This LN shall be used to model the logic scheme for line protection function co-ordination. The protection scheme allows the exchange of the "operate" outputs of different protection functions and conditions for line protection schemes. It includes data for teleprotection if applicable. In this case, all appropriate data shall be subscribed.

| PSCH class | | | | |
|---|---|---|---|---|
| **Attribute Name** | **Attr. Type** | **Explanation** | **T** | **M/O** |
| LNName | | Shall be inherited from Logical-Node Class (see IEC 61850-7-2) | | |
| **Data** | | | | |
| ***Common Logical Node Information*** | | | | |
| | | LN shall inherit all Mandatory Data from Common Logical Node Class | | M |
| OpCntRs | INC | Resetable operation counter | | O |
| ***Status Information*** | | | | |
| ProTx | SPS | Teleprotection signal transmitted | T | M |
| ProRx | SPS | Teleprotection signal received | T | M |
| Str | ACD | Carrier Send | | M |
| Op | ACT | Operate | T | M |
| CarRx | ACT | Carrier received after unblock logic | | O |

| PSCH class | | | | |
|---|---|---|---|---|
| **Attribute Name** | **Attr. Type** | **Explanation** | **T** | **M/O** |
| LosOfGrd | SPS | Loss of guard | | O |
| Echo | ACT | Echo signal from weak end infeed function | | O |
| WeiOp | ACT | Operate signal from weak end infeed function | | O |
| RvABlk | ACT | Block signal from current reversal function | | O |
| GrdRx | SPS | Guard Received | | O |
| ***Settings*** | | | | |
| SchTyp | ING | Scheme Type | | O |
| OpDlTmms | ING | Operate Delay Time | | O |
| CrdTmms | ING | Co-ordination timer for blocking scheme | | O |
| DurTmms | ING | Minimum duration of carrier send signal | | O |
| UnBlkMod | ING | Unblock function mode for scheme type | | O |
| SecTmms | ING | Pickup security timer on loss of carrier guard signal | | O |
| WeiMod | ING | Mode of weak end infeed function | | O |
| WeiTmms | ING | Co-ordination time for weak end infeed function | | O |
| PPVVal | ASG | Voltage level for weak end infeed function – phase-phase | | O |
| PhGndVal | ASG | Voltage level for weak end infeed function – phase-ground | | O |
| RvAMod | ING | Mode of current reversal function | | O |
| RvATmms | ING | Pickup time for current reversal logic | | O |
| RvRsTmms | ING | Delay time for reset of current reversal output | | O |

### 5.4.16 LN: Sensitive directional earthfault Name: PSDE

For a general description of directed earth fault protection, see IEC 61850-5. This LN is used for directional earthfault handling in compensated and isolated networks. The use of “operate” is optional and depends both on protection philosophy and on instrument transformer capabilities. For compensated networks, this function is often called wattmetric directional earthfault. The very high accuracy needed for fault current measurement in compensated networks may require phase angle compensation. This shall be done on the related LN TCTR.

| PSDE class | | | | |
|---|---|---|---|---|
| **Attribute Name** | **Attr. Type** | **Explanation** | **T** | **M/O** |
| LNName | | Shall be inherited from Logical-Node Class (see IEC 61850-7-2) | | |
| **Data** | | | | |
| ***Common Logical Node Information*** | | | | |
| | | LN shall inherit all Mandatory Data from Common Logical Node Class | | M |
| OpCntRs | INC | Resetable operation counter | | O |
| ***Status Information*** | | | | |
| Str | ACD | Start | | M |
| Op | ACT | Operate | T | O |
| ***Settings*** | | | | |
| GndStr | ASG | Ground Start Value ($3U_0$) | | O |
| GndOp | ASG | Ground Operate Value ($3I_0$) | | O |
| StrDlTmms | ING | Start Delay Time | | O |
| OpDlTmms | ING | Operate Delay Time | | O |
| DirMod | ING | Directional Mode | | O |

### 5.4.17 LN: Transient earth fault Name: PTEF

For a description of this LN, see IEC 61850-5. This LN shall be used to detect (“start”) transient earth fault in compensated networks. It has no “operate”.

| PTEF class | | | | |
|---|---|---|---|---|
| **Attribute Name** | **Attr. Type** | **Explanation** | **T** | **M/O** |
| LNName | | Shall be inherited from Logical-Node Class (see IEC 61850-7-2) | | |
| **Data** | | | | |
| ***Common Logical Node Information*** | | | | |
| | | LN shall inherit all Mandatory Data from Common Logical Node Class | | M |
| OpCntRs | INC | Resetable operation counter | | O |
| ***Status Information*** | | | | |
| Str | ACD | Start (Transient earth fault) | T | M |
| ***Settings*** | | | | |
| GndStr | ASG | Ground Start Value | | O |
| DirMod | ING | Directional Mode | | O |

### 5.4.18 LN: Time overcurrent Name: PTOC

For a description of this LN, see IEC 61850-5 (LN PTOC). This LN shall also be used to model the Directional Time Overcurrent (PDOC/IEEE 67). The Definite Time overcurrent (also PTOC/IEEE 51) shall be modelled by use of PTOC and selecting the related curve.

| PTOC class | | | | |
|---|---|---|---|---|
| **Attribute Name** | **Attr. Type** | **Explanation** | **T** | **M/O** |
| LNName | | Shall be inherited from Logical-Node Class (see IEC 61850-7-2) | | |
| **Data** | | | | |
| ***Common Logical Node Information*** | | | | |
| | | LN shall inherit all Mandatory Data from Common Logical Node Class | | M |
| OpCntRs | INC | Resetable operation counter | | O |
| ***Status Information*** | | | | |
| Str | ACD | Start | | M |
| Op | ACT | Operate | T | M |
| TmASt | CSD | Active curve characteristic | | O |
| ***Settings*** | | | | |
| TmACrv | CURVE | Operating Curve Type | | O |
| StrVal | ASG | Start Value | | O |
| TmMult | ASG | Time Dial Multiplier | | O |
| MinOpTmms | ING | Minimum Operate Time | | O |
| MaxOpTmms | ING | Maximum Operate Time | | O |
| OpDlTmms | ING | Operate Delay Time | | O |
| TypRsCrv | ING | Type of Reset Curve | | O |
| RsDlTmms | ING | Reset Delay Time | | O |
| DirMod | ING | Directional Mode | | O |

### 5.4.19 LN: Overfrequency Name: PTOF

For a description of this LN, see IEC 61850-5 (LN PFRQ). This LN shall be used to model the overcurrent part of PFRQ. One instance shall be used per stage.

| PTOF class | | | | |
|---|---|---|---|---|
| **Attribute Name** | **Attr. Type** | **Explanation** | **T** | **M/O** |
| LNName | | Shall be inherited from Logical-Node Class (see IEC 61850-7-2) | | |
| **Data** | | | | |
| ***Common Logical Node Information*** | | | | |
| | | LN shall inherit all Mandatory Data from Common Logical Node Class | | M |
| OpCntRs | INC | Resetable operation counter | | O |
| ***Status Information*** | | | | |
| Str | ACD | Start | | M |
| Op | ACT | Operate | T | M |
| BlkV | SPS | Blocked because of voltage | | O |
| ***Settings*** | | | | |
| StrVal | ASG | Start Value (frequency) | | O |
| BlkVal | ASG | Voltage Block Value | | O |
| OpDlTmms | ING | Operate Delay Time | | O |
| RsDlTmms | ING | Reset Delay Time | | O |

### 5.4.20 LN: Overvoltage Name: PTOV

See IEC61850-5. For some applications such as transformer star-point or delta supervision, “operate” may not be used.

| PTOV class | | | | |
|---|---|---|---|---|
| **Attribute Name** | **Attr. Type** | **Explanation** | **T** | **M/O** |
| LNName | | Shall be inherited from Logical-Node Class (see IEC 61850-7-2) | | |
| **Data** | | | | |
| ***Common Logical Node Information*** | | | | |
| | | LN shall inherit all Mandatory Data from Common Logical Node Class | | M |
| OpCntRs | INC | Resetable operation counter | | O |
| ***Status Information*** | | | | |
| Str | ACD | Start | | M |
| Op | ACT | Operate | T | O |
| TmVSt | CSD | Active curve characteristic | | O |
| ***Settings*** | | | | |
| TmVCrv | CURVE | Operating Curve Type | | O |
| StrVal | ASG | Start Value | | O |
| TmMult | ASG | Time Dial Multiplier | | O |
| MinOpTmms | ING | Minimum Operate Time | | O |
| MaxOpTmms | ING | Maximum Operate Time | | O |
| OpDlTmms | ING | Operate Delay Time | | O |
| RsDlTmms | ING | Reset Delay Time | | O |

### 5.4.21 LN: Protection trip conditioning Name: PTRC

This LN shall be used to connect the “operate” outputs of one or more protection functions to a common “trip” to be transmitted to XCBR. In addition or alternatively, any combination of “operate” outputs of the protection functions may be combined to a new “operate” of PTRC.

| PTRC class | | | | |
|---|---|---|---|---|
| **Attribute Name** | **Attr. Type** | **Explanation** | **T** | **M/O** |
| LNName | | Shall be inherited from Logical-Node Class (see IEC 61850-7-2) | | |
| **Data** | | | | |
| ***Common Logical Node Information*** | | | | |
| | | LN shall inherit all Mandatory Data from Common Logical Node Class | | M |
| OpCntRs | INC | Resetable operation counter | | O |
| ***Status Information*** | | | | |
| Tr | ACT | Trip | | C |
| Op | ACT | Operate (combination of subscribed Op from protection functions) | | C |
| Str | ACD | Sum of all starts of all connected Logical Nodes | | O |
| ***Settings*** | | | | |
| TrMod | ING | Trip Mode | | O |
| TrPlsTmms | ING | Trip Pulse Time | | O |

Condition C: At least one of the two status information (Tr, Op) shall be used.

### 5.4.22 LN: Thermal overload Name: PTTR

For a description of this LN, see IEC 61850-5 (LNs PROL, PSOL). PTTR shall be used for all thermal overload functions. Depending on the algorithm, the LN describes either a temperature or a current (thermal model). Temperature data are also provided by other LNs. Examples are the Hot spot temperature in LN YPTR or the Isolation gas temperature in LN SIMG.

| PTTR class | | | | |
|---|---|---|---|---|
| **Attribute Name** | **Attr. Type** | **Explanation** | **T** | **M/O** |
| LNName | | Shall be inherited from Logical-Node Class (see IEC 61850-7-2) | | |
| **Data** | | | | |
| ***Common Logical Node Information*** | | | | |
| | | LN shall inherit all Mandatory Data from Common Logical Node Class | | M |
| OpCntRs | INC | Resetable operation counter | | O |
| ***Measured Values*** | | | | |
| Amp | MV | Current for thermal load model | | O |
| Tmp | MV | Temperature for thermal load | | O |
| TmpRl | MV | Relation between temperature and max. temperature | | O |
| LodRsvAlm | MV | Load reserve to alarm | | O |
| LodRsvTr | MV | Load reserve to trip | | O |
| AgeRat | MV | Ageing rate | | O |
| ***Status Information*** | | | | |
| Str | ACD | Start | | O |
| Op | ACT | Operate | T | M |
| AlmThm | ACT | Thermal Alarm | | O |
| TmTmpSt | CSD | Active curve characteristic | | O |
| TmASt | CSD | Active curve characteristic | | O |
| ***Settings*** | | | | |
| TmTmpCrv | CURVE | Characteristic Curve for temperature measurement | | O |
| TmACrv | CURVE | Characteristic Curve for current measurement /Thermal model | | O |
| TmpMax | ASG | Maximum allowed temperature | | O |
| StrVal | ASG | Start Value | | O |
| OpDlTmms | ING | Operate Delay Time | | O |
| MinOpTmms | ING | Minimum Operate Time | | O |

| PTTR class | | | | |
|---|---|---|---|---|
| **Attribute Name** | **Attr. Type** | **Explanation** | **T** | **M/O** |
| MaxOpTmms | ING | Maximum Operate Time | | O |
| RsDlTmms | ING | Reset Delay Time | | O |
| ConsTms | ING | Time constant of the thermal model | | O |
| AlmVal | ASG | Alarm Value | | O |

### 5.4.23 LN: Undercurrent Name: PTUC

For a description of this LN, see IEC 61850-5 (LN PUCP). This LN shall be used for the undercurrent part of PUCP. The underpower part of LN PUCP is covered by PDUP already. Different instances shall be used for phase and ground.

| PTUC class | | | | |
|---|---|---|---|---|
| **Attribute Name** | **Attr. Type** | **Explanation** | **T** | **M/O** |
| LNName | | Shall be inherited from Logical-Node Class (see IEC 61850-7-2) | | |
| **Data** | | | | |
| ***Common Logical Node Information*** | | | | |
| | | LN shall inherit all Mandatory Data from Common Logical Node Class | | M |
| OpCntRs | INC | Resetable operation counter | | O |
| ***Status Information*** | | | | |
| Str | ACD | Start | | M |
| Op | ACT | Operate | T | M |
| TmASt | CSD | Active curve characteristic | | O |
| ***Settings*** | | | | |
| TmACrv | CURVE | Operating Curve Type | | O |
| StrVal | ASG | Start Value | | O |
| OpDlTmms | ING | Operate Delay Time | | O |
| TmMult | ASG | Time Dial Multiplier | | O |
| MinOpTmms | ING | Minimum Operate Time | | O |
| MaxOpTmms | ING | Maximum Operate Time | | O |
| TypRsCrv | ING | Type of Reset Curve | | O |
| RsDlTmms | ING | Reset Delay Time | | O |
| DirMod | ING | Directional Mode | | O |

### 5.4.24 LN: Undervoltage Name: PTUV

For a description of this LN, see IEC 61850-5. With an appropriate low operating curve, PTUV functions also as Zero voltage relay.

| PTUV class | | | | |
|---|---|---|---|---|
| **Attribute Name** | **Attr. Type** | **Explanation** | **T** | **M/O** |
| LNName | | Shall be inherited from Logical-Node Class (see IEC 61850-7-2) | | |
| **Data** | | | | |
| ***Common Logical Node Information*** | | | | |
| | | LN shall inherit all Mandatory Data from Common Logical Node Class | | M |
| OpCntRs | INC | Resetable operation counter | | O |
| ***Status Information*** | | | | |
| Str | ACD | Start | | M |
| Op | ACT | Operate | T | M |
| TmVSt | CSD | Active curve characteristic | | O |
| ***Settings*** | | | | |

| PTUV class | | | | |
|---|---|---|---|---|
| **Attribute Name** | **Attr. Type** | **Explanation** | **T** | **M/O** |
| TmVCrv | CURVE | Operating Curve Type | | O |
| StrVal | ASG | Start Value | | O |
| TmMult | ASG | Time Dial Multiplier | | O |
| MinOpTmms | ING | Minimum Operate Time | | O |
| MaxOpTmms | ING | Maximum Operate Time | | O |
| OpDlTmms | ING | Operate Delay Time | | O |
| RsDlTmms | ING | Reset Delay Time | | O |

### 5.4.25 LN: Underpower factor Name: PUPF

For a description of this LN, see IEC 61850-5 (LN PPFR). This LN shall be used for the underpower factor part of PPFR.

| PUPF class | | | | |
|---|---|---|---|---|
| **Attribute Name** | **Attr. Type** | **Explanation** | **T** | **M/O** |
| LNName | | Shall be inherited from Logical-Node Class (see IEC 61850-7-2) | | |
| **Data** | | | | |
| ***Common Logical Node Information*** | | | | |
| | | LN shall inherit all Mandatory Data from Common Logical Node Class | | M |
| OpCntRs | INC | Resetable operation counter | | O |
| ***Status Information*** | | | | |
| Str | ACD | Start | | M |
| Op | ACT | Operate | T | M |
| BlkA | SPS | Blocked below minimum operating current | | O |
| BlkV | SPS | Blocked below minimum operating voltage | | O |
| ***Settings*** | | | | |
| StrVal | ASG | Start Value | | O |
| OpDlTmms | ING | Operate Delay Time | | O |
| RsDlTmms | ING | Reset Delay Time | | O |
| BlkValA | ASG | Block Value (Minimum operating current) | | O |
| BlkValV | ASG | Block Value (Minimum operating voltage) | | O |

### 5.4.26 LN: Underfrequency Name: PTUF

For a description of this LN, see IEC 61850-5 (LN PFRQ). This LN shall be used to model the underfrequency part of PFRQ. One instance shall be used per stage.

| PTUF class | | | | |
|---|---|---|---|---|
| **Attribute Name** | **Attr. Type** | **Explanation** | **T** | **M/O** |
| LNName | | Shall be inherited from Logical-Node Class (see IEC 61850-7-2) | | |
| **Data** | | | | |
| ***Common Logical Node Information*** | | | | |
| | | LN shall inherit all Mandatory Data from Common Logical Node Class | | M |
| OpCntRs | INC | Resetable operation counter | | O |
| ***Status Information*** | | | | |
| Str | ACD | Start | | M |
| Op | ACT | Operate | T | M |
| BlkV | SPS | Blocked because of voltage | | O |
| ***Settings*** | | | | |
| StrVal | ASG | Start Value (frequency) | | O |

| PTUF class | | | | |
|---|---|---|---|---|
| Attribute Name | Attr. Type | Explanation | T | M/O |
| BlkVal | ASG | Voltage Block Value | | O |
| OpDlTmms | ING | Operate Delay Time | | O |
| RsDlTmms | ING | Reset Delay Time | | O |

### 5.4.27 LN: Voltage controlled time overcurrent Name: PVOC

For a description of this LN, see IEC 61850-5.

| PVOC class | | | | |
|---|---|---|---|---|
| Attribute Name | Attr. Type | Explanation | T | M/O |
| LNName | | Shall be inherited from Logical-Node Class (see IEC 61850-7-2) | | |
| **Data** | | | | |
| ***Common Logical Node Information*** | | | | |
| | | LN shall inherit all Mandatory Data from Common Logical Node Class | | M |
| OpCntRs | INC | Resetable operation counter | | O |
| ***Status Information*** | | | | |
| Str | ACD | Start | | M |
| Op | ACT | Operate | T | M |
| AVSt | CSD | Active curve characteristic | | O |
| TmASt | CSD | Active curve characteristic | | O |
| ***Settings*** | | | | |
| AVCrv | CURVE | Operating Curve Type (for voltage controlled current curve) | | O |
| TmACrv | CURVE | Operating Curve Type (for current) | | O |
| TmMult | ASG | Time Dial Multiplier | | O |
| MinOpTmms | ING | Minimum Operate Time | | O |
| MaxOpTmms | ING | Maximum Operate Time | | O |
| OpDlTmms | ING | Operate Delay Time | | O |
| TypRsCrv | ING | Type of Reset Curve | | O |
| RsDlTmms | ING | Reset Delay Time | | O |

### 5.4.28 LN: Volts per Hz Name: PVPH

For a description of this LN, see IEC 61850-5. One instance of PVPH shall be used per protection stage.

| PVPH class | | | | |
|---|---|---|---|---|
| Attribute Name | Attr. Type | Explanation | T | M/O |
| LNName | | Shall be inherited from Logical-Node Class (see IEC 61850-7-2) | | |
| **Data** | | | | |
| ***Common Logical Node Information*** | | | | |
| | | LN shall inherit all Mandatory Data from Common Logical Node Class | | M |
| OpCntRs | INC | Resetable operation counter | | O |
| ***Status Information*** | | | | |
| Str | ACD | Start | | M |
| Op | ACT | Operate | T | M |
| VHzSt | CSD | Active curve characteristic | | O |
| ***Settings*** | | | | |
| VHzCrv | CURVE | Operating Curve Type | | O |
| StrVal | ASG | Volts per hertz Start Value | | O |
| OpDlTmms | ING | Operate Delay Time | | O |

| PVPH class | | | | |
|---|---|---|---|---|
| **Attribute Name** | **Attr. Type** | **Explanation** | **T** | **M/O** |
| TypRsCrv | ING | Type of Reset Curve | | O |
| RsDlTmms | ING | Reset Delay Time | | O |
| TmMult | ASG | Time Dial Multiplier | | O |
| MinOpTmms | ING | Minimum Operate Time | | O |
| MaxOpTmms | ING | Maximum Operate Time | | O |

### 5.4.29 LN: Zero speed or underspeed Name: PZSU

For a description of this LN, see IEC 61850-5.

| PZSU class | | | | |
|---|---|---|---|---|
| **Attribute Name** | **Attr. Type** | **Explanation** | **T** | **M/O** |
| LNName | | Shall be inherited from Logical-Node Class (see IEC 61850-7-2) | | |
| **Data** | | | | |
| ***Common Logical Node Information*** | | | | |
| | | LN shall inherit all Mandatory Data from Common Logical Node Class | | M |
| OpCntRs | INC | Resetable operation counter | | O |
| ***Status Information*** | | | | |
| Str | ACD | Start | | M |
| Op | ACT | Operate | T | M |
| ***Settings*** | | | | |
| StrVal | ASG | Start Value (Speed) | | O |
| OpDlTmms | ING | Operate Delay Time | | O |
| RsDlTmms | ING | Reset Delay Time | | O |

## 5.5 Logical Nodes for protection related functions LN Group: R

### 5.5.1 Modelling Remarks

**Table 4 – Relation between IEC 61850-5 and IEC 61850-7-4 for protection related LNs**

| Functionality | IEEE reference | Defined in IEC 61850-5 by LN | Modelled in IEC 61850-7-4 by LN | Comments |
|---|---|---|---|---|
| Directional element | | | RDIR | Directional element for modelling directed protection with Pxyz nodes |
| Disturbance recording (acquisition) | | RDRE | RDRE<br>RADR<br>RBDR | Basic functionality<br>Analogue channel<br>Binary channel |
| Others | | R… | R… | 1:1 Relationship |

### 5.5.2 LN: Disturbance recorder function Name: RDRE

For consistent modelling, the disturbance recorder function described as a requirement in IEC 61850-5 is decomposed into one LN class for analogue channels (RADR) and another LN class for binary channels (RBDR). The output refers to the “IEEE Standard Format for Transient Data Exchange (COMTRADE) for Power Systems” (IEC 60255-24). Disturbance recorders are logical devices built up with one LN per channel. Since the content of Logical Devices (LD) are not standardised, other LNs may be inside the LD “Disturbance recorder” if applicable. All enabled channels are included in the recording, independently of the trigger mode (TrgMod).

| RDRE class | | | | |
|---|---|---|---|---|
| **Attribute Name** | **Attr. Type** | **Explanation** | **T** | **M/O** |
| LNName | | Shall be inherited from Logical-Node Class (see IEC 61850-7-2) | | |
| **Data** | | | | |
| ***Common Logical Node Information*** | | | | |
| | | LN shall inherit all Mandatory Data from Common Logical Node Class | | M |
| OpCntRs | INC | Resetable operation counter | | O |
| ***Controls*** | | | | |
| RcdTrg | SPC | Trigger recorder | | O |
| MemRs | SPC | Reset recorder memory | T | O |
| MemClr | SPC | Clear Memory | T | O |
| ***Status Information*** | | | | |
| RcdMade | SPS | Recording made | | M |
| FltNum | INS | Fault Number | | M |
| GriFltNum | INS | Grid Fault Number | | O |
| RcdStr | SPS | Recording started | | O |
| MemUsed | INS | Memory used in % | | O |
| ***Settings*** | | | | |
| TrgMod | ING | Trigger mode (internal trigger, external or both) | | O |
| LevMod | ING | Level Trigger Mode | | O |
| PreTmms | ING | Pre-trigger time | | O |
| PstTmms | ING | Post-trigger time | | O |
| MemFull | ING | Memory full level | | O |
| MaxNumRcd | ING | Maximum number of records | | O |
| ReTrgMod | ING | Retrigger Mode | | O |
| PerTrgTms | ING | Periodic trigger time in s | | O |
| ExclTmms | ING | Exclusion time | | O |
| OpMod | ING | Operation mode (Saturation, Overwrite) | | O |

NOTE 1 The trigger modes (TrgMod) of RDRE, RADR and RBDR are not independent. If the trigger mode of RDRE is external, the trigger modes of RADR and RBDR may be external (no extension of trigger possibilities) or internal (extension of the external trigger mode). If the trigger mode of RDRE is internal, the trigger modes of RADR and RBDR should also be internal because otherwise, no trigger possibility is provided.

NOTE 2 The source of the external trigger is a local issue. It may be a contact or a signal from another logical node.

NOTE 3 The source of the internal trigger is an event detected by the supervision of the channel. It may, for analogue channels, be a limit violation or it may, for binary channels, be a status change. The trigger levels (High/Low) for analogue channels for internal triggering have to be set per channel.

### 5.5.3 LN: Disturbance recorder channel analogue Name: RADR

In addition to the channel number, all attributes needed for the COMTRADE file are provided either by data from the TVTR or TCTR or by attributes of the measured value (samples subscribed from TVTR or TCTR) itself. The “circuit component” and “phase identification” is provided by the instance identification of the LN RADR. Channels “1” to “*n*” are created by “1” to “*n*” instances.

| RADR class | | | | |
|---|---|---|---|---|
| **Attribute Name** | **Attr. Type** | **Explanation** | **T** | **M/O** |
| LNName | | Shall be inherited from Logical-Node Class (see IEC 61850-7-2) | | |
| **Data** | | | | |
| ***Common Logical Node Information*** | | | | |
| | | LN shall inherit all Mandatory Data from Common Logical Node Class | | M |
| OpCntRs | INC | Resetable operation counter | | O |
| ***Measured values*** | | | | |
| Access via COMTRADE only | | Analogue input channel | | M |
| ***Status Information*** | | | | |
| ChTrg | SPS | Channel triggered | | M |
| ***Settings*** | | | | |
| ChNum | ING | Channel number | | O |
| TrgMod | ING | Trigger mode (internal trigger, external or both) | | O |
| LevMod | ING | Level Trigger Mode | | O |
| HiTrgLev | ASG | High (positive) trigger level | | O |
| LoTrgLev | ASG | Low (negative) trigger level | | O |
| PreTmms | ING | Pre-trigger time | | O |
| PstTmms | ING | Post-trigger time | | O |

### 5.5.4 LN: Disturbance recorder channel binary Name: RBDR

In addition to the channel number, all attributes needed for the COMTRADE file are provided by attributes of the binary input (subscribed from another LN). The “circuit component” and “phase identification” is provided by the instance identification of the LN RBDR. Channels “1” to “*n*” are created by “1” to “*n*” instances.

| RBDR class | | | | |
|---|---|---|---|---|
| **Attribute Name** | **Attr. Type** | **Explanation** | **T** | **M/O** |
| LNName | | Shall be inherited from Logical-Node Class (see IEC 61850-7-2) | | |
| **Data** | | | | |
| ***Common Logical Node Information*** | | | | |
| | | LN shall inherit all Mandatory Data from Common Logical Node Class | | M |
| OpCntRs | INC | Resetable operation counter | | O |
| ***Status Information*** | | | | |
| Access via COMTRADE only | | Binary input channel | | M |
| ChTrg | SPS | Channel triggered | | M |
| ***Settings*** | | | | |
| ChNum | ING | Channel number | | O |
| TrgMod | ING | Trigger mode (internal trigger, external or both) | | O |
| LevMod | ING | Level Trigger Mode | | O |
| PreTmms | ING | Pre-trigger time | | O |
| PstTmms | ING | Post-trigger time | | O |

### 5.5.5 LN: Disturbance record handling Name: RDRS

For a description of this LN, see IEC 61850-5. This LN shall handle the disturbance records acquired by some local function. This LN is normally located at station level.

| RDRS class | | | | |
|---|---|---|---|---|
| **Attribute Name** | **Attr. Type** | **Explanation** | **T** | **M/O** |
| LNName | | Shall be inherited from Logical-Node Class (see IEC 61850-7-2) | | |
| **Data** | | | | |
| ***Common Logical Node Information*** | | | | |
| | | LN shall inherit all Mandatory Data from Common Logical Node Class | | M |
| ***Controls*** | | | | |
| AutoUpLod | SPC | Automatic upload | | O |
| DltRcd | SPC | Delete record | | O |

### 5.5.6 LN: Breaker failure Name: RBRF

For a description of this LN, see IEC 61850-5.

| RBRF class | | | | |
|---|---|---|---|---|
| **Attribute Name** | **Attr. Type** | **Explanation** | **T** | **M/O** |
| LNName | | Shall be inherited from Logical-Node Class (see IEC 61850-7-2) | | |
| **Data** | | | | |
| ***Common Logical Node Information*** | | | | |
| | | LN shall inherit all Mandatory Data from Common Logical Node Class | | M |
| OpCntRs | INC | Resetable operation counter | | O |
| ***Status Information*** | | | | |
| Str | ACD | Start, timer running | | O |
| OpEx | ACT | Breaker failure trip (“external trip”) | T | C |
| OpIn | ACT | Operate, retrip (“internal trip”) | T | C |
| ***Settings*** | | | | |
| FailMod | ING | Breaker Failure Detection Mode (current, breaker status, both, other) | | O |
| FailTmms | ING | Breaker Failure Time Delay for bus bar trip | | O |
| SPTrTmms | ING | Single Pole Retrip Time Delay | | O |
| TPTrTmms | ING | Three Pole Retrip Time Delay | | O |
| DetValA | ASG | Current Detector Value | | O |
| ReTrMod | ING | Retrip Mode | | O |

Condition C: At least one of either data shall be used depending on the applied tripping schema.

### 5.5.7 LN: Directional element Name: RDIR

This LN shall be used to represent all directional Data in a dedicated LN used for directional relays. The protection function itself is modelled by the dedicated protection LN. LN RDIR may be used with functions 21, 32 or 67 according to IEEE device function number designation.

| RDIR class | | | | |
|---|---|---|---|---|
| **Attribute Name** | **Attr. Type** | **Explanation** | **T** | **M/O** |
| LNName | | Shall be inherited from Logical-Node Class (see IEC 61850-7-2) | | |
| **Data** | | | | |
| ***Common Logical Node Information*** | | | | |
| | | LN shall inherit all Mandatory Data from Common Logical Node Class | | M |
| ***Status Information*** | | | | |
| Dir | ACD | Direction | | M |
| ***Settings*** | | | | |
| ChrAng | ASG | Characteristic Angle | | O |
| MinFwdAng | ASG | Minimum Phase Angle in Forward Direction | | O |
| MinRvAng | ASG | Minimum Phase Angle in Reverse Direction | | O |

| RDIR class | | | | |
|---|---|---|---|---|
| **Attribute Name** | **Attr. Type** | **Explanation** | **T** | **M/O** |
| MaxFwdAng | ASG | Maximum Phase Angle in Forward Direction | | O |
| MaxRvAng | ASG | Maximum Phase Angle in Reverse Direction | | O |
| BlkValA | ASG | Minimum operating current | | O |
| BlkValV | ASG | Minimum operating voltage | | O |
| PolQty | ING | Polarising Quantity | | O |
| MinPPV | ASG | Min Phase-Phase Voltage | | O |

### 5.5.8 LN: Fault locator Name: RFLO

For a description of this LN, see IEC 61850. In case of a fault, the fault location is calculated in Ω. To convert it into km, the line parameters (settings) also have to be known.

| RFLO class | | | | |
|---|---|---|---|---|
| **Attribute Name** | **Attr. Type** | **Explanation** | **T** | **M/O** |
| LNName | | Shall be inherited from Logical-Node Class (see IEC 61850-7-2) | | |
| **Data** | | | | |
| ***Common Logical Node Information*** | | | | |
| | | LN shall inherit all Mandatory Data from Common Logical Node Class | | M |
| OpCntRs | INC | Resetable operation counter | | O |
| ***Measured values*** | | | | |
| FDOhm | MV | Fault Distance in Ω | | M |
| FDkm | MV | Fault Distance in km | | M |
| ***Status Information*** | | | | |
| FltLoop | INS | Fault Loop | | O |
| ***Settings*** | | | | |
| LinLenKm | ASG | Line length in km | | O |
| R1 | ASG | Positive-sequence line resistance | | O |
| X1 | ASG | Positive-sequence line reactance | | O |
| R0 | ASG | Zero-sequence line resistance | | O |
| X0 | ASG | Zero-sequence line reactance | | O |
| Z1Mod | ASG | Positive-sequence line impedance value | | O |
| Z1Ang | ASG | Positive-sequence line impedance angle | | O |
| Z0Mod | ASG | Zero-sequence line impedance value | | O |
| Z0Ang | ASG | Zero-sequence line impedance angle | | O |
| Rm0 | ASG | Mutual resistance | | O |
| Xm0 | ASG | Mutual reactance | | O |
| Zm0Mod | ASG | Mutual impedance value | | O |
| Zm0Ang | ASG | Mutual impedance angle | | O |

### 5.5.9 LN: Power swing detection/blocking Name: RPSB

For a description of this LN, see IEC 61850-5. The power swing is characterised by slow periodic changing of measured impedance. Such a moderate impedance change is tolerated, but may result in tripping of the distance protection function. To avoid this unwanted behaviour, tripping of distance protection function shall be blocked in the correlated zone (power swing blocking). For convenience, the instances of RPSB should have the same instance numbers like the PDIS per zone (RPSB1 and PDIS1, etc.). If the generator is out of step (pole slipping), transient changes of impedance (one per slip) are measured. After a small number of slips, (MaxNumSlp) in a dedicated time window (EvTmms), the generator shall be tripped to avoid mechanical damage (out of step tripping). The actual number of slips is reset either by the trip or by the end of evaluation time.

| RPSB class | | | | |
|---|---|---|---|---|
| **Attribute Name** | **Attr. Type** | **Explanation** | **T** | **M/O** |
| LNName | | Shall be inherited from Logical-Node Class (see IEC 61850-7-2) | | |
| **Data** | | | | |
| ***Common Logical Node Information*** | | | | |
| | | LN shall inherit all Mandatory Data from Common Logical Node Class | | M |
| OpCntRs | INC | Resetable operation counter | | O |
| ***Status Information*** | | | | |
| Str | ACD | Start (Power Swing Detected) | | C1 |
| Op | ACT | Operate (Out of step Tripping) | T | C2 |
| BlkZn | SPS | Blocking of correlated PDIS zone | | C1 |
| ***Settings*** | | | | |
| ZeroEna | SPG | Zero Enable | | O |
| NgEna | SPG | Negative Sequence Current Supervision Enabled | | O |
| MaxEna | SPG | Max Current Supervision Enabled | | O |
| SwgVal | ASG | Power Swing Delta | | O |
| SwgRis | ASG | Power Swing Delta R | | O |
| SwgReact | ASG | Power Swing Delta X | | O |
| SwgTmms | ING | Power Swing Time | | O |
| UnBlkTmms | ING | Unblocking Time | | O |
| MaxNumSlp | ING | Maximum number of pole slips until tripping (Op, Out of step tripping) | | O |
| EvTmms | ING | Evaluation time (time window, Out of step tripping) | | O |

Condition C1: Mandatory if RPSB is used for “Power swing blocking”

Condition C2: Mandatory if RPSB is used for “Out of step tripping”

### 5.5.10 LN: Autoreclosing Name: RREC

For a description of this LN, see IEC 61850-5. In order to represent auto reclosers with more than three reclose cycles, the RREC should be extended with additional reclose times. The trigger for the activation of RREC can be the trip signal of PTRC, or the report “breaker open” of the circuit breaker, or any other signals and combination of signals.

| RREC class | | | | |
|---|---|---|---|---|
| **Attribute Name** | **Attr. Type** | **Explanation** | **T** | **M/O** |
| LNName | | Shall be inherited from Logical-Node Class (see IEC 61850-7-2) | | |
| **Data** | | | | |
| ***Common Logical Node Information*** | | | | |
| | | LN shall inherit all Mandatory Data from Common Logical Node Class | | M |
| OpCntRs | INC | Resetable operation counter | | O |
| ***Controls*** | | | | |
| BlkRec | INC | Block Reclose | | O |
| ChkRec | SPC | Check Reclosing | | O |
| Auto | SPC | Automatic Operation (external switch status) | | O |
| ***Status Information*** | | | | |
| Op | ACT | Operate (used here to provide close to XCBR) | T | M |
| AutoRecSt | INS | Auto Reclosing Status | | M |
| ***Settings*** | | | | |
| Rec1Tmms | ING | First Reclose Time | | O |
| Rec2Tmms | ING | Second Reclose Time | | O |
| Rec3Tmms | ING | Third Reclose Time | | O |
| PlsTmms | ING | Close Pulse Time | | O |

| RREC class | | | | |
|---|---|---|---|---|
| **Attribute Name** | **Attr. Type** | **Explanation** | **T** | **M/O** |
| RclTmms | ING | Reclaim Time | | O |

### 5.5.11 LN: Synchronism-check or synchronising Name: RSYN

For a description of this LN, see IEC 61850-5. The voltage phasor difference from both sides of an open breaker is calculated and compared with predefined switching conditions (synchrocheck). Included is the case that one side is dead (example: energising a dead line) and the case that the phasor on one side can be actively controlled by "higher" or "lower" (means synchronising).

| RSYN class | | | | |
|---|---|---|---|---|
| **Attribute Name** | **Attr. Type** | **Explanation** | **T** | **M/O** |
| LNName | | Shall be inherited from Logical-Node Class (see IEC 61850-7-2) | | |
| **Data** | | | | |
| ***Common Logical Node Information*** | | | | |
| | | LN shall inherit all Mandatory Data from Common Logical Node Class | | M |
| ***Controls*** | | | | |
| RHz | SPC | Raise Frequency | | O |
| LHz | SPC | Lower Frequency | | O |
| RV | SPC | Raise Voltage | | O |
| LV | SPC | Lower Voltage | | O |
| ***Status Information*** | | | | |
| Rel | SPS | Release | | M |
| VInd | SPS | Voltage Difference Indicator | | O |
| AngInd | SPS | Angle Difference Indicator | | O |
| HzInd | SPS | Frequency Difference Indicator | | O |
| SynPrg | SPS | Synchronising in progress | | O |
| ***Measured values*** | | | | |
| DifVClc | MV | Calculated Difference in Voltage | | O |
| DifHzClc | MV | Calculated Difference in Frequency | | O |
| DifAngClc | MV | Calculated Difference of Phase Angle | | O |
| ***Settings*** | | | | |
| DifV | ASG | Difference Voltage | | O |
| DifHz | ASG | Difference Frequency | | O |
| DifAng | ASG | Difference Phase Angle | | O |
| LivDeaMod | ING | Live Dead Mode | | O |
| DeaLinVal | ASG | Dead Line Value | | O |
| LivLinVal | ASG | Live Line Value | | O |
| DeaBusVal | ASG | Dead Bus Value | | O |
| LivBusVal | ASG | Live Bus Value | | O |
| PlsTmms | ING | Close Pulse Time | | O |
| BkrTmms | ING | Closing time of breaker | | O |

## 5.6 Logical Nodes for control LN Group: C

### 5.6.1 Modelling remarks

**Table 5 – Relation between IEC 61850-5 and IEC 61850-7-4 for control LNs**

| Functionality | Defined in IEC 61850-5 by LN | Modelled in IEC 61850-7-4 by LN | Comments |
|---|---|---|---|
| Transformer incl. cooling | YPTR | CCGR | Dedicated cooling group control split off from YPTR |
| Tap changer controller | CTCC | ATCC | Automatic tap changer controller |

### 5.6.2 LN: Alarm handling Name: CALH

For a description of this LN, see IEC 61850-5. Individual alarms are generated in the corresponding logical nodes, for example metering alarms are found in MMXU or MMTR, etc. CALH allows the creation of group warnings and alarms. The individual alarms, which are used to calculate the group alarms/warnings, are subscribed from elsewhere. The calculation is a local issue.

| CALH class | | | | |
|---|---|---|---|---|
| **Attribute Name** | **Attr. Type** | **Explanation** | **T** | **M/O** |
| LNName | | Shall be inherited from Logical-Node Class (see IEC 61850-7-2) | | |
| **Data** | | | | |
| ***Common Logical Node Information*** | | | | |
| | | LN shall inherit all Mandatory Data from Common Logical Node Class | | M |
| ***Status Information*** | | | | |
| GrAlm | SPS | Group alarm | | M |
| GrWrn | SPS | Group warning | | O |
| AlmLstOv | SPS | Alarm list overflow | | O |

### 5.6.3 LN: Cooling group control Name: CCGR

This LN class shall be used to control the cooling equipment. One instance per cooling group shall be used.

| CCGR class | | | | |
|---|---|---|---|---|
| **Attribute Name** | **Attr. Type** | **Explanation** | **T** | **M/O** |
| LNName | | Shall be inherited from Logical-Node Class (see IEC 61850-7-2) | | |
| **Data** | | | | |
| ***Common Logical Node Information*** | | | | |
| | | LN shall inherit all Mandatory Data from Common Logical Node Class | | M |
| EEHealth | INS | External equipment health | | O |
| EEName | DPL | External equipment name plate | | O |
| OpTmh | INS | Operation time | | O |
| ***Measured values*** | | | | |
| EnvTmp | MV | Temperature of environment | | O |
| OilTmpIn | MV | Oil temperature cooler in | | O |
| OilTmpOut | MV | Oil temperature cooler out | | O |
| OilMotA | MV | Oil circulation motor drive current | | O |
| FanFlw | MV | Air flow in fan | | O |
| FanA | MV | Motor drive current fan | | O |

| CCGR class | | | | |
|---|---|---|---|---|
| **Attribute Name** | **Attr. Type** | **Explanation** | **T** | **M/O** |
| ***Controls*** | | | | |
| CECtl | SPC | Control of complete cooling group (pumps and fans) | | O |
| PmpCtlGen | INC | Control of all pumps | | O |
| PmpCtl | INC | Control of a single pump | | O |
| FanCtlGen | INC | Control of all fans | | O |
| FanCtl | INC | Control of a single fan | | O |
| Auto | SPC | Automatic or manual | | O |
| ***Status Information*** | | | | |
| FanOvCur | SPS | Fan overcurrent trip | | O |
| PmpOvCur | SPS | Pump overcurrent trip | | O |
| PmpAlm | SPS | Loss of pump | | O |
| ***Settings*** | | | | |
| OilTmpSet | ASG | Set point for oil temperature | | O |

### 5.6.4 LN: Interlocking Name: CILO

For a description of this LN, see IEC 61850-5. This LN shall be used to “enable” a switching operation if the interlocking conditions are fulfilled. One instance per switching device is needed. At least all related switchgear positions have to be subscribed. The interlocking algorithm is a local issue.

| CILO class | | | | |
|---|---|---|---|---|
| **Attribute Name** | **Attr. Type** | **Explanation** | **T** | **M/O** |
| LNName | | Shall be inherited from Logical-Node Class (see IEC 61850-7-2) | | |
| **Data** | | | | |
| ***Common Logical Node Information*** | | | | |
| | | LN shall inherit all Mandatory Data from Common Logical Node Class | | M |
| ***Status Information*** | | | | |
| EnaOpn | SPS | Enable Open | | M |
| EnaCls | SPS | Enable Close | | M |

### 5.6.5 LN: Point-on-wave switching Name: CPOW

For a description of this LN, see IEC 61850. This LN shall be used if the circuit breaker is able to perform point-on-wave switching. In this case, the start signal for CPOW is OpOpn or OpCls to be subscribed from CSWI. CPOW shall then perform its entire dedicated algorithm using data from the allocated TCTR or local and remote TVTR (local issue) and shall then release a “Time Activated Control” (see IEC 61850-7-2) to XCBR. OpOpn and OpCls shall be used if no “Time Activated Control” services with real-time capability is available between CPOW and XCBR.

| CPOW class | | | | |
|---|---|---|---|---|
| **Attribute Name** | **Attr. Type** | **Explanation** | **T** | **M/O** |
| LNName | | Shall be inherited from Logical-Node Class (see IEC 61850-7-2) | | |
| **Data** | | | | |
| ***Common Logical Node Information*** | | | | |
| | | LN shall inherit all Mandatory Data from Common Logical Node Class | | M |
| ***Status Information*** | | | | |
| TmExc | SPS | Maximum allowed time exceeded | | M |
| StrPOW | SPS | CPOW started | | O |

| CPOW class | | | | |
|---|---|---|---|---|
| **Attribute Name** | **Attr. Type** | **Explanation** | **T** | **M/O** |
| OpOpn | ACT | Open switch | T | O |
| OpCls | ACT | Close switch | T | O |
| ***Settings*** | | | | |
| MaxDlTmms | ING | Maximum allowed delay time | | O |

### 5.6.6 LN: Switch controller Name: CSWI

For a description of this LN, see IEC 61850-5. This LN class shall be used to control all switching conditions above process level. CSWI shall subscribe the data POWCap (“point-on-wave switching capability”) from XCBR if applicable. If a switching command (for example Select-before-Operate) arrives and point-on-wave switching capability” is supported by the breaker, the command shall be passed to CPOW. OpOpn and OpCls shall be used if no real time services are available between CSWI and XCBR (see GSE in IEC 61850-7-2).

| CSWI class | | | | |
|---|---|---|---|---|
| **Attribute Name** | **Attr. Type** | **Explanation** | **T** | **M/O** |
| LNName | | Shall be inherited from Logical-Node Class (see IEC 61850-7-2) | | |
| **Data** | | | | |
| ***Common Logical Node Information*** | | | | |
| | | LN shall inherit all Mandatory Data from Common Logical Node Class | | M |
| Loc | SPS | Local operation | | O |
| OpCntRs | INC | Resetable operation counter | | O |
| ***Controls*** | | | | |
| Pos | DPC | Switch, general | | M |
| PosA | DPC | Switch L1 | | O |
| PosB | DPC | Switch L2 | | O |
| PosC | DPC | Switch L3 | | O |
| OpOpn | ACT | Operation “Open Switch” | T | O |
| OpCls | ACT | Operation “Close Switch” | T | O |

## 5.7 Logical nodes for generic references LN Group: G

### 5.7.1 LN: Generic automatic process control Name: GAPC

For a description of this LN, see IEC 61850-5. This node shall be used to model in a generic way the processing/automation of functions that are not predefined by one of the groups A, C, M, P, or R.

| GAPC class | | | | |
|---|---|---|---|---|
| **Attribute Name** | **Attr. Type** | **Explanation** | **T** | **M/O** |
| LNName | | Shall be inherited from Logical-Node Class (see IEC 61850-7-2) | | |
| **Data** | | | | |
| ***Common Logical Node Information*** | | | | |
| | | LN shall inherit all Mandatory Data from Common Logical Node Class | | M |
| Loc | SPS | Local operation | | O |
| OpCntRs | INC | Resetable operation counter | | O |
| ***Controls*** | | | | |
| Auto | SPC | Automatic operation | | O |
| SPCSO | SPC | Single point controllable status output | | O |
| DPCSO | DPC | Double point controllable status output | | O |
| ISCSO | INC | Integer status controllable status output | | O |
| ***Status Information*** | | | | |

| GAPC class | | | | |
|---|---|---|---|---|
| **Attribute Name** | **Attr. Type** | **Explanation** | **T** | **M/O** |
| Str | ACD | Start | | M |
| Op | ACT | Operate | T | M |
| ***Settings*** | | | | |
| StrVal | ASG | Start Value | | O |

### 5.7.2 LN: Generic process I/O Name: GGIO

For a description of this LN, see IEC 61850-5. This node shall be used to model in a generic way device processes that are not predefined by the groups S, T, X, Y, or Z. All data listed in Clause 6 of this document can be used for a dedicated application of LN GGIO.

| GGIO class | | | | |
|---|---|---|---|---|
| **Attribute Name** | **Attr. Type** | **Explanation** | **T** | **M/O** |
| LNName | | Shall be inherited from Logical-Node Class (see IEC 61850-7-2) | | |
| **Data** | | | | |
| ***Common Logical Node Information*** | | | | |
| | | LN shall inherit all Mandatory Data from Common Logical Node Class | | M |
| EEHealth | INS | External equipment health (external sensor) | | O |
| EEName | DPL | External equipment name plate | | O |
| Loc | SPS | Local operation | | O |
| OpCntRs | INC | Resetable operation counter | | O |
| ***Measured values*** | | | | |
| AnIn | MV | Analogue input | | O |
| ***Controls*** | | | | |
| SPCSO | SPC | Single point controllable status output | | O |
| DPCSO | DPC | Double point controllable status output | | O |
| ISCSO | INC | Integer status controllable status output | | O |
| ***Status Information*** | | | | |
| IntIn | INS | Integer status input | | O |
| Alm | SPS | General single alarm | | O |
| Ind | SPS | General indication (binary input) | | O |

### 5.7.3 LN: Generic security application Name: GSAL

For a description of this LN, see IEC 61850-7-2. This node shall be used to monitor security violations regarding authorisation, access control, service privileges and inactive associations.

| GSAL class | | | | |
|---|---|---|---|---|
| **Attribute Name** | **Attr. Type** | **Explanation** | **T** | **M/O** |
| LNName | | Shall be inherited from Logical-Node Class (see IEC 61850-7-2) | | |
| **Data** | | | | |
| ***Common Logical Node Information*** | | | | |
| | | LN shall inherit all Mandatory Data from Common Logical Node Class | | M |
| OpCntRs | INC | Resetable Security Violations counter | | M |
| ***Controls*** | | | | |
| NumCntRs | INC | Number of counter resets | | M |
| ***Status Information*** | | | | |
| AuthFail | SEC | Authorisation failures | | M |
| AcsCtlFail | SEC | Access control failures detected | | M |
| SvcViol | SEC | Service privilege violations | | M |
| Ina | SEC | Inactive associations | | M |

## 5.8 Logical Nodes for interfacing and archiving LN Group: I

### 5.8.1 LN: Archiving Name: IARC

For a description of this LN, see IEC 61850-5.

| IARC class | | | | |
|---|---|---|---|---|
| **Attribute Name** | **Attr. Type** | **Explanation** | **T** | **M/O** |
| LNName | | Shall be inherited from Logical-Node Class (see IEC 61850-7-2) | | |
| **Data** | | | | |
| ***Common Logical Node Information*** | | | | |
| | | LN shall inherit all Mandatory Data from Common Logical Node Class | | M |
| OpCntRs | INC | Resetable Security Violations counter | | M |
| ***Controls*** | | | | |
| NumCntRs | INC | Number of counter resets | | M |
| ***Status Information*** | | | | |
| MemOv | SPS | Memory Overflow | | M |
| MemUsed | INS | Memory used in % | | O |
| NumRcd | INS | Actual number of records | | O |
| ***Settings*** | | | | |
| MaxNumRcd | ING | Maximum number of records | | O |
| OpMod | ING | Operation mode (Saturation, Overwrite) | | O |
| MemFull | ING | Memory full level | | O |

### 5.8.2 LN: Human machine interface Name: IHMI

For a description of this LN, see IEC 61850-5.

| IHMI class | | | | |
|---|---|---|---|---|
| **Attribute Name** | **Attr. Type** | **Explanation** | **T** | **M/O** |
| LNName | | Shall be inherited from Logical-Node Class (see IEC 61850-7-2) | | |
| **Data** | | | | |
| ***Common Logical Node Information*** | | | | |
| | | LN shall inherit all Mandatory Data from Common Logical Node Class | | M |

### 5.8.3 LN: Telecontrol interface Name: ITCI

For a description of this LN, see IEC 61850-5.

| ITCI class | | | | |
|---|---|---|---|---|
| **Attribute Name** | **Attr. Type** | **Explanation** | **T** | **M/O** |
| LNName | | Shall be inherited from Logical-Node Class (see IEC 61850-7-2) | | |
| **Data** | | | | |
| ***Common Logical Node Information*** | | | | |
| | | LN shall inherit all Mandatory Data from Common Logical Node Class | | M |

### 5.8.4 LN: Telemonitoring interface Name: ITMI

For a description of this LN, see IEC 61850-5.

| ITMI class | | | | |
|---|---|---|---|---|
| **Attribute Name** | **Attr. Type** | **Explanation** | **T** | **M/O** |
| LNName | | Shall be inherited from Logical-Node Class (see IEC 61850-7-2) | | |
| **Data** | | | | |
| ***Common Logical Node Information*** | | | | |
| | | LN shall inherit all Mandatory Data from Common Logical Node Class | | M |

## 5.9 Logical Nodes for automatic control LN Group: A

### 5.9.1 Modelling remarks

**Table 6 – Relation between IEC 61850-5 and IEC 61850-7-4 for automatic control LNs**

| Functionality | Defined in IEC 61850-5 by LN | Modelled in IEC 61850-7-4 by LN | Comments |
|---|---|---|---|
| Automatic tap changer controller | | ATCC | See Table 5 |
| Synchronised switching | AsySw or CPBC | CPOW | See Table 5 |
| Zero voltage tripping | AZVT | PTUV | The start value has to discriminate between live and dead. The delay time has to be reasonably long to discriminate between a transient voltage zero or a permanent switched off line. |

### 5.9.2 LN: Neutral current regulator Name: ANCR

For a description of this LN, see IEC 61850-5.

| ANCR class | | | | |
|---|---|---|---|---|
| Attribute Name | Attr. Type | Explanation | T | M/O |
| LNName | | Shall be inherited from Logical-Node Class (see IEC 61850-7-2) | | |
| Data | | | | |
| Common Logical Node Information | | | | |
| | | LN shall inherit all Mandatory Data from Common Logical Node Class | | M |
| Loc | SPS | Local operation | | M |
| OpCntRs | INC | Resetable operation counter | | O |
| Controls | | | | |
| TapChg | BSC | Change Tap Position (stop, higher, lower) | | M |
| Auto | SPC | Automatic operation | | O |
| RCol | SPC | Raise Plunge Core Position | | O |
| LCol | SPC | Lower Plunge Core Position | | O |

### 5.9.3 LN: Reactive power control Name: ARCO

For a description of this LN, see IEC 61850-5. This LN shall be used for a reactive controller independent of the control method beeing used.

| ARCO class | | | | |
|---|---|---|---|---|
| **Attribute Name** | **Attr. Type** | **Explanation** | **T** | **M/O** |
| LNName | | Shall be inherited from Logical-Node Class (see IEC 61850-7-2) | | |
| **Data** | | | | |
| ***Common Logical Node Information*** | | | | |
| | | LN shall inherit all Mandatory Data from Common Logical Node Class | | M |
| Loc | SPS | Local operation | | M |
| OpCntRs | INC | Resetable operation counter | | O |
| ***Controls*** | | | | |
| TapChg | BSC | Change reactive power (stop, higher, lower) | | M |
| Auto | SPC | Automatic operation | | O |
| ***Status Information*** | | | | |
| VOvSt | SPS | Voltage override status | | O |
| NeutAlm | SPS | Neutral alarm is present | | O |
| DschBlk | SPS | Bank switch close blocked due to discharge | T | O |

### 5.9.4 LN: Automatic tap changer controller Name: ATCC

For a description of this LN, see IEC 61850-5.

| ATCC class | | | | |
|---|---|---|---|---|
| **Attribute Name** | **Attr. Type** | **Explanation** | **T** | **M/O** |
| LNName | | Shall be inherited from Logical-Node Class (see IEC 61850-7-2) | | |
| **Data** | | | | |
| ***Common Logical Node Information*** | | | | |
| | | LN shall inherit all Mandatory Data from Common Logical Node Class | | M |
| Loc | SPS | Local operation | | M |
| OpCntRs | INC | Resetable operation counter | | O |
| ***Controls*** | | | | |
| TapChg | BSC | Change Tap Position (stop, higher, lower) | | C |
| TapPos | ISC | Tap position | | C |
| ParOp | DPC | Parallel/Independent operation | | M |
| Auto | SPC | Automatic/Manual operation | | O |
| LTCBlk | SPC | Block (Inhibit) Automatic Control of LTC | | O |
| LTCDragRs | SPC | Reset LTC Drag Hands | T | O |
| VRed1 | SPC | Voltage reduction step 1 | | O |
| VRed2 | SPC | Voltage reduction step 2 | | O |
| ***Measured values*** | | | | |
| CtlV | MV | Control Voltage | | M |
| LodA | MV | Load Current (total transformer secondary current) | | O |
| CircA | MV | Circulating Current | | O |
| PhAng | MV | Phase Angle of LodA relative to CtlV at 1.0 power factor, FPF | | O |
| ***Metered Values*** | | | | |
| HiCtlV | MV | Highest Control Voltage | | O |
| LoCtlV | MV | Lowest Control Voltage | | O |
| HiDmdA | MV | High current demand (Load Current Demand) | | O |
| ***Status Information*** | | | | |
| HiTapPos | INS | High tap position | | O |
| LoTapPos | INS | Low tap position | | O |
| ***Settings*** | | | | |
| BndCtr | ASG | Band center voltage (FPF presumed) | | O |
| BndWid | ASG | Band width voltage (as voltage or percent of nominal voltage, FPF presumed) | | O |
| CtlDlTmms | ING | Control intentional time delay (FPF presumed) | | O |
| LDCR | ASG | Line drop voltage due to line resistance component | | O |
| LDCX | ASG | Line drop voltage due to line reactance component | | O |
| BlkLV | ASG | Control voltage below which auto Lower commands blocked | | O |
| BlkRV | ASG | Control voltage above which auto Raise commands blocked | | O |
| RnbkRV | ASG | Runback Raise Voltage | | O |
| LimLodA | ASG | Limit Load Current (LTC Block Load Current) | | O |
| LDC | SPG | Line Drop Compensation is R&X or Z model | | O |
| TmDlChr | SPG | Time delay linear or inverse characteristic | | O |
| LDCZ | ASG | Line drop voltage due to line total impedance | | O |
| VRedVal | ASG | Reduction of band centre (percent) when voltage step 1 is active | | O |
| TapBlkR | ING | Tap position of Load Tap Changer where automatic Raise commands are blocked | | O |

| ATCC class | | | | |
|---|---|---|---|---|
| **Attribute Name** | **Attr. Type** | **Explanation** | **T** | **M/O** |
| TapBlkL | ING | Tap position of Load Tap Changer where automatic Lower commands are blocked | | O |

Condition C: depending on the tap-change method at least one of the two controls TapChg and TapPos shall be used.

### 5.9.5 LN: Voltage control Name: AVCO

For a description of this LN, see IEC 61850-5. This LN shall be used for a voltage controller independent of the control method beeing used.

| AVCO class | | | | |
|---|---|---|---|---|
| **Attribute Name** | **Attr. Type** | **Explanation** | **T** | **M/O** |
| LNName | | Shall be inherited from Logical-Node Class (see IEC 61850-7-2) | | |
| **Data** | | | | |
| ***Common Logical Node Information*** | | | | |
| | | LN shall inherit all Mandatory Data from Common Logical Node Class | | M |
| Loc | SPS | Local operation | | M |
| OpCntRs | INC | Resetable operation counter | | O |
| ***Controls*** | | | | |
| TapChg | BSC | Change Voltage (stop, higher, lower) | | M |
| Auto | SPC | Automatic operation | | O |
| ***Status Information*** | | | | |
| BlkEF | SPS | Blocked by earth fault | | O |
| BlkAOv | SPS | Blocked by current limit overflow | | O |
| BlkVOv | SPS | Blocked by Voltage limit overflow | | O |
| ***Settings*** | | | | |
| LimAOv | ASG | Current limit for overflow blocking | | O |
| LimVOv | ASG | Voltage limit for overflow blocking | | O |

## 5.10 Logical Nodes for metering and measurement LN Group: M

### 5.10.1 Modelling remarks

If the values for metering or measurement are provided by an external sensor connected via a 4 to 20 mA link, the live zero alarm is provided by the data external health (EEHealth).

**Table 7 – Relation between IEC 61850-5 and IEC 61850-7-4 for metering and measurement LNs**

| Functionality | Defined in IEC 61850-5 by LN | Modelled in IEC 61850-7-4 by LN | Comments |
|---|---|---|---|
| Measurement | MMXU | MMXU | Three-phase version |
| | | MMXN | Non-phase related version (single phase) |
| Metering | MMTR | MMTR | Metering (values) |
| | | MSTA | Metering (statistics) |
| Harmonics and interharmonics | MHAI | MHAI | Three-phase version |
| | | MHAN | Non-phase related version (single phase) |
| Differential measurements | | MDIF | Calculated data for differential protection |

### 5.10.2 LN: Differential measurements Name: MDIF

This LN shall be used to provide calculated process values representing the other side of the line (or of another object) as used for differential protection (PDIF). The LN MDIF is also used with function 87 according to IEEE device function number designation (IEEE 32R.2 1996)

| MDIF class | | | | |
|---|---|---|---|---|
| **Attribute Name** | **Attr. Type** | **Explanation** | **T** | **M/O** |
| LNName | | Shall be inherited from Logical-Node Class (see IEC 61850-7-2) | | |
| **Data** | | | | |
| ***Common Logical Node Information*** | | | | |
| | | LN shall inherit all Mandatory Data from Common Logical Node Class | | M |
| ***Measured values*** | | | | |
| OpARem | WYE | Operate Current (phasor) of the remote current measurement | | C |
| Amp1 | SAV | Current (Sampled value) phase A | | C |
| Amp2 | SAV | Current (Sampled value) phase B | | C |
| Amp3 | SAV | Current (Sampled value) phase C | | C |

Condition C: Either OpARem or Amp1/Amp2/Amp3 shall be used.

### 5.10.3 LN: Harmonics or interharmonics Name: MHAI

For a description of this LN, see IEC 61850-5. This LN shall be used for calculation of harmonics or interharmonics in a three-phase system. Instances either for harmonics (including subharmonics and multiples) or interharmonics are possible depending on the value of the basic settings, i.e.:

- frequency $f$ (“Hz”);
- evaluation window $\Delta t$ (“EvTmms”).

The frequency may either be given or calculated by means such as a phase-locked loop (only possible for a dominant frequency like the basic power frequency).

a) Settings for Harmonics, Subharmonics and multiples

EvTmms = 1/Hz (16 ms for 60 Hz, 20 ms for 50 Hz)
NumCyc = 1 results in Harmonics only, i.e in multiples of Hz in a)
NumCyc > 1 results in addition in Subharmonics and multiples
Lowest frequency = 1/EvTmms
Highest frequency = (SmpRte)/2 (see TVTR, TCTR and IEC 61850-7-3)

b) Settings for Interharmonics

EvTmms = 1/Hz (adopted to the lowest interharmonics frequency expected)
NumCyc = 1 results in Interharmonics, i.e. in multiples of Hz in b)
NumCyc > 1 normally not used since the lowest frequency is freely adjusted by choice of Hz
Lowest frequency = 1/EvTmms
Highest frequency = (SmpRte)/2 (see TVTR, TCTR and IEC 61850-7-3)

Both harmonics and interharmonics carry power and produce distortions. There are different methods to calculate disturbances. For more information and definitions see IEC 61000-4-7 (1991), IEEE Std 519-1992, and IEEE Std 1459-2000.

| MHAI class | | | | |
|---|---|---|---|---|
| **Attribute Name** | **Attr. Type** | **Explanation** | **T** | **M/O** |
| LNName | | Shall be inherited from Logical-Node Class (see IEC 61850-7-2) | | |
| **Data** | | | | |
| ***Common Logical Node Information*** | | | | |
| | | LN shall inherit all Mandatory Data from Common Logical Node Class | | M |
| EEHealth | INS | External equipment health (external sensor) | | O |
| EEName | DPL | External equipment name plate | | O |
| ***Measured values*** | | | | |
| Hz | MV | Basic frequency | | C |
| HA | HWYE | Sequence of Harmonics or Interharmonics current | | O |
| HPhV | HWYE | Sequence of Harmonics or Interharominics phase to ground voltages | | O |
| HPPV | HDEL | Sequence of Harmonics or Interharmonics phase to phase voltages | | O |
| HW | HWYE | Sequence of Harmonics or Interharmonics active power | | O |
| HVAr | HWYE | Sequence of Harmonics or Interharmonics reactive power | | O |
| HVA | HWYE | Sequence of Harmonics or Interharmonics apparent power | | O |
| HRmsA | WYE | Current RMS Harmonic or Interharmonics (un-normalized Total harmonic disortion, Thd) | | O |
| HRmsPhV | WYE | Voltage RMS Harmonic or Interharmonics (un-normalized Thd) for phase to ground | | O |
| HRmsPPV | DEL | Voltage RMS Harmonic or Interharmonics (un-normalized Thd) for phase to phase | | O |
| HTuW | WYE | Total phase Harmonic or Interharmonics active power (no fundamental) unsigned sum | | O |
| HTsW | WYE | Total phase Harmonic or Interharmonic active power (no fundamental) signed sum | | O |
| HATm | WYE | Current Time (IT) product | | O |
| HKf | WYE | K Factor | | O |
| HTdf | WYE | Transformer derating factor | | O |
| ThdA | WYE | Current Total Harmonic or Interharmonic Distortion (different methods) | | O |
| ThdOddA | WYE | Current Total Harmonic or Interharmonic Distortion (different methods – odd components) | | O |
| ThdEvnA | WYE | Current Total Harmonic or Interharmonic Distortion (different methods – even components) | | O |
| TddA | WYE | Current Total Demand Distortion per IEEE 519 | | O |
| TddOddA | WYE | Current Total Demand Distortion per IEEE 519 (odd components) | | O |
| TddEvnA | WYE | Current Total Demand Distortion per IEEE 519 (even components) | | O |
| ThdPhV | WYE | Voltage Total Harmonic or Interharmonic Distortion (different methods) for phase to ground | | O |
| ThdOddPhV | WYE | Voltage Total Harmonic or Interharmonic Distortion (different methods) for phase to ground (odd components) | | O |
| ThdEvnPhV | WYE | Voltage Total Harmonic or Interharmonic Distortion (different methods) for phase to ground (even components) | | O |
| ThdPPV | DEL | Voltage Total Harmonic or Interharmonic Distortion (different methods) for phase to phase | | O |
| ThdOddPPV | DEL | Voltage Total Harmonic or Interharmonic Distortion (different methods) for phase to phase (odd components) | | O |
| ThdEvnPPV | DEL | Voltage Total Harmonic or Interharmonic Distortion (different methods) for phase to phase (even components) | | O |
| HCfPhV | WYE | Voltage crest factors (peak waveform value/sqrt(2)/fundamental) for phase to ground | | O |

| MHAI class | | | | |
|---|---|---|---|---|
| **Attribute Name** | **Attr. Type** | **Explanation** | **T** | **M/O** |
| HCfPPV | DEL | Voltage crest factors (peak waveform value/sqrt(2)/fundamental) for phase to phase | | O |
| HCfA | WYE | Current crest factors (peak waveform value/sqrt(2)/fundamental) | | O |
| HTif | WYE | Voltage Telephone Influence Factor | | O |
| ***Settings*** | | | | |
| HzSet | ASG | Basic frequency | | C |
| EvTmms | ASG | Evaluation time (time window) determines the lowest frequency | | O |
| NumCyc | ING | Number of cycles of the basic frequency | | O |
| ThdAVal | ASG | ThdA alarm Setting – value entered in % | | O |
| ThdVVal | ASG | ThdPhV / ThdPPV alarm Setting – value entered in % | | O |
| ThdATmms | ING | ThdA alarm time delay in ms | | O |
| ThdVTmms | ING | ThdPhV / ThdPPV alarm time delay in ms | | O |
| NomA | ASG | Normalising demand current used in IEEE 519 TDD calculation | | O |

Condition C: Hz and HzSet are exclusive.

### 5.10.4 LN: Non phase related harmonics or interharmonics Name: MHAN

This LN shall be used for calculation of harmonics or interharmonics in a single-phase system, i.e. a single line with no phase relations. Instances either for harmonics (including subharmonics and multiples) or interharmonics are possible depending on the value of the basic settings, i.e.:

- frequency *f* (“Hz”);
- evaluation window Δ*t* (“EvTmms”).

The frequency may either be given or calculated by means such as a phase-locked loop (only possible for a dominant frequency like the basic power frequency). The settings for Harmonics and Interharmonics instances, see MHAI.

| MHAN class | | | | |
|---|---|---|---|---|
| **Attribute Name** | **Attr. Type** | **Explanation** | **T** | **M/O** |
| LNName | | Shall be inherited from Logical-Node Class (see IEC 61850-7-2) | | |
| **Data** | | | | |
| ***Common Logical Node Information*** | | | | |
| | | LN shall inherit all Mandatory Data from Common Logical Node Class | | M |
| EEHealth | INS | External equipment health (external sensor) | | O |
| EEName | DPL | External equipment name plate | | O |
| ***Measured values*** | | | | |
| Hz | MV | Basic frequency | | C |
| HaAmp | HMV | Sequence of Harmonics or Interharmonics for current | | O |
| HaVol | HMV | Sequence of Harmonics or Interharmonics for voltages | | O |
| HaWatt | HMV | Sequence of Harmonics or Interharmonics for active power | | O |
| HaVolAmpr | HMV | Sequence of Harmonics or Interharmonics for reactive power | | O |
| HaVolAmp | HMV | Sequence of Harmonics or Interharmonics for apparent power | | O |
| HaRmsAmp | MV | Current RMS Harmonic or Interharmonic (un-normalized Thd) | | O |
| HaRmsVol | MV | Voltage RMS Harmonic or Interharmonic (un-normalized Thd) | | O |
| HaTuWatt | MV | Total Harmonic or Interharmonic active power (no fundamental) unsigned sum | | O |
| HaTsWatt | MV | Total Harmonic or Interharmonic active power (no fundamental) signed sum | | O |
| HaAmpTm | MV | Current Time (IT) product | | O |
| HaKFact | MV | K Factor | | O |

| MHAN class | | | | |
|---|---|---|---|---|
| **Attribute Name** | **Attr. Type** | **Explanation** | **T** | **M/O** |
| HaTdFact | MV | Transformer derating factor | | O |
| ThdAmp | MV | Current Total Harmonic or Interharmonic Distortion (different methods) | | O |
| ThdOddAmp | MV | Current Total Harmonic or Interharmonic Distortion (different methods – odd components) | | O |
| ThdEvnAmp | MV | Current Total Harmonic or Interharmonic Distortion (different methods – even components) | | O |
| TddAmp | MV | Current Total Demand Distortion per IEEE 519 | | O |
| TddOddAmp | MV | Current Total Demand Distortion per IEEE 519 (odd components) | | O |
| TddEvnAmp | MV | Current Total Demand Distortion per IEEE 519 (even components) | | O |
| ThdVol | MV | Voltage Total Harmonic or Interharmonic Distortion (different methods) | | O |
| ThdOddVol | MV | Voltage Total Harmonic or Interharmonic Distortion (different methods - odd components) | | O |
| ThdEvnVol | MV | Voltage Total Harmonic or Interharmonic Distortion (different methods- even components) | | O |
| HaCfAmp | MV | Current crest factors (peak waveform value/sqrt(2)/fundamental) | | O |
| HaCfVol | MV | Voltage crest factors (peak waveform value/sqrt(2)/fundamental) | | O |
| HaTiFact | MV | Voltage Telephone Influence Factor | | O |
| ***Settings*** | | | | |
| HzSet | ASG | Basic frequency | | C |
| EvTmms | ASG | Evaluation time (time window) determines the lowest frequency | | O |
| NumCyc | ING | Number of cycles of the basic frequency | | O |
| ThdAVal | ASG | ThdA alarm Setting – value entered in % | | O |
| ThdVVal | ASG | ThdV alarm Setting – value entered in % | | O |
| ThdATmms | ING | ThdA alarm time delay in ms | | O |
| ThdVTmms | ING | ThdV alarm time delay in ms | | O |
| NomA | ASG | Normalising demand current used in IEEE 519 TDD calculation | | O |

Condition C: Hz and HzSet are exclusive.

### 5.10.5 LN: Metering Name: MMTR

For a description of this LN, see IEC 61850-5. This LN shall be used for calculation of energy in a three-phase system. The main use is for billing purposes.

| MMTR class | | | | |
|---|---|---|---|---|
| **Attribute Name** | **Attr. Type** | **Explanation** | **T** | **M/O** |
| LNName | | Shall be inherited from Logical-Node Class (see IEC 61850-7-2) | | |
| **Data** | | | | |
| ***Common Logical Node Information*** | | | | |
| | | LN shall inherit all Mandatory Data from Common Logical Node Class | | M |
| EEHealth | INS | External equipment health (external sensor) | | O |
| EEName | DPL | External equipment name plate | | O |
| ***Metered Values*** | | | | |
| TotVAh | BCR | Net apparent energy since last reset | | O |
| TotWh | BCR | Net Real energy since last reset | | O |
| TotVArh | BCR | Net Reactive energy since last reset | | O |
| SupWh | BCR | Real energy supply (default supply direction: energy flow towards busbar) | | O |
| SupVArh | BCR | Reactive energy supply (default supply direction: energy flow towards busbar) | | O |
| DmdWh | BCR | Real energy demand (default demand direction: energy flow from busbar away) | | O |

| MMTR class | | | | |
|---|---|---|---|---|
| **Attribute Name** | **Attr. Type** | **Explanation** | **T** | **M/O** |
| DmdVArh | BCR | Reactive energy demand (default demand direction: energy flow from busbar away) | | O |

### 5.10.6 LN: Non phase related Measurement Name: MMXN

This LN shall be used for calculation of currents, voltages, powers and impedances in a single-phase system, i.e. in a system where voltages and currents are not phase-related. The main use is for operative applications.

| MMXN class | | | | |
|---|---|---|---|---|
| **Attribute Name** | **Attr. Type** | **Explanation** | **T** | **M/O** |
| LNName | | Shall be inherited from Logical-Node Class (see IEC 61850-7-2) | | |
| **Data** | | | | |
| ***Common Logical Node Information*** | | | | |
| | | LN shall inherit all Mandatory Data from Common Logical Node Class | | M |
| EEHealth | INS | External equipment health (external sensor) | | O |
| EEName | DPL | External equipment name plate | | O |
| ***Measured values*** | | | | |
| Amp | MV | Current I (rms) not allocated to a phase | | O |
| Vol | MV | Voltage V (rms) not allocated to a phase | | O |
| Watt | MV | Power (P) not allocated to a phase | | O |
| VolAmpr | MV | Reactive Power (Q) not allocated to a phase | | O |
| VolAmp | MV | Apparent Power (S) not allocated to a phase | | O |
| PwrFact | MV | Power Factor not allocated to a phase | | O |
| Imp | CMV | Impedance | | O |
| Hz | MV | Frequency | | O |

### 5.10.7 LN: Measurement Name: MMXU

For a description of this LN, see IEC 61850-5. This LN shall be used for calculation of currents, voltages, powers and impedances in a three-phase system. The main use is for operative applications.

| MMXU class | | | | |
|---|---|---|---|---|
| **Attribute Name** | **Attr. Type** | **Explanation** | **T** | **M/O** |
| LNName | | Shall be inherited from Logical-Node Class (see IEC 61850-7-2) | | |
| **Data** | | | | |
| ***Common Logical Node Information*** | | | | |
| | | LN shall inherit all Mandatory Data from Common Logical Node Class | | M |
| EEHealth | INS | External equipment health (external sensor) | | O |
| ***Measured values*** | | | | |
| TotW | MV | Total Active Power (Total P) | | O |
| TotVAr | MV | Total Reactive Power (Total Q) | | O |
| TotVA | MV | Total Apparent Power (Total S) | | O |
| TotPF | MV | Average Power factor (Total PF) | | O |
| Hz | MV | Frequency | | O |
| PPV | DEL | Phase to phase voltages (VL1VL2, …) | | O |
| PhV | WYE | Phase to ground voltages (VL1ER, …) | | O |
| A | WYE | Phase currents (IL1, IL2, IL3) | | O |
| W | WYE | Phase active power (P) | | O |
| VAr | WYE | Phase reactive power (Q) | | O |

| MMXU class | | | | |
|---|---|---|---|---|
| **Attribute Name** | **Attr. Type** | **Explanation** | **T** | **M/O** |
| VA | WYE | Phase apparent power (S) | | O |
| PF | WYE | Phase power factor | | O |
| Z | WYE | Phase Impedance | | O |

### 5.10.8 LN: Sequence and imbalance Name: MSQI

For a description of this LN, see IEC 61850-5.

| MSQI class | | | | |
|---|---|---|---|---|
| **Attribute Name** | **Attr. Type** | **Explanation** | **T** | **M/O** |
| LNName | | Shall be inherited from Logical-Node Class (see IEC 61850-7-2) | | |
| **Data** | | | | |
| ***Common Logical Node Information*** | | | | |
| | | LN shall inherit all Mandatory Data from Common Logical Node Class | | M |
| EEHealth | INS | External equipment health (external sensor) | | O |
| EEName | DPL | External equipment name plate | | O |
| ***Measured values*** | | | | |
| SeqA | SEQ | Positive, Negative and Zero Sequence Current | | C |
| SeqV | SEQ | Positive, Negative and Zero Sequence Voltage | | C |
| DQ0Seq | SEQ | DQ0 Sequence | | O |
| ImbA | WYE | Imbalance current | | O |
| ImbNgA | MV | Imbalance negative sequence current | | O |
| ImbNgV | MV | Imbalance negative sequence voltage | | O |
| ImbPPV | DEL | Imbalance phase-phase voltage | | O |
| ImbV | WYE | Imbalance voltage | | O |
| ImbZroA | MV | Imbalance zero sequence current | | O |
| ImbZroV | MV | Imbalance zero sequence voltage | | O |
| MaxImbA | MV | Maximum imbalance current | | O |
| MaxImbPPV | MV | Maximum imbalance phase-phase voltage | | O |
| MaxImbV | MV | Maximum imbalance voltage | | O |

Condition C: At least one of either data shall be used.

### 5.10.9 LN: Metering Statistics Name: MSTA

The metered values are not always used directly, but as average values, minima and maxima over a given evaluation period. The reporting may be started after the end of this period.

| MSTA class | | | | |
|---|---|---|---|---|
| **Attribute Name** | **Attr. Type** | **Explanation** | **T** | **M/O** |
| LNName | | Shall be inherited from Logical-Node Class (see IEC 61850-7-2) | | |
| **Data** | | | | |
| ***Common Logical Node Information*** | | | | |
| | | LN shall inherit all Mandatory Data from Common Logical Node Class | | M |
| EEHealth | INS | External equipment health (external sensor) | | O |
| EEName | DPL | External equipment name plate | | O |
| ***Metered Values*** | | | | |
| AvAmps | MV | Average current | | O |
| MaxAmps | MV | Maximum current | | O |
| MinAmps | MV | Minimum current | | O |
| AvVolts | MV | Average voltage | | O |

| MSTA class | | | | |
|---|---|---|---|---|
| **Attribute Name** | **Attr. Type** | **Explanation** | **T** | **M/O** |
| MaxVolts | MV | Maximum voltage | | O |
| MinVolts | MV | Minimum voltage | | O |
| AvVA | MV | Average apparent power | | O |
| MaxVA | MV | Maximum apparent power | | O |
| MinVA | MV | Minimum apparent power | | O |
| AvWh | MV | Average real power | | O |
| MaxWh | MV | Maximum real power | | O |
| MinWh | MV | Minimum real power | | O |
| AvVArh | MV | Average reactive power | | O |
| MaxVArh | MV | Maximum reactive power | | O |
| MinVArh | MV | Minimum reactive power | | O |
| ***Controls*** | | | | |
| EvStr | SPC | Start of evaluation interval | | O |
| ***Settings*** | | | | |
| EvTmms | ASG | Evaluation time (time window) for averages, etc. | | O |

## 5.11 Logical Nodes for sensors and monitoring LN Group: S

### 5.11.1 Modelling remarks

**Table 8 – Relation between IEC 61850-5 and IEC 61850-7-4 for sensors and monitoring LNs**

| Functionality | Defined in IEC 61850-5 by LN | Modelled in IEC 61850-7-4 by LN | Comments |
|---|---|---|---|
| Insulation medium supervision | SIMS | SIML | Insulation liquid like oil |
| | | SIMG | Insulation gas like $SF_6$ |

### 5.11.2 LN: Monitoring and diagnostics for arcs Name: SARC

For a description of this LN, see IEC 61850-5.

| SARC class | | | | |
|---|---|---|---|---|
| **Attribute Name** | **Attr. Type** | **Explanation** | **T** | **M/O** |
| LNName | | Shall be inherited from Logical-Node Class (see IEC 61850-7-2) | | |
| **Data** | | | | |
| ***Common Logical Node Information*** | | | | |
| | | LN shall inherit all Mandatory Data from Common Logical Node Class | | M |
| EEHealth | INS | External equipment health | | O |
| EEName | DPL | External equipment name plate | | O |
| OpCntRs | INC | Resetable Operation Counter (Switch and fault arcs) | | O |
| ***Status Information*** | | | | |
| FACntRs | INC | Fault arc counter | | M |
| FADet | SPS | Fault arc detected | | M |
| ArcCntRs | INC | Switch arc counter | | O |
| SwArcDet | SPS | Switch arc detected | | O |

### 5.11.3 LN: Insulation medium supervision (gas) Name: SIMG

General description of this LN see IEC 61850-5. The insulation medium is a gas, for example $SF_6$ in gas isolated devices. If more measurement positions are needed, these shall be added by numbered extensions of the data (for Tmp use Tmp1, Tmp2, …).

| SIMG class | | | | |
|---|---|---|---|---|
| **Attribute Name** | **Attr. Type** | **Explanation** | **T** | **M/O** |
| LNName | | Shall be inherited from Logical-Node Class (see IEC 61850-7-2) | | |
| **Data** | | | | |
| ***Common Logical Node Information*** | | | | |
| | | LN shall inherit all Mandatory Data from Common Logical Node Class | | M |
| EEHealth | INS | External equipment health | | O |
| EEName | DPL | External equipment name plate | | O |
| ***Measured values*** | | | | |
| Pres | MV | Isolation gas pressure | | O |
| Den | MV | Isolation gas density | | O |
| Tmp | MV | Isolation gas temperature | | O |
| ***Status Information*** | | | | |
| InsAlm | SPS | Insulation gas critical (refill isolation medium) | | M |
| InsBlk | SPS | Insulation gas  not safe (block device operation) | | O |
| InsTr | SPS | Insulation gas  dangerous (trip for device isolation) | | O |
| PresAlm | SPS | Isolation gas pressure alarm | | C |
| DenAlm | SPS | Isolation gas density alarm | | C |
| TmpAlm | SPS | Isolation gas temperature alarm | | C |
| InsLevMax | SPS | Insulation gas level maximum (relates to predefined filling value) | | O |
| InsLevMin | SPS | Insulation gas level minimum (relates to predefined filling value) | | O |

Condition C: depending on the supervised properties of the insulation gas, at least one of the measured values shall be used.

### 5.11.4 LN: Insulation medium supervision (liquid) Name: SIML

For a description of this LN, see IEC 61850-5. The insulation medium is a liquid such as oil like that used for example for some transformers and tap changers. If more measurement positions are needed, these shall be added by numbered extensions of the data (for Tmp use Tmp1, Tmp2, …).

| SIMO class | | | | |
|---|---|---|---|---|
| **Attribute Name** | **Attr. Type** | **Explanation** | **T** | **M/O** |
| LNName | | Shall be inherited from Logical-Node Class (see IEC 61850-7-2) | | |
| **Data** | | | | |
| ***Common Logical Node Information*** | | | | |
| | | LN shall inherit all Mandatory Data from Common Logical Node Class | | M |
| EEHealth | INS | External equipment health | | O |
| EEName | DPL | External equipment name plate | | O |
| ***Measured values*** | | | | |
| Tmp | MV | Insulation liquid temperature | | O |
| Lev | MV | Insulation liquid level | | O |
| Pres | MV | Insulation liquid pressure | | O |
| H2O | MV | Relative saturation of moisture in insulating liquid (in %) | | O |
| H2OTmp | MV | Temperature of insulating liquid at point of H2O measurement | | O |
| H2 | MV | Measurement of Hydrogen ($H_2$ in ppm) | | O |

| SIMO class | | | | |
|---|---|---|---|---|
| **Attribute Name** | **Attr. Type** | **Explanation** | **T** | **M/O** |
| ***Status Information*** | | | | |
| InsAlm | SPS | Insulation liquid critical (refill isolation medium) | | M |
| InsBlk | SPS | Insulation liquid not safe (block device operation) | | O |
| InsTr | SPS | Insulation liquid dangerous (trip for device isolation) | | O |
| TmpAlm | SPS | Insulation liquid temperature alarm | | C |
| LevAlm | SPS | Insulation liquid pressure trip | | C |
| PresAlm | SPS | Insulation liquid pressure alarm | | C |
| GasInsAlm | SPS | Gas in insulation liquid alarm (may be used for Buchholz alarm) | | O |
| GasInsTr | SPS | Gas in insulation liquid trip (may be used for Buchholz trip) | | O |
| GasFlwTr | SPS | Insulation liquid flow trip because of gas (may be used for Buchholz trip) | | O |
| InsLevMax | SPS | Insulation liquid level maximum | | O |
| InsLevMin | SPS | Insulation liquid level minimum | | O |
| H2Alm | SPS | H2 alarm | | O |
| MstAlm | SPS | Moisture sensor alarm | | O |

Condition C: depending on the supervised properties of the liquid, at least one of the measured values shall be used.

#### 5.11.5 LN: Monitoring and diagnostics for partial discharges Name: SPDC

For a description of this LN, see IEC 61850-5.

| SPDC class | | | | |
|---|---|---|---|---|
| **Attribute Name** | **Attr. Type** | **Explanation** | **T** | **M/O** |
| LNName | | Shall be inherited from Logical-Node Class (see IEC 61850-7-2) | | |
| **Data** | | | | |
| ***Common Logical Node Information*** | | | | |
| | | LN shall inherit all Mandatory Data from Common Logical Node Class | | M |
| EEHealth | INS | External equipment health | | O |
| EEName | DPL | External equipment name plate | | O |
| OpCnt | INS | Operation counter | | M |
| ***Measured values*** | | | | |
| AcuPaDsch | MV | Acoustic level of partial discharge in db | | C |
| ***Status information*** | | | | |
| PaDschAlm | SPS | Partial discharge alarm | | C |

Condition C: depending on the functionality, at least one of the data AcuPaDsch or PaDschAlm shall be used.

### 5.12 Logical Nodes for switchgear LN Group: X

#### 5.12.1 LN: Circuit breaker Name: XCBR

This LN is used for modelling switches with short circuit breaking capability. Additional LNs for example SIMS, etc. may be required to complete the logical modelling for the breaker being represented. The closing and opening commands shall be subscribed from CSWI or CPOW if applicable. If no services with real-time capability are available between CSWI or CPOW and XCBR, the opening and closing commands are performed with a GSE-message (see IEC 61850-7-2).

| XCBR class | | | | |
|---|---|---|---|---|
| **Attribute Name** | **Attr. Type** | **Explanation** | **T** | **M/O** |
| LNName | | Shall be inherited from Logical-Node Class (see IEC 61850-7-2) | | |
| **Data** | | | | |
| ***Common Logical Node Information*** | | | | |
| | | LN shall inherit all Mandatory Data from Common Logical Node Class | | M |
| Loc | SPS | Local operation (local means without substation automation communication, hardwired direct control) | | M |
| EEHealth | INS | External equipment health | | O |
| EEName | DPL | External equipment name plate | | O |
| OpCnt | INS | Operation counter | | M |
| ***Controls*** | | | | |
| Pos | DPC | Switch position | | M |
| BlkOpn | SPC | Block opening | | M |
| BlkCls | SPC | Block closing | | M |
| ChaMotEna | SPC | Charger motor enabled | | O |
| ***Metered Values*** | | | | |
| SumSwARs | BCR | Sum of Switched Amperes, resetable | | O |
| ***Status Information*** | | | | |
| CBOpCap | INS | Circuit breaker operating capability | | M |
| POWCap | INS | Point On Wave switching capability | | O |
| MaxOpCap | INS | Circuit breaker operating capability when fully charged | | O |

### 5.12.2 LN: Circuit switch Name: XSWI

This LN is used for modelling switches without short circuit breaking capability, for example disconnectors, air break switches, earthing switches, etc. Additional LNs, SIMS, etc. may be required to complete the logical model for the switch being represented. The closing and opening commands shall be subscribed from CSWI. If no services with real-time capability are available between CSWI and XSWI, the opening and closing commands are performed with a GSE-message (see IEC 61850-7-2).

| XSWI class | | | | |
|---|---|---|---|---|
| **Attribute Name** | **Attr. Type** | **Explanation** | **T** | **M/O** |
| LNName | | Shall be inherited from Logical-Node Class (see IEC 61850-7-2) | | |
| **Data** | | | | |
| ***Common Logical Node Information*** | | | | |
| | | LN shall inherit all Mandatory Data from Common Logical Node Class | | M |
| Loc | SPS | Local operation | | M |
| EEHealth | INS | External equipment health | | O |
| EEName | DPL | External equipment name plate | | O |
| OpCnt | INS | Operation counter | | M |
| ***Controls*** | | | | |
| Pos | DPC | Switch position | | M |
| BlkOpn | SPC | Block opening | | M |
| BlkCls | SPC | Block closing | | M |
| ChaMotEna | SPC | Charger motor enabled | | O |
| ***Status Information*** | | | | |
| SwTyp | INS | Switch type | | M |
| SwOpCap | INS | Switch operating capability | | M |
| MaxOpCap | INS | Circuit switch operating capability when fully charged | | O |

## 5.13 Logical Nodes for instrument transformers LN Group: T

### 5.13.1 LN: Current transformer Name: TCTR

For a description of this LN, see IEC 61850-5. The current is delivered as sampled values. The sampled values are transmitted as engineering values, i.e. as "true" (corrected) primary current values. Therefore, the transformer ratio and the correction factors are of no interest for the transmitted samples, but for maintenance purposes of an external conventional (magnetic) transducer only. In addition, status information is provided and some other settings are accepted from the LN TCTR.

| TCTR class | | | | |
|---|---|---|---|---|
| **Attribute Name** | **Attr. Type** | **Explanation** | **T** | **M/O** |
| LNName | | Shall be inherited from Logical-Node Class (see IEC 61850-7-2) | | |
| **Data** | | | | |
| ***Common Logical Node Information*** | | | | |
| | | LN shall inherit all Mandatory Data from Common Logical Node Class | | M |
| EEHealth | INS | External equipment health | | O |
| EEName | DPL | External equipment name plate | | O |
| OpTmh | INS | Operation time | | O |
| ***Measured values*** | | | | |
| Amp | SAV | Current (Sampled value) | | M |
| ***Settings*** | | | | |
| ARtg | ASG | Rated Current | | O |
| HzRtg | ASG | Rated Frequency | | O |
| Rat | ASG | Winding ratio of an external current transformer (transducer) if applicable | | O |
| Cor | ASG | Current phasor magnitude correction of an external current transformer | | O |
| AngCor | ASG | Current phasor angle correction of an external current transformer | | O |

### 5.13.2 LN: Voltage transformer Name: TVTR

For a description of this LN, see IEC 61850-5. The voltage is delivered as sampled values. The sampled values are transmitted as engineering values, i.e. as "true" (corrected) primary voltage values. Therefore, the transformer ratio and the correction factors are of no interest for the transmitted samples but for maintenance purposes of an external conventional (magnetic) transducer only. In addition, status information is provided and some other settings are accepted from the LN TVTR.

| TVTR class | | | | |
|---|---|---|---|---|
| **Attribute Name** | **Attr. Type** | **Explanation** | **T** | **M/O** |
| LNName | | Shall be inherited from Logical-Node Class (see IEC 61850-7-2) | | |
| **Data** | | | | |
| ***Common Logical Node Information*** | | | | |
| | | LN shall inherit all Mandatory Data from Common Logical Node Class | | M |
| EEHealth | INS | External equipment health | | O |
| EEName | DPL | External equipment name plate | | O |
| OpTmh | INS | Operation time | | O |
| ***Measured values*** | | | | |
| Vol | SAV | Voltage (sampled value) | | M |
| ***Status Information*** | | | | |
| FuFail | SPS | TVTR fuse failure | | O |
| ***Settings*** | | | | |
| VRtg | ASG | Rated Voltage | | O |

| TVTR class | | | | |
|---|---|---|---|---|
| **Attribute Name** | **Attr. Type** | **Explanation** | **T** | **M/O** |
| HzRtg | ASG | Rated frequency | | O |
| Rat | ASG | Winding ratio of external voltage transformer (transducer) if applicable | | O |
| Cor | ASG | Voltage phasor magnitude correction of external voltage transformer | | O |
| AngCor | ASG | Voltage phasor angle correction of external voltage transformer | | O |

## 5.14 Logical Nodes for power transformers LN Group: Y

### 5.14.1 LN: Earth fault neutralizer (Petersen coil) Name: YEFN

For a description of this LN, see IEC 61850-5.

| YEFN class | | | | |
|---|---|---|---|---|
| **Attribute Name** | **Attr. Type** | **Explanation** | **T** | **M/O** |
| LNName | | Shall be inherited from Logical-Node Class (see IEC 61850-7-2) | | |
| **Data** | | | | |
| ***Common Logical Node Information*** | | | | |
| | | LN shall inherit all Mandatory Data from Common Logical Node Class | | M |
| Loc | SPS | Local operation | | M |
| EEHealth | INS | External equipment health | | O |
| EEName | DPL | External equipment name plate | | O |
| OpTmh | INS | Operation time | | O |
| ***Measured values*** | | | | |
| ECA | MV | Earth coil current | | M |
| ***Controls*** | | | | |
| ColTapPos | ISC | Coil Tap Position | | M |
| ColPos | APC | Plunge Core Position | | O |

### 5.14.2 LN: Tap changer Name: YLTC

For a description of this LN, see IEC 61850-5.

| YLTC class | | | | |
|---|---|---|---|---|
| **Attribute Name** | **Attr. Type** | **Explanation** | **T** | **M/O** |
| LNName | | Shall be inherited from Logical-Node Class (see IEC 61850-7-2) | | |
| **Data** | | | | |
| ***Common Logical Node Information*** | | | | |
| | | LN shall inherit all Mandatory Data from Common Logical Node Class | | M |
| EEHealth | INS | External equipment health | | O |
| EEName | DPL | External equipment name plate | | O |
| OpCnt | INS | Operation counter | | O |
| ***Measured values*** | | | | |
| Torq | MV | Drive torque | | O |
| MotDrvA | MV | Motor drive current | | O |
| ***Controls*** | | | | |
| TapPos | ISC | Change Tap Position to dedicated position | | C |
| TapChg | BSC | Change Tap Position (stop, higher, lower) | | C |
| ***Status Information*** | | | | |
| EndPosR | SPS | End position raise reached | | M |
| EndPosL | SPS | End position lower reached | | M |
| OilFil | SPS | Oil filtration | | O |

Condition C: depending on the tap-change method, at least one of the two controls TapChg and TapPos shall be used.

### 5.14.3 LN: Power shunt Name: YPSH

For a description of this LN, see IEC 61850-5. The LN class power shunt also includes the switch for closing and opening the shunt.

| YPSH class | | | | |
|---|---|---|---|---|
| **Attribute Name** | **Attr. Type** | **Explanation** | **T** | **M/O** |
| LNName | | Shall be inherited from Logical-Node Class (see IEC 61850-7-2) | | |
| **Data** | | | | |
| ***Common Logical Node Information*** | | | | |
| | | LN shall inherit all Mandatory Data from Common Logical Node Class | | M |
| EEHealth | INS | External equipment health | | O |
| EEName | DPL | External equipment name plate | | O |
| OpTmh | INS | Operation time | | O |
| ***Controls*** | | | | |
| Pos | DPC | Switch position | | M |
| BlkOpn | SPC | Block opening | | M |
| BlkCls | SPC | Block closing | | M |
| ShOpCap | INS | Operating capability | | M |
| ChaMotEna | SPC | Charger motor enabled | | O |
| MaxOpCap | INS | Power shunt operating capability when fully charged | | O |

### 5.14.4 LN: Power transformer Name: YPTR

For a description of this LN, see IEC 61850-5.

| YPTR class | | | | |
|---|---|---|---|---|
| **Attribute Name** | **Attr. Type** | **Explanation** | **T** | **M/O** |
| LNName | | Shall be inherited from Logical-Node Class (see IEC 61850-7-2) | | |
| **Data** | | | | |
| ***Common Logical Node Information*** | | | | |
| | | LN shall inherit all Mandatory Data from Common Logical Node Class | | M |
| EEHealth | INS | External equipment health | | O |
| EEName | DPL | External equipment name plate | | O |
| OpTmh | INS | Operation time | | O |
| ***Measured values*** | | | | |
| HPTmp | MV | Winding hotspot temperature (in °C) | | O |
| ***Status Information*** | | | | |
| HPTmpAlm | SPS | Winding hot point temperature alarm | | O |
| HPTmpTr | SPS | Winding hot point temperature trip | T | O |
| OANL | SPS | Operation at no load | | O |
| OpOvA | SPS | Operation at overcurrent | | O |
| OpOvV | SPS | Operation at overvoltage | | O |
| OpUnV | SPS | Operation at undervoltage | | O |
| CGAlm | SPS | Core ground alarm | | O |
| ***Settings*** | | | | |
| HiVRtg | ASG | Rated Voltage (High voltage level) | | O |
| LoVRtg | ASG | Rated Voltage (Low voltage level) | | O |
| PwrRtg | ASG | Rated power | | O |

## 5.15 Logical Nodes for further power system equipment LN Group: Z

### 5.15.1 LN: Auxiliary network Name: ZAXN

For a description of this LN, see IEC 61850-5.

| ZAXN class | | | | |
|---|---|---|---|---|
| **Attribute Name** | **Attr. Type** | **Explanation** | **T** | **M/O** |
| LNName | | Shall be inherited from Logical-Node Class (see IEC 61850-7-2) | | |
| **Data** | | | | |
| ***Common Logical Node Information*** | | | | |
| | | LN shall inherit all Mandatory Data from Common Logical Node Class | | M |
| EEHealth | INS | External equipment health | | O |
| EEName | DPL | External equipment name plate | | O |
| OpTmh | INS | Operation time | | O |
| ***Measured Values*** | | | | |
| Volt | MV | Voltage of the auxiliary network | | O |
| Amp | MV | Current of the auxiliary network | | O |

### 5.15.2 LN: Battery Name: ZBAT

For a description of this LN, see IEC 61850-5.

| ZBAT class | | | | |
|---|---|---|---|---|
| **Attribute Name** | **Attr. Type** | **Explanation** | **T** | **M/O** |
| LNName | | Shall be inherited from Logical-Node Class (see IEC 61850-7-2) | | |
| **Data** | | | | |
| ***Common Logical Node Information*** | | | | |
| | | LN shall inherit all Mandatory Data from Common Logical Node Class | | M |
| EEHealth | INS | External equipment health | | O |
| EEName | DPL | External equipment name plate | | O |
| OpTmh | INS | Operation time | | O |
| ***Measured Values*** | | | | |
| Volt | MV | Battery voltage | | M |
| VolChgRte | MV | Rate of battery voltage change | | O |
| Amp | MV | Battery drain current | | O |
| ***Controls*** | | | | |
| BatTest | SPC | Start battery test | | O |
| ***Status Information*** | | | | |
| TestRsl | SPS | Battery Test Results | | O |
| BatHi | SPS | Battery high (voltage or charge - Overcharge) | | O |
| BatLo | SPS | Battery low (voltage or charge) | | O |
| ***Settings*** | | | | |
| LoBatVal | ASG | Low battery alarm value | | O |
| HiBatVal | ASG | High battery alarm value | | O |

### 5.15.3 LN: Bushing Name: ZBSH

For a description of this LN, see IEC 61850-5.

| ZBSH class | | | | |
|---|---|---|---|---|
| **Attribute Name** | **Attr. Type** | **Explanation** | **T** | **M/O** |
| LNName | | Shall be inherited from Logical-Node Class (see IEC 61850-7-2) | | |
| **Data** | | | | |
| ***Common Logical Node Information*** | | | | |
| | | LN shall inherit all Mandatory Data from Common Logical Node Class | | M |
| EEHealth | INS | External equipment health | | O |
| EEName | DPL | External equipment name plate | | O |
| OpTmh | INS | Operation time | | O |
| ***Measured values*** | | | | |
| React | MV | Relative capacitance of bushing | | M |
| LosFact | MV | Loss Factor (tan delta) | | O |
| Vol | MV | Voltage of bushing | | O |
| ***Settings*** | | | | |
| RefReact | ASG | Reference capacitance for bushing at commissioning | | O |
| RefPF | ASG | Reference power factor for bushing at commissioning | | O |
| RefV | ASG | Reference voltage for bushing at commissioning | | O |

### 5.15.4 LN: Power cable Name: ZCAB

For a description of this LN, see IEC 61850-5.

| ZCAB class | | | | |
|---|---|---|---|---|
| **Attribute Name** | **Attr. Type** | **Explanation** | **T** | **M/O** |
| LNName | | Shall be inherited from Logical-Node Class (see IEC 61850-7-2) | | |
| **Data** | | | | |
| ***Common Logical Node Information*** | | | | |
| | | LN shall inherit all Mandatory Data from Common Logical Node Class | | M |
| EEHealth | INS | External equipment health | | O |
| EEName | DPL | External equipment name plate | | O |
| OpTmh | INS | Operation time | | O |

### 5.15.5 LN: Capacitor bank Name: ZCAP

For a description of this LN, see IEC 61850-5.

| ZCAP class | | | | |
|---|---|---|---|---|
| **Attribute Name** | **Attr. Type** | **Explanation** | **T** | **M/O** |
| LNName | | Shall be inherited from Logical-Node Class (see IEC 61850-7-2) | | |
| **Data** | | | | |
| ***Common Logical Node Information*** | | | | |
| | | LN shall inherit all Mandatory Data from Common Logical Node Class | | M |
| EEHealth | INS | External equipment health | | O |
| EEName | DPL | External equipment name plate | | O |
| OpTmh | INS | Operation time | | O |
| ***Controls*** | | | | |
| CapDS | SPC | Capacitor bank device status | | M |
| ***Status Information*** | | | | |
| DschBlk | SPS | Blocked due to discharge | | M |

### 5.15.6 LN: Converter Name: ZCON

For a description of this LN, see IEC 61850-5.

| ZCON class | | | | |
|---|---|---|---|---|
| **Attribute Name** | **Attr. Type** | **Explanation** | **T** | **M/O** |
| LNName | | Shall be inherited from Logical-Node Class (see IEC 61850-7-2) | | |
| **Data** | | | | |
| ***Common Logical Node Information*** | | | | |
| | | LN shall inherit all Mandatory Data from Common Logical Node Class | | M |
| EEHealth | INS | External equipment health | | O |
| EEName | DPL | External equipment name plate | | O |
| OpTmh | INS | Operation time | | O |

### 5.15.7 LN: Generator Name: ZGEN

For a description of this LN, see IEC 61850-5.

| ZGEN class | | | | |
|---|---|---|---|---|
| **Attribute Name** | **Attr. Type** | **Explanation** | **T** | **M/O** |
| LNName | | Shall be inherited from Logical-Node Class (see IEC 61850-7-2) | | |
| **Data** | | | | |
| ***Common Logical Node Information*** | | | | |
| | | LN shall inherit all Mandatory Data from Common Logical Node Class | | M |
| EEHealth | INS | External equipment health | | O |
| EEName | DPL | External equipment name plate | | O |
| OpTmh | INS | Operation time | | O |
| ***Controls*** | | | | |
| GnCtl | DPC | Generator control | | M |
| DExt | SPC | De-excitation | | M |
| AuxSCO | SPC | Aux. supply change over | | O |
| StopVlv | SPC | Stop valve | | O |
| ReactPwrR | SPC | Reactive power raise | | O |
| ReactPwrL | SPC | Reactive power lower | | O |
| ***Measured values*** | | | | |
| GnSp | MV | Speed | | O |
| ***Status Information*** | | | | |
| GnSt | INS | Generator state (stopped, Starting, Started, Stopping, Disabled) | | M |
| OANL | SPS | Operation at no load | | M |
| ClkRot | SPS | Phase rotation clockwise | | M |
| CntClkRot | SPS | Phase rotation counter clockwise | | M |
| OpUnExt | SPS | Operation at under-excitation | | M |
| OpOvExt | SPS | Operation at over-excitation | | M |
| LosOil | SPS | Loss of oil | | O |
| LosVac | SPS | Loss of vacuum | | O |
| PresAlm | SPS | Low pressure alarm | | O |
| ***Settings*** | | | | |
| DmdPwr | ASG | Demanded power | | O |
| PwrRtg | ASG | Rated power | | O |
| VRtg | ASG | Rated Voltage | | O |

### 5.15.8 LN: Gas insulated line Name: ZGIL

For a description of this LN, see IEC 61850-5.

| ZGIL class | | | | |
|---|---|---|---|---|
| **Attribute Name** | **Attr. Type** | **Explanation** | **T** | **M/O** |
| LNName | | Shall be inherited from Logical-Node Class (see IEC 61850-7-2) | | |
| **Data** | | | | |
| ***Common Logical Node Information*** | | | | |
| | | LN shall inherit all Mandatory Data from Common Logical Node Class | | M |
| EEHealth | INS | External equipment health | | O |
| EEName | DPL | External equipment name plate | | O |
| OpTmh | INS | Operation time | | O |

### 5.15.9 LN: Power overhead line Name: ZLIN

For a description of this LN, see IEC 61850-5.

| ZCAB class | | | | |
|---|---|---|---|---|
| **Attribute Name** | **Attr. Type** | **Explanation** | **T** | **M/O** |
| LNName | | Shall be inherited from Logical-Node Class (see IEC 61850-7-2) | | |
| **Data** | | | | |
| ***Common Logical Node Information*** | | | | |
| | | LN shall inherit all Mandatory Data from Common Logical Node Class | | M |
| EEHealth | INS | External equipment health | | O |
| EEName | DPL | External equipment name plate | | O |
| OpTmh | INS | Operation time | | O |

### 5.15.10 LN: Motor Name: ZMOT

For a description of this LN, see IEC 61850-5.

| ZMOT class | | | | |
|---|---|---|---|---|
| **Attribute Name** | **Attr. Type** | **Explanation** | **T** | **M/O** |
| LNName | | Shall be inherited from Logical-Node Class (see IEC 61850-7-2) | | |
| **Data** | | | | |
| ***Common Logical Node Information*** | | | | |
| | | LN shall inherit all Mandatory Data from Common Logical Node Class | | M |
| EEHealth | INS | External equipment health | | O |
| EEName | DPL | External equipment name plate | | O |
| OpTmh | INS | Operation time | | O |
| ***Controls*** | | | | |
| DExt | SPC | De-excitation | | M |
| ***Status Information*** | | | | |
| LosOil | SPS | Loss of oil | | O |
| LosVac | SPS | Loss of vacuum | | O |
| PresAlm | SPS | Low pressure alarm | | O |

### 5.15.11 LN: Reactor Name: ZREA

For a description of this LN, see IEC 61850-5.

| ZREA class | | | | |
|---|---|---|---|---|
| **Attribute Name** | **Attr. Type** | **Explanation** | **T** | **M/O** |
| LNName | | Shall be inherited from Logical-Node Class (see IEC 61850-7-2) | | |
| **Data** | | | | |
| ***Common Logical Node Information*** | | | | |
| | | LN shall inherit all Mandatory Data from Common Logical Node Class | | M |
| EEHealth | INS | External equipment health | | O |
| EEName | DPL | External equipment name plate | | O |
| OpTmh | INS | Operation time | | O |

### 5.15.12 LN: Rotating reactive component Name: ZRRC

For a description of this LN, see IEC 61850-5.

| ZRRC class | | | | |
|---|---|---|---|---|
| **Attribute Name** | **Attr. Type** | **Explanation** | **T** | **M/O** |
| LNName | | Shall be inherited from Logical-Node Class (see IEC 61850-7-2) | | |
| **Data** | | | | |
| ***Common Logical Node Information*** | | | | |
| | | LN shall inherit all Mandatory Data from Common Logical Node Class | | M |
| EEHealth | INS | External equipment health | | O |
| EEName | DPL | External equipment name plate | | O |
| OpTmh | INS | Operation time | | O |

### 5.15.13 LN: Surge arrestor Name: ZSAR

For a description of this LN, see IEC 61850-5.

| ZSAR class | | | | |
|---|---|---|---|---|
| **Attribute Name** | **Attr. Type** | **Explanation** | **T** | **M/O** |
| LNName | | Shall be inherited from Logical-Node Class (see IEC 61850-7-2) | | |
| **Data** | | | | |
| ***Common Logical Node Information*** | | | | |
| | | LN shall inherit all Mandatory Data from Common Logical Node Class | | M |
| EEHealth | INS | External equipment health | | O |
| EEName | DPL | External equipment name plate | | O |
| OpCnt | INS | Operation counter | | O |
| ***Status Information*** | | | | |
| OPSA | SPS | Operation of surge arrestor | T | M |

### 5.15.14 LN: Thyristor controlled frequency converter Name: ZTCF

For a description of this LN, see IEC 61850-5.

| ZTCF class | | | | |
|---|---|---|---|---|
| **Attribute Name** | **Attr. Type** | **Explanation** | **T** | **M/O** |
| LNName | | Shall be inherited from Logical-Node Class (see IEC 61850-7-2) | | |
| **Data** | | | | |
| ***Common Logical Node Information*** | | | | |
| | | LN shall inherit all Mandatory Data from Common Logical Node Class | | M |
| EEHealth | INS | External equipment health | | O |
| EEName | DPL | External equipment name plate | | O |
| OpTmh | INS | Operation time | | O |

| ZTCF class | | | | |
|---|---|---|---|---|
| **Attribute Name** | **Attr. Type** | **Explanation** | **T** | **M/O** |
| ***Settings*** | | | | |
| PwrFrq | ASG | Target frequency | | O |

### 5.15.15 LN: Thyristor controlled reactive component Name: ZTCR

For a description of this LN, see IEC 61850-5.

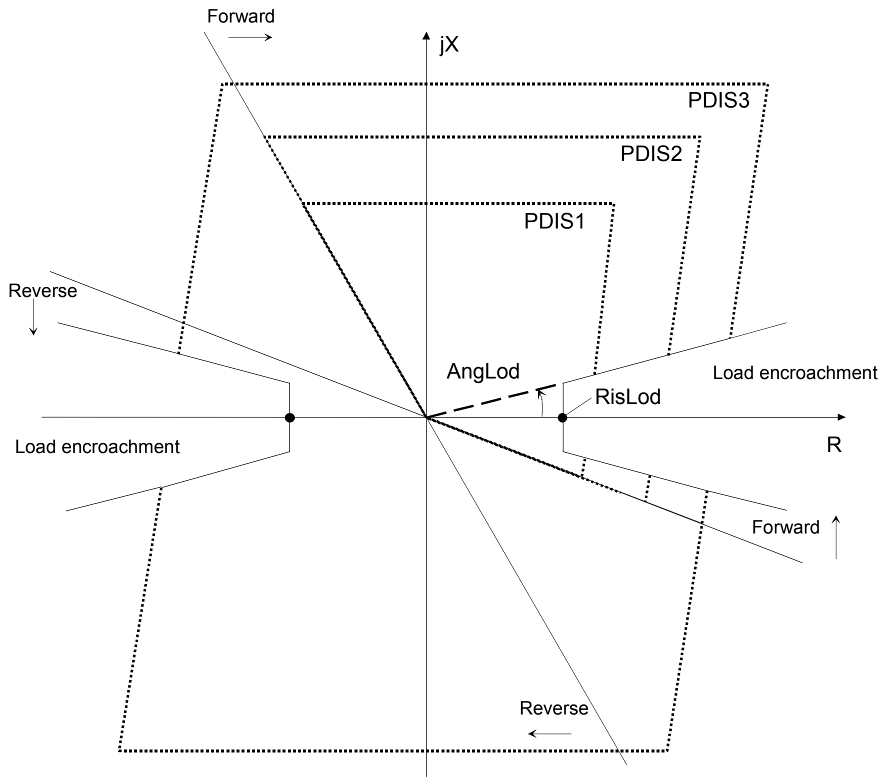
| ZTCR class | | | | |
|---|---|---|---|---|
| **Attribute Name** | **Attr. Type** | **Explanation** | **T** | **M/O** |
| LNName | | Shall be inherited from Logical-Node Class (see IEC 61850-7-2) | | |
| **Data** | | | | |
| ***Common Logical Node Information*** | | | | |
| | | LN shall inherit all Mandatory Data from Common Logical Node Class | | M |
| EEHealth | INS | External equipment health | | O |
| EEName | DPL | External equipment name plate | | O |
| OpTmh | INS | Operation time | | O |

## 6 Data name semantics

In Table 9, the data used in Clause 5 are described. The meaning of Boolean values are FALSE = 0, TRUE = 1.

**Table 9 – Description of Data**

| Data Name | Semantics |
|---|---|
| AcsCtlFail | Number of access control failures detected. |
| AcuPaDsch | Acoustic level of partial discharge in db. |
| AgeRat | Ageing rate, for example of transformer. |
| Alm | General single alarm. |
| AlmLstOv | TRUE = Indication that the Alarm List has overflowed. |
| AlmThm | Thermal Alarm. |
| AlmVal | Alarm Value is the pre-set value for a measurand that when reached will result in an alarm. |
| Amp | Current of a non-three-phase circuit. |
| Ang | Angle between phase voltage and current. |
| AngCor | Phase angle correction of a phasor (used for example for instrument transformers/transducers). |
| AngInd | This Data indicates the check result of the differences between the angles of the busbar and line voltages. FALSE indicates that the angle difference is below the required limit. The angle difference criteria for the synchronising are fulfilled. TRUE indicates the angle difference exceeds the limit. The synchronising process shall be aborted because the angle criteria are not fulfilled (synchrocheck) or shall be continued with turbine control activities (synchronising). |

| Data Name | Semantics |
|---|---|
| AngLod | Angle for load area. The following is an example of the definition of load encroachment used for the Data AngLod and RisLod with polygonal characteristic, applicable also with MHO. PDIS1, PDIS2, and PDIS3 are different instances of the LN PDIS, one for each zone. See also RisGndRch.   |
| AnIn | Analogue Input used for generic I/O. |
| ArcCntRs | Arc counter, resetable. |
| ARtg | Rated current, intrinsic property of the device, which cannot be set/changed from remote. |
| AStr | Current level: if this level is exceeded, the related functions start a dedicated action. |
| AuthFail | Number of authorisation failures. |
| Auto | This Data is responsible for the enabling or disabling of the output circuit of the automatic controller; automatic (TRUE) = output circuit is enabled, not automatic (FALSE) = output circuit is disabled. |
| AutoRecSt | This Data represents whether or not the auto reclosing is ready, in progress, or successful.<br><table><tr><th>Auto Reclosing Status</th><th>Value</th></tr><tr><td>Ready</td><td>1</td></tr><tr><td>In Progress</td><td>2</td></tr><tr><td>Successful</td><td>3</td></tr></table> |
| AutoUpLod | TRUE = automatic uploading of the disturbance recorder files. |
| AuxSCO | TRUE = Commands change over to operation from the auxiliary power supply. |
| AvAmps | Average current in a defined evaluation interval (period) |
| AVCrv | Characteristic Curve for protection operation of the form: $y = f(x)$, where $x$ = V (voltage) and $y$ = A (current) The integers representing the different curves are given in the definition of CDC CURVE in IEC 61850-7-3. |
| AVSt | Delivers the active curve characteristic. |
| AvVA | Average apparent power in a defined evaluation interval (period). |
| AvVAr | Average reactive power in a defined evaluation interval (period). |
| AvVolts | Average voltage in a defined evaluation interval (period). |
| AvW | Average real power in a defined evaluation interval (period). |

<table>
<tr><th>Data Name</th><th>Semantics</th></tr>
<tr><td>BatHi</td><td>TRUE = Indicates that battery is in overcharge condition.</td></tr>
<tr><td>BatLo</td><td>TRUE = Indicates that battery voltage has dropped below a pre-set level.</td></tr>
<tr><td>BatTest</td><td>TRUE = Command to start the battery test.</td></tr>
<tr><td>Beh</td><td>Since the logical device controls all logical nodes that are part of the logical device, the mode of the logical device (“LDMode” = LLN0.Mod) and the mode of a specific logical node (“LNMode” = XXXX.Mod) are related. The behaviour of a logical node is therefore a combination of LLN0.Mod and XXXX.Mod and is described in the ”LNBeh” = XXXX.Beh. This Data is read-only and has the same possible values as Mod (Mode). The value is determined according the following table:
<table>
<tr><th>LNMode<br>XXXX.Mod</th><th>LDMode<br>LLN0.Mod</th><th>LNBeh (read only)<br>XXXX.Beh</th><th>LNBeh Value</th></tr>
<tr><td>on</td><td>on</td><td>on</td><td>1</td></tr>
<tr><td>on</td><td>blocked</td><td>blocked</td><td>2</td></tr>
<tr><td>on</td><td>test</td><td>test</td><td>3</td></tr>
<tr><td>on</td><td>test-blocked</td><td>test-blocked</td><td>4</td></tr>
<tr><td>on</td><td>off</td><td>off</td><td>5</td></tr>
<tr><td>blocked</td><td>on</td><td>blocked</td><td>2</td></tr>
<tr><td>blocked</td><td>blocked</td><td>blocked</td><td>2</td></tr>
<tr><td>blocked</td><td>test</td><td>test-blocked</td><td>4</td></tr>
<tr><td>blocked</td><td>test-blocked</td><td>test-blocked</td><td>4</td></tr>
<tr><td>blocked</td><td>off</td><td>off</td><td>5</td></tr>
<tr><td>test</td><td>on</td><td>test</td><td>3</td></tr>
<tr><td>test</td><td>blocked</td><td>test-blocked</td><td>4</td></tr>
<tr><td>test</td><td>test</td><td>test</td><td>3</td></tr>
<tr><td>test</td><td>test-blocked</td><td>test-blocked</td><td>4</td></tr>
<tr><td>test</td><td>off</td><td>off</td><td>5</td></tr>
<tr><td>test-blocked</td><td>on</td><td>test-blocked</td><td>4</td></tr>
<tr><td>test-blocked</td><td>blocked</td><td>test-blocked</td><td>4</td></tr>
<tr><td>test-blocked</td><td>test</td><td>test-blocked</td><td>4</td></tr>
<tr><td>test-blocked</td><td>test-blocked</td><td>test-blocked</td><td>4</td></tr>
<tr><td>test-blocked</td><td>off</td><td>off</td><td>5</td></tr>
<tr><td>off</td><td>on</td><td>off</td><td>5</td></tr>
<tr><td>off</td><td>blocked</td><td>off</td><td>5</td></tr>
<tr><td>off</td><td>test</td><td>off</td><td>5</td></tr>
<tr><td>off</td><td>test-blocked</td><td>off</td><td>5</td></tr>
<tr><td>off</td><td>off</td><td>off</td><td>5</td></tr>
</table>
</td></tr>
<tr><td>BinIn</td><td>Binary input array used for generic I/O, and represents a set of binary inputs.</td></tr>
<tr><td>BkrTmms</td><td>Closing time of breaker including other delays until the operation of the breaker. This is a property of the breaker that is subject to ageing.</td></tr>
<tr><td>BlkA</td><td>TRUE = Operation is blocked by current reasons.</td></tr>
<tr><td>BlkAOv</td><td>TRUE = Switch operation is blocked by current limit overflow.</td></tr>
<tr><td>BlkCls</td><td>This Data is used to block 'close operation' (for example, for XCBR, XSWI, YPSH) from another logical node such as a protection node or from a local/remote switch. An example may be the low isolation gas density. Block closing is not reflected in operating capability. TRUE = block operation 'close circuit breaker’.</td></tr>
<tr><td>BlkEF</td><td>TRUE = Switch activity blocked due to earth fault.</td></tr>
<tr><td>BlkLV</td><td>Control voltage below which auto Lower commands blocked.</td></tr>
<tr><td>BlkOpn</td><td>This Data is used to block 'open operation' (for example to XCBR, XSWI, YPSH) from another logical node such as a protection node or from a local/remote switch. An example may be the blocking of the buscoupler also for trips during busbar transfer. Block opening is not reflected in operating capability. TRUE = block operation 'open circuit breaker'.</td></tr>
<tr><td>BlkRec</td><td>Block Reclosing.</td></tr>
<tr><td>BlkRV</td><td>Control voltage above which auto Raise commands blocked.</td></tr>
<tr><td>BlkV</td><td>TRUE = Operation is blocked for voltage reasons.</td></tr>
<tr><td>BlkVal</td><td>When the measurements exceed (or drop below, in the case of a dropout function) this value, the function operation is blocked.</td></tr>
<tr><td>BlkValA</td><td>Block Value (Minimum operating current).</td></tr>
<tr><td>BlkValV</td><td>Block Value (Minimum operating voltage).</td></tr>
</table>

<table>
<tr><th>Data Name</th><th>Semantics</th></tr>
<tr><td>BlkVOv</td><td>TRUE = Switch operation is blocked by voltage limit overflow.</td></tr>
<tr><td>BlkZn</td><td>This Data is used by the power swing protection to block operation of protection for a specific protection zone i.e. the related instance of PDIS.<br>TRUE = blocked, FALSE = not blocked.</td></tr>
<tr><td>BndCtr</td><td>Centre of control bandwidth, forward power flow presumed.</td></tr>
<tr><td>BndWid</td><td>Band width, i.e. the defined range of control voltage given either as voltage value or percentage of the nominal voltage. Forward power flow is presumed if applicable.</td></tr>
<tr><td>CapDS</td><td>TRUE = Capacitor bank is on line, or close. FALSE = Capacitor bank off line or open.</td></tr>
<tr><td>CarRx</td><td>Carrier has been received after initiation of unblock logic.</td></tr>
<tr><td>CBOpCap</td><td>This is an enumeration representing the physical capabilities of the breaker to operate. It reflects the switching energy as well as additional blocking due to some local problems.<br>CBOpCap is always less or equal to MaxOpCap.
<table>
<tr><th>Breaker Operating Capability</th><th>Value</th></tr>
<tr><td>None</td><td>1</td></tr>
<tr><td>Open</td><td>2</td></tr>
<tr><td>Close – Open</td><td>3</td></tr>
<tr><td>Open – Close – Open</td><td>4</td></tr>
<tr><td>Close – Open – Close – Open</td><td>5</td></tr>
</table>
More values (6...n) describe higher Operating Capabilities. A new value, i.e. a new line in the table must start alternating with "Close" and "Open" and must end always with “Open”.</td></tr>
<tr><td>CECtl</td><td>Control of complete cooling group (pumps and fans).</td></tr>
<tr><td>CGAlm</td><td>TRUE = Core Ground Alarm indicates that the insulation has broken down.</td></tr>
<tr><td>ChaMotEna</td><td>This Data is used to enable the charger motor; used to prevent overload of the power supply after a busbar trip. TRUE = enable charger motor, FALSE = disable charger motor.</td></tr>
<tr><td>ChkRec</td><td>Determines if the reclosing is with (TRUE) or without (FALSE) synch-check.</td></tr>
<tr><td>ChNum</td><td>Channel number being monitored (for example for COMTRADE).</td></tr>
<tr><td>ChrAng</td><td>The angle by which the current is displaced from the polarising quantity in order to obtain maximum sensitivity.</td></tr>
<tr><td>ChTrg</td><td>Channel triggered. TRUE = channel started recording, FALSE = channnel not started recording.</td></tr>
<tr><td>CircA</td><td>Measured circulating current, which circulates between transformers operated in parallel (one component of transformer secondary current in a paralleling installation).</td></tr>
<tr><td>ClkRot</td><td>TRUE = indication that phase rotation is clockwise (forward).</td></tr>
<tr><td>CntClkRot</td><td>TRUE = indication that phase rotation is counter clockwise (reverse).</td></tr>
<tr><td>ColPos</td><td>Represents the continuous adjustment of a coil (plunge core position) such as a Petersen Coil.</td></tr>
<tr><td>ColTapPos</td><td>Represents the discrete adjustment of a coil such as a Petersen Coil.</td></tr>
<tr><td>ConsTms</td><td>Time constant, for example for a thermal model.</td></tr>
<tr><td>Cor</td><td>Magnitude correction of a phasor (used for example for instrument transformers/transducers).</td></tr>
<tr><td>CrdTmms</td><td>Delay time in ms to wait on additional input if other actions are called for.</td></tr>
<tr><td>CtlDlTmms</td><td>Control delay time before operating after reaching control point forward power flow presumed.</td></tr>
<tr><td>CtlV</td><td>Voltage on secondary of transformer as used for voltage control.</td></tr>
<tr><td>DeaBusVal</td><td>Voltage setting used to detect a Dead Bus bar, for example for auto reclosing.</td></tr>
<tr><td>DeaLinVal</td><td>Voltage setting used to detect a Dead Line, for example for auto reclosing.</td></tr>
<tr><td>Den</td><td>Density of insulating medium.</td></tr>
<tr><td>DetValA</td><td>Used to detect that the breaker has opened when the current is below that setting.</td></tr>
<tr><td>DExt</td><td>TRUE = Command to de-excite the machine.</td></tr>
<tr><td>Diag</td><td>TRUE = Diagnostic is running, FALSE = Diagnostic is not running.</td></tr>
<tr><td>DifAClc</td><td>Differential Current.</td></tr>
<tr><td>DifAng</td><td>Setting for the phase angle difference between two measured values by a synch-check LN.</td></tr>
</table>

<table>
<tr><th>Data Name</th><th>Semantics</th></tr>
<tr><td>DifAngClc</td><td>Calculated value for the phase angle difference between two measured values by a LN synch-check.</td></tr>
<tr><td>DifHz</td><td>Setting for the frequency difference between two measured values by a synch-check LN.</td></tr>
<tr><td>DifHzClc</td><td>Calculated value for the frequency difference between two measured values by a LN synch-check.</td></tr>
<tr><td>DifV</td><td>Setting for the voltage difference between two measured values by a synch-check LN.</td></tr>
<tr><td>DifVClc</td><td>Calculated value for the voltage difference between two measured values by a LN synch-check.</td></tr>
<tr><td>Dir</td><td>The direction of a fault or power flow.</td></tr>
<tr><td>DirMod</td><td>This Data is used to enable operation when the following directional conditions are met:
<table>
<tr><th>Direction Mode</th><th>Value</th></tr>
<tr><td>Non Directional</td><td>1</td></tr>
<tr><td>Forward</td><td>2</td></tr>
<tr><td>Reverse</td><td>3</td></tr>
</table></td></tr>
<tr><td>DltRcd</td><td>TRUE = delete the selected record.</td></tr>
<tr><td>DmdPwr</td><td>Demanded Power.</td></tr>
<tr><td>DmdVArh</td><td>Reactive energy demand (default demand direction: energy flow from busbar away).</td></tr>
<tr><td>DmdWh</td><td>Real energy demand (default demand direction: energy flow from busbar away).</td></tr>
<tr><td>DPCSO</td><td>Generic double point control.</td></tr>
<tr><td>DQ0Seq</td><td>Direct, quadrature, and zero axis quantity.</td></tr>
<tr><td>DschBlk</td><td>TRUE = indicates that switch close action for capacitor bank is blocked due to the discharge state of the bank.</td></tr>
<tr><td>DurTmms</td><td>Minimum duration of carrier signal sent by a communication based scheme in ms.</td></tr>
<tr><td>ECA</td><td>This is the measured current through a Petersen Coil in neutral compensated networks.</td></tr>
<tr><td>Echo</td><td>Echo signal from weak end infeed function.</td></tr>
<tr><td>EEHealth</td><td>This information reflects the state of external equipment, for example circuit breaker controlled by the logical node XCBR. The values are the same as for the Health.</td></tr>
<tr><td>EEName</td><td>This information reflects the name plate of external equipment, for example the circuit breaker XCBR controlled by the logical node CSWI.</td></tr>
<tr><td>EnaCls</td><td>The interlocking function itself determines the status of this data and thus permits the closing of the device when TRUE. The control service checks this value before he controls “Close/On” a switch.</td></tr>
<tr><td>EnaOpn</td><td>The interlocking function itself determines the status of this data and thus permits the opening of the device when TRUE. The control service checks this value before he controls “Open/Off” a switch.</td></tr>
<tr><td>EndPosL</td><td>TRUE = Load tap changer is in the maximum lower position.</td></tr>
<tr><td>EndPosR</td><td>TRUE = Load tap changer is in the maximum raise position.</td></tr>
<tr><td>EnvTmp</td><td>Temperature of environment.</td></tr>
<tr><td>EqTmm</td><td>Temperature Equalisation Time (min). For the duration of EqTmm, the thermal memory will be kept, i.e. the thermal memory is frozen. This time is active after the motor is switched off.</td></tr>
<tr><td>EvTmms</td><td>Evaluation time in ms (time window) determines the lowest frequency.</td></tr>
<tr><td>ExclTmms</td><td>Exclusion time in ms that consecutive triggers from the same source are ignored.</td></tr>
<tr><td>FACntRs</td><td>Fault arc counter, resetable.</td></tr>
<tr><td>FADet</td><td>TRUE = Alarm that fault arc has been detected.</td></tr>
<tr><td>Fail</td><td>TRUE = indicates a breaker has failed to operate and a breaker failure has occurred.</td></tr>
<tr><td>FailMod</td><td>Circuit Breaker failure detection mode.
<table>
<tr><th>Detection Mode</th><th>Value</th></tr>
<tr><td>Current</td><td>1</td></tr>
<tr><td>Breaker Status</td><td>2</td></tr>
<tr><td>Both Current and Breaker Status</td><td>3</td></tr>
<tr><td>Other</td><td>4</td></tr>
</table></td></tr>
</table>

<table>
<tr><th>Data Name</th><th>Semantics</th></tr>
<tr><td>FailTmms</td><td>The time delay in ms until the Breaker Failure function will issue the trip to an alternate device.</td></tr>
<tr><td>FanA</td><td>Motor drive current of a fan in A.</td></tr>
<tr><td>FanCtlGen<br>FanCtl</td><td>FanCtlGen – Control of all fans<br>FanCtl – Control of a single fan
<table>
<tr><th>Fan Control</th><th>Value</th></tr>
<tr><td>Inactive</td><td>1</td></tr>
<tr><td>Stage 1</td><td>2</td></tr>
<tr><td>Stage 2</td><td>3</td></tr>
<tr><td>Stage 3</td><td>4</td></tr>
</table>
More stages may be added with numbers greater than 4.</td></tr>
<tr><td>FanFlw</td><td>Air flow in fan.</td></tr>
<tr><td>FanOvCur</td><td>Fan overcurrent trip.</td></tr>
<tr><td>FDkm</td><td>The distance to a fault in km.</td></tr>
<tr><td>FDOhm</td><td>The distance to a fault in Ω.</td></tr>
<tr><td>FltLoop</td><td>
<table>
<tr><th>Fault Loop</th><th>Value</th></tr>
<tr><td>Phase A to Ground</td><td>1</td></tr>
<tr><td>Phase B to Ground</td><td>2</td></tr>
<tr><td>Phase C to Ground</td><td>3</td></tr>
<tr><td>Phase A to Phase B</td><td>4</td></tr>
<tr><td>Phase B to Phase C</td><td>5</td></tr>
<tr><td>Phase C to Phase A</td><td>6</td></tr>
<tr><td>Others</td><td>7</td></tr>
</table></td></tr>
<tr><td>FltNum</td><td>Fault Number (number allocation is local issue).</td></tr>
<tr><td>FuFail</td><td>TRUE = indicates that the TVTR fuse has opened/failed.</td></tr>
<tr><td>GasFlwTr</td><td>Insulation liquid (for example oil) flow trip because of gas (maybe used for Buchholz trip).</td></tr>
<tr><td>GasInsAlm</td><td>Gas in insulation liquid (for example oil) alarm because of an abnormal condition (FALSE = Normal, TRUE = alert, maybe used for Buchholz trip).</td></tr>
<tr><td>GasInsTr</td><td>Gas in insulation liquid trip because of a dangerous condition (maybe used for Buchholz trip).</td></tr>
<tr><td>GnCtl</td><td>Generator Control.</td></tr>
<tr><td>GndDlMod</td><td>Operate Time Delay for Single Phase Ground Mode. TRUE = on, FALSE = off.</td></tr>
<tr><td>GndDlTmms</td><td>Operate Time Delay for single-phase ground faults in ms.</td></tr>
<tr><td>GndStr</td><td>When the ground measurements exceed (or drop below, in the case of a dropout function) this value, the operation of the related function is initiated.</td></tr>
<tr><td>GnSp</td><td>Generator Speed.</td></tr>
<tr><td>GnSt</td><td>Generator State.
<table>
<tr><th>Generator State</th><th>Value</th></tr>
<tr><td>Stopped</td><td>1</td></tr>
<tr><td>Stopping</td><td>2</td></tr>
<tr><td>Started</td><td>3</td></tr>
<tr><td>Starting</td><td>4</td></tr>
<tr><td>Disabled</td><td>5</td></tr>
</table></td></tr>
<tr><td>GrAlm</td><td>This Data summarises different alarms, assigned via configuration. TRUE = Indicates a Group Alarm.</td></tr>
<tr><td>GrdRx</td><td>If TRUE: receipt of a guard signal from the carrier set interface.</td></tr>
<tr><td>GriFltNum</td><td>Grid Fault Number is used for identification of disturbance records of a common fault (number allocation is local issue).</td></tr>
<tr><td>GrWrn</td><td>This Data summarises different warnings, assigned via configuration TRUE = Indicates a Group Warning.</td></tr>
<tr><td>H2</td><td>Measurement of Hydrogen ($H_2$ in ppm). Combustible gas measurement in oil indicating the amount of deterioration of the insulation system.</td></tr>
</table>

<table>
<tr><th>Data Name</th><th>Semantics</th></tr>
<tr><td>H2Alm</td><td>H2 alarm for gas composition (FALSE = Normal, TRUE = alert).</td></tr>
<tr><td>H2O</td><td>Relative saturation of moisture in oil (in %). Note that this a measurement used in conjunction with H2OTmp.</td></tr>
<tr><td>H2OTmp</td><td>Temperature of oil at point of measurement of relative saturation of moisture in oil (in °C). Note that this is a measurement used in conjunction with H2O.</td></tr>
<tr><td>HA</td><td>Phase related sequence of Harmonics or Interharmonics current for A, B C, N, Net, Res.</td></tr>
<tr><td>HaAmp</td><td>Non phase related sequence of Harmonics or Interharmonics current.</td></tr>
<tr><td>HaAmpTm</td><td>Non phase related Current Time product.</td></tr>
<tr><td>HaCfAmp</td><td>Non phase related current crest factors (peak waveform value/sqrt(2)/fundamental).</td></tr>
<tr><td>HaCfVol</td><td>Non phase related voltage crest factors (peak waveform value/sqrt(2)/fundamental).</td></tr>
<tr><td>HaKFact</td><td>Non phase related K Factor.</td></tr>
<tr><td>HaRmsAmp</td><td>Non phase related current RMS Harmonic or Interharmonic (un-normalized Thd).</td></tr>
<tr><td>HaRmsVol</td><td>Non phase related voltage RMS Harmonic or Interharmonic (un-normalized Thd).</td></tr>
<tr><td>HaRst</td><td>Number of the harmonic that is being monitored for restraint.</td></tr>
<tr><td>HaTdFact</td><td>Non phase related Transformer derating factor.</td></tr>
<tr><td>HaTiFact</td><td>Non phase related voltage Telephone Influence Factor, Method 1, 2, 3, …</td></tr>
<tr><td>HATm</td><td>Phase related Current Time product.</td></tr>
<tr><td>HaTsWatt</td><td>Non phase related total harmonic or interharmonic active power (no fundamental) signed sum.</td></tr>
<tr><td>HaTuWatt</td><td>Non phase related total harmonic or interharmonic active power (no fundamental) unsigned sum.</td></tr>
<tr><td>HaVol</td><td>Non phase related sequence of Harmonics or Interharmonics voltage.</td></tr>
<tr><td>HaVolAmp</td><td>Non phase related sequence of Harmonics or Interharmonics apparent power.</td></tr>
<tr><td>HaVolAmpr</td><td>Non phase related sequence of Harmonics or Interharmonics reactive power.</td></tr>
<tr><td>HaWatt</td><td>Non phase related sequence of Harmonics or Interharmonics active power.</td></tr>
<tr><td>HCfA</td><td>Phase related current crest factors (peak waveform value/sqrt(2)/fundamental).</td></tr>
<tr><td>HCfPhV</td><td>Phase to ground voltage crest factors (peak waveform value/sqrt(2)/fundamental).</td></tr>
<tr><td>HCfPPV</td><td>Phase to phase voltage crest factors (peak waveform value/sqrt(2)/fundamental).</td></tr>
<tr><td>Health</td><td>This information reflects the state of the logical node related HW and SW. More detailed information related to the source of the problem may be provided by specific Data. For LLN0, this Data reflects the worst value of “Health” of the logical nodes that are part of the logical device associated with LLN0.
<table>
<tr><th>Health State</th><th>Value</th></tr>
<tr><td>Ok (“green”) – no problems, normal operation</td><td>1</td></tr>
<tr><td>Warning (“yellow ”) – minor problems, but in safe operation mode</td><td>2</td></tr>
<tr><td>Alarm (“red”) – severe problem, no operation possible</td><td>3</td></tr>
</table>
Health states 1 (“green”) and 3 (“red”) are unambiguous by definition. The detailed meaning of Health state 2 (“yellow”) is a local issue depending from the dedicated function/device.</td></tr>
<tr><td>HiBatVal</td><td>High battery alarm value.</td></tr>
<tr><td>HiCtlV</td><td>Highest control voltage since last reset.</td></tr>
<tr><td>HiDmdA</td><td>Highest current demand since last reset.</td></tr>
<tr><td>HiSet</td><td>High operate value, percentage of the nominal current.</td></tr>
<tr><td>HiTapPos</td><td>Highest tap position since last reset.</td></tr>
<tr><td>HiTrgLev</td><td>High (positive) trigger level.</td></tr>
<tr><td>HiVRtg</td><td>Rated Voltage (high voltage level).</td></tr>
<tr><td>HKf</td><td>Phase related K Factor for A, B, C.</td></tr>
<tr><td>HPhV</td><td>Sequence of Harmonics or Interharmonics for phase to ground voltages AN, BN, CN, NG.</td></tr>
</table>

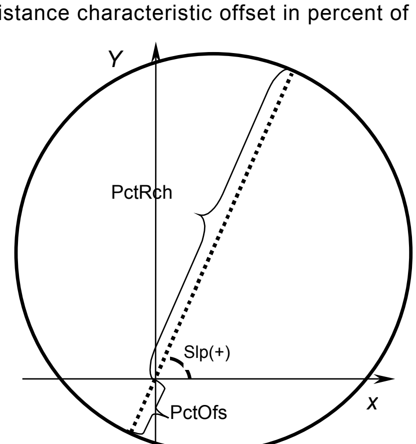
| Data Name | Semantics |
|---|---|
| HPPV | Sequence of Harmonics or Interharmonics for phase to phase voltage AB, BC, CA. |
| HPTmp | Winding hotspot temperature (in °C). |
| HPTmpAlm | Hot Point Temperature alarm (FALSE = Normal, TRUE = High). |
| HPTmpTr | TRUE = indicates that a trip has occurred due to winding hot point temperature. |
| HRmsA | Phase related Current RMS Harmonic or Interharmonics (un-normalized Total harmonic disortion, Thd) for A, B, C, N. |
| HRmsPhV | Phase to ground voltage RMS Harmonic or Interharmonic (un-normalized Thd) for AN, BN, CN, NG. |
| HRmsPPV | Phase to phase voltage RMS Harmonic or Interharmonic (un-normalized Thd) for AB, BC, CA. |
| HTdf | Phase related Transformer derating factor for A, B, C. |
| HTif | Phase related voltage Telephone Influence Factor, Method 1, 2, 3, … |
| HTsW | Phase related total phase harmonic or interharmonic active power (no fundamental) signed sum for A, B, C. |
| HTuW | Phase related total phase harmonic or interharmonic active power (no fundamental) unsigned sum for A, B, C. |
| HVA | Phase related sequence of Harmonics or Interharmonics apparent power for A, B, C. |
| HVAr | Phase related sequence of Harmonics or Interharmonics reactive power for A, B, C. |
| HVStr | When the third harmonic phase voltage measurement exceeds this value, the PHIZ protection control operation is initiated. |
| HW | Phase related sequence of Harmonics or Interharmonics active power for A, B, C. |
| Hz | The frequency of a power system in Hz. |
| HzInd | This Data indicates the check result of the differences between the frequencies of the busbar and line voltages. FALSE indicates that the frequency difference is below the required limit. The frequency difference criteria for the synchronising are fulfilled. TRUE indicates the frequency difference exceeds the limit. The synchronising process shall be aborted because the frequency criteria are not fulfilled (synchrocheck) or shall be continued with turbine control activities (synchronising). |
| HzRtg | Rated frequency, intrinsic property of the device, which cannot be set/changed from remote. |
| HzSet | Setting of a frequency. |
| IhA | Phase related sequence of Interharmonics Current for A, B C, N, Net, Res. |
| IhAmp | Non phase related sequence of Interharmonics Current. |
| IhPhV | Sequence of Interharmonics for phase to ground voltages AN, BN, CN, NG. |
| IhPPV | Sequence of Interharmonics for phase to phase voltage AB, BC, CA. |
| IhVA | Phase related sequence of Interharmonics apparent power for A, B, C. |
| IhVAr | Phase related sequence of Interharmonics reactive power for A, B, C. |
| IhVol | Non phase related sequence of Interharmonics voltage. |
| IhVolAmp | Non phase related sequence of Interharmonics apparent power. |
| IhVolAmpr | Non phase related sequence of Interharmonics reactive power. |
| IhW | Phase related sequence of Interharmonics active power for A, B, C. |
| IhWatt | Non phase related sequence of Interharmonics active power. |
| ImbA | Deviation from the average phase current.<br>ImbA.phsX = $\left\| I_X - I_{ave} \right\|$ with $I_{ave} = (1/3) \times (I_A + I_B + I_C)$ |
| ImbNgA | Current Imbalance Negative Sequence Method. ImbNgA = I2 / I1 |
| ImbNgV | Voltage Imbalance Negative Sequence Method. ImbNgV = V2 / V1 |
| ImbPPV | Deviation from the average phase-to-phase voltage.<br>ImbPPV.phsXY = $\left\| V_{XY} - PPV_{ave} \right\|$ with $PPV_{ave} = (1/3) \times (V_{ab} + V_{bc} + V_{ca})$. |
| ImbV | Deviation from the average phase-to-neutral voltage.<br>ImbV.phsX = $\left\| V_X - V_{ave} \right\|$ with $V_{ave} = (1/3) \times (V_{an} + V_{bn} + V_{cn})$. |
| ImbZroA | Current Imbalance Zero Sequence Method. ImbZroA = I0 / I1 |

<table>
<tr><th>Data Name</th><th>Semantics</th></tr>
<tr><td>ImbZroV</td><td>Voltage Imbalance Zero Sequence Method. ImbZroV = V0 / V1</td></tr>
<tr><td>Ina</td><td>Number of associations terminated due to inactivity.</td></tr>
<tr><td>Ind</td><td>General indication.</td></tr>
<tr><td>InhTmm</td><td>Time Setting for Restart Inhibition (min). Once the StrInh is activated, the motor should not be allowed to start until this time has elapsed.</td></tr>
<tr><td>InOv</td><td>This Data indicates that a buffer overflow occurred for the input buffer and important annunciation’s may be lost (TRUE) for the communication. A general interrogation is recommended or an integrity scan is started automatically.</td></tr>
<tr><td>InsAlm</td><td>TRUE = provides an alarm after a pre-set limit is reached, for example low insulation level. Setting of the limits is a local issue and depends on the supervised media property. An appropriate action may be to refill the insulation medium.</td></tr>
<tr><td>InsBlk</td><td>TRUE = block the operation of the isolated device when the level is reached where operation is not safe anymore. Setting of the limits is a local issue and depends on the supervised media property.</td></tr>
<tr><td>InsLevMax</td><td>TRUE = Insulation medium level has reached predetermined maximum level, mainly used for the filling process.</td></tr>
<tr><td>InsLevMin</td><td>TRUE = Insulation medium level has dropped to a predetermined minimum level, mainly used for the filling process.</td></tr>
<tr><td>InsTr</td><td>TRUE = the isolation of the device is not guaranteed anymore. The device has to switch off from the power system, i.e. it has to be isolated by tripping the surrounding breakers. Setting of the limits is a local issue and depends on the supervised media property.</td></tr>
<tr><td>IntIn</td><td>Integer status input used for generic I/O.</td></tr>
<tr><td>ISCSO</td><td>Generic integer control output.</td></tr>
<tr><td>K0Fact</td><td>K0 is Zero Sequence Compensation Factor = (Z0 – Z1)/3Z1 where Z0 is Zero Sequence Impedance, and Z1 is Positive Sequence Impedance.</td></tr>
<tr><td>K0FactAng</td><td>Residual Compensation Factor Angle for K0.</td></tr>
<tr><td>LCol</td><td>Lower Plunge Core Position.</td></tr>
<tr><td>LDC</td><td>Line Drop Compensation. LDC is R&X or Z model TRUE = R&X, FALSE = Z.</td></tr>
<tr><td>LDCR</td><td>Line drop voltage due to line resistance component (FPF presumed) at rated current.</td></tr>
<tr><td>LDCX</td><td>Line drop voltage due to line reactance component (FPF presumed) at rated current.</td></tr>
<tr><td>LDCZ</td><td>Line drop voltage due to line total impedance (FPF presumed) at rated current.</td></tr>
<tr><td>LEDRs</td><td>Resets all light emitting diodes, true causes reset to occur.</td></tr>
<tr><td>Lev</td><td>Level of insulating medium.</td></tr>
<tr><td>LevAlm</td><td>Level alarm because of an abnormal condition (FALSE = Normal, TRUE = alert).</td></tr>
<tr><td>LevMod</td><td>Internal Trigger Mode for disturbance recording.
<table>
<tr><th>Internal Trigger Mode</th><th>Value</th></tr>
<tr><td>Positive or Rising</td><td>1</td></tr>
<tr><td>Negative or Falling</td><td>2</td></tr>
<tr><td>Both</td><td>3</td></tr>
<tr><td>Other</td><td>4</td></tr>
</table></td></tr>
<tr><td>LHz</td><td>TRUE = Lower frequency, FALSE = no action.</td></tr>
<tr><td>LimAOv</td><td>Current limit for overflow blocking.</td></tr>
<tr><td>LimLodA</td><td>The Data LodA current (percent) above which automatic commands suspended.</td></tr>
<tr><td>LimVOv</td><td>Voltage limit for overflow blocking.</td></tr>
<tr><td>LinAng</td><td>Line angle is the feeder/line impedance angle.</td></tr>
<tr><td>LinLenKm</td><td>The length of the line in km.</td></tr>
<tr><td>LivBusVal</td><td>Voltage setting used to detect Live Bus, for example for auto reclosing.</td></tr>
</table>

<table>
<tr><th>Data Name</th><th>Semantics</th></tr>
<tr><td>LivDeaMod</td><td>Live Dead Mode of operation under which switching may be carried out.
<table>
<tr><th>Live Dead Mode</th><th>Value</th></tr>
<tr><td>Dead Line, Dead Bus</td><td>1</td></tr>
<tr><td>Live Line, Dead Bus</td><td>2</td></tr>
<tr><td>Dead Line, Live Bus</td><td>3</td></tr>
<tr><td>Dead Line, Dead Bus OR<br>Live Line, Dead Bus</td><td>4</td></tr>
<tr><td>Dead Line, Dead Bus OR<br>Dead Line, Live Bus</td><td>5</td></tr>
<tr><td>Live Line, Dead Bus OR<br>Dead Line, Live Bus</td><td>6</td></tr>
<tr><td>Dead Line, Dead Bus OR<br>Live Line, Dead Bus OR<br>Dead Line, Live Bus</td><td>7</td></tr>
</table></td></tr>
<tr><td>LivLinVal</td><td>Voltage setting used to detect Live Line, for example for auto reclosing.</td></tr>
<tr><td>LoBatVal</td><td>Low battery alarm value.</td></tr>
<tr><td>Loc</td><td>This changeover is always done locally with a physical key or toggle switch. The physical key or toggle switch may have a set of contacts from which the position can be read. This Data indicates the switchover between local and remote operation; local = TRUE, remote = FALSE. At bay level ‘local’ means operation from the bay unit and ‘remote’ means opereation from a station unit. At process level, ‘local’ means operation direct on the process device, for example on a circuit breaker and ‘remote’ means operation from a bay unit. If in a Logical Device the Loc of LLN0 is in contradiction to the Loc of any contained LN, “local” is always dominant.</td></tr>
<tr><td>LoCtlV</td><td>Lowest Control Voltage since last reset.</td></tr>
<tr><td>LodA</td><td>Load side current of transformer.</td></tr>
<tr><td>LodRsvAlm</td><td>Load reserve to alarm.</td></tr>
<tr><td>LodRsvTr</td><td>Load reserve to trip.</td></tr>
<tr><td>LokRotTms</td><td>Locked Rotor Time (s). This time is the permissible locked rotor time during start-up.</td></tr>
<tr><td>LoSet</td><td>Low operate value, percentage of the nominal current.</td></tr>
<tr><td>LosFact</td><td>Loss Factor (tan delta)</td></tr>
<tr><td>LosOfGrd</td><td>Loss of guard.</td></tr>
<tr><td>LosOil</td><td>TRUE = indicates that a loss of oil has been detected.</td></tr>
<tr><td>LosVac</td><td>TRUE = indicates when vacuum drops below a predetermined level.</td></tr>
<tr><td>LoTapPos</td><td>Lowest tap position since last reset.</td></tr>
<tr><td>LoTrgLev</td><td>Low (negative) trigger level.</td></tr>
<tr><td>LoVRtg</td><td>Rated Voltage (low voltage level).</td></tr>
<tr><td>LTCBlk</td><td>TRUE = Automatic control of LTC blocked (inhibited).</td></tr>
<tr><td>LTCDragRs</td><td>TRUE = Reset LTC Drag Hands (high and low positions to present position).</td></tr>
<tr><td>LV</td><td>TRUE = Lower voltage, FALSE = no action.</td></tr>
<tr><td>MaxAmps</td><td>Maximum current in a defined evaluation interval (period).</td></tr>
<tr><td>MaxDlTmms</td><td>Operation instant difference (between intended and performed operation).</td></tr>
<tr><td>MaxEna</td><td>Monitoring of current exceeding a set value is enabled (TRUE) in order to detect a fault condition during power swing in the system.</td></tr>
<tr><td>MaxFwdAng</td><td>Maximum phase angle in forward direction.</td></tr>
<tr><td>MaxImbA</td><td>Maximum deviation from the average current.<br>Max(Idev_a,Idev_b,Idev_c)</td></tr>
<tr><td>MaxImbPPV</td><td>Maximum deviation from the average phase-to-phase voltage.<br>MaxImbPPV = Max(PPVdev_a,PPVdev_b,PPVdev_c)</td></tr>
<tr><td>MaxImbV</td><td>Maximum deviation from the average phase-to-neutral voltage.<br>MaxImbV = Max(Vdev_a,Vdev_b,Vdev_c)</td></tr>
<tr><td>MaxNumRcd</td><td>Maximum number of records that can be recorded.</td></tr>
</table>

| Data Name | Semantics |
|---|---|
| MaxNumStr | Setting for the maximum number of starts. This Data is also used for the permissible number of cold starts. For example, the motor manufacturer may state that three starts at the maximum are allowed within 1 h. These parameters are intended for this. So MaxNumStr is set to 3 and MaxStrTmm is set to 60 (min). |
| MaxOpCap | This Data shall provide the information of the operation capability available when the switch mechanism is fully charged. The Maximum Operating Capability gives the information about the maximum of CBOpCap. |
| MaxOpTmms | The Data maximum operating time in ms for the LN is used for co-ordinating action of the related function. |
| MaxRvAng | Maximum phase angle in reverse direction. |
| MaxStrTmm | The time period in which the maximum number of starts is allowed. |
| MaxVA | Maximum apparent power in a defined evaluation interval (period). |
| MaxVAr | Maximum reactive power in a defined evaluation interval (period). |
| MaxVolts | Maximum voltage in a defined evaluation interval (period). |
| MaxW | Maximum real power in a defined evaluation interval (period). |
| MaxWrmStr | Permissible number of warm starts, in most cases cold starts – 1. |
| MemClr | TRUE = Clear Memory. |
| MemFull | This Data is the percentage at which to indicate memory is full. |
| MemOv | TRUE = Memory overflow has occurred. |
| MemRs | TRUE = resetting the memory in the recorder. |
| MemUsed | Percentage of storage memory in use. |
| MinAmps | Minimum current in a defined evaluation interval (period). |
| MinFwdAng | Minimum phase angle in forward direction. |
| MinOpTmms | The Data minimum operating time in ms for the LN is used for co-ordinating with older electromechanical relays. |
| MinPPV | Minimum phase to phase Voltage. |
| MinRvAng | Minimum phase angle in reverse direction. |
| MinVA | Minimum apparent power in a defined evaluation interval (period). |
| MinVAr | Minimum reactive power in a defined evaluation interval (period). |
| MinVolts | Minimum voltage in a defined evaluation interval (period). |
| MinW | Minimum real power in a defined evaluation interval (period). |

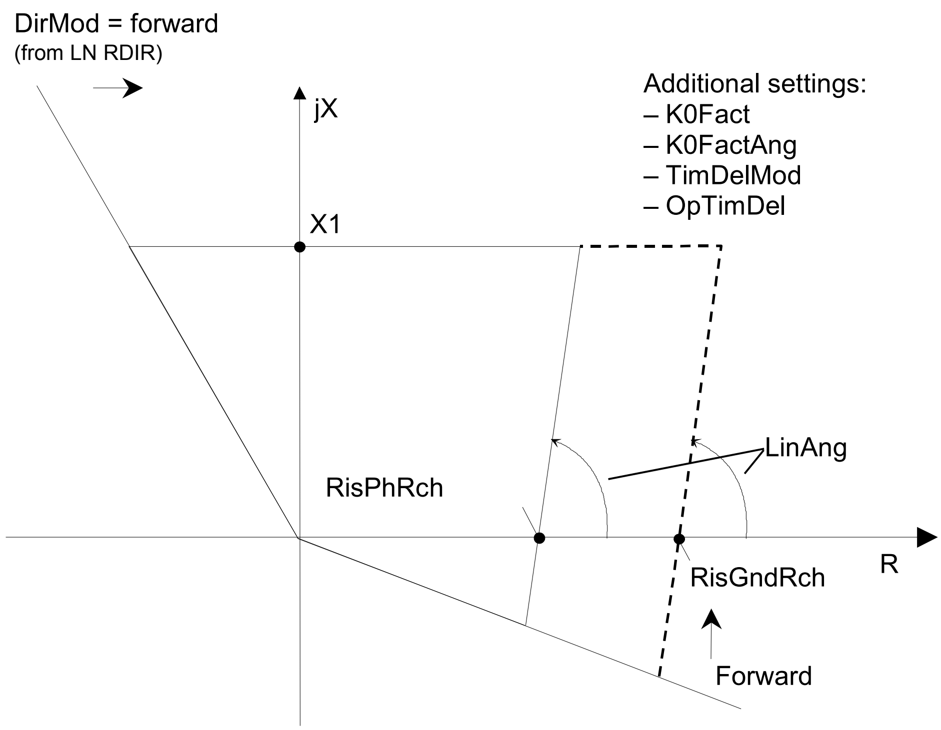
<table>
<tr><th>Data Name</th><th>Semantics</th></tr>
<tr><td>Mod</td><td>
<table>
<tr><th>Mode and Behaviour</th><th>Value</th></tr>
<tr><td>ON (enabled)<br>Function active<br>Outputs (to process) generated<br>Reporting (to client)<br>Controls (from client) accepted<br>Functional (process related) data visible<br>Configuration (capability) data visible<br>(Normal state)</td><td>1</td></tr>
<tr><td>BLOCKED<br>Function active<br>No Outputs (to process) generated<br>No Reporting<br>Controls (from client) rejected<br>Functional (process related) data visible<br>Configuration (capability) data visible<br>(Process is passively supervised)</td><td>2</td></tr>
<tr><td>TEST<br>Function active<br>Outputs (to process) generated<br>Reporting (to client) flagged as test<br>Controls (from client) accepted<br>Functional (process related) data visible<br>Configuration (capability) data visible<br>(Function is operated but results are indicated as test results)</td><td>3</td></tr>
<tr><td>TEST/BLOCKED<br>Function active<br>No Outputs (to process) generated<br>Reporting (to client) flagged as test<br>Controls (from client) accepted<br>Functional (process related) data visible<br>Configuration (capability) data visible<br>(Function is operated in test mode but with no impact to the process)</td><td>4</td></tr>
<tr><td>OFF (disabled)<br>Function not active<br>No Outputs (to process) generated<br>No Reporting (to client)<br>Controls (from client) rejected<br>Functional (process related) data not visible<br>Configuration (capability) data visible<br>(Function is inactive but shows its configuration capability)</td><td>5</td></tr>
</table>
</td></tr>
<tr><td>MotDrvA</td><td>Motor drive current.</td></tr>
<tr><td>MotStr</td><td>I-Motor Startup Threshold. This value identifies a motor starting condition.</td></tr>
<tr><td>MstAlm</td><td>Moisture sensor alarm (FALSE = Normal, TRUE = High Moisture).</td></tr>
<tr><td>NamPlt</td><td>This is the name plate of the logical node.</td></tr>
<tr><td>NeutAlm</td><td>TRUE = Neutral Alarm is present.</td></tr>
<tr><td>NgEna</td><td>Monitoring of Negative sequence current is enabled (TRUE) in order to detect an unbalanced fault condition during power swing in the system.</td></tr>
<tr><td>NomA</td><td>Normalising demand current used in IEEE 519 TDD calculation (maximum demand load current in 15 or 30 min).</td></tr>
<tr><td>NumCntRs</td><td>Number of times a counter is reset.</td></tr>
<tr><td>NumCyc</td><td>Number of cycles of the basic frequency.</td></tr>
<tr><td>NumPwrUp</td><td>The number of power up operations of the physical/logical device since the last reset.</td></tr>
<tr><td>NumRcd</td><td>Actual number of records.</td></tr>
<tr><td>OANL</td><td>TRUE = Provides indication that power system devices is operating with no load.</td></tr>
</table>

| Data Name | Semantics |
|---|---|
| Ofs | Offset, for Analogue Values, the offset from zero of the Analogue Value. |
| OilFil | TRUE = Oil filtration is operational/running. |
| OilMotA | Oil circulation motor drive current. |
| OilTmpIn | Oil temperature cooler in. |
| OilTmpOut | Oil temperature cooler out. |
| OilTmpSet | Set point for oil temperature. |
| Op | Operate (Common Data Classes ACT) indicates the trip decision of a protection function (LN). The trip itself is issued by PTRC. |
| OpARem | The remote operating current (phasor) used by the differential protection function. |
| OpCls | Operation Close Switch. OpCls shall be used if no real time services are available between CSWI and XCBR. |
| OpCnt | This Data represents a count of operations that is not resetable. In general, this type of counter is included in the following LNs: XCBR, XSWI, and YLTC. The counter shall not be reset from remote but maybe from local. |
| OpCntRs | This Data represents a resetable LN operations counter. In general, this type of counter is included in the following LN Groups: C, A, P, & G. The use of the ISC Common Data Class, permits setting the counter to something other than “0”. |
| OpDlTmms | Time delay in ms before operating once operate conditions have been met. |
| OpEx | Breaker failure trip (“external trip”). |
| OpIn | Retrip operation for breaker failure (“internal trip”). |
| OpOpn | Operation Open Switch. OpOpn shall be used if no real time services are available between CSWI and XCBR. |
| OpOvA | TRUE = Device is operating under an overcurrent condition. |
| OpOvExt | TRUE = Device operating in an over excited condition. |
| OpOvV | TRUE = Device is operating under an overvoltage condition. |
| OPSA | TRUE = Surge arrestor operation detected. |
| OpTmh | This Data indicates the Operation time in h of a physical device since start of the operation. Details are LN specific. |
| OpUnExt | TRUE = Device operated in an under-excited condition. |
| OpUnV | TRUE = Device operating in an under voltage condition. |
| OutOv | This Data indicates that a buffer overflow occurred for the output buffer and important annunciation’s may be lost (TRUE) for the communication. A general interrogation is recommended or an integrity scan is started automatically. |
| PaDschAlm | TRUE = Partial Discharge has reached pre-set alarm level. |
| ParOp | Transformers are operating in parallel. |
| PctOfs | Distance characteristic offset in percent of the line length.   REACH |
| PctRch | Distance characteristic reach in percent of the line length; see curve in PctOfs. |

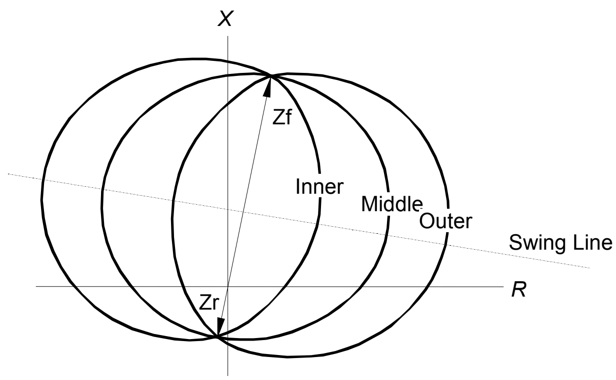
<table>
<tr><th>Data Name</th><th>Semantics</th></tr>
<tr><td>PerTrgTms</td><td>Periodic trigger time in s.</td></tr>
<tr><td>PF</td><td>Phase to ground power factor for Phases 1, 2, and 3, including Angle.</td></tr>
<tr><td>PhA</td><td>Phase current in amperes for Phases 1, 2, and 3, including Angle.</td></tr>
<tr><td>PhAng</td><td>Phase angle of LodA relative to CtlV at 1.0 power factor, assuming forward power flow.</td></tr>
<tr><td>PhDlMod</td><td>Operate Time Delay Multiphase Mode. TRUE = on, FALSE = off</td></tr>
<tr><td>PhDlTmms</td><td>Operate Time Delay for Multiphase Faults in ms.</td></tr>
<tr><td>PhGndVal</td><td>Phase to ground is the Undervoltage level for WEI (weak end infeed) condition for a phase to ground measurement.</td></tr>
<tr><td>PhStop</td><td>Phase Stop Value.</td></tr>
<tr><td>PhStr</td><td>When the phase measurements exceed (or drop below, in the case of a dropout function) this value, the operation of the related function is initiated.</td></tr>
<tr><td>PhV</td><td>Phase to ground voltages for Phases 1, 2, and 3, including Angle.</td></tr>
<tr><td>PhVA</td><td>Phase to ground apparent power for Phases 1, 2, and 3, including Angle.</td></tr>
<tr><td>PhVAr</td><td>Phase to ground reactive for Phases 1, 2, and 3, including Angle.</td></tr>
<tr><td>PhW</td><td>Phase to ground active power for Phases 1, 2, and 3, including Angle.</td></tr>
<tr><td>PhyHealth</td><td>See Health in Common Logical Node Information.</td></tr>
<tr><td>PhyName</td><td>This is the name plate of the physical device.</td></tr>
<tr><td>PhZ</td><td>Phase Impedance.</td></tr>
<tr><td>PlsTmms</td><td>Defines the length of the breaker closing pulse from the reclosing LN.</td></tr>
<tr><td>PmpAlm</td><td>Loss of pump is indicated.</td></tr>
<tr><td>PmpCtlGen<br>PmpCtl</td><td>PmpCtlGen – Control of all pumps.<br>PmpCtl – Control of a single pump.
<table>
<tr><th>Pump Control</th><th>Value</th></tr>
<tr><td>Inactive</td><td>1</td></tr>
<tr><td>Stage 1</td><td>2</td></tr>
<tr><td>Stage 2</td><td>3</td></tr>
<tr><td>Stage 3</td><td>4</td></tr>
</table>
More stages may be added with numbers greater than 4</td></tr>
<tr><td>PmpOvCur</td><td>Pump overcurrent trip.</td></tr>
<tr><td>PolQty</td><td>This Data indicates the reference quantity used to determine fault direction.
<table>
<tr><th>Polarizing Quantity</th><th>Value</th></tr>
<tr><td>None</td><td>1</td></tr>
<tr><td>Zero sequence current</td><td>2</td></tr>
<tr><td>Zero sequence voltage</td><td>3</td></tr>
<tr><td>Negative sequence voltage</td><td>4</td></tr>
<tr><td>Phase to Phase Voltages (Cross Polarising)</td><td>5</td></tr>
<tr><td>Phase to Ground Voltages</td><td>6</td></tr>
</table></td></tr>
<tr><td>PoRch</td><td>Polar Reach is the diameter of the Mho diagram, see PctRch.</td></tr>
<tr><td>Pos</td><td>This Data is accessed when performing a switch command or to verify the switch status or position. When this Data is also used for a hand-operated switch, the (optional) CtlVal attribute in IEC 61850-7-3 does not exist.</td></tr>
<tr><td>PosA</td><td>This Data shall be used for switching, where single phase A may be operated separately.</td></tr>
<tr><td>PosB</td><td>This Data shall be used for switching, where single phase B may be operated separately.</td></tr>
<tr><td>PosC</td><td>This Data shall be used for switching, where single phase C may be operated separately.</td></tr>
</table>

| Data Name | Semantics |
|---|---|
| POWCap | Point On Wave switching capability.<br><table><tr><th>POW Switching Capability</th><th>Value</th></tr><tr><td>None</td><td>1</td></tr><tr><td>Close</td><td>2</td></tr><tr><td>Open</td><td>3</td></tr><tr><td>Close and Open</td><td>4</td></tr></table> |
| PPV | Phase to phase voltages. |
| PPVVal | Undervoltage level for WEI conditions for a phase-phase measurement. |
| Pres | Pressure in a specific volume. |
| PresAlm | Pressure alarm because of an abnormal condition (FALSE = Normal, TRUE = alert) |
| PreTmms | This is the time prior to trigger for which data is recorded when a trigger occurs. |
| ProRx | TRUE = indicates that the protection function has received the information about a fault in forward direction from the other end of the line. |
| ProTx | TRUE = indicates that the protection function has detected a fault in forward direction and has transmitted this information to the other end of the line. |
| PstTmms | This is the time following the trigger that the data capture is recorded. |
| PwrDn | A device power down has been detected if PwrDn is TRUE. |
| PwrFact | Power factor not allocated to a phase. |
| PwrRtg | Rated Power. |
| PwrSupAlm | Alarm from external power supply if PwrSupAlm is TRUE. May be an external contact. It refers always to the local power supply of the IED modelled by LPHD and not to the health (EEHealth) of the complete external supply system. |
| PwrUp | A device power up has been detected if PwrUp is TRUE. |
| R0 | Zero sequence line resistance. |
| R1 | Positive sequence line resistance. |
| Rat | Winding ratio of an instrument transformer/transducer |
| RcdMade | TRUE = Disturbance recording complete. |
| RcdMod | This Data defines whether the recording will stop when the memory is full or saturated, or overwrite existing values.<br><table><tr><th>Recording Mode</th><th>Value</th></tr><tr><td>Overwrite existing values</td><td>1</td></tr><tr><td>Stop when full or saturated</td><td>2</td></tr></table> |
| RcdStr | TRUE = Disturbance recording processes started. |
| RcdTrg | External command to trigger recorder (TRUE). |
| RclTmms | Recloser reclaim time (after successful reclose) in ms. |
| RCol | Raise Plunge Core Position. |
| ReactPwrL | TRUE = Lower reactive power, FALSE = no action. |
| ReactPwrR | TRUE = Raise reactive power, FALSE = no action. |
| Rec1Tmms | First reclose delay time (shot) in ms. |
| Rec2Tmms | Second reclose delay time after first reclose (shot) in ms. |
| Rec3Tmms | Third reclose delay time after second reclose (shot) in ms. |
| RefPF | Reference power factor for bushing at commissioning. |
| RefReact | Reference capacitance for bushing at commissioning. |
| RefV | Reference voltage for bushing at commissioning. |
| Rel | This Data indicates that all criteria are fulfilled and the switching/operation action is released to proceed if value is TRUE, and blocked if FALSE. |
| ReTrgMod | If the mode is true, the recorder will start a new recording if it is retriggered while still collecting samples on previous recording (during post fault time). If false, the recorder ignores the retrigger. |

<table>
<tr><th>Data Name</th><th>Semantics</th></tr>
<tr><td>ReTrMod</td><td>Retrip Mode
<table>
<tr><th>Retrip Mode</th><th>Value</th></tr>
<tr><td>Off</td><td>1</td></tr>
<tr><td>Without Check</td><td>2</td></tr>
<tr><td>With Current Check</td><td>3</td></tr>
<tr><td>With Breaker Status Check</td><td>4</td></tr>
<tr><td>With Current and Breaker Status Check</td><td>5</td></tr>
<tr><td>Other Checks</td><td>6</td></tr>
</table></td></tr>
<tr><td>RHz</td><td>TRUE = Raise frequency, FALSE = no action</td></tr>
<tr><td>RisGndRch</td><td>Resistive reach of the quadrilateral ground distance element shown as the difference between the left and right resistive blinders in the diagram below. See also AngLod.


</td></tr>
<tr><td>RisLod</td><td>Resistive reach for load area…see AngLod for an example of the definition of load encroachment used for the Data AngLod and RisLod with polygonal characteristic, applicable also with MHO.</td></tr>
<tr><td>RisPhRch</td><td>Resistive reach of quadrilateral phase distance element; see RisGndRch.</td></tr>
<tr><td>Rm0</td><td>Mutual resistance coupling from parallel line.</td></tr>
<tr><td>RnbkRV</td><td>Runback Raise Voltage is the control voltage above which auto Lower command issued.</td></tr>
<tr><td>RsDlTmms</td><td>Time delay in ms before reset once reset conditions have been met.</td></tr>
<tr><td>RsStat</td><td>This Data resets device security statistics if RsStat set TRUE.</td></tr>
<tr><td>RstA</td><td>Restraint Current</td></tr>
<tr><td>RstMod</td><td>Identifies the Restraint Mode for the Differential LN.
<table>
<tr><th>Restraint Mode</th><th>Value</th></tr>
<tr><td>None</td><td>1</td></tr>
<tr><td>$2^{nd}$ Harmonic</td><td>2</td></tr>
<tr><td>$5^{th}$ Harmonic</td><td>3</td></tr>
<tr><td>$2^{nd}$ & $5^{th}$ Harmonic</td><td>4</td></tr>
<tr><td>Waveform analysis</td><td>5</td></tr>
<tr><td>$2^{nd}$ Harmonic and waveform analysis</td><td>6</td></tr>
<tr><td>Other</td><td>7</td></tr>
</table></td></tr>
<tr><td>RV</td><td>TRUE = Raise voltage, FALSE = no action</td></tr>
</table>

| Data Name | Semantics |
|---|---|
| RvABlk | Block signal from current reversal function. |
| RvAMod | This Data is the current reversal function mode.<br><br>***Current Reversals Mode*** / **Value**:<br>Off = 1<br>On = 2 |
| RvATmms | Pickup time in ms for current reversal logic. |
| RvRsTmms | After the reverse fault has disappeared, the current reversal output still will be active for this time. |
| SchTyp | This Data indicates the scheme type for line protection.<br><br>***Scheme Type*** / **Value**:<br>None = 1<br>Intertrip = 2<br>Permissive Under Reach = 3<br>Permissive Over Reach = 4<br>Blocking = 5 |
| SecTmms | Pickup security timer on loss of carrier guard signal in ms. |
| SeqA | The absolute measured values of positive, negative and zero sequence current. |
| SeqV | The absolute measured values of positive, negative and zero sequence voltage. |
| SetA | Current setting for a limit in motor start-up (for example counting operate condition or thermal stress). This setting is used in motor start-up protection. |
| SetTms | Time Setting for a limit in motor start-up (for example counting operate condition or thermal stress). This setting is used in motor start-up protection. |
| ShOpCap | This is an enumeration representing the operating capabilities of the power shunt.<br><br>**Shunt Operating Capability** / **Value**:<br>None = 1<br>Open = 2<br>Close = 3<br>Open and Close = 4 |
| SPCSO | Generic single point controllable status output. |
| SPTrTmms | Single pole delay time in ms before the Breaker Failure tries to retrip the failed breaker. |
| StopVlv | This Data is responsible for control and indication of the valve that stops the generator driving forces, for example fluid flow. TRUE = valve close(d) |
| Str | Start (Common Data Classes ACD) indicates the detection of a fault or an unacceptable condition. Str may contain phase and directional information. |
| StrInh | Status Information Restart inhibited. After a limit is reached (for example maximum number of starts or permissible temperature), restart inhibit is activated. |
| StrInhTmm | Time Setting for Restart Inhibition. Once the StrInh is activated, the motor should not be allowed to start until this time has elapsed. |
| StrPOW | TRUE = Start CPOW (for example by select) – Request by CSWI or RREC. |
| StrVal | Level of the supervised value, which starts a dedicated action of the related function. |
| SumSwARs | Sum of switched amperes, resetable. This Data indicates the sum or integration of all switched currents since the last reset of the counter for example after maintenance of the contacts, the nozzle and other aging parts. |
| SupVArh | Reactive energy supply (default supply direction: energy flow towards busbar). |
| SupWh | Real energy supply (default supply direction: energy flow towards busbar). |
| SvcViol | Service is support, but remote is not allowed to execute. |
| SwArcDet | TRUE = Alarm that switch arc has been detected. |
| SwgReact | Value of the power swing reactance band, see figure under SwgVal. |
| SwgRis | Value of the power swing resistance band, see figure under SwgVal. |
| SwgTmms | Power swing detection time in ms. |

<table>
<tr><th>Data Name</th><th>Semantics</th></tr>
<tr><td>SwgVal</td><td>Value of the power swing band.<br>
</td></tr>
<tr><td>SwOpCap</td><td>This is an enumeration representing the physical capabilities of the switch to operate. It includes additional blocking due to some local problems.<br><table><tr><th>Switch Operating Capability</th><th>Value</th></tr><tr><td>None</td><td>1</td></tr><tr><td>Open</td><td>2</td></tr><tr><td>Close</td><td>3</td></tr><tr><td>Open and Close</td><td>4</td></tr></table></td></tr>
<tr><td>SwTyp</td><td><table><tr><th>Switch Type</th><th>Value</th></tr><tr><td>Load Break</td><td>1</td></tr><tr><td>Disconnector</td><td>2</td></tr><tr><td>Earthing Switch</td><td>3</td></tr><tr><td>High Speed Earthing Switch</td><td>4</td></tr></table></td></tr>
<tr><td>SynPrg</td><td>Synchronizing in progress.</td></tr>
<tr><td>TapBlkL</td><td>Tap position of Load Tap Changer where automatic Lower commands blocked.</td></tr>
<tr><td>TapBlkR</td><td>Tap position of Load Tap Changer where automatic Raise commands blocked.</td></tr>
<tr><td>TapChg</td><td>This Data represents the control of a process to raise or lower a single step or tap.</td></tr>
<tr><td>TapPos</td><td>Represents the discrete adjustment of a transformer such as used in a load tap changer to a specified tap position.</td></tr>
<tr><td>TddA</td><td>Current Total Demand Distortion (according to IEEE 519, phase related).</td></tr>
<tr><td>TddAmp</td><td>Current Total Demand Distortion (according to IEEE 519,non-phase related).</td></tr>
<tr><td>TddEvnA</td><td>Current Total Demand Distortion (according to IEEE 519, even components, phase related).</td></tr>
<tr><td>TddEvnAmp</td><td>Current Total Demand Distortion (according to IEEE 519, even components, non-phase related).</td></tr>
<tr><td>TddOddA</td><td>Current Total Demand Distortion (according to IEEE 519, odd components, phase related).</td></tr>
<tr><td>TddOddAmp</td><td>Current Total Demand Distortion (according to IEEE 519, odd components, non-phase related).</td></tr>
<tr><td>TestRsl</td><td>Test Results value is TRUE if passed and FALSE if failed.</td></tr>
<tr><td>ThdA</td><td>Current otal Harmonic or Interharmonic Distortion (different methods, phase related).</td></tr>
<tr><td>ThdAmp</td><td>Current Total Harmonic or Interharmonic Distortion (different methods, non-phase related).</td></tr>
<tr><td>ThdATmms</td><td>Total harmonic or interharmonic distortion current alarm delay time in ms after the ThdAVal has been exceeded.</td></tr>
<tr><td>ThdAVal</td><td>Total harmonic or interharmonic distortion amperes alarm setting – value entered in %. Thd values above this threshold cause an alarm.</td></tr>
<tr><td>ThdEvnA</td><td>Current Total Harmonic or Interharmonic Distortion (even components, phase related).</td></tr>
<tr><td>ThdEvnAmp</td><td>Current Total Harmonic or Interharmonic Distortion (different methods, even components, non-phase related).</td></tr>
<tr><td>ThdEvnPhV</td><td>Phase to ground voltage Total Harmonic or Interharmonic Distortion (different methods, even components, phase related).</td></tr>
</table>

<table>
<tr><th>Data Name</th><th>Semantics</th></tr>
<tr><td>ThdEvnPPV</td><td>Phase to phase voltage Total Harmonic or Interharmonic Distortion (different methods, even components, phase related).</td></tr>
<tr><td>ThdEvnVol</td><td>Phase voltage Total Harmonic or Interharmonic Distortion (different methods, even components, non-phase related).</td></tr>
<tr><td>ThdOddA</td><td>Current Total Harmonic or Interharmonic Distortion (different methods, odd components, phase related).</td></tr>
<tr><td>ThdOddAmp</td><td>Current Total Harmonic or Interharmonic Distortion (different methods, odd components, non-phase related).</td></tr>
<tr><td>ThdOddPhV</td><td>Phase to ground voltage Total Harmonic or Interharmonic Distortion (different methods, odd components, phase related).</td></tr>
<tr><td>ThdOddPPV</td><td>Phase to phase voltage Total Harmonic or Interharmonic Distortion (different methods, odd components, phase related).</td></tr>
<tr><td>ThdOddVol</td><td>Phase to ground voltage Total Harmonic or Interharmonic Distortion (different methods, odd components, non-phase related).</td></tr>
<tr><td>ThdPhV</td><td>Phase to ground voltage Total Harmonic or Interharmonic Distortion (different methods, phase related).</td></tr>
<tr><td>ThdPPV</td><td>Phase to phase voltage Total Harmonic or Interharmonic Distortion (different methods, phase related).</td></tr>
<tr><td>ThdVol</td><td>Voltage Total Harmonic or Interharmonic Distortion (different methods, non-phase related).</td></tr>
<tr><td>ThdVTmms</td><td>Total harmonic or Interharmonic distortion voltage alarm time delay in ms after the ThdVVal has been exceeded.</td></tr>
<tr><td>ThdVVal</td><td>Total harmonic or Interharmonic distortion alarm setting – value entered in %. Thd values above this threshold cause an alarm.</td></tr>
<tr><td>TmACrv</td><td>Characteristic Curve for protection operation of the form: y = f(x), where x = A (current) and y = Tm (time). The integers representing the different curves are given in the definition of CDC CURVE in IEC 61850-7-3.</td></tr>
<tr><td>TmASt</td><td>Delivers the active curve characteristic.</td></tr>
<tr><td>TmDlChr</td><td>Time delay linear or inverse characteristic.<table><tr><th>Timer Delay</th><th>Value</th></tr><tr><td>Linear</td><td>TRUE</td></tr><tr><td>Inverse characteristic</td><td>FALSE</td></tr></table></td></tr>
<tr><td>TmDlMod</td><td>Operate Time Delay Mode. TRUE = on, FALSE = off</td></tr>
<tr><td>TmExc</td><td>TRUE = Maximum allowed time exceeded (LN CPOW).</td></tr>
<tr><td>TmMult</td><td>This Data is the time dial multiplier or Time Dial Setting mainly used for protection.</td></tr>
<tr><td>Tmp</td><td>The temperature of a specified component or in a specified volume.</td></tr>
<tr><td>TmpAlm</td><td>Temperature alarm because of an abnormal condition (FALSE = Normal, TRUE = alert).</td></tr>
<tr><td>TmpMax</td><td>Maximum temperature.</td></tr>
<tr><td>TmpRl</td><td>Relation between temperature and maximum temperature.</td></tr>
<tr><td>TmTmpCrv</td><td>Characteristic Curve for protection operation of the form: y = f(x), where x = Tmp (Temperature) and y = Tm (time). The integers representing the different curves are given in the definition of CDC CURVE in IEC 61850-7-3.</td></tr>
<tr><td>TmTmpSt</td><td>Delivers the active curve characteristic.</td></tr>
<tr><td>TmVCrv</td><td>Characteristic Curve for protection operation of the form: y = f(x), where x = V (voltage) and y = Tm (time). The integers representing the different curves are given in the definition of CDC CURVE in IEC 61850-7-3.</td></tr>
<tr><td>TmVSt</td><td>Delivers the active curve characteristic.</td></tr>
<tr><td>Torq</td><td>Drive torque.</td></tr>
<tr><td>TotPF</td><td>Average power factor for a three-phase circuit.</td></tr>
<tr><td>TotVA</td><td>Total apparent power in a three-phase circuit.</td></tr>
<tr><td>TotVAh</td><td>Net Apparent energy since last rest.</td></tr>
<tr><td>TotVAr</td><td>Total reactive power in a three-phase circuit.</td></tr>
</table>

<table>
<tr><th>Data Name</th><th>Semantics</th></tr>
<tr><td>TotVArh</td><td>Net Reactive energy since last reset.</td></tr>
<tr><td>TotW</td><td>Total real power in a three phase circuit.</td></tr>
<tr><td>TotWh</td><td>Net Real energy since last reset.</td></tr>
<tr><td>TPTrTmms</td><td>Three-pole delay time in ms before the Breaker Failure tries to retrip the failed breaker.</td></tr>
<tr><td>Tr</td><td>Trip is the command to open the breaker when issued in case of fault by PTRC.</td></tr>
<tr><td>TrgMod</td><td>Disturbance recorder trigger mode. The source of the External trigger is a local issue.
<table>
<tr><th>Trigger Mode</th><th>Value</th></tr>
<tr><td>Internal</td><td>1</td></tr>
<tr><td>External</td><td>2</td></tr>
<tr><td>Both</td><td>3</td></tr>
</table></td></tr>
<tr><td>TrMod</td><td>This data represents type of trip function; 3ph means only 3phase tripping possible, 1 or 3ph means PTRC with 1 and 3 phase tripping possibility and first trip depending on fault type. Specific means for example PTRC with 1 and 2ph and 3ph tripping possibility and first trip depending on fault type.
<table>
<tr><th>Trip Mode</th><th>Value</th></tr>
<tr><td>3 phase tripping</td><td>1</td></tr>
<tr><td>1 or 3 phase tripping</td><td>2</td></tr>
<tr><td>specific</td><td>3</td></tr>
</table></td></tr>
<tr><td>TrPlsTmms</td><td>Trip pulse time is the minimum pulse time for breaker operation.</td></tr>
<tr><td>TypRsCrv</td><td>This is the type of the reset curve that is used to co-ordinate the reset with electromechanical relays that do not reset instantaneously.
<table>
<tr><th>Reset Curve</th><th>Value</th></tr>
<tr><td>None</td><td>1</td></tr>
<tr><td>Definite Time Delayed Reset</td><td>2</td></tr>
<tr><td>Inverse Reset</td><td>3</td></tr>
</table></td></tr>
<tr><td>UnBlkMod</td><td>This Data is the unblock function mode.
<table>
<tr><th>Unblock Function Mode</th><th>Value</th></tr>
<tr><td>Off</td><td>1</td></tr>
<tr><td>Permanent</td><td>2</td></tr>
<tr><td>Time Window</td><td>3</td></tr>
</table></td></tr>
<tr><td>UnBlkTmms</td><td>Unblocking Time.</td></tr>
<tr><td>VHzCrv</td><td>Characteristic Curve for protection operation of the form: $y$ = f($x$), where $x$ = Hz (frequency) and $y$ = V (voltage) The integers representing the different curves are given in the definition of CDC CURVE in IEC 61850-7-3.</td></tr>
<tr><td>VHzSt</td><td>Delivers the active curve characteristic.</td></tr>
<tr><td>VInd</td><td>This Data indicates the check result of the differences between the absolute values of the busbar and line voltages. FALSE indicates that the voltage difference is below the required limit. The voltage difference criteria for the synchronising are fulfilled. TRUE indicates that the voltage difference exceeds the limit. The synchronising process shall be aborted because the voltage band criteria are not fulfilled (synchrocheck) or shall be continued with generator control activities (synchronising).</td></tr>
<tr><td>Vol</td><td>Voltage non phase related.</td></tr>
<tr><td>VolAmp</td><td>Apparent power measurement of a non-three-phase circuit.</td></tr>
<tr><td>VolAmpr</td><td>Volt-amperes reactive of a non-three-phase circuit.</td></tr>
<tr><td>VolChgRte</td><td>Rate of voltage change (change over time).</td></tr>
<tr><td>VOvSt</td><td>TRUE = Indicates voltage override control status.</td></tr>
<tr><td>VRed</td><td>TRUE = Voltage reduction is active to reduce load side voltage below the normal setting.</td></tr>
<tr><td>VRedVal</td><td>Reduction of band centre (percent) when voltage step $x$ is active.</td></tr>
<tr><td>VRtg</td><td>Rated Voltage, intrinsic property of the device, which cannot be set/changed from remote.</td></tr>
<tr><td>VStr</td><td>Value of the voltage that must be reached that a dedicated action is started of the related function.</td></tr>
</table>

<table>
<tr><th>Data Name</th><th>Semantics</th></tr>
<tr><td>WacTrg</td><td>The number of times the watchdog circuit has reset the device since the counter reset.</td></tr>
<tr><td>Watt</td><td>Real power in a non-three-phase circuit.</td></tr>
<tr><td>WeiMod</td><td>This Data is the weak end infeed function mode.<br>NOTE Normal are values 1, 3 and 4.<br><table><tr><th>Weak End Infeed Mode</th><th>Value</th></tr><tr><td>Off</td><td>1</td></tr><tr><td>Operate</td><td>2</td></tr><tr><td>Echo</td><td>3</td></tr><tr><td>Echo & Operate</td><td>4</td></tr></table></td></tr>
<tr><td>WeiOp</td><td>Operate signal from week end infeed function.</td></tr>
<tr><td>WeiTmms</td><td>Co-ordination time for weak end feed function in ms.</td></tr>
<tr><td>WrmStr</td><td>The number of warm starts made by the physical/logical device since the last reset.</td></tr>
<tr><td>X0</td><td>Zero sequence line reactance.</td></tr>
<tr><td>X1</td><td>Positive sequence line (reach) reactance.</td></tr>
<tr><td>Xm0</td><td>Mutual reactance coupling from parallel line.</td></tr>
<tr><td>Z0Ang</td><td>Zero sequence source angle, near end (A).</td></tr>
<tr><td>Z0Mod</td><td>Zero sequence source module, remote end (B).</td></tr>
<tr><td>Z1Ang</td><td>Positive sequence line angle.</td></tr>
<tr><td>Z1Mod</td><td>Positive sequence line Mod.</td></tr>
<tr><td>ZeroEna</td><td>Zero Sequence Current Supervision Enabled (TRUE).</td></tr>
<tr><td>Zm0Ang</td><td>Mutual impedance coupling from parallel line Angle.</td></tr>
<tr><td>Zm0Mod</td><td>Mutual impedance coupling from parallel line Module.</td></tr>
</table>

# Annex A
(normative)

# Extension rules

## A.1 The use of Logical Nodes and Data and its extensions

### A.1.1 Basic rules

#### A.1.1.1 Logical Nodes (LN)

- If there is any Logical Nodes Class which fits the function to be modelled, an instance of this logical node shall be used with all its mandatory data (M). The rules of a unique instantiation can be found in IEC 61850-7-2.
- If there are dedicated versions of this function with the same basic data (for example ground, phase, zone A, zone B, etc.), different instances of this Logical Node Class shall be used.
- If there are no Logical Nodes Classes which fit to the function to be modelled, a new logical node shall be created according to the rules for new Logical Nodes, see A.4.
- Other extensions are not allowed in the domain of substation automation.

#### A.1.1.2 Data

- If, in addition to the mandatory data (M), there are also optional data (O), which fit the function to be modelled, these optional data shall be used.
- If there are same data (M or O) which are needed more times than defined in the Logical Node Class, additional data with number extensions shall be used.
- If, in the Logical Node Class, data are missing for the allocated function, the first choice shall be to use one of the data listed in Clause 6.
- If none of the data in Clause 6 covers the open requirement of the function, new data shall be created according to the rules for new data (see A.6).
- Other extensions are not allowed in the domain of substation automation.

## A.2 Multiple instances of LN classes for dedicated and complex functions

### A.2.1 Example for time overcurrent

| Logical Node Class Name: PTOC (Time overcurrent) | | |
|---|---|---|
| LN Instance Name | Meaning | Meaning of “Start value” StrVal |
| GFDPTOC | Ground Fault Detection | “Ground Start Value” |
| PFDPTOC | Phase Fault Detection | “Phase Start Value” |

### A.2.2 Example for Distance

| Logical Node Class Name: PDIS (Distance) | |
|---|---|
| LN Instance Name (without LN-Prefix) | Meaning |
| PDIS1 | Zone 1 of the distance protection |
| PDIS2 | Zone 2 of the distance protection |
| PDIS3 | Zone 3 of the distance protection |
| etc. | etc. |

The semantics of the different instances may be given in the description attribute of data NamPlt (Name Plate). Instances of PSCH co-ordinate the “start” (Str) and “operate” (Op) according to the protection scheme. This co-ordination includes the PDIS functions on both sides of the line. The result of the co-ordination is a trip via PTRC to the local circuit breaker (see example in B.2).

### A.2.3 Example for Power transformer

| Logical Node Class Name: YPTR (Power transformer) | |
|---|---|
| LN Instance Name (without LN-Prefix) | Meaning |
| YPTR1 | Transformer unit phase L1 |
| YPTR2 | Transformer unit phase L2 |
| YPTR3 | Transformer unit phase L3 |

The semantics of the different instances may be given in the description attribute of data NamPlt (Name Plate).

### A.2.4 Example for Auxiliary network

| Logical Node Class Name: ZAXN (Auxiliary network) | |
|---|---|
| LN Instance Name (without LN-Prefix) | Meaning |
| ZAXN1 | 220 V DC |
| ZAXN2 | 60 V DC |
| ZAXN3 | 380 V AC |

The semantics of the different instances may be given in the description attribute of data NamPlt (Name Plate).

## A.3 Specialisation of Data by use of the number extension

Standardised data names in Logical Nodes provide a unique identification. If the same data (i.e. data with the same semantics) are needed more times as defined, additional data with number extensions shall be used. Examples are given in the following.

| Logical Node Class Name: YPTR (Power transformer) | |
|---|---|
| Data name: HPTmp (Winding hotspot temperature in °C) | |
| HPTmp1 | Winding hotspot 1 temperature (in °C) |
| HPTmp2 | Winding hotspot 2 temperature (in °C) |
| HPTmp3 | Winding hotspot 3 temperature (in °C) |
| HPTmp4 | Winding hotspot 4 temperature (in °C) |

The semantics of the different hot spots may be given in the description attribute of the data.

## A.4 Rules for names of new Logical Nodes

If no standardised Logical Node class is applicable for the function to be modelled a new class with a new name may be created. To keep interoperability simple this option shall be used with care. A new Logical Node class name shall be created by use of the following naming conventions:

- The first character shall be chosen in accordance with the relevant prefix of the Logical Node group (see Table 1) if applicable.
- The other characters shall be defined in relation to the English name of the new LN class name.

- New Logical Node classes shall be marked by a "name space attribute" according to IEC 61850-7-3.

The creator of the new Logical Node class shall ensure that each additional name is consistent with the mnemonic naming conventions of the standardised LN classes and unique in the substation automation system considered. The description of this new Logical Node Class shall be added to the IEC documentation of the provider specific system or customer specific project.

## A.5 Examples for new LNs

### A.5.1 New LN "Automatic door entrance control"

| 1. Character<br>Logical Node Group Indication | 2. Character | 3. Character | 4. Character | new LN |
|---|---|---|---|---|
| **A** for "Automatic Control" | **D**oor | **E**ntrance | **C**ontrol | **ADEC**<br>"Automatic door entrance control" |

### A.5.2 New LN "Fire protection"

| 1. Character<br>Logical Node Group Indication | 2. Character | 3. Character | 4. Character | new LN |
|---|---|---|---|---|
| **Z** for " Further equipment" | **F**ire | **P**rotection | **T**ransformer | **ZFPT**<br>"Fire Protection of a power transformer" |

## A.6 Rules for names of new Data

When in a standardised LN, data are missing or for a new LN data are needed, the data names from Clause 6 shall be used if applicable. If no standardised data fulfils the needs for a special instance of a standardised LN class, a "new" data may be created. To keep interoperability simple, this option shall be used with care. In any case, the following rules shall be followed:

- For building the new Data name, the abbreviations of Clause 4 shall be used if applicable. Only in other cases are new abbreviations out of the English name for the data allowed.
- The Data shall be assigned to any of the Common Data Classes as defined in IEC 61850-7-3. If no standardised Common Data Class fulfills the needs of the new data, an extended or new data class may be used (see A.8).
- Any data name shall be allocated to one Common Data Class (CDC) only.
- New Data names shall be marked by a "name space attribute" according to IEC 61850-7-3.

The creator of new data shall ensure that each additional name is consistent with the mnemonic naming conventions of the standardised data names and unique in the substation automation system considered. The description of the new names shall be published to the user of the dedicated substation automation system.

## A.7 Example for new Data

New Data "<u>Col</u>ou<u>r</u> of <u>T</u>ransformer <u>Oil</u>"

New Data name: **ColrTOil** Attribute Type (CDC): INS (Integer status)

## A.8 Rules for new Common Data Classes (CDC)

When for new data names, an appropriate CDC is missing the existing CDC can be extended or a new CDC may be created. To keep interoperability simple, this option shall be used with care. The rules for creating new CDC are defined in IEC 61850-7-3. New CDC shall be marked by a "name space attribute" according to IEC 61850-7-3.

The creator of new CDC shall ensure that each additional CDC is consistent with the mnemonic naming conventions of the standardised CDC and unique in the substation automation system considered. The description of the new CDC shall be published to the user of the dedicated substation automation system.

# Annex B
(informative)

# Modelling examples

## B.1 PTEF and PSDE

The functions PTEF “Protection function Transient Earth Fault” and PSDE “Sensitive directional earthfault” are shown for an earth fault in a compensated network. The PTEF detects the transient charging current related to the network capacitance. Therefore the PTEF can only detect the beginning of an earth fault. The PSDE detects the residual current ($3I_0$). Therefore, PSDE is able to detect the beginning and the end of an earth fault. If PSDE is used for tripping, the scheme would then depend on the protection philosophy and the instrument transformer capabilities.

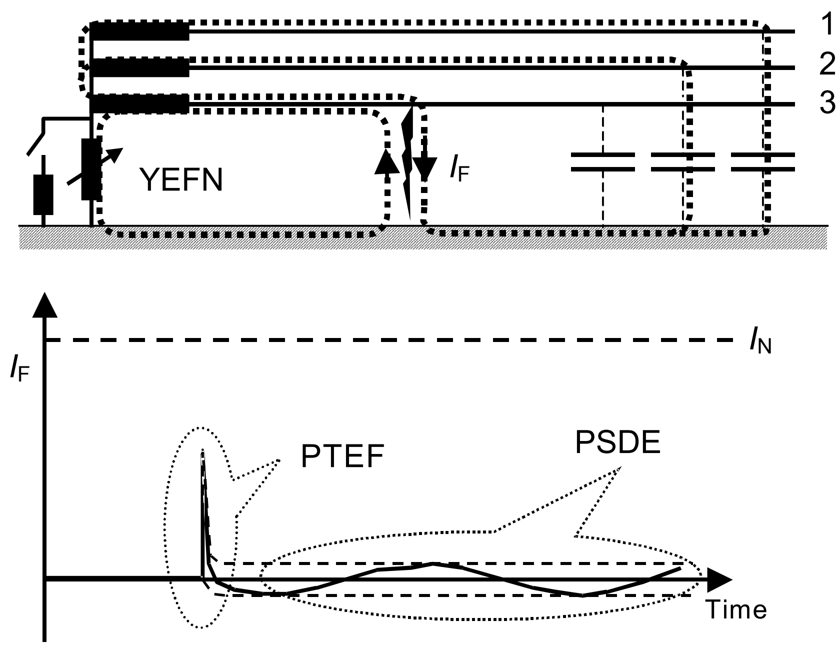



**Figure B.1 – Fault current $I_F$ in a compensated network with earth fault**

## B.2 PSCH and PTRC

PSCH is used for modelling typical schemes in multifunctional IEDs for line protection. The data provided allow its use for modelling of different communications based accelerating schemes for transmission line protection.

PSCH may exchange data with many Logical Nodes (PDIS, PTOC,…, other PSCH). All these Logical Nodes may be located in different Logical Devices and Physical Devices (IEDs). PTRC is used to combine and condition various signals intended for tripping into a single trip condition.

The example in Figure B.2 illustrates a line protection scheme consisting of functions for distance protection (three instances for three zones) with teleprotection (PDIS + PSCH), for directional earth fault comparison protection (PTOC2) and for back up overcurrent protection (PTOC1) on both ends of the line.

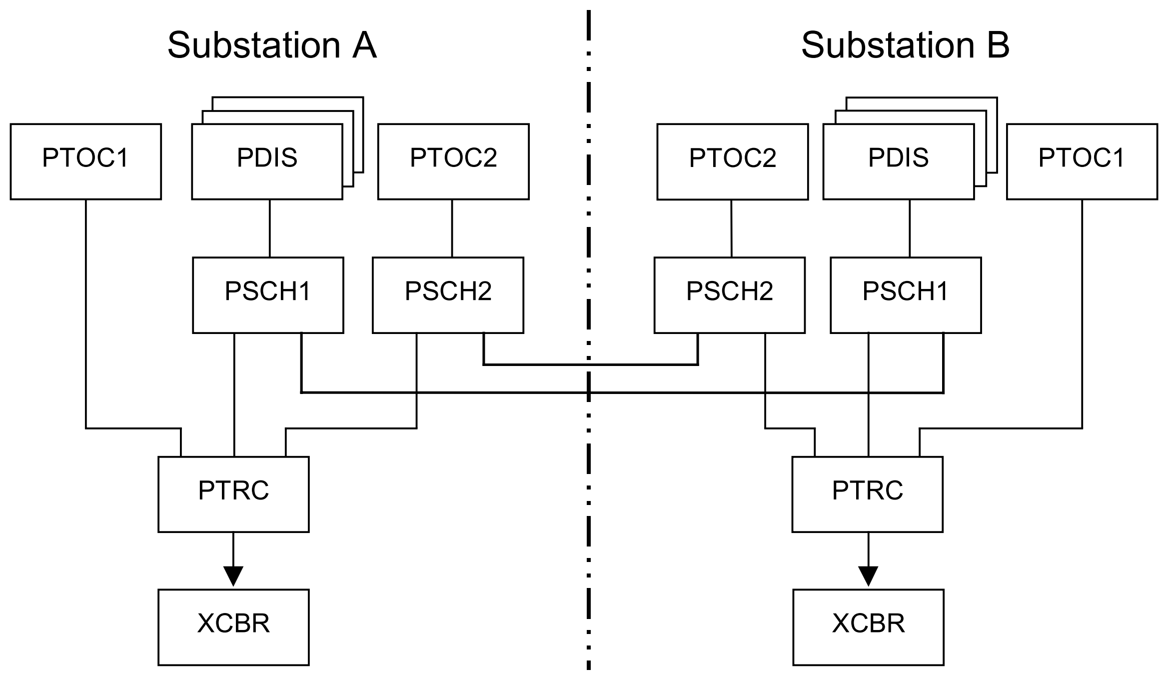



**Figure B.2 – Use of PSCH and PTRC**

The teleprotection functions (permissive overreach, permissive under reach, blocking, unblocking, etc.) of the distance protection and of the directional earth fault comparison scheme are concentrated in the logical nodes instances PSCH1 and PSCH2 of LN PSCH. These logical nodes control the communication between the two line ends.

All operate signals coming from the PSCH-nodes and from the protection nodes without an additional PSCH-node are combined to a trip-command in one PTRC. PTRC handles the trip signal conditioning (minimum trip command duration, single/three-pole decision, etc).

## B.3 MDIF and PDIF

This is a Measuring Logical Node for IEDs with differential protection functions. In the case of a three terminal line differential protection, each IED at each terminal of the line will measure the local phase and sequence components and prepare the phasors (MDIF). Then this information is then sent to the IEDs at the other ends of the line (not part of this standard). Based on the local measurement and the received measurements, each IED (PDIF) will calculate the differential current (the sum of the three vectors for each phase current) and the restrained (bias) current (for example the sum of the three scalars divided by some constant). These are available as measurements from each IED through the MDIF.

The example in Figure B.3 illustrates a line protection scheme consisting of functions for differential protection PDIF (three instances for three zones) with remote provision of data by MDIF (differential measurements). MDIF comprises all three phases for a real time view including all phase relations of the other side.

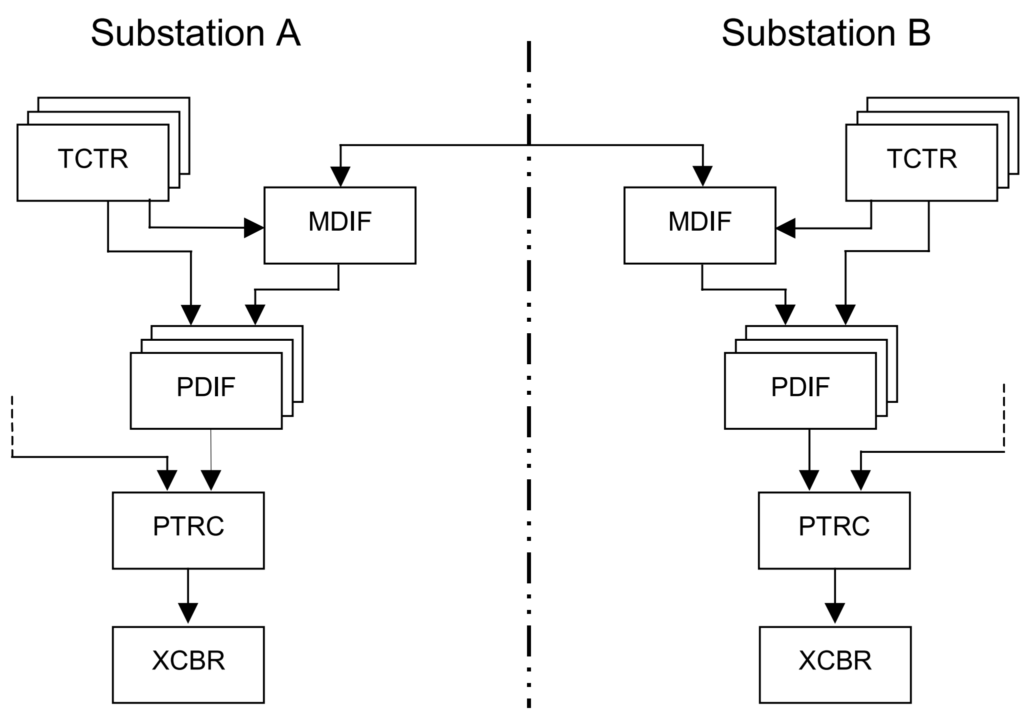



**Figure B.3 – Use of MDIF and PDIF**

## B.4 RDRE and Disturbance Recorder

Figure B.4 represents the modeling of a disturbance recorder as a Logical Device containing the necessary LN. In the case of conventional wiring, TCTR, TVTR, XCBR, and GGIO represent the hardwired inputs. In the case of using a process bus, these LNs will be outside the Logical Device disturbance recorder. They will be in a Logical Device allocated either to a sensor/actor or to a remote I/O in the switchgear.

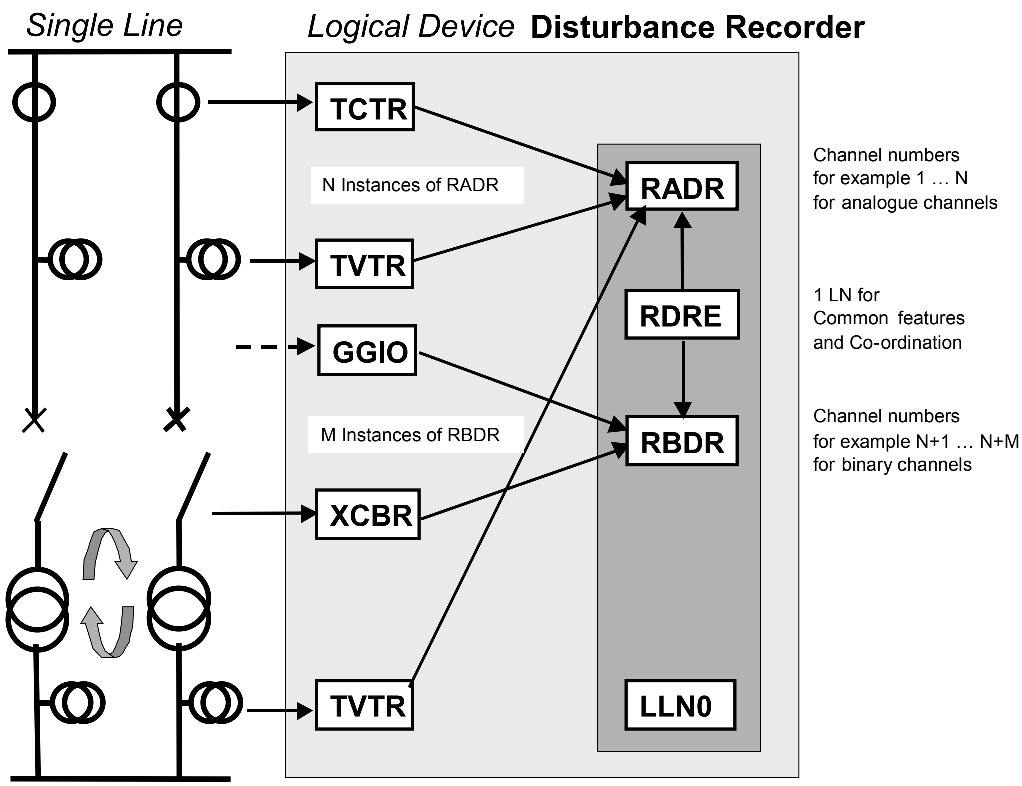



**Figure B.4 – Modelling of Disturbance Recorder**

## B.5 PTRC

The example in Figure B.5 shows the different allocation of Logical Nodes (LN) to devices (IED). The Logical Nodes involved are PTOC (Time overcurrent protection), PDIS (Distance Protection), PTRC (Trip Conditioning) and XCBR (Circuit Breaker). Case (a) shows a protection device with two functions, which is hardwired connected with the circuit breaker. Case (b) shows a protection device with two functions where the Trip goes as a GSE-message over the process bus to the circuit breaker. Case (c) shows the two protection functions in dedicated devices, which may operate both in a fault and where the **trips** are transmitted as **GSE-messages** over the process bus independently to the circuit breaker IED (XCBR).

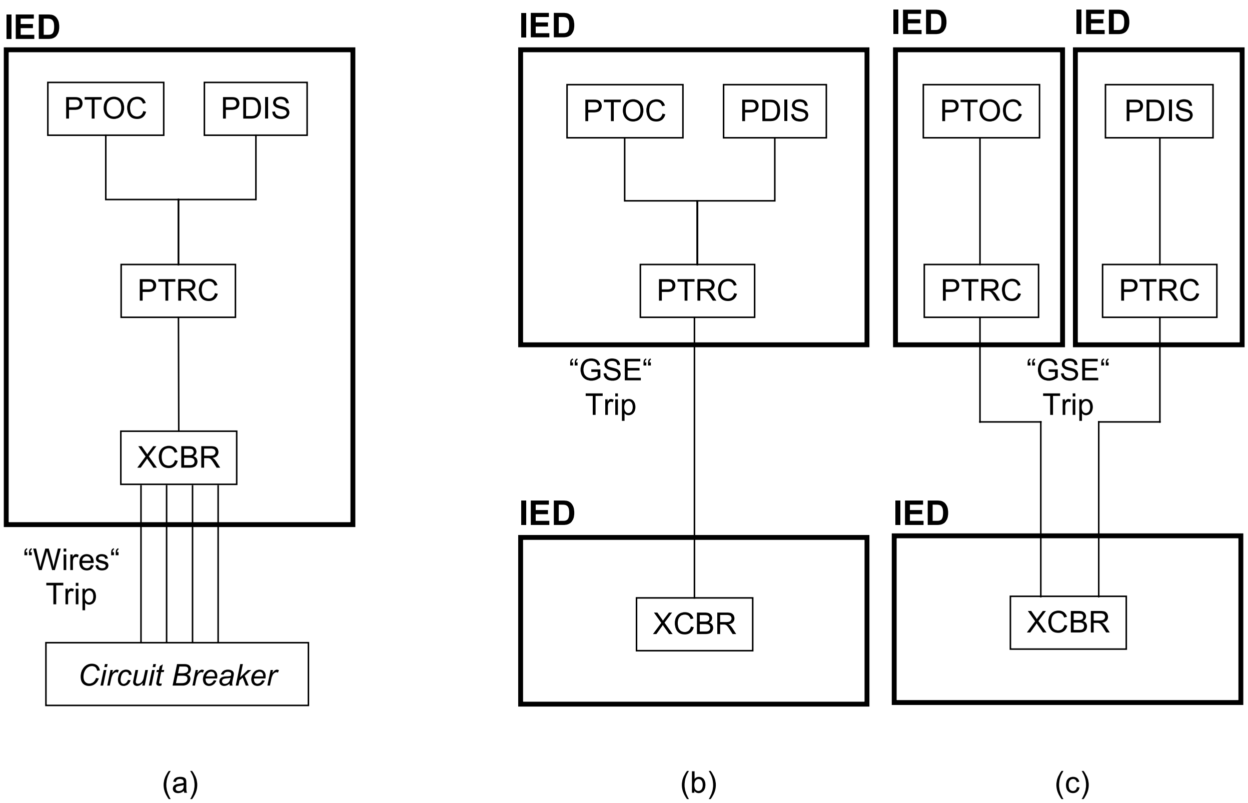



**Figure B.5 – Examples for allocation of Logical Nodes to IEDs**

## B.6 PDIR

Figure B.6 illustrates the use of PDIR to combine the directional information for Busbar Protection where multiple Bays are connected to one busbar. Directional time overcurrent (PTOC) protects the bays. PDIR compares the direction signals of the bay protection functions and makes the trip decision for the circuit breakers of the bays based on the busbar image.

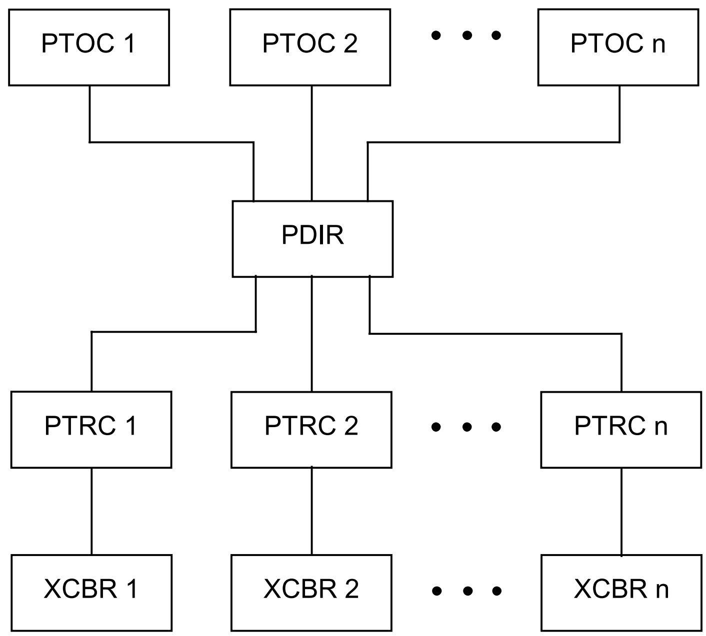



**Figure B.6 – Use of PDIR**

## B.7 RREC

Figure B.7 illustrates the use of the autoreclosure LN RREC in co-operation with a protection LN (LN PTOC), the control LN CSWI and the circuit breaker LN XCBR. Case (a) shows the conventional scheme, where no process bus is used. The autoreclosure LN RREC is implemented in the protection IED and the controller CSWI in an independent bay level IED. The operator's place is indicated as LN IHMI. In case (b) the autoreclosure is located in a dedicated IED and the circuit breaker connected with a process bus. If no services with real-time capability are available between RREC and CSWI on one side and XCBR on the other side, the opening and (re-)closing commands are performed with a GSE-message (see IEC 61850-7-2).

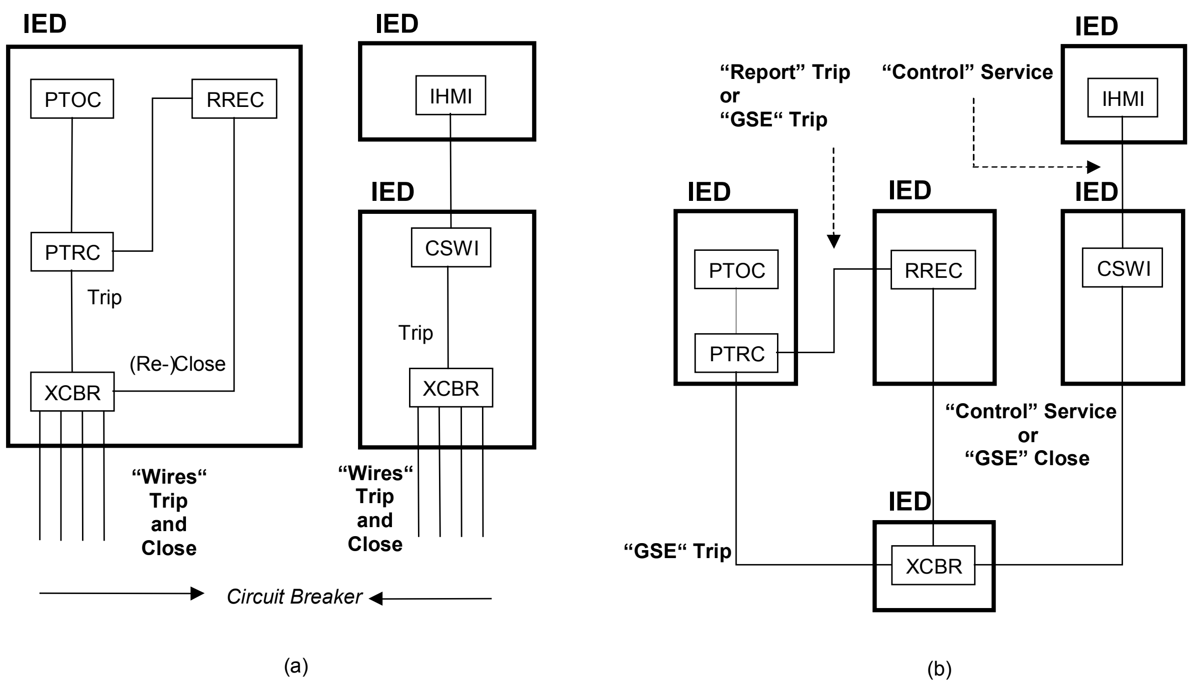



**Figure B.7 – Use of RREC**

## B.8 PDIS

The following examples illustrate the varying complexity available when instantiating a PDIS LN.

Example instantiation of PDIS for a “Normal Zone”

| PDIS class | | | |
|---|---|---|---|
| **Attribute Name** | **Attr. Type** | **Explanation** | **T** |
| LNName | | Shall be inherited from Logical-Node Class (see IEC 61850-7-2) | |
| **Data** | | | |
| ***Common Logical Node Information*** | | | |
| | | LN shall inherit all Mandatory Data from Common Logical Node Class | |
| OpCntRs | ISC | Resetable operation counter | |
| ***Status Information*** | | | |
| Str | ACD | Start | |
| Op | ACT | Operate | T |
| ***Settings*** | | | |
| RisLod | ASG | Resistive reach for load area | |
| AngLod | ASG | Angle for load area | |
| TmDlMod | SPG | Operate Time Delay Mode | |
| OpDlTmms | ING | Operate Time Delay | |
| X1 | ASG | Reactive reach positive sequence | |
| RisGndRch | ASG | Resistive Ground Reach | |
| RisPhRch | ASG | Resistive Phase Reach | |
| K0Fact | ASG | Residual Compensation Factor $K_0$ | |
| K0FactAng | ASG | Residual Compensation Factor Angle | |

Example instantiation of “High end” zone with phase/ground with independent timers

| PDIS class | | | |
|---|---|---|---|
| **Attribute Name** | **Attr. Type** | **Explanation** | **T** |
| LNName | | Shall be inherited from Logical-Node Class (see IEC 61850-7-2) | |
| **Data** | | | |
| ***Common Logical Node Information*** | | | |
| | | LN shall inherit all Mandatory Data from Common Logical Node Class | |
| OpCntRs | ISC | Resetable operation counter | |
| ***Status Information*** | | | |
| Str | ACD | Start | |
| Op | ACT | Operate | T |
| ***Settings*** | | | |
| RisLod | ASG | Resistive reach for load area | |
| AngLod | ASG | Angle for load area | |
| PhDlMod | SPG | Operate Time Delay Multiphase Mode | |
| PhDlTmms | ING | Operate Time Delay for Multiphase Faults | |
| GndDlMod | SPG | Operate Time Delay for Single Phase Ground Mode | |
| GndDlTmms | ING | Operate Time Delay for single phase ground faults | |
| X1 | ASG | Reactive reach positive sequence | |

| | | | |
|---|---|---|---|
| LinAng | ASG | Line Angle | |
| RisGndRch | ASG | Resistive Ground Reach | |
| RisPhRch | ASG | Resistive Phase Reach | |
| K0Fact | ASG | Residual Compensation Factor $K_0$ | |
| K0FactAng | ASG | Residual Compensation Factor Angle | |

Example instantiation of "Simple Impedance Zone" phase protection

| **PDIS class** | | | |
|---|---|---|---|
| **Attribute Name** | **Attr. Type** | **Explanation** | **T** |
| LNName | | Shall be inherited from Logical-Node Class (see IEC 61850-7-2) | |
| **Data** | | | |
| ***Common Logical Node Information*** | | | |
| | | LN shall inherit all Mandatory Data from Common Logical Node Class | |
| OpCntRs | ISC | Resetable operation counter | |
| ***Status Information*** | | | |
| Str | ACD | Start | |
| Op | ACT | Operate | T |
| ***Settings*** | | | |
| OpDlTmms | ING | Operate Time Delay | |
| X1 | ASG | Reactive reach positive sequence | |
| RisPhRch | ASG | Resistive Phase Reach | |

# Annex C
(informative)

## Relationship between this standard and IEC 61850-5

The Logical Nodes listed in IEC 61850-5 define requirements; the Logical Nodes listed in this part define the modelling. Some requirements of the LNs from IEC 61850-5 are modelled by LNs not explicitly in this standard. Its functionality is provided by the services or by the communication stack. Some system support functions are too dependent on implementation to be standardised in this part. In Table C.1 examples are listed.

**Table C.1 – Relationship between IEC 61850-5 and this standard for some miscellaneous LNs**

| **Functionality** | **Defined in IEC 61850-5 by LN** | **Modelled in IEC 61850-7-4 by LN** | **Comments** |
|---|---|---|---|
| Time master | STIM | n.a. | Dedicated function providing time from some external source to the system |
| System supervision | SSYS | n.a. | Implementation dependent function provided by the system. Some minimum supervision is provided by the system logical nodes (group L) |
| Test generator | GTES | n.a. | Dedicated function outside the system. For testing see IEC 61850-10 |

ISBN 2-8318-XXX-X

**ICS 33.200**

Typeset and printed by the IEC Central Office
GENEVA, SWITZERLAND