

SIEMENS

SIPROTEC

Distributed Busbar/Breaker Failure Protection 7SS52

V4.6

IEC 61850

PIXIT

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Preface

Purpose of this manual

In this Manual, you will find the

- ❑ Specification of the applications of the IEC 61850 interface
- ❑ General information about the effects of configuration of your device to the different Logical Nodes and DOIs
- ❑ Mapping of device relevant information to Logical Nodes as part of protocol IEC61850

Target audience

This manual is intended mainly for all persons who configure, parameterize and operate a SIPROTEC Device 7SS52.

Scope of validity of this Manual

SIPROTEC 7SS52, Version 4.60.

Standards

This document has been created according to the ISO 9001 quality standards.

Further Support

If you have questions about SIPROTEC IEC 61850 interface, please contact your Siemens sales representative.

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Literature

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Applications

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1.1 General

This chapter specifies the protocol implementation extra information for testing (PIXIT) of the IEC 61850 interface in SIPROTEC 7SS52 V4.6.

It is based on the service subset definition given in the protocol implementation conformance statement (PICS), which is specified within the user manual *SIPROTEC 4 Ethernet Module EN 100 IEC 61850 Electrical Interface 100 MBit, Manual /1/*.

The following applicable ACSI service models are specified:

- Association model
- Server model
- Data set model
- Substitution model
- Reporting model
- Logging model
- Generic substitution model
- Transmission of sample values model
- Control model
- Time and time synchronisation model
- File transfer model
- General items

Together with the PICS and the MICS the PIXIT forms the basis for a conformance test according to IEC 61850-10.

The mapping between the IEC 61850 server data model and the SIPROTEC specific data is specified in Chapter 3.

1.2 Association model

| Description | Value / Clarification |
|--|--|
| Maximum number of clients that can set-up an association simultaneously | 5 |
| Lost connection detection time range (default range of TCP_KEEPALIVE is 1 -30 seconds) Remark: Regarding router/socket holding with OS of client | 10 seconds |
| Is authentication supported | N |
| What called association parameters are necessary for successful association ? | Transport selector Y Session selector Y Presentation selector Y AP Title ANY AE Qualifier ANY Where Y means: as defined within the ICD-File ANY means: any value accepted |
| What is the maximum and minimum MMS PDU size ? | Max MMS PDU size 32768 Min MMS PDU size |
| What is the typical startup time after a power supply interrupt ? | 15 SECONDS |
| <additional items> | |

1.3 Server model

| Description | Value / Clarification |
|---|--|
| Which analogue value (MX) quality bits are supported (can be set by server) ? | Validity: Y Good, Y Invalid, N Reserved, Y Questionable Y Overflow Y OutofRange N BadReference N Oscillatory Y Failure Y OldData N Inconsistent Y Inaccurate Source: Y Process N Substituted Y Test Y OperatorBlocked |
| Which status value (ST) quality bits are supported (can be set by server) ? | Validity: Y Good, Y Invalid, N Reserved, Y Questionable N BadReference Y Oscillatory Y Failure Y OldData N Inconsistent N Inaccurate Source: Y Process Y Substituted Y Test Y OperatorBlocked |
| What is the maximum number of data values in one GetDataValues request ? | Not restricted; depends on the max. MMS PDU size given above. |
| What is the maximum number of data values in one SetDataValues request ? | Not restricted; depends on the max. MMS PDU size given above. No Data Attribute within our object directory is writable with the service SetDataValues. |
| <additional items> | |

1.4 Data set model

| Description | Value / Clarification |
|---|---|
| Maximum number of data elements in one data set | Not limited by an internal configuration parameter. It depends on the available memory. |
| How many persistent data sets can be created by one or more clients ? | 64 data sets for each LD. It depends on the available memory. |
| How many non-persistent data sets can be created by one or more clients ? | 10 data sets. It depends on the available memory. |
| additional items: | |
| Maximum number of data sets | Could not be defined, it depends on the available memory space. In principle, this information is not necessary from type conformance testing standpoint. |

1.5 Substitution model

This service will not be supported (see also *SIPROTEC 4 Ethernet Module EN 100 IEC 61850 Electrical Interface 100 MBit, Manual /1/*).

1.6 Reporting model

1.6.1 Unbuffered Report

| Description | Value / Clarification |
|--|--|
| The supported trigger conditions are | Y Integrity Y Data change Y Quality change Y Data update Y General Interrogation |
| The supported optional fields are | Y Sequence-number Y Report-time-stamp Y Reason-for-inclusion Y Data-set-name Y Data-reference N Buffer-overflow N EntryID Y Conf-rev Y Segmentation |
| Can the server send segmented reports ? | Y |
| Mechanism on second internal data change notification of the same analogue data value within buffer period (Compare IEC 61850-7-2 §14.2.2.9) | Send report immediately |
| Multi client URCB approach (Compare IEC 61850-7-2 §14.2.1) | All clients can access all URCB's |
| additional items: | |
| Interrupt of general interrogation | Running GI could not be interrupted. If a new GI request occurs during a running GI, the current GI will be finished first before the second GI request will be processed. |
| Integrity period | Configurable ≥ 1 second; |
| Dynamic URCB reservation after an abort of the client/server association | Reservation of the URCB is lost. After a re-establishment of the association the URCB reservation has to be done by the client before. This behavior is implemented to avoid unnecessary memory residuals if temporarily client associations (e.g. for maintenance) are established. |
| Configured URCB reservation after an abort of the client/server association | Reservation of the URCB is not lost. |

1.6.2 Buffered Report

| Description | Value / Clarification |
|--|--|
| The supported trigger conditions are | Y Integrity Y Data change Y Quality change Y Data update Y General Interrogation |
| The supported optional fields are | Y Sequence-number Y Report-time-stamp Y Reason-for-inclusion Y Data-set-name Y Data-reference Y Buffer-overflow Y EntryID Y Conf-rev Y Segmentation |
| Can the server send segmented reports ? | Y |
| Mechanism on second internal data change notification of the same analogue data value within buffer period (Compare IEC 61850-7-2 §14.2.2.9) | Buffer the Entry Send report if the report is enabled |
| Multi client BRCB approach (Compare IEC 61850-7-2 §14.2.1) | All clients can access all BRCB's |
| What is the format of EntryID ? | First 2 Byte : Integer Last 6 Bytes: BTime6 time stamp |
| What is the buffer size for each BRCB or how many reports can be buffered ? | About 1 MB are available for the buffering. Each BRCB has an extension attribute Memory that display the percentage of those 1 MB that have been reserved/forseen for its own entries. Default amount 1 MB/(2*Number of logical devices) |
| additional items: | |
| Interrupt of general interrogation | Running GI could not be interrupted. If a new GI request occurs during a running GI, the current GI will be finished first before the second GI request will be processed. |
| Integrity period | Configurable >=1 second; |
| Dynamic BRCB reservation after an abort of the client/server association | Reservation of the BRCB has been fixed with TISSUE 453. The value of the attribute ResvTms delivers the time interval during which the reservation is still active after the connection has been lost. In case a BRCB is still reserved, and a client connects with the same IP address as the one used during the reservation, then the BRCB attribute can be written by this client without prior setting the ResvTms attribute as long as the reservation timer has not expired. |

| | |
|--|--|
| <p>Configured BRCB reservation after an abort of the client/server association</p> | <p>Reservation of the BRCB is not lost for BRCBs that have been pre-associated to a specific client (pre-association defined with means of the CLientLN element with the BRCB instantiation in the SCD file). Reservation of a BRCB is lost for BRCBs, that have not been pre-associated to a specific client, after the expiration of the reservation timer set with the ResvTms attribute. In case ResvTms is not set (backward compatibility), ResvTms will get a default value for all preconfigured BRCBs that are not pre-associated to a specific client.</p> |
| <p>Optional use of a flow control for transmitting history of a BRCB</p> | <p>As specified in the IEC61850-7-2, transmission of entries may required some times, depending of the amount of entries that have to be transmmitted. Therefore, the SIPROTEC has an optional flow control feature to accelerate the transmission of the entries: each BRCB has an extended attribute MaxOutReports that can be set from the associated-client to change the transmmision strategy of the entries. The number ordered will then be transmmitted as long as they exist in the buffer; the server then reset the attribute to 0 and wait for the client to set it again in order to continue the history transmission with MaxOutReports entries. The attribute only influences the flow control of entries while dealing with the history, and not after the history transmission has completed.</p> |

1.7 Logging model

This service will not be supported (see also *SIPROTEC 4 Ethernet Module EN 100 IEC 61850 Electrical Interface 100 MBit, Manual /1/*).

1.8 Generic substation model

| Description | Value / Clarification |
|--|--|
| What is the behavior when one subscribed GOOSE message isn't received or syntactically incorrect ? | The telegram will be discarded (i.e not forwarded to the application) since it is corrupt or syntactically incorrect and therefore not readable. The data objects will be declared as invalid after a timeout detection since no telegram have been received by the application. |
| What is the behavior when a subscribed GOOSE message is out-of-order ? | Error message will be stored into the error buffer (could be accessed by EN100 web-server). All expected data objects will be declared as invalid. |
| What is the behavior when a subscribed GOOSE message is duplicated ? | The sequence number given in the GOOSE-message is out-of-order. Error message will be stored into the error buffer (could be accessed by EN100 web-server). All expected data objects will be declared as invalid. |
| additional items: | |
| Maximum number of GOOSE messages which could be sent | <= 16 ; It depends on the available memory. |
| Maximum number of GOOSE messages which could be received | <= 128 ; It depends on the available memory. |
| Interpretation of GOOSE messages at subscriber side | <ol style="list-style-type: none"> 1. Received GOOSE data objects without assigned quality attribute are interpreted as invalid. 2. Received GOOSE data objects which quality attribute are set to questionable are changed to invalid. |
| GOOSE subscriber behavior in case of missing GOOSE messages | After a GOOSE multicast application association has been interrupted, the reception of the second consecutive GOOSE telegram is required to validate the state of this GOOSE association again. However, the IED tolerates a missing telegram as long as the next telegram (expected n, received n+1) is received within the time allowed to live time out detection (the time allowed to live timeout detection occurs after 2*TAL). |
| GOOSE subscriber behaviour in case of multiple GOOSE messages | If a message is received twice or more, the IED already reports an error after the second reception. Therefore, network configuration error can be more easily tracked. |
| What is the behavior when a GOOSE header parameter is mismatching with the expected one? (datSet, goID, confRev, numDatSetEntries, number of allData) | Error message will be stored into the error buffer (could be accessed by EN100 web-server). All expected data objects will be declared as invalid. |
| What is the behavior when a timeAllowedToLive is 0? | Error message will be stored into the error buffer (could be accessed by EN100 web-server) since the timeAllowedToLive expired. All expected data objects will be declared as invalid. |

| | |
|--|--|
| What is the behavior when there is an out-of-order entry in the allData? | The confRev attribute in the header guarantees that the allData entries are in the correct order. Therefore, it's necessary to check the confRev attribute. There is no chance to detect such an out-of-order. |
| What is the behavior when no telegram is received within a TAL timeout? | To avoid an incorrect timeout detection, the subscriber detects a timeout after a period of 2×TAL. The information is then declared as questionable, oldData. |
| What is the behavior when a GOOSE header parameter goCBRef is mismatching with the expected one? | Since the goCBRef shall be unique stationwide, the received telegram with the mismatched goCBRef will be discarded: it has not been published. In that case only the timeout detection will set the data to invalid. |
| What is the behavior when a GOOSE header parameter APPID is mismatching with the expected one? | The APPID is a link layer parameter. It is used as a filter on link layer. If the APPID is mismatching, the telegram will therefore be discarded on link layer without notifying the application. Only the timeout detection will set the data to invalid. |
| What is the behavior when a GOOSE header parameter t is not increasing? | The t parameter is not checked. Therefore it doesn't lead to any error detection. |
| What is the behavior when numDatSetEntries and number of allData are inconsistent? | The telegram is discarded since it is corrupt (not well formed). After the timeout detection (no telegram forwarded to the application) the data objects are declared invalid. |

1.9 Transmission of sample values model

Compare the "Implementation Guidelines for Electrical Current and Voltage Transducers according to IEC 60044-7/8 with Digital Output according to IEC 61850-9-2; Version 1.0; as specified by ABB, Areva, Landis+Gyr, OMICRON and SIEMENS

This service will not be supported (see also *SIPROTEC 4 Ethernet Module EN 100 IEC 61850 Electrical Interface 100 MBit, Manual /1/*).

1.10 Control model

| Description | Value / Clarification |
|--|--|
| What control models are supported ? | Y Status-only Y Direct-with-normal-security N Sbo-with-normal-security N Direct-with-enhanced-security N Sbo-with-enhanced-security |
| Is Time activated operate (operTm) supported | N |
| Is pulse configuration supported ? | N |
| What service error types are supported ? | Y Instance-not-available Y Instance-in-use Y Access-violation Y Access-not-allowed-in-current-state Y Parameter-value-inappropriate Y Parameter-value-inconsistent Y Class-not-supported Y Instance-locked-by-other-client Y Control-must-be-selected Y Type-conflict Y Failed-due-to-communications Y Constraint failed-due-to-server-constraint |
| What additional cause diagnosis are supported ? | N Blocked-by-switching-hierarchy Y Select-failed Y Invalid-position Y Position-reached Y Parameter-change-in-execution Y Step-limit Y Blocked-by-Mode Y Blocked-by-process Y Blocked-by-interlocking Y Blocked-by-synchrocheck Y Command-already-in-execution N Blocked-by-health Y 1-of-n-control Y Abortion-by-cancel Y Time-limit-over N Abortion-by-trip Y Object-not-selected |
| additional items: | |
| What additional cause diagnosis extensions are supported ? | Y Plausibility_error Y Parameter_setting_invalid Y Hardware_error Y System_overload Y Internal_fault Y Command_sequence_error |

| | |
|--|--|
| Changing the control services by configuration | N |
| Format of the control time stamp attribute ? | TimeStamp instead of EntryTime acc. to the 7-2 Errata List. |

1.11 Time and time synchronisation model

| Description | Value / Clarification |
|---|---|
| What kind of quality bits are supported ? | N LeapSecondsKnown Y ClockFailure Y ClockNotSynchronized |
| What kind of quality accuracy bits are supported ? | Y Invalid N Unspecified |
| What is the behavior when the time synchronization signal/messages are lost ? | The quality attribute "ClockFailure" will be set to TRUE after a configured time period. |
| What is the behaviour when the time synchronisation messages indicate that the stratum is greater than 3? | A stratum with a value greater than 3 with the SNTP time synchronization messages indicates that the time server has a questionable synchronisation. It might also indicate that no GPS connection are available. Therefore the time quality attribute "ClockNotSynchronized" will be set to TRUE as long as the stratum content is greater than 3. |
| additional items: | |
| What is the behavior at start up time when a time synchronization via SNTP is configured ? | The "ClockNotSynchronized" attribute is set to TRUE as long as no time synchronization is established. |

1.12 File transfer model

| Description | Value / Clarification |
|---|--|
| What is structure of files and directories? | Directory name / COMTRADE / *; Directory name / LD / *; Files according to the comtrade standard. |
| What is the resulting behavior if no file specification is present in the file directory request? | If no file specification is present in the directory request, all files are returned - not only the files in the root directory. |
| Is the IETF FTP protocol also implemented ? | N |
| Directory names are separated from the file name by | "/" |
| The maximum file name size including path (default 64 chars) | 64 |
| Are directory/file name case sensitive | Case sensitive |
| Maximum file size | Not limited by implementation or configuration. Depends on available memory. |
| additional items: | |
| Maximum number of clients that can use the FTP service simultaneously | 1 |
| Maximum number of files that can be accessed simultaneously | 1 |

1.13 General items

| Description | Value / Clarification |
|---|---|
| IED behavior when the Logical Device is blocked : LLN0.Mod.stVal = blocked | Unlike the definition of the Data Objects “Mod/Beh” in IEC 61850-7-4, outputs to the process will be generated. Details to this behavior are specified in <i>SIPROTEC 4 Ethernet Module EN 100 IEC 61850 Electrical Interface 100 MBit, Manual /1/</i> |
| additional items: | |
| GOOSE Proxy object | To be able to subscribe Data over GOOSE, Proxy Objects are added into the object directory. Typically, they are Data of GGIO logical nodes: SPCSOxx, DPCSOxx, ISCSOxx. The Data Attributes of those Data are ctIVal, q and t. The control model associated to those Data is status-only. They are not controllable from an IEC61850 client, and their function is only to enable the GOOSE subscribing. |
| What is the type of the attribute actVal in the BCR (Binary Counter Reading) CDC? | The type is integer 32 (INT32). |

1.14 TISSUES

| Topic | TISSUE -No. | Link | Description | Impact of Interoper. |
|--------------|-------------|---|--|----------------------|
| Object Model | 120 | http://www.tissue.iec61850.com/tissue.aspx?issueid=120 | Type - Mod.stVal and Mod.ctlVal | - |
| | 146 | http://www.tissue.iec61850.com/tissue.aspx?issueid=146 | CtxInt | - |
| | 173 | http://www.tissue.iec61850.com/tissue.aspx?issueid=173 | Ctl modelling harmonization | - |
| | 234 | http://www.tissue.iec61850.com/tissue.aspx?issueid=234 | New type CtxInt | x |
| Services | 377 | http://www.tissue.iec61850.com/tissue.aspx?issueid=377 | DeleteDataSet response- | - |
| | 276 | http://www.tissue.iec61850.com/tissue.aspx?issueid=276 | File Services Negative Responses | - |
| | 183 | http://www.tissue.iec61850.com/tissue.aspx?issueid=183 | GetNameList error handling | x |
| | 165 | http://www.tissue.iec61850.com/tissue.aspx?issueid=165 | Improper Error Response for GetDataSetValues | x |
| | 116 | http://www.tissue.iec61850.com/tissue.aspx?issueid=116 | GetNameList with empty response? | x |
| Reporting | 474 | http://www.tissue.iec61850.com/tissue.aspx?issueid=474 | GI for URCB | - |
| | 453 | http://www.tissue.iec61850.com/tissue.aspx?issueid=453 | Reporting & Logging model revision | x |
| | 438 | http://www.tissue.iec61850.com/tissue.aspx?issueid=438 | EntryTime base should be GMT | - |
| | 349 | http://www.tissue.iec61850.com/tissue.aspx?issueid=349 | BRCB TimeOfEntry has two definitions | x |
| | 348 | http://www.tissue.iec61850.com/tissue.aspx?issueid=348 | URCB class and report | x |

| | | | | |
|---------------|-----|---|--|---|
| Reporting | 344 | http://www.tissue.iec61850.com/tissue.aspx?issueid=344 | TimeOfEntry misspelled | - |
| | 335 | http://www.tissue.iec61850.com/tissue.aspx?issueid=335 | Clearing of Bufovfl | x |
| | 332 | http://www.tissue.iec61850.com/tissue.aspx?issueid=332 | Ambiguity in use of trigger options | x |
| | 329 | http://www.tissue.iec61850.com/tissue.aspx?issueid=329 | Reporting and BufOvl | x |
| | 322 | http://www.tissue.iec61850.com/tissue.aspx?issueid=322 | Write Configuration attribute of BRCBs | |
| | 301 | http://www.tissue.iec61850.com/tissue.aspx?issueid=301 | SqNum in Buffered Reports | - |
| | 300 | http://www.tissue.iec61850.com/tissue.aspx?issueid=300 | Attribute Resv in BRCB | x |
| | 298 | http://www.tissue.iec61850.com/tissue.aspx?issueid=298 | Type of SqNum | x |
| | 297 | http://www.tissue.iec61850.com/tissue.aspx?issueid=297 | Sequence number | x |
| | 278 | http://www.tissue.iec61850.com/tissue.aspx?issueid=278 | EntryId not valid for a server | x |
| | 275 | http://www.tissue.iec61850.com/tissue.aspx?issueid=275 | Confusing statement on GI usage | x |
| | 191 | http://www.tissue.iec61850.com/tissue.aspx?issueid=191 | BRCB: Integrity and buffering reports | x |
| | 190 | http://www.tissue.iec61850.com/tissue.aspx?issueid=190 | BRCB: EntryId and TimeOfEntry | x |
| | 177 | http://www.tissue.iec61850.com/tissue.aspx?issueid=177 | Ignoring OptFlds bits for URCB | - |
| | 52 | http://www.tissue.iec61850.com/tissue.aspx?issueid=52 | Ambiguity GOOSE SqNum | x |
| | 49 | http://www.tissue.iec61850.com/tissue.aspx?issueid=49 | BRCB TimeOfEntry? | x |
| Control Model | 46 | http://www.tissue.iec61850.com/tissue.aspx?issueid=46 | Synchro check cancel | x |
| | 44 | http://www.tissue.iec61850.com/tissue.aspx?issueid=44 | AddCause - Object not sel | x |
| | 30 | http://www.tissue.iec61850.com/tissue.aspx?issueid=30 | control parameter T | x |

Basics

Contents

This chapter contains general information about the effects of device configuration on Logical Nodes and DOIs.

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2.1 General

The protocol IEC 61850 was developed to define a standard that can be internationally employed for the transmission of power automation system data.

This cross national standard enables an interoperability between automation systems and devices made by different manufacturers.

The devices and high voltage bay control units of the SIPROTEC 4 series can be equipped with an Ethernet module EN100 via which the protocol IEC 61850 is interpreted.

The configuration of the protocol and the integration of the device with redundant IEC 61850 interfaces in your network are performed via the configuration system DIGSI.

For details please refer to the manuals:

- ❑ *SIPROTEC 4 Ethernet Module EN 100 IEC 61850 Electrical Interface 100 MBit, Manual /1/ and*
- ❑ *SIPROTEC 4 System Description /2/.*



Note

The following definitions are taken mainly from standard IEC 61850, Technical Specification IEC TS 61850-2.

Logical Devices

LD Logical Devices represent a functional structuring of the LN Logical Nodes of a SIPROTEC device.

The following Logical Devices are present:

- ❑ Logical Device Protection PROT
- ❑ Logical Device Measurement MEAS
- ❑ Logical Device Disturbance Recorder DR
- ❑ Logical Device Control CTRL
- ❑ Logical Device Extended EXT

Each LD contains LN LLN0 and LN LPHD1.

The allocation of the Logical Nodes to the Logical Devices is listed in Chapter 2.3.

Logical Node LN

Smallest part of a function that exchanges data. A logical node is an object defined by its data and methods.

Data object instance DOI

A Data object is part of a logical node object representing specific information for example status of measurement. From an object-oriented point of view, a data object is an instance of a data class. Specific data classes carry the semantic within a logical node.

Data attribute instance DAI

A Data attribute defines the name (semantic), format, range of possible values, and representation of values while being communicated.

Annunciation types via GOOSE

Generic Object Oriented Substation Event

A GOOSE report enables high speed trip signals to be issued with a high probability of delivery.

The following types of information can be configured via GOOSE.

- External single point indication O/O
- External single point indication I/O
- External double point indication
- External double point indication, fast
- External operational measured values
- External metered values

2.2 Effects of Configuration on the Logical Nodes

The Logical Nodes of a SIPROTEC 7SS52 are not dependent on the configuration of function parameters.

The following Logical Nodes are always available:

| | |
|--------------------------------------|-------------------------------------|
| Logical Device Protection: | LLN0, LPHD1, PTRC1, PDIF1, RBRF1 |
| Logical Device Measurement: | LLN0, LPHD1 |
| Logical Device Disturbance Recorder: | LLN0, LPHD1, RDRE1 |
| Logical Device Control: | LLN0, LPHD1, CALH1 |

2.3 Allocation of Logical Nodes to Logical Devices

All Logical Nodes (LN) are allocated to Logical Devices (LD). The following tables show this allocation and the DOIs available for each LN.

LD PROT

The Logical Device PROT (Protection) contains the following LNs:

Table 2-1 LD PROT - Logical Nodes

| LN | Function | DOI |
|-------|--|--|
| LLN0 | General | Mod, Beh, Health, NamPlt, |
| PTRC1 | General device pickup Total OFF (not available) | Mod, Beh, Health, NamPlt, Tr |
| PDIF1 | Differential Protection | Mod, Beh, Health, NamPlt, Op, DifAClc, RstA |
| RBRF1 | Breaker Failure Protection | Mod, Beh, Health, NamPlt, OpIn, OpEx |
| LPHD1 | Device | PhyNam, PhyHealth, Proxy |

LD MEAS

The Logical Device MEAS (Measurement) contains the following LNs:

Table 2-2 LD MEAS - Logical Nodes

| LN | Function | DOIs |
|-------|----------|----------------------------|
| LLN0 | General | Mod, Beh, Health, NamPlt |
| LPHD1 | Device | PhyNam, PhyHealth Proxy |

LD DR

The Logical Device DR (Disturbance Recorder) contains the following LNs:

Table 2-3 LD DR - Logical Nodes

| LN | Function | DOIs |
|-------|---------------|---|
| LLN0 | General | Mod, Beh, Health, NamPlt |
| RDRE1 | Fault Records | Mod, Beh, Health, NamPlt, RcdMade FitNum, GriFitNum RcdStr |
| LPHD1 | Device | PhyNam, PhyHealth Proxy |

LD CTRL

The Logical Device CTRL (Control) contains the following LNs:

Table 2-4 LD CTRL - Logical Nodes

| LN | Function | DOIs |
|-------|---|--|
| LLN0 | General | Mod, Beh, Health, NamPlt, LEDRs |
| CALH1 | Alarms, warning messages and group alarms | Mod, Beh, Health, NamPlt, GrAlm, GrWrn |
| LPHD1 | Device | PhyNam, PhyHealth Proxy, CtlNum, DevStr |

The Logical Nodes of the switching (and userdefined) objects will be created by DIGSI during the parameterization of your SIPROTEC device.

MICS, Model Implementation Conformance Statement, shows the assignment of the DOIs; you can use DIGSI to print the MICS.

LD EXT

The Logical Device EXT (Extended) contains the following LNs:

Table 2-5 LD EXT - Logical Nodes

| LN | Function | DOIs |
|-------|----------|----------------------------|
| LLN0 | General | Mod, Beh, Health, NamPlt |
| LPHD1 | Device | PhyNam, PhyHealth Proxy |

2.4 Logical Node LLN0

2.4.1 Logical Device PROT

LLN0.Mod

| No. | Information | | | | | | | | |
|-----------------------|--------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|
| 55 | Reset Device (Reset Device) | x | x | x | x | x | x | x | x |
| 10442 | TRIP commands blocked (TRIP blocked) | 0 | 1 | 0 | x | 0 | 1 | 0 | x |
| | All busbars blocked by command | 0 | 0 | 1 | x | 0 | 0 | 1 | x |
| | Test mode (Test mode) | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 |
| | Stop data transmission (DataStop) | 0 | x | x | 1 | 0 | x | x | 1 |
| LLN0.Mod.stVal | | 1 | 2 | 2 | 2 | 3 | 4 | 4 | 4 |

device annunciation / setting: 1 - ON / TRUE
0 - OFF / FALSE
x - irrelevant

IEC Status Mod.stVal:

1 - ON
2 - BLOCKED
3 - TEST
4 - TEST/BLOCKED
5 - OFF

LLN0.Beh

| No. | Information | | | | | | | | |
|-----------------------|--------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|
| 55 | Reset Device (Reset Device) | x | x | x | x | x | x | x | x |
| 10442 | TRIP commands blocked (TRIP blocked) | 0 | 1 | 0 | x | 0 | 1 | 0 | x |
| | All busbars blocked by command | 0 | 0 | 1 | x | 0 | 0 | 1 | x |
| | Test mode (Test mode) | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 |
| | Stop data transmission (DataStop) | 0 | x | x | 1 | 0 | x | x | 1 |
| LLN0.Beh.stVal | | 1 | 2 | 2 | 2 | 3 | 4 | 4 | 4 |

device annunciation / setting: 1 - ON / TRUE
0 - OFF / FALSE
x - irrelevant

IEC Status Beh.stVal:

1 - ON
2 - BLOCKED
3 - TEST
4 - TEST/BLOCKED
5 - OFF

LLN0.Health

| No. | Information | | | | |
|--------------------------|--|----------|----------|----------|----------|
| 51 | Device is Operational and Protecting (Device OK) | 0 | x | 1 | 1 |
| | Busbar blocked by failure | x | x | 1 | 0 |
| | All busbars blocked by failure | x | 1 | 0 | 0 |
| LLN0.Health.stVal | | 3 | 3 | 2 | 1 |

device annunciation / setting: 1 - ON / TRUE IEC Status Health.stVal: 1 - OK
 0 - OFF / FALSE 2 - WARNING
 x - irrelevant 3 - ALARM

2.5 DOI Behavior

2.5.1 Logical Device PROT

For the Logical Nodes of the PROT Logical Device, **LNx.Beh.stVal** is formed from **LNx.Mod.stVal** of the Logical Node and the status of the following device messages:

- Test mode (Test mode),
- Stop data transmission.

| No. | Information | | | | | | |
|----------------------|-----------------------------------|----------|----------|----------|----------|----------|----------|
| | Test mode (Test mode) | 0 | 0 | 1 | 1 | 0 | 1 |
| | Stop data transmission (DataStop) | 0 | x | 0 | x | x | x |
| | LNx .Mod.stVal | 1 | 1 | 1 | 1 | 2 | 2 |
| LNx.Beh.stVal | | 1 | 2 | 3 | 4 | 2 | 4 |

device annunciation / setting: 1 - ON / TRUE
 0 - OFF / FALSE
 x - irrelevant

IEC Status Beh.stVal:

1 - ON
 2 - BLOCKED
 3 - TEST
 4 - TEST/BLOCKED
 5 - OFF

2.5.2 Logical Devices MEAS, CTRL, DR and EXT

For the Logical Nodes of the MEAS, CTRL, DR and EXT Logical Devices, **LNx.Beh.stVal** is formed from **LNx.Mod.stVal** of the Logical Node and the status of the following device messages:

- Test mode (Test mode),
- Stop data transmission.

| No. | Information | | | | | | | | | | |
|-----|-----------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|--|
| | Test mode (Test mode) | 0 | 0 | 1 | 1 | 1 | 0 | x | x | x | |
| | Stop data transmission (DataStop) | 0 | 1 | 0 | 1 | x | x | 0 | x | x | |
| | LNx .Mod.stVal | 1 | 1 | 1 | 1 | 2 | 2 | 3 | 4 | 5 | |
| | LNx.Beh.stVal | 1 | 2 | 3 | 4 | 4 | 2 | 3 | 4 | 5 | |

device annunciation / setting: 1 - ON / TRUE
 0 - OFF / FALSE
 x - irrelevant

IEC Status Beh.stVal:

1 - ON
 2 - BLOCKED
 3 - TEST
 4 - TEST/BLOCKED
 5 - OFF

Mapping

Contents

This chapter shows the mapping of the information relevant to the device on the Logical Node of protocol IEC61850. It is structured according to function. In Chapter 2 you can find general information about IEC 61850 mapping of information.

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3.1 Device (LPHD1, CALH1)

LPHD1.DevStr

| No. | Information | | | | |
|---------------------------|---|----------|----------|----------|----------|
| 56 | Initial Start of Device (Initial Start) | 0 | 0 | 1 | 1 |
| 67 | Resume (Resume) | 0 | 1 | 0 | 1 |
| LPHD1.DevStr.stVal | | T | 2 | 1 | T |

device annunciation: 1 - ON
0 - OFF

IEC Status DevStr.stVal:

1 - Initial Start
2 - Resume
T - toggle between 1 and 2

LPHD1.Proxy

| No. | Information | | |
|--------------------------|-----------------------------|----------|----------|
| 55 | Reset Device (Reset Device) | 0 | 1 |
| LPHD1.Proxy.stVal | | 1 | 0 |

device annunciation: 1 - ON
0 - OFF

IEC Status Proxy.stVal:

0 - DEVICE is not a PROXY
1 - DEVICE is a PROXY

LPHD1.PhyHealth

| No. | Information | | |
|------------------------------|--|----------|----------|
| 51 | Device is Operational and Protecting (Device OK) | 0 | 1 |
| LPHD1.PhyHealth.stVal | | 3 | 1 |

device annunciation: 1 - ON
0 - OFF

IEC Status PhyHealth.stVal:

1 - OK
2 - WARNING
3 - ALARM

3.1.1 Error with a summary alarm and Alarm summary event

CALH1.Mod

| No. | Information | |
|------------------------|-----------------------------|----------|
| 55 | Reset Device (Reset Device) | 1 |
| CALH1.Mod.stVal | | 1 |

device annunciation: 1 - ON IEC Status Mod.stVal: 1 - ON
 0 - OFF 2 - BLOCKED
 3 - TEST
 4 - TEST/BLOCKED
 5 - OFF

CALH1.Health

| No. | Information | | |
|---------------------------|--|----------|----------|
| 51 | Device is Operational and Protecting (Device OK) | 0 | 1 |
| CALH1.Health.stVal | | 3 | 1 |

device annunciation: 1 - ON IEC Status Health.stVal: 1 - OK
 0 - OFF 2 - WARNING
 3 - ALARM

CALH1.GrAlm

| No. | Information | | |
|--------------------------|---|----------|----------|
| 10476 | Error with protection blocking (Err PROT BLOCK) | 1 | 0 |
| CALH1.GrAlm.stVal | | 1 | 0 |

device annunciation: 1 - ON IEC Status GrAlm.stVal: 0 - FALSE
 0 - OFF 1 - TRUE

CALH1.GrWrn

| No. | Information | | |
|--------------------------|---|----------|----------|
| 10475 | Error without protection blocking (Err PROT ACTIVE) | 1 | 0 |
| CALH1.GrWrn.stVal | | 1 | 0 |

device annunciation: 1 - ON IEC Status GrWrn.stVal: 0 - FALSE
 0 - OFF 1 - TRUE

The LN CALH1.ErrBoard1 to CALH1.ErrBoard7 are available with Firmware V04.61 and higher.

CALH1.ErrBoard1

| No. | Information | | |
|------------------------------|-------------------------------|----------|----------|
| 183 | Error Board 1 (Error Board 1) | 1 | 0 |
| CALH1.ErrBoard1.stVal | | 1 | 0 |

device annunciation: 1 - ON IEC Status ErrBoard1.stVal: 0 - FALSE
0 - OFF 1 - TRUE

CALH1.ErrBoard2

| No. | Information | | |
|------------------------------|-------------------------------|----------|----------|
| 184 | Error Board 2 (Error Board 2) | 1 | 0 |
| CALH1.ErrBoard2.stVal | | 1 | 0 |

device annunciation: 1 - ON IEC Status ErrBoard2.stVal: 0 - FALSE
0 - OFF 1 - TRUE

CALH1.ErrBoard3

| No. | Information | | |
|------------------------------|-------------------------------|----------|----------|
| 185 | Error Board 3 (Error Board 3) | 1 | 0 |
| CALH1.ErrBoard3.stVal | | 1 | 0 |

device annunciation: 1 - ON IEC Status ErrBoard3.stVal: 0 - FALSE
0 - OFF 1 - TRUE

CALH1.ErrBoard4

| No. | Information | | |
|------------------------------|-------------------------------|----------|----------|
| 186 | Error Board 4 (Error Board 4) | 1 | 0 |
| CALH1.ErrBoard4.stVal | | 1 | 0 |

device annunciation: 1 - ON IEC Status ErrBoard4.stVal: 0 - FALSE
0 - OFF 1 - TRUE

3.2 Fault Records (RDRE1)

RDRE1.Mod

| No. | Information | |
|------------------------|-----------------------------|----------|
| 55 | Reset Device (Reset Device) | x |
| RDRE1.Mod.stVal | | 1 |

device annunciation: 1 - ON
0 - OFF
x - irrelevant

IEC Status Mod.stVal: 1 - ON
2 - BLOCKED
3 - TEST
4 - TEST/BLOCKED
5 - OFF

RDRE1.Health

| No. | Information | | |
|---------------------------|--|----------|----------|
| 51 | Device is Operational and Protecting (Device OK) | 0 | 1 |
| RDRE1.Health.stVal | | 3 | 1 |

device annunciation: 1 - ON
0 - OFF

IEC Status Health.stVal: 1 - OK
2 - WARNING
3 - ALARM

RDRE1.RcdMade

| No. | Information | | |
|----------------------------|--|----------|----------|
| 30053 | Fault recording is running (Fault rec. run.) | 0 | 1 |
| RDRE1.RcdMade.stVal | | 1 | 0 |

device annunciation: 1 - ON
0 - OFF

IEC Status RodMade.stVal: 0 - FALSE
1 - TRUE
(Recording complete)

RDRE1.FltNum

| No. | Information | Value | |
|-----|---------------------------|--------------------|----------------------|
| 302 | Fault Event (Fault Event) | RDRE1.FltNum.stVal | Present fault number |

RDRE1.GriFltNum

| No. | Information | Value | |
|-----|-----------------------------------|-----------------------|----------------------|
| 301 | Power System fault (Pow.Sys.Flt.) | RDRE1.GriFltNum.stVal | Network fault number |

RDRE1.RcdStr

| No. | Information | | |
|---------------------------|--|----------|----------|
| 30053 | Fault recording is running (Fault rec. run.) | 0 | 1 |
| RDRE1.RcdStr.stVal | | 0 | 1 |

device annunciation:

1 - ON
0 - OFF

IEC Status RcdStr.stVal:

0 - FALSE
1 - TRUE

3.3 Differential Protection (PDIF1)

PDIF1.Mod

| No. | Information | | | |
|------------------------|--------------------------------------|----------|----------|----------|
| 55 | Reset Device (Reset Device) | x | x | x |
| 10442 | TRIP commands blocked (TRIP blocked) | 0 | x | 1 |
| | All busbars blocked by command | 0 | 1 | x |
| PDIF1.Mod.stVal | | 1 | 2 | 2 |

device annunciation / setting: 1 - ON / TRUE IEC Status Mod.stVal: 1 - ON
 0 - OFF / FALSE 2 - BLOCKED
 x - irrelevant 3 - TEST
 4 - TEST/BLOCKED
 5 - OFF

PDIF1.Health

| No. | Information | | | |
|---------------------------|--------------------------------|----------|----------|----------|
| | Busbar blocked by failure | x | 1 | 0 |
| | All busbars blocked by failure | 1 | 0 | 0 |
| PDIF1.Health.stVal | | 3 | 2 | 1 |

device annunciation / setting: 1 - ON / TRUE IEC Status Health.stVal: 1 - OK
 0 - OFF / FALSE 2 - WARNING
 x - irrelevant 3 - ALARM

PDIF1.Op

| No. | Information | | |
|-------------------------|---|----------|----------|
| 10449 | Trip command BBP (group alarm) (Trip BBP M) | 0 | 1 |
| PDIF1.Op.general | | 0 | 1 |

device annunciation: 1 - ON IEC Status Op.general: 0 - FALSE
 0 - OFF 1 - TRUE

PDIF1.DifAClc

| No. | Information | Value | | |
|-------|---------------------------------------|-------------------------------------|----------------|----------------|
| 10401 | CZ: IdiffL1 (% I/Ino)= (CZ Id L1=) | PDIF1.DifAClc.phsA.cVal.mag.f | Measured value | Absolute value |
| | | PDIF1.DifAClc.phsA.units.SIUnit | 1 | none |
| | | PDIF1.DifAClc.phsA.units.multiplier | 0 | 1 |

| No. | Information | Value | | |
|-------|---------------------------------------|-------------------------------------|----------------|----------------|
| 10402 | CZ: IdiffL2 (% I/Ino)= (CZ Id L2=) | PDIF1.DifAClc.phsB.cVal.mag.f | Measured value | Absolute value |
| | | PDIF1.DifAClc.phsB.units.SIUnit | 1 | none |
| | | PDIF1.DifAClc.phsB.units.multiplier | 0 | 1 |

| No. | Information | Value | | |
|-------|---------------------------------------|-------------------------------------|----------------|----------------|
| 10403 | CZ: IdiffL3 (% I/Ino)= (CZ Id L3=) | PDIF1.DifAClc.phsC.cVal.mag.f | Measured value | Absolute value |
| | | PDIF1.DifAClc.phsC.units.SIUnit | 1 | none |
| | | PDIF1.DifAClc.phsC.units.multiplier | 0 | 1 |

PDIF1.RstA

| No. | Information | Value | | |
|-------|---------------------------------------|----------------------------------|----------------|----------------|
| 10404 | CZ: IstabL1 (% I/Ino)= (CZ Is L1=) | PDIF1.RstA.phsA.cVal.mag.f | Measured value | Absolute value |
| | | PDIF1.RstA.phsA.units.SIUnit | 1 | none |
| | | PDIF1.RstA.phsA.units.multiplier | 0 | 1 |

| No. | Information | Value | | |
|-------|---------------------------------------|----------------------------------|----------------|----------------|
| 10405 | CZ: IstabL2 (% I/Ino)= (CZ Is L2=) | PDIF1.RstA.phsB.cVal.mag.f | Measured value | Absolute value |
| | | PDIF1.RstA.phsB.units.SIUnit | 1 | none |
| | | PDIF1.RstA.phsB.units.multiplier | 0 | 1 |

| No. | Information | Value | | |
|-------|---------------------------------------|----------------------------------|----------------|----------------|
| 10406 | CZ: IstabL3 (% I/Ino)= (CZ Is L3=) | PDIF1.RstA.phsC.cVal.mag.f | Measured value | Absolute value |
| | | PDIF1.RstA.phsC.units.SIUnit | 1 | none |
| | | PDIF1.RstA.phsC.units.multiplier | 0 | 1 |

RBRF1.OpIn

| No. | Information | | | |
|---------------------------|--|----------|----------|----------|
| 10436 | Trip command BF (group alarm) (Trip BF M) | 1 | x | 0 |
| | Breaker Failure Protection caused by external TRIP | 0 | 1 | x |
| RBRF1.OpIn.general | | 1 | 0 | 0 |

device annunciation / setting: 1 - ON / TRUE IEC Status OpIn.general: 0 - FALSE
0 - OFF / FALSE 1 - TRUE
x - irrelevant

RBRF1.OpEx

| No. | Information | | | |
|---------------------------|--|----------|----------|----------|
| 10436 | Trip command BF (group alarm) (Trip BF M) | x | 0 | 1 |
| | Breaker Failure Protection caused by external TRIP | 0 | x | 1 |
| RBRF1.OpEx.general | | 0 | 0 | 1 |

device annunciation / setting: 1 - ON / TRUE IEC Status OpEx.general: 0 - FALSE
0 - OFF / FALSE 1 - TRUE
x - irrelevant

3.5 Tripping Logic of the Entire Device (PTRC1)

PTRC1.Mod

| No. | Information | | | |
|------------------------|--------------------------------------|----------|----------|----------|
| 55 | Reset Device (Reset Device) | x | x | x |
| 10442 | TRIP commands blocked (TRIP blocked) | 0 | x | 1 |
| | All busbars blocked by command | 0 | 1 | x |
| PTRC1.Mod.stVal | | 1 | 2 | 2 |

device annunciation / setting: 1 - ON / TRUE IEC Status Mod.stVal: 1 - ON
0 - OFF / FALSE 2 - BLOCKED
x - irrelevant 3 - TEST
4 - TEST/BLOCKED
5 - OFF

PTRC1.Health

| No. | Information | | | |
|---------------------------|--------------------------------|----------|----------|----------|
| | Busbar blocked by failure | x | 1 | 0 |
| | All busbars blocked by failure | 1 | 0 | 0 |
| PTRC1.Health.stVal | | 3 | 2 | 1 |

device annunciation / setting: 1 - ON / TRUE IEC Status Health.stVal: 1 - OK
0 - OFF / FALSE 2 - WARNING
x - irrelevant 3 - ALARM

PTRC1.Tr

| No. | Information | | |
|-------------------------|---|----------|----------|
| 10445 | Device Trip (group alarm) (Device trip M) | 0 | 1 |
| PTRC1.Tr.general | | 0 | 1 |

device annunciation: 1 - ON IEC Status Tr.general: 0 - FALSE
0 - OFF 1 - TRUE

Literature

- /1/ SIPROTEC 4 Ethernet Module EN 100 IEC 61850 Electrical Interface 100 MBit, Manual
C54000-G1176-C167
- /2/ SIPROTEC 4 System Description
E50417-H1176-C151
- /3/ SIPROTEC DIGSI, StartUP
E50417-G1176-C152
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