

# 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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# Applications

# 1

## Contents

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

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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	3 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 dedends 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.
<b>additional items:</b>	
Maximum number of data sets	Could not be defined, it depends on the available memory space. In principle, this information it 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

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
What is the format of EntryID ?	EntryID is an attribute of BRCB. Buffered report will not supported acc. to PICS.
What is the buffer size for each BRCB or how many reports can be buffered ?	Not supported.
<b>additional items:</b>	
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 $\geq 1$ 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.

## 1.7 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.
<b>additional items:</b>	
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"> <li>1. Received GOOSE data objects without assigned quality attribute are interpreted as invalid.</li> <li>2. Received GOOSE data objects which quality attribute are set to questionable are changed to invalid.</li> </ol>
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.

<p>What is the behavior when a timeAllowedToLive is 0?</p>	<p>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.</p>
<p>What is the behavior when there is an out-of-order entry in the allData?</p>	<p>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.</p>
<p>What is the behavior when no telegram is received within a TAL timeout?</p>	<p>To avoid an incorrect timeout detection, the subscriber detects a timeout after a period of <math>2 \times \text{TAL}</math>. The information is then declared as questionable, oldData.</p>
<p>What is the behavior when a GOOSE header parameter goCBRef is mismatching with the expected one?</p>	<p>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.</p>
<p>What is the behavior when a GOOSE header parameter APPID is mismatching with the expected one?</p>	<p>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.</p>
<p>What is the behavior when a GOOSE header parameter t is not increasing?</p>	<p>The t parameter is not checked. Therefore it doesn't lead to any error detection.</p>
<p>What is the behavior when numDatSetEntries and number of allData are inconsistent?</p>	<p>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.</p>



## 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 N 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
<b>additional items:</b>	
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

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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.
<b>additional items:</b>	
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.
<b>additional items:</b>	
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>
<b>additional items:</b>	
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.

# Basics

# 2

## 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.

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**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.



<b>Logical Node LN</b>	Smallest part of a function that exchanges data. A logical node is an object defined by its data and methods.
<b>Data object instance DOI</b>	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.
<b>Data attribute instance DAI</b>	A Data attribute defines the name (semantic), format, range of possible values, and representation of values while being communicated.
<b>Annunciation types via GOOSE</b>	<p>Generic Object Oriented Substation Event</p> <p>A GOOSE report enables high speed trip signals to be issued with a high probability of delivery.</p> <p>The following types of information can be configured via GOOSE.</p> <ul style="list-style-type: none"><li><input type="checkbox"/> External single point indication O/O</li><li><input type="checkbox"/> External single point indication I/O</li><li><input type="checkbox"/> External double point indication</li><li><input type="checkbox"/> External double point indication, fast</li><li><input type="checkbox"/> External operational measured values</li><li><input type="checkbox"/> External metered values</li></ul>

## 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
Logical Device Extended:	LLN0, LPHD1

## 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, NamPIt
RDRE1	Fault Records	Mod, Beh, Health, NamPIt, 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, NamPIt, LEDRs
CALH1	Alarms, warning messages and group alarms	Mod, Beh, Health, NamPIt, 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, NamPIt
LPHD1	Device	PhyNam, PhyHealth Proxy







## 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
<b>LNx.Beh.stVal</b>		<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>2</b>	<b>4</b>

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







# Mapping

# 3

## 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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### 3.3 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
<b>PDIF1.Mod.stVal</b>		<b>1</b>	<b>2</b>	<b>2</b>

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
<b>PDIF1.Health.stVal</b>		<b>3</b>	<b>2</b>	<b>1</b>

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
<b>PDIF1.Op.general</b>		<b>0</b>	<b>1</b>

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



**PDIF1.DifAClc**

No.	Information	Value		
10401	CZ: IdiffL1 (% I/I <sub>no</sub> )= (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/I <sub>no</sub> )= (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/I <sub>no</sub> )= (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/I <sub>no</sub> )= (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/I <sub>no</sub> )= (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/I <sub>no</sub> )= (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







# 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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