SATEC

High Performance Analyzer

EM235/PM335/PM17X PRO

IEC 61850 Communications Protocol

Reference Guide

BG0619 Rev. A3

REVISION HISTORY

A1	Sep 2019	Initial release.
A2	Jan 2021	The IEC 61850 conformance statement is moved to a separate document.
A3	Feb 2025	Updated IEC 61850 configuration instructions for Ed2.

Table of Contents

Chapter 1   General

This document provides information on setting up and operating an IEC 61850 server in EM235/PM335/PM17X PRO devices with IEC 61850-8-1 and IEC 61850-9-2 interfaces compliant with the IEC 61850 set of standards.

See the EM235/PM335/PM17X PRO IEC 61850 Conformance Statement (PICS, PIXIT, MICS, TICS) for information on the device data object model, protocol implementation, and communication capabilities of the EM235/PM335/PM17X PRO IEC 61850 server.

The device capabilities and data model are described in the template ICD configuration file provided with your device (PM13xPRO_2007B_Rev8.icd).

Refer to the EM235/PM335/PM17X PRO Operation Manual for basic information on configuring and operating.

IMPORTANT

Control commands addressed to the CSWI switch controller nodes and to the boGGIO general binary output nodes will be rejected until the internal BOOLEAN variable REMOTE CONTROL is set to TRUE via a setpoint logic equation. See Controls in Section 2.2 for details.

This document applies to EM235/PM335/PM17X PRO devices with firmware version X.5.9.YY for IEC 61850 Ed2 releases, where X indicates the device type and YY indicates the firmware build number.

The IEC 61850 configuration instructions in this document apply to PAS V1.5.7.5 and higher.

Chapter 2   Impact of Device Settings

2.1   Logical Device Mode

Logical device mode given by LLN0.Mod is always ON.

2.2   Controls

The Loc attribute in logical nodes containing controls indicates the complementary status of the internal BOOLEAN variable REMOTE CONTROL defaulted to FALSE. Use PAS setpoint logic equations to operate REMOTE CONTROL status.

Control commands addressed to the CSWI switch controller nodes and to the boGGIO general binary output nodes will be rejected with AddCause=2 Blocked-by-switching-hierarchy until REMOTE CONTROL is set to TRUE.

The EM235/PM335/PM17X PRO can provide additional protection for control nodes based on client IP addresses by enabling control commands for specific clients and disabling or conditional blocking via logic equations for others. Commands received from a blocked client port are rejected with AddCause=2 Blocked-by-switching-hierarchy.

2.3   Measurement Units

Voltage, current and power units are selectable (see Section 3.2 for details).

Measurement type	Units (precision)	
	PT = 1	PT > 1
Current	A/kA (0.01 A)	A/kA (0.01 A)
Voltage AC	V/kV (0.1 V)	V/kV (1 V)
Power	kW, kVA, kvar or MW, Mvar, MVA (0.001 kW/kVA/kvar)	kW, kVA, kvar or MW, Mvar, MVA (1 kW/kVA/kvar)
Energy	0.001/0.01/0.1/1 kWh, kVAh, kvarh	0.001/0.01/0.1/1 kWh, kVAh, kvarh

2.4   Process Measurement Limits

Measurement type	Measurement limits		
	Condition	min	max
Current (standard inputs)		0	Current Scale $\times$ CT Ratio [1, 2] (Imax)
Auxiliary current I4 (standard input)		0	Current Scale $\times$ I4 CT Ratio [1, 2]
Current (extended inputs)		0	20 $\times$ CT Primary current
Auxiliary current I4x (extended input)		0	20 $\times$ I4 CT Primary current
Voltage AC		0	Voltage Scale $\times$ PT Ratio [3] (Vmax)
Auxiliary voltage V4		0	Voltage Scale $\times$ V4 PT Ratio [3]
Power signed (kW, kvar)		-Vmax $\times$ Imax $\times$ 2/1000	Vmax $\times$ Imax $\times$ 2/1000 [4]
Power unsigned (kVA, kW import/export, kvar import/export) and power demands		0	Vmax $\times$ Imax $\times$ 2/1000 [4]
Power factor signed		-1.000	1.000
Power factor unsigned (lag, lead)		0	1.000
Unbalance		0	300.0
THD		0	999.9
TDD		0	999.9
K-Factor		1.0	999.9
Harmonics		0	100.00
Analog inputs and outputs	+/-1mA	-AI full scale $\times$ 2	AI full scale $\times$ 2
	0-20mA	AI zero scale	AI full scale
	4-20mA	AI zero scale	AI full scale
	0-1mA	AI zero scale	AI full scale
	0-50mA	AI zero scale	AI full scale $\times$ 2
	+/-10V	-AI full scale	AI full scale

NOTES:

1. CT Ratio = CT primary current/CT secondary current.
2. The default Current Scale is 4 $\times$ CT secondary current for devices with a 400% overload (ANSI) or 2 $\times$ CT secondary current for devices with a 200% overload (IEC). It can be changed via the Device Options setup in PAS.
3. The default Voltage Scale is 828V. It can be changed via the Device Options setup in PAS.
4. If PT Ratio = 1.0 and Pmax is greater than 9,999 kW, then it is truncated to 9,999 kW.

2.5   Deadbands

The db (deadband) value represents the percentage of difference between max and min process measurement limits indicated in the table above. The default db attribute values in functional constraint CF are defined in the ICD file. They can be changed to provide reasonable conditions for generating reportable events.

2.6   Textual Descriptions

The default d (textual description of the data) attribute values in functional constraint DC are defined in the device. They can be changed for descriptions of measured/metered and status data.

2.7   Preconfigured Datasets

2.7.1 Predefined Datasets

Item	Value/Comments
Predefined datasets in ICD file	Measurand data: MET1/LLN0$DSet01Mx MET1/LLN0$DSet02Mx MET1/LLN0$DSet03Mx MET1/LLN0$DSet04St MET1/LLN0$DSet05Mx Status data: MET1/LLN0$DSet01StInd MET1/LLN0$DSet02StInd MET1/LLN0$DSet03StInd MET1/LLN0$DSet04StInd MET1/LLN0$DSet04StSPCSO MET1/LLN0$DSet05StSPCSO MET1/LLN0$DSet06StSPCSO MET1/LLN0$DSet07StSPCSO MET1/LLN0$DSet08StInd MET1/LLN0$DSet09StInd MET1/LLN0$DSet09StFltNum GOOSE publisher data set: CTRL/LLN0$DSetGOOSE1

2.7.2   Predefined Dataset Members

Dataset name	Members
MET1/LLN0$DSet01Mx	MET1/osvMMXU1MXAvPhV MET1/osvMMXU1MXAvPPV MET1/osvMMXU1MXAvA MET1/osvMMXU1MXTotW MET1/osvMMXU1MXTotVAr MET1/osvMMXU1MXTotVA MET1/osvMMXU1MXTotPF MET1/osvMMXU1MXHz
MET1/LLN0$DSet02Mx	MET1/osvMMXU1MXPhV$phsA MET1/osvMMXU1$MXPhVphsB MET1/osvMMXU1MXPhV$phsC MET1/osvMMXU1$MXPPVphsAB MET1/osvMMXU1MXPPV$phsBC MET1/osvMMXU1$MXPPVphsCA MET1/osvMMXU1MXA$phsA MET1/osvMMXU1$MXAphsB MET1/osvMMXU1MXA$phsC MET1/osvMMXU1$MXAneut
MET1/LLN0$DSet03Mx	MET1/osvMMXU1MXW$phsA MET1/osvMMXU1$MXWphsB MET1/osvMMXU1MXW$phsC MET1/osvMMXU1$MXVArphsA MET1/osvMMXU1MXVAr$phsB MET1/osvMMXU1$MXVArphsC MET1/osvMMXU1MXVA$phsA MET1/osvMMXU1$MXVAphsB MET1/osvMMXU1MXVA$phsC MET1/osvMMXU1$MXPFphsA MET1/osvMMXU1MXPF$phsB MET1/osvMMXU1$MXPFphsC
MET1/LLN0$DSet04St	MET1/engMMTR1STSupWh MET1/engMMTR1STDmdWh MET1/engMMTR1STSupVArh MET1/engMMTR1STDmdVArh
MET1/LLN0$DSet05Mx	MET1/osvMMXU1MXAuxA MET1/osvMMXU1MXAuxV MET1/osvMMXU1MXExtA$phsA MET1/osvMMXU1$MX$ExtA$phsB MET1/osvMMXU1MXExtA$phsC MET1/osvMMXU1$MX$ExtAuxA MET1/osvMMXU1$MX$AvExtA

Dataset name	Members
MET1/LLN0$DSet01StInd	MET1/biGGIO1STInd1 MET1/biGGIO1STInd2 … MET1/biGGIO1STInd16 MET1/biGGIO2STInd1 MET1/biGGIO2STInd2 … MET1/biGGIO2STInd16
MET1/LLN0$DSet02StInd	MET1/biGGIO3STInd1 MET1/biGGIO3STInd2 … MET1/biGGIO3STInd16 MET1/biGGIO4STInd1 MET1/biGGIO4STInd2 … MET1/biGGIO4STInd16
MET1/LLN0$DSet03StInd	MET1/biGGIO5STInd1 MET1/biGGIO5STInd2 … MET1/biGGIO5STInd16 MET1/biGGIO6STInd1 MET1/biGGIO6STInd2 … MET1/biGGIO6STInd16
MET1/LLN0$DSet04StInd	MET1/biGGIO7STInd1 MET1/biGGIO7STInd2 … MET1/biGGIO7STInd16 MET1/biGGIO8STInd1 MET1/biGGIO8STInd2 … MET1/biGGIO8STInd16
MET1/LLN0$DSet04StSPCSO	MET1/boGGIO1STSPCSO1 MET1/boGGIO1STSPCSO2 … MET1/boGGIO1STSPCSO8 MET1/boGGIO2STSPCSO1 MET1/boGGIO2STSPCSO2 … MET1/boGGIO2STSPCSO8
MET1/LLN0$DSet05StSPCSO	MET1/boGGIO3STSPCSO1 MET1/boGGIO3STSPCSO2 …

Dataset name	Members
	MET1/boGGIO3STSPCSO8
	MET1/boGGIO4STSPCSO1
	MET1/boGGIO4STSPCSO2
	…
	MET1/boGGIO4STSPCSO8
MET1/LLN0$DSet06StSPCSO	MET1/boGGIO5STSPCSO1
	MET1/boGGIO5STSPCSO2
	…
	MET1/boGGIO5STSPCSO8
	MET1/boGGIO6STSPCSO1
	MET1/boGGIO6STSPCSO2
	…
	MET1/boGGIO6STSPCSO8
MET1/LLN0$DSet07StSPCSO	MET1/boGGIO7STSPCSO1
	MET1/boGGIO7STSPCSO2
	…
	MET1/boGGIO7STSPCSO8
	MET1/boGGIO8STSPCSO1
	MET1/boGGIO8STSPCSO2
	…
	MET1/boGGIO8STSPCSO8
MET1/LLN0$DSet08StInd	MET1/spGGIO1STInd1
	MET1/spGGIO1STInd2
	…
	MET1/spGGIO1STInd32
MET1/LLN0$DSet09StInd	MET1/spGGIO2STInd1
	MET1/spGGIO2STInd2
	…
	MET1/spGGIO2STInd32
MET1/LLN0$DSet09StFltNum	MET1/drRDRE1STFltNum
	MET1/drRDRE2STFltNum
	…
	MET1/drRDRE8STFltNum
CTRL/LLN0$DSetGOOSE1	CTRL/QA1XCBR1STPos$stVal
	CTRL/QA1XCBR1STPos$q
	CTRL/QA2XCBR2STPos$stVal
	CTRL/QA2XCBR2STPos$q
	CTRL/QB1XSWI1STPos$stVal
	CTRL/QB1XSWI1STPos$q
	CTRL/QB2XSWI2STPos$stVal
	CTRL/QB2XSWI2STPos$q
	CTRL/QB3XSWI3STPos$stVal
	CTRL/QB3XSWI3STPos$q

Dataset name	Members
	CTRL/QB4XSWI4STPos$stVal
	CTRL/QB4XSWI4STPos$q
	CTRL/QB5XSWI5STPos$stVal
	CTRL/QB5XSWI5STPos$q
	CTRL/QB6XSWI6STPos$stVal
	CTRL/QB6XSWI6STPos$q
	CTRL/QE1XSWI7STPos$stVal
	CTRL/QE1XSWI7STPos$q
	CTRL/QE2XSWI8STPos$stVal
	CTRL/QE2XSWI8STPos$q
	CTRL/QE3XSWI9STPos$stVal
	CTRL/QE3XSWI9STPos$q
	CTRL/QE4XSWI10STPos$stVal
	CTRL/QE4XSWI10STPos$q
	CTRL/QE5XSWI11STPos$stVal
	CTRL/QE5XSWI11STPos$q
	CTRL/QE6XSWI12STPos$stVal
	CTRL/QE6XSWI12STPos$q
	CTRL/QE71XSWI13STPos$stVal
	CTRL/QE7XSWI13STPos$q
	CTRL/QE8XSWI14STPos$stVal
	CTRL/QE8XSWI14STPos$q
	MET1/osvMMXU1MXPhV$phsA$cVal
	MET1/osvMMXU1MXPhV$phsA$q
	MET1/osvMMXU1MXPhV$phsB$cVal
	MET1/osvMMXU1MXPhV$phsB$q
	MET1/osvMMXU1MXPhV$phsC$cVal
	MET1/osvMMXU1MXPhV$phsC$q

2.8   Preconfigured Reports

2.8.1 Predefined RCB

See Section 3.2 on configuring the number of RCB instances in the device.

Number of Instances	Report ID
Number of RCB instances = 1 (non-indexed RCBs)	16 URCBs: 　　CTRL/LLN0RPURep01 　　CTRL/LLN0RPURep02 　　CTRL/LLN0RPURep03 　　CTRL/LLN0RPURep04 　　CTRL/LLN0RPURep05 　　CTRL/LLN0RPURep06 　　CTRL/LLN0RPURep07 　　CTRL/LLN0RPURep08 　　MET1/LLN0RPURep01 　　MET1/LLN0RPURep02 　　MET1/LLN0RPURep03 　　MET1/LLN0RPURep04 　　MET1/LLN0RPURep05 　　MET1/LLN0RPURep06 　　MET1/LLN0RPURep07 　　MET1/LLN0RPURep08 16 BRCBs: 　　CTRL/LLN0BRBRep01 　　CTRL/LLN0BRBRep02 　　CTRL/LLN0BRBRep03 　　CTRL/LLN0BRBRep04 　　CTRL/LLN0BRBRep05 　　CTRL/LLN0BRBRep06 　　CTRL/LLN0BRBRep07 　　CTRL/LLN0BRBRep08 　　MET1/LLN0BRBRep01 　　MET1/LLN0BRBRep02 　　MET1/LLN0BRBRep03 　　MET1/LLN0BRBRep04 　　MET1/LLN0BRBRep05 　　MET1/LLN0BRBRep06 　　MET1/LLN0BRBRep07 　　MET1/LLN0BRBRep08

Number of Instances	Report ID

Number of RCB instances = 1 (indexed RCBs, RptEnabled max=1)	16 URCBs:
	  CTRL/LLN0RPURepA01
	  CTRL/LLN0RPURepB01
	  CTRL/LLN0RPURepC01
	  CTRL/LLN0RPURepD01
	  CTRL/LLN0RPURepE01
	  CTRL/LLN0RPURepF01
	  CTRL/LLN0RPURepG01
	  CTRL/LLN0RPURepH01
	  MET1/LLN0RPURepA01
	  MET1/LLN0RPURepB01
	  MET1/LLN0RPURepC01
	  MET1/LLN0RPURepD01
	  MET1/LLN0RPURepE01
	  MET1/LLN0RPURepF01
	  MET1/LLN0RPURepG01
	  MET1/LLN0RPURepH01
	16 BRCBs:
	  CTRL/LLN0BRBRepA01
	  CTRL/LLN0BRBRepB01
	  CTRL/LLN0BRBRepC01
	  CTRL/LLN0BRBRepD01
	  CTRL/LLN0BRBRepE01
	  CTRL/LLN0BRBRepF01
	  CTRL/LLN0BRBRepG01
	  CTRL/LLN0BRBRepH01
	  MET1/LLN0BRBRepA01
	  MET1/LLN0BRBRepB01
	  MET1/LLN0BRBRepC01
	  MET1/LLN0BRBRepD01
	  MET1/LLN0BRBRepE01
	  MET1/LLN0BRBRepF01
	  MET1/LLN0BRBRepG01
	  MET1/LLN0BRBRepH01

Number of RCB instances = 2 (indexed RCBs, RptEnabled max=2)	8 URCBs x 2 clients:
	  CTRL/LLN0RPURepA01
	  CTRL/LLN0RPURepA02
	  CTRL/LLN0RPURepB01
	  CTRL/LLN0RPURepB02
	  CTRL/LLN0RPURepC01
	  CTRL/LLN0RPURepC02
	  CTRL/LLN0RPURepD01
	  CTRL/LLN0RPURepD02
	  MET1/LLN0RPURepA01
	  MET1/LLN0RPURepA02

Number of Instances	Report ID
	MET1/LLN0RPURepB01
	MET1/LLN0RPURepB02
	MET1/LLN0RPURepC01
	MET1/LLN0RPURepC02
	MET1/LLN0RPURepD01
	MET1/LLN0RPURepD02
	8 BRCBs x 2 clients:
	CTRL/LLN0BRBRepA01
	CTRL/LLN0BRBRepA02
	CTRL/LLN0BRBRepB01
	CTRL/LLN0BRBRepB02
	CTRL/LLN0BRBRepC01
	CTRL/LLN0BRBRepC02
	CTRL/LLN0BRBRepD01
	CTRL/LLN0BRBRepD02
	MET1/LLN0BRBRepA01
	MET1/LLN0BRBRepA02
	MET1/LLN0BRBRepB01
	MET1/LLN0BRBRepB02
	MET1/LLN0BRBRepC01
	MET1/LLN0BRBRepC02
	MET1/LLN0BRBRepD01
	MET1/LLN0BRBRepD02
Number of RCB instances = 4 (indexed RCBs, RptEnabled max=4)	4 URCBs x 4 clients:
	CTRL/LLN0RPURepA01
	CTRL/LLN0RPURepA02
	CTRL/LLN0RPURepA03
	CTRL/LLN0RPURepA04
	CTRL/LLN0RPURepB01
	CTRL/LLN0RPURepB02
	CTRL/LLN0RPURepB03
	CTRL/LLN0RPURepB04
	MET1/LLN0RPURepA01
	MET1/LLN0RPURepA02
	MET1/LLN0RPURepA03
	MET1/LLN0RPURepA04
	MET1/LLN0RPURepB01
	MET1/LLN0RPURepB02
	MET1/LLN0RPURepB03
	MET1/LLN0RPURepB04
	4 BRCBs x 4 clients:
	CTRL/LLN0BRBRepA01
	CTRL/LLN0BRBRepA02
	CTRL/LLN0BRBRepA03
	CTRL/LLN0BRBRepA04

Number of Instances	Report ID
	CTRL/LLN0BRBRepB01
	CTRL/LLN0BRBRepB02
	CTRL/LLN0BRBRepB03
	CTRL/LLN0BRBRepB04
	MET1/LLN0BRBRepA01
	MET1/LLN0BRBRepA02
	MET1/LLN0BRBRepA03
	MET1/LLN0BRBRepA04
	MET1/LLN0BRBRepB01
	MET1/LLN0BRBRepB02
	MET1/LLN0BRBRepB03
	MET1/LLN0BRBRepB04

2.8.2   Predefined RCB Attributes

Report ID	Dataset
CTRL/LLN0RPURep01	Not defined
CTRL/LLN0RPURep02	Not defined
CTRL/LLN0RPURep03	Not defined
CTRL/LLN0RPURep04	Not defined
CTRL/LLN0RPURep05	Not defined
CTRL/LLN0RPURep06	Not defined
CTRL/LLN0RPURep07	Not defined
CTRL/LLN0RPURep08	Not defined
CTRL/LLN0BRBRep01	Not defined
CTRL/LLN0BRBRep02	Not defined
CTRL/LLN0BRBRep03	Not defined
CTRL/LLN0BRBRep04	Not defined
CTRL/LLN0BRBRep05	Not defined
CTRL/LLN0BRBRep06	Not defined
CTRL/LLN0BRBRep07	Not defined
CTRL/LLN0BRBRep08	Not defined
MET1/LLN0RPURep01	MET1/LLN0$DSet01Mx
MET1/LLN0RPURep02	MET1/LLN0$DSet02Mx
MET1/LLN0RPURep03	MET1/LLN0$DSet03Mx
MET1/LLN0RPURep04	MET1/LLN0$DSet05Mx
MET1/LLN0RPURep05	Not defined
MET1/LLN0RPURep06	Not defined

Report ID	Dataset
MET1/LLN0RPURep07	Not defined
MET1/LLN0RPURep08	Not defined
MET1/LLN0BRBRep01	Not defined
MET1/LLN0BRBRep02	Not defined
MET1/LLN0BRBRep03	Not defined
MET1/LLN0BRBRep04	Not defined
MET1/LLN0BRBRep05	Not defined
MET1/LLN0BRBRep06	Not defined
MET1/LLN0BRBRep07	Not defined
MET1/LLN0BRBRep08	Not defined

2.8.3   Report Service Information

Any predefined RCB attribute value may be written when RptEna is FALSE. Only existing data sets (see Dataset model table) may be used for DatSet attribute changing. Internal events, caused by data-change and quality-change trigger options only, result in immediate sending of reports or buffering events for transmission (limited by a buffer size of 64 Kbytes per report).

Chapter 3   Configuring IEC 61850

The PAS software supplied with the EM235/PM335/PM17X PRO provides an IED configuration tool for customizing your device settings and exporting IED configuration description files (CID/IID/ICD) for use with IEC 61850 client applications. See the EM235/PM335/PM17X PRO Operation Manual for general information on installing and operating PAS.

NOTE

When you select an IEC 61850 configuration tab while the On-line checkbox on the PAS toolbar is checked, the currently displayed configuration settings show the online settings from the connected device. In case the On-line checkbox on the PAS toolbar is not checked, the currently displayed configuration settings show the offline settings from the IED database, or default IED settings if the setup is not present in the IED database.

Click the Open button on the configuration tab to display IED database settings.

Click the Receive button on the configuration tab to display online device settings.

3.1   Licensing IEC 61850

A valid license key must be provided in the EM235/PM335/PM17X PRO for IEC 61850 communications. The device is usually shipped with a temporary license, which is valid for a 30-day operation and then can be extended for an additional month.

A permanent license can be obtained from your local distributor for an additional fee. A device serial number must be provided in the license request. The device may also be shipped with the permanent license in the event of a pre-paid fee.

To program a license key in your device:

1.   Select Administration->Update License from the Monitor menu.

2.   Type in the license code and click Send.

3.2   Initializing IED Site Database

IEC 61850 configuration settings for an IED are stored in the IED site database, from where they can be downloaded to your device online or exported to an IED configuration file. See the EM235/PM335/PM17X PRO Operation Manual for information on how to create a site database for your device.

The IED database can be initialized with default settings applicable to your device, or settings imported from another IED's database, or settings uploaded directly from the IED online.

To initialize the IED site database for your device:

1. Select IEC 61850 Setup from the Meter Setup menu and click on the IED Configurator tab. The settings shown on the tab indicate the communication parameters of the IED stored in the IED database.

2. Select one of the following options to initialize the IED database:

- To initialize the database with default settings, click the "Initialize" button.

- To import IEC 61850 settings from another IED's database, click the "Import from…" button, and then select the source IED database file.

- To import the settings from the connected device, make sure the On-line checkbox on the PAS toolbar is checked, and then click the "Save from IED" button.

In case the IED database is initialized with default settings, the IED site name is used as a temporary name for the IED. The figure above shows what the IED database settings might look like after initialization with default values.

See the following sections in this manual for information on how to configure IEC 61850 parameters for your specific application.

3.3   Configuring IED Properties

To configure the IED identification parameters and general IEC 61850 protocol options for your IED:

1. Select IEC 61850 Setup from the Meter Setup menu and click on the IED Properties tab.
2. Select the IEC 61850 edition implemented in your device and configure other IED parameters to suit your application.

NOTES

- The configured IED name will be concatenated with logical device instances' names in IEC 61850 object references.

- The device location will also identify the substation location in COMTRADE configuration files as the station_name attribute.

- Attributes marked with the asterisk in PAS cannot be changed in the device via this setup but you can define and store them to the device database when working offline for later updating a device CID/IID/ICD configuration file.

- The number of RCB instances defines how pre-defined RCBs are arranged in the device for use in multi-client applications. The RCBs are automatically pre-configured in the device in the way indicated in Section "Reporting model". The RCB names and report IDs are set to defaults as the number of RCB instances changes. If you intend to change the default setting, setup the number of RCB instances first before configuring report control blocks.

- The TCP_KEEPALIVE interval can be configured in the device from 1 to 60 seconds (the default is 20 s) or can be set to 0 to inactivate keepalive probes.

- Client connection idle timeout can be used with keepalive probes or separately to terminate a TCP connection if the connection is idle for too long. The idle timeout can be set between 1 and 10 minutes or set to 0 to inactivate the idle timer. The timer is disabled in the device by default.

PM335 - IEC 61850 Setup

| GOOSE Subscriber Setup | Report Deadbands | IED Configurator |
| IED Properties | IEC 61850 Datasets | IEC 61850 Reports | GOOSE Publisher Setup |

IED Properties	
IED Name	PM335_681612
IEC 61850 Edition	Ed2
Subnet Name	W01
Access Point Name	S1
IP Address *	10 . 0 . 0 . 188
Subnet Mask *	255 . 255 . 255 . 0
Default Gateway *	10 . 0 . 0 . 254
Location	
Client Connection Idle Timeout, min	0
TCP Keepalive Time, s	20
Number of RCB Instances	1 (non-indexed)
Voltage Units	V
Current Units	A
Power Units	kW

* Configured in the device via Network Setup

Open   Save as...   Default   Print   Send   Receive

OK   Cancel   Apply   Help

3. Click on "Save as …" to save your setup to the IED database.

4. To update the device's online settings right now, send your new setting to the device.

NOTE

The network IP address and subnet settings received online from the device always indicate the actual device's network settings and may not match your settings in the IDE database, unless they are imported from the device or you have changed them via the device network setup (see note in Section 3.12).

3.4   Configuring Datasets

This setup dialog allows you to create, reconfigure, or delete any deletable dataset. Pre-defined datasets are non-deletable and are not listed in this dialog.

NOTES

1. **A dataset cannot be deleted or its attributes changed if it is referenced by any currently enabled report, GOOSE, or sampled values control block.**

2. **Create your new datasets before configuring your reports; otherwise, you may see an incomplete dataset list in your reports setup dialog.**

To review or configure deletable IEC 61850 datasets:

1. Select IEC 61850 Setup from the Meter Setup menu, and then click on the IEC 61850 Datasets tab.
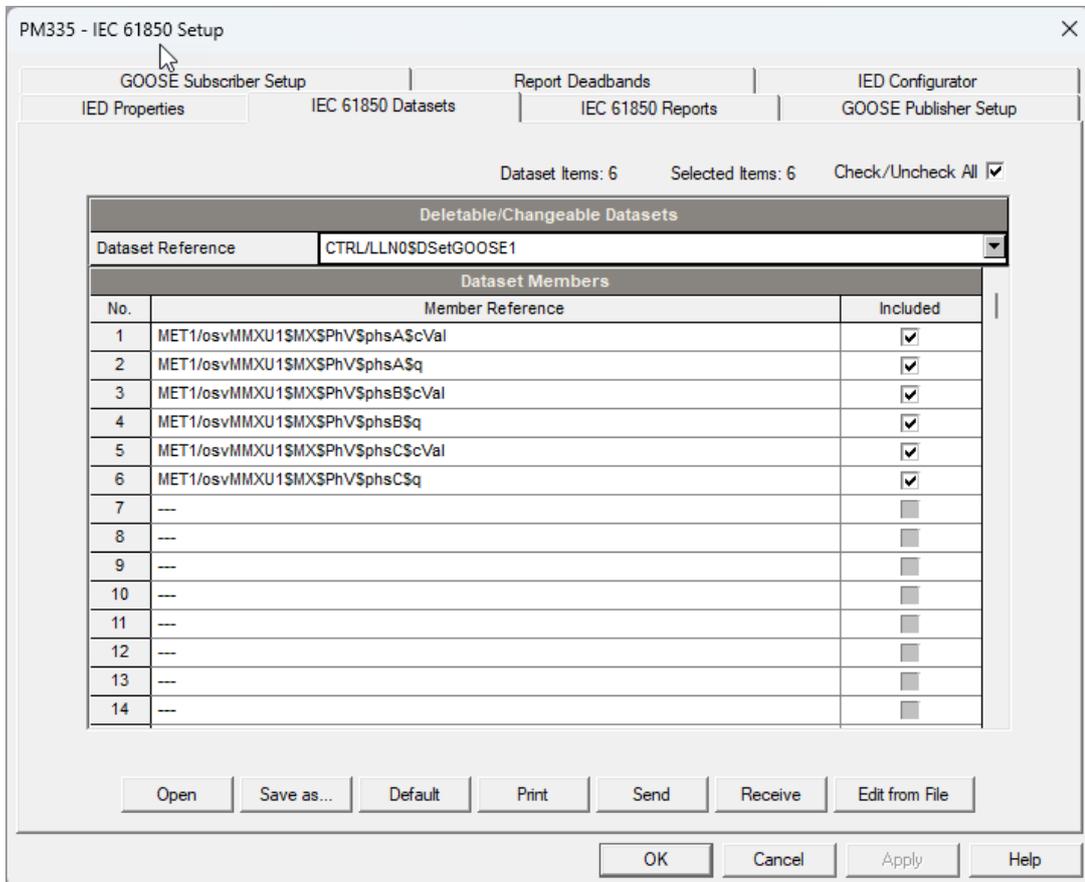
2. Select a dataset you wish to view or configure in the "Dataset Reference" box. Select "New Dataset" to create a new dataset.

3. To delete dataset members, uncheck the appropriate "Included" boxes. Uncheck all dataset members to delete the entire dataset.

4. To add or change dataset members, you need to use a preconfigured CID or IID configuration description file for your IED. See Section 3.10 "Exporting IEC 61850 IED Configuration Files" for instructions on creating a CID/IID file for your device. Click "Edit from file", select the type of the IED configuration file, locate the file, and then click Open.

    A full list of the available data objects and data attributed is displayed, where included dataset members are checked.

    To create a new dataset, select a logical device where the dataset to be located and type a dataset name in the "Dataset Name" box.

    Check the "Included" boxes for items you wish to be members of the dataset and click OK.

    To make easy selection of items across the list, use filters for functional constraints or/and a selected logical device/logical node. Click "Filter checked" to see and revise a list of the selected items.
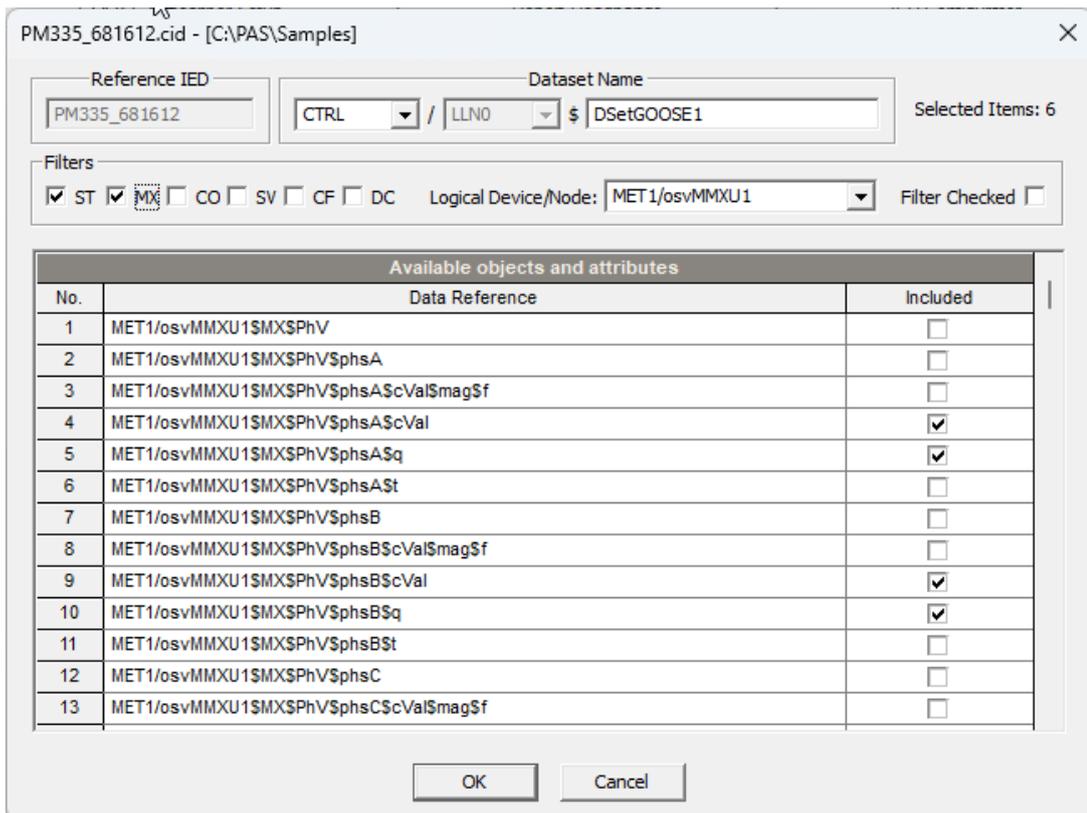
5. Click on "Save as …" to save your setup to the IED database.

6. To update the device's online settings right now, send the new setting to the device.

3.5   Configuring Reports

NOTES:

1. **No change of attribute values of the report control block is allowed while the report is enabled by a client.**

2. **If you have created new datasets previously, make sure they have been saved in the IED database if you are working offline, or updated in the device if you are connected to the device online; otherwise, the list of dataset references may be incomplete.**

To configure Report Control Blocks (RCB) for your IED:

1. Select IEC 61850 Setup from the Meter Setup menu, and then click on the IEC 61850 Reports tab.

2. Select an RCB you wish to view or configure in the "RCB Reference" box.

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GOOSE Subscriber Setup	Report Deadbands	IED Configurator
IED Properties	IEC 61850 Datasets	IEC 61850 Reports	GOOSE Publisher Setup

RCB #1 - Unbuffered Report Control Block	
RCB Reference	MET1/LLN0RPURep01 ▼
Report ID	MET1/LLN0RPURep01
Enabled	NO
Reserved	NO
Dataset Reference	MET1/LLN0$DSet01Mx ▼
Configuration Revision	1
Optional Fields	0111110000
Buffer Time	0
Sequence Number	0
Trigger Options	011001
Integrity Period, ms	0

Open   Save as...   Default   Print   Send   Receive

OK   Cancel   Apply   Help

3. Configure the RCB attributes as required for your application. The following items can be configured:

- Report ID
- Dataset reference (can be selected from the available datasets list)
- Configuration revision
- Optional fields
- Trigger options
- Buffer time
- Integrity period for periodic reports with the integrity trigger option selected

To change the Optional fields or Trigger options, click the arrow button to the right of the item, check the appropriate options and click OK.

NOTES:

- **The dataset list shows only datasets located in the same logical node as the selected report control block.**

- **In case you change the dataset reference while the configuration revision is still unchanged, the device will automatically increment the configuration revision when you download your new settings to the device. Keep this in mind when validating your device settings.**

4. Click on "Save as …" to save your setup to the IED database.

5. To update the device's online settings right now, send your new setting to the device.

3.6   Configuring the GOOSE Publisher

NOTE

No change of attribute values of the GOOSE publisher control block is allowed while the GOOSE publisher is enabled.

To configure the GOOSE publisher:

1. Select IEC 61850 Setup from the Meter Setup menu, and then click on the GOOSE Publisher Setup tab.

2. You can configure the destination MAC address, GOOSE ID, application ID and the maximum message retransmission interval for your application. You can also preset the configuration revision if needed. Other attributes are indicated for information only.

The default GOOSE dataset reference is preconfigured in your device for GOOSE communications. The dataset variables list can be modified via the IEC 61850 Datasets setup (see Section 3.4).

In Ed2 versions, a GOOSE dataset can also be selected from the supplied list. Note that only datasets located in the same logical device as the GOOSE publisher are displayed. **In case you change the GOOSE dataset reference while the configuration revision is still unchanged, the device will automatically increment the configuration revision when you download your new settings to the device.**

3. Select Yes in the Publisher Enabled box to enable publisher operation.

4. Click on "Save as …" to save your setup to the IED database.

5. To update the device's online settings right now, send the new setting to the device.

3.7   Configuring the GOOSE Subscriber

The EM235/PM335/PM17X PRO can subscribe to messages sent by any GOOSE network device including both EM235/PM335/PM17X PRO and non-SATEC devices.

The GOOSE subscriber supports up to 64 subscriptions with up to 16 data elements in each subscription. The location of the subscribed elements in GOOSE data sets and mapping to the EM235/PM335/PM17X PRO internal variables are configurable. The subscribed elements can be selected from a publishing device's CID/IID IED configuration description file or a SCD substation configuration description. See Section 3.10 "Exporting IEC 61850 IED Configuration File" for instructions on creating a CID/IID file for your device.

The EM235/PM335/PM17X PRO provides a set of internal variables for mapping external GOOSE data:

- a 128-bit binary string composed of 128 binary variables ExtInd1…ExtInd128 of type BOOLEAN called external indication and intended for mapping single-point BOOLEAN and integer elements and double-point Dbpos data;

- 64 variables ExtiVal1…ExtiVal64 of type INT32 for mapping signed and unsigned integer numbers of any size;

- 64 variables ExtfVal1…ExtfVal64 of type FLOAT32 for mapping single-precision floating point numbers.

When the subscriber receives GOOSE message updates, the subscribed data is copied to the internal variables that can be monitored and recorded in the device like any other measured value. When the subscriber does not receive updates, or the declared message live time has expired, or the data set differs from the subscriber setup, the internal variables are zeroed and the non-active status is indicated in the subscription status.

The subscription status can be monitored from an IEC 61850 client via the GOOSE subscriber logical nodes CTRL/sbsLGOS1-CTRL/sbsLGOS64, or from a Modbus client application via the GOOSE subscriber status register (see the EM235/PM335/PM17X PRO Modbus Reference Guide for the register location).

NOTE

No change of attribute values of the GOOSE subscriber control block is allowed while the GOOSE subscriber is enabled.

To configure the GOOSE subscriber:

1. Select IEC 61850 Setup from the Meter Setup menu, and then click on the GOOSE Subscriber Setup tab.

2. In the Subscription Number box, select the subscription you wish to configure.

3. Click the "Open SCL File" button and open a CID, IID or SCD file of the publishing device you wish to subscribe to. PAS shows you a list of all datasets linked to GOOSE publisher control blocks that are found in the IED or SCD configuration file.
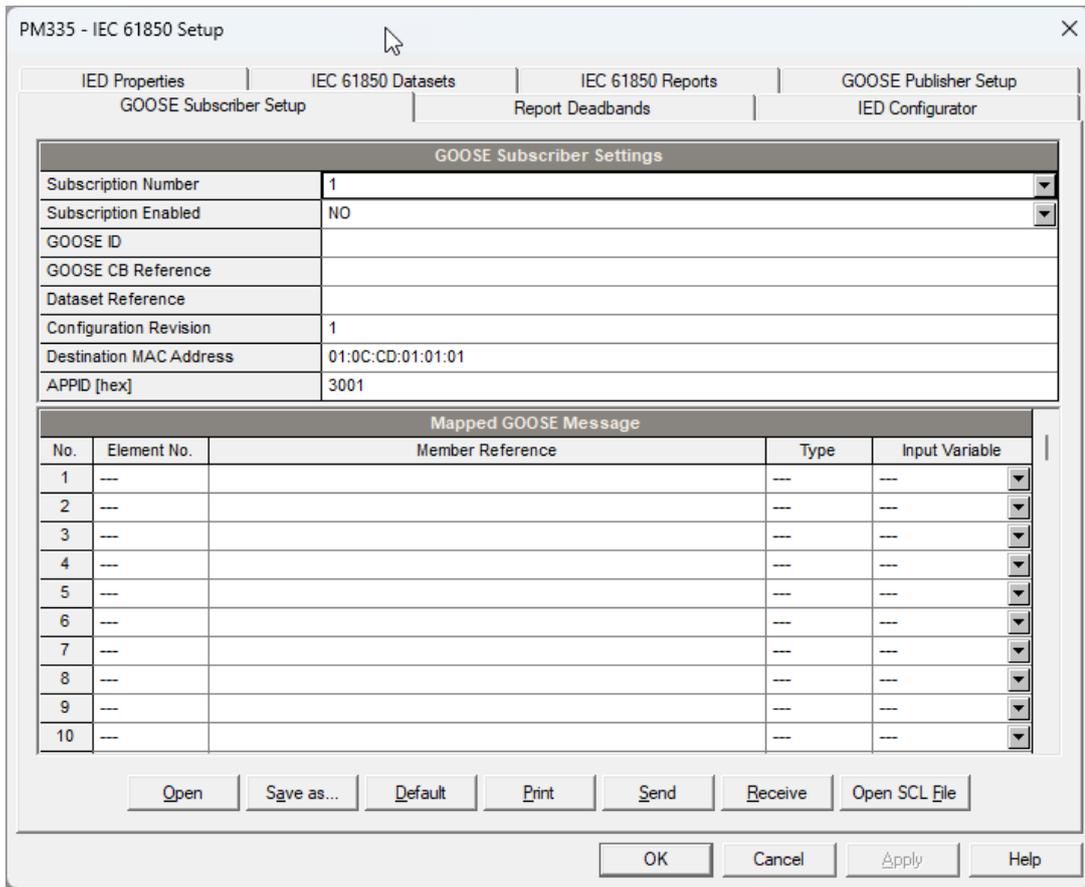
4. Check the Subscribe box for the dataset you wish to subscribe to.
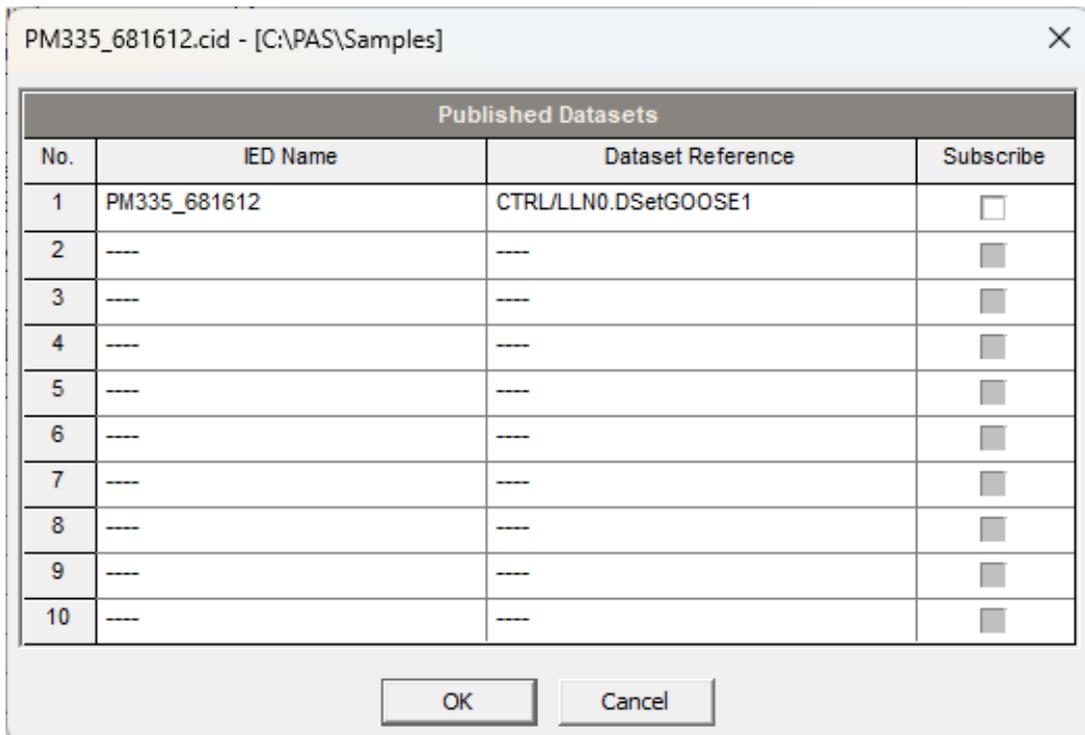
5. The publisher attributes and a list of dataset members for the selected dataset are displayed as shown in the picture below. PAS also indicates a basic IEC 61850 data element type and a physical MMS type for dataset members. Check the Subscribe boxes for elements you want to subscribe to, and then click OK.
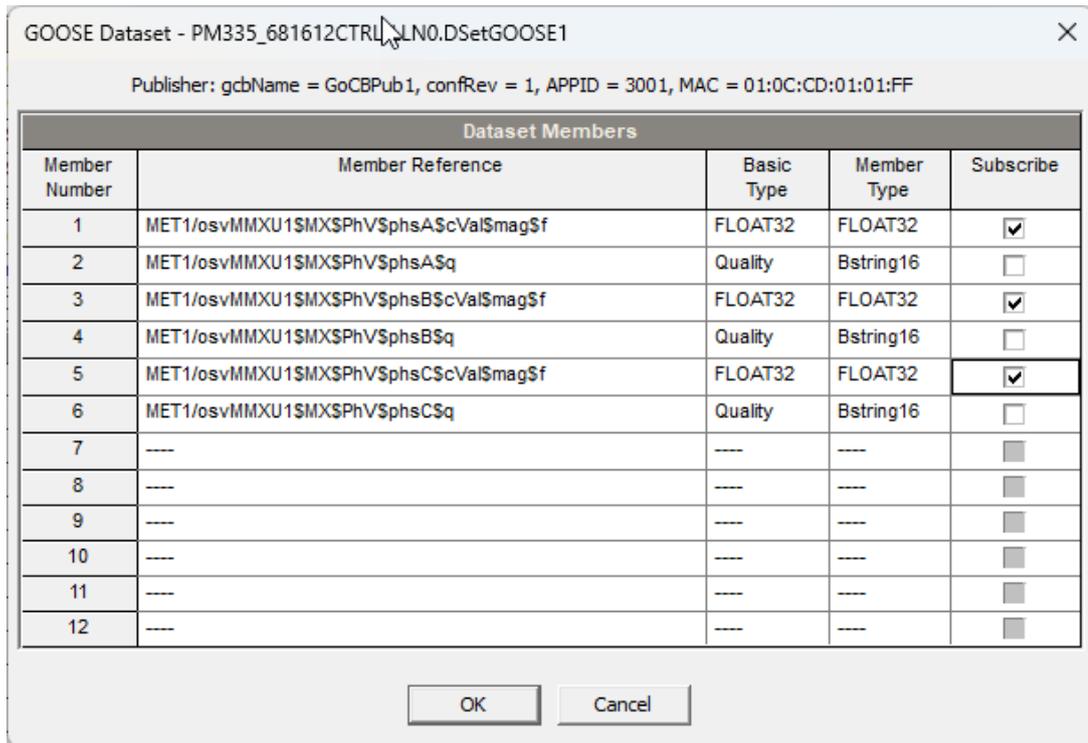
You are allowed to select no more than 16 elements. Elements with incompatible data types cannot be selected.

The publisher attributes of the selected dataset and the selected data elements are copied to the current subscription.

For your convenience, PAS automatically maps the selected elements to the compatible input variables. If desired, you can change the mapping of the selected elements using the compatible types listed in the table below.

Basic Data Type	MMS Data Type	Compatible Input Variables
BitString32	Bstring32	ExtInd, ExtiVal
Dbpos	Bstring8	ExtInd, ExtiVal
Enum	INT8	ExtInd, ExtiVal
INT32	INT32	ExtInd, ExtiVal
INT32U	INT32U	ExtInd, ExtiVal
INT16	INT16	ExtInd, ExtiVal
INT16U	INT16U	ExtInd, ExtiVal
INT8	INT8	ExtInd, ExtiVal
INT8U	INT8U	ExtInd, ExtiVal
BOOLEAN	BOOLEAN	ExtInd, ExtiVal
FLOAT32	FLOAT32	ExtfVal

NOTES:

- Mapping integer data to a BOOLEAN ExtInd variable results in copying a least-significant bit of the dataset member only.

- Mapping double-point data of type Dbpos to a BOOLEAN ExtInd variable causes a high-order bit of the dataset member to be copied to the following BOOLEAN ExtInd variable.

6. Check the application ID, configuration revision and destination MAC address imported from the IED configuration file to meet the requirements of your application.

7. Select Yes in the Subscription Enabled box to activate the subscription.

8. Repeat the setup for other subscriptions you wish to configure.

9. Click on "Save as …" to save your setup to the IED database.

   The dataset member references are only stored in the IED database and are not sent to the device, so they may not be displayed when reading the device settings online if you have not saved the settings in the IED database.

10. To update the device's online settings right now, send your new setting to the device.

3.8   Configuring Report Deadbands

Generic deadbands for reporting measured analog values can be configured via PAS without the need to setup individual deadbands for every data element via IEC 61850 services. If required, you can then change deadbands for individual variables via your IEC 61850 application.

Downloading new report deadbands to the device changes deadbands for all analog data of the same type in all logical nodes, so it is recommended to do that before you make your individual deadband adjustments.

NOTE

The process measurement scales for most analog values depend on your external PT and CT settings and on the voltage and current scales defined in the device. Configure them in your device and save to the device site database before changing report deadbands. See Basic Setup and Device Options Setup in the EM235/PM335/PM17X PRO Operation Manual on how to configure these parameters in the device. See Programming Analog Inputs in the EM235/PM335/PM17X PRO Operation Manual on how to setup the measurement scales for analog inputs.

To configure the deadbands for measured analog values:

1.   Select IEC 61850 Setup from the Meter Setup menu, and then click on the Report Deadbands tab.

For your convenience, PAS shows the deadbands both in percent and in engineering units, and indicates the minimum and maximum process measurements from which the percent deadband is taken.

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| IED Properties | IEC 61850 Datasets | IEC 61850 Reports | GOOSE Publisher Setup |
| GOOSE Subscriber Setup | | Report Deadbands | IED Configurator |

Report Deadbands

Measured Value	Deadband, %	Deadband, units	Minimum Measurement	Maximum Measurement
Phase voltage, V	1.000	10.0	0.0	1000.0
Auxiliary voltage V4, V	----	----	----	----
DC voltage, V	----	----	----	----
Phase currents, A	1.000	2.00	0.00	200.00
Neutral current, A	1.000	2.00	0.00	200.00
Auxiliary current I4, A	1.000	2.00	0.00	200.00
Phase currents (extended inputs), A	----	----	----	----
Neutral current (extended inputs), A	----	----	----	----
Auxiliary current I4 (extended inputs), A	----	----	----	----
Voltage sequence, V	1.000	10.0	0.0	1000.0
Current sequence, A	1.000	2.00	0.00	200.00
Current sequence (extended inputs), A	----	----	----	----
Voltage unbalance, %	0.333	1.0	0.0	300.0
Current unbalance, %	0.333	1.0	0.0	300.0
Active power, kW	0.500	4.000	-400.000	400.000
Reactive power, kvar	0.500	4.000	-400.000	400.000
Active power import/export, kW	1.000	4.000	0.000	400.000
Reactive power import/export, kvar	1.000	4.000	0.000	400.000

Open   Save as...   Default   Print   Send   Receive

OK   Cancel   Apply   Help

2.   Adjust the default percent deadbands to the desired values as required for your application. The allowable range is 0.001% to 50.000%. Press Enter or click elsewhere on the dialog window with the left mouse button to update the engineering deadbands.

3.   Click on "Save as …" to save your setup to the IED database.

4.   To update the device's online settings right now, send your new setting to the device.

The following table shows the default factory-set deadbands for measured analog values.

Measured Value	Default Deadband, %
Phase voltage	1.000
Auxiliary voltage V4	1.000
Phase currents	1.000
Neutral current	1.000
Auxiliary current I4	1.000
Phase currents (extended inputs)	0.133
Neutral current (extended inputs)	0.133
Auxiliary current I4 (extended inputs)	0.133
Voltage sequence	1.000
Current sequence	1.000
Current sequence (extended inputs)	0.133
Voltage unbalance	0.333
Current unbalance	0.333
Active power	0.500
Reactive power	0.500
Active power import/export	1.000
Reactive power import/export	1.000
Apparent power	1.000
Active power demand	1.000
Reactive power demand	1.000
Apparent power demand	1.000
Power factor	5.000
Power factor lag/lead	10.000
Frequency	0.100
Voltage THD	0.100
Current THD	0.500
Voltage interharmonic THD	0.100
Current interharmonic THD	0.500
Current TDD	1.000
Current K-factor	0.100
Analog input #1	1.000
Analog input #2	1.000
Analog input #3	1.000
Analog input #4	1.000
Analog input #5	1.000
Analog input #6	1.000

Measured Value	Default Deadband, %
Analog input #7	1.000
Analog input #8	1.000
Analog input #9	1.000
Analog input #10	1.000
Analog input #11	1.000
Analog input #12	1.000
Analog input #13	1.000
Analog input #14	1.000
Analog input #15	1.000
Analog input #16	1.000

3.9   Exporting IEC 61850 IED Configuration Files (CID/IID/ICD)

Generating a new or updating a preconfigured CID/IID/ICD file for your device is done from the IED Configurator tab. A template ICD file or a preconfigured CID/IID is used as a source for creating a new SCL file.

Make sure the IED database is up to date and all configuration settings are consistent with the device before exporting the IED configuration.

To create or update a device CID/IID/ICD file:

1.   Click on the IED Configurator tab.

2.   Click the "Export SCL file" button.

3.   Select the type of the source template file in the "Files of type" box, locate the EM235/PM335/PM17X PRO IED template ICD file or a preconfigured CID/IID/ICD file for your device you wish to update and click Open.

   Use the basic template ICD file provided with your device (EM235/PM335/PM17X PRO_2003_RevXX.icd for Ed1 or EM235/PM335/PM17X PRO_2007B_RevXX.icd for Ed2) as a primary template for creating new CID/IID/ICD files.

4.   Select the type of the output file in the "Files of type" box, locate the folder and type the name of the target CID/IID/ICD file where to store your new IED configuration description, and then click Open. You can point to the same CID/IID/ICD file you used as the source if you intend to update the existing IED configuration. In case that the *.icd file extension is selected for the output file, the generic "TEMPLATE" name will be written in place of the actual IED name.

NOTES

- In the event an RCB reference is used as the Report ID (the default setting for non-indexed RCBs), update the IED configuration file after changing the IED name even if no changes to RCBs have been made to keep consistency with your device.
- Breaker/switch nodes prefixes are configured in a CID/IID file as they are defined in the device database while updating the IED properties. If you change the default breaker/switch prefixes in your device via the Bay Control setup, update the setup in the device database, and then update the IED properties in an IED configuration file even if no other properties have been changed.

3.10   Importing IEC 61850 SCD Configuration

Basic IED communication settings can be imported from the communication part of an SCD substation configuration file to the IED database. These include the IED name, IED network and subnet parameters, access point name, and communication and configuration settings of the GOOSE publishers.

To import the IED settings from an SCD file:

1. Click on the IED Configurator tab.
2. Click the "Import SCD file" button.
3. Locate an SCD substation configuration file and click Open.
4. The list of IEDs found in the SCD file is displayed. IEDs of incompatible types will have a shaded Select box.
5. Check the "Select" box for the IED whose configuration description you want to import.

3.11   Downloading the IEC 61850 Configuration to the Device

Make sure the IED database is up to date and all configuration settings are consistent with the device before downloading the IED configuration to the device.

To download the IED configuration settings to the device:

1. Make sure the On-line checkbox on the PAS toolbar is checked.
2. Click on the IED Configurator tab.
3. Click the "Download to IED" button.

NOTE

The IP network settings are not changed in the device online by downloading the IEC 61850 configuration, as this could immediately affect communication with other parts of the EM235/PM335/PM17X PRO device. To change the device's IP address and subnet settings, select Communication Setup from the Meter Setup menu, make the required changes in the Network Setup dialog tab, and then send your new network settings to the device.

3.12   Resetting the IEC 61850 Configuration in the Device

If required, the IEC 61850 configuration settings in your device can be reset to the factory defaults.

To reset the IEC 61850 configuration settings in the device:

1. Select Administration->Master Reset from the Monitor menu.
2. Click the "Reset IEC 61850 Configuration" button, and then confirm the command.

After the command is executed, the device's network restarts, so communication with the device may be lost for a while if you are connected to the device through the network port.