

# Process Power Manager 5 Library for 800xA PMS 5.6.5 Synchronization Library Manual

Version 5.6-5



# **Process Power Manager 5**

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# **About This User Manual**

## General

This User Manual provides the configuration information for the Synchronization control modules that are part of the PMS Library. The information in this manual is directed towards the project engineers.

The user should be familiar with the Control IT for AC 800M/C and Operate IT environment.

## **Document Conventions**

Microsoft Windows conventions are normally used for the standard presentation of material when entering text, key sequences, prompts, messages, menu items, screen elements, and so on.

The following conventions are used for the presentation of material:

- The words in names of screen elements (for example, the title in the title bar of a window, the label for a field in a dialog box) are initially capitalized.
- Capital letters are used for the name of a keyboard key if it is labelled on the keyboard. For example, press the ENTER key.
- Lowercase letters are used for the name of a keyboard key that is not labelled on the keyboard. For example, the space bar, comma key, and so on.
- Press CTRL+C indicates that you must hold down the CTRL key while pressing the C key (to copy a selected object in this case).
- The names of push and toggle buttons are boldfaced. For example, click OK.
- The names of menus and menu items are boldfaced. For example, the File menu.
- The following convention is used for menu operations: MenuName > MenuItem > CascadedMenuItem. For example: choose File > New > Type.
- The Start menu name always refers to the Start menu on the Windows Task Bar.
- System prompts/messages are shown in the Courier font, and user responses/input in boldfaced Courier font. For example, if you enter a value out of range, the following message is displayed:

Entered value is not valid. The value must be 0 to 30.

• You may be instructed to enter the string TIC132 in a field. The string is shown as follows in the procedure:

TIC132

• Variables are shown in italics:

IOPar.Govmode8.value

Faceplate tabs are boldfaced:

**AVR Mode handler** 

## Warning, Caution, Information, and Tip Icons

This publication includes **Warning**, **Caution**, and **Information** if/where appropriate to point out safety related or other important information. It also includes **Tip** to point out useful hints to the reader. The corresponding symbols should be interpreted as follows:



Electrical warning icon indicates the presence of a hazard which could result in *electrical shock*.



Warning icon indicates the presence of a hazard which could result in *personal injury*.

Caution icon indicates important information or warning related to the concept discussed in the text. It might indicate the presence of a hazard which could result in *corruption of software or damage to equipment/property*.



Information icon alerts the reader to pertinent facts and conditions.

Tip icon indicates advice on, for example, how to design your project or how to use a certain function.

Although **Warning** hazards are related to personal injury, and **Caution** hazards are associated with equipment or property damage, it should be understood that operation of damaged equipment could, under certain operational conditions, result in degraded process performance leading to personal injury or death. Therefore, comply fully with all **Warning** and **Caution** notices.

# Terminology

 Table 1 lists terms used in this document and associated with the Process Power Manager 5.

 The reader should be familiar with these terms before proceeding further in this user manual.

Term	Description		
AC 800M/C Connect	Name of the connection/integration between Control IT for AC 800M/C and Operate IT. The following software packages are included under this name:		
	- Aspect System for AC 800M/C		
	- Graphics Object Type Library for AC 800M/C		
Aspect	A description of some properties of an Aspect Object. Some examples of aspects are name, circuit diagram, process display and control logic.		
Aspect Object	A computer representation of a real object, such as a pump, a valve, an order or a virtual object, such as a service or an object type. An Aspect Object is described by its aspects and these aspects are organized in structures.		
Aspect System for AC 800M/C	One part of the AC 800M/C Controller Integration product (the other part is the Graphics Type Library for AC 800M/C, see below). Gives access to the controllers AC 800M, AC 800C and Advant Controller 250, by mirroring all functions in the controllers and their I/O to Operate IT Process Portal from Control Builder Professional.		
Connectivity Server	Provides the integration between the Operate IT system and a controller or a device capable of sourcing data.		
Contingency	An electrical network within the plant consists of at least one load busbar to which loads, generation and the public grid can be connected. Several of these electrical networks can exist at the same time within the plant electrical network. Each combination is called a contingency.		

Table 1 Terminology

Term	Description	
Control Builder M	Name of the Control Builder M software products. Available in three versions: Control Builder Basic, Control Builder Standard and Control Builder Professional. These are fully integrated Windows 2000 Professional / Windows XP applications for efficient configuration and programming of the ABB controllers AC 800M, AC 800C and Advant Controller 250.	
Control Builder Professional	The powerful programming version of the Control Builder M software.	
Control Builder Project Explorer	The name of the project navigator in the Control Builder M software, which is used to navigate through, create or modify an automation project.	
Control IT for AC 800M/C	The name of the collection of ABB hardware and software products for AC 800M/C.	
Control Network	Product name of the ABB network between AC 800M/C controllers, tools and Operator workplaces.	
Critical breaker	A breaker the position of which determines the electrical network configuration.	
Display Element	A graphical element, which illustrates an object (motor, regulator etc.). In general, clicking on the element will show a faceplate for supervision and control of the object.	
Droop mode (PMS-level)	In this mode the generator is running in manual control, the adjustment of speed is operated from operator station by using UP/DOWN keys. Machine behaviour is according to the droop line.	
Electrical network	A combination of components such as load busbars, generators, transformers and cables connected electrically. A network contains at least one load busbar.	
Faceplate	A configurable type of graphic interface normally used by operators for process supervision and control.	
Graphics Type Library for AC 800M/C	One part of the AC 800M/C Controller Integration product (the other part is the Aspect System for AC 800M/C, see above). Graphic aspects such as display elements, faceplates and dialogs are available for use in Operate IT Workplace. The graphic aspects correspond to the types delivered in the Control Builder library.	
HSI	Human System Interface.	
Instance	An individual description of the type. Every instance has the characteristics defined by the type, but each instance has its own individual behaviour.	
I/O	Input / Output signals.	
IP	Internet Protocol.	
Island	A network with no connections to the public grid. An Island contains at least power generation and load components.	
ISO mode (PMS-level)	Isochronous mode. An automatic mode for the speed governor. This mode is only allowed when a machine is not grid connected. For islanded networks, only one machine can be "master of frequency".	
IT	Information Technologies.	
LVS	Low Voltage Switchgear.	
MCC	Motor Control Centre.	

Term	Description	
MMS	Manufacturing Message Specification. Specifies the structure of messages used for industrial communication (manufacturing, process robotics, etc.). This is the application layer used within MAP (Manufacturing Automation Protocol), a specification for open communication based on the OSI model.	
	MMS for AC 800M/C is a protocol used in ABB Control	
MVAr mode (PMS-level)	A manual setpoint mode for the AVR. An operator must issue the MVAr setpoint.	
MW mode (PMS-level)	A manual setpoint mode for the governor. The MW setpoint must be issued by an operator.	
Object	Objects represent the combination of data and associated procedures (operations that can be applied to the data) are represented. Objects represent significant elements or functions in the process control/process automation domain. Combining these objects creates applications.	
OLE	Object Linking and Embedding.	
OPC	OLE for Process Control. The Control IT for AC 800M/C software contains an OPC Server for AC 800M/C.	
Operate IT	The name of the collection of ABB products for daily operation and supervision of an automated process. These products provide an environment for different user categories, such as engineers,	
	operators and maintenance personnel.	
P-control / Q-control mode (PMS-level)	Automatic setpoint modes for the active/reactive power control scheme of a plant. The PQ control algorithm calculates the MW/MVAr setpoints, which are distributed to the generators' governor and AVR.	
Plant Explorer	The name of the project or plant navigator in the Operate IT workplace for creating the Aspect Objects that are used for assembling the various components of the plant. Can also be used for browsing and searching the structures of the plant.	
PMS	Power Management System.	
PPM	Process Power Manager	
Process Panel	The name of the ABB product for local process monitoring and control. The key functionality is presentation of process information (numerical, text or graphical) on local operator or process panels including functional control keys.	
Process Portal A	The name of the ABB product for process monitoring and control. The key functionality is presentation of process graphics, usage of faceplates, presentation of trends, and presentation of alarms.	
Structure	A hierarchical tree organization of Aspect Objects that describes the dependencies between the real objects. An Aspect Object can exist in multiple structures, e.g. both in a functional structure and in a location structure.	
Synchronosc ope	An instrument for indication of the "in phase" condition of a reference supply (busbar) and a synchronizing supply (generator) to determine the correct moment for circuit breaker closure.	
System Extension	A plug-in software package, which provides the Operate IT system with extended functions and properties.	
Туре	A general description of a unit that defines the behaviour of an individual unit called Instance. See also Instance.	

Term	Description
Voltage mode (PMS-level)	An automatic mode for the AVR of a generator. This mode is only allowed when a machine is not grid connected. For islanded networks, only one machine can be "master of voltage".

# **Related Documentation**

Related documentation includes, but is not limited to, the table below. Other ABB 800xA documentation may also be relevant when configuring an 800xA Process Power Manager.

Document ID	Title
3BNP100234-0390	PMS Library 5.6-5 Release Notes
3BNP100234-0391	PMS Library 5.6-5 Circuit Breaker Control
3BNP100234-0392	PMS Library 5.6-5 Generator Control
3BNP100234-0393	PMS Library 5.6-5 Transformer Control
3BNP100234-0394	PMS Library 5.6-5 Loadshedding
3BNP100234-0395	PMS Library 5.6-5 Power Control
3BNP100234-0396	PMS Library 5.6-5 Restart & Reacceleration
3BNP100234-0397	PMS Library 5.6-5 Report Data Collector
3BNP100234-0398	PMS Library 5.6-5 Synchronization
3BSE037410	Administration and Security

Table 2 Related I	Documentation
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# **Target Audience**

This user manual is primarily intended for technical sales personnel, application, system engineers and maintenance personnel within ABB, external users and customers.



This user manual does not contain last-minute product information and updates which might affect functionality and/or performance. For information on last revisions, late changes and restrictions the user shall refer to document *Release Notes*.



Some graphics have been carried over from previous loadshedding manuals, hence Windows frames, and aspect names, library versions, etc. might be different than in current 800xA and PMS version. (e.g. PG2 suffix in aspect names is no longer present, etc.)

# Compatibility

For compatibility with previous versions of the product, refer to the Release Notes.

# **System Security**

The supplier of automation systems, based on PMS libraries, is responsible for the system integrity and security. We strongly recommend that strict password policies are applied.



Reference is made to document *Administration and Security*. The whole manual must be carefully consulted, with special attention given to *Security Planning* and *Security Configurations* for guidelines regarding system security, user authentication, and password policies and setting up audit trails.

# **Section 1 Introduction**

The synchronization function in the PMS Library is based on the control module type *pmsSNSyncSuperv*. The control module supervises up to 15 energized networks and can provide synchronization across dedicated circuit breakers (synchronize-able breakers) interacting with relevant breakers, generators and synchronizing equipment (e.g. ABB Synchrotact).

The synchronization feature interacts with control modules from other libraries:

- pmsTopologyDet (pmsMatrixLib)
- pmsCBSynchM (pmsCBLib)
- pmsGenM (pmsGenLib)

The synchronization feature can handle up to:

- 10 synchronize-able circuit breakers
- 15 generators participating in synchronization
- 15 subnetworks

# **Section 2 Function**

## 2.1 General

The *pmsSNSynchSuperv* module collects synch requests from synchronize-able circuit breakers, provides selection of relevant generators and subsequently interacts with a synchronizing devise to initiate synchronization across the selected circuit breaker.

The synchronization process requires the voltage level, frequency and phase on both sides of the circuit breaker to be equal before the breaker is allowed to close. To achieve synchronization, one side of the circuit breaker (defined as the variable side, U-Var) is adjusting the voltage and frequency, by means of a participating generator, to be the same as the voltage and frequency on the other side of the circuit breaker (defined as the reference side, U-Ref).

A typical synchronization process is based on the following field equipment:

- Synchronizing device, e.g. ABB Synchrotact
- Circuit breaker selection relays
- Generator selection relays or external selection code
- U-Var/U-Ref exchange relay

## 2.2 Features

### 2.2.1 Network determination

The control module pmsTopologyDet supervises the network configuration of the plant and determine the contingencies that are energized, based on the feedback position of the critical breakers.

### 2.2.2 Selection relays for Circuit Breakers

Up to 10 circuit breakers can be interfaced with one pmsSNSyncSuperv control module. The following interactions are provided to the operator:

- o activation of circuit breaker selection relay
- o feedback monitoring from the selected relay

### 2.2.3 Frequency and Voltage measurements

The frequency and voltage measurements from the U-Var and U-Ref side of the circuit breaker can be monitored and validated compared to the network determination. If there are inconsistencies (e.g. spurious powered bus or spurious dead bus), alarms will be raised and the synchronization process will be cancelled.

### 2.2.4 Selection relays for Generators

Up to 15 generators can be interfaced with one pmsSNSyncSuperv control module. The following interactions are provided to the operator:

- activation of generator selection relay(s)
- feedback monitoring from the selected relay(s)

### 2.2.5 Exchange relay for U-Var/U-Ref side

When synchronizing two island networks, the pmsSNSyncSuperv control module can detect if it is required to activate a relay for interchanging the measurements from the variable/reference side of the circuit breaker, so that it will correctly be applied to the synchronizing device. The following features are supported:

- automatic activation of exchange relay
- feedback monitoring from the exchange relay

### 2.2.6 Signal interface with Synchronizing Device

The pmsSNSyncSuperv control module can monitor the signal interface to/from the synchronizing device for proper response throughout the phases of the synchronization. The following signals are supported:

### 2.2.6.1 Feedback signals from the Synchronizing device:

- Local/Remote point of control (the device is in Local or Remote control)
- Ready (the device can be started)
- Operate (the device has started)
- Error (the device has a failure)

### 2.2.6.2 Command signals to the Synchronizing device:

- Start (the device is requested to begin the synchronizing operation)
- Stop (the device is requested to terminate the synchronizing operation)
- Parameter sets (the device is requested to activate a predefined parameter set, depending on the characteristics of the selected generator(s))

### 2.2.7 Governor/AVR mode handling for Generators

When a generator is selected on the U-Var side of the circuit breaker, it will participate in the synchronization process by adjusting the frequency and/or voltage of the variable side. The control module pmsSNSyncSuperv will influence the modes of the governor and AVR in the following way:

- The selected generator(s) will be set in droop mode for governor and droop mode for the AVR, to receive the raise/lower pulses according to the adjustments dictated by the synchronizing device.
- The generators that run parallel to the selected machine(s) are set in MW mode for the governor and PF mode for the AVR, to avoid MW/MVAr transfer between the generators.
- After the synchronizing session is completed, all governors and AVRs will return to their previous modes.



The pmsSNSyncSuperv module does not check if the previous modes are viable for the new electrical contingency. For example; one should not reinstate ISO mode in if a connection to Grid has been established. This is done by the pmsCMM (Central Mode Manager) found in both pmsPQSmallLib and pmsPQLargeLib.

### 2.2.8 Status indication for synchronization in progress and for U-VAR/U-REF side

The control module pmsSNSyncSuperv will provide an indication that the synchronization sequence is in progress and it will also present the identity numbers of the variable and reference side of the selected circuit breaker.

### 2.2.9 Time-out of synchronization session

The duration of the synchronization session is compared to a configurable time-out setting and when the period has elapsed, the control module pmsSNSyncSuperv will raise an alarm and cancel the software sequence.

### 2.2.10 Alarm & Event handling during the synchronizing process

Critical operational changes that affect the synchronization sequence are recorded and presented in Alarm and Event lists.

### 2.2.11 Optional direct operation of the synchronization sequence

The module pmsSNSyncSuperv automatically controls the interaction with the pmsCBSyncM and the pmsGenM control modules at certain steps of the synchronization software sequence. Alternatively, there is an option to allow direct operation of all the necessary steps (i.e. select a circuit breaker, select the generator(s), start or stop the synchronization device, etc.).

# 2.3 Synchronizing device

The synchronizing device is an essential equipment for the synchronizing process with facilities for:

- measuring voltage, frequency and phase angle on both sides of a circuit breaker
- increase/decrease output commands for adjusting the voltage and frequency of one side of the breaker (U-Var) against the other side (U-Ref)
- synchro-check relay for safe closure operation of the circuit breaker
- close relay for direct closure of the circuit breaker
- monitoring signals for status and operation of the synchronization process
- local panel with facilities for manual operation (e.g. push-buttons, synchronoscope, measurement instruments)

# 2.4 Circuit breaker selection relays

Selection relays are required when multiple circuit breaker closure is supported by the same synchronizing device. A panel shall provide selector switches and relays for routing the proper U-Var/U-Ref measurements from each selected breaker to the synchronizing device. It should be possible to activate the relays both locally (by selector switches) and remotely (via the control system).

# 2.5 Generator selection relays

If a selection of multiple generators shall receive increase/decrease commands for voltage and frequency adjustments, selection relays or external selection (routing) code is required to direct the commands to the correct AVR(s) and Governor(s). The generators may be selected from a list of available generators presented in the faceplate of *pmsSNSynchsuperv*.

A panel with selector switches and relays, or external selection code, must be configured to route the increase/decrease commands to the proper generator(s). It should be possible to activate the relays, or external selection code, both locally and remotely.



Figure 1 Overview of the synchronization system

# 2.6 U-Var/U-Ref exchange relay

When the selected circuit breaker is connecting two energized busbars (e.g. a bus-coupler) where either side can be the U-Var or U-Ref, a relay is normally installed for exchanging the reference and variable side. The purpose of the exchange relay is to swap the measurements applied to the synchronizing equipment, depending on the side of the bus that the selected generator(s) is connected to.

# !

The circuit breaker must be closed, automatically or manually, through the synchronizing device. The close command output must always be routed through a synch-check relay.

In the case of an automatic closure, the synchronizing device shall pass the command to the synch-check relay automatically which subsequently releases the command to close the breaker when frequency, voltage and phase-angle match, i.e. a synchro-check function.

For manual synchronization, the synchronizing device will receive a manual close release request. The signal is passed to the synch-check relay which releases the close command at the right moment, closing the breaker when voltage, frequency and phase-angle match.

# **Section 3 Matrix library**

# 3.1 General

All PMS library features depends on live network determination. This is provided by the following modules in *pmsMatrixLib*:

- pmsBusCon
  - Creates a digital representation of a de-energized electrical plant configuration.
- pmsTopologyDet
  - Combines the de-energized plant interpretation with actual critical breaker status and thus provides a digital representation of energized networks.

# 3.2 Introduction pmsBusCon

The *pmsBusConn* module detects the de-energized electrical plant configuration based on user input derived from the single line diagram. The input is done via faceplate.

The digital representation of the single line diagram is available to the *pmsTopologyDet* module via *MatrixIndex*, a structured data type for up to 160 circuit breakers.



Figure 2 Control module pmsBusConn

Parameter	Direction	Significance
Reset	Input	IN: Clear index numbers, output <i>MatrixIndex</i> is cleared when TRUE
MatrixIndex	Output	OUT: Calculated index numbers, represents the de-energized electrical plant

Table 3 Parameter configuration for pmsBusConn control module

# 3.3 Detailed Engineering

### 3.3.1 Network determination

As an example we shall configure the simple single line diagram shown below



Figure 3 Simple single line diagram

- 1. Assign numbers to the single line diagram with labels according to the following rules:
  - a. Assign generators and grid connections to the available 35 PBB identifiers. PBB1 to PBB4 is reserved for the grid connections if necessary. E.g. if there is only one grid connection, it must be assigned to PBB1, PBB2 is then first generator, and so on.
  - b. Assign busbars to the available 35 LBB identifiers. Single loads, substation types, generators and grids must be directly connected to the load busbars.
  - c. Critical breakers interconnect identified PBBs and LBBs shall have identities starting from CB01 up to maximum CB160.
- 2. Instantiate pmsBusConn and pmsTopologyDet.
- 3. Use the faceplate of the pmsBusConn, to enter busbar numbers that each CB interconnects.
  - a. According to Figure 2 the bus-coupler CB7 interconnects LBB1 and LBB2. Enter this into the faceplate of pmsBusConn, as shown in Figure 4.

Index_LS : Fac	eplate PG2			_ 🗆 X		Index_LS : Fac	eplate PG2				X
<u></u>	Index_	LS					Index	LS			
Matrix						Matrix					
CB 01	LBB01	•	PBB01	•		CB 01	LBB01	•	PBB01	-	
CB 02	LBB02	٠	PBB02	-	H	CB 02	LBB02	*	PBB02	-	
CB 03	LBB01	*	PBB03	*	H	CB 03	LBB01	٠	PBB03	•	
CB 04	LBB01	•	PBB04	*	H	CB 04	LBB01	٠	PBB04	•	
CB 05	LBB02	•	PBB05	*	H	CB 05	LBB02	٠	PBB05	٠	
CB 06	LBB02	•	PBB06	*	H	CB 06	LBB02	٠	PBB06	•	
CB 07	LBB01	٠	LBB02		H	CB 07	LBB01	٠	LBB02	٠	
CB 08		•	LBB02	-	H	CB 08	Î 📃	۲		•	
CB 09		٠	LBB04		H	CB 09	Î.	۲		٠	
CB 10		٠	LBB05	Ť	H	CB 10	ĺ	٠		•	
			LBB08 LBB08 LBB09						Confir	n	Confirm Cancel
	00		LBB10	3			0 00	Ι.	000		3

Figure 4 pmsBusConn faceplate

The digital representation of the de-energized electrical plant configuration available from *pmsBusCon* on output parameter *MatrixIndex*. <u>The datatype is *CBIndex*</u>.

Parameter	Parameter direction	Description
CBIndex.CB001_Index1	Input	Matrix number Index1 for CB01
CBIndex.CB001_Index2	Input	Matrix number Index2 for CB01
CBIndex.CB002_Index1	Input	Matrix number Index1 for CB02
CBIndex.CB002_Index2	Input	Matrix number Index2 for CB02
•		Matrix numbers Index1,2 for CB03-CB159
CBIndex.CB160_Index1	Input	Matrix number Index1 for CB160
CBIndex.CB160_Index2	Input	Matrix number Index2 for CB160

Table 4 Parameter configuration for matrix index numbers (CBIndex)



The *MatrixIndex* needs to execute once to be established. It is thus sufficient to execute *pmsBusCon* on demand as long as the CBIndex variable is cold made retain.

Some users choose to hardcoding established MatrixIndes data.



Matrix indexes shall not be changed online, but requires a warm download.

# 3.4 Introduction pmsBusCon

The *pmsTopologyDet* module reads the de-energized network representation and combine it with circuit breaker positions to determine existing energized network topologies (i.e. contingencies).

	pmsTo	pologyDet	-
-	Enable	NetTopology	-
-	CBIndex		;
	iCB		÷
	NetSize		ļ
1	C	1	1

Figure 5 Control module pmsBusConn

Parameter	Direction	Significance
Enable	Input	IN: Execute module when TRUE
CBIndex	Input	IN: Structured datatype, input from pmsBusCon output MatrixIndex
iCB	Input	IN: Structured datatype, contains critical breaker status
NetSize	Input	IN: Setting to avoid unnecessary code execution, can reduce cyclic load
NetTopology	Output	OUT: Digital representation of momentary live network topologies

### Table 5 Parameter configuration for pmsBusConn control module

# 3.5 Detailed Engineering

### 3.5.1 Network supervision

Energized electrical topologies are supervised by monitoring critical breaker status via the *iCB* parameter. The feedback signals are *BoollO* data types and can be connected to digital input signals. This parameter is a structured data type with the feedback signals (i.e. CI, OI, SP and LO) for up to 160 circuit breakers.

Parameter	Direction	Description
iCB.CB001.CI	Input	CB01 feedback signal "closed"
iCB.CB001.OI	Input	CB01 feedback signal "open"
iCB.CB001.SP	Input	CB01 feedback signal "test/racked-out"
iCB.CB001.LO	Input	CB01 feedback signal "lock-out"
iCB.CB002.CI	Input	CB02 feedback signal "closed"
iCB.CB002.OI	Input	CB02 feedback signal "open"
iCB.CB002.SP	Input	CB02 feedback signal "test/racked-out"
iCB.CB002.LO	Input	CB02 feedback signal "lock-out"
· · · · · · · · · · · · · · · · · · ·	Input	CB03-CB159 feedback signals
iCB.CB160.CI	Input	CB160 feedback signal "closed"
iCB.CB160.OI		CB160 feedback signal "open"
iCB.CB160.SP	Input	CB160 feedback signal "test/racked-out"
iCB.CB160.LO	Input	CB160 feedback signal "lock-out"

Table 6 Parameter	configuration	for critical	breaker	position (	(iCB)	)
					/	e



The breaker is considered closed if feedback is according to Table 7.

Parameter	Direction	Value	Description
iCB.CBxxx.CI.Value	Input	true	This signal monitors the closed position of the breaker. The limit switch for the closed indication of the breaker must report that there is a confirmed "closed" position.
iCB.CBxxx.OI.Value	Input	false	This signal monitors the open position of the breaker. The limit switch for the open indication of the breaker must report that there is no confirmed "open" position.
iCB.CBxxx.SP.Value	Input	true	This signal monitors if the breaker is in service. A feedback signal from the breaker must report that the breaker is not "racked-out" and not in "test" position.
iCB.CBxxx.LO.Value	Input	false	This signal monitors if the breaker is tripped. A feedback signal from the breaker must report that the breaker does not receive a trip command from a "lock-out" relay.

Table 7 Feedback	signals for a	critical breake	r position	(iCB)
------------------	---------------	-----------------	------------	-------



Loadshedding requires fastest possible critical breaker status update. We thus recommend that relevant IO is connected directly to the iCB structure, or via fast executing external code in case two physical breakers are combined into one critical breaker.

The output of *pmsTopologyDet* is made available to other PMS functions, via the output parameter NetTopology. This parameter is a structured data type which contains the topology of all 35 possible subnetworks, as shown in Table 8.

Parameter	Parameter direction	Description
NetTopology.PBB01	Input	Number for the subnetwork that the PBB01 belongs to.
	Input	Similar numbers for PBB02-PBB34.
NetTopology.PBB35	Input	Number for the subnetwork that the PBB35 belongs to.
NetTopology.BB01	Input	Subnetwork number of switchgear BB01.
		Similar numbers of switchgear for BB02-BB34.
NetTopology.BB35	Input	Subnetwork number of switchgear BB35.
CB_opened	Output	Parameter is set to true for one scan when one of the critical breakers is tripped.
RefreshNet	Output	Parameter is set to true for one scan when one of the critical breakers changes its position.
NoActiveSN	Output	Number of active subnetworks in the plant.

Table 8 Parameter configuration for network topology (NetTopology)

# **Section 4 Synchronization library**

# 4.1 General

The synchronization library, *pmsSNLib* contains the following control modules:

- pmsCBSN multiplexing interface for up to 10 synchronize-able circuit breakers
- *pmsGenSN* multiplexing interface for up to 15 generators
- pmsSNSyncSuperv main control module for synchronizing supervision
- *pmsSimSynchrotact* simple control module simulating ABB Synchrotact interaction

# 4.2 Introduction – pmsCBSN

The pmsCBSN control module is handling the interface from up to 10 circuit breaker modules pmsCBSyncM. A block presentation of the module is shown in Figure 6. The parameters are briefly described in Table 9.

pmsC	BSN
- CBSNParl_1	CBSNParO -
- CBSNParl_2	Index -
- CBSNParl_3	Count -
- CBSNParl_4	
- CBSNParl_5	
- CBSNParl_6	
- CBSNParl_7	
- CBSNParl_8	
- CBSNParl_9	
- CBSNParl_10	
S	

Figure 6 Control module pmsCBSN

Parameter	Direction	Description
CBSNParl_1 CBSNParl_10	Input	Each input parameter is a structured data type for receiving the components of <i>CBSynPar</i> from 10 different pmsCBSyncM control modules.
CBSNParO	Output	A structured data type for filtering one of the 10 incoming CBSNParl_1CBSNParl_10 data.
Index	Output	The identity number for the selected pmsCBSyncM control module.
Count	Output	The count number of the selected pmsCBSyncM control modules.

# 4.3 Detailed Engineering – pmsCBSN

The control module pmsCBSN multiplexes data from up to 10 different pmsCBSyncM control modules. The features of the pmsCBSN module are:

### Parameters CBSynPar from 10 pmsCBSyncM control modules

The parameters *CBSynPar* from up to 10 different pmsCBSyncM modules can be processed with one pmsCBSN control module.

#### • Index number from the selected pmsCBSyncM module

Index number (configured for each pmsCBSyncM control module) of selected circuit breaker for synchronization, is an output from the pmsCBSN control module.

### Count number of the selected pmsCBSyncM modules

When more than one circuit breaker is selected for synchronization, the count number will be calculated by the pmsCBSN control module.

### 4.3.1 Parameters CBSynPar from 10 pmsCBSyncM control modules

The output parameter *CBSynPar* of the circuit breaker module shall be interconnected to the input *CBSynPar* of the *pmsCBSN control* module.



When more than one circuit breakers are interfaced by the same synchronization module, the *CBSNParl\_1...CBSNParl\_10* must be utilized to collect the data from the different breakers. Depending on the selected breaker, the output parameter *CBSNParO* will contain the data from one of the relevant *CBSNParl\_1...CBSNParl\_10* inputs.

Parameter	Description
CBSNParl_1.MBBA	Input from 1 <sup>st</sup> circuit breaker - Bus bar configuration number for the variable side of the circuit breaker.
CBSNParl_1.MBBB	Input from 1 <sup>st</sup> circuit breaker - Bus bar configuration number for the reference side of the circuit breaker.
CBSNParl_1.SyncType	Input from 1 <sup>st</sup> circuit breaker - Configuration number for the circuit breaker (generator, grid, network).
CBSNParl_1.SynIndex	Input from 1 <sup>st</sup> circuit breaker - Configuration number for the circuit breaker Index.
	Input from circuit breakers 2 – 9.
CBSNParl_10.MBBA	Input from 10 <sup>th</sup> circuit breaker - Bus bar configuration number for the variable side of the circuit breaker.
CBSNParl_10.MBBB	Input from 10 <sup>th</sup> circuit breaker - Bus bar configuration number for the reference side of the circuit breaker.
CBSNParl_10.SyncType	Input from 10 <sup>th</sup> circuit breaker - Configuration number for the circuit breaker (generator, grid, network).
CBSNParl_10.SynIndex	Input from 10 <sup>th</sup> circuit breaker - Configuration number for the circuit breaker Index.

### Table 10 Parameters pmsCBSNParl\_1... pmsCBSNParl\_10

### 4.3.2 Index number from the selected pmsCBSyncM module

The output parameter *Index* shall present the identity number of the selected breaker (*pmsCBSyncM:Index*). This output is not required to be further connected to another software module. It can be used for information and validation of the application configuration.



When more than one circuit breaker is selected, the parameter Index will show value -1.

### 4.3.3 Count number of the selected pmsCBSyncM modules

The pmsCBSN control module is monitoring how many circuit breakers are being selected for the synchronization process. This is reflected in the output parameter *Count*. This output is not required to be further connected to another software module.



When *Count* >1, the synchronization process will be cancelled.

# 4.4 Introduction – pmsGNSN

The pmsGNSN control module is handling the interface from up to 15 generator modules pmsGenM. A block presentation of the module is shown Figure 7. The parameters are briefly described in Table 11.

	pmsGl	VSN
-	GNSNParl_1	GNSNParO -
-	GNSNParl_2	Count -
-	GNSNParl_3	
-	GNSNParl_4	
-	GNSNParl_5	
-	GNSNParl_6	
-	GNSNParl_7	
-	GNSNParl_8	
-	GNSNParl_9	
-	GNSNParl_10	
-	GNSNParl_11	
-	GNSNParl_12	
-	GNSNParl_13	
-	GNSNParl_14	
-	GNSNParl_15	

Figure 7 Control module pmsGNSN

Parameter	Direction	Description
GNSNParl_1 GNSNParl_15	Input	Each input parameter is a structured data type for receiving the components of <i>GNSynPar</i> from 15 different pmsGenM control modules.
GNSNParO	Output	A structured data type for filtering one of the 15 incoming GNSNParl_1GNSNParl_15 data.
Count	Output	The count number indicates how many pmsGenM control modules are selected.

Table 11 Parameters for pmsGNSN control module

# 4.5 Detailed Engineering – pmsGNSN

The control module pmsGNSN works as switchboard function for processing the data from up to 15 different pmsGenM control modules. The features of the pmsGNSN module are:

### - Parameters GNSynPar from 15 pmsGenM control modules

The parameters *GNSynPar* from up to 15 different pmsGenM modules can be processed with one pmsGNSN control module.

#### - Count number of the selected pmsGenM modules

The count number will be calculated by the *pmsGNSN* control module. This will indicate the number of generator sets that have been selected to participate in the synchronization process (refer to Figure 12).

### 4.5.1 Parameters GNSynPar from 15 pmsGenM control modules

The output parameter *GNSynPar* of the generator module shall be interconnected to the input *GNSynPar* of the pmsGNSN control module.



When more than one generators are interfaced by the same synchronization module, the *GNSNParl\_1...GNSNParl\_15* must be utilized to collect the data from the different generators. Depending on the selected generator, the output parameter *GNSNParO* will contain the data from the relevant *GNSNParl\_1...GNSNParl\_15* inputs.

Parameter	Description
GNSNParl_1.GenIDFB.Gen1	Input from 1 <sup>st</sup> generator - Index of selected generator
GNSNParl_1.SyncUnavailable.Gen1	Input from 1 <sup>st</sup> generator - Available flags for participation.
	Input from generators 2 - 14.
GNSNParl_15.GenIDFB.Gen15	Input from 15 <sup>th</sup> generator - Index of selected generator.
GNSNParl_15.SyncUnavailable.Gen15	Input from 15 <sup>th</sup> generator - Available flags for participation.

### Table 12 Parameters pmsGNSNParl\_1... pmsGNSNParl\_15

### 4.5.2 Count number of the selected pmsGenM modules

The pmsGNSN control module is monitoring how many generators have been selected for the synchronization process. This is reflected in the output parameter *Count*. This output is not required to be further connected to another software module. It can be used for information and validation of the application configuration.

# 4.6 Introduction – pmsSNSynchSuperv

The pmsSNSyncSuperv control module is included in the *pmsSNLib library*. A block presentation of the control module is shown in Figure 8.



Figure 8 Control module pmsSNSyncSuperv

Table 13 Parameters of the	control module	pmsSNSyncs	Superv
----------------------------	----------------	------------	--------

Parameter	Direction	Significance
Name	Input	Name of the object (e.g. synchronizing equipment tag). With the name upload tool of the process portal, this property will be used for identifying the object in the 800xA system. The name will be used for grouping the alarms and events and identifying the faceplate of an object. The name must be unique in the project.

Parameter	Direction	Significance
Description	Input	Description of the object (e.g. synchronizing cabinet information). With the name upload tool of the process portal, this property will be used for identifying the object in the 800xA system.
EvSeverity	Input	Event severity. The event severity can be used for filtering the event list. Range 1-1000.
AlSeverity	Input	Alarm severity. The alarm severity can be used for filtering the alarm list. Range 1-1000.
Class	Input	Alarm and Event Class. This parameter can be used for grouping objects to appear in separate alarm/event lists. Range 1-9999.
Enable	Input	If TRUE the control module is executed.
NetTopology	Input	Structured parameter: Network Configuration Matrix from pmsTopologyDet.
iMV_Freq	Input	Measurements for busbar frequency on both sides of the circuit breaker. This parameter is a structured data type.
iMV_Volt	Input	Measurements for busbar voltage on both sides of the circuit breaker. This parameter is a structured data type.
PB01PB15	Input	Power Bus bar type identification for the network determination. 1 = Generator, 2= Grid. NOTE: Only PB01 and PB02 can be assigned with value = 2.
IO_Input	Input	Input signals for monitoring the status and feedbacks from the Synchronizing equipment and the field relays.
CB_ID	Input	Identity assignment for the CBs monitored by the Synchronizing equipment.
GNSynPAr	Input	Interface from Generator control module. Interface input signals received from pmsGenM module (Index, unavailable, etc.) This parameter is a structured data type.
CBSynPar	Input	Interface from Circuit Breaker control module. Interface input signals received from pmsCBSyncM module (mode set, etc.). This parameter is a structured data type.
ExtPar	Input	External parameters for application interaction. With this parameter it is possible to block the participation and the selection of the generator. The parameter set utilized by the synchronization equipment, depending on the generators participating in the synchronization process, can be defined using this parameter.
ParamSet	Input	Assignment of the parameter set utilized by the synchronization equipment, depending on the generator participating in the synchronization process.

Parameter	Direction	Significance
MaxNoGenSelection	Input	Assignment of the maximum number of generator sets that are allowed to participate in adjusting of frequency/voltage, on the Variable side of a network circuit breaker, during the synchronization process.
FreqLowLimit	Input	Frequency low limit value for spurious dead or powered bus condition.
VoltLowLimit	Input	Voltage low limit value for spurious dead or powered bus condition.
SynCfgPar	Input	Configuration parameter for selection relays time-out settings and circuit breaker names for event messages.
SelectedGen	Output	Indication of the generators that have been selected to participate in the synchronization process from the pmsSNSyncSuperv faceplate tab Main.
SynGNPAr	Output	Interface to Generator control module. Interface output signals send to the pmsGenM module (mode set, etc.) This parameter is a structured data type.
SyncOperation	Output	Indication that the synchronization control module is initiated and interacting with the Synchronizing equipment.
SynCBPar	Output	Interface to Circuit Breaker control module. Interface output signals sent to the pmsCBSyncM module (operate, cancel, etc.) This parameter is a structured data type.
UREF	Output	Indication of the busbar identity being the Reference side during the synchronization process.
UVAR	Output	Indication of the power busbar identity being the Variable side during the synchronization process.
IO_Output	Output	Output signals for commands to the Synchronizing equipment and the field relays.



For the spurious dead or powered bus detection to work, it is necessary that <u>both</u> limits FreqLowLimit and VoltLowLimit have a value unequal zero. If any of them are equal zero no test or restrictions for starting synchronisation are made.

# 4.7 Detailed Engineering

### 4.7.1 Selection relays for Circuit Breakers

The control module *pmsSNSyncSuperv* can supervise up to 10 circuit breaker relays for selection in the synchronization process. Each relay must be assigned with an identity number matching the *Index* parameter of a pmsCBSyncM circuit breaker module.

The circuit breaker relay identities are configured via the *CB\_ID* parameter. This parameter is a structured data type and receives up to 10 index numbers (one index number per pmsCBSyncM control module), as shown in Table 14.

Parameter	Description
CB_ID.CB1	Circuit breaker index number for 1 <sup>st</sup> CB in synchronization scheme.
CB_ID.CB2	Circuit breaker index number for 2 <sup>nd</sup> CB in synchronization scheme.
CB_ID.CB3	Circuit breaker index number for 3 <sup>rd</sup> CB in synchronization scheme.
CB_ID.CB4	Circuit breaker index number for 4 <sup>th</sup> CB in synchronization scheme.
CB_ID.CB5	Circuit breaker index number for 5 <sup>th</sup> CB in synchronization scheme.
CB_ID.CB6	Circuit breaker index number for 6 <sup>th</sup> CB in synchronization scheme.
CB_ID.CB7	Circuit breaker index number for 7 <sup>th</sup> CB in synchronization scheme.
CB_ID.CB8	Circuit breaker index number for 8 <sup>th</sup> CB in synchronization scheme.
CB_ID.CB9	Circuit breaker index number for 9 <sup>th</sup> CB in synchronization scheme.
CB_ID.CB10	Circuit breaker index number for 10 <sup>th</sup> CB in synchronization scheme.

### Table 14 Identity (index) for circuit breaker relays



The CB\_ID is used as a cross-reference between the parameter Index of a pmsCBSyncM circuit breaker module and the corresponding selection relay.
# 4.7.2 Operator interface for Circuit Breaker selection

The faceplate view of the *pmsCBSyncM* control module type has two command buttons to start/stop the interaction with the *pmsSNSyncSuperv* module. When the button for initiating synchronization is operated, as shown in Figure 9, the input parameter *CBSynPar.SynIndex* shall receive the corresponding Index assigned to the *pmsCBSyncM* module. If this number is equal to one of the *CB\_ID* components (e.g. *CB\_ID.CB7*), the relevant component from the *IO\_Output* parameter will be activated (e.g. *IO\_Output.CB7.Value*). The output represents the request to energize a selection relay for the corresponding circuit breaker



Figure 9 Synchronizing interaction from pmsCBSyncM faceplate and Main tab

Field	ltem	Description
1	Push-button	Button to initiate the synchronization request
2	Push-button	Button to cancel (terminate) the synchronization request
3	Status box	Indication that the circuit breaker selection relay is activated

### Table 15 Synchronizing interaction from pmsCBSyncM faceplate and Main tab



The feedback from activating a circuit breaker relay must be received via the parameter IO\_Input.CB1 ...CB10 (i.e. one digital input for each circuit breaker relay). If the feedback is not received within a configurable time-out setting, the control module pmsSNSyncSuperv will raise an alarm and the synchronization sequence will be cancelled. The time-out value is configured via the parameter SynCfgPar.SelCBTO and it is common for all the circuit breaker selection relays.



It is possible to change the descriptions (tag names) of the circuit breakers relays. This configuration is done via the tab Edit >Selection >CB Names from the extended faceplate view, as shown in Figure 10. A description must be entered in the text field followed by pressing the ENTER key. To hide a certain circuit breaker selection relay,

the corresponding text must be deleted and the field shall be left empty. A user with Application Engineer role can perform this configuration.

The configuration of the circuit breaker relay names is saved in the General Properties aspect of the pmsSNSyncSuperv object type in 800xA. It is important to take a backup of this aspect (e.g. by using the Import/Export tool from the 800xA Plant Explorer) after completing the configuration, in case there is a need to restore the settings.

	💥 Synchronization : Faceplate PG2 📃 🔀	🙀 Synchronization : Faceplate PG2
	Synchronization	Synchronization
	Edit	Main Block
		Ready     Remote     Parameter Set 1
Ů	CB Names	Operate OError OParameter Set
	1 CR text 1	A B Gen. Status CB Status
		O CB text 2
	2 <u>CB text 2</u>	CB text 3
	3 CB text 3	CB text 4
	4 CB text 4	CB text 5
	5 00 1 1 5	CB text 6
2	S CB text S	O Bus A-B coupler
$\cup$	6 CB text 6	CB text 8
	7 Bus A-B coupler	CB text 10
	9 CB text 9	CD text 10
		Par. Commands
	9 <u>CB text 9</u>	
	10 CB text 10	-Sync. Commands
		G Sync.
	• • • •	• • • • • •

Figure 10 Faceplate tab Edit - CB Names

Field	Indication	ltem	Description
1	CB Names	Drop-down menu	When the option <b>CB Names</b> is selected the faceplate will show the text description input fields for the circuit breakers.
2	CB text 1CB text 10	Text input fields	Text description. Empty field hides the CB Name from the faceplate tab <b>Main</b> .

Table 16 Faceplate	configuration	for text	description	of circu	it



When the configuration parameter SynCfgPar.DirectSyncOperation is true, the circuit breaker selection relays can be activated via check-boxes in the pmsSNSyncSuperv faceplate tab Main, as shown in Figure 11. This configuration is intended as an alternative operation method, where the pmsSNSyncSuperv control module is independent from the pmsCBSyncM and pmsGenM modules. The synchronization process will be executed according to the manual interaction from the faceplate buttons and not by the automatic sequence.



Figure 11 Direct circuit breaker selection

Table 17	Faceplate	configuration	for direct	circuit	breaker	selection
----------	-----------	---------------	------------	---------	---------	-----------

Field	Indication	ltem	Description
1	Selection menu	Push-button	If <i>SynCfgPar.DirectSyncOperation</i> = true, from the selection menu is possible to select or cancel the selection of a circuit breaker relay.
2	CB text 110	Check-boxes	If <i>SynCfgPar.DirectSyncOperation</i> = true, the selected check box will activate a circuit breaker selection relay.



When the parameter SynCfgPar.DirectSyncOperation is true, the visibility of the circuit breaker check-boxes listed in the faceplate tab Main is depending on the entered text via the tab Edit > Selection >CB Names (Figure 10) from the extended view of the faceplate. If an input text field is left empty, the corresponding circuit breaker will be hidden from the listed check-boxes.



After a circuit breaker relay has been selected all the other check boxes will be dimmed. In order to change the circuit breaker relay selection, first the current selected relay must be deselected.

# 4.7.3 Frequency and Voltage measurements

The control *module pmsSNSyncSuperv* can supervise the frequency and voltage measurements from the variable (U-Var) and the reference (U-Ref) side of the circuit breakers.

The measurements must be configured via the *iMV\_Freq* and *iMV\_Volt* parameters. The components of the parameters *iMV\_Freq* and *iMV\_Volt*, shown in Table 18 and

Table 19, refer to the busbar identities from the network determination matrix.

Table 18 Parameter configuration for Frequency measurements (iMV\_Freq)

Parameter	Description
iMV_Freq.BB01.Value	Frequency measured value from bus PB01
iMV_Freq.BB02.Value	Frequency measured value from bus PB02
iMV_Freq.BB03.Value	Frequency measured value from bus PB03
•	Frequency measured values from bus PB04-PB14
iMV_Freq.BB15.Value	Frequency measured value from bus PB15
iMV_Freq.BB16.Value	Frequency measured value from bus LB01
iMV_Freq.BB17.Value	Frequency measured value from bus LB02
iMV_Freq.BB18.Value	Frequency measured value from bus LB03
•	Frequency measured values from bus LB04-LB34
iMV_Freq.BB50.Value	Frequency measured value from bus LB35

Table 19 Parameter	configuration for	Voltage measurements	(iMV Vola	t)
				·/

Parameter	Description
iMV_Volt.BB01.Value	Voltage measured value from bus PB01
iMV_Volt.BB02.Value	Voltage measured value from bus PB02
iMV_Volt.BB03.Value	Voltage measured value from bus PB03
- - -	Voltage measured values from bus PB04-PB14
iMV_Volt.BB15.Value	Voltage measured value from bus PB15
iMV_Volt.BB16.Value	Voltage measured value from bus LB01
iMV_Volt.BB17.Value	Voltage measured value from bus LB02
iMV_Volt.BB18.Value	Voltage measured value from bus LB03
• •	Voltage measured values from bus LB04-LB34
iMV_Volt.BB50.Value	Voltage measured value from bus LB35



The measurements configured via the parameters iMV\_Freq and iMV\_Volt provide an additional check for validating the measurements applied directly (e.g. hardwired) on the synchronization device. The measurements are compared to the input parameters FreqLowLimit and VoltLowLimit and if a conflict is detected, an alarm will be raised and the synchronization sequence will be cancelled. The relevant alarms are described in Table 42 (items 1 and 2).

This function is enabled when the parameter SynCfgPar.DirectSyncOperation is false.

# 4.7.4 Selection Relays for Generators

The control module *pmsSNSyncSuperv* can supervise up to 15 generator relays for selection in the synchronization process. Each generator is defined via the network configuration matrix. For a generator to be represented as a power source, the value 1 shall be assigned to the parameters *PB01* to *PB15*, as shown in Table 20.

Parameter	Description
PB01	PB01=1, for Generator with Index=1. PB01=2, for 1 <sup>st</sup> Grid.
PB02	PB02=1, for Generator with Index=2. PB02=2, for 2 <sup>nd</sup> Grid.
PB03	PB03=1, for Generator with Index=3
PB04	PB04=1, for Generator with Index=4
PB05	PB05=1, for Generator with Index=5
PB06	PB06=1, for Generator with Index=6
PB07	PB07=1, for Generator with Index=7
PB08	PB08=1, for Generator with Index=8
PB09	PB09=1, for Generator with Index=9
PB10	PB10=1, for Generator with Index=10
PB11	PB11=1, for Generator with Index=11
PB12	PB12=1, for Generator with Index=12
PB13	PB13=1, for Generator with Index=13
PB14	PB14=1, for Generator with Index=14
PB15	PB15=1, for Generator with Index=15

Table 20 Configuration of generators for network determination

The parameters PB01 to PB15 are used as a cross-reference between the parameter Index of a pmsGenM generator module and the corresponding selection relay.



The maximum number of generator sets that can be selected to participate in adjusting the voltage/frequency on the variable side of a network breaker in the synchronization process cannot be higher than the value set for the parameter MaxNoGenSelection. When the value set for the MaxNoGenSelection parameter (e.g. MaxNoGenSelection = 2) has been reached, as shown in Figure 12, all the other generator check-boxes will be automatically dimmed, thus restricted from selection.

	Cumokuoni	ization
<u>ey</u>	Synchron	zation
-Status		
Ready	Remote	Parameter Set 1
Operate	Error	Parameter Set
	Gen. Status	CB Status
	GEN text 1	CB text 1
✓ Select	Deselect	CB text 2
	GEN LEXE	CB text 3
	GEN text 4	CB text 4
		CB text 5
		CB text 6
		OCB text 7
		CB text 8
		CB text 9
		CB text 10
		Par. Commands
		Svnc. Commands
		Gync.

Figure 12 Faceplate tab Main - Generator selection

Table 21 Faceplate tab Main –	Generator selection
-------------------------------	---------------------

Field	ield Item Description	
1	Check-box	Check mark indication for selection of the participating generators
2	Push button	Button for selection or cancel selection of a participating generator



When a generator is selected from the pmsSNSyncSuperv faceplate tab **Main**, as shown in Figure 13, (e.g. via the check-box for Generator 1, Generator 2), and the synchronization process has been started (from Sync. command button), the relevant output from the *IO\_Output* parameter will be activated (e.g.*IO\_Output.Gen1.Value*, *IO\_Output.Gen2.Value*). This will activate the selection relays for the selected generators. This function is enabled when the parameter *SynCfgPar.DirectSyncOperation* is false.



Figure 13 Faceplate tab Main – Generator selection relay active

Table 22 Faceplat	e tab GEN	selection
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Field	Field Item Description	
1	Checked mark	Indication for selection of the participating generator(s)
2	Status box	Indication that the requested generator selection relay is activated



The feedback from activating a generator selection relay must be received via the parameter *IO\_Input.Gen1 ...Gen15* (i.e. one digital input for each generator relay). If the feedback is not received within a configurable time-out setting, the control module pmsSNSyncSuperv will raise an alarm and the synchronization sequence will be cancelled. The time-out value is configured via the parameter *SynCfgPar.SelGenTO* and it is common for all the generator selection relays.



It is possible to change the descriptions (tag names) of the generator relays. This configuration is done via the tab Edit > Selection > Gen Names from the extended faceplate view, as shown in Figure 14. A description must be entered in the text field followed by the ENTER key. A user with Application Engineer role can perform this configuration.



The configuration of the generator relay names is saved in the General Properties aspect of the pmsSNSyncSuperv object type in 800xA. It is important to take a backup of this aspect (e.g. by using the Import/Export tool from the Plant Explorer) after completing the configuration, in case there is a need to restore the settings.

	🙀 Synchronization : Faceplate PG2 📃 🛛 🔀	🛿 🕍 Synchronization : Faceplate PG2
	Synchronization	Synchronization
1-	Edit Selection Gen Names	Main       Block         Status       Status         Ready       Remote       Parameter Set 1         Operate       Error       Parameter Set         A       B       Gen. Status         CB Status       CB Status         CB text 1       CB text 1
	1 GEN text 1 11 GEN text 11	GEN text 1 CB text 1
	2 GEN text 2 12 GEN text 12	Gas Turbine CB text 3
	3 Gas Turbine 13 GEN text 13	GEN text 4 CB text 4
	4 GEN text 4 14 GEN text 14	CB text 5
2	5 GEN text 5 15 GEN text 15	CB text 7
	6 GEN text 6	CB text 8
	7 GEN text 7	CB text 9 CB text 10
	8 GEN text 8	Par. Commands
	9 GEN text 9	
	10 GEN text 10	Sync. Commands
	<u></u>	

Figure 14 Faceplate tab Edit – GEN Names

Table 23 Faceplate	configuration	for text	description	of generator	r relavs
rabio Lo rabopiato	oonngaraaon	101 10/11	400011011	er generater	, 0, a y 0

Field	Indication	ltem	Description
1	Gen Names	Drop-down menu	When the option <b>Gen Names</b> is selected the faceplate will show the text description input fields for the generators.
1	GEN text 1GEN text 15	Text input fields	Text description.



The visibility of the generator check-boxes in the faceplate tab Main is depending on the following conditions:

#### 4.7.4.1 Network determination

Depending on the physical location of a selected circuit breaker in the plant, the network determination function will list only the relevant generators in the faceplate.

#### 4.7.4.2 Generator status

The following conditions will cause a generator to become unavailable for selection and participation in synchronization. The generator will not be listed in the faceplate tab **Main** and the configuration check-boxes in the faceplate tab **Block** will be disabled.

- local point of control for Governor or AVR
- mode reset function is active for Governor or AVR
- external mode is selected for Governor or AVR
- external mode reset is active for Governor or AVR
- external dimming of modes for Governor or AVR
- external dimming of direct adjust buttons for Governor or AVR



The parameter *GNSynPAr.SyncUnavailable.Gen1...Gen15* will receive the input for the unavailable generators from the interaction with the pmsGenM modules.

#### 4.7.4.3 Faceplate configuration

It is possible to block a generator from being visible and/or selectable for synchronization by using the check-boxes from the faceplate tab Block, as shown in Figure 15.

- The check-box under the column Block Participation will prevent the generator from being listed in the faceplate. The Governor/AVR modes will not be influenced by the mode handling functionality described in section 4.7.7.
- The check-box under the column Block Selection will list the generator (either in column A or B, depending on the network determination) but it will appear dimmed and thus restricted for selection. The governor/AVR modes will be influenced by the mode handling functionality described in section 4.7.7.



The configuration of the check-boxes must be done prior to the initiation of the synchronization process. A user with Tune permission rights can perform this configuration.



When the parameter *GNSynPAr.SyncUnavailable.Gen1...Gen15* indicates that a certain generator is unavailable, the corresponding Block Participation check-box will be automatically selected and dimmed and the Block Selection check-box will be dimmed.



When the parameter *SynCfgPar.DirectSyncOperation* is true, the visibility of the generator check-boxes listed in the faceplate tab Main is depending on the entered text via the tab **Edit** > Selection > GEN Names (Figure 14). If an input text field is left empty, the corresponding generator will be hidden from the listed option-buttons.

### 4.7.4.4 Application logic

It is possible to configure the blocking settings by using the input parameter *ExtPar*.

- When the input parameter *ExtPar.ExtSelBlockGenParticipation* is true, the participation of the generators will be blocked if the respective values from the parameter *ExtPar.ExtCmdBlockGenParticipation.Gen1...Gen15* are set to true. While *ExtPar.ExtSelBlockGenParticipation* is true, the faceplate interaction (Figure 15, field 1) is disabled.
- After the parameter *ExtPar.ExtSelBlockGenParticipation* returns to false, the blocking settings will remain to their current values and the faceplate interaction (Figure 15, field 1) will be enabled.
- When the input parameter *ExtPar.ExtSelBlockGenSelection* is true, the selection of the generators will be blocked if the respective values from the parameter *ExtPar.ExtCmdBlockGenSelection.Gen1...Gen15* are set to true. While *ExtPar.ExtSelBlockGenSelection* is true, the faceplate interaction (Figure 15, field 2) is disabled.
- After the parameter *ExtPar.ExtSelBlockGenSelection* returns to false, the blocking settings will remain to their current values and the faceplate interaction (Figure 15, field 2) will be enabled.



Figure 15 Faceplate tab Block and visibility of generators

Field	Indication	ltem	Description
1	Block Participation Gen1Gen15	Check-box	When a check-box is marked, the generator will be hidden from the list. The mode change of the governor/AVR will not apply.
2	Block Selection Gen1Gen15	Check-box	When a check-box is marked, the generator will be shown in the list, but it will be dimmed. The mode change will still apply.
3	Check-boxes for generator selection	Check-box	The Gen1 check-box is hidden, because the check-box for Block Participation Gen1 is marked.
			The Gen4 check-box is dimmed, because the check-box for Block Selection Gen4 is marked.



When the configuration parameter *SynCfgPar.DirectSyncOperation* is true, the generator selection relays can be activated via check-boxes in the faceplate tab Main, as shown in Figure 16. This configuration is intended as an alternative operation method, where the pmsSNSyncSuperv control module is independent from the pmsCBSyncM and pmsGenM modules. The synchronization process will be executed according to the manual interaction from the faceplate buttons and not by the automatic sequence.



Figure 16 Direct generator selection

Table 25 Faceplate	configuration	for direct circ	cuit breaker s	selection
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Field	Indication	ltem	Description
1	GEN text 115	Check-boxes	If <i>SynCfgPar.DirectSyncOperation</i> = true, the selected check-box will activate a generator relay when the synchronization process is started.

# 4.7.5 Exchange Relay for U-Var/U-Ref

The frequency and voltage measurements from the two sides of a circuit breaker are directed to the synchronizing device. In principle, the variable side (U-Var) and the reference side (U-Ref) for different types of circuit breakers is defined according to the drawing shown Figure 17.



Figure 17 U-Var / U-Ref definition

Table 2	6 U-Var	·/U-Ref	definition
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Circuit breaker type	Circuit breaker tag	Definition of U-Var/U-Ref
Grid breaker	СВ-А, СВ-В	The grid side is the U-Ref, the busbar side is the U-Var.
Generator breaker	CB-C, CB-D, CB-E, CB-F	The generator side is the U-Var, the busbar side is the U-Ref.
Network breaker	CB-G	The left/top side is the U-Var, the right/down side is the U-Ref.

For network breakers (e.g. bus-couplers), the measurements applied to the synchronization equipment may need to be interchanged depending on the busbar where the participating generator(s) is connected. If a generator is physically connected to the side of the breaker defined as U-Ref, the measurements brought to the synchronizing device need to be swapped.

The control module pmsSNSyncSuperv will automatically activate the output parameter *IO\_Output.VarRefEx.Value* for connection to an exchange relay, when a generator selected for synchronization is located on the reference side of a network breaker. This is shown in Figure 18, where a generator is selected from the faceplate tab Main. When one or more generators are selected from column B and the synchronization process is started, the dedicated exchange relay output will be activated.



Figure 18 Exchange relay activation with GEN selection from B-column

Field	ltem	Description
1	Check-box	A selected generator from the A-column will not activate the parameter <i>IO_Output.VarRefEx.Value.</i>
2	Check-box	A selected generator from the B-column will activate the parameter IO Output.VarRefEx.Value.

Table 27. Exchange relay activation v	with GEN selection from B-column
---------------------------------------	----------------------------------



The feedback from activating the exchange relay must be received via the parameter *IO\_Input.VarRefEx*. If the feedback is not received within a configurable time-out setting, the control module pmsSNSyncSuperv will raise an alarm and the synchronization sequence will be cancelled. The time-out value is configured via the parameter *SynCfgPar.SelVarExTO*.

# 4.7.6 Signal interface with Synchronizing Device

# 4.7.6.1 Remote, Ready, Operate, Error

The faceplate tab **Main** presents the status signals from the synchronizing device, as shown in Figure 19. These digital input signals are configured via the *IO\_Input* parameter of the control module, as shown in Table 28.

Status Status Ready Operate	Synchroni	<ul> <li>Parameter Set 1</li> <li>Parameter Set</li> </ul>
A B	Remote Error Gen. Status	<ul> <li>Parameter Set 1</li> <li>Parameter Set</li> </ul>
		CB Status CB text 1 CB text 2 CB text 3 CB text 4 CB text 5 CB text 5 CB text 6 CB text 7 CB text 8
		CB text 9 CB text 10 Par. Commands

Figure 19 Faceplate tab Main – Sync device status

Field	Indication	Parameter	Description
1	Sync Ready	IO_Input.SyncReady1.Value	If parameter is TRUE, the sync device is not operating (i.e. stand-by) and it is ready to be started.
2	Sync Operate	IO_Input.SyncOperate1.Value	If parameter is TRUE, the sync device is operating (i.e. active) and it can be stopped.
3	Sync Remote	IO_Input.Remote.Value	If parameter is FALSE, the sync device is in Local point of control.
4	Sync Error	IO_Input.SyncError1.Value	If parameter is TRUE, the sync device is reporting a failure.

Table 28 Parameter configuration for Status signals



When the synchronizing device is controlled remotely (i.e. *IO\_Input.Remote.Value* = true) the synchronizing equipment must be in Auto operating mode thus allowing the automatic synchronization from a remote location.



When the synchronizing device is controlled locally (i.e. *IO\_Input.Remote.Value* = false) or when it reports a failure (i.e. *IO\_Input.SyncError1.Value* = true), the pmsSNSyncSuperv control module will cancel the software sequence and all selection relays will be deactivated.

It is possible to change the descriptions (tag names) of the status signals. This configuration is done via the NLS aspect in **Plant Explorer under Library Structure > Preferences & Customizations > pms\_NLS > pmsSNLib\_PG2 > NLS pmsSNLib PG2**, as it is described in Table 29.

The descriptions can be changed from English language to another language by modifying the text description of the relevant Resource Id.

No.	Indication	NLS Resource (Resource Id)	Description
1	Sync Ready	NLSID_pmsReady	Text input for Sync Ready status description
2	Sync Operate	NLSID_pmsOperate	Text input for Sync Operate status description
3	Sync Remote	NLSID_pmsRemote	Text input for Sync Remote status description
4	Sync Error	NLSID_pmsError	Text input for Sync Error status description

# Table 29 Description configuration for sync device status

### 4.7.6.2 Start, Stop

The start and stop command signals to the synchronizing device are issued from the faceplate tab **Main**, as shown in Figure 20. The digital output signals are configured via the *IO\_Output* parameter of the control module, as shown Table 30.

Table 30 Parameter configuration	for Start/Stop commands
----------------------------------	-------------------------

No	Command	Parameter	Description
1	Start Sync	IO_Output.SyncStart.Value	When parameter is TRUE the sync device is requested to start.
2	Stop Sync	IO_Output.SyncStop.Value	When parameter is TRUE the sync device is requested to stop.

Synchronization					
/lain Block	:				
Status Ready	Remote	Parameter Set 1			
<ul> <li>Operat</li> </ul>	e 🔘 Error	Parameter Set			
A B-	Gen. Status	CB Status			
	GEN text 1	O CB text 1			
	GEN text 2	CB text 2			
~	GEN text 3	CB text 3			
	GEN text 4	CB text 4			
		CB text 5			
		CB text 6			
		OCB text 7			
		CB text 8			
		CB text 9			
		CB text 10			
		Par. Commands			
		Parameter Set 3 🔹			
		-Sync. Commands			
		Sync. Start	Stop		
L	0	JJ			
	0 00				
			' b		

Figure 20 Faceplate tab Main - Commands (Start, Stop)

Field	Indication	Item	Description
1	Start Sync icon	Push-button	The Start sync button is enabled for operation when IO_Input.SyncReady1.Value = true, IO_Input.SyncRemote.Value = true and a circuit breaker selection relay is active.
2	Stop Sync icon	Push-button	The Stop sync button is enabled for operation when IO_Input.SyncOperate1.Value = true.

The synchronization sequence is initiated by the pmsSNSyncSuperv control module under the following conditions.

- A feedback from a circuit breaker selection relay is received and the dead bus detection function is enabled (refer to parameter set 1 in paragraph Parameter Sets).
- A feedback from a circuit breaker selection relay is received and the start synchronization command from the pmsSNSyncSuperv faceplate tab Main is issued.

Start command remains active (IO\_Output.SyncStart.Value = true) until operate feedback is received (IO\_Input.SyncOperate1.Value = true), confirms that the operation has started.

When the synchronization sequence is initiated, the pmsSNSyncSuperv control module will automatically issue a stop command when

- A time-out for dead bus detection has elapsed (refer to parameter set 1 in paragraph Parameter Sets).
- A generator selection is deactivated and the corresponding parameter set is reset (refer to parameter sets 2-7 in paragraph Parameter Sets).
- The selected circuit breaker has been successfully closed and the synchronization sequence has ended.



Stop command remain active (IO\_Output.SyncStop.Value = true) until ready feedback is received (IO\_Input.SyncReady1.Value = true), confirms that the operation has stopped.

The feedback from activating the start and stop commands must be received via the parameters *IO\_Input.SyncStart and IO\_Input.SyncStop*, respectively. If the feedback is not received within a configurable time, the control module *pmsSNSyncSuperv* will raise an alarm and the synchronization sequence will be cancelled. The time-out value is configured via the parameters *SynCfgPar.SelSyncStartTO* (for the Start command) and *SynCfgPar.SelSyncStopTO* (for the Stop command).

When the synchronization sequence in progress (*IO\_Input.SyncOperate1.Value* = true), the selection options (e.g. Generator selection) from the faceplate tab Main are not available, as it is shown in Figure 21. This is to prevent any selection change while the synchronization process is in progress.

This function is available when the parameter SynCfgPar.DirectSyncOperation is false.



Figure 21 Faceplate tab Main – Synchronization in progress



It is possible to change the descriptions of the start/stop commands. This configuration is done via the NLS aspect in Plant Explorer under Library Structure > Preferences & Customizations > pms\_NLS > pmsSNLib\_PG2 > NLS\_pmsSNLib\_PG2, as it is described in Table 32. The descriptions can be changed from English language to another language by modifying the text description of the relevant Resource Id.

Table 32 Tag names configuration	n for Start/Stop command buttons
----------------------------------	----------------------------------

No.	Push Button	NLS Resource (Resource Id)	Description
1	Sync Start	NLSID_pmsStartSynchronization	Text input for Sync Start command button
2	Sync Stop	NLSID_pmsStopSynchronization	Text input for Sync Stop command button



When the configuration parameter *SynCfgPar.DirectSyncOperation* is true, the synchronization Start and Stop commands can be activated from the faceplate, as shown in Figure 22, as long as the synchronizing device is in remote (*IO\_Input.SyncRemote.Value* = true), This configuration is intended as an alternative operation method, where the pmsSNSyncSuperv control module is independent from the pmsCBSyncM and pmsGenM modules.

📶 Synchroniza	tion : Faceplate PG2		
	Synchroni	zation	
Main Block	1		
© Ready	O Remote	O Parameter Set 1	
O Operate	e 🔘 Error	Parameter Set	
Man	Gen. Status GEN text 1 GEN text 2 GEN text 3 GEN text 4 GEN text 5 GEN text 5 GEN text 6 GEN text 7 GEN text 8 GEN text 9	CB CB Status CB text 1 CB text 2 CB text 3 CB text 3 CB text 4 CB text 5 CB text 5 CB text 6 CB text 7 CB text 8 CB text 9	
	GEN text 10 GEN text 11 GEN text 12 GEN text 13 GEN text 14 GEN text 15	CB text 10 Par. Commands Parameter Set 3 Sync. Commands Sync. Start	Stop
	0		

Figure 22 Start/stop commands

Field	Indication	Item	Description
1	Start Sync icon	Push-button	If SynCfgPar.DirectSyncOperation = true, the start sync button is enabled for operation when IO_Input.SyncReady1.Value = true and IO_Input.SyncRemote.Value = true.
2	Stop Sync icon	Push-button	If <i>SynCfgPar.DirectSyncOperation</i> = true, the stop sync button is enabled for operation when <i>IO_Input.SyncOperate1.Value</i> = true and <i>IO_Input.SyncRemote.Value</i> = true.



The synchronization process will be executed according to the manual interaction from the faceplate buttons and not by the automatic sequence.

1

If the command for stop or start the synchronization process is activated (*IO\_Input.SyncStart* and *IO\_Input.SyncStop*) and the alarm generated by the absence of feedback from the synchronizing device is received (refer to the alarm description in paragraph Alarms) the output commands *IO\_Output.SyncStart* and *IO\_Output.SyncStop* are automatically reset.

#### 4.7.6.3 Parameter Sets

The synchronizing devices often support different configuration settings (i.e. parameter sets), depending on the type of generator or generator groups that are selected for the synchronization process. These settings are a group of values which are stored on the programmable panel of the device. They affect important parameters of the synchronizing process, such as the pulse length for frequency and voltage adjustments, the breaker closing time, etc.

The control module pmsSNSyncSuperv supports 7 different parameter sets and the active parameter set selection relay is presented in the faceplate tab **Main**, as shown Figure 23.

The parameter set selection relay activation is included in the components of the *IO\_Input* parameter, as shown in Table 35.

ization	
	_
O Parameter Set 1	-(1
Parameter Set 3	- 2
CB Status	
CB text 1	
CB text 2	
CB text 3	
CB text 4	
CB text 5	
CB text 6	
O CB text 7	
CB text 8	
CB text 9	
CB text 10	
Par. Commands	
Parameter Set 3 🔹	
Sync. Commands	
G Sync.	
Joyner	
	<ul> <li>Parameter Set 1</li> <li>Parameter Set 3</li> <li>CB Status</li> <li>CB text 1</li> <li>CB text 2</li> <li>CB text 3</li> <li>CB text 4</li> <li>CB text 5</li> <li>CB text 6</li> <li>CB text 6</li> <li>CB text 7</li> <li>CB text 8</li> <li>CB text 9</li> <li>CB text 10</li> <li>Parameter Set 3</li> <li>Sync.</li> </ul>

Figure 23 Faceplate tab Main - Status (Parameter Sets)

Field	Indication	Item	Description
1	Parameter Set 1	IO_Input.ParamSet1.Value	Indication of status for parameter set 1.
2	Parameter Set 27	IO_Input.ParamSet27.Value	Indication of status for parameter set 27



The feedback from activating a Parameter Set must be received via the parameters *IO\_Input.ParamSet1.Value... IO\_Input.ParamSet7.Value*. If the feedback is not received within a configurable time-out setting, the control module pmsSNSyncSuperv will raise an alarm and the synchronization sequence will be cancelled. The time-out value is configured via the parameters *SynCfgPar.SelParamSetTO* and it is common for all the parameter set commands.



The *IO\_Intput.ParamSet1* is reserved for a dead bus or synchronous net condition, therefore the value 1 must not be assigned to any generator. The parameter set 1 will be activated for a configurable time period via the parameter *SynCfgPar.SyncCheck\_TO*. This setting represents the time period to allow the synchronizing device to detect a dead bus or synchronous net condition and close the circuit breaker. When the time period has elapsed and the circuit breaker has not closed, the control module pmsSNSyncSuperv will continue with the synchronization sequence and present the list of available generators for selection.

The purpose of activating the parameter set 1 is to request the synchronizing device to check if the circuit breaker can be closed immediately, without going through the synchronization process. Such conditions may apply during a dead bus connection to an already energized network or when the frequency and voltage measurements are within tolerable values.

The synchronizing device is expected to rely on a synchro-check feature for a safe and reliable closing of the breaker, thus omitting the selection of the generator for measurement adjustments.

If the synchronizing device does not support the feature of dead bus detection, the parameter *SynCfgPar.SyncCheck\_TO* must be set to 0d0h0m0s0ms and the ParamSet1 will be voided.

The commands to activate the digital output signals for each of the 7 different parameter sets are included in the components of the *IO\_Output* parameter, as shown Table 35.

No	Item	Description
1	IO_Output.ParamSet1.Value	Activate parameter set 1 selection relay.
2	IO_Output.ParamSet2.Value	Activate parameter set 2 selection relay.
3	IO_Output.ParamSet3.Value	Activate parameter set 3 selection relay.
4	IO_Output.ParamSet4.Value	Activate parameter set 4 selection relay.
5	IO_Output.ParamSet5.Value	Activate parameter set 5 selection relay.
6	IO_Output.ParamSet6.Value	Activate parameter set 6 selection relay.
7	IO_Output.ParamSet7.Value	Activate parameter set 7 selection relay.

### Table 35 Parameter configuration for parameter sets

Configuration of which parameter set shall be activated can be done from application code or via the pmsSNSyncSuperv control module faceplate tab **Main**. The pmsSNSyncSuperv control module can handle single and multiple generator set selection.

The parameter *MaxNoGenSelection* must be assigned with a dint number corresponding with the maximum number of generators allowed to participate in the synchronization process. This feature is relevant for the synchronization of network circuit breakers (i.e. bus coupler).



It is possible to change the descriptions (tag names) of the parameter set selection relays. This configuration is done via the tab **Edit** > Selection > Parameter Set from the extended faceplate view, as shown in Figure 24. A description must be entered in the text field followed by the ENTER key. A user with Application Engineer role can perform this configuration.



Figure 24 Faceplate tab Edit - Parameter Set names

Table 36 Faceplate configuration	for text description	of generator relays
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Field	Indication	ltem	Description
1	Parameter Set	Drop-down menu	When the option Parameter Set is selected the faceplate will show the text description input fields for the parameter sets.
2	Parameter Set 17	Text input fields	Text description.



The configuration of the parameter set relay names is saved in the General Properties aspect of the pmsSNSyncSuperv object type in 800xA. It is important to take a backup of this aspect (e.g. by using the Import/Export tool from the Plant Explorer) after completing the configuration, in case there is a need to restore the settings.



It is possible to identify the generator sets that have been selected to participate in the synchronization process via the pmsSNSyncSuperv control module faceplate tab Main from the parameter SelectedGen.Gen1...Gen15. This can be used in the application logic to define the generator selection configuration when the parameter set is selected from the parameter ExtPar.

### 4.7.6.4 Parameter Sets - single generator selection

The configuration, of which parameter set shall be activated, when single generator selection is applicable, is done via the *ParamSet* parameter, as shown Table 37. The components *ParamSet.Gen1...Gen15* must be assigned with a dint number 2, 3, 4, 5, 6 or 7. Based on this number, the corresponding parameter set 2-7 will be activated via the digital output signals *IO\_Output.ParamSet2.Value ... IO\_Output.ParamSet7.Value*, when the relevant generator is selected.

Parameter	Description		
ParamSet.TRF	Shall not be used.		
ParamSet.TRF2	Shall not be used.		
ParamSet.Gen1	Parameter set 2-7, when the generator 1 is selected.		
ParamSet.Gen2	Parameter set 2-7, when the generator 2 is selected.		
ParamSet.Gen3	Parameter set 2-7, when the generator 3 is selected.		
ParamSet.Gen4	Parameter set 2-7, when the generator 4 is selected.		
ParamSet.Gen5	Parameter set 2-7, when the generator 5 is selected.		
ParamSet.Gen6	Parameter set 2-7, when the generator 6 is selected.		
ParamSet.Gen7	Parameter set 2-7, when the generator 7 is selected.		
ParamSet.Gen8	Parameter set 2-7, when the generator 8 is selected.		
ParamSet.Gen9	Parameter set 2-7, when the generator 9 is selected.		
ParamSet.Gen10	Parameter set 2-7, when the generator 10 is selected.		
ParamSet.Gen11	Parameter set 2-7, when the generator 11 is selected.		
ParamSet.Gen12	Parameter set 2-7, when the generator 12 is selected.		
ParamSet.Gen13	Parameter set 2-7, when the generator 13 is selected.		
ParamSet.Gen14	Parameter set 2-7, when the generator 14 is selected.		
ParamSet.Gen15	Parameter set 2-7, when the generator 15 is selected.		
ParamSet.NumberOfGrids	Shall not to be used.		

Table 37 Parameter configuration for ParamSet



MaxNoGenSelection parameter must be set to value 1 indicating that the single generator selection is applicable in the synchronization process. If the MaxNoGenSelection is set to a value higher than 1 the parameter set selection from the parameter *ParamSet* will not be applicable.

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It is possible to externally select the parameter set that needs to be activated by setting the input parameter *ExtPar.ExtParamSelection* to true and *ExtPar.ExtSelectParamSetID* to a dint number 2, 3, 4, 5, 6 or 7. Based on this number, the corresponding parameter set 2-7 will be activated via the digital output signals *IO\_Output.ParamSet2.Value* ... *IO\_Output.ParamSet7.Value*.

#### 4.7.6.5 Parameter Sets - multiple generator selection

When multiple generator selection is applicable the parameter set selection relay activation can be done directly from the pmsSNSyncSuperv faceplate tab **Main** as shown in Figure 25.

💥 Synchroniza	ation : Faceplate PG2			
Synchronization				
Main Block				
<ul> <li>Ready</li> </ul>	Remote	O Parameter Set 1		
Operat	e 🔘 Error	O Parameter Set		
A B-	Gen. Status	CB Status		
	GEN text 1	CB text 1		
	O GEN text 2	CB text 2		
	GEN text 3	CB text 4		
<b>_</b>	O GEN ICAL I	CB text 5		
		CB text 6		
		CB text 7		
		O CB text 8		
		CB text 9		
		CB text 10		
		Par. Commands		
		Parameter Set 3 🔹		
		Parameter Set 2		
		Parameter Set 3	(1	
		Parameter Set 5	Ľ	
		Parameter Set 6		
	0	Parameter Set 7		

Figure 25 Faceplate tab Main - Parameter Set commands

Table 38 Parameter set	t commands	configuration
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Field	Indication	Item	Description
1	Parameter Set selection	Drop down menu	Selection list to choose the parameter set that is necessary to be activated on the sync device in the synchronization process. Available when the parameter <i>MaxNoGenSelection</i> is > 1.

The visibility of each of the parameter sets in the drop down menu listed in the faceplate tab **Main** is depending on the entered text via the tab **Edit** > Selection > Parameter Set, as shown in Figure 24. If an input text field is left empty, the corresponding parameter set will be hidden from the listed available parameter sets.



*MaxNoGenSelection* parameter must be set to a dint value higher than 1 indicating that the multiple generator selection is applicable in the synchronization process. If the *MaxNoGenSelection* is not set to a value higher than 1 the parameter set selection from the parameter faceplate tab Main will not be applicable.



I t is possible to externally select the parameter set that needs to be activated by setting the input parameter *ExtPar.ExtParamSelection* to true and *ExtPar.ExtSelectParamSetID* to a dint number 2, 3, 4, 5, 6 or 7. Based on this number, the corresponding parameter set 2-7 will be activated via the digital output signals *IO\_Output.ParamSet2.Value* ... *IO\_Output.ParamSet7.Value*. When the parameter *ExtPar.ExtParamSelection* is true the parameter set selection drop-down menu from the faceplate **Main** tab will be automatically dimmed, thus restricted from selection.



The parameter selection drop-down menu can be hidden from the faceplate **Main** tab by setting the *ExtPar.ExtHideParamCmds* parameter to true.

### 4.7.6.6 Close Permissive

The control module pmsSNSyncSuperv can affect the visibility of the direct close command button in the pmsCBSyncM faceplate, which is by default dimmed when the position of breaker is open. When the synchronization session is initiated from the command button in the pmsCBSyncM faceplate, the pmsSNSyncSuperv module will monitor the input parameter *IO\_Input.ClosePermissive* and if the value is true, the close command button will be enabled for operation, as shown in Figure 26.

The parameter *IO\_Input.ClosePermissive* should be used as an alternative method for bypassing the synchronization sequence, if the parameter Set 1 is not supported by the synchronizing device.



Figure 26 Close permissive and pmsCBSyncM faceplate

Field	Indication	ltem	Description
1	Close command	Push-button	When the <i>IO_Input.ClosePermissive.Value</i> = true and the synchronization is in progress, the direct close command button will be enabled.
2	Initiates sync command	Push-button	Request to initiate the synchronization software in the pmsSNSyncSuperv module.

Table 39	Close	permissive	and pr	nsCBSyn	cM faceplate
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### 4.7.7 Generator mode handling

The control module pmsSNSyncSuperv affects the Governor and AVR modes on the generators which are connected to the U-Var side of the selected circuit breaker in the following way:

- The selected generator(s) will be set in droop mode for governor and droop mode for the AVR, to receive the raise/lower pulses according to the adjustments dictated by the synchronizing device.
- The generators that run parallel to the selected machine(s) are set in MW mode for the governor and PF mode for the AVR, to avoid MW/MVAr transfer between the generators. Exceptions apply if a generator is unavailable, as described in section Selection Relays for Generators.
- After the synchronizing session is completed, all governors and AVRs will return to their previous modes.

When a selection is made from the available generators listed in the pmsSNSyncSuperv faceplate, the parameter *SynGNPar.ModeSet.Gen1...Gen15* will interact with the control module pmsGenM to change the governor and AVR modes.

$\overline{\mathcal{N}}$		Synchron	ization	
in	Block			
Statu Re	us eady	Remote	O Parameter Set 1	
00	perate	Error	Parameter Set	
А	B	Gen. Status	CB Status	
~		GEN text 1	CB text 1	
•		GEN text 2	CB text 2	
		GEN text 3	CB text 3	
		GEN text 4	CB text 4	
			CB text 5	
			CB text 6	
			CB text 7	
			CB text 8	
			CB text 9	
			CB text 10	
			Par. Commands	
			·	
			Sync. Commands	
			Gy Sync.	
	in Statu	in Block Status Ready Operate	in Block Status Ready Remote Operate Error A B Gen. Status GEN text 1 GEN text 2 GEN text 3 GEN text 4	

Figure 27 Governor and AVR mode handling (pmsSNSyncSuperv faceplate)

Field	Indication	ltem	Description
1	Gen1	Check-box	The Governor and AVR mode of the selected generator will be set to Droop/Droop.
2	Gen2	Check-box	The Governor and AVR mode of the generator in parallel with the selected machine, will be set to MW/PF.

|--|

Generator-1 : Fa	ceplate_PG2		1	👑 Gener	ator-1 : Face	plate_PG2		_ 🗆 🗙	1
$\sim$	Generato Generato	or-1 or 1		$\sim$		Generato Generato	or-1 or 1		
Main Turbine C	Cmd.   Trend   A	larms   Events   Measu	1	Main	Turbine Cm	d.   Trend   Al	larms   Events	Measu 🚺	ļ
_	_	Governor			_	_	-Governor -		
мм	G	Droop <u>Conf.</u>	-1	1	мм с		MW	• Conf.	-3
L		Direct Adjust		l	-	1	Seto	oint	
U	132.0 kV			U		132.0 kV	1	2.0 MW	
f	50.0 Hz		I .	f		50.0 Hz			
Р	12.0 MW	AVR	I .	Р		12.0 MW	AVR		
Q	3.0 MVAr	Droop - Conf.	2	Q		3.0 MVAr	PF	* Conf.	4
PF T	1.0 Ind.			PF		1.0 Ind.			
Pmax	20.0 MW	Direct Adjust		Pmax		20.0 MW	Setpoint		
Amb.temp	39.9			Amb.	temp	39.9 C	1.0	Inductive	
	0	•••• §				0	000	<b>%</b>	

Figure 28 Governor and AVR mode handling (pmsGenM faceplate)

Field	Indication	ltem	Description
1	Gov Droop	Text field	The Governor mode of the selected generator is set to Droop.
2	AVR Droop	Text field	The AVR mode of the selected generator is set to Droop.
3	Gov MW	Text field	The Governor mode of the generator on the same side as the selected machine is set to MW. Refer to section Selection Relays for Generators for the mode handling exceptions when a generator becomes unavailable for participation.
4	AVR PF	Text field	The AVR mode of the generator on the same side as the selected machine is set to PF. Refer to section Selection Relays for Generators for the mode handling exceptions when a generator becomes unavailable for participation.

# Table 41 Governor and AVR mode handling (pmsGenM faceplate)

# 4.7.8 Indication of synchronization in progress

The control module pmsSNSyncSuperv is providing a software indication that the synchronization sequence is in progress. When a circuit breaker is selected for synchronization via the pmsCBSyncM faceplate or when a direct operation is performed from the pmsSNSyncSuperv faceplate, the Boolean output parameter *SyncOperation* will be set to true.

# 4.7.9 Indication of Variable/Reference side

The control module pmsSNSyncSuperv is providing a software indication of the busbar identity numbers assigned to the variable and reference side of a selected circuit breaker, according to the network determination. When a circuit breaker is selected for synchronization via the pmsCBSyncM faceplate, the double integer output parameters *UREF* and *UVAR* will be set to the PB/LB identity numbers, according to the network matrix configuration.

# 4.7.10 Synchronization time-out

The control module pmsSNSyncSuperv is monitoring the time period of the synchronization session. When the operation is in progress (i.e. *SyncOperation* = true) and the configuration time parameter *SynCfgPar.SyncCancelTO* has elapsed, an alarm will be raised and the synchronization sequence will be cancelled.

It is possible to override the synchronization time-out feature, by setting the parameter *SynCfgPar.SyncCanceITO* to 0d0h0m0s0ms.

# 4.7.11 Alarms

The control module pmsSNSyncSuperv shall monitor the alarm conditions and will generate the alarm messages, as described in Table 42.

No.	Description	Alarm condition	Alarm message (Resource Id)
1	Spurious dead bus.	When the network determination detects a contingency on any side of the breaker with power sources connected and frequency measurement< <i>FreqLowLimit</i> or voltage measurement< <i>VoltLowLimit</i> .	NLSID_SpurDB
2	Spurious powered bus.	When the network determination detects a contingency on any side of the breaker with no power sources connected and frequency measurement> <i>FreqLowLimit</i> or voltage measurement> <i>VoltLowLimit</i> .	NLSID_SpurPow
3	Feedback from multiple circuit breaker selection relays.	When the feedback <i>IO_Input.CB1C10</i> is received from more than one circuit breaker selection relays.	NLSID_TwoCBSel
4	Feedback from multiple generator selection relays.	When the feedback <i>IO_Input.Gen1Gen15</i> is received from more than the maximum allowed generator selection relays.	NLSID_MaxGenSel
5	No feedback from circuit breaker selection relay.	When the feedback <i>IO_Input.CB1C10</i> is not received after a circuit breaker selection relay <i>IO_Output.CB1C10</i> is activated.	NLSID_cCBFeedback

#### Table 42 Alarm configuration

No.	Description	Alarm condition	Alarm message (Resource Id)
6	No feedback from generator selection relay.	When the feedback <i>IO_Input.Gen1Gen15</i> is not received after a generator selection relay <i>IO_Output.Gen1Gen15</i> is activated.	NLSID_cGenFeedback
7	Spurious energized circuit breaker selection relay.	When the feedback <i>IO_Input.CB1C10</i> is received from a circuit breaker selection relay without a synchronization session in progress.	NLSID_SpurCBSel
8	Spurious energized generator selection relay.	When the feedback <i>IO_Input.Gen1Gen15</i> is received from a generator selection relay without a synchronization session in progress.	NLSID_SpurGenSel
9	No feedback from the synchronizing device.	When the proper feedback is not received after the following commands to the synchronizing device: Parameter set: <i>IO_Output.ParamSet1ParamSet7</i> Sync Start command: <i>IO_Output.SyncStart</i> Sync Stop command: <i>IO_Output.SyncStop</i> Var/Ref exchange command: <i>IO_Output.VarRefEx.</i>	NLSID_SyncFeedback
10	Error from synchronizing device.	When the <i>IO_Input.SyncError1.Value</i> = true.	NLSID_SyncError1
11	Multiple circuit breaker request.	A request for synchronization is received from more than one pmsCBSyncM faceplate command buttons.	NLSID_MultiCBSyncReq
12	Synchronizing session timed out.	The synchronization session has reached the time-out period of SynCfgPar.SyncCanceITO.	NLSID_SyncTimeout

The text messages (i.e. in Alarm List) for the above alarms are configurable via the Alarm and Event Translator aspect in Plant Explorer under Library Structure > Preferences & Customizations > PMS\_Alarm&Event. These messages can be changed from English language to another language by modifying the relevant Resource Id (i.e. NLSID\_....) to a desired message (a text string up to 60 characters).

# 4.7.12 Events

The control module pmsSNSyncSuperv shall monitor the event conditions and will generate the event messages, as described in Table 43.

No	Description	Event condition	Event message (Resource Id)
1	Circuit breaker selection relay feedback	When any feedback <i>IO_Input.CB1C10</i> is activated or deactivated.	NLSID_SyncSelectionRelay + SynCfgPar.NameSyncCB01 +NLSID_On  NLSID_SyncSelectionRelay +SynCfgPar.NameSyncCB10 +NLSID_On (or NLSID_Off)
2	Generator selection relay feedback	When any feedback <i>IO_Input.Gen1Gen15</i> is activated or deactivated.	NLSID_SyncSelectionRelay +NLSID_GEN1Sel +NLSID_On NLSID_SyncSelectionRelay +NLSID_GEN2Sel +NLSID_On  NLSID_SyncSelectionRelay +NLSID_GEN15Sel +NLSID_On (or NLSID_Off)
3	Parameter Set feedback	When <i>IO_Input.ParamSet1…7</i> is activated or deactivated.	NLSID_SyncSelectionRelay +NLSID_Param1 +NLSID_On NLSID_SyncSelectionRelay +NLSID_Param2 +NLSID_On  NLSID_SyncSelectionRelay +NLSID_Param7 +NLSID_On (or NLSID_Off)
4	Sync Ready feedback	When <i>IO_Input.SyncReady1</i> is activated or deactivated.	NLSID_SyncReady1 +NLSID_On (or NLSID_Off)
5	Sync Operate feedback	When <i>IO_Input.SyncOperate1</i> is activated or deactivated.	NLSID_SyncStart1 +NLSID_On (or NLSID_Off)
6	Remote feedback	When <i>IO_Input.Remote</i> is activated or deactivated.	NLSID_Remote +NLSID_On (or NLSID_Off)
7	Error feedback	When <i>IO_Input.Error1</i> is activated or deactivated.	NLSID_Error1 +NLSID_On (or NLSID_Off)
8	Close Permissive feedback	When <i>IO_Input.ClosePermissive</i> is activated or deactivated.	NLSID_ClosePermissive +NLSID_On (or NLSID_Off)
9	U-Var/U-Ref exchange relay feedback	When <i>IO_Input.VarRefEx</i> is activated or deactivated.	NLSID_UVarRef +NLSID_On (or NLSID_Off)

The text messages (i.e. in Event List) for the above events are configurable via the Alarm and Event Translator aspect in Plant Explorer under Library Structure > Preferences & Customizations > PMS\_Alarm&Event. These messages can be changed from English language to another language by modifying the relevant Resource Id (i.e. NLSID\_....) to a desired message (a text string up to 60 characters).

# 4.7.13 Required I/O

An overview of the required I/O is listed in Table 44, Table 45 and Table 46, with respect to significance when setting up the interface connections for the synchronization control module. The description "mandatory" implies that the internal logic of the control modules requires data from the variable in order to function properly. The description "optional" implies that the internal logic of the control modules can also handle data from the variable, but it could be omitted without affecting the functionality of the module.

Field	IO_Input	Importance	Description
1	iMV_Freq.BB01	Optional	Frequency PB01.
2	iMV_Freq.BB02	Optional	Frequency PB02.
3	iMV_Freq.BB03 BB15	Optional	Frequency PB03-PB15.
4	iMV_Freq.BB16	Optional	Frequency LB01.
5	iMV_Freq.BB17	Optional	Frequency LB02.
6	iMV_Freq.BB18BB50	Optional	Frequency LB03-PB35.
7	iMV_Volt.BB01	Optional	Voltage PB01.
8	iMV_Volt.BB02	Optional	Voltage PB02.
9	iMV_Volt.BB03BB15	Optional	Voltage PB03-PB15.
10	iMV_Volt.BB16	Optional	Voltage LB01.
11	iMV_Volt.BB17	Optional	Voltage LB02.
12	iMV_Volt.BB18BB50	Optional	Voltage LB03-PB35.

Table 44 Significance iMV\_Freq, iMV\_Volt components (analogue inputs)

Field	IO_Input	Importance	Description
1	IO_Input.CB1	Mandatory	Feedback from selection relay for CB1.
2	IO_Input.CB2 CB10	Optional	Feedback from selection relays for CB2-CB10. Required depending on the applicable circuit breakers.
3	IO_Input.Gen1	Mandatory	Feedback from selection relay for Gen1.
4	IO_Input.Gen2 Gen15	Optional	Feedback from selection relays for Gen2-Gen15. Required depending on the applicable generators.
5	IO_Input.SyncReady1	Mandatory	Feedback from synchronizing device for Ready status.
6	IO_Input.SyncOperate1	Mandatory	Feedback from synchronizing device for Operate status
7	IO_Input.SyncError1	Optional	Feedback from synchronizing device for Error status.
8	IO_Input.ParamSet1	Optional	Feedback from synchronizing device for ParamSet1. Required for dead bus feature.
9	IO_Input.ParamSet2	Mandatory	Feedback from synchronizing device for ParamSet2
10	IO_Input.ParamSet3 ParamSet7	Optional	Feedback from synchronizing device for ParamSet3-7. Required depending on the applicable parameter sets.
11	IO_Input.VarRefEx	Optional	Feedback from exchange relay. Required for network breakers.
12	IO_Input.ClosePermissive	Optional	Feedback from synchronizing device for direct closing.
13	IO_Input.Remote	Mandatory	Feedback from synchronizing device for Remote status

	Table 45 Significance of IO	Input components	(digital inputs)
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# Table 46 Significance of IO\_Output components (digital outputs)

Field	IO_Input	Importance	Description
1	IO_Output.CB1	Mandatory	Command for selection relay CB1.
2	IO_Output.CB2CB10	Optional	Command for selection relay CB2-CB10. Required depending on the applicable circuit breakers.
3	IO_Output.Gen1	Mandatory	Command for selection relay Gen1.
4	IO_Output.Gen2 Gen15	Optional	Command for selection relays Gen2-Gen15. Required depending on the applicable generators.
5	IO_Output.SyncStart	Mandatory	Command for starting the synchronizing device.
6	IO_Output.SyncStop	Mandatory	Command for stopping the synchronizing device.
7	IO_Output.ParamSet1	Optional	Command for activating the dead bus detection feature
8	IO_Output.ParamSet2	Mandatory	Command for activating the parameter set for a selected generator.
9	IO_Output.ParamSet3 ParamSet7	Optional	Command for activating the parameter sets depending on the applicable generators.
10	IO_Output.VarRefEx	Optional	Command for activating the exchange relay. Required for network breakers.

# 4.8 Operation

The operational steps required to perform the synchronization procedure are described in the following sections. The text remark "optional" indicates that a feature may be omitted.

# 4.8.1 Synchronization with supervision of pmsCBSyncM/pmsGenM modules

The steps described in this section apply when the control module pmsSNSyncSuperv is configured to supervise the pmsCBSyncM and pmsGenM control modules. This is a typical case where the synchronization functionality is fully integrated with the generator and circuit breaker objects available in the pmsGenLib and pmsCBLib libraries respectively.

STEP 1:

Initiating the synchronization process for closing a circuit breaker (refer to Figure 9).

Operation <sup>.</sup>	Result <sup>.</sup>	Comment:
<ul> <li>The faceplate aspect of the circuit breaker module pmsCBSyncM is called up and the synchronization request command button is operated from the main faceplate view.</li> </ul>	<ul> <li>The output for the circuit breaker selection relay is activated.</li> <li>The output for starting the synchronizing device is activated.</li> <li>The output for parameter set 1 is activated (optional).</li> <li>The output for stopping the synchronizing device is activated if parameter set 1 is deactivated (optional).</li> </ul>	<ul> <li>The feedback that the selected circuit breaker relay is activated must be received within a preconfigured time setting.</li> <li>The hardware engineering of the selection relay panel and the synchronizing panel must ensure that, when a breaker is selected, the proper voltage and frequency measurements from the two sides of the breaker (U-Var and U-Ref) shall be sent to the synchronizing equipment.</li> <li>The feedback that the synchronizing device is operating shall deactivate the start output.</li> <li>If the synchronizing equipment supports the dead bus or synchronous network detection and parameter set 1 is implemented, the feedback that the parameter set 1 is activated must be received within a preconfigured time setting.</li> <li>The synchronizing equipment must ensure that the parameter set 1 shall initiate the check for dead bus or synchronous network in order to issue a direct close command to the circuit breaker without performing voltage/frequency adjustments.</li> <li>The parameter set 1 output will remain activated for a preconfigured time setting, thus allowing the synchronizing device to close the circuit breaker. If the circuit breaker has not closed after the defined time has elapsed, the parameter set 1 output will be deactivated and the stop command will be issued to set the device in idle status.</li> </ul>
		the parameter set 1 but can detect a dead bus condition, the close command button in the pmsCBSyncM faceplate can be enabled for operation, when a "permissive" input is received.

# STEP 2:

Selecting the generator(s) that will be required to participate in the process of adjusting the voltage/frequency on the variable side of the circuit breaker (refer to Figure 12).

Operation:	Result:	Comment:
<ul> <li>The faceplate of the pmsSNSyncSuperv control module is called up and the generator(s) will be selected from the list presented in the Main tab.</li> <li>If the parameter set 1 is implemented, the list of available generators will be presented when the time period for the direct closure has elapsed. If the parameter set 1 is not applicable, the generators will be presented right after performing step 1.</li> </ul>	<ul> <li>The generator(s) that has been selected will have the relevant check- box marked, indicating the selection that has been made.</li> </ul>	<ul> <li>When a generator breaker is selected for synchronizing a generator to a bus bar, the faceplate tab Main will present for selection only the specific generator.</li> <li>When a network breaker is selected for synchronizing, the faceplate tab Main will present the available generators on both sides of the respective circuit breaker. The maximum number of generators that can be selected to participate in the sync process is equal to the value of the parameter MaxNoGenSelection.</li> </ul>

# STEP 3 (Optional):

Selecting the parameter set that will be activated on the synchronizing device.

Operation:	Result:	Comment:
- The faceplate of the pmsSNSyncSuperv control module is called up and parameter set will be selected from the drop-down menu presented in the faceplate <b>Main</b> tab.	- The parameter set that will be activated on the synchronizing device, when the synchronization process is started, is now selected.	- When the sync process is started the relevant parameter set selection relay will be activated on the synchronizing device.
If the parameter set will be selected from application code the drop-down menu will be automatically dimmed/hidden (refer to paragraph Parameter Sets).		

### STEP 4:

Proceeding with the command for starting the synchronization (refer to Figure 20).

Operation:	Result:	Comment:		
<ul> <li>The faceplate of the pmsSNSyncSuperv control module is</li> </ul>	- The output for the generator selection relay(s) is	- The feedback that the selected generator relay(s) is activated must be received within a preconfigured time setting.		
called up and the synch start command is issued from the <b>Main</b> tab	activated. - The output for a parameter set (2-7) is activated	The feedback that a parameter set (2-7) is activated must be received within a preconfigured time setting.		
	- The output for starting the synchronizing	The software parameterization of the synchronizing equipment must ensure that the parameter set 2-7 shall reflect the selected generator(s).		
	<ul> <li>device is activated.</li> <li>The governor and AVR modes for the selected generator are both changed to Droop.</li> </ul>	When the output for starting the synchronizing device is activated, the hardware design must ensure that the respective synchronizing equipment is in Auto operating mode, thus allowing the automatic synchronization from a remote location.		
	- The governor and AVR modes for the generators running in parallel with the selected generator are changed to MW (for governor) and PF (for AVR).	- The feedback that the synchronizing device is operating shall deactivate the start output.		
		- The mode change for the governor and AVR is forced on the pmsGenM modules while the synchronization is in progress. When the synchronization is terminated (either by a breaker closure or by cancelling the operation), the governor and AVR will return to their previous modes.		
		The hardware engineering of the selection relay panel and the synchronizing panel must ensure that, when one or more generators are selected, the raise/lower commands for the voltage and frequency adjustments shall be directed from the synchronizing equipment to the proper generator(s).		

# STEP 5:

Terminating the synchronization process (refer to Figure 9)

Operation: - The faceplate of the circuit breaker module pmsCBSyncM is called up and the synchronization cancel command button is operated from the main faceplate view	<ul> <li>Result:</li> <li>The output for stopping the synchronizing device is activated.</li> <li>All outputs for selection relays are deactivated.</li> </ul>	Comment: - The feedback that the synchronizing device is ready shall deactivate the stop output. The synchronization process can be terminated automatically, if the time-out feature is configured or when the synchronizing equipment reports an error (optional).
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When a generator breaker is selected for synchronizing a generator to a busbar, the faceplate tab **Main** will only present the specific generator, as shown in Figure 29.

Figure 29 Generator selection list for a generator breaker

Field	Indication	Description
1	Circuit breaker graphical icon	Graphic element for calling up the faceplate aspect of the pmsCBSyncM circuit breaker (refer to STEP 1 in section Synchronization with supervision of pmsCBSyncM/pmsGenM modules).
2	Faceplate command button	Command to initiate the synchronization procedure in pmsSNSyncSuperv (refer to STEP 4 in section Synchronization with supervision of pmsCBSyncM/pmsGenM modules).
3	Faceplate check- box	Command to select a generator for adjusting frequency/voltage (refer to STEP 2 in section Synchronization with supervision of pmsCBSyncM/pmsGenM modules).

Table 47	Generator	selection	list for a	generator	breaker
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When a grid circuit breaker is selected for synchronizing a plant network to a grid, the faceplate tab **Main** will present the generators that are connected to the variable side of the selected breaker, as shown in Figure 30.



Figure 30 Generator selection list for a grid breaker

Field	Indication	Description
1	Circuit breaker graphical icon	Graphic element for calling up the faceplate aspect of the pmsCBSyncM circuit breaker (refer to STEP 1 in section Synchronization with supervision of pmsCBSyncM/pmsGenM modules).
2	Faceplate command button	Command to initiate the synchronization procedure in pmsSNSyncSuperv (refer to STEP 4 in section Synchronization with supervision of pmsCBSyncM/pmsGenM modules).
3	Faceplate option- buttons	Commands to select a generator for adjusting frequency/voltage (refer to STEP 2 in section Synchronization with supervision of pmsCBSyncM/pmsGenM modules).

# Table 48 Generator selection list for a grid breaker


When a network breaker is selected for synchronizing two islanded busbars, the faceplate tab **Main** will present the generators connected to both sides of the breaker, as shown in Figure 31.

Figure 31 Generator selection list for a network breaker (bus-tie)

Field	Indication	Description
1	Circuit breaker graphical icon	Graphic element for calling up the faceplate aspect of the pmsCBSyncM circuit breaker (refer to STEP 1 in section Synchronization with supervision of pmsCBSyncM/pmsGenM modules).
2	Faceplate command button	Command to initiate the synchronization procedure in pmsSNSyncSuperv (refer to STEP 1 in section Synchronization with supervision of pmsCBSyncM/pmsGenM modules).
3	Faceplate check-boxes	Commands to select a generator for adjusting frequency/voltage (refer to STEP 2 in section Synchronization with supervision of pmsCBSyncM/pmsGenM modules). The A-column reflects the variable side (U-Var) of a circuit breaker according to the hardware configuration. If a generator is selected from the B-column, the exchange relay will be activated for swapping the U-Var/U-Ref measurements applied to the synchronizing device.

Table 49 Generator selection list for a network breaker (bus-tie)

## 4.8.2 Synchronization independent from pmsCBSyncM/pmsGenM modules

The steps described in this section apply when the pmsSNSyncSuperv is configured with no interaction with the pmsCBSyncM and pmsGenM modules. This alternative is used when the synchronization functionality requires to be implemented as a stand-alone feature without integration with the generator and circuit breaker objects.

STEP 1: Selecting a circuit breaker	(refer to	Figure	11).
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Operation:	Result:	Comment:
The faceplate of the synchronization module pmsSNSyncSuperv is called up and a circuit breaker is selected	The output for the circuit breaker selection relay is activated.	The feedback that the selected circuit breaker relay is activated must be received within a preconfigured time setting.
from the <b>Main</b> tab.		The hardware engineering of the selection relay panel and the synchronizing panel must ensure that, when a breaker is selected, the proper voltage and frequency measurements from the two sides of the breaker (U- Var and U-Ref) shall be applied to the synchronizing equipment.

STEP 2: Selecting a generator (refer to Figure 16).

Operation: The faceplate of the	Result: The generator(s) that has been	Comment: The maximum number of
pmsSNSyncSuperv is called up and the generator(s) selected from the <b>Main</b> tab.	check-box marked, indicating the selection that has been made.	to participate in the synchronization process is equal to the value assigned to the parameter <i>MaxNoGenSelection</i> .
		The number of the generators selected must not be higher than the value set for the parameter <i>MaxNoGenSelection</i> .

STEP 3 (Optional): Selecting the parameter set that will be activated on the sync device (refer to Figure 25).

Operation:	Result:	Comment:
The faceplate of the pmsSNSyncSuperv control module is called up and parameter set will be selected from the drop-down menu presented in the <b>Main</b> tab.	The parameter set that will be activated on the synchronizing device when the synchronization process is started has been selected.	When the sync process is started the relevant parameter set selection relay will be activated on the synchronizing device.
If the parameter set will be selected from application code the drop-down menu will be automatically dimmed/hidden (refer to Parameter Sets).		

Operation:	Result:	Comment:
The faceplate of the synchronization module pmsSNSyncSuperv is called up and the synch start command is	The output for the generator selection relay is activated. The output for a parameter set (2-7) is activated.	The feedback that the selected generator relay is activated must be received within a preconfigured time setting.
issued from the <b>Main</b> tab.		The feedback that a parameter set (2-7) is activated must be received within a preconfigured time setting.
		The software parameterization of the synchronizing equipment must ensure that the parameter set 2- 7 shall reflect the selected generator.
		The hardware engineering of the selection relay panel and the synchronizing panel must ensure that, when a generator is selected, the raise/lower commands for the voltage and frequency adjustments shall be directed from the synchronizing
		equipment to the proper generator.

STEP 4: Starting the synchronizing device (refer to Figure 22).

#### STEP 5: Stopping the synchronizing device (refer to Figure 22).

Operation:	Result:	Comment:
The faceplate of the synchronization module pmsSNSyncSuperv is called up and the Stop command is	The output for stopping the synchronizing device is activated (when the Stop command is issued).	The feedback that the synchronizing device is operating shall deactivate the start output.
operated.	The outputs for the selection relays are deactivated.	The feedback that the synchronizing device is ready shall deactivate the stop output.

# **Section 5 Relations**

# **5.1 Related Control Modules**

The relation between the pmsSNSyncSuperv control module and the pmsCBSyncM and pmsGenM modules is shown in Figure 32.



Figure 32 Interconnection between pmsSNSyncSuperv and other modules in PMS

# 5.2 All modules in one application

When the pmsGenM, pmsCBSyncM and the pmsSNSyncSuperv modules are implemented in one application, the interconnection between the modules is established by global variables. A configuration overview is shown in Figure 33.



Figure 33 Interconnection of related modules in one application

# 5.3 Modules distributed over several applications

When the pmsGenM, pmsCBSyncM and the pmsSNSyncSuperv modules are implemented in different applications, interconnection is established by using MMS communication and access variables. A configuration overview is shown Figure 34.



Figure 34 Interconnection of related modules in more than one application

# Section 6 Capacity & Performance

Table 50 Firmware version downloaded in AC800M controllers

Unit	Firmware version
PM866	FW866 5.1.48.40 2010-07-02 (BasicHwLib 5.1-0)
PM891	FW891 5.1.48.40 2010-07-02 (BasicHwLib 5.1-0)

# 6.1 Heap utilization

### 6.1.1 pmsSNSyncSuperv

Table 51 Heap utilization of pmsSNSyncSuperv in AC800M controller

	First instance	2 <sup>nd</sup> and following instances
Heap utilization(MB) in PM866	0.202	0.174
Heap utilization(MB) in PM891	0.212	0.182

### 6.1.2 pmsGNSN

Table 52 Heap utilization of pmsCBSN in AC800M controller

	First instance	2 <sup>nd</sup> and following instances
Heap utilization(MB) in PM866	0.013	0.004
Heap utilization(MB) in PM891	0.011	0.005

# 6.2 Execution Time

### 6.2.1 pmsSNSyncSuperv

Table 53 Execution time of pmsSNSyncSuperv in AC800M controller

Execution time (ms)	Notes
5 ms	For one instance in PM866
1 ms	For one instance in PM891

## 6.2.2 pmsGNSN

Table 54 Execution time of pmsGNSN in AC800M controller

Execution time (ms)	Notes
<0.01 ms	For one instance in PM866
<0.005 ms	For one instance in PM891

## 6.2.3 pmsCBSN

Table 55 Execution time of pmsCBSN in AC800M controller

Execution time (ms)	Notes
<0.01 ms	For one instance in PM866
<0.005 ms	For one instance in PM891

# **Section 7 Application Notes**

A configuration example of the synchronization software will be described in the following sections. The single line diagram in Figure 35 will be used as a basis for the example.



Figure 35 Example of Single Line Diagram

This configuration example will assume that the following circuit breakers are included in the synchronization scheme as shown in Figure 35:

- Incomers from Grid 1 and Grid 2.
- Generator breakers from G1, G2, G3 and G4.
- Bus-coupler between bus sections A-B.

# 7.1 Project structure

A PMS project configured with the Control Builder M Professional is shown in Figure 36. The examples described in the following sections will be based on this project structure.



Figure 36 Example of project structure

# 7.2 Network determination

The first task in configuring the network matrix, is to assign unique identity numbers for all network components (i.e. power busbars, load busbars and circuit breakers):

- Power busbars (PB01 to PB15): The power busbars must be identified starting from the grid connections. The grid connections are defined with the identity PB01 and PB02. If grid connections are not applicable for a certain plant, then PB01 and PB02 shall be configured for generators. The power busbars for the generators must start from identity PBx, where x is 1 + Number of grid connections in the plant. If the plant has 2 grid connections then the first generator must start from identity PB03.
- Load busbars (LB01 to LB35): The load busbars with shed items and connections to power busbars must be identified first. The load busbars of a substation configuration type are not required to be given an identity number.
- Circuit breakers (CB01 to CB160): The circuit breakers that determine if a busbar is connected to an energized network must be identified. The circuit breakers that connect a load to a busbar are not required to be given an identity number.

The assignment of identities for the network example is shown in Figure 37. The power busbars are marked with red background colour, the load busbars with green background colour and the circuit breakers with orange background colour.



Figure 37 Example of network determination

# 7.3 Configuration of circuit breaker and generator objects

The synchronization function supports software connections with the circuit breaker modules (pmsCBSyncM) and the generator modules (pmsGenM). The following sections will describe the configuration of these objects for the synchronization application.

## 7.3.1 Application code for pmsCBSyncM control modules

The control modules pmsCBSyncM are instantiated under a library structure named *Objects*, as shown in Figure 38.



Figure 38 Example of pmsCBSyncM instances used in synchronization

To connect the parameters of the instances it is recommended to create an application specific data type. The example in Figure 39 shows the data type named *pmsNode1*. The necessary components for the parameter connections to the pmsCBSyncM modules are shown with a red frame.

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	Name	Data Type	Attributes	
39	CB1_CBPar	CBPar	retain	1
40	CB2_CBPar	CBPar	retain	
41	CB3_CBPar	CBPar	retain	
42	CB4_CBPar	CBPar	retain	
43	CB5_CBPar	CBPar	retain	
44	CB6_CBPar	CBPar	retain	
45	CB7_CBPar	CBPar	retain	
46	SN_AllCBSynPar	pmsCBSNPar	retain	
47	SN AllSynCBPar	pmsSNCBPar	retain	

Figure 39 Example of data type components for the pmsCBSyncM instances

One control module of type pmsCBSyncM must be instantiated for each breaker included in the synchronization scheme. An example of the parameter connections is shown, in Figure 40.

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	Name	Data Type	Parameter	Description	•
1	Name	string[30]	'CB-01'	IN EDIT: Name of the object	1
2	Description	string[40]	'Grid-1 Incomer'	IN EDIT: Description of the object	
3	VoltageLevel	dint	1	IN EDIT: Voltage level for object colouring [110]	
4	СВТуре	dint		IN EDIT: [1=CB] [2=CB synch.] [11=CB w/Earthed] [12=CB synch. w/Earthed]	
5	FBConfig	dint		IN EDIT: [0=FB1,FB0] [1=FB1] [2=FB1,FB0,SP] [3=FB1,SP] [4=FB1,FB0,SP,TP] [5=FB1,SP,TP]	
6	NormalMode	dint		IN EDIT: [1=Manual][2=Auto][3=Local]	
7	FollowLocalFB	bool		IN EDIT: [False = Cmd0\Cmd1Level output is reset in local, True = Cmd0\Cmd1Level output follow FB in local]	
8	Index	dint	1	IN EDIT: Index for synchronization must be unique	
9	AlSeverity	dint		IN EDIT: Alarm severity	
10	EvSeverity	dint		IN EDIT: Event severity	
11	Class	dint		IN EDIT: Alarm and Event Class	
12	IOPar	pmsCBIOPar	pmsNode1.CB1_CBPar.IOPar	IN_OUT: Circuit Breaker I/O signals	
13	AutoPar	pmsCBAutoPar	pmsNode1.CB1_CBPar.AutoPar	IN: Parameters for Auto mode control	
14	AlarmPar	pmsExtAll	pmsNode1.CB1_CBPar.AlarmPar	IN: For Extended Alarm indication in Faceplate	
15	EventPar	pmsExtEvt	pmsNode1.CB1_CBPar.EventPar	IN: For Extended Event indication in Faceplate	
16	llockPar	pmslLockPar	pmsNode1.CB1_CBPar.llockPar	IN: Interlock input signals and configuration	
17	ErrPar	pmsErrPar	pmsNode1.CB1_CBPar.ErrPar	IN: Error Indication	
18	SyncPar	pmsCBSyncPar	pmsNode1.CB1_CBPar.SyncPar	IN_EDIT: Synchronization parameter settings	
19	SynCBPar	pmsSNCBPar	pmsNode1.SN_AllSynCBPar	IN: Interface from Synchronization module	
20	MeasPar	pmsExtIO	pmsNode1.CB1_CBPar.MeasPar	IN: For Extended Measurements indication in Faceplate	
21	ExtPar	pmsCBExtPar	pmsNode1.CB1_CBPar.ExtPar	IN: External parameters, for application interaction	
22	Status	pmsCBstatus	pmsNode1.CB1_CBPar.Status	OUT: Circuit Breaker status	
23	CBSynPar	pmsCBSNPar	pmsNode1.CB1_CBPar.CBSynPar	OUT: Interface to Synchronization module	-
4 )	Parameters /	8		( )	11.
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	Name	Data Type	Parameter	Description	٠
1	Name	string[30]	'CB-02'	IN EDIT: Name of the object	_
2	Description	string[40]	'Grid-2 Incomer'	IN EDIT: Description of the object	
3	VoltageLevel	dint	1	IN EDIT: Voltage level for object colouring [110]	
4	СВТуре	dint		IN EDIT: [1=CB] [2=CB synch.] [11=CB w/Earthed] [12=CB synch. w/Earthed]	
5	FBConfig	dint		IN EDIT: [0=FB1,FB0] [1=FB1] [2=FB1,FB0,SP] [3=FB1,SP] [4=FB1,FB0,SP,TP] [5=FB1,SP,TP]	
6	NormalMode	dint		IN EDIT: [1=Manual][2=Auto][3=Local]	
7	FollowLocalFB	bool		IN EDIT: [False = Cmd0\Cmd1Level output is reset in local, True = Cmd0\Cmd1Level output follow FB in local]	
8	Index	dint	2	IN EDIT: Index for synchronization must be unique	
9	AlSeverity	dint		IN EDIT: Alarm severity	
10	EvSeverity	dint		IN EDIT: Event severity	
11	Class	dint		IN EDIT: Alarm and Event Class	
12	IOPar	pmsCBIOPar	pmsNode1.CB2_CBPar.IOPar	IN_OUT: Circuit Breaker I/O signals	
13	AutoPar	pmsCBAutoPar	pmsNode1.CB2_CBPar.AutoPar	IN: Parameters for Auto mode control	
14	AlarmPar	pmsExtAll	pmsNode1.CB2_CBPar.AlarmPar	IN: For Extended Alarm indication in Faceplate	
15	EventPar	pmsExtEvt	pmsNode1.CB2_CBPar.EventPar	IN: For Extended Event indication in Faceplate	
16	llockPar	pmslLockPar	pmsNode1.CB2_CBPar.llockPar	IN: Interlock input signals and configuration	
17	ErrPar	pmsErrPar	pmsNode1.CB2_CBPar.ErrPar	IN: Error Indication	
18	SyncPar	pmsCBSyncPar	pmsNode1.CB2_CBPar.SyncPar	IN_EDIT: Synchronization parameter settings	
19	SynCBPar	pmsSNCBPar	pmsNode1.SN_AllSynCBPar	IN: Interface from Synchronization module	
20	MeasPar	pmsExtIO	pmsNode1.CB2_CBPar.MeasPar	IN: For Extended Measurements indication in Faceplate	
21	ExtPar	pmsCBExtPar	pmsNode1.CB2_CBPar.ExtPar	IN: External parameters, for application interaction	
22	Status	pmsCBstatus	pmsNode1.CB2_CBPar.Status	OUT: Circuit Breaker status	
23	CBSynPar	pmsCBSNPar	pmsNode1.CB2_CBPar.CBSynPar	OUT: Interface to Synchronization module	-
4 >	<u>Parameters</u>			<u>×</u>	1

Row 3, Col 6

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	Name	Data Type	Parameter	Description	*
1	Name	string[30]	'CB-07'	IN EDIT: Name of the object	
2	Description	string[40]	'Bus Coupler A-B'	IN EDIT: Description of the object	
3	VoltageLevel	dint	1	IN EDIT: Voltage level for object colouring [110]	
4	CBType	dint		IN EDIT: [1=CB] [2=CB synch.] [11=CB w/Earthed] [12=CB synch. w/Earthed]	
5	FBConfig	dint	-	IN EDIT: [0=FB1,FB0] [1=FB1] [2=FB1,FB0,SP] [3=FB1,SP] [4=FB1,FB0,SP,TP] [5=FB1,SP,TP]	
6	NormalMode	dint		IN EDIT: [1=Manual][2=Auto][3=Local]	
7	FollowLocalFB	bool		IN EDIT: [False = Cmd0\Cmd1Level output is reset in local, True = Cmd0\Cmd1Level output follow FB in local]	
8	Index	dint	7	IN EDIT: Index for synchronization must be unique	
9	AlSeverity	dint		IN EDIT: Alarm severity	
10	EvSeverity	dint		IN EDIT: Event severity	
11	Class	dint		IN EDIT: Alarm and Event Class	
12	IOPar	pmsCBIOPar	pmsNode1.CB7_CBPar.IOPar	IN_OUT: Circuit Breaker I/O signals	
13	AutoPar	pmsCBAutoPar	pmsNode1.CB7_CBPar.AutoPar	IN: Parameters for Auto mode control	
14	AlarmPar	pmsExtAll	pmsNode1.CB7_CBPar.AlarmPar	IN: For Extended Alarm indication in Faceplate	
15	EventPar	pmsExtEvt	pmsNode1.CB7_CBPar.EventPar	IN: For Extended Event indication in Faceplate	
16	llockPar	pmslLockPar	pmsNode1.CB7_CBPar.llockPar	IN: Interlock input signals and configuration	
17	ErrPar	pmsErrPar	pmsNode1.CB7_CBPar.ErrPar	IN: Error Indication	
18	SyncPar	pmsCBSyncPar	pmsNode1.CB7_CBPar.SyncPar	IN_EDIT: Synchronization parameter settings	
19	SynCBPar	pmsSNCBPar	pmsNode1.SN_AllSynCBPar	IN: Interface from Synchronization module	
20	MeasPar	pmsExtIO	pmsNode1.CB7_CBPar.MeasPar	IN: For Extended Measurements indication in Faceplate	
21	ExtPar	pmsCBExtPar	pmsNode1.CB7_CBPar.ExtPar	IN: External parameters, for application interaction	
22	Status	pmsCBstatus	pmsNode1.CB7_CBPar.Status	OUT: Circuit Breaker status	
23	CBSynPar	pmsCBSNPar	pmsNode1.CB7_CBPar.CBSynPar	OUT: Interface to Synchronization module	-
4 )	Parameters /			× >	11.
				Row 1, Col 5	

Figure 40 Example of parameter connections for the pmsCBSyncM instances

**E**.

### 7.3.2 Connection of Index

The parameter *Index* in the pmsCBSyncM control module is a unique identity number which must be assigned to each circuit breaker included in the synchronization scheme.

The configuration example in Figure 40 shows the following index numbers assigned to the relevant circuit breakers:

Table 56 Example of Index numbers assigned to pmsCBSyncM modules

Control module name	Description	Index
CB-01	Grid-1 Incomer	1
CB-02	Grid-2 Incomer	2
CB-03	Generator 1 Incomer	3
СВ-04	Generator 2 Incomer	4
CB-05	Generator 3 Incomer	5
CB-06	Generator 4 Incomer	6
CB-07	Bus Coupler A-B	7



Any double integer number can be assigned to the parameter Index of a circuit breaker, as long as it is unique among the pmsCBSyncM modules included in the synchronization scheme. In the example shown in Table 55, the index numbers are equal to the identity of the circuit breakers in the network determination, thus ensuring that they are unique.

#### 7.3.2.1 Connection of SyncPar

The parameter *SyncPar* in the pmsCBSyncM control module shall be used for defining the variable and reference side (i.e. U-Var and U-Ref) of each circuit breaker in the synchronization scheme, according to the principle described in Figure 17. It is also used for assigning a configuration value for the type of the breaker (i.e. grid breaker, generator breaker or network breaker), according to the network topology. An example of the necessary application code is shown in Figure 41.

🔚 Control module type - PMS_Applicatio	nLib.Synchronizat	ion	_ 🗆 🗵
Editor Edit View Insert Tools Window	Help		
- R B S & B D 9 P X 1		ð   🎓   🚍   🛵 🗛 🚙   🕜 🕅   🍸 🛔	<b>2↓ 2</b> ↑
Name Data Type	Attributes	Description	<u> </u>
1 ioNode1 ioNode			
2 pmsNode1 pmsNode			*
Parameters      Variables      Ext	ernal Variables	Function Blocks	> //
<pre>2 pmsNode1 pmsNode 4  Parameters Variables Ext (* Breakers with Synchron (* Assign type of CB and (* control modules (* CB1 breaker : Incomer (* CB2 breaker : Incomer (* CB3 breaker : Generat (* CB4 breaker : Generat (* CB5 breaker : Generat (* CB5 breaker : Generat (* CB6 breaker : Generat (* CB7 breaker : Generat (* CB7 breaker : Bus A-B (* (* CB1 Incomer Grid-1 *) pmsNode1 CB1_CBPar.SyncPar. pmsNode1 CB1_CBPar.SyncPar. pmsNode1 CB2_CBPar.SyncPar. (* CB2 Incomer Grid-2 *) pmsNode1 CB2_CBPar.SyncPar. (* CB3 Generator Gen-1 *) pmsNode1 CB3_CBPar.SyncPar. (* CB3 Generator Gen-1 *) pmsNode1 CB3_CBPar.SyncPar. (* CB4 Generator Gen-2 *) pmsNode1 CB4_CBPar.SyncPar. (* CB4 Generator Gen-2 *) pmsNode1 CB4_CBPar.SyncPar. (* CB5 Generator Gen-3 *) pmsNode1 CB5_CBPar.SyncPar. (* CB5 Generator Gen-3 *) pmsNode1 CB4_CBPar.SyncPar.</pre>	ernal Variables	Function Blocks	<pre>********) ** ** ** ** ** ** ** ** ** **</pre>
<pre>pmsNode1.CB5_CBPar.SyncPar. pmsNode1.CB5_CBPar.SyncPar. (* CB6 Generator Gen-4 *) pmsNode1.CB6_CBPar.SyncPar. pmsNode1.CB6_CBPar.SyncPar.</pre>	MBBAin := 1 MBBBin := 1 SyncType := 1 MBBAin := 1	5: (* Var connected to PB05 17: (* Ref connected to IB02 1: (* Type 1, Gen. breaker 6: (* Var connected to PB06	*) *) *)
<pre>pmsNode1.CB6_CBPar.SyncPar. (* CB7 Bus A-B Coupler *) pmsNode1.CB7_CBPar.SyncPar. pmsNode1.CB7_CBPar.SyncPar. pmsNode1.CB7_CBPar.SyncPar.</pre>	MBBBin := SyncType := 1 MBBAin := MBBBin := :	17: (* Ref connected to LB02 0: (* Type 0, network break 16: (* Var connected to LB01 17: (* Ref connected to LB02	*) *) *)
CodeSync_Config / CodeSync	_SignalsIN_}	CodeSync_SignalsOUT /	<u> </u>
		Dow 0 Cold	

Figure 41 Example of application code for the parameter SyncPar in pmsCBSyncM module

#### 7.3.2.2 Connection of SynCBPar

The parameter *SynCBPar* shall be used for receiving the necessary data, from the synchronization module pmsSNSyncSuperv, into the circuit breaker module pmsCBSyncM.

The configuration example in Figure 38 shows that the variable *pmsNode1.gSN\_AllSynCBPar* is connected to the parameter *SynCBPar* for all the circuit breakers in the synchronization scheme. The same variable *pmsNode1.gSN\_AllSynCBPar* shall also be connected to the parameter *SynCBPar* in the pmsSNSyncSuperv, as shown in Figure 42.

Connections - Synchroni	zation pmsSNLib.pn	nsSNSyncSuperv	
Editor Edit <u>V</u> iew Insert <u>I</u>	ools <u>W</u> indow <u>H</u> elp		
	C & 2 0 0	🎍 🦀 🛛 🔜 🗛 🗢 🗞	
Name	Data Type	Parameter	Description _
1 Name	string[30]	'Synchronization'	IN EDIT: Name of the object -
2 Description	string[40]	'Synchronization function'	IN EDIT: Description of the object
3 EvSeverity	dint		IN EDIT: Event severity
4 AlSeverity	dint		IN EDIT: Alarm severity
5 Class	dint		IN EDIT: Alarm and Event Class
6 Enable	bool	true	IN: Enable module execution
7 NetTopology	pmsNetTopology	pmsNode1.NetTopology	IN: Network topology
8 iMV_Freq	pmsBBReallO50	pmsNode1.SN_iMV_Freq	IN: Measured values Freq
9 iMV_Volt	pmsBBReallO50	pmsNode1.SN_iMV_Volt	IN: Measured values Voltage
10 PB01	dint	2	IN: Power Bus Bar.01 type 1 = Generator, 2 = Grid
11 PB02	dint	2	IN: Power Bus Bar.02 type 1 = Generator, 2 = Grid
12 PB03	dint	1	IN: Power Bus Bar 03 type 0 = None, 1 = Generator
13 PB04	dint	1	IN: Power Bus Bar 04 type 0 = None, 1 = Generator
14 PB05	dint	1	IN: Power Bus Bar 05 type 0 = None, 1 = Generator
15 PB06	dint	1	IN: Power Bus BarDS type D = None, 1 = Generator
16 PB07	dint	0	N: Power Bus Barl7 type 0 = None, 1 = Generator
17 PB08	dint	0	Not Power Bue Barth type 0 - None, 1 - Cenerator
10 0000	dint	0	IN. Power Bus Barbo type 0 = None, 1 = Cenerator
10 PB10	dint	0	IN: Power Bus Bar 10 type 0 - None, 1 - Generator
	dist	0	IN: Power Dus Dar. 10 type 0 = None, 1 = Generator
20 PD11	dist	0	IN, Hower Dus Dar, Hitype U = None, T = Generator
21 PB12	aint	0	IN: Power Bus Bar 12 type U = None, 1 = Generator
22 PB13	dint	0	IN: Power Bus Bar:13 type 0 = None, 1 = Generator
23 PB14	dint	0	IN: Power Bus Bar:14 type 0 = None, 1 = Generator
24 PB15	dint	0	IN: Power Bus Bar:15 type 0 = None, 1 = Generator
25 IO_Input	pmsSNIOPar	pmsNode1.SN_IO_Input	IN: Feedback from synchronizing panel
26 CB_ID	pmsSNCB_ID	pmsNode1.SN_CB_ID	IN: CB Identity for CB with Sync request
27 GNSynPar	pmsGNSNPar	pmsNode1.SN_AllGenSynPar	IN: Connection from Gen Control Modules
28 CBSynPar	pmsCBSNPar	pmsNode1.SN_AllCBSynPar	IN: Connection from CBSync Control Modules
29 ExtPar	pmsSNExtPar	pmsNode1.SN ExtPar	IN: External Parameters
30 ParamSet	pmsGenDint	pmsNode1.SN ParamSet	IN EDIT: Fill in corresponding parameter set for selected generator
31 MaxNoGenSelection	dint	4	IN: Maximum number of Generators participating in the sync process
32 Freal owl imit	real	pmsNode1.SN Freal owl.imit	IN EDIT: Value of Frequency limit value for spurious powered hus
33 VoltI owl imit	real	nmsNode1 SN VoltI owl imit	IN EDIT: Value of Voltage limit value for sourious nowered hus
34 SynCfaPar	nmeSNCfaPar	nmsNode1 SN_SynCfaPar	IN EDIT. Synchroniser timeaut configurer
35 SelectedCen	nmsGenBool	pmsNode1.SN_SelectedGen	OID HS selected comparison
36 SynGNPar	nmeSNGNPar	pmsNode1_SyncGNPar	OLT: Connection to Gen Control Modules
27 SunaOneration	heal	emoNede1.SN SupeOneration	OUT Sume analytics in common
37 SyncOperation	DUUI SmaCNCDDay	pmsNode1.SN_SyncOperation	OUT concerning the Program Control Medules
DO UDEE	phisonoprai	phiskodet.SN_AliSyncDFai	OUT Indication of Charges cide (Deshee) D
J9 UREF	dint	pmsNode1.SN_UREP	OUT indication of reference side (Bus parity)
40 0VAR		pmsNode1.SN_OVAR	OUT indication of variable side (Power source ib)
41 IO_Output	pmsSNiOPar	pmsNode1.SN_IO_Output	OUT: commands to synchronizing panel
Parameters			
			Row 1, Col 5
Connections - CB01 pmst	) bjLib.pmsCBSync™	1	
ditor Edit View Insert I	ools <u>W</u> indow <u>H</u> elp		
	NXONA	4 A A A A A A A A A A A A A A A A A A A	
Manua	Data Tuna	Bernatte	Description
Ivame	Data Type	Parameter	Description
i Name	string[30]	CD-01	IN EDIT. NAME OF THE ODJECT
2 Description	string[4U]	Gra-1 Incomer	IN EUTI: Description of the object
3 VoltageLevel	dint	1	IN EDIT: Voltage level for object colouring [110]
4 CBType	dint		IN EDIT: [1=CB] [2=CB synch.] [11=CB w/Earthed] [12=CB synch. w/Earthed]
5 FBConfig	dint		IN EDIT: [0=FB1,FB0] [1=FB1] [2=FB1,FB0,SP] [3=FB1,SP] [4=FB1,FB0,SP,TP] [5=FB1,SP,TP]
6 NormalMode	dint		IN EDIT: [1=Manual][2=Auto][3=Local]
7 FollowLocalFB	bool		IN EDIT: [False = Cind0\Cmd1Level output is reset in local, True = Cmd0\Cmd1Level output follow FB in loc
8 Index	dint	1	IN EDIT: Index for synchronization must be unique
9 AlSeverity	dint		IN EDIT: Alarm seve <mark>r</mark> ity
10 EvSeverity	dint		IN EDIT: Event severity
11 Class	dint		IN EDIT: Alarm and Event Class
12 IOPar	pmsCBIOPar	pmsNode1.CB1_CBPar.IOPar	IN OUT: Circuit Breaker I/O signals
13 AutoPar	pmsCBAutoPar	pmsNode1.CB1_CBPar AutoPar	IN: Parameters for Auto mode control
4 AlarmPar	pmsExtAll	pmsNode1.CB1_CBPar AlarmPar	IN: For Extended Alarm indication in Faceplate
5 EventPar	pmsExtEvt	pmsNode1 CB1 CBPar EventPar	IN: For Extended Event indication in Eaceplate
16 llockPar	nmsll ockPar	pmsNode1 CB1_CBPar llockPar	IN: Interlock input signals and configuration
17 Empor	nmeErrPor	nmeNode1 CB1 CBPar ErrPar	IN: Error Indication
	prilsEllFal	pmaNade1.CD1_CDPat.EllPat	IN EDIT Curchasization parameter settings
o Syncear	priscosyncPar	prisivode1.CD1_CDPar.SyncPar	IN_COL Synchronization parameter settings
9 SynCBPar	pmsSNCBPar	pmsivode1.SN_AllSynCBPar	IN: Interface from Synchronization module
WeasPar	pmsExtIO	pmsNode1.CB1_CBPar.MeasPar	IN: For Extended Measurements indication in Faceplate
21 ExtPar	pmsCBExtPar	pmsNode1.CB1_CBPar.ExtPar	IN: External parameters, for application interaction
22 Status	pmsCBstatus	pmsNode1.CB1_CBPar.Status	OUT: Circuit Breaker status
23 CBSynPar	pmsCBSNPar	pmsNode1.CB1_CBPar.CBSynPar	OUT: Interface to Synchronization module
Parameters			•
			Pow 1 Col 5

Figure 42 Example of SynCBPar parameter interconnection with pmsSNSyncSuperv

#### 7.3.2.3 Connection of CBSynPar

The parameter *CBSynPar* shall be used for sending the necessary data from the circuit breaker modules pmsCBSyncM into the synchronization module pmsSNSyncSuperv.

The configuration example in Figure 40 shows that the following variables are connected to the *CBSynPar* parameter of the relevant circuit breakers in the synchronization scheme:

Table 57 Example of CBSynPar connections to pmsCBSyncM modules

Control module name	Description	Variable connected to CBSynPar
CB-01	Grid-1 Incomer	pmsNode1.CB1_CBPar.CBSynPar
CB-02	Grid-2 Incomer	pmsNode1.CB2_CBPar.CBSynPar
CB-03	Generator 1 Incomer	pmsNode1.CB3_CBPar.CBSynPar
CB-04	Generator 2 Incomer	pmsNode1.CB4_CBPar.CBSynPar
CB-05	Generator 3 Incomer	pmsNode1.CB5_CBPar.CBSynPar
CB-06	Generator 4 Incomer	pmsNode1.CB6_CBPar.CBSynPar
CB-07	Bus Coupler A-B	pmsNode1.CB7_CBPar.CBSynPar

The *CBSynPar* from up to 10 different circuit breakers shall be collected in a *pmsCBSN* control module, as shown in Figure 43. The output *CBSNParO* shall be further linked to the input parameter *CBSynPar* of the pmsSNSyncSuperv module.

E Connections - CBSN p	msSNLib.pmsCBSN			_ 🗆 🗵
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ः 🔜 🖬 🚿 🖷 🔊 ।	n e 2 1 0	🐴 🗛 🕋 🚍 🗛 🗢 🗞		
Name	Data Type	Parameter	Description	
1 CBSNParl_1	pmsCBSNPar	pmsNode1.CB1_CBPar.CBSynPar	IN: from pmsCBSyncM parameter CBSNPar	
2 CBSNParl_2	pmsCBSNPar	pmsNode1.CB2_CBPar.CBSynPar	IN: from pmsCBSyncM parameter CBSNPar	
3 CBSNParl_3	pmsCBSNPar	pmsNode1.CB3_CBPar.CBSynPar	IN: from pmsCBSyncM parameter CBSNPar	
4 CBSNParl_4	pmsCBSNPar	pmsNode1.CB4_CBPar.CBSynPar	IN: from pmsCBSyncM parameter CBSNPar	
5 CBSNParl_5	pmsCBSNPar	pmsNode1.CB5_CBPar.CBSynPar	IN: from pmsCBSyncM parameter CBSNPar	
6 CBSNParl_6	pmsCBSNPar	pmsNode1.CB6_CBPar.CBSynPar	IN: from pmsCBSyncM parameter CBSNPar	
7 CBSNParl_7	pmsCBSNPar	pmsNode1.CB7_CBPar.CBSynPar	IN: from pmsCBSyncM parameter CBSNPar	
8 CBSNParl 8	pmsCBSNPar		IN: from pmsCBSyncM parameter CBSNPar	
9 CBSNParl_9	pmsCBSNPar		IN: from pmsCBSyncM parameter CBSNPar	
10 CBSNParl_10	pmsCBSNPar		IN: from pmsCBSyncM parameter CBSNPar	
11 CBSNParO	pmsCBSNPar	pmsNode1.SN_AIICBSynPar	OUT: to pmsSNSyncSuperv parameter CBSNPar	
12 Index	dint		OUT: Index of selected breaker	
13 Count	dint		OUT: more than one breaker selected	-
Parameters				• //.
			Row 4, Col 5	10
E Connections - Synchr	onization pmsSNLib.p	omsSNSyncSuperv		- 🗆 ×
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: 🔜 🖬 🔌 🖶 🧕 🛛	のやど面白	🏘 🍓 👔 🚍 🗛 🗢 😪		
Name	Data Type	Parameter	Description	<b></b>
24 PB15	dint	0	IN: Power Bus Bar 15 type 0 = None, 1 = Generator	
25 IO_Input	pmsSNIOPar	pmsNode1.SN_IO_Input	IN: Feedback from synchronizing panel	
26 CB ID	pmsSNCB ID	pmsNode1.SN CB ID	IN: CB Identity for CB with Sync request	
27 GNSynPar	pmsGNSNPar	pmsNode1.SN_AllGenSynPar	IN: Connection from Gen Control Modules	
28 CBSynPar	pmsCBSNPar	pmsNode1.SN AllCBSynPar	IN: Connection from CBSync Control Modules	
29 ExtPar	pmsSNExtPar	pmsNode1.SN ExtPar	IN: External Parameters	
30 ParamSet	pmsGenDint	pmsNode1.SN_ParamSet	IN EDIT: Fill in corresponding parameter set for selected generator	
31 MaxNoGenSelecti	on dint	4	IN: Maximum number of Generators participating in the sync process	-
+  Parameters		A.c.		•
			Row 39 Col 1	

Figure 43 Example of SynCBPar parameter interconnection with pmsSNSyncSuperv

## 7.3.3 Application code for pmsGenM control modules

The control modules pmsGenM are instantiated under a library structure named *Objects*, as shown in Figure 44.



Figure 44 Example of pmsGenM instances used in synchronization

To connect the parameters of the instances it is recommended to create an application specific data type. The example in Figure 45 shows the data type named pmsNode1. The necessary components for the parameter connections to the pmsGenM modules are shown with a red frame.

	🖌 🍠 🤌 🖶 🧕	🤊 🖱 🔏 👜 🗋	🐴 🖓 🖓 🖓
	Name	Data Type	Attributes
34	Gen1_GenPar	GenPar	retain
35	Gen2_GenPar	GenPar	retain
36	Gen3_GenPar	GenPar	retain
37	Gen4_GenPar	GenPar	retain
38	SyncGNPar	pmsSNGNPar	retain
39	CB1_CBPar	CBPar	retain
40	CB2_CBPar	CBPar	retain
41	CB3_CBPar	CBPar	retain
42	CB4_CBPar	CBPar	retain
43	CB5_CBPar	CBPar	retain
44	CB6_CBPar	CBPar	retain
45	CB7_CBPar	CBPar	retain
46	SN_AIICBSynPar	pmsCBSNPar	retain
47	SN_AllSynCBPar	pmsSNCBPar	retain
48	SN AllGenSynPar	pmsGNSNPar	retain

Figure 45 Example of data type components for the pmsGenM instances

One control module of type pmsGenM must be instantiated for each generator included in the synchronization scheme. An example of the parameter connections is shown, in Figure 46.

<u> </u>	onnections - Gen1 pms	ObjLib.pmsGenM		
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	H 🎽 🖶 💆 🕐	C & C 0	🖗 🆓  🗔 🙏 🗢 😢	
	Name	Data Type	Parameter	Description
1	Name	string[30]	'Generator-1'	IN EDIT: Name of the object
2	Description	string[40]	'Generator 1'	IN EDIT: Description of the object
3	VoltageLevel	dint	-	IN EDIT: Voltage level for object colouring [110]
4	Index NermalMada COV/	dint	3	IN EDIT: Generator ID [115], for first GEN the Index = NumberOfGrids+1
5	NormalMode_00V	dint		IN EDIT: [1=Manual][2=Auto][3=Local]
7	AlSeverity	dint		IN EDIT: Alarm severity
8	EvSeverity	dint		IN EDIT: Event severity
9	Class	dint		IN EDIT: Alarm and Event Class
10	ManualSyncEnable	bool		IN EDIT: Manual synchronizing commands enabled, for Faceplate interaction [NOT USED]
11	llockPar	pmslLockPar	pmsNode1.Gen1_GenPar.llockPar	IN: Interlock input signals and configuration
12	ExtPar	pmsGenExtPar	pmsNode1.Gen1_GenPar.ExtPar	IN: External parameters, for application interaction
13	MeasPar	pmsExtIO	pmsNode1.Gen1_GenPar.MeasPar	IN: For Extended Measurements indication in Faceplate
14	AutoPar	pmsGenAutoPar	pmsNode1.AllGen_AutoPar	IN: Parameters for P/Q mode control
15	SyncGNPar	pmsSNGNPar	pmsNode1.SyncGNPar	IN: Interface from Synchronization module
10	IUPar AlamaDaa	pmsGeniOPar	pmsNode1.Gen1_GenPar.IOPar	IN_OUT: Generator I/O signals
10	AlarmPar EventDer	prisextAll	pmsNode1.Gen1_GenPar.FirentPar	IN_OUT: For Extended Alarm Indication in Paceplate
19	GNSyncPar	nmsGNSNPar	nmsNode1 Gen1 GenPar GNSyncPar	OUT: Interface to Synchronization module
20	Status	pmsGenStat	pmsNode1 AllGen GenStatus	OUT: Generator status
1)	Parameters /			
				Pow1 Col 5
_				Row I, Cors
Bc	onnections - Gen2 pms	ObjLib.pmsGenM		
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		6 % 6 0 4		
	Name	Data Type	Parameter	Description
1	Name	string[30]	'Generator-2'	IN EDIT: Name of the object
2	Description	string[40]	'Generator 2'	IN EDIT: Description of the object
3	VoltageLevel	dint		IN EDIT: Voltage level for object colouring [110]
4	Index	dint	4	IN EDIT: Generator ID [115], for first GEN the Index = NumberOlGrids+1
0	NormalMode_GUV	dint		IN EDIT. [1=Manual][2=Auto][3=Local]
0	AlSeverity	dint		IN EDIT. Alarm severity
8	EvSeverity	dint		IN EDIT: Event severity
9	Class	dint		IN EDIT: Alarm and Event Class
10	ManualSyncEnable	bool		IN EDIT: Manual synchronizing commands enabled, for Faceplate interaction [NOT USED]
11	llockPar	pmslLockPar	pmsNode1.Gen2 GenPar.llockPar	IN: Interlock input signals and configuration
12	ExtPar	pmsGenExtPar	pmsNode1.Gen2_GenPar.ExtPar	IN: External parameters, for application interaction
13	MeasPar	pmsExtIO	pmsNode1.Gen2_GenPar.MeasPar	IN: For Extended Measurements indication in Faceplate
14	AutoPar	pmsGenAutoPar	pmsNode1.AllGen_AutoPar	IN: Parameters for P/Q mode control
15	SyncGNPar	pmsSNGNPar	pmsNode1.SyncGNPar	IN: Interface from Synchronization module
16	IOPar	pmsGenIOPar	pmsNode1.Gen2_GenPar.IOPar	IN_OUT: Generator I/O signals
17	AlarmPar	pmsExtAll	pmsNode1.Gen2_GenPar.AlarmPar	IN_OUT: For Extended Alarm indication in Faceplate
18	EventPar	pmsExtEvt	pmsNode1.Gen2_GenPar.EventPar	IN_OUT: For Extended Event indication in Faceplate
19	GNSyncPar	pmsGNSNPar	pmsNode1.Gen2_GenPar.GNSyncPar	OUT: Interface to Synchronization module
20	Status Darametere	pmsGenStat	pmsNode1.AllGen_GenStatus	UUI: Generator status
				Row 1, Col 5
_				
E co	onnections - Gen3 pms	ObjLib.pmsGenM		
Edito	onnections - Gen3 pms r Egit View Insert I	ObjLib.pmsGenM ools <u>W</u> indow <u>H</u> elp		_[_ X
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Edito	onnections - Gen3 pmst F Egit View Insert I F I I IIIIIIIIIIIIIIIIIIIIIIIIIIIIII	ObjLib.pmsGenM cols Window Help P & Y P I 4 Data Type string[30] string[40]	Parameter 'Generator-3' 'Generator 3'	Description IN EDIT: Name of the object IN EDIT: Description of the object IN EDIT: Description of the object IN EDIT: A the second of the
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Figure 46 Example of parameter connections for the pmsGenM instances

#### 7.3.3.1 Connection of Index

The parameter *Index* in the pmsGenM control module is a unique identity number which must be assigned to each generator according to the network determination (refer to section Network determination).

The configuration example in Figure 46 shows that the following index numbers are assigned to the relevant generators:

Control module name	Description	Index
GEN-1	Generator 1	3
GEN-2	Generator 2	4
GEN-3	Generator 3	5
GEN-4	Generator 4	6

Table 58 Example of Index numbers assigned to pmsGenM modules



The parameter Index of the pmsGenM modules depends on the identity PB01...PB15 assigned to each generator in the network determination and the total number of grid connections that are applicable for the plant: Index number = PBx + Number of grids.

In the example shown in Table 58, the index number 5 is assigned to the GEN-3, because the identity in the network determination from Figure 47 is PB03 and there are two grid connections in the plant (i.e. PBx = 3, Number of grids = 2, Index = 3+2).

#### 7.3.3.2 Connection of SyncGNPar

The parameter *SyncGNPar* shall be used for receiving the necessary data from the synchronization module pmsSNSyncSuperv into the generator module pmsGenM.

The configuration example in Figure 46 shows that the variable *pmsNode1.gSN\_AllSynGNPar* is connected to the parameter *SyncGNPar* for all the generators. The same variable *pmsNode1.gSN\_AllSynGNPar* shall also be connected to the parameter *SynGNPAr* in the pmsSNSyncSuperv module, as shown in Figure 47.

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No. Treng         metabelish Mitrogelary         metabelish Mitrogelary         No. Neekee treng           M. M., Freq         Metaived values Vehage         Metaived values Vehage           M. M. Treng         No. Neekee treng         Metaived values Vehage           M. M. Treng         No. Neekee treng         Metaived values Vehage           M. Dever Dis Buck Dipped - Neeke, 1 = Generator, 2 = Ord         Metaived values Vehage         Metaived values Vehage           M. Power Dis Buck Dipped - Neeke, 1 = Generator, 2 = Ord         Metaived values Vehage         Neekee trend values Vehage           M. Power Dis Buck Dipped - Neeke, 1 = Generator, 2 = Ord         Metaived values Vehage         Neekee trend values Vehage           M. Power Dis Buck Dipped - Neeke, 1 = Generator, 2 = Ord         Metaived values Vehage         Neekee trend values Vehage           M. Power Dis Buck Dipped - Neeke, 1 = Generator         Description         Metaived values Vehage         Neekee trend values Vehage           M. Power Dis Buck Dipped - Neeke, 1 = Generator         Description         Neekee trend values Vehage         Neekee trend values Vehage           M. Power Dis Buck Dipped - Neeke, 1 = Generator         Description         Neekee trend values Vehage         Neekee trend values Vehage           M. Power Dis Buck Dipped - Neeke, 1 = Generator         Description         Neekee trend values Vehage         Neekee trend values Vehage <tr< td=""><td>6 Enable</td><td>bool</td><td>true</td><td>IN: Enable module execution</td></tr<>	6 Enable	bool	true	IN: Enable module execution																																		
B M/, Yea M/, Val M/, Val M	7 NetTopology	pmsNetTopology	pmsNode1.NetTopology	IN: Network topology																																		
9. M/V.vii         perdBitali200         perdbitali2	8 iMV Freq	pmsBBReall050	pmsNode1.SN iMV Freq	IN: Measured values Freq																																		
0         PB02         end         2         NN         Power Dis Sur20 (pp 1 = Generator, 2 = Grid           2         PB03         dent         1         NN         Power Dis Sur20 (pp 1 = Generator, 2 = Grid           2         PB04         dent         1         NN         Power Dis Sur20 (pp 1 = Generator, 2 = Grid           2         PB04         dent         1         NN         Power Dis Sur20 (pp 1 = Generator, 2 = Grid           6         PB05         dent         1         NN         Power Dis Sur20 (pp 1 = Generator, 2 = Grid           6         PB06         dent         0         NN         Power Dis Sur20 (pp 0 = Non, 1 = Generator, 2 = Gene	9 iMV Volt	pmsBBReall050	pmsNode1.SN iMV Volt	IN: Measured values Voltage																																		
11       PBC2       of m       PN Peer Bor Berd 2 type 1 = Generator 2 = Gid         2       PBC3       of m       1       NN Peer Bor Berd 3 type 0 = Next, 1 = Generator         3       PBC4       of m       1       NN Peer Bor Berd 3 type 0 = Next, 1 = Generator         6       PBC5       of def       1       NN Peer Bor Berd 3 type 0 = Next, 1 = Generator         6       PBC6       of def       0       NN Peer Bor Berd 3 type 0 = Next, 1 = Generator         6       PBC6       of def       0       NN Peer Bor Berd 3 type 0 = Next, 1 = Generator         8       PBC8       of def       0       NN Peer Bor Berd 3 type 0 = Next, 1 = Generator         8       PBC8       of def       0       NN Peer Bor Berd 3 type 0 = Next, 1 = Generator         9       PBC1       of def       0       NN Peer Bor Berd 3 type 0 = Next, 1 = Generator         0       PBC1       of def       0       NN Peer Bor Berd 3 type 0 = Next, 1 = Generator         2       PBC3       of def       0       NN Peer Bor Berd 3 type 0 = Next, 1 = Generator         2       PBC3       of def       0       NN Peer Bor Berd 3 type 0 = Next, 1 = Generator         2       PBC3       of def       0       NN Peer Bor Berd 3 type 0 = Next, 1 = Generator	10 PB01	dint	2	IN: Power Bus Bar:01 type 1 = Generator, 2 = Grid																																		
2 PB3 def 1	11 PB02	dint	2	IN: Power Bus Bar.02 type 1 = Generator, 2 = Grid																																		
3 PDM def 1 PDG	12 PB03	dint	1	IN: Power Bus Bar:03 type 0 = None, 1 = Generator																																		
4 PB05       def       1       IN IP Peer Dia Back 5 type D Nee, 1 = Generator         6 PB06       def       0       IN IP Peer Dia Back 5 type D Nee, 1 = Generator         6 PB07       def       0       IN IP Peer Dia Back 5 type D Nee, 1 = Generator         9 PB06       def       0       IN IP Peer Dia Back 5 type D Nee, 1 = Generator         9 PB06       def       0       IN IP Peer Dia Back 5 type D Nee, 1 = Generator         9 PB01       def       0       IN IP Peer Dia Back 5 type D Nee, 1 = Generator         9 PB11       def       0       IN IP Peer Dia Back 5 type D Nee, 1 = Generator         9 PB14       def       0       IN IP Peer Dia Back 5 type D Nee, 1 = Generator         3 PB14       def       0       IN IP Peer Dia Back 5 type D Nee, 1 = Generator         3 PB14       def       0       IN IP Peer Dia Back 5 type D Nee, 1 = Generator         3 PB14       def       0       IN IP Peer Dia Back 5 type D Nee, 1 = Generator         3 PB14       def       0       IN IP Peer Dia Back 5 type D Nee, 1 = Generator         4 PB15       def       0       IN IP Peer Dia Back 5 type D Nee, 1 = Generator         5 Obgpt Par Per Per Dia Mack 5 type D Peer Per Nee, 1 = Generator       IN IP Peer Dia Back 5 type D Peer Peer Peer Peer Peer Peer Peer P	13 PB04	dint	1	IN: Power Bus Bar:04 type 0 = None, 1 = Generator																																		
5 PB06       did       1       M. Power Dus Bur (B) yog 0 = Non, 1 = Generator         7 PB08       did       0       N. Power Dus Bur (B) yog 0 = Non, 1 = Generator         8 PB09       did       0       N. Power Dus Bur (B) yog 0 = Non, 1 = Generator         9 PB10       did       0       N. Power Dus Bur (B) yog 0 = Non, 1 = Generator         9 PB10       did       0       N. Power Dus Bur (B) yog 0 = Non, 1 = Generator         2 PB13       did       0       N. Power Dus Bur (B) yog 0 = Non, 1 = Generator         2 PB13       did       0       N. Power Dus Bur (B) yog 0 = Non, 1 = Generator         3 PB14       did       0       N. Power Dus Bur (B) yog 0 = Non, 1 = Generator         4 PB15       did       0       N. Power Dus Bur (B) yog 0 = Non, 1 = Generator         5 (B, D)       ymsNot/Bur (B)       ymsNot/Bur (B)       ymsNot/Bur (B)       ymsNot/Bur (B)         6 (B, D)       ymsNot/Bur (B)       ymsNot/Bur (B)       ymsNot/Bur (B)       ymsNot/Bur (B)       ymsNot/Bur (B)         8 (B) C/Pur (P)       ymsNot/Bur (B)       ymsNot/B	14 PB05	dint	1	IN: Power Bus Bar:05 type 0 = None, 1 = Generator																																		
6 PB07       did       0       N. Power Dus Bur Dryge 0 = Non, 1 = Germator         9 PB09       did       0       N. Power Dus Bur Dryge 0 = Non, 1 = Germator         9 PB10       did       0       N. Power Dus Bur Dryge 0 = Non, 1 = Germator         0 PB11       did       0       N. Power Dus Bur Dryge 0 = Non, 1 = Germator         0 PB13       did       0       N. Power Dus Bur Dryge 0 = Non, 1 = Germator         1 PB14       did       0       N. Power Dus Bur Dryge 0 = Non, 1 = Germator         2 PB14       did       0       N. Power Dus Bur Dryge 0 = Non, 1 = Germator         3 PB14       did       0       N. Power Dus Bur Dryge 0 = Non, 1 = Germator         4 PB15       did       0       N. Power Dus Bur Dryge 0 = Non, 1 = Germator         5 Orpgut       pmRidod 1 SN (C.B.D)       N. Concection from Gen Costrol Modules         7 (NSPyR*u       pmRidod 1 SN (C.B.D)       N. Concection from Gen Costrol Modules         9 EufD*u       pmRidod 1 SN (C.B.D)       N. Concection from Gen Costrol Modules         9 EufD*u       pmRidod 1 SN (C.B.D)       N. Concection from Gen Costrol Modules         9 EufD*u       pmRidod 1 SN (NotLowdman)       N. EDT Nute I de reguters (Imt Autor for spantore at fo	15 PB06	dint	1	IN: Power Bus Bar:06 type 0 = None, 1 = Generator																																		
7       PB08       did       0       N: Power Dus Bur 08 yrop 0 = Non, 1 = Generator         9       PB10       did       0       N: Power Dus Bur 08 yrop 0 = Non, 1 = Generator         9       PB10       did       0       N: Power Dus Bur 10 yrop 0 = Non, 1 = Generator         1       PB12       did       0       N: Power Dus Bur 10 yrop 0 = Non, 1 = Generator         2       PB14       did       0       N: Power Dus Bur 12 yrop 0 = Non, 1 = Generator         3       PB14       did       0       N: Power Dus Bur 12 yrop 0 = Non, 1 = Generator         3       PB14       did       0       N: Power Dus Bur 12 yrop 0 = Non, 1 = Generator         3       PB14       did       0       N: Power Dus Bur 12 yrop 0 = Non, 1 = Generator         5       Digit did       did       0       N: Power Dus Bur 12 yrop 0 = Non, 1 = Generator         5       Digit did       did       Digit did       N: Domestic non Cost Number 15 yrop 0 = Non, 1 = Generator         6       Digit did       did       Digit did       N: Domestic non Gene Cost Modules         8       Digit did       N: Domestic non Gene Cost Modules       N: Domestic non Gene Cost Modules         9       Paratochinn       markbed 15N, Voltavinnt       N: Domestic non Gene Cost Modules	16 PB07	dint	0	IN: Power Bus Bar:07 type 0 = None, 1 = Generator																																		
B PB09       did       0       N. Power Dus Bur (D) you 0 = Non, 1 = Generator         0       PB10       did       0       N. Power Dus Bur (D) you 0 = Non, 1 = Generator         1       PB12       did       0       N. Power Dus Bur (D) you 0 = Non, 1 = Generator         2       PB13       did       0       N. Power Dus Bur (D) you 0 = Non, 1 = Generator         2       PB13       did       0       N. Power Dus Bur (D) you 0 = Non, 1 = Generator         3       PB15       did       0       N. Power Dus Bur (D) you 0 = Non, 1 = Generator         4       PB15       did       0       N. Power Dus Bur (D) you 0 = Non, 1 = Generator         5       O. Nopud       pmsNob(D) we molecular (D) Nopud       N. Power Dus Bur (D) you 0 = Non, 1 = Generator         7       ONStypPar       pmsNob(D) NA CB (D) Nopud       N. Concection from Gen Control Modules         5       ExTara       pmsNob(D) NA ESI Para       N. Concection from Gen Control Modules         5       ExTara       pmsNob(D) NA Esign Para       N. External Parameters         6       Synchortan       N. Bit Multic N Control Modules       Dimension (D)         1       MaxNobrum mumber of Generator parameters after parameters       Dimension (D)         1       MaxNobrum mumber of Generator parameters<	17 PB08	dint	0	IN: Power Bus Bar:08 type 0 = None, 1 = Generator																																		
9 PB10 dint 0 MR Power Bus Bus 11 type 0 None, 1 = Generator 1 PB12 dint 0 MR Power Bus Bus 11 type 0 None, 1 = Generator 2 PB13 dint 0 MR Power Bus Bus 11 type 0 None, 1 = Generator 3 PB14 dint 0 MR Power Bus Bus 11 type 0 None, 1 = Generator 3 PB14 dint 0 MR Power Bus Bus 11 type 0 None, 1 = Generator 3 PB14 dint 0 MR Power Bus Bus 11 type 0 None, 1 = Generator 3 PB14 dint 0 MR Power Bus Bus 11 type 0 None, 1 = Generator 3 PB14 dint 0 MR Power Bus Bus 11 type 0 None, 1 = Generator 3 PB14 dint 0 MR Power Bus Bus 11 type 0 None, 1 = Generator 3 PB14 dint 0 MR Power Bus Bus 11 type 0 None, 1 = Generator 4 PB15 dint NOP monobel SN Q Bund MR Peedback from synchronizing panel 4 PB15 dint NOP monobel SN Q Bund MR Power Bus Bus 11 type 0 None, 1 = Generator 4 PB15 MR Power Bus Power Power Bus Note Power Bus Not	18 PB09	dint	0	IN: Power Bus Bar:09 type 0 = None, 1 = Generator																																		
93       PB11       dirt       0       IN: Power Bus Bus 12 type 0       None, 1 = Generator         22       PB13       dirt       0       IN: Power Bus Bus 12 type 0       None, 1 = Generator         23       PB14       dirt       0       IN: Power Bus Bus 12 type 0       None, 1 = Generator         24       PB15       dirt       0       IN: Power Bus Bus 12 type 0       None, 1 = Generator         36       GB, D       pmt3NOER       0       mmNodol SN, 26, D       N. None, 1 = Generator         36       GB, D       pmt3NOER, D       pmtNodol SN, 26, CB, D       N. Cledentry for CB with Sync request         36       CB, D       pmtSNOER, D       pmtNodol SN, 26, CB, D       N. Concelton Modules         36       CB, SynPar       pmtSNOER, D       pmtNodol SN, 26, CB, D       N. Concelton Modules         36       CB, SynPar       pmtSNOER, D       pmtNodol SN, 26, CB, D       N. Morrow market of Generator participation in the synp process         37       pmtSNOER, D       pmtNodol SN, SN, 26, OP       N. Morrow market of Generator participation       SNOER         38       VALLowLink       N. DET Value of Value for Values travelse for synchrows travel	19 PB10	dint	0	IN: Power Bus Bar:10 type 0 = None, 1 = Generator																																		
11 PB12       dint       0       NP Power Due Bin12 type 0 = None, 1 = Generator         23 PB14       dint       0       NP Power Due Bin12 type 0 = None, 1 = Generator         23 PB14       dint       0       NP Power Due Bin12 type 0 = None, 1 = Generator         25 PD14       dint       0       NP Power Due Bin12 type 0 = None, 1 = Generator         25 PD16       pmSNCB_01       pmSNCB_012 (Sc 0, 0       N C Generator for CBMS) Power request         26 CB2       pmSNCB_012 (Sc 0, 0       N C Generator for CBMS) Power request       pmSNCB_012 (Sc 0, 0         27 CNS/PPIPr       pmSNCB15 NLPPIPr       pmSNCB_012 (Sc 0, 0       N C Generator for CBMS) Power request         27 CNS/PPIPr       pmSNCB47       pmSNCB47       PM Control CSMS, Power Parce       N Connection from CBSY: Control Modules         28 CHF#rat       pmSNCB47       pmSNCB47       PMSNCB47       N Connection from CBSY: Control Modules         39 CHF#rat       pmSNCB47       pmSNCB47       N Connection from CBSY: Control Modules         30 VALCALINE       real       pmSNCB47       N Connection from CBSY: Control Modules         30 VALCALINE       real       pmSNCB47       N Connection from CBSY: Control Modules         30 VALCALINE       real       pmSNCB47       N Connection from CBSY: Control Modules         30 VALCAL	20 PB11	dint	0	IN: Power Bus Bar:11 type 0 = None, 1 = Generator																																		
22 PB13       dird       0       NP Power Bus Bin1 13 type 0 = Noe, 1 = Generater         44 PB15       dird       0       NP Power Bus Bin1 14 type 0 = Noe, 1 = Generater         45 PB15       dird       0       NP Power Bus Bin1 14 type 0 = Noe, 1 = Generater         65 CB_10_0       pmsND4015_NL_00_hput       NP Power Bus Bin1 14 type 0 = Noe, 1 = Generater         65 CB_10_0       pmsND4015_NL_ABLGesSynPar       N. Context Modules         76 CBSynPar       pmsND4015_NL_ABLGesSynPar       N. Context Modules         87 CBSynPar       pmsND4015_NL_ABLGesSynPar       N. Context Modules         88 CBSynPar       pmsND4015_NL_ABLGesSynPar       N. Context Modules         89 CBSNDPar       pmsND4015_NL_ABLGESSYnPar       N. Context Modules         90 ParantSteption       pmsND4015_NL_ABLGesSynPar       N. Context Modules         91 ParantSteption       pmsND401_SN_SN_SNGPPar       N. EDF: Fill is context batatios participating in the sync process         91 ParantSteption       pmsND401_SN_SNGPPar       N. EDF: Fill is context batation participating in the sync process         92 ParantSteption       pmsND401_SN_SNGPPar       OUT: Context bodules       PomsND401_SN_SNGPPar         92 ParantSteption       pmsND401_SN_SNGPPar       OUT: Module of frequencips on tools by the bata is a synchronized paranter too tool Modules         93 Paranter	21 PB12	dint	0	IN: Power Bus Bar:12 type 0 = None, 1 = Generator																																		
31 PB14       (end       0       N: Power Bus Bark 14 type 0 = Noet, 1 = Generator         51 OL Input       pmrSNBQPar       pmrSNBQPar       pmrSNBQPar         55 OL Input       pmrSNBQPar       pmrSNBQPar       pmrSNBQPar         76 CRS, Dirpart       pmrSNBQPar       pmrSNBQPar       N: Connection from Genz During April 44         76 CRS, Dirpart       pmrSNBQPar       N: Connection from Genz During April 44       M: Connection from Genz During April 44         77 CRS, Dirpart       pmrSNBQPar       N: External Parameters       M: External Parameters         97 ExtPark       pmrSNBQPar       PmrSNBQPar       N: External Parameters       M: External Parameters         97 ExtPark       pmrSNBQPar       PmrSNBQPar       N: External Parameters       M: External Parameters         97 ExtPark       pmrSNBQPar       PmrSNBQPar       N: External Parameters       M: External Parameters         97 ExtPark       pmrSNBQPar       PmrSNBQPar       N: External Parameters       M: External Parameters         97 OrcClassion       pmrSNBQPar       PmrSNBQPar       N: External Parameters       M: External Parameters         97 OrcClassion       pmrSNBQPar       PmrSNBQPar       N: External Parameters       M: External Parameters         97 OrcClassion       pmrSNBQPar       PmrSNBQPar	22 PB13	dint	0	IN: Power Bus Bar.13 type 0 = None, 1 = Generator																																		
At PB15       dinf       0       N: Power Bus Bar15 (type 0 = Note, 1= Content Medials         St (D, Dup prmSNRCB, D)       pmRNdet1 SN, D, Ipudt       N: CB Identify for CB with Sync request         St (SE, D)       pmRNdet1 SN, MCB, D)       N: CB Identify for CB with Sync request         St (SE, D)       pmRNdet1 SN, MCB, D)       N: CB Identify for CB with Sync request         St (SE, SprPar       pmRNdet1 SN, MCB/SynPar       N: Connection from: CD contol Modules         St (SE, SprPar       pmRNdet1 SN, MCB/SynPar       N: Connection from: CD contol Modules         D ParamSt       pmRNdet1 SN, MCB/SynPar       N: External Parameters         D ParamSt       pmRNdet1 SN, VoltandLinnt       N: EXTERNAL ParamSt         D ParamSt       pmRNdet1 SN, SSNCBPar       N: EXTERNAL ParamSt         D ParamSt       pmRNdet1 SN, SSNCBPar       N: EXTERNAL ParamSt         D ParamSt       pmRNdet1 SN, SSNCBPar       OUT: Connection to Cancor External Parameters         S VoltzouLinnt       real       pmRNdet1 SN, SSNCBPar       OUT: Connection to CBN: Control Modules         S VoltzouLinnt       pmRNdet1 SN, SSNCBPar       OUT: Connection to CBN: Control Modules       Proceedia         S VoltzouLinnt       pmRNdet1 SN, SSNCBPar       OUT: Connection to CBN: Control Modules       Proceedia         S VoltzouLinnt       pmRNdet1 SN, SNCBPar	23 PB14	dint	0	IN: Power Bus Bar:14 type 0 = None, 1 = Generator																																		
5 IO_priput       pmsSNDQPar       pmsSNDQPar       pmsSNDQPar         6 IOB_D       pmsSNDQPar       pmsSNDQPar       pmsSNDQPar         7 (NSpnPar       pmsSNDQPar       pmsSNDQPar       NC Connection from Gen Control Modules         8 (BSpnPar       pmsSNDQPar       pmsSNDQPar       NC Connection from Gen Control Modules         9 (ExPar       pmsSNDQPar       pmsSNDQPar       NC Connection from Gen Control Modules         9 (ExPar       pmsSNDQPar       pmsSNDQPar       NC External Parameters         9 (ExPar       pmsSNDQPar       pmsSNDQPar       NE External Parameters         9 (ExDam)       nanother in all       pmsNDqDat SN, Para/SNU       NE External Parameters         10 (MsLockinnt real       pmsNDqDat SN, SNCQPar       NE DIT Value of Fraquocution into value for spurous powered bus         13 (MsLockinnt real       pmsNDqDat SN, SNCQPar       OUT. INSI selected generators         15 (Selected)       pmsNDqDat SN, SNCQPar       OUT. Indecinon of reference side (Bus North)         15 (Selected)       pmsNDqDat SN, SNCQPar       OUT. Indecinon of reference side (Bus North)         10 (Output       pmsNDqDat SN, SNCQPar       OUT. Indecinon of reference side (Bus North)         10 (Output       pmsNDqDat SN, SNCQPar       OUT. Indecinon of reference side (Bus North)         10 (Output       <	24 PB15	dint	0	IN: Power Bus Bar:15 type 0 = None, 1 = Generator																																		
6. GB. D         pm:SNC4P.D         pm:Note1 SN(CP,D         NN. CB Heatry for CB with Sync request           7. (SNy:Par         pm:SNC4P.D         pm:Note1 SN, AllCeSynPar         NN. Connection from CBynC Centrel           8. (CS:ynPar         pm:SNC4P.D         pm:Note1 SN, AllCeSynPar         NN. Connection from CBynC Centrel           9. (Pars)mar         pm:SNC4P.D         pm:Note1 SN, AllCeSynPar         NN. External Parameters           0. ParaSit         pm:Note1 SN, ParaSit         NN. External Parameters         External Parameters           0. ParaSit         pm:Note1 SN, VoltowLimit         NN EDT. Nute of Central Generators participating the sync process         External Parameters           2. FreqLowLimit         real         pm:Note1 SN, SyncCiPar         NN EDT. Nute of Voltage Imit value for spurious powered bus           3. (SNCCiPar         pm:Note1 SN, SyncCiPar         OUT. Connection to Centrom Modules         Precedenation           5. (SNCFiPar         pm:Note1 SN, SyncCiPar         OUT. Connection to Centrom Voldules         Precedenation           6. (SNCFiPar         pm:Note1 SN, UVEF         OUT. Connection to Centrom set Modules         Precedenation           8. (SNCFiPar         pm:Note1 SN, UVEF         OUT. Connection to Centrom Soft Modules         Precedenation           9. (NCFiPar         pm:Note1 SN, UVEFF         OUT. Connection to Centrom Soft Modules	25 IO_Input	pmsSNIOPar	pmsNode1.SN_IO_Input	IN: Feedback from synchronizing panel																																		
Z. (KSynPar         pms0kd5NPar         pms0kd5NPar         N: Connection from Gen Cantrol Modules           S. (ESynPar         pms0kd5NPar         Precomment of the pms0kd5NPar         N: Connection from Gen Cantrol Modules           9: ELPar         pms0kd5NPar         pms0kd5NPar         Pms0kd5NPar         Pms0kd5NPar           9: ELPar         pms0kd5NPar         Pms0kd5NPar         Pms0kd5NPar         Pms0kd5NPar           9: ELPar         pms0kd5NPar         Pms0kd5NPar         Pms0kd5NPar         Pms0kd5NPar           11: MaxNoGenSelection (dmt         4         N: Maximum number of Generators powered bus         Pms0kd5NPar           3: VoltLowLinnt         real         pms0kd5NPar         Pms0kd5NPar         Pms0kd5NPar           5: SelectedGen         pms0kd5NPar         Pms0kd5NPar         OUT: Strokchores introsot configar           6: SymC6Par         OUT: Strokchores introsot configar         Pms0kd5NPar         OUT: Connection to Configar           6: SymC6Par         OUT: Indication of maximal stale of Power source ID)         Pms0kd5NPar         OUT: Connection to Configar           9: VREF         dmt         pms0kd5LSN_UVAR         OUT: Indication of maximal stale of Power source ID)         Pms0kd5NPar           10: VDuput         pms0kd5LSN_UVAR         OUT: Indication of maximads tas PreCoperator         Pms1kd5     <	26 CB_ID	pmsSNCB_ID	pmsNode1.SN_CB_ID	IN: CB Identity for CB with Sync request																																		
B. CESynPar         pmstNoE1SNPar         pmstNoE1SNPar           PERPar         pmstNoE1SN_Par         pmstNoE1SN_Par           D ParaSit         pmstNoE1SN_Para         pmstNoE1SN_Para           D ParaSit         pmstNoE1SN_Para         NE Eternal Parameters           D ParaSit         pmstNoE1SN_Para         NE Eternal Parameters           D ParaSit         pmstNoE1SN_Para         NE Eternal Parameters           D ParaMode1.SN_Para         pmstNoE1SN_Para         NE Eternal Parameters           D YoltLowLimit         real         pmstNoE1SN_Para         pmstNoE1SN_Para           pmstNoE1SN_Para         pmstNoE1SN_Para         pmstNoE1SN_Para         pmstNoE1SN_Para           pmstNoE1SN_Para         pmstNoE1SN_SN_SNCPara         pmstNoE1SN_SNCPara         pmstNoE1SN_SNCPara           pmstNoE1SN_NAPara         pmstNoE1SN_NAPara         pmstNoE1SN_NAPara         pmstNoE1SN_NAPara           pmstNoE1SN_NAPara         pmstNoE1SN_NAPara         pmstNoE1SN_NAPara         pmstNoE1SN_NAPara           pmstNoE1SN_NAPara         pmstNoE1SN_NAPara         pmstNoE1SN_NAPara         pmstNoE1SN_NAParaa           pmstNoE1SN_NAPara         pmstNoE1SN_NAPAraa         QUT: Comparetorin to CBSync Control Modules           pmstNoE1SN_NAParaa         pmstNoE1SN_NAPAraa         QUT: ComstNoE3         Gov 1_C os	27 GNSynPar	pmsGNSNPar	pmsNode1.SN_AllGenSynPar	IN: Connection from Gen Control Modules																																		
9 ErPar 9 ErP	28 CBSynPar	pmsCBSNPar	pmsNode1.SN_AllCBSynPar	IN: Connection from CBSync Control Modules																																		
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Solution all     prisolver all     prisolver all     prisolver all     prisolver all       Solution all     prisolver all     prisolver all     prisolver all     prisolver all       File     prisolver all     prisolver all     prisolver all     prisolver all       File     prisolver all     prisolver all     prisolver all     prisolver all       File     prisolver all     prisolver all     prisolver all     prisolver all       File     prisolver all     prisolver all     prisolver all     prisolver all       File     prisolver all     prisolver all     prisolver all     prisolver all       File     prisolver all     prisolver all     prisolver all     prisolver all       File     prisolver all     prisolver all     prisolver all     prisolver all	15 SuncCNDer	prinsGenAutoPar	pmsNode1.AliGen_AUtoPar	N. Farameters for F/G mode control																																		
Inscretion         Inscret	16 IOPar	prisononPar	pmsNode1.SynConPar	IN OLD: Consister I/O signals																																		
Rest         Priss and p	17 AlarmPer	procEvtAll	nmcNode1.Gen1_GenPer AlermPer	IN_OLIT: For Extended Alerm indication in Eccentrate																																		
Operation         prinstruction         prinstructio	19 EventDer	prisextAll	pmsNode1.Gen1_GenPar.AramPar	IN_OUT: For Extended Super indication in Faceplate																																		
Status     Presenters	10 EventPar	prisextevi	pmsNode1.Gen1_GenPar.EventPar	OUT: Interface to Supervisition medule																																		
Parameters     Parameters	20 Status	prinsGivaNPar	pmsNode1.Gen1_GenPar.GNSyncPar	OUT: Generater etatue																																		
	Parameters	prinsGenStat	pmshoder.AliGen_GenStatus																																			

Figure 47 Example of SyncGNPar parameter interconnection with pmsSNSyncSuperv

#### 7.3.3.3 Connection of GNSyncPar

The parameter *GNSyncPar* shall be used for sending the necessary data from the generator modules pmsGenM into the synchronization module pmsSNSyncSuperv.

The configuration example in Figure 46 shows the following variables connected to the *GNSyncPar* parameter of the relevant generators:

i able 59 Example of GNSyncPar connections to priseening module	Table 59 Exampl	e of GNSyncPar	connections to	pmsGenM module.
---	-----------------	----------------	----------------	-----------------

Control module name	Description	Variable connected to CBSynPar
GEN-1	Generator 1	pmsNode1.GEN1_GenPar.GNSyncPar
GEN-2	Generator 2	pmsNode1.GEN2_GenPar.GNSyncPar
GEN-3	Generator 3	pmsNode1.GEN3_GenPar.GNSyncPar
GEN-4	Generator 4	pmsNode1.GEN4_GenPar.GNSyncPar

The *GNSyncPar*, from up to 15 different generators, shall be collected in a pmsGNSN control module, as shown in Figure 48 The output *GNSNParO* shall be further linked to the input parameter *GNSynPar* of the pmsSNSyncSuperv module.

Connections - GNSN pm	sSNLib.pmsGNSN		
ditor Edit Yiew Insert	<u>L</u> ools <u>W</u> indow <u>H</u> elp	a	
	P & 2 1	🐴 🍓 🎓 🚍 🗛 🗢 😢	
Name	Data Type	Parameter	Description
1 GNSNParl 1	pmsGNSNPar	pmsNode1.Gen1 GenPar.GNSyncPar	IN: from pmsGenM parameter GNSynPar
2 GNSNParl 2	pmsGNSNPar	pmsNode1.Gen2 GenPar.GNSyncPar	IN: from pmsGenM parameter GNSynPar
3 GNSNParl 3	pmsGNSNPar	pmsNode1.Gen3 GenPar.GNSyncPar	IN: from pmsGenM parameter GNSynPar
4 GNSNParl 4	pmsGNSNPar	pmsNode1.Gen4 GenPar.GNSyncPar	IN: from pmsGenM parameter GNSynPar
5 GNSNParl 5	pmsGNSNPar		IN: from pmsGenM parameter GNSynPar
6 GNSNParl 6	pmsGNSNPar		IN: from pmsGenM parameter GNSynPar
7 GNSNParl 7	pmsGNSNPar		IN: from pmsGenM parameter GNSynPar
8 GNSNParl 8	pmsGNSNPar		IN: from pmsGenM parameter GNSynPar
9 GNSNParl 9	pmsGNSNPar		IN: from pmsGenM parameter GNSynPar
10 GNSNParl 10	pmsGNSNPar		IN: from pmsGenM parameter GNSynPar
11 GNSNParl 11	pmsGNSNPar		IN: from pmsGenM parameter GNSynPar
12 GNSNParl 12	pmsGNSNPar		IN: from pmsGenM parameter GNSynPar
13 GNSNParl 13	pmsGNSNPar		IN: from pmsGenM parameter GNSynPar
14 GNSNParl 14	pmsGNSNPar		IN: from pmsGenM parameter GNSynPar
15 GNSNParl 15	pmsGNSNPar		IN: from pmsGenM parameter GNSynPar
16 GNSNParO	pmsGNSNPar	pmsNode1.SN AllGenSynPar	OUT: to pmsSNSyncSupery parameter GNSynPar
17 Count	dint		OUT: Number of selected machines
Parameters		-	
			Dent Cit
Connections - Synchron	ization pmsSNI ib p	msSNSvncSuperv	Row I, Col S
Editor Edit View Tocert	Tools Window Helr		
	10 & 10 L		
Name	Data Type	Parameter	Description
26 CB_ID	pmsSNCB_ID	pmsNode1.SN_CB_ID	IN: CB Identity for CB with Sync request
27 GNSynPar	pmsGNSNPar	pmsNode1.SN_AllGenSynPar	IN: Connection from Gen Control Modules
28 CBSynPar	pmsCBSNPar	pmsNode1.SN_AIICBSynPar	IN: Connection from CBSync Control Modules
29 ExtPar	pmsSNExtPar	pmsNode1.SN_ExtPar	IN: External Parameters
30 ParamSet	pmsGenDint	pmsNode1.SN_ParamSet	IN EDIT: Fill in corresponding parameter set for selected generator
31 MaxNoGenSelection	dint	4	IN: Maximum number of Generators participating in the sync process
32 FreqLowLimit	real	pmsNode1.SN_FreqLowLimit	IN EDIT: Value of Frequency limit value for spurious powered bus
33 VoltLowLimit	real	pmsNode1.SN_VoltLowLimit	IN EDIT: Value of Voltage limit value for spurious powered bus
34 SynCfgPar	pmsSNCfgPar	pmsNode1.SN_SynCfgPar	IN EDIT: Synchroniser timeout configpar
35 SelectedGen	pmsGenBool	pmsNode1.SN_SelectedGen	OUT: HSI selected generators
36 SynGNPar	pmsSNGNPar	pmsNode1.SyncGNPar	OUT: Connection to Gen Control Modules

Figure 48 Example of GNSynPar parameter interconnection with pmsSNSyncSuperv

# 7.4 Configuration of synchronization objects

The following sections will describe the configuration of the pmsSNSyncSuperv control module type and the supporting module types; pmsCBSN and pmsGNSN which are required for the synchronization function.

## 7.4.1 Application code for pmsSNSyncSuperv control module

The example in Figure 49 shows a control module type *pmSNSyncSuperv* instantiated under the structure named *Synchronization*.



Figure 49 Example of pmsSNSyncSuperv control module type instance

To connect the parameters of the instance it is recommended to create two application specific data types; one that will contain the control module internal connection variables and one that will contain the I/O signal variables. The example in Figure 50 shows the data types named pmsNode1 and ioNode1.

122	Current Tools Mindow Help	1	1.5
In the		] @ @ # # &	1
	Name	Data Type	-
46	SN_AIICBSynPar	pmsCBSNPar	-
47	SN_AllSynCBPar	pmsSNCBPar	
48	SN_AllGenSynPar	pmsGNSNPar	
49	SN_IMV_Freq	pmsBBReallO50	
50	SN_IMV_Volt	pmsBBReall050	
51	SN_IO_Input	pms5NiOPar	
52	SN_IO_OUTput	pmsSNIOPar	
53	SN ParamSet	pmsGenDint	
55	SN EvtPar	nmcSNEvtPar	-
56	SN Fred owl imit	real	
57	SN VoltLowLimit	real	
58	SN SyncOperation	bool	
59	SN UREF	dint	
60	SN UVAR	dint	
61	SN SelectedGen	pmsGenBool	
62	SN_SynCfgPar	pmsSNCfgPar	
()	Components /	•	Γ
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dito	ata Type - PMS_ApplicationLib.ioNode		12
uito	Egit view pisert Tools window nep	a 1 60 60 60 1 0	1.7
103			
	Name	Data Type	-
51	SN_DI_Operate	BoollO	
52	SN_DI_Error	BoollO	
53	SN_DI_ExchangeVarRefSide_FB	BoollO	
54	SN_DI_SelectSyncCB_Grid1_FB	BoollO	
55	SN_DI_SelectSyncCB_Grid2_FB	BoollO	
56	SN_DI_SelectSyncCB_Gen1_FB	BoollO	
5/	SN_DI_SelectSyncCB_Gen2_FB	BoollO	
50	SN_DI_SelectSyncCB_Gen3_FB	BooliO	
59	SN_DI_SelectSynccB_Gen4_FB	Boolio	
00	SN_DI_SelectSyncCon_Con1_EB	BooliO	
<u> </u>	1.313 FUL .3PEPEL.3010.CPPUL CPPUL FUL	Doolo	
61 62	SN DI SelectSyncGen Gen2 FB	BoollO	
61 62 63	SN_DI_SelectSyncGen_Gen2_FB	BoollO BoollO	
61 62 63 64	SN_DI_SelectSyncGen_Gen2_FB SN_DI_SelectSyncGen_Gen3_FB SN_DI_SelectSyncGen_Gen4_FB	BoollO BoollO BoollO	
51 52 53 54	SN_DI_SelectSyncGen_Gen2_FB SN_DI_SelectSyncGen_Gen3_FB SN_DI_SelectSyncGen_Gen4_FB SN_DI_SelectSyncGen_Gen4_FB	BoolIO BoolIO BoolIO BoolIO	
51 52 53 54 55 56	SN_DI_SelectSyncGen_Gen2_FB SN_DI_SelectSyncGen_Gen3_FB SN_DI_SelectSyncGen_Gen4_FB SN_DI_SelectParamSet_NoSync_FB SN_DI_SelectParamSet_Gen1_FB	BoolIO BoolIO BoolIO BoolIO BoolIO	
51 52 53 54 55 56 57	SN_DI_SelectSyncGen_Gen2_FB SN_DI_SelectSyncGen_Gen3_FB SN_DI_SelectSyncGen_Gen4_FB SN_DI_SelectParamSet_NoSync_FB SN_DI_SelectParamSet_Gen1_FB SN_DI_SelectParamSet_Gen2_FB	BoollO BoollO BoollO BoollO BoollO BoollO	
51 52 53 54 55 56 57 58	SN_DI_SelectSyncGen_Gen2_FB SN_DI_SelectSyncGen_Gen3_FB SN_DI_SelectSyncGen_Gen4_FB SN_DI_SelectParamSet_NoSync_FB SN_DI_SelectParamSet_Gen1_FB SN_DI_SelectParamSet_Gen2_FB SN_DI_SelectParamSet_Gen3_FB	BoollO           BoollO           BoollO           BoollO           BoollO           BoollO           BoollO           BoollO           BoollO	-
51 52 53 54 55 56 56 57 58 59	SN_DI_SelectSyncGen_Gen2_FB SN_DI_SelectSyncGen_Gen3_FB SN_DI_SelectSyncGen_Gen4_FB SN_DI_SelectParamSet_NoSync_FB SN_DI_SelectParamSet_Gen1_FB SN_DI_SelectParamSet_Gen2_FB SN_DI_SelectParamSet_Gen3_FB SN_DI_SelectParamSet_Gen4_FB	BoollO	
51 52 53 54 55 56 56 57 58 59 70	SN_DI_SelectSyncGen_Gen2_FB SN_DI_SelectSyncGen_Gen3_FB SN_DI_SelectSyncGen_Gen4_FB SN_DI_SelectParamSet_NoSync_FB SN_DI_SelectParamSet_Gen1_FB SN_DI_SelectParamSet_Gen2_FB SN_DI_SelectParamSet_Gen3_FB SN_DI_SelectParamSet_Gen4_FB SN_DI_SelectParamSet_Gen4_FB	BoollO	
51 52 53 54 55 56 56 57 58 59 70 71	SN_DI_SelectSyncGen_Gen2_FB SN_DI_SelectSyncGen_Gen3_FB SN_DI_SelectSyncGen_Gen4_FB SN_DI_SelectParamSet_NoSync_FB SN_DI_SelectParamSet_Gen1_FB SN_DI_SelectParamSet_Gen3_FB SN_DI_SelectParamSet_Gen3_FB SN_DI_SelectParamSet_Gen4_FB SN_DI_SelectParamSet_Gen4_FB SN_DD_StartSync SN_DO_StopSync	BoollO	
51 52 53 54 55 56 56 57 58 59 70 71 72	SN_DI_SelectSyncGen_Gen2_FB SN_DI_SelectSyncGen_Gen3_FB SN_DI_SelectSyncGen_Gen4_FB SN_DI_SelectParamSet_NoSync_FB SN_DI_SelectParamSet_Gen1_FB SN_DI_SelectParamSet_Gen3_FB SN_DI_SelectParamSet_Gen3_FB SN_DI_SelectParamSet_Gen4_FB SN_DI_SelectParamSet_Gen4_FB SN_DO_StartSync SN_DO_StopSync SN_DO_ExchangeVarRefSide	BoollO	
51 52 53 54 55 56 56 56 56 56 57 58 59 70 71 72 73	SN_DI_SelectSyncGen_Gen2_FB SN_DI_SelectSyncGen_Gen3_FB SN_DI_SelectSyncGen_Gen4_FB SN_DI_SelectParamSet_NoSync_FB SN_DI_SelectParamSet_Gen1_FB SN_DI_SelectParamSet_Gen3_FB SN_DI_SelectParamSet_Gen4_FB SN_DI_SelectParamSet_Gen4_FB SN_DO_StartSync SN_DO_StopSync SN_DO_ExchangeVarRefSide SN_DO_SelectSyncCB_Grid1	BoollO	
51 52 53 54 55 56 56 56 56 56 56 56 57 58 59 70 71 72 73 74	SN_DI_SelectSyncGen_Gen2_FB SN_DI_SelectSyncGen_Gen3_FB SN_DI_SelectSyncGen_Gen4_FB SN_DI_SelectParamSet_NoSync_FB SN_DI_SelectParamSet_Gen1_FB SN_DI_SelectParamSet_Gen2_FB SN_DI_SelectParamSet_Gen4_FB SN_DI_SelectParamSet_Gen4_FB SN_D0_StartSync SN_D0_StartSync SN_D0_ExchangeVarRefSide SN_D0_SelectSyncCB_Grid1 SN_D0_SelectSyncCB_Grid2	BoollO	
51 52 53 54 55 56 56 56 56 56 56 56 56 57 58 59 70 71 72 73 74 75	SN_DI_SelectSyncGen_Gen2_FB SN_DI_SelectSyncGen_Gen3_FB SN_DI_SelectSyncGen_Gen4_FB SN_DI_SelectParamSet_NoSync_FB SN_DI_SelectParamSet_Gen1_FB SN_DI_SelectParamSet_Gen2_FB SN_DI_SelectParamSet_Gen4_FB SN_DI_SelectParamSet_Gen4_FB SN_DO_StartSync SN_DO_StartSync SN_DO_ExchangeVarRefSide SN_DO_SelectSyncCB_Grid1 SN_DO_SelectSyncCB_Grid2 SN_DO_SelectSyncCB_Gen1	BoollO	
51 52 53 54 55 56 56 56 56 56 56 57 56 58 59 70 71 72 73 74 75 76	SN_DI_SelectSyncGen_Gen2_FB SN_DI_SelectSyncGen_Gen3_FB SN_DI_SelectSyncGen_Gen4_FB SN_DI_SelectParamSet_NoSync_FB SN_DI_SelectParamSet_Gen1_FB SN_DI_SelectParamSet_Gen3_FB SN_DI_SelectParamSet_Gen3_FB SN_DI_SelectParamSet_Gen4_FB SN_DD_StartSync SN_DO_StartSync SN_DO_StopSync SN_DO_ExchangeVarRefSide SN_DO_SelectSyncCB_Grid1 SN_DO_SelectSyncCB_Grid2 SN_DO_SelectSyncCB_Gen1 SN_DO_SelectSyncCB_Gen2	BoollO	
51 52 53 54 55 56 57 58 59 70 71 72 73 74 75 76 77	SN_DI_SelectSyncGen_Gen2_FB SN_DI_SelectSyncGen_Gen3_FB SN_DI_SelectSyncGen_Gen4_FB SN_DI_SelectParamSet_NoSync_FB SN_DI_SelectParamSet_Gen1_FB SN_DI_SelectParamSet_Gen3_FB SN_DI_SelectParamSet_Gen3_FB SN_DI_SelectParamSet_Gen4_FB SN_DO_StartSync SN_DO_StartSync SN_DO_StopSync SN_DO_ExchangeVarRefSide SN_DO_SelectSyncCB_Grid1 SN_DO_SelectSyncCB_Grid2 SN_DO_SelectSyncCB_Gen1 SN_DO_SelectSyncCB_Gen2 SN_DO_SelectSyncCB_Gen3	BoollO	
51 52 53 54 55 56 56 56 56 56 56 56 56 56 56 57 70 71 72 73 74 75 76 77 78	SN_DI_SelectSyncGen_Gen2_FB SN_DI_SelectSyncGen_Gen3_FB SN_DI_SelectSyncGen_Gen4_FB SN_DI_SelectParamSet_NoSync_FB SN_DI_SelectParamSet_Gen1_FB SN_DI_SelectParamSet_Gen2_FB SN_DI_SelectParamSet_Gen3_FB SN_DI_SelectParamSet_Gen4_FB SN_DD_StartSync SN_DO_StartSync SN_DO_StopSync SN_DO_SelectSyncCB_Grid1 SN_DO_SelectSyncCB_Gen1 SN_DO_SelectSyncCB_Gen2 SN_DO_SelectSyncCB_Gen3 SN_DO_SelectSyncCB_Gen3 SN_DO_SelectSyncCB_Gen3 SN_DO_SelectSyncCB_Gen4	BoollO	
51 52 53 54 55 56 57 58 59 70 71 72 73 74 75 76 77 78 79	SN_DI_SelectSyncGen_Gen2_FB SN_DI_SelectSyncGen_Gen3_FB SN_DI_SelectSyncGen_Gen4_FB SN_DI_SelectParamSet_NoSync_FB SN_DI_SelectParamSet_Gen1_FB SN_DI_SelectParamSet_Gen2_FB SN_DI_SelectParamSet_Gen3_FB SN_DI_SelectParamSet_Gen4_FB SN_DO_StartSync SN_DO_StartSync SN_DO_StopSync SN_DO_SelectSyncCB_Grid1 SN_DO_SelectSyncCB_Gen1 SN_DO_SelectSyncCB_Gen3 SN_DO_SelectSyncCB_Gen3 SN_DO_SelectSyncCB_Gen4 SN_DO_SelectSyncCB_Gen4 SN_DO_SelectSyncCB_Gen4 SN_DO_SelectSyncCB_Gen4 SN_DO_SelectSyncCB_Gen4 SN_DO_SelectSyncCB_BusTieAB	BoollO	
51 52 53 54 55 56 56 56 57 58 59 70 71 72 73 74 75 76 77 78 79 80	SN_DI_SelectSyncGen_Gen2_FB SN_DI_SelectSyncGen_Gen2_FB SN_DI_SelectSyncGen_Gen3_FB SN_DI_SelectSyncGen_Gen4_FB SN_DI_SelectParamSet_Gen1_FB SN_DI_SelectParamSet_Gen2_FB SN_DI_SelectParamSet_Gen3_FB SN_DI_SelectParamSet_Gen4_FB SN_DO_StartSync SN_DO_StartSync SN_DO_StopSync SN_DO_SelectSyncCB_Grid1 SN_DO_SelectSyncCB_Gen1 SN_DO_SelectSyncCB_Gen3 SN_DO_SelectSyncCB_Gen3 SN_DO_SelectSyncCB_Gen4 SN_DO_SelectSyncCB_Gen4 SN_DO_SelectSyncCB_Gen4 SN_DO_SelectSyncCB_Gen4 SN_DO_SelectSyncCB_Gen4 SN_DO_SelectSyncCB_Gen4 SN_DO_SelectSyncCB_Gen1	BoollO	
51 52 53 54 55 56 56 56 56 56 56 56 56 56 56 56 57 70 71 72 73 74 75 76 77 78 79 50 51	SN_DI_SelectSyncGen_Gen2_FB SN_DI_SelectSyncGen_Gen2_FB SN_DI_SelectSyncGen_Gen3_FB SN_DI_SelectSyncGen_Gen4_FB SN_DI_SelectParamSet_Gen1_FB SN_DI_SelectParamSet_Gen2_FB SN_DI_SelectParamSet_Gen3_FB SN_DI_SelectParamSet_Gen4_FB SN_DO_StopSync SN_DO_StopSync SN_DO_StopSync SN_DO_StopSync SN_DO_SelectSyncCB_Grid1 SN_DO_SelectSyncCB_Gen1 SN_DO_SelectSyncCB_Gen3 SN_DO_SelectSyncCB_Gen3 SN_DO_SelectSyncCB_Gen4 SN_DO_SelectSyncCB_Gen4 SN_DO_SelectSyncCB_Gen4 SN_DO_SelectSyncCB_Gen4 SN_DO_SelectSyncCB_Gen4 SN_DO_SelectSyncCB_Gen1 SN_DO_SelectSyncCB_Gen4 SN_DO_SelectSyncCB_Gen4 SN_DO_SelectSyncCB_Gen1 SN_DO_SelectSyncCB_Gen4 SN_DO_SelectSyncCB_Gen4 SN_DO_SelectSyncCB_Gen5 SN_DO_SelectSyncCB_Gen6 SN_DO_SelectSyncCB_Gen6 SN_DO_SelectSyncCB_Gen7 SN_DSS SN_DO_SELSS SN_DD_SS SN_DS SN_DD_SS SN_DD_SS SN_DD_SS SN	BoollO	
51 52 53 54 55 56 56 56 56 56 56 57 56 56 57 57 70 71 72 73 74 75 76 77 78 79 80 81 82	SN_DI_SelectSyncGen_Gen2_FB SN_DI_SelectSyncGen_Gen2_FB SN_DI_SelectSyncGen_Gen3_FB SN_DI_SelectSyncGen_Gen4_FB SN_DI_SelectParamSet_Gen4_FB SN_DI_SelectParamSet_Gen2_FB SN_DI_SelectParamSet_Gen3_FB SN_DI_SelectParamSet_Gen4_FB SN_DO_StopSync SN_DO_StopSync SN_DO_StopSync SN_DO_StopSync SN_DO_SelectSyncCB_Grid1 SN_DO_SelectSyncCB_Gen1 SN_DO_SelectSyncCB_Gen3 SN_DO_SelectSyncCB_Gen3 SN_DO_SelectSyncCB_Gen3 SN_DO_SelectSyncCB_Gen4 SN_DO_SelectSyncCB_Gen4 SN_DO_SelectSyncCB_Gen4 SN_DO_SelectSyncCB_Gen4 SN_DO_SelectSyncCB_Gen5 SN_DO_SelectSyncCB_Gen6 SN_DO_SelectSyncCB_Gen7 SN_DSSNCB_SSNCB	BoollO	
51 52 53 54 55 56 56 57 58 59 70 71 72 73 74 75 76 77 78 79 80 81 82 83	SN_DI_SelectSyncGen_Gen2_FB SN_DI_SelectSyncGen_Gen2_FB SN_DI_SelectSyncGen_Gen3_FB SN_DI_SelectSyncGen_Gen4_FB SN_DI_SelectParamSet_Gen1_FB SN_DI_SelectParamSet_Gen2_FB SN_DI_SelectParamSet_Gen3_FB SN_DI_SelectParamSet_Gen4_FB SN_DO_StartSync SN_DO_StartSync SN_DO_StartSyncCB_Grid1 SN_DO_SelectSyncCB_Grid2 SN_DO_SelectSyncCB_Gen3 SN_DO_SelectSyncCB_Gen3 SN_DO_SelectSyncCB_Gen4 SN_DO_SelectSyncCB_Gen3 SN_DO_SelectSyncCB_Gen4 SN_DO_SelectSyncCB_Gen4 SN_DO_SelectSyncCB_Gen4 SN_DO_SelectSyncCB_Gen4 SN_DO_SelectSyncCB_Gen3 SN_DO_SelectSyncGe_Gen3 SN_DO_SelectSyncGe_Gen3 SN_DO_SelectSyncGe_Gen3 SN_DO_SelectSyncGe_Gen3 SN_DO_SelectSyncGe_Gen3 SN_DO_SelectSyncGe_Gen3 SN_DO_SelectSyncGe_Gen3 SN_DO_SelectSyncGe_Gen3 SN_DO_SelectSyncGe_Gen3 SN_DO_SelectSyncGe_Gen3 SN_DO_SelectSyncGe_Gen3 SN_DO_SelectSyncGe_Gen3 SN_DO_SelectSyncGe_Gen4	BoollO	
51 52 53 54 55 56 56 56 56 56 56 56 57 58 50 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84	SN_DI_SelectSyncGen_Gen2_FB SN_DI_SelectSyncGen_Gen2_FB SN_DI_SelectSyncGen_Gen3_FB SN_DI_SelectSyncGen_Gen4_FB SN_DI_SelectParamSet_Gen1_FB SN_DI_SelectParamSet_Gen2_FB SN_DI_SelectParamSet_Gen3_FB SN_DI_SelectParamSet_Gen4_FB SN_DO_StartSync SN_DO_StartSync SN_DO_StopSync SN_DO_StelectSyncCB_Grid1 SN_DO_SelectSyncCB_Gen1 SN_DO_SelectSyncCB_Gen3 SN_DO_SelectSyncCB_Gen3 SN_DO_SelectSyncCB_Gen4 SN_DO_SelectSyncCB_Gen4 SN_DO_SelectSyncCB_Gen4 SN_DO_SelectSyncCB_Gen4 SN_DO_SelectSyncCB_Gen1 SN_DO_SelectSyncCB_Gen3 SN_DO_SelectSyncCB_Gen4 SN_DO_SelectSyncCB_Gen3 SN_DO_SelectSyncGen_Gen3 SN_DO_SelectSyncGen_Gen3 SN_DO_SelectSyncGen_Gen3 SN_DO_SelectSyncGen_Gen4 SN_DO_SelectParamSet_NoSync	BoollO	
51 52 53 54 55 56 56 56 56 56 56 56 56 56 56 56 56	SN_DI_SelectSyncGen_Gen2_FB SN_DI_SelectSyncGen_Gen3_FB SN_DI_SelectSyncGen_Gen3_FB SN_DI_SelectSyncGen_Gen4_FB SN_DI_SelectParamSet_Gen1_FB SN_DI_SelectParamSet_Gen2_FB SN_DI_SelectParamSet_Gen3_FB SN_DI_SelectParamSet_Gen4_FB SN_D0_StartSync SN_D0_StartSync SN_D0_StartSyncCB_Grid1 SN_D0_SelectSyncCB_Grid2 SN_D0_SelectSyncCB_Gen3 SN_D0_SelectSyncCB_Gen3 SN_D0_SelectSyncCB_Gen3 SN_D0_SelectSyncCB_Gen3 SN_D0_SelectSyncCB_Gen3 SN_D0_SelectSyncCB_Gen3 SN_D0_SelectSyncCB_Gen3 SN_D0_SelectSyncCB_Gen3 SN_D0_SelectSyncCB_Gen3 SN_D0_SelectSyncCB_Gen3 SN_D0_SelectSyncCB_Gen3 SN_D0_SelectSyncCB_Gen3 SN_D0_SelectSyncCB_Gen3 SN_D0_SelectSyncCB_Gen3 SN_D0_SelectSyncGe_Gen4 SN_D0_SelectSyncGe_Gen3 SN_D0_SelectSyncGe_Gen4 SN_D0_SelectSyncGe_Gen4 SN_D0_SelectSyncGe_Gen3 SN_D0_SelectSyncGe_Gen4 SN_D0_SelectParamSet_NoSync SN_D0_SelectParamSet_Gen1	BoollO	
51 52 53 54 55 56 56 57 70 71 72 73 74 75 76 77 78 90 81 82 83 84 85 86 80 80 80 80 80 80 80 80 80 80	SN_DI_SelectSyncGen_Gen2_FB SN_DI_SelectSyncGen_Gen3_FB SN_DI_SelectSyncGen_Gen3_FB SN_DI_SelectSyncGen_Gen4_FB SN_DI_SelectParamSet_Gen1_FB SN_DI_SelectParamSet_Gen2_FB SN_DI_SelectParamSet_Gen3_FB SN_DI_SelectParamSet_Gen4_FB SN_D0_StartSync SN_D0_StartSync SN_D0_StartSyncCB_Grid1 SN_D0_SelectSyncCB_Grid2 SN_D0_SelectSyncCB_Gen3 SN_D0_SelectSyncCB_Gen3 SN_D0_SelectSyncCB_Gen3 SN_D0_SelectSyncCB_Gen3 SN_D0_SelectSyncCB_Gen3 SN_D0_SelectSyncCB_Gen3 SN_D0_SelectSyncCB_Gen3 SN_D0_SelectSyncCB_Gen3 SN_D0_SelectSyncCB_Gen3 SN_D0_SelectSyncCB_Gen3 SN_D0_SelectSyncCB_Gen3 SN_D0_SelectSyncCB_Gen3 SN_D0_SelectSyncCB_Gen3 SN_D0_SelectSyncCB_Gen3 SN_D0_SelectSyncGe_Gen4 SN_D0_SelectSyncGe_Gen3 SN_D0_SelectSyncGe_Gen4 SN_D0_SelectSyncGe_Gen3 SN_D0_SelectSyncGe_Gen4 SN_D0_SelectParamSet_Gen1 SN_D0_SelectParamSet_Gen1 SN_D0_SelectParamSet_Gen2	BoollO           Bo	

Figure 50 Example of application-defined data types for pmsSNSyncSuperv

An example of the paramete	connections for the	pmsSNSyncSuperv	is shown in Figure 51.
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Connections - Synchro	onization pmsSNLib.pn	nsSNSyncSuperv		_ D >
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Name	Data Type	Parameter	Description	-
1 Name	string[30]	'Synchronization'	IN EDIT: Name of the object	_
2 Description	string[40]	Synchronization function	IN EDIT: Description of the object	
3 EvSeverity	dint		IN EDIT: Event severity	
4 AlSeverity	dint		IN EDIT: Alarm severity	
5 Class	dint		IN EDIT: Alarm and Event Class	
6 Enable	bool	true	IN: Enable module execution	
7 NetTopology	pmsNetTopology	pmsNode1.NetTopology	IN: Network topology	
8 iMV Freq	pmsBBRealIO50	pmsNode1.SN iMV Freq	IN: Measured values Freq	
9 iMV Volt	pmsBBReallO50	pmsNode1.SN iMV Volt	IN: Measured values Voltage	
10 PB01	dint	2	IN: Power Bus Bar.01 type 1 = Generator, 2 = Grid	
11 PB02	dint	2	IN: Power Bus Bar.02 type 1 = Generator, 2 = Grid	
12 PB03	dint	1	IN: Power Bus Bar:03 type 0 = None, 1 = Generator	
13 PB04	dint	1	IN: Power Bus Bar:04 type 0 = None, 1 = Generator	
14 PB05	dint	1	IN: Power Bus Bar:05 type 0 = None, 1 = Generator	
15 PB06	dint	1	IN: Power Bus Bar:06 type 0 = None, 1 = Generator	
16 PB07	dint	D	IN: Power Bus Bar.07 type 0 = None, 1 = Generator	
17 PB08	dint	D	IN: Power Bus Bar:08 type 0 = None, 1 = Generator	
18 PB09	dint	D	IN: Power Bus Bar.09 type 0 = None, 1 = Generator	
19 PB10	dint	D	IN: Power Bus Bar 10 type 0 = None, 1 = Generator	
20 PB11	dint	0	IN: Power Bus Bar.11 type 0 = None, 1 = Generator	
21 PB12	dint	D	IN: Power Bus Bar 12 type 0 = None, 1 = Generator	
22 PB13	dint	D	IN: Power Bus Bar 13 type 0 = None, 1 = Generator	
23 PB14	dint	D	IN: Power Bus Bar.14 type 0 = None, 1 = Generator	
24 PB15	dint	D	IN: Power Bus Bar:15 type 0 = None, 1 = Generator	
25 IO Input	pmsSNIOPar	pmsNode1.SN IO Input	IN: Feedback from synchronizing panel	
26 CB ID	pmsSNCB ID	pmsNode1.SN CB ID	IN: CB Identity for CB with Sync request	
27 GNSynPar	pmsGNSNPar	pmsNode1.SN AllGenSynPar	IN: Connection from Gen Control Modules	
28 CBSynPar	pmsCBSNPar	pmsNode1.SN AllCBSynPar	IN: Connection from CBSync Control Modules	
29 ExtPar	pmsSNExtPar	pmsNode1.SN ExtPar	IN: External Parameters	
30 ParamSet	pmsGenDint	pmsNode1.SN ParamSet	IN EDIT: Fill in corresponding parameter set for selected generator	
31 MaxNoGenSelectin	on dint	4	IN: Maximum number of Generators participating in the sync process	
32 FreqLowLimit	real	pmsNode1.SN FreqLowLimit	IN EDIT: Value of Frequency limit value for spurious powered bus	
33 VoltLowLimit	real	pmsNode1.SN VoltLowLimit	IN EDIT: Value of Voltage limit value for spurious powered bus	
34 SynCfgPar	pmsSNCfgPar	pmsNode1.SN SynCfgPar	IN EDIT: Synchroniser timeout configuer	
35 SelectedGen	pmsGenBool	pmsNode1.SN SelectedGen	OUT: HSI selected generators	
36 SynGNPar	pmsSNGNPar	pmsNode1 SyncGNPar	OUT: Connection to Gen Control Modules	
37 SyncOperation	bool	pmsNode1 SN SyncOperation	OUT: Sync operation in progress	
38 SynCBPar	pmsSNCBPar	pmsNode1.SN_AllSynCBPar	OUT: Connection to CBSync Control Modules	
39 UREE	dint	omsNode1 SN_UREF	OUT: Indication of reference side (Bus har ID)	
40 UVAR	dint	pmsNode1 SN_UVAR	OUT: Indication of variable side (Power source ID)	
41 IO Output	pmsSNIOPar	pmsNode1 SN IO Output	OUT: Commands to synchronizing namel	
Parameters	participation of	miner to a strong to a bothor	A A A A A A A A A A A A A A A A A A A	

Figure 51 Example of parameter connection in pmsSNSyncSuperv control module

#### 7.4.1.1 Connection of CB

The index numbers required for the circuit breakers in the network determination shall be calculated by the control module type *pmsBusConn*. An example of this module is shown in Figure 52.



Figure 52 Example of pmsBusConn control module type instance

The faceplate aspect of the *pmsBusConn* module is shown in Figure 53 .This faceplate shall be utilized to assign the PBx and LBx identities for the circuit breakers of the network determination example presented in Figure 37.

MatrixInde	x : Faceplate I	PG2	
$\langle \rangle$	SNMatrix	Index	
Matrix			
CB 01	BB01	• PBB01	-
CB 02	LBB02	<ul> <li>PBB02</li> </ul>	
CB 03	LBB01	• PBB03	3 •
CB 04	LBB01	▪ PBB04	1 -
CB 05	LBB02	PBB05	5 •
CB 06	LBB02	PBB06	5 🔹
CB 07	LBB01	LBB02	2 •
CB 08		•	•
CB 09		•	· .
CB 10		•	• •
		Con	firms
		Con	mm
		-	
	00	000	<u>R</u>

Figure 53 Example of pmsBusConn faceplate

A dropdown menu shall appear after a mouse-click on any of the cells inside the *pmsBusConn* faceplate. A busbar identity must be selected for each circuit breaker included in the network determination. The example in Figure 53shows that CB01 has been assigned with the identities LBB01 and PBB01, because according to the network example in Figure 37, the breaker CB01 is interconnecting bus LB01 with bus PB01.

When all circuit breakers are assigned with a pair of identities, the *pmsBusConn* control module will calculate the index numbers for each circuit breaker. The Figure 54 shows the output parameter *MatrixIndex*, in on-line mode, which shall contain the calculated index numbers for the configuration example in Figure 53.

🙂 🚳 🌸 🛸 🐨 🕊				
lame C	Current Value	Data Type	Variable	
– Reset fa	alse	bool	<snmatrixindex.reset></snmatrixindex.reset>	
MatrixIndex		pmsCBIndex	pmsNode1.MatrixIndex	
- CB001_Index1 1		dint	pmsNode1.MatrixIndex.CB001_Index1	
- CB001_Index2 3	6	dint	pmsNode1.MatrixIndex.CB001_Index2	
- CB002_Index1 2		dint	pmsNode1.MatrixIndex.CB002_Index1	
- CB002_Index2 3	7	dint	pmsNode1.MatrixIndex.CB002_Index2	
- CB003_Index1 1		dint	pmsNode1.MatrixIndex.CB003_Index1	
- CB003_Index2 3	8	dint	pmsNode1.MatrixIndex.CB003_Index2	
- CB004_Index1 1		dint	pmsNode1.MatrixIndex.CB004_Index1	
- CB004_Index2 3	9	dint	pmsNode1.MatrixIndex.CB004_Index2	
- CB005_Index1 2		dint	pmsNode1.MatrixIndex.CB005_Index1	
- CB005_Index2 4	0	dint	pmsNode1.MatrixIndex.CB005_Index2	
- CB006_Index1 2	1	dint	pmsNode1.MatrixIndex.CB006_Index1	
- CB006_Index2 4	1	dint	pmsNode1.MatrixIndex.CB006_Index2	
- CB007_Index1 1		dint	pmsNode1.MatrixIndex.CB007_Index1	
- CB007 Index2 2	( )	dint	pmsNode1.MatrixIndex.CB007 Index2	

Figure 54 Example of parameter connections in pmsBusConn

The variable connected to the output parameter *MatrixIndex*, in the control module *pmsBusConn*, shall be further connected to the input parameter *CB* in the control module *pmsTopologyDet*. An example is shown in Figure 55.

E Connections - SNM	latrixIndex pmsBasicLib.j	pmsBusConn		_ 🗆 X
Editor Edit View Ins	sert <u>T</u> ools <u>W</u> indow <u>H</u> elp			
: 🔜 🖬 🔌 🖶 🧕	1	🏘 🍓   🎓   🚍   🗛 🗢 😘		
Name	Data Type	Parameter	Description	<b></b>
1 Reset	bool		IN: Reset and clear the indexes	
2 MatrixIndex	pmsCBIndex	pmsNode1.MatrixIndex	OUT: Calculated Index Numbers (input from faceplate)	-
Parameters /				▶ 11.
			Row 1, Col	5
🔚 Connections - NetD	Determination pmsBasicL	ib.pmsTopologyDet		_ 🗆 🗙
Editor Edit View Ins	ert Iools <u>W</u> indow <u>H</u> elp			
: 🗟 🖬 🔌 🖶 🖻	190800	🎒 🎒 👔 🚍 🗛 🗢 😪		
Name	Data Type	Parameter	Description	*
1 Enable	bool	true	IN: Enable execution of the module	
2 CBIndex	pmsCBIndex	pmsNode1.MatrixIndex	IN: CB indexes NetMatrix	
3 iCB	pmsCBIO	pmsNode1.iCB	IN: Status main circuit breakers	
4 NetSize	pmsNetSize	pmsNode1.NetSize	IN: Size of the network	
5 NetTopology	pmsNetTopology	pmsNode1.NetTopology	OUT:Network topology	<b>*</b>
Parameters /				► 11.
			Row 2 Col	5



### 7.4.1.2 Connection of iCB

The parameter *iCB* shall be used for connecting the physical position feedback signals of the circuit breakers identified for the network determination Figure 37. An example of the necessary application code is shown in Figure 56.

🔚 Control module type - PM5_ApplicationLib.Synchronization	_ 🗆 ×
Editor Edit View Insert Iools Window Help	
:品品 彩彩   帚 외   ゥ ゃ ぷ 心白   舟 桑 品   余   ヨ   ‱ 品 碑   永 段   マ 와 ☆	
Name Data Type Attributes Description	*
1 ioNode1 ioNode	
2 pmsNode1 pmsNode	*
Parameters & Variables & External Variables & Function Blocks ,	•
(*************************************	
(*************************************	
pmsNode1.iCB.CB001.01 := ioNode1.CB01_D1_FeedBackClosed;	
<pre>pmsNode1.iCB.CB001.SP := ioNode1.CB01_DI_FeedBackInService;</pre>	
<pre>pmsNodel.iCB.CB001.L0 := ioNodel.CB01_DI_FeedBackLockedOut;</pre>	
pmsNode1.iCB.CB002.CI := ioNode1.CB02 DI FeedBackClosed;	
<pre>pmsNode1.iCB.CB002.0I := ioNode1.CB02_DI_FeedBackOpened;</pre>	
pmsNodel_iCB_CB002.SP := ioNodel_CB02_DI_FeedBackInService;	
pmsNodel.iCB.CB002.10 := 10Nodel.CB02_D1_FeedbackLockedOut;	
<pre>pmsNode1.iCB.CB003.CI := ioNode1.CB03_DI_FeedBackClosed;</pre>	
pmsNode1.iCB.CB003.0I := ioNode1.CB03_DI_FeedBackOpened;	
pmsNodel iCB.CB003.SP := ioNodel.CB03_DI_FeedBackInService;	
pmsmodel.icb.cb003.io iomodel.cb03_b1_reedbacklockedowc,	
<pre>pmsNode1.iCB.CB004.CI := ioNode1.CB04_DI_FeedBackClosed;</pre>	
pmsNodel iCB CB004.0I := ioNodel CB04_DI FeedBackOpened;	
pmsNodel_ICB_CB004.57 := ioNodel_CB04_DI_reedBackInSerVice; pmsNodel_ICB_CB004_IO := ioNodel_CB04_DI_reedBackInSerVice;	
<pre>pmsNode1.iCB.CB005.CI := ioNode1.CB05_DI_FeedBackClosed;</pre>	
pmsNodel.iCB.CB005.CD := ioNodel.CB05_DI_reedBackOpened;	
pmsNode1.iCB.CB005.IO := ioNode1.CB05_DI_FeedBackInService,	
pmsNodel_iCB_CB006.CI := ioNodel_CB06_DI_FeedBackClosed;	
pmsNode1 (CB CB006 SP := ioNode1 CB06 DI FeedBackDened,	
pmsNode1.iCB.CB006.LO := ioNode1.CB06_DI_FeedBackLockedOut;	
N 1 4 CD CDOOD OT C N 1 4 CDOOD DT D ID 101 1	
pmsNode1.1CB.CB007.0I := 10Node1.CB07_DI_FeedBackClosed;	
pmsNode1.iCB.CB007.SP := ioNode1.CB07_DI_FeedBackInService;	
<pre>pmsNode1.iCB.CB007.LO := ioNode1.CB07_DI_FeedBackLockedOut;</pre>	-
CodeSync_Config      CodeSync_SignalstN      CodeSync_SignalsOUT      I	•
	_ //_
Row 83, Col 75	

Figure 56 Example of application code for iCB connections

If the feedback signal for the service position of a circuit breaker (e.g. CB01) is not applicable for a specific project, it will still be required to permanently set the parameter *iCB.CB01.SP.Value* to true. If the feedback signal for the open position or the locked-out position of a circuit breaker (e.g. CB01) is not applicable for a specific project, the application code for the *iCB.CB01.OI* and *iCB.CB01.LO* can be omitted. The feedback signal for the closed position of a critical circuit breaker (e.g. CB01) is a minimum requirement for the network matrix and therefore the parameter *iCB.CB01.CI* must always be connected via application code.



If a generator or grid is connected to a busbar via several interconnections, the network determination can be simplified by reducing the number of busbars and merging the number of circuit breakers. This option may prove useful when the maximum number of breakers (i.e. 160) is exceeded for a plant.



Figure 57 Example of reduced network determination

The following application code shall be used for combining the feedback positions from the circuit breakers shown in Figure 57:

(* GRID *)	
iCB.CB1.CI.Value :=	= CB11.IOPAR.CI.Value AND
	CB12.IOPAR.CI.Value AND
	CB13.IOPAR.CI.Value AND
	CB14.IOPAR.CI.Value;
iCB.CB1.OI.Value :=	= CB11.IOPAR.OI.Value OR
	CB12.IOPAR.OI.Value OR
	CB13.IOPAR.OI.Value OR
	CB14.IOPAR.OI.Value;
iCB.CB1.SP.Value :=	CB11.IOPAR.SP.Value AND
	CB12.IOPAR.SP.Value AND
	CB13.IOPAR.SP.Value AND
	CB14.IOPAR.SP.Value;
(* Gen 1 *)	
iCB.CB2.CI.Value:=	CB21.IOPAR.CI.Value AND
	CB22.IOPAR.CI.Value;
iCB.CB2.OI.Value:=	CB21.IOPAR.OI.Value OR
	CB22.IOPAR.OI.Value;
<pre>iCB.CB2.SP.Value:=</pre>	CB21.IOPAR.SP.Value AND
	CB22.IOPAR.SP.Value;

#### 7.4.1.3 Connection of NetSize

The parameter NetSize shall be used to determine the maximum number of:

- circuit breakers
- power sources
- load busbars
- potential subnetworks
- grids

... used in the project. An example of the necessary application code is shown in Figure 58.

📑 Connections - NetDete	ermination pmsBasicLi	b.pmsTopologyDet				_ 🗆 🗙
Editor Edit View Insert	<u>I</u> ools <u>₩</u> indow <u>H</u> elp					
: 🔜 🖬 🔌 🖶 🙆 🕛	クマ ど 白 🗋 👌	A A A A				
Name	Data Type	Parameter	Description			<b></b>
1 Enable	bool	true	IN: Enable execution of the module			
2 CBIndex	pmsCBIndex	pmsNode1.MatrixIndex	IN: CB indexes NetMatrix			
3 iCB	pmsCBIO	pmsNode1.iCB	IN: Status main circuit breakers			
4 NetSize	pmsNetSize	pmsNode1.NetSize	N: Size of the network			
5 NetTopology	pmsNetTopology	pmsNode1.NetTopology	OUT:Network topology			*
Parameters						▶ <i>[]</i> ,
					Row 1, Col 5	Lukasz Dembicki
	5	Control module type - PMS ApplicationLib.Synch	ronization	_ 🗆 ×		
Editor Edit Yiew Insert Tools Window Help						
· 品目 多沙   冊 2] 9 2 2 3 1   冊 冊 品   金   記 品 尋   2 10   て計計			21			
Name Data Type Attributes Description						
		1 ioNode1 ioNode				
	1	2 pmsNode1 pmsNode		-		
		Parameters & Variables & External Varia	bles / Function Blocks , •	▶ <i>[</i> ],		
	- -	<pre>(* Network Size configuration pmsNodel NetSize CBmax := 7; pmsNodel NetSize LBBmax := 2; pmsNodel NetSize NetOfGrids := 2; pmsNodel NetSize PBBmax := 6; pmsNodel NetSize SNmax := 2; </pre>		-		

Figure 58 Example of Network Size configuration



*NetworkSize* parameter is a one time setting and should not be modified during runtime of the code depending on different conditions.

*NetworkSize* setting for load busbars (*LBBmax*) and subnetworks to be monitored (*SNmax*) should be set to same value in the network determination.

### 7.4.1.4 Connection of iMV\_Freq and iMV\_Volt

The parameters *iMV\_Freq* and *iMV\_Volt* shall be used for connecting the analogue frequency and voltage measurements from the variable and reference side of the circuit breaker. An example of the necessary application code is shown in Figure 59.

Control module typ	e - PMS_Applicatio	onLib.Synchroniza	ition		_ 🗆 ×
ditor E <u>d</u> it ⊻iew Inse	ert <u>T</u> ools <u>W</u> indow	Help			
	D J L Y		18 🔊 🗔 👬 🗛 🏨	ਡਿ f9   了 ⊉↓ ⊉↑	
Name	Data Type	Attributes	Description		<u>^</u>
1 ioNode1	ioNode				
2 pmsNode1	pmsNode	tornal Variables	Eurotion Blocks		
					<u>ات</u>
(* Analog me (*	asurements fo	or Frequency	and Voltage	*) *)	Ê
(* From BB01 (* From BB02	: Grid-1 2 : Grid-2			*) *)	
(* From BB03 (* From BB04	: Gen-1 : Gen-2			*) *)	
(* From BB05	: Gen-3			<b>*</b> )	
(* From BB16	: Bus A			*)	
(* From BB17 (*	': Bus B			*) *)	-
( <del>************</del> *	**********	*********	*****	•************	
pmsNode1.SN_iM pmsNode1.SN_iM	(V_Freq.BB01 (V_Volt.BB01	= ioNode1.Gr = ioNode1.Gr	id1_AI_Freq; id1_AI_Volt;		
pmsNode1.SN_iM	W_Freq.BB02	= ioNode1.Gr	rid2_AI_Freq;		
pmshoder.on_in			. Idz_RI_VOIC,		
pmsNodel.SN_1M pmsNodel.SN_iM	IV_Freq.BB03 IV_Volt.BB03	= ioNodel.Ge	enl_AI_Freq; enl_AI_Volt;		
nwsNodel SN iM	W Freq BB04	= ioNodel Ge	an2 AT Freq.		
pmsNode1.SN_iM	V_Volt.BB04	= ioNode1.Ge	en2_AI_Volt;		
pmsNode1.SN_iM	V_Freq.BB05	= ioNode1.Ge	m3_AI_Freq;		
pmsNode1.SN_iM	Volt.BB05	= ioNode1.Ge	en3_AI_Volt;		
pmsNodel.SN_iM	V_Freq.BB06	= ioNode1.Ge	en4_AI_Freq;		
pmsNodel.SN_1M	IV_VOIT.BBU6	= 10Nodel.Ge	en4_A1_Volt;		
pmsNode1.SN_iM pmsNode1.SN_iM	W_Freq.BB16 W_Volt.BB16	= ioNode1.Bu = ioNode1.Bu	usA_AI_Freq; usA_AI_Volt;		
pmsNode1.SN iM	W Freg.BB17	= ioNode1.Bu	sB AI Freq;		
pmsNode1.SN_iM	V_Volt.BB17	= ioNode1.Bu	ISB_AI_Volt;		
► CodeSync_Co	ontig_A_CodeSyn	c_signalsIN_/_	CodeSync_SignalsOUT /		<u> </u>
				Row 83, Col 75	

Figure 59 Example of application code for iMV\_Freq and iMV\_Volt

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The example in Figure 59 shows that the variables pmsNode1.SN\_iMV\_Freq.BBxx and pmsNode1.SN\_iMV\_Volt.BBxx are receiving the frequency and voltage values from physical AI signals representing the field measurements.

The variables pmsNode1.SN\_iMV\_Freq and pmsNode1.SN\_iMV\_Volt shall be connected to the inputs iMV\_Freq and iMV\_Volt as shown in Figure 60.

E Connections - Synchron	nization pmsSNLib.pn	nsSNSyncSuperv		- O ×
Editor Edit View Insert	Tools Window Help			
: 🗟 🖬 🔌 🖶 🔊 🕐	C & M D I	🕹 🦀   🎓   🚍   🗛 🗢 🔞		
Name	Data Type	Parameter	Description	<u> </u>
1 Name	string[30]	'Synchronization'	IN EDIT: Name of the object	
2 Description	string[40]	'Synchronization function'	IN EDIT: Description of the object	
3 EvSeverity	dint		IN EDIT: Event severity	
4 AlSeverity	dint		IN EDIT: Alarm severity	
5 Class	dint		IN EDIT: Alarm and Event Class	
6 Enable	bool	true	IN: Enable module execution	
7 NetTopology	pmsNetTopology	pmsNode1.NetTopology	IN: Network topology	
8 iMV Freq	pmsBBRealIO50	pmsNode1.SN iMV Freq	IN: Measured values Freq	
9 iMV Volt	pmsBBReallO50	pmsNode1.SN iMV Volt	IN: Measured values Voltage	
10 PB01	dint	2	IN: Power Bus Bar:01 type 1 = Generator, 2 = Grid	
11 PB02	dint	2	IN: Power Bus Bar:02 type 1 = Generator, 2 = Grid	
12 PB03	dint	1	IN: Power Bus Bar 03 type 0 = None, 1 = Generator	
13 PB04	dint	1	IN: Power Bus Bar:04 type 0 = None, 1 = Generator	
14 PB05	dint	1	IN: Power Bus Bar 05 type 0 = None, 1 = Generator	
15 PB06	dint	1	IN: Power Bus Bar 06 type 0 = None, 1 = Generator	
16 PB07	dint	0	IN: Power Bus Bar 07 type 0 = None, 1 = Generator	
17 PB08	dint	0	IN: Power Bus Bar 08 type 0 = None, 1 = Generator	
18 PB09	dint	0	IN: Power Bus Bar 09 type 0 = None, 1 = Generator	
19 PB10	dint	0	IN: Power Bus Bar 10 type 0 = None, 1 = Generator	
20 PB11	dint	0	IN: Power Bus Bar 11 type 0 = None, 1 = Generator	
21 PB12	dint	0	IN: Power Bus Bar 12 type 0 = None, 1 = Generator	
22 PB13	dint	0	IN: Power Bus Bar 13 type 0 = None, 1 = Generator	
23 PB14	dint	0	IN: Power Bus Bar 14 type 0 = None, 1 = Generator	
24 PB15	dint	0	IN: Power Bus Bar 15 type 0 = None, 1 = Generator	
25 IO Input	pmsSNIOPar	pmsNode1 SN IO Input	IN: Feedback from synchronizing panel	
26 CB ID	pmsSNCB ID	pmsNode1 SN_CB_ID	IN: CB Identity for CB with Sync request	
27 GNSynPar	pmsGNSNPar	pmsNode1 SN_AllGepSynPar	IN: Connection from Gen Control Modules	
28 CBSynPar	nmsCBSNPar	pmsNode1 SN_AllCBSynPar	IN: Connection from CBSvnc Control Modules	
29 EvtPar	nmsSNEvtPar	nmsNode1 SN EvtPar	IN: External Parameters	
30 ParamSet	nmsGenDint	nmsNode1 SN ParamSet	IN EDIT: Fill in corresponding parameter set for selected generator	
31 MaxNoGenSelection	dint	4	IN: Maximum number of Generators narticinating in the sync process	
32 Fred owl imit	real	nmsNode1 SN Fred owl imit	IN EDIT. Value of Frequency limit value for sourious nowered bus	
33 Volt owl imit	real	pmsNode1.SN_/requowLimit	IN EDIT: Value of Voltage limit value for spurious powered bus	
34 SynCfgPar	nmsSNCfgPar	nmsNode1 SN_SynCfgPar	IN EDIT. Sunchroniser timeout configurar	
35 SelectedGen	nmsGenBool	nmsNode1 SN_SelectedGen	OUT: HSI calented generators	
36 SunGNPor	prisoendoor	pmsNode1.SN_SelectedGen	OUT: Connection to Con Control Medules	
37 SynoOperation	had	prisivide1.Synconration	OUT. Suga aparetian in program	
39 SunCPDor	pmoSNCPDor	pmsNode1.SN_SyncOperation	OUT: Connection to CRSuna Control Medules	
30 LIDEE	dint	pmshode1.SN_AlloyIICBFar	OUT: Indication of reference cide (Buc her ID)	
	dint	pmsNode1.SN_UVAP	OUT: Indication of variable cide (Daviar course ID)	
40 0VAR	omeSNIOPer	pmsNode1.SN_0VAR	OUT: Commande to cynchronizing namel	
A Parameters	prosonioral	prinsidode1.3id_IO_Odtput	oor. commands to synchronizing panel	<b>_</b>
				<u> </u>

Figure 60 Example of parameter connection iMV\_Freq and iMV\_Volt

#### 7.4.1.5 Connection of PB01...PB15

The parameters *PB01…PB15* shall be used for configuring the power sources (generators and grid connections) included in the network determination. An example of the necessary connections is shown in Figure 61.

Be	Connections - Synchronization pmsSNLib.pmsSNSyncSuperv				
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	Name	Data Type	Parameter	Description	<u> </u>
1	Name	string[30]	'Synchronization'	IN EDIT: Name of the object	
2	Description	string[40]	'Synchronization function'	IN EDIT: Description of the object	
3	EvSeverity	dint		IN EDIT: Event severity	
4	AlSeverity	dint		IN EDIT: Alarm severity	
5	Class	dint		IN EDIT: Alarm and Event Class	
6	Enable	bool	true	IN: Enable module execution	
7	NetTopology	pmsNetTopology	pmsNode1.NetTopology	IN: Network topology	
8	iMV_Freq	pmsBBRealIO50	pmsNode1.SN_iMV_Freq	IN: Measured values Freq	
9	iMV_Volt	pmsBBRealIO50	pmsNode1.SN_iMV_Volt	IN: Measured values Voltage	
10	PB01	dint	2	IN: Power Bus Bar:01 type 1 = Generator, 2 = Grid	
11	PB02	dint	2	IN: Power Bus Bar:02 type 1 = Generator, 2 = Grid	
12	PB03	dint	1	IN: Power Bus Bar:03 type 0 = None, 1 = Generator	
13	PB04	dint	1	IN: Power Bus Bar:04 type 0 = None, 1 = Generator	
14	PB05	dint	1	IN: Power Bus Bar:05 type 0 = None, 1 = Generator	
15	PB06	dint	1	IN: Power Bus Bar:06 type 0 = None, 1 = Generator	
16	PB07	dint	0	IN: Power Bus Bar.07 type 0 = None, 1 = Generator	
17	PB08	dint	0	IN: Power Bus Bar.08 type 0 = None, 1 = Generator	
18	PB09	dint	0	IN: Power Bus Bar:09 type 0 = None, 1 = Generator	
19	PB10	dint	0	IN: Power Bus Bar:10 type 0 = None, 1 = Generator	
20	PB11	dint	0	IN: Power Bus Bar.11 type 0 = None, 1 = Generator	
21	PB12	dint	0	IN: Power Bus Bar:12 type 0 = None, 1 = Generator	
22	PB13	dint	0	IN: Power Bus Bar:13 type 0 = None, 1 = Generator	
23	PB14	dint	0	IN: Power Bus Bar:14 type 0 = None, 1 = Generator	
24	PB15	dint	0	IN: Power Bus Bar:15 type 0 = None, 1 = Generator	
25	IO_Input	pmsSNIOPar	pmsNode1.SN_IO_Input	IN: Feedback from synchronizing panel	
26	CB_ID	pmsSNCB_ID	pmsNode1.SN_CB_ID	IN: CB Identity for CB with Sync request	
27	GNSynPar	pmsGNSNPar	pmsNode1.SN_AllGenSynPar	IN: Connection from Gen Control Modules	
28	CBSynPar	pmsCBSNPar	pmsNode1.SN_AllCBSynPar	IN: Connection from CBSync Control Modules	
29	ExtPar	pmsSNExtPar	pmsNode1.SN_ExtPar	IN: External Parameters	
30	ParamSet	pmsGenDint	pmsNode1.SN_ParamSet	IN EDIT: Fill in corresponding parameter set for selected generator	
31	MaxNoGenSelection	dint	4	IN: Maximum number of Generators participating in the sync process	
32	FreqLowLimit	real	pmsNode1.SN_FreqLowLimit	IN EDIT: Value of Frequency limit value for spurious powered bus	
33	VoltLowLimit	real	pmsNode1.SN_VoltLowLimit	IN EDIT: Value of Voltage limit value for spurious powered bus	
34	SynCfgPar	pmsSNCfgPar	pmsNode1.SN_SynCfgPar	IN EDIT: Synchroniser timeout configpar	
35	SelectedGen	pmsGenBool	pmsNode1.SN_SelectedGen	OUT: HSI selected generators	
36	SynGNPar	pmsSNGNPar	pmsNode1.SyncGNPar	OUT: Connection to Gen Control Modules	
37	SyncOperation	bool	pmsNode1.SN_SyncOperation	OUT: Sync operation in progress	
38	SynCBPar	pmsSNCBPar	pmsNode1.SN_AllSynCBPar	OUT: Connection to CBSync Control Modules	
39	UREF	dint	pmsNode1.SN_UREF	OUT: Indication of reference side (Bus bar ID)	
40	UVAR	dint	pmsNode1.SN_UVAR	OUT: Indication of variable side (Power source ID)	
41	IO_Output	pmsSNIOPar	pmsNode1.SN_IO_Output	OUT: Commands to synchronizing panel	<b>_</b>
4)	Parameters			•	▶ //.
1				Row 1, Col 5	

Figure 61 Example of parameter connection PB01-PB15



The example in Figure 61 reflects the configuration of the power sources in the network determination example from Figure 37. The PB01 and PB02 are set to number 2 because they represent the grid connections, while the PB03 to PB06 are set to number 1 because they represent the generators. The rest of PB07 to PB15 are set to number 0 because they are not applicable for the specific network determination.

### 7.4.1.1 Connection of IO\_Input and IO\_Output

The parameters *IO\_Input* and *IO\_Output* shall be used for configuring the I/O interface signals with the synchronizing equipment. An example of the necessary connections is shown in Figure 62 and Figure 63.

🔁 Control module type - PMS_Applicati	onLib.Synchroniza	ition	_ 🗆 X
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Name Data Type	Attributes	Description	
1 ioNode1 ioNode	, and aloo	2000 mpilet	
2 pmsNode1 pmsNode			-
↓ Parameters λ Variables λ Ex	ternal Variables	K Function Blocks	+
	**********		
(* Interface with the Syn	nchronizing I	)evice (equipment) *)	-
(*		*)	
(* Device is in "Remote"	Point of Cor	ntrol *)	
(* Device is "Ready"		*)	
(* Device is "Operating"		*)	
(* Device in Error		*)	
(* Feedback after activa	ting the "Van	RefExchange" relay *)	
(* Feedbacks after active	ating the "CH	Selection relays *)	
(* Feedbacks after active	ating the "Ge	merator belection relays *)	
(*	soing one of	*)	
(******************	***********	••••••••••••••••••••••••••••••••••••••	
preNodel SN TO Input Remote		Nodel SN DI Remote	
pmsNode1.SN_IO_Input.SvncR	eadv1 := id	Nodel SN DI Ready:	
pmsNode1.SN_IO_Input.Sync0	perate1 := ic	Node1.SN_DI_Operate;	
pmsNode1.SN_IO_Input.SyncE:	rror1 := ic	oNode1.SN_DI_Error;	
pmsNode1.SN_IO_Input.VarRes	fEx := io	Node1.SN_DI_ExchangeVarRefSide_FB;	
provedel SN TO Input CP1		Wedel SN DI SelectSumeCP Cridi FP:	
pmsNode1.SN_IO_Input.CB2	:= 10	Nodel SN DI SelectSynccB Grid2 FB:	
pmsNode1.SN_IO_Input.CB3	:= io	Node1.SN_DI_SelectSyncCB_Gen1_FB;	
pmsNode1.SN_IO_Input.CB4	:= ic	Node1.SN_DI_SelectSyncCB_Gen2_FB;	
pmsNodel SN_IO_Input CB6	:= 10	Nodel SN_DI_SelectSyncCB_Gen3_FB;	
pmsNode1.SN_IO_Input.CB7	:= ic	Node1.SN_DI_SelectSyncCB_BusTieAB_FB;	
pmsNodel.SN_IO_Input.Gen1	:= 10	Nodel.SN_DI_SelectSyncGen_Gen1_FB;	
pmsNode1.SN_IO_Input.Gen3	:= i0	Nodel SN DI SelectSyncGen Gen3 FB:	
pmsNode1.SN_IO_Input.Gen4	:= ic	Node1.SN_DI_SelectSyncGen_Gen4_FB;	
anaWadal SN TO Inaut Danas		Wedel CN DI CelestPerseCet NeCome ED.	
pmsNodel SN IO Input Param	Set2 := 10	Nodel SN DI SelectParamSet Gen1 FB:	
pmsNode1.SN_IO_Input.Param	Set3 := id	Node1.SN_DI_SelectParamSet_Gen1_FB;	
pmsNode1_SN_IO_Input_Param	Set4 := ic	Node1.SN_DI_SelectParamSet_Gen1_FB;	
pmswodel.SN_IU_input.Param	bet5 := 10	<pre>bnode1.5n_D1_SelectFaramSet_Gen1_FB;</pre>	-
CodeSync_Config CodeSyn	c_SignalsIN	CodeSync_SignalsOUT / 4	1
		Pow 83 Col 75	

*Figure 62 Example of application code for IO\_Input parameter* 

🖀 Control module type - PMS_ApplicationLib.Synchronization	_ 🗆 ×
Editor Edit View Insert Iools Window Help	
1 😡 🖬 乡 🅪 🗐 🤚 ୯ ४ 🕸 🗋 🖓 🍓 🏔 象 🖃 🔚 🏭 🔗 🕅 (7 計 計	
Name Data Type Attributes Description	<u>*</u>
1 ioNode1 ioNode	_
2 pmsNode1 pmsNode	-
Parameters Variables External Variables Function Blocks 4	<u> </u>
(*************************************	-
(* *) (* OUTDUTE:	
(* Command for "Start" *)	
(* Command for "Stop" *) (* *)	
(* Energize the relay for "VarRefExchange" *)	
(* Energize the relay for "Generator Selection" *)	
(* Energize the selected generator's "Parameter Set" *) (* *)	
(` <del>******************************</del> )	
ioNode1.SN_D0_StartSync.Value := pmsNode1.SN_I0_Output.SyncStart.Va	lue;
ioNode1.SN_D0_StopSync.Value := pmsNode1.SN_I0_Output.SyncStop.Val ioNode1_SN_D0_ExchangeVarRefSide_Value := pmsNode1_SN_I0_Output_VarRefEx_Val	ue;
ioNode1.SN_D0_SelectSynccB_Grid2.Value := pmsNode1.SN_I0_Output.CB1.Value;	
ioNode1.SN_DO_SelectSyncCB_Gen1.Value := pmsNode1.SN_IO_Output.CB3.Value; ioNode1_SN_DO_SelectSyncCB_Gen2_Value := pmsNode1_SN_IO_Output_CB4_Value;	
ioNode1_SN_DO_SelectSyncCB_Gen3_Value = pmsNode1_SN_IO_Output.CB5_Value;	
ioNodel.SN_D0_SelectSyncCB_BusTieAB.Value: = pmsNodel.SN_D0_Output.CB5.value; ioNodel.SN_D0_SelectSyncCB_BusTieAB.Value: = pmsNodel.SN_I0_Output.CB7.Value;	
ioNodel SN D0 SelectSuncCen Gen1 Value := nmsNodel SN T0 Output Gen1 Value:	
ioNode1.SN_D0_SelectSyncGen_Gen2.Value := pmsNode1.SN_I0_Output.Gen2.Value;	
ioNodel.SN_DO_SelectSyncGen_Gen3.Value := pmsNodel.SN_IO_Output.Gen3.Value; ioNodel.SN_DO_SelectSyncGen_Gen4.Value := pmsNodel.SN_IO_Output.Gen4.Value;	
ioNodel SN DO SelectParamSet NoSunc Value:= nmeNodel SN TO Output ParamSet1 Va	lue
ioNode1.SN_DO_SelectParamSet_Gen1.Value := pmsNode1.SN_IO_Output.ParamSet2.Va	lue:
ioNodel.SN_DU_SelectParamSet_Gen2.Value := pmsNodel.SN_IU_Output.ParamSet3.Va ioNodel.SN_DO_SelectParamSet_Gen3.Value := pmsNodel.SN_IO_Output.ParamSet4.Va	lue;
ioNode1.SN_D0_SelectParamSet_Gen4.Value := pmsNode1.SN_I0_Output.ParamSet5.Va	lue;
	-
CodeSync_Config & CodeSync_SignalsIN & CodeSync_SignalsOUT	• //
Row 36, Col 65	

Figure 63 Example of application code for IO\_Output parameter



The example in Figure 62 shows that the variables *pmsNode1.SN\_IO\_Input.xx* are receiving the feedback signals from DI signals representing the status of the synchronizing device and the field selection relays (refer to the comments in the structure text code).

The example in Figure 63 shows that the variables *pmsNode1.SN\_IO\_Output.xx* are sending the software commands to DO outputs representing the operation commands towards the synchronizing device and the field relays (refer to the comments in the structure text code).

The variables pmsNode1.*SN\_IO\_Input and pmsNode1.SN\_IO\_Output* shall be connected to the parameters *IO\_Input and IO\_Output*, as shown in Figure 64.

Вc	Connections - Synchronization pmsSNLib.pmsSNSyncSuperv				
Edito	or E <u>d</u> it ⊻iew Insert <u>I</u>	ools <u>W</u> indow <u>H</u> elp			
	Name	Data Type	Parameter	Description	-
1	Name	string[30]	'Synchronization'	IN EDIT: Name of the object	_
2	Description	string[40]	'Synchronization function'	IN EDIT: Description of the object	
3	EvSeverity	dint		IN EDIT: Event severity	
4	AlSeverity	dint		IN EDIT: Alarm severity	
5	Class	dint		IN EDIT: Alarm and Event Class	
6	Enable	bool	true	IN: Enable module execution	
7	NetTopology	pmsNetTopology	pmsNode1.NetTopology	IN: Network topology	
8	iMV_Freq	pmsBBRealIO50	pmsNode1.SN_iMV_Freq	IN: Measured values Freq	
9	iMV_Volt	pmsBBReallO50	pmsNode1.SN_iMV_Volt	IN: Measured values Voltage	
10	PB01	dint	2	IN: Power Bus Bar:01 type 1 = Generator, 2 = Grid	
11	PB02	dint	2	IN: Power Bus Bar:02 type 1 = Generator, 2 = Grid	
12	PB03	dint	1	IN: Power Bus Bar:03 type 0 = None, 1 = Generator	
13	PB04	dint	1	IN: Power Bus Bar:04 type 0 = None, 1 = Generator	
14	PB05	dint	1	IN: Power Bus Bar:05 type 0 = None, 1 = Generator	
15	P806	dint	1	IN: Power Bus Bar:06 type 0 = None, 1 = Generator	
16	PB07	dint	0	IN: Power Bus Bar:07 type 0 = None, 1 = Generator	
17	P808	dint	0	IN: Power Bus Bar.08 type 0 = None, 1 = Generator	
18	PB09	dint	0	IN: Power Bus Bar:09 type 0 = None, 1 = Generator	
19	PB10	dint	0	IN: Power Bus Bar:10 type 0 = None, 1 = Generator	
20	PB11	dint	0	IN: Power Bus Bar.11 type 0 = None, 1 = Generator	
21	PB12	dint	0	IN: Power Bus Bar:12 type 0 = None, 1 = Generator	
22	PB13	dint	0	IN: Power Bus Bar 13 type 0 = None, 1 = Generator	
23	PB14	dint	0	IN: Power Bus Bar:14 type 0 = None, 1 = Generator	
24	PB15	dint	0	IN: Power Bus Bar:15 type 0 = None, 1 = Generator	
25	IO_Input	pmsSNIOPar	pmsNode1.SN_IO_Input	IN: Feedback from synchronizing panel	
26	CB_ID	pmsSNCB_ID	pmsNode1.SN_CB_ID	IN: CB Identity for CB with Sync request	
27	GNSynPar	pmsGNSNPar	pmsNode1.SN_AllGenSynPar	IN: Connection from Gen Control Modules	
28	CBSynPar	pmsCBSNPar	pmsNode1.SN_AllCBSynPar	IN: Connection from CBSync Control Modules	
29	ExtPar	pmsSNExtPar	pmsNode1.SN_ExtPar	IN: External Parameters	
30	ParamSet	pmsGenDint	pmsNode1.SN_ParamSet	IN EDIT: Fill in corresponding parameter set for selected generator	
31	MaxNoGenSelection	dint	4	IN: Maximum number of Generators participating in the sync process	
32	FreqLowLimit	real	pmsNode1.SN_FreqLowLimit	IN EDIT: Value of Frequency limit value for spurious powered bus	
33	VoltLowLimit	real	pmsNode1.SN_VoltLowLimit	IN EDIT: Value of Voltage limit value for spurious powered bus	
34	SynCfgPar	pmsSNCfgPar	pmsNode1.SN_SynCfgPar	IN EDIT: Synchroniser timeout configpar	
35	SelectedGen	pmsGenBool	pmsNode1.SN_SelectedGen	OUT: HSI selected generators	
36	SynGNPar	pmsSNGNPar	pmsNode1.SyncGNPar	OUT: Connection to Gen Control Modules	
37	SyncOperation	bool	pmsNode1.SN_SyncOperation	OUT: Sync operation in progress	
38	SynCBPar	pmsSNCBPar	pmsNode1.SN_AllSynCBPar	OUT: Connection to CBSync Control Modules	
39	UREF	dint	pmsNode1.SN_UREF	OUT: Indication of reference side (Bus bar ID)	
40	UVAR	dint	pmsNode1.SN_UVAR	OUT: Indication of variable side (Power source ID)	
41	IO_Output	pmsSNIOPar	pmsNode1.SN_IO_Output	OUT: Commands to synchronizing panel	-
4 >	Parameters /				11.
				Down 1 Col 5	

Figure 64 Example of parameter connection IO\_Input and IO\_Output
### 7.4.1.2 Connection of CB\_ID

The parameter *CB\_ID* shall be used for activating the circuit breaker selection relays, depending on the faceplate of the pmsCBSyncM module which is initiating the synchronization process (refer to Figure 9). An example of the necessary application code is shown in Figure 65.

🔚 Control module type - PMS_A	pplicationLib.Synchroni	zation		_ 🗆 X
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Name Data Typ	e Attributes	Description		<u> </u>
1 ioNode1 ioNode				
2 pmsNode1 pmsNode	3			•
Parameters Variables	External Variables	Function Blocks		<u> </u>
(*************************************	<pre>ay Assigment mer Grid-1 mer Grid-2 rator Gen1 rator Gen3 rator Gen4 A-B Coupler := 1: := 2: := 3: := 4: := 5: := 6: := 7.</pre>		**************************************	
CodeSync_Config	odeSync_SignalsIN_	CodeSync_SignalsOUT _/		•
			Row 90, Col 67	1

Figure 65 Example of application code for CB\_ID parameter



The example in Figure 65 shows that the variables *pmsNode1.SN\_CB\_ID.CB1...CB8* are set to a value representing the index number of the circuit breakers in the synchronizing scheme (refer to Table 56). The variable *pmsNode1.SN\_CB\_ID* shall be connected to the parameter CB\_ID, as shown in Figure 66.

According to the configuration example, when the circuit breaker with index 2 is selected for the synchronization, the variable *pmsNode1.SN\_IO\_Output.CB2.Value* will be set to true. The application code in Figure 63 shows that this variable will cause the selection relay for the Grid-2 breaker to be activated.

Editor Edit View Incert	zation pmsSNLib.pm	nsSNSyncSuperv		- 🗆 ×	
The first fi					
Name	Data Tyne	Parameter	Description		
1 Name	string[30]	'Synchronization'	IN EDIT. Name of the object		
2 Description	string[40]	'Synchronization function'	IN EDIT: Description of the object		
3 EvSeverity	dint		IN EDIT: Event severity		
4 AlSeverity	dint		IN EDIT: Alarm severity		
5 Class	dint		IN EDIT: Alarm and Event Class		
6 Enable	bool	true	IN: Enable module execution		
7 NetTopology	pmsNetTopology	pmsNode1.NetTopology	IN: Network topology		
8 iMV_Freq	pmsBBReallO50	pmsNode1.SN_iMV_Freq	IN: Measured values Freq		
9 iMV_Volt	pmsBBReallO50	pmsNode1.SN_iMV_Volt	IN: Measured values Voltage		
10 PB01	dint	2	IN: Power Bus Bar.01 type 1 = Generator, 2 = Grid		
11 PB02	dint	2	IN: Power Bus Bar.02 type 1 = Generator, 2 = Grid		
12 PB03	dint	1	IN: Power Bus Bar.03 type 0 = None, 1 = Generator		
13 PB04	dint	1	IN: Power Bus Bar:04 type 0 = None, 1 = Generator		
14 PB05	dint	1	IN: Power Bus Bar.05 type 0 = None, 1 = Generator		
15 PB06	dint	1	IN: Power Bus Bar.06 type 0 = None, 1 = Generator		
16 PB07	dint	0	IN: Power Bus Bar.07 type 0 = None, 1 = Generator		
17 PB08	dint	0	IN: Power Bus Bar:08 type 0 = None, 1 = Generator		
18 PB09	dint	0	IN: Power Bus Bar.09 type 0 = None, 1 = Generator		
19 PB10	dint	0	IN: Power Bus Bar 10 type 0 = None, 1 = Generator		
20 PB11	dint	0	IN: Power Bus Bar.11 type 0 = None, 1 = Generator		
21 PB12	dint	0	IN: Power Bus Bar:12 type 0 = None, 1 = Generator		
22 PB13	dint	0	IN: Power Bus Bar:13 type 0 = None, 1 = Generator		
23 PB14	dint	0	IN: Power Bus Bar:14 type 0 = None, 1 = Generator		
24 PB15	dint	0	IN: Power Bus Bar 15 type 0 = None, 1 = Generator		
25 IO_Input	pmsSNIOPar	pmsNode1.SN_IO_Input	IN: Feedback from synchronizing panel		
26 CB_ID	pmsSNCB_ID	pmsNode1.SN_CB_ID	IN: CB Identity for CB with Sync request		
27 GNSynPar	pmsGNSNPar	pmsNode1.SN_AllGenSynPar	IN: Connection from Gen Control Modules		
28 CBSynPar	pmsCBSNPar	pmsNode1.SN_AllCBSynPar	IN: Connection from CBSync Control Modules		
29 ExtPar	pmsSNExtPar	pmsNode1.SN_ExtPar	IN: External Parameters		
30 ParamSet	pmsGenDint	pmsNode1.SN_ParamSet	IN EDIT: Fill in corresponding parameter set for selected generator		
31 MaxNoGenSelection	dint	4	IN: Maximum number of Generators participating in the sync process		
32 FreqLowLimit	real	pmsNode1.SN_FreqLowLimit	IN EDIT: Value of Frequency limit value for spurious powered bus		
33 VoltLowLimit	real	pmsNode1.SN_VoltLowLimit	IN EDIT: Value of Voltage limit value for spurious powered bus		
34 SynCfgPar	pmsSNCfgPar	pmsNode1.SN_SynCfgPar	IN EDIT: Synchroniser timeout configpar		
35 SelectedGen	pmsGenBool	pmsNode1.SN_SelectedGen	OUT: HSI selected generators		
36 SynGNPar	pmsSNGNPar	pmsNode1.SyncGNPar	OUT: Connection to Gen Control Modules		
37 SyncOperation	bool	pmsNode1.SN_SyncOperation	OUT: Sync operation in progress		
38 SynCBPar	pmsSNCBPar	pmsNode1.SN_AllSynCBPar	OUT: Connection to CBSync Control Modules		
39 UREF	dint	pmsNode1.SN_UREF	OUT: Indication of reference side (Bus bar ID)		
40 UVAR	dint	pmsNode1.SN_UVAR	OUT: Indication of variable side (Power source ID)		
41 IO_Output	pmsSNIOPar	pmsNode1.SN_IO_Output	OUT: Commands to synchronizing panel	-	
Parameters				<u> </u>	
			Row 1, Col 5	14	

Figure 66 Example of parameter connection CB\_ID

## 7.4.1.3 Connection of GNSynPar and SynGNPAr

The parameters *GNSynPar* and *SynGNPAr* are described in Connection of SyncGNPar and section Connection of GNSyncPar. Refer to Figure 47 and Figure 48 for the relevant examples.

## 7.4.1.4 Connection of SyncOperation

The parameter *SyncOperation* is providing a Boolean indication that the synchronization session is in progress and the control module pmsSNSyncSuperv is active. It can be used in project specific application logic or in graphic displays for presenting the status of the synchronization function. An example of the necessary connection is shown in Figure 67.

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NL		A 🗛   🚁   🔜   A., 🗢 😰		
Name	Data Type	Parameter	Description	<u> </u>
1 Name	string[30]	'Synchronization'	IN EDIT: Name of the object	
2 Description	string[40]	Synchronization function	IN EDIT: Description of the object	
3 EvSeverity	dint		IN EDIT: Event severity	
4 AlSeverity	dint		IN EDIT: Alarm severity	
5 Class	dint		IN EDIT: Alarm and Event Class	
6 Enable	bool	true	IN: Enable module execution	
7 NetTopology	pmsNetTopology	pmsNode1.NetTopology	IN: Network topology	
8 iMV Freq	pmsBBRealIO50	pmsNode1.SN iMV Freq	IN: Measured values Freq	
9 iMV Volt	pmsBBReallO50	pmsNode1.SN iMV Volt	IN: Measured values Voltage	
10 PB01	dint	2	IN: Power Bus Bar:01 type 1 = Generator, 2 = Grid	
11 PB02	dint	2	IN: Power Bus Bar 02 type 1 = Generator, 2 = Grid	
12 PB03	dint	1	IN: Power Bus Bar 03 type 0 = None, 1 = Generator	
13 PB04	dint	1	IN: Power Bus Bar 04 type 0 = None 1 = Generator	
14 PB05	dint	1	IN: Power Bus Bar 05 type 0 = None, 1 = Generator	
15 PB06	dint	1	IN: Power Bus Bar $\Omega$ 5 type $\Omega$ = None 1 = Generator	
16 PB07	dint	0	IN: Power Bus Bar $\Omega$ type $\Omega$ = None 1 = Generator	
17 PB08	dint	0	IN: Power Bus Bar 08 type 0 = None, 1 = Generator	
18 PB09	dint	0	IN: Power Bus Bar 09 type 0 = None, 1 = Generator	
19 PB10	dint	0	IN: Power Bus Bar 10 type 0 = None, 1 = Generator	
20 PB11	dint	0	IN: Prover Bus Bar 11 type 0 = None, 1 = Generator	
21 PB12	dint	0	IN: Power Bus Bar 12 type 0 = None, 1 = Generator	
22 PB13	dint	0	IN: Power Bus Bar 13 type 0 = None, 1 = Generator	
23 DB1/	dint	0	IN: Power Bus Bar 14 type 0 = None, 1 = Generator	
24 0815	dint	0	IN: Power Bus Bar 15 tune 0 = None, 1 = Cenerator	
24 PD15	omo@NIODor	pmoNedel SN IQ Input	IN: Fower Dus Dation type 0 - None, 1 - Generator	
25 IO_IIIput	phisonioral pmsCNCP_ID	pmsNode1.SN_IO_input	IN. CP Identity for CP with Superconduct	
20 CD_ID	pmsSNCD_ID	pmsNode1.SN_CD_ID	IN: CB Identity for CB with Sync request	
27 GNSynPar	pmsGNSNPar	pmsNode1.SN_AliGenSynPar	IN. Connection from Gen Control Modules	
28 CBSynPar	pmsCBSNPar	pmsNode1.SN_AICBSynPar	IN: Connection from CBSync Control Modules	
29 ExtPar	pmsSNExtPar	pmsNode1.SN_ExtPar	IN: External Parameters	
30 ParamSet	pmsGenDint	pmsNode1.SN_ParamSet	IN EUTE Fill in corresponding parameter set for selected generator	
31 MaxNoGenSelection	dint	4	IN: Maximum number of Generators participating in the sync process	
32 FreqLowLimit	real	pmsNode1.SN_FreqLowLimit	IN EDIT: Value of Frequency limit value for spurious powered bus	
33 VoltLowLimit	real	pmsNode1.SN_VoltLowLimit	IN EDIT: Value of Voltage limit value for spurious powered bus	
34 SynCtgPar	pmsSNCtgPar	pmsNode1.SN_SynCtgPar	IN EDIT: Synchroniser timeout configpar	
35 SelectedGen	pmsGenBool	pmsNode1.SN_SelectedGen	OUT: HSI selected generators	
36 SynGNPar	pmsSNGNPar	pmsNode1.SyncGNPar	OUT: Connection to Gen Control Modules	
37 SyncOperation	bool	pmsNode1.SN_SyncOperation	OUT: Sync operation in progress	
38 SynCBPar	pmsSNCBPar	pmsNode1.SN_AllSynCBPar	OUT: Connection to CBSync Control Modules	
39 UREF	dint	pmsNode1.SN_UREF	OUT: Indication of reference side (Bus bar ID)	
40 UVAR	dint	pmsNode1.SN_UVAR	OUT: Indication of variable side (Power source ID)	
41 IO_Output	pmsSNIOPar	pmsNode1.SN_IO_Output	OUT: Commands to synchronizing panel	
Parameters				• //.

Figure 67 Example of parameter connection SyncOperation

## 7.4.1.5 Connection of CBSynPar and SynCBPar

The parameters *CBSynPar* and *SynCBPar* are described in section Connection of SynCBPar and section Connection of CBSynPar. Refer to Figure 42 and Figure 43 for the relevant examples.

# 7.4.1.6 Connection of UREF and UVAR

The parameters *UREF* and *UVAR* are providing a numerical indication of the selected variable and reference side in the synchronization session. They can be used in project specific application logic or in graphic displays for presenting the variable and reference side. An example of the necessary connections is shown in Figure 68.

E Connections - Synchroni	ization pmsSNLib.pm	155NSyncSuperv			
Éditor Egit View Insert Iools Window Help					
Name	Data Type	Parameter	Description	<b>_</b>	
1 Name	string[30]	'Synchronization'	IN EDIT: Name of the object		
2 Description	string[40]	'Synchronization function'	IN EDIT: Description of the object		
3 EvSeverity	dint		IN EDIT: Event severity		
4 AlSeverity	dint		IN EDIT: Alarm severity		
5 Class	dint		IN EDIT: Alarm and Event Class		
6 Enable	bool	true	IN: Enable module execution		
7 NetTopology	pmsNetTopology	pmsNode1.NetTopology	IN: Network topology		
8 iMV_Freq	pmsBBRealIO50	pmsNode1.SN_iMV_Freq	IN: Measured values Freq		
9 iMV_Volt	pmsBBReallO50	pmsNode1.SN_iMV_Volt	IN: Measured values Voltage		
10 PB01	dint	2	IN: Power Bus Bar:01 type 1 = Generator, 2 = Grid		
11 PB02	dint	2	IN: Power Bus Bar:02 type 1 = Generator, 2 = Grid		
12 PB03	dint	1	IN: Power Bus Bar:03 type 0 = None, 1 = Generator		
13 PB04	dint	1	IN: Power Bus Bar:04 type 0 = None, 1 = Generator		
14 PB05	dint	1	IN: Power Bus Bar.05 type 0 = None, 1 = Generator		
15 PB06	dint	1	IN: Power Bus Bar.06 type 0 = None, 1 = Generator		
16 PB07	dint	0	IN: Power Bus Bar:07 type 0 = None, 1 = Generator		
17 PB08	dint	0	IN: Power Bus Bar.08 type 0 = None, 1 = Generator		
18 PB09	dint	0	IN: Power Bus Bar:09 type 0 = None, 1 = Generator		
19 PB10	dint	0	IN: Power Bus Bar:10 type 0 = None, 1 = Generator		
20 PB11	dint	0	IN: Power Bus Bar.11 type 0 = None, 1 = Generator		
21 PB12	dint	0	IN: Power Bus Bar:12 type 0 = None, 1 = Generator		
22 PB13	dint	0	IN: Power Bus Bar.13 type 0 = None, 1 = Generator		
23 PB14	dint	0	IN: Power Bus Bar:14 type 0 = None, 1 = Generator		
24 PB15	dint	0	IN: Power Bus Bar 15 type 0 = None, 1 = Generator		
25 IO_Input	pmsSNIOPar	pmsNode1.SN_IO_Input	IN: Feedback from synchronizing panel		
26 CB_ID	pmsSNCB_ID	pmsNode1.SN_CB_ID	IN: CB Identity for CB with Sync request		
27 GNSynPar	pmsGNSNPar	pmsNode1.SN_AllGenSynPar	IN: Connection from Gen Control Modules	£	
28 CBSynPar	pmsCBSNPar	pmsNode1.SN_AllCBSynPar	IN: Connection from CBSync Control Modules		
29 ExtPar	pmsSNExtPar	pmsNode1.SN_ExtPar	IN: External Parameters		
30 ParamSet	pmsGenDint	pmsNode1.SN_ParamSet	IN EDIT: Fill in corresponding parameter set for selected generator		
31 MaxNoGenSelection	aint	4 mashindat Chi Frank and init	IN: Maximum number of Generators participating in the sync process		
32 FreqLowLimit	real	pmsNode1.SN_FreqLowLimit	IN EDIT: Value of Frequency limit value for spurious powered bus		
33 VoltLowLimit	real	pmsNode1.SN_VoltLowLimit	IN EDIT: Value of Voltage limit value for spurious powered bus		
34 SyncigPar	pmsSivCigPar	pmsNode1.SN_SynCigPar	IN EUTE Synchroniser timeout configpar		
35 SelectedGen	pmsGenBool	pmsNode1.SN_SelectedGen	OUT: HSI selected generators		
36 SynGNPar	pmsSNGNPar	pmsNode1.SyncGNPar	OUT: Connection to Gen Control Modules		
37 SyncOperation	DOOL	pmsNode1.SN_SyncOperation	OUT Sync operation in progress		
30 SYNCBPar	pmsSNCBPar	pmsNode1.SN_AIISynCDPar	OUT connection to CBSync Control Modules		
40 UNAD	dint	pmsNode1.SN_UKEP	OUT Indication of reference side (Dus bar ID)		
40 OVAR	um emeSNIODer	pmsNode1.SN_UVAR	OUT: Indication of variable side (Power source ID)		
41 IO_Output	prissivioPar	pmsnude1.SN_IO_Output	OUT. Commands to synchronizing panel	<u> </u>	
(r drumeters)					
			Row 1, Col 5	4	

Figure 68 Example of parameter connection UREF and UVAR

### 7.4.1.7 Connection of ParamSet

The *ParamSet* shall be used for activating the parameter sets utilized by the synchronization equipment, depending on the pmsGenM module which is participating in the synchronization process. An example of the necessary application code is shown in Figure 69.



Figure 69 Example of application code for ParamSet parameter



The example in Figure 69 shows that the variables

*pmsNode1.SN\_ParamSet.Gen1...Gen4* are set to a value representing the desired parameter set. The variable *pmsNode1.SN\_ParamSet* shall be connected to the parameter *ParamSet*, as shown in Figure 68.

According to the configuration example, when the generator 4 is selected for the synchronization, the variable *pmsNode1.SN\_IO\_Output.ParamSet5.Value* will be set to true. The application code in Figure 63 shows that this variable will cause the output for parameter set 5 to be activated.

E Connections - Synchroni	zation pms5NLib.pm	ns5N5ync5uperv		_ <b>_</b> ×	
zator tgit yew Inset Ioos Window Hep					
	1° 4 91 🖬 🕅				
Name	Data Type	Parameter	Description	<u> </u>	
1 Name	string[30]	'Synchronization'	IN EDIT: Name of the object		
2 Description	string[40]	'Synchronization function'	IN EDIT: Description of the object		
3 EvSeverity	dint		IN EDIT: Event severity		
4 AlSeverity	dint		IN EDIT: Alarm severity		
5 Class	dint		IN EDIT: Alarm and Event Class		
6 Enable	bool	true	IN: Enable module execution		
7 NetTopology	pmsNetTopology	pmsNode1.NetTopology	IN: Network topology		
8 IMV_Freq	pmsBBReallO50	pmsNode1.SN_iMV_Freq	IN: Measured values Freq		
9 iMV_Volt	pmsBBReallO50	pmsNode1.SN_iMV_Volt	IN: Measured values Voltage		
10 PB01	dint	2	IN: Power Bus Bar:01 type 1 = Generator, 2 = Grid		
11 PB02	dint	2	IN: Power Bus Bar:02 type 1 = Generator, 2 = Grid		
12 PB03	dint	1	IN: Power Bus Bar:03 type 0 = None, 1 = Generator		
13 PB04	dint	1	IN: Power Bus Bar:04 type 0 = None, 1 = Generator		
14 PB05	dint	1	IN: Power Bus Bar:05 type 0 = None, 1 = Generator		
15 PB06	dint	1	IN: Power Bus Bar:06 type 0 = None, 1 = Generator		
16 PB07	dint	0	IN: Power Bus Bar:07 type 0 = None, 1 = Generator		
17 PB08	dint	0	IN: Power Bus Bar:08 type 0 = None, 1 = Generator		
18 PB09	dint	0	IN: Power Bus Bar:09 type 0 = None, 1 = Generator		
19 PB10	dint	0	IN: Power Bus Bar:10 type 0 = None, 1 = Generator		
20 PB11	dint	0	IN. Power Bus Bar.11 type 0 = None, 1 = Generator		
21 PB12	dint	0	IN: Power Bus Bar:12 type 0 = None, 1 = Generator		
22 PB13	dint	0	IN: Power Bus Bar:13 type 0 = None, 1 = Generator		
23 PB14	dint	0	IN: Power Bus Bar:14 type 0 = None, 1 = Generator		
24 PB15	dint	0	IN: Power Bus Bar:15 type 0 = None, 1 = Generator		
25 IO_Input	pmsSNIOPar	pmsNode1.SN_IO_Input	IN: Feedback from synchronizing panel		
26 CB_ID	pmsSNCB_ID	pmsNode1.SN_CB_ID	IN: CB Identity for CB with Sync request		
27 GNSynPar	pmsGNSNPar	pmsNode1.SN_AllGenSynPar	IN: Connection from Gen Control Modules		
28 CBSynPar	pmsCBSNPar	pmsNode1.SN_AllCBSynPar	IN: Connection from CBSync Control Modules		
29 ExtPar	pmsSNExtPar	pmsNode1.SN_ExtPar	IN: External Parameters		
30 ParamSet	pmsGenDint	pmsNode1.SN_ParamSet	IN EDIT: Fill in corresponding parameter set for selected generator		
31 MaxNoGenSelection	dint	4	IN: Maximum number of Generators participating in the sync process		
32 FreqLowLimit	real	pmsNode1.SN_FreqLowLimit	IN EDIT: Value of Frequency limit value for spurious powered bus		
33 VoltLowLimit	real	pmsNode1.SN_VoltLowLimit	IN EDIT: Value of Voltage limit value for spurious powered bus		
34 SynCfgPar	pmsSNCfgPar	pmsNode1.SN_SynCfgPar	IN EDIT: Synchroniser timeout configpar		
35 SelectedGen	pmsGenBool	pmsNode1.SN_SelectedGen	OUT: HSI selected generators		
36 SynGNPar	pmsSNGNPar	pmsNode1.SyncGNPar	OUT: Connection to Gen Control Modules		
37 SyncOperation	bool	pmsNode1.SN_SyncOperation	OUT: Sync operation in progress		
38 SynCBPar	pmsSNCBPar	pmsNode1.SN_AllSynCBPar	OUT: Connection to CBSync Control Modules		
39 UREF	dint	pmsNode1.SN_UREF	OUT: Indication of reference side (Bus bar ID)		
40 UVAR	dint	pmsNode1.SN_UVAR	OUT: Indication of variable side (Power source ID)		
41 IO_Output	pmsSNIOPar	pmsNode1.SN_IO_Output	OUT: Commands to synchronizing panel		
Parameters				• //	
			Row 1, Col 5	1	

Figure 70 Example of parameter connection ParamSet

#### 7.4.1.8 Connection of MaxNoGenSelection

The parameter *MaxNoGenSelection* shall be used to configure the maximum allowed number of generators sets that can participate in adjusting of voltage/frequency in the synchronization process. This parameter is relevant for the synchronization of a network breaker (e.g. bus coupler) where more machines can participate in adjusting the voltage/frequency on the variable side of the breaker. An example of the necessary connections is shown in Figure 71.

E Connections - Sy	nchronization pmsSNLib.pn	nsSNSyncSuperv					
Editor Edit View Insert Tools Window Help							
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Name	Data Type	Parameter	Description				
1 Name	string[30]	'Synchronization'	IN EDIT: Name of the object				
2 Description	string[40]	'Synchronization function'	IN EDIT: Description of the object				
3 EvSeverity	dint		IN EDIT: Event severity				
4 AlSeverity	dint		IN EDIT: Alarm severity				
5 Class	dint		IN EDIT Alarm and Event Class				
6 Enable	hool	true	IN: Enable module execution				
7 NetTopology	pmsNetTopology	pmsNode1 NetTopology	IN: Network topplagy				
8 iMV Freq	nmsBBReall050	pmsNode1 SN iMV Freq	IN: Measured values Freq				
9 iMV Volt	pmsBBReall050	pmsNode1_SN_iMV_Volt	IN: Measured values Voltage				
10 PB01	dint	2	IN: Power Bus Bar 01 type 1 = Generator 2 = Grid				
11 PB02	dint	2	IN: Power Bus Bar 02 type 1 = Generator, 2 = Grid				
12 PB03	dint	1	IN: Power Bus Bar 03 type 0 = None 1 = Generator				
13 PB04	dint	1	IN: Power Bus Bar 04 type 0 = None, 1 = Generator				
14 PB05	dint	1	IN: Power Bus Bar 05 type $\Omega$ = None, 1 = Generator				
15 PB06	dint	1	IN: Power Bus Bar 06 type 0 = None, 1 = Generator				
16 PB07	dint	0	IN: Power Bus Bar 07 type $0 = None, 1 = Generator$				
17 PB08	dint	0	IN: Power Bus Bar 08 type 0 = None, 1 = Generator				
18 PB09	dint	0	IN: Power Bus Bar 09 type 0 = None, 1 = Generator				
19 PB10	dint	0	IN: Power Bus Bar 10 type 0 = None, 1 = Generator				
20 PB11	dint	0	IN Prover Bus Bar 11 type 0 – None, 1 – Generator				
21 PB12	dint	0	IN: Power Bus Bar 12 type 0 = None, 1 = Generator				
22 PB13	dint	0	IN: Power Bus Bar 13 type 0 = None, 1 = Generator				
23 PB14	dint	0	IN: Power Bus Bar 14 type 0 = None 1 = Generator				
24 PB15	dint	0	IN: Power Bus Bar 15 type 0 = None, 1 = Generator				
25 IO Input	nmsSNIOPar	nmsNode1 SN IO Input	IN: Feedback from synchronizing page				
26 CB ID	nmsSNCB ID	pmsNode1 SN_CB_ID	IN: CB Identity for CB with Sync request				
27 GNSynPar	nmsGNSNPar	nmsNode1_SN_AllGenSynPar	IN: Connection from Gen Control Modules				
28 CBSynPar	nmsCBSNPar	pmsNode1 SN_AllCBSynPar	IN: Connection from CBSvnc Control Modules				
29 ExtPar	nmsSNExtPar	pmsNode1 SN ExtPar	IN: External Parameters				
30 ParamSet	nmsGenDint	nmsNode1 SN ParamSet	IN EDIT: Fill in corresponding parameter set for selected generator				
31 MaxNoGenSe	lection dint	4	IN: Maximum number of Generators participating in the sync process				
32 Fred owl imit	real	nmsNade1 SN Fred awl imit	IN EDIT: Value of Frequency limit value for sources nowered hus				
33 VoltI owd imit	real	pmsNode1 SN Volti owi imit	IN EDIT: Value of Voltage limit value for sources powered bus				
34 SynCfaPar	nmeSNCfaPar	nmsNode1 SN_SynCfgPar	IN EDIT: Synchroniser timeout confignar				
35 SelectedGen	nmsGenBool	nmsNode1 SN_SelectedGen	OLIT: HSI selected generators				
36 SynGNPar	nmsSNGNPar	pmsNode1_SyncGNPar	OUT: Connection to Gen Control Modules				
37 SyncOneration	hool	nmsNode1 SN SyncOneration	OUT: Sync operation in progress				
38 SynCBPar	pmsSNCBPar	pmsNode1 SN_AllSynCBPar	OUT: Connection to CBSvnc Control Modules				
39 UREE	dint	pmsNode1 SN UREF	OUT: Indication of reference side (Bus har ID)				
	dint	nmsNode1 SN LIVAR	OUT: Indication of variable side (Power source ID)				
40 00AR	nmeSNIOPer	pmsNode1.SN_0.Output	OLIT: Commande to synchronizing nanal				
A Parameters	/ prisonior at	pmanager.on_io_output	A A A A A A A A A A A A A A A A A A A				
, aramatera	/			///			
			Row 1, Col 5	1			

Figure 71 Example of connection for MaxNoGenSelection



The Figure 71 presents an example where the parameter MaxNoGenSelection is assigned to the dint value 4. This indicates that maximum four generator sets can participate in the adjustment of voltage and frequency, on the variable side a of a network breaker network, during the synchronization process.

# 7.4.1.9 Connection of SelectedGen

The parameter *SelectedGen* provides an indication of which generator set(s) has been selected from the pmsSNSyncSuperv faceplate to participate in the synchronization process. An example of the necessary connections is shown in Figure 72.

Bo	Connections - Synchronization pmsSNSbncSuperv					
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Inc						
	Name	Data Type	Parameter	Description	<b>_</b>	
1	Name	string[30]	'Synchronization'	IN EDIT: Name of the object		
2	Description	string[40]	'Synchronization function'	IN EDIT: Description of the object		
3	EvSeverity	dint		IN EDIT: Event severity		
4	AlSeverity	dint		IN EDIT: Alarm severity		
5	Class	dint		IN EDIT: Alarm and Event Class		
6	Enable	bool	true	IN: Enable module execution		
7	NetTopology	pmsNetTopology	pmsNode1.NetTopology	IN: Network topology		
8	iMV_Freq	pmsBBRealIO50	pmsNode1.SN_iMV_Freq	IN: Measured values Freq		
9	iMV_Volt	pmsBBReallO50	pmsNode1.SN_iMV_Volt	IN: Measured values Voltage		
10	PB01	dint	2	IN: Power Bus Bar:01 type 1 = Generator, 2 = Grid		
11	PB02	dint	2	IN: Power Bus Bar.02 type 1 = Generator, 2 = Grid		
12	PB03	dint	1	IN: Power Bus Bar:03 type 0 = None, 1 = Generator		
13	PB04	dint	1	IN: Power Bus Bar:04 type 0 = None, 1 = Generator		
14	PB05	dint	1	IN: Power Bus Bar:05 type 0 = None, 1 = Generator		
15	PB06	dint	1	IN: Power Bus Bar:06 type 0 = None, 1 = Generator		
16	PB07	dint	0	IN: Power Bus Bar:07 type 0 = None, 1 = Generator		
17	PB08	dint	0	IN: Power Bus Bar:08 type 0 = None, 1 = Generator		
18	PB09	dint	0	IN: Power Bus Bar.09 type 0 = None, 1 = Generator		
19	PB10	dint	0	IN: Power Bus Bar:10 type 0 = None, 1 = Generator		
20	PB11	dint	0	IN: Power Bus Bar.11 type 0 = None, 1 = Generator		
21	PB12	dint	0	IN: Power Bus Bar:12 type 0 = None, 1 = Generator		
22	PB13	dint	0	IN: Power Bus Bar:13 type 0 = None, 1 = Generator		
23	PB14	dint	0	IN: Power Bus Bar:14 type 0 = None, 1 = Generator		
24	PB15	dint	0	IN: Power Bus Bar:15 type 0 = None, 1 = Generator		
25	IO_Input	pmsSNIOPar	pmsNode1.SN_IO_Input	IN: Feedback from synchronizing panel		
26	CB_ID	pmsSNCB_ID	pmsNode1.SN_CB_ID	IN: CB Identity for CB with Sync request		
27	GNSynPar	pmsGNSNPar	pmsNode1.SN_AllGenSynPar	IN: Connection from Gen Control Modules		
28	CBSynPar	pmsCBSNPar	pmsNode1.SN_AllCBSynPar	IN: Connection from CBSync Control Modules		
29	ExtPar	pmsSNExtPar	pmsNode1.SN_ExtPar	IN: External Parameters		
30	ParamSet	pmsGenDint	pmsNode1.SN_ParamSet	IN EDIT: Fill in corresponding parameter set for selected generator		
31	MaxNoGenSelection	dint	4	IN: Maximum number of Generators participating in the sync process		
32	FreqLowLimit	real	pmsNode1.SN_FreqLowLimit	IN EDIT: Value of Frequency limit value for spurious powered bus		
33	VoltLowLimit	real	pmsNode1.SN_VoltLowLimit	IN EDIT: Value of Voltage limit value for spurious powered bus		
34	SynCfgPar	pmsSNCfgPar	pmsNode1.SN_SynCfgPar	IN EDIT: Synchroniser timeout configpar		
35	SelectedGen	pmsGenBool	pmsNode1.SN_SelectedGen	OUT: HSI selected generators		
36	SynGNPar	pmsSNGNPar	pmsNode1.SyncGNPar	OUT: Connection to Gen Control Modules		
37	SyncOperation	bool	pmsNode1.SN_SyncOperation	OUT: Sync operation in progress		
38	SynCBPar	pmsSNCBPar	pmsNode1.SN_AllSynCBPar	OUT: Connection to CBSync Control Modules		
39	UREF	dint	pmsNode1.SN_UREF	OUT: Indication of reference side (Bus bar ID)		
40	UVAR	dint	pmsNode1.SN_UVAR	OUT: Indication of variable side (Power source ID)		
41	IO_Output	pmsSNIOPar	pmsNode1.SN_IO_Output	OUT: Commands to synchronizing panel	-	
4	Parameters /				• //	
				Pow1 Col 5		

Figure 72 Example of connection SelectedGen



The parameter can be used for any external application logic needed for configuring the synchronization function.

#### 7.4.1.10 Connection of FreqLowLimit and VoltLowLimit

The parameters *FreqLowLimit* and *VoltLowLimit* shall be used for configuring the alarm limit settings for the spurious dead bus and spurious powered bus alarms. An example of the necessary connections is shown in Figure 73.

📑 Connections - Synchro	nization pmsSNLib.pn	nsSNSyncSuperv		- O ×
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- 🗟 🖬 🔌 📾 🙆 🕨	1 1 1 1 1 1 1	🗛 🗛   🎥   🚍   A., 🗢 🗞		
Name	Data Type	Parameter	Description	
1 Name	string[30]	'Synchronization'	IN EDIT: Name of the object	
2 Description	string[40]	'Synchronization function'	IN EDIT: Description of the object	
3 EvSeverity	dint		IN EDIT: Event severity	
4 AlSeverity	v dint IN EDIT: Alarm severity		IN EDIT: Alarm severity	
5 Class	dint		IN EDIT: Alarm and Event Class	
6 Enable	bool	true	IN: Enable module execution	
7 NetTopology	pmsNetTopology	pmsNode1.NetTopology	IN: Network topology	
8 iMV Freq	pmsBBReallO50	pmsNode1.SN iMV Freq	IN: Measured values Freq	
9 iMV Volt	pmsBBReall050	omsNode1_SN_iMV_Volt	IN: Measured values Voltage	
10 PB01	dint	2	IN: Power Bus Bar 01 type 1 = Generator 2 = Grid	
11 PB02	dint	2	IN: Power Bus Bar 02 type 1 = Generator 2 = Grid	
12 PB03	dint	1	IN: Power Bus Bar 03 type 0 = None 1 = Generator	
13 PB04	dint	1	IN: Power Bus Bar 04 type 0 = None, 1 = Generator	
14 PB05	dint	1	IN: Power Bus Bar/05 type 0 = None, 1 = Generator	
15 PB06	dint	1	IN: Power Bus Bands type 0 - None, 1 - Generator	
16 PB07	dint	0	IN: Power Bus Bar07 type 0 = None, 1 = Generator	
17 2808	dint	0	IN: Power Bus Bar08 type 0 = None, 1 = Generator	
18 0809	dint	0	IN: Power Bus Bar 00 type 0 - None, 1 - Generator	
To PD09 drift U drift		IN: Power Bus Bar 10 type 0 - None, 1 - Generator		
13 PDIU 20 DP11	dint	0	IN. Power Bus Bar to type 0 - None, 1 - Generator	
20 PD11	dint	0	IN. Power Bus Bar 11 type 0 = None, 1 = Cenerator	
21 PD12	dint	0	IN. Power Dus Dar, 12 type 0 – None, 1 – Generator	
22 PDI3	dint	0	IN. Power Bus Bar, 13 type 0 = None, 1 = Generator	
23 PB14	dint	0	IN: Power Bus Bar: 14 type U = None, 1 = Generator	
24 PD15	dint chiloDo	U amethodet ON IO Jacob	IN. Power Dus Dar, 15 type 0 = None, 1 = Generator	
25 IO_Input	pms5NUPar	pmsNode1.SN_IO_Input	IN: Feedback from synchronizing panel	
	pmsSNCB_ID	pmsNode1.SN_CB_ID	IN: CB Identity for CB with Sync request	
27 GNSynPar	pmsGNSNPar	pmsNode1.SN_AllGenSynPar	IN: Connection from Gen Control Modules	
28 CBSynPar	pmsCBSNPar	pmsNode1.SN_AllCBSynPar	IN: Connection from CBSync Control Modules	
29 ExtPar	pmsSNExtPar	pmsNode1.SN_ExtPar	IN: External Parameters	
30 ParamSet	pmsGenDint	pmsNode1.SN_ParamSet	IN EDIT: Fill in corresponding parameter set for selected generator	
31 MaxNoGenSelection	n dint	4	IN: Maximum number of Generators participating in the sync process	
32 FreqLowLimit	real	pmsNode1.SN_FreqLowLimit	IN EDIT: Value of Frequency limit value for spurious powered bus	
33 VoltLowLimit	real	pmsNode1.SN_VoltLowLimit	IN EDIT: Value of Voltage limit value for spurious powered bus	
34 SynCfgPar	pmsSNCfgPar	pmsNode1.SN_SynCfgPar	IN EDIT: Synchroniser timeout configpar	
35 SelectedGen	pmsGenBool	pmsNode1.SN_SelectedGen	OUT: HSI selected generators	
36 SynGNPar	pmsSNGNPar	pmsNode1.SyncGNPar	OUT: Connection to Gen Control Modules	
37 SyncOperation	bool	pmsNode1.SN_SyncOperation	OUT: Sync operation in progress	
38 SynCBPar	pmsSNCBPar	pmsNode1.SN_AllSynCBPar	OUT: Connection to CBSync Control Modules	
39 UREF	dint	pmsNode1.SN_UREF	OUT: Indication of reference side (Bus bar ID)	
40 UVAR	dint	pmsNode1.SN_UVAR	OUT: Indication of variable side (Power source ID)	
41 IO_Output	pmsSNIOPar	pmsNode1.SN_IO_Output	OUT: Commands to synchronizing panel	-
Parameters				1

Figure 73 Example of connection FreqLowLimit and VoltLowLimit



The variables pmsNode1.SN\_FreqLowLimit and pmsNode1.SN\_VoltLowLimit, from the example in Figure 73, are configured with initial values of 40 and 110 (for frequency and voltage respectively) as shown in Figure 50. When the network determination detects a de-energized contingency with frequency>40Hz or voltage>110kV, the spurious powered bus alarm will be generated. When the network determination detects an energized contingency with frequency<40Hz or voltage<110kV, the spurious dead bus alarm will be generated.



To disable spurious dead bus and spurious powered bus alarms where project does not have frequency and voltage measurements, temporary setting iMV\_Freq\Volt values for the busbars missing measurements will solve the problem. Caution is advised.

## 7.4.1.11 Connection of SynCfgPar

The parameter *SynCfgPar* shall be used for configuring time delay settings for the feedbacks received from the synchronization equipment and the selection relays. An example of the necessary settings is shown in Figure 74.

Synchronization - PMS_Application.5	ynchronization.Synchronization (pmsSNL	ib.pms5NSyncSuperv)			_ 🗆 ×
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🙂 🐣 🖀 😹 🗗 🖸 🝸 🕯	t↓ 2↑				
Name	Current Value	Data Type	Variable	Initial Value	I/O Address 🔔
- VoltLowLimit	120.0	real	pmsNode1.SN_VoltLowLimit	100	
□ SynCfgPar		pmsSNCfgPar	pmsNode1.SN_SynCfgPar	default	
- SelCBTO	0d0h0m2s0ms	time	pmsNode1.SN_SynCfgPar.SelCBTO	2s	
- SelGenTO	0d0h0m2s0ms	time	pmsNode1.SN_SynCfgPar.SelGenTO	2s	
- SelSyncStartTO	0d0h0m2s0ms	time	pmsNode1.SN_SynCfgPar.SelSyncStartTO	2s	
- SelSyncStopTO	0d0h0m2s0ms	time	pmsNode1.SN_SynCfgPar.SelSyncStopTO	2s	
- SelParamSetTO	0d0h0m2s0ms	time	pmsNode1.SN_SynCfgPar.SelParamSetTO	2s	
- SelVarExTO	0d0h0m2s0ms	time	pmsNode1.SN_SynCfgPar.SelVarExTO	2s	
- SelSyncAutoTO	OdOhOmOsOms	time	pmsNode1.SN_SynCfgPar.SelSyncAutoTO	Os	
- SelSyncTestTO	0d0h0m0s0ms	time	pmsNode1.SN_SynCfgPar.SelSyncTestTO	Os	
- SelSyncManTO	0d0h0m0s0ms	time	pmsNode1.SN_SynCfgPar.SelSyncManTO	Os	
- SyncCheck_TO	0d0h0m2s0ms	time	pmsNode1.SN_SynCfgPar.SyncCheck_TO	2s	
- SynSelectionChange	OdOhOmOsOms	time	pmsNode1.SN_SynCfgPar.SynSelectionChange	Os	
- SyncCancelTO	0d0h5m0s0ms	time	pmsNode1.SN_SynCfgPar.SyncCancelTO	5m	
<ul> <li>DirectSyncOperation</li> </ul>	false	bool	pmsNode1.SN_SynCfgPar.DirectSyncOperation	false	
- NameSyncCB01	CB01	string[30]	pmsNode1.SN_SynCfgPar.NameSyncCB01	'CB01'	
- NameSyncCB02	CB02	string[30]	pmsNode1.SN_SynCfgPar.NameSyncCB02	'CB02'	
- NameSyncCB03	CB03	string[30]	pmsNode1.SN_SynCfgPar.NameSyncCB03	'CB03'	
- NameSyncCB04	CB04	string[30]	pmsNode1.SN_SynCfgPar.NameSyncCB04	'CB04'	
- NameSyncCB05	CB05	string[30]	pmsNode1.SN_SynCfgPar.NameSyncCB05	'CB05'	
<ul> <li>NameSyncCB06</li> </ul>	CB06	string[30]	pmsNode1.SN_SynCfgPar.NameSyncCB06	'CB06'	
- NameSyncCB07	CB07	string[30]	pmsNode1.SN_SynCfgPar.NameSyncCB07	'CB07'	
- NameSyncCB08	CB08	string[30]	pmsNode1.SN_SynCfgPar.NameSyncCB08	'CB08'	
- NameSyncCB09	CB09	string[30]	pmsNode1.SN_SynCfgPar.NameSyncCB09	'CB09'	
NameSyncCB10	CB10	string[30]	pmsNode1.SN_SynCfgPar.NameSyncCB10	'CB10'	
SelectedGen		pmsGenBool	pmsNode1.SN_SelectedGen	default	
🕮 – SynGNPar		pmsSNGNPar	pmsNode1.SyncGNPar	default	
<ul> <li>SyncOperation</li> </ul>	false	bool	pmsNode1.SN_SyncOperation	default	_
🖨 – SynCBPar		pmsSNCBPar	pmsNode1.SN_AllSynCBPar	default	
- UREF	0	dint	pmsNode1.SN_UREF	default	-
Parameters / Variables / E	xternal Variables \lambda Function Blocks /				
			rr		
				Row 1, Col 0	

Figure 74 Example of parameter connection SynCfgPar



The example in Figure 74 shows the variable *pmsNode1.SN\_SynCfgPar* in on-line mode and the various configuration settings for the allowed time delay between issuing a command and receiving the respective feedback, for the direct synchronization feature and for the string names of the circuit breaker selection events.

# Appendix A Revision table

Rev. ind.	Page (P) / Chapter ©	Description	Date
А		Initial document release for 5.6-5	2022.08.30/KAA

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