Process Power Manager 5

Library for 800xA

PMS 5.6.5 Circuit Breaker Control Library

Manual

Version 5.6-5

Power and productivity
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About This User Manual

General

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

The reader 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.

Table 1 Terminology

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.
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.
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.
IT	Information Technologies.
LVS	Low Voltage Switchgear.
MCC	Motor Control Center.
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 Network communication.

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.
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.
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 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.
System Extension	A plug-in software package, which provides the Operate IT system with extended functions and properties.
Type	A general description of a unit that defines the behaviour of an individual unit called Instance. See also Instance.
DCS	Distributed Control System
ENMC	Electrical Network Monitoring & Control

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.

Table 2 Related Documentation

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

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 *Release Notes.*.

Some graphics have been carried over from previous loadshedding manuals, hence Windows frames, 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 Function

There are three types of circuit breaker control modules in the PMS Library *pmsCBLib*:

- *pmsCBStandardM* - Circuit breaker with control and supervision features.
- *pmsCBIndM* - Circuit breaker with no control, only supervision features.
- *pmsCBSyncM* - Circuit breaker with control, supervision and synchronization features.

The three control modules are described in the following chapters.

Section 2 Control Module pmsCBStandardM

The *pmsCBStandardM* control module is included in the *pmsCBLib* library. A block presentation of the control module is shown in Figure 1. The parameters are briefly described in Table 3.

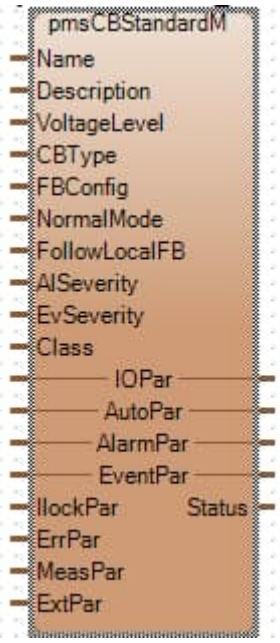


Figure 1 Control module pmsCBStandardM

Table 3 Parameters of the control module pmsCBStandardM

Parameter	Significance
Name	Name of the circuit breaker. With the name upload tool from the process portal, this property will be used for identifying the object in 800xA. The name will be used to group the alarms and events and to identify the faceplate of the object. The name must be unique in the project.
Description	Description of the circuit breaker. With the name upload tool of process portal, this property will be used for identifying the object in 800xA.
Voltage level	Voltage level for object colouring. This property gives the object a colour in Single Line Diagrams. Default settings for the colours are: Level 1 - RGB N(0,176,232) - D(0,126,182) - L(50,226,255) Level 2 - RGB N(232,160,168) - D(182,110,118) - L(255,210,218) Level 3 - RGB N(176,232,176) - D(126,182,126) - L(226,255,226) Level 4 - RGB N(255,255,128) - D(205,205,78) - L(255,255,178) Level 5 - RGB N(64,128,128) - D(14,78,78) - L(114,178,178) Level 6 - RGB N(198,101,0) - D(140,70,0) - L(255,154,53) Level 7 - RGB N(240,160,13) - D(182,121,10) - L(249,209,136) Level 8 - RGB N(207,204,73) - D(153,150,40) - L(227,225,149) Level 9 - RGB N(81,181,171) - D(53,125,120) - L(174,221,217) Level10- RGB N(185,157,91) - D(135,112,58) - L(223,210,181)

Parameter	Significance
CBType	The parameter is used for configuring the graphical presentation of the circuit breaker; ‘1’= circuit breaker, ‘3’= isolator (disconnector), ‘11’= circuit breaker with earthing, ‘13’= isolator (disconnector) with earthing.
FBConfig	Configuration parameter for position status signals applicable for the circuit breaker; ‘0’= Open and Closed positions, ‘1’= Closed position, ‘2’= Open, Closed and Service positions, ‘3’= Closed and Service positions, '4'= Open, Closed, Service position and Test Position, ‘5’= Closed, Service position and Test position.
NormalMode	The parameter is used to configure the graphical presentation of normal mode; ‘1’= Manual, ‘2’= Auto, ‘3’= Local, ref. Table 7 Breaker indications
FollowLocalFB	Configuration parameter for the circuit breaker when in local point of control ‘False’= Cmd0\Cmd1Level output is reset in local, ‘True’ = Cmd0\Cmd1Level follows FB in local.
AlSeverity	Alarm severity. The alarm severity can be used for filtering the alarm list. Range 1-1000.
EvSeverity	Event severity. The event severity can be used for filtering the event list. Range 1-1000.
Class	Alarm and Event Class. This property can be used for grouping objects to appear in separate alarm/event lists. Range 1-9999.
IOPar	Input/Output signals. This parameter is used for connecting the I/O signals to the object. This parameter is a structured data type.
AutoPar	Structured parameter for connecting auto open/close commands to the circuit breaker.
AlarmPar	Structured parameter for 16 user defined alarms.
EventPar	Structured parameter for 16 user defined events.
IlockPar	Structured parameter for and configuring interlock signals.
ErrPar	Structured parameter for error signals to the circuit breaker.
MeasPar	Structured parameter for 16 user defined analogue measurements.
ExtPar	External parameters for application interaction. With this parameter it is possible to disable standard alarms and to disable the mode command buttons of the faceplate.
Status	Status indication for the checked closed/open position and the manual/auto mode of the breaker.

2.1 Introduction

The control module type *pmsCBStandardM* provides control and supervision of circuit breakers. Following features are supported:

- **Measurements**

There are two kinds of mesurements, standard and customized:

  - Standard measurements: Important electrical measurements displayed in the main faceplate tab:
    - Voltage
    - Frequency
    - Active power
    - Reactive power
    - Power factor
    - Current
  - Customized measurements: Additionally, up to 16 customized measurements can be displayed numerically in another faceplate tab.

- **Position status**

The following feedback signals facilitates supervision of circuit breaker position status:

  - Open indication
  - Closed indication
  - Service position
  - Test position
  - Earthed position

- **Graphical Standard - IEC, ANSI**

The graphical element can be configured to follow either the IEC or ANSI graphical standard.

- **Output commands**

Open and close commands can be issued as pulsed or as steady outputs:

  - Open command (level)
  - Open command (edge)
  - Close command (level)
  - Close command (edge)

Pulsed outputs remain high for a configurable time period. Steady outputs remain active until the opposite command is initiated. The control module checks for discrepancies between output commands and position status. Conflicts will raise alarms after a configurable period.

In local point of control steady outputs follow local feedback if the parameter ‘Follow LocalFB’ is set to ‘True’.

- **Interlocking**

The circuit breaker can be interlocked for operation by conditions arising from supervisory programs or other objects. Five interlocks are available; one A-interlock (which can be overridden) and four B-interlocks.

- **Point of Control (PoC)**

The circuit breaker can be controlled from two locations:

  - Remote point of control: PMS-level of control via ABB's graphical aspects.
  - Local point of control: equipment-level of control via vendor's local panel.

- **Control modes**

Different control modes affect the operability:

  - Maintenance mode: No operation commands are allowed.
  - Simulation mode: The operation commands are simulated.
  - Auto mode: Operation commands are controlled by application logic.
  - Manual mode: Operation commands are issued via the faceplate.

- **Operation commands**

Following operations are available to the operator via the circuit breaker faceplate:

  - Change of control modes
  - Open/Close commands
  - Override interlock

- **Operations counter**

A counter is provided to calculate how many times the circuit breaker is operated. It only counts when the circuit breaker is opened and it does not count when the maintenance or simulation mode are activated.

- **Alarms**

Alarms are divided in two categories:

  - Standard alarms: : Alarms informing the operator of essential alarm conditions, and conditions arising from internal control module logic.
  - Customized alarms: Up to 16 customized alarms can be raised through the control module although they originate from external logic.

- **Events**

Events are divided in two categories:

  - Standard events: Default events informing the operator of operational status changes according to internal logic of the control module.
  - Customized events: Up to 16 customized events informing the operator of status/events programmed outside the control module logic.

2.2 Detailed Engineering

2.2.1 Operator Note

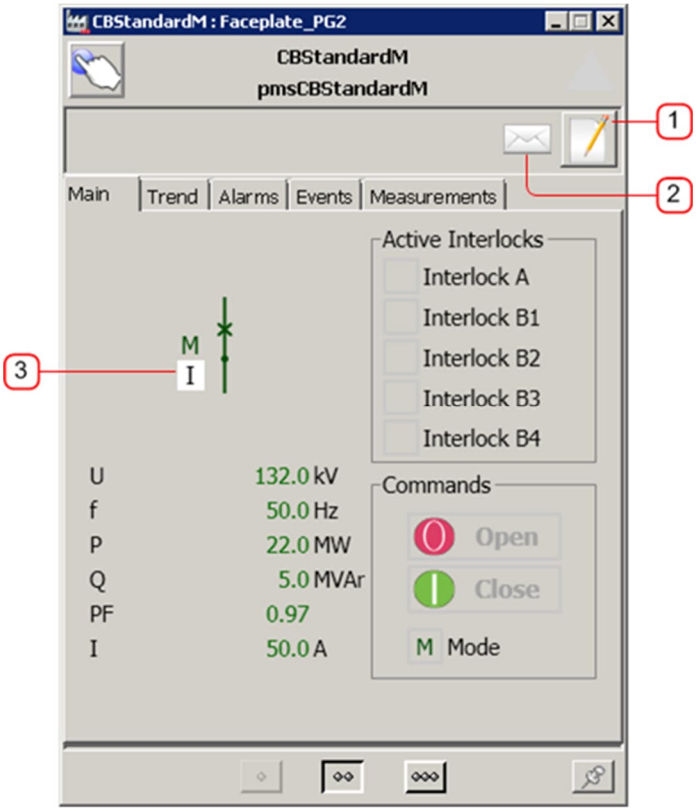


Figure 2 Operator note

The Operator Note is an aspect in the Control Structure that can contain information that an operator may wish to share with other operators. When the operator presses the button (1), a window with an editor will be opened, in which the operator can write a message. When the aspect contains information, this will be indicated with an envelope (2) in the faceplate and with an “I” (3) in the graphic element.

Only users with operator role can write to the Operator Note aspect.

2.2.2 Measurements

The faceplate tab **Main** presents the standard measurements, as shown in Figure 3. These analogue signals are configured via the IOPar parameter of the control module, as shown in Table 4.

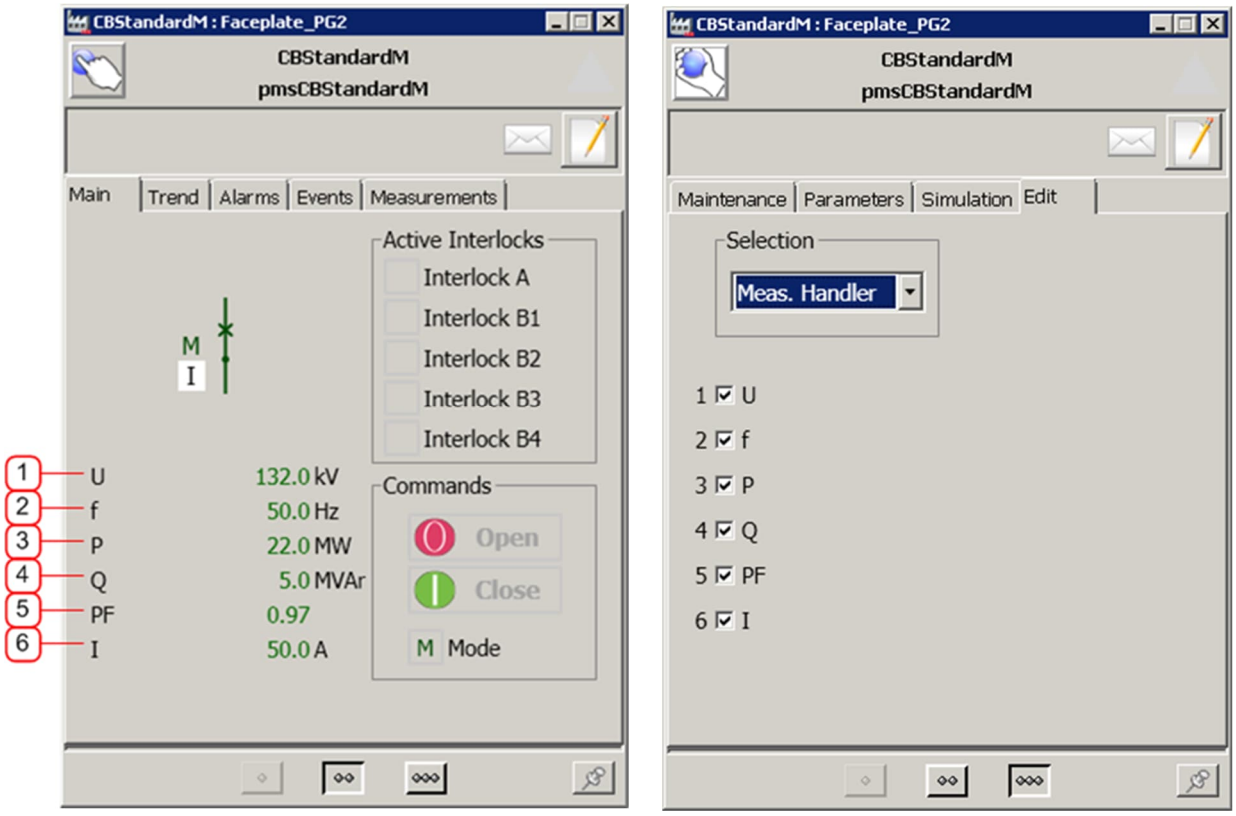


Figure 3 Faceplate tab Main and Extended faceplate, Edit

Table 4 Parameter configuration for measurement signals

Field	Indication	Parameter configuration	Description
1	Voltage	*IOPar.MeaInput.Voltage*	Voltage measurement
2	Frequency	*IOPar.MeaInput.Freq*	Frequency measurement
3	Active power	*IOPar.MeaInput.ActPow*	Active power measurement
4	Reactive power	*IOPar.MeaInput.RePow*	Reactive power measurement
5	Power factor	*IOPar.MeaInput.PowFact*	Power factor measurement
6	Current	*IOPar.MeaInput.Cur*	Current measurement

The measurements which are not available can be hidden by deselecting them from the extended faceplate tab **Edit** in the extended faceplate.

There is no built in signal error handling for measurements inside the control module logic. External collection of relevant IO signal status must be made. The external code must set the ErrPar.IOErr to TRUE in case of signal error detection.

2.2.3 Breaker Position

The circuit breaker position is presented in the **Main** tab of the faceplate, as shown in Figure 4.

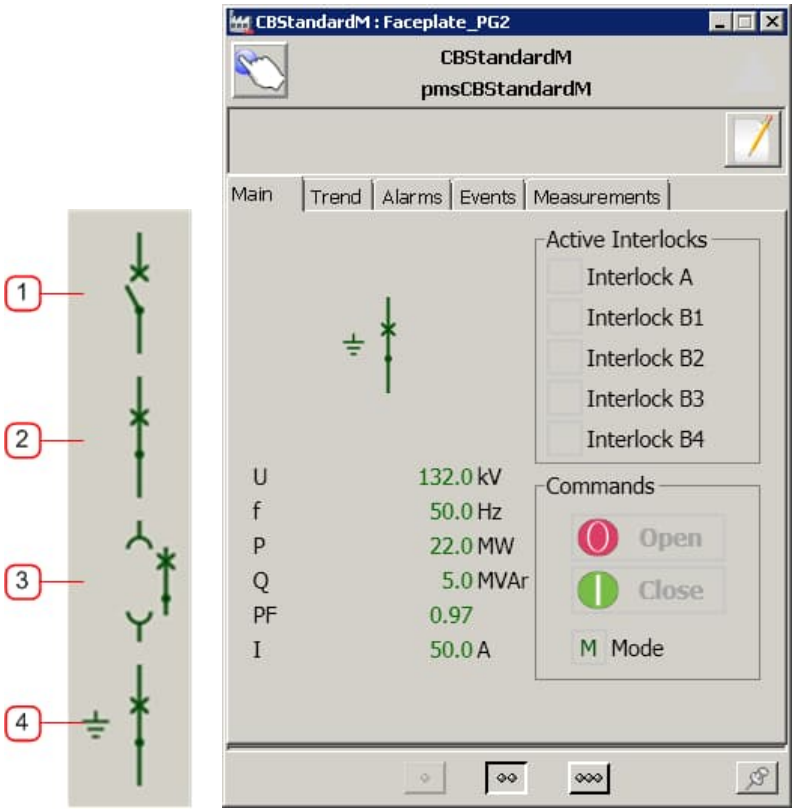


Figure 4 Circuit breaker status

Table 5 Parameter configuration for circuit breaker status

Item	Indication	Parameter configuration	Description
1	Opened position	*IOPar.OI*	Feedback from open limit switch.
2	Closed position	*IOPar.CI*	Feedback from close limit switch.
3	Racked-Out position	*IOPar.SP, (IOPar.TP)*	Feedback from 'in–service' limit switch.
4	Earthed position	*IOPar.FBE*	Feedback from earth-switch.

The *FBConfig* parameter shall be used for enabling the open and/or service position feedbacks, as shown in Table 6.

Open, Closed and **Test Position** feedback raise the IOError alarm automatically if faulty. The circuit breaker is not forced to **Manual** mode if rased through these signals.

The status of other relevant digital signal must be collected. The external code must set the ErrPar.IOErr to TRUE in case of signal error detection.

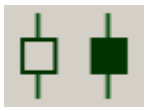
The control module is forced to **Manual** as long as the ErrPar.IOErr remains TRUE. When returning to FALSE the circuit breaker will return to **Auto** mode, if initially selected.

Table 6 Configuration values for the FBConfig parameter

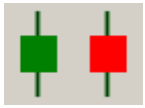
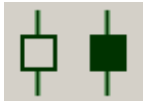
***FBConfig* value**	**Applicable feedback signals**	**Remarks**
0	- Feedback Opened - Feedback Closed	Two limit switches are monitored; the Service Position input is not included. Note: service position is the opposite of racked out position.
1	- Feedback Closed	Only closed limit switch feedback is considered.
2	- Feedback Opened - Feedback Closed - Feedback Service Position	Both opened and closed limit switches are considered in conjunction with the service position. Note: that if the service position is ‘0’, i.e. the circuit breaker is racked out; the checked open indication is always true to indicate an electrical disconnection.
3	- Feedback Closed - Feedback Service Position	The close limit switch and the service position feedbacks are monitored.
4	- Feedback Opened - Feedback Closed - Feedback Service Position - Feedback Test Position	Both opened and closed limit switches are considered in conjunction with the service position. Both the service position and the test position is monitored before the circuit breaker is considered racked out; the checked open indication is always true to indicate an electrical disconnection.
5	- Feedback Closed - Feedback Service Position - Feedback Test Position	The close limit switch and both service position and test position feedbacks are monitored.

2.2.4 Graphic Symbol Standard

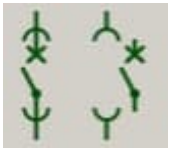
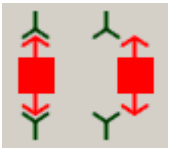
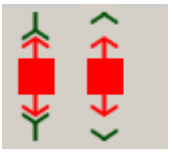
The graphic symbols standard (IEC or ANSI) used in the faceplates can be configured by setting the project constant **pmsConstants.cGraphicSymbolStd_IEC_ANSI**.

Value	Standard	Symbols
0		
1(default)	IEC(default)	
2	ANSI	

When ANSI is selected, the fill color of the symbol can be configured by setting the project constant **pmsConstants.cANSI_FillColouring**.

Value	Remarks	Symbols
0(default)	Green = Open Red = Closed	
1	Not filled = Open Filled = Closed	

The position of the breaker symbol when racked out can be configured by setting the project constant **pmsConstants.cBreaker_RackoutConfig**.

Value	Remarks	Symbols	
0(default)	Move symbol outside line when racked out.		
1	Keep symbol on line when racked out.		

See Appendix1 for detailed table with configuration and corresponding symbols.

2.2.5 Indications for Breaker Status, Mode, Alarm and Synchronization

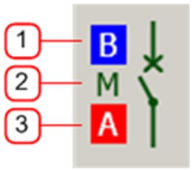


Figure 5 Breaker indications

Table 7 Breaker indications

Item	Indication	Symbol	Description
1	Status	B	Maintenance
		F	Forced
		S	Simulation
		I	Interlocked
		B	Blocked
2	Mode	⏚	Earthed
		NormalMode	
		1 / 2 / 3	
		M / M / M	Manual
		A / A / A	Auto
		L / L / L	Local
3	Alarm/Sync	A	Alarm
		I	Information (Operator note)
		S	Indicates synchronizable breaker
		S	Synchronization request active

2.2.6 Output commands

The commands can be either pulsed or steady outputs. The pulsed open and close commands are available through the output parameters *IOPar.Cmd0Edge* and *IOPar.Cmd1Edge*, respectively. The pulse time is configurable, as shown in Figure 6. The steady open and close commands are available through the output parameters *IOPar.Cmd0Level* and *IOPar.Cmd1Level*, respectively.

Table 8 Output open and close commands from pmsCBStandardM

Item	Output	Parameter configuration	Description
1	Open command	*IOPar.Cmd0Edge*	Pulsed open command
		IOPar.Cmd0Level	Continuous open command
2	Close command	*IOPar.Cmd1Edge*	Pulsed close command
		IOPar.Cmd1Level	Continuous close command

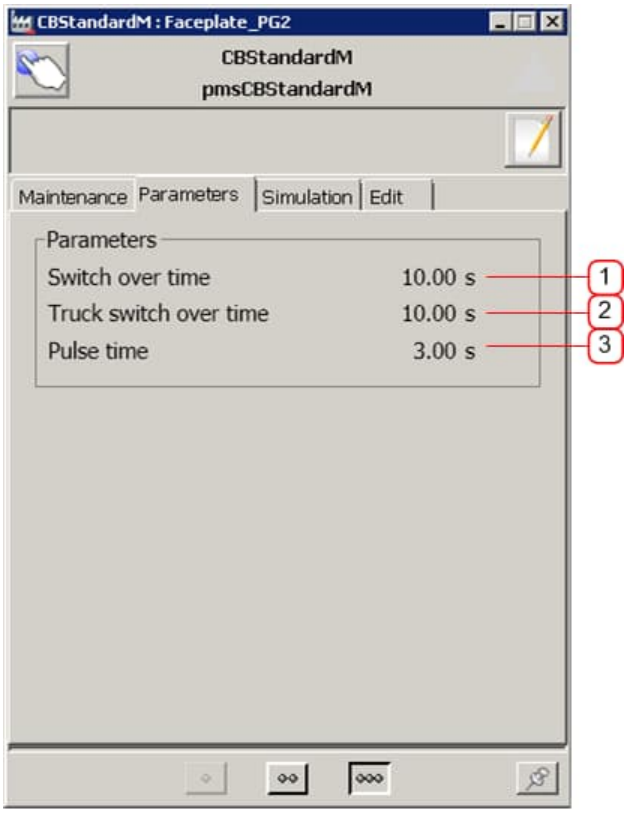


Figure 6 Faceplate tab Parameters - Pulse time configuration

Table 9 Time configuration for intermediate pos. alarms and open/close commands

Field	Indication	Faceplate configuration	Description
1	Switch over time	Numerical input field	Time duration before intermediate position alarm is activated.
2	Truck switch over time	Numerical input field	Time duration before intermediate position alarm for truck is activated.
3	Pulse Time	Numerical input field	Time duration for open/close pulsed type commands to the circuit breaker.

The *FollowLocalFB* parameter shall be used for configuring the behavior of the steady open and close commands *IOPar.Cmd0Level* and *IOPar.Cmd1Level* when the circuit breaker is in local point of control. The open and close steady commands behavior is described according to Table 10.

Table 10 Configuration values for the FollowLocalFB parameter

FollowLocalFB value	IOPar.POCLoc value	Remarks
false	false	*IOPar.Cmd0Level* and *IOPar.Cmd1Level* are not following the position feedback signals.
true	false	*IOPar.Cmd0Level* and *IOPar.Cmd1Level* are not following the position feedback signals.
true	true	*IOPar.Cmd0Level* and *IOPar.Cmd1Level* are following the position feedback signals.

If the circuit breaker is in remote point of control, the steady output commands remain active until the opposite command is initiated.

2.2.7 Interlocking

The interlocking function prevents the operation of the open/close command buttons in the circuit breaker faceplate. This function does not have any impact on the actual position of the breaker; it is an operation restriction for the open or close commands.

One process interlock (Interlock A) and four safety interlock (Interlock B1, B2, B3 and B4) are available for interconnection with other control modules or dedicated digital input signals. The interlock status is presented to the operator through the faceplate, as shown in Figure 7.

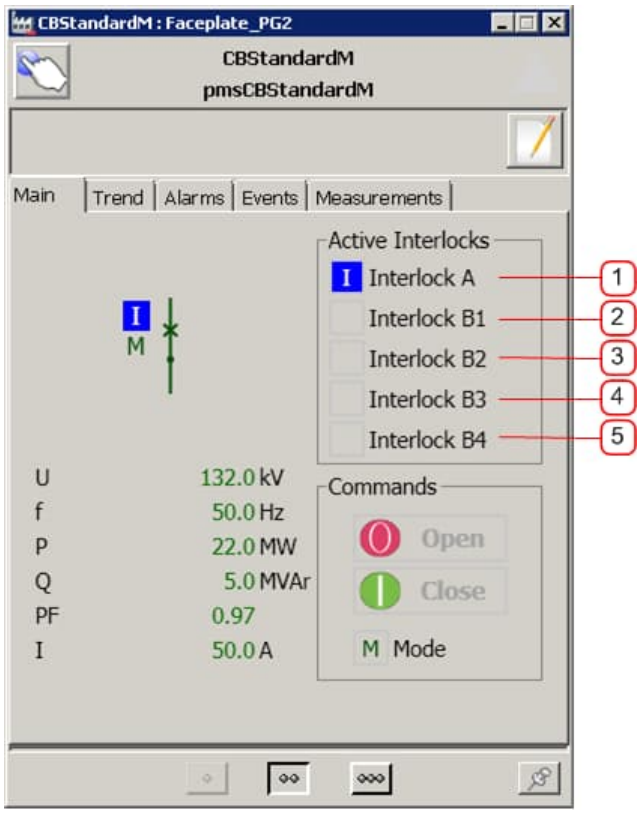


Figure 7 Presentation of interlock in the main faceplate

Table 11 Configuration parameters for interlock

Field	Indication	Parameter configuration	Description
1	Interlock A	*IlockPar.IlockA*	Interlock condition active when IlockPar.IlockA = true.
2	Interlock B1	*IlockPar.IlockB1*	Interlock condition active when IlockPar.IlockB1 = true.
3	Interlock B2	*IlockPar.IlockB2*	Interlock condition active when IlockPar.IlockB2 = true.
4	Interlock B3	*IlockPar.IlockB3*	Interlock condition active when IlockPar.IlockB3 = true.
5	Interlock B4	*IlockPar.IlockB4*	Interlock condition active when IlockPar.IlockB4 = true.

The parameter *IlockPar* must be used for configuring how an interlock condition shall affect the open or close command buttons. It is possible to assign a condition as an interlock for opening or closing or both opening/closing, as shown in Table 12.

Table 12 Parameter configuration for interlocking behaviour

Item	Parameter configuration	Description
1	*IlockPar.IlockAConfig*	When parameter is 1, the open command button is disabled. When parameter is 2, the close command button is disabled. When parameter is 3, the open and close command buttons are disabled.
2	*IlockPar.IlockB1Config*	When parameter is 1, the open command button is disabled. When parameter is 2, the close command button is disabled. When parameter is 3, the open and close command buttons are disabled.
3	*IlockPar.IlockB2Config*	When parameter is 1, the open command button is disabled. When parameter is 2, the close command button is disabled. When parameter is 3, the open and close command buttons are disabled.
4	*IlockPar.IlockB3Config*	When parameter is 1, the open command button is disabled. When parameter is 2, the close command button is disabled. When parameter is 3, the open and close command buttons are disabled.
5	*IlockPar.IlockB4Config*	When parameter is 1, the open command button is disabled. When parameter is 2, the close command button is disabled. When parameter is 3, the open and close command buttons are disabled.

If any of the parameters in Table 12 is configured with a value different than 1, 2 or 3, the interlocking function will not work.

It is possible for an operator to override the interlock A, as shown in Figure 8.

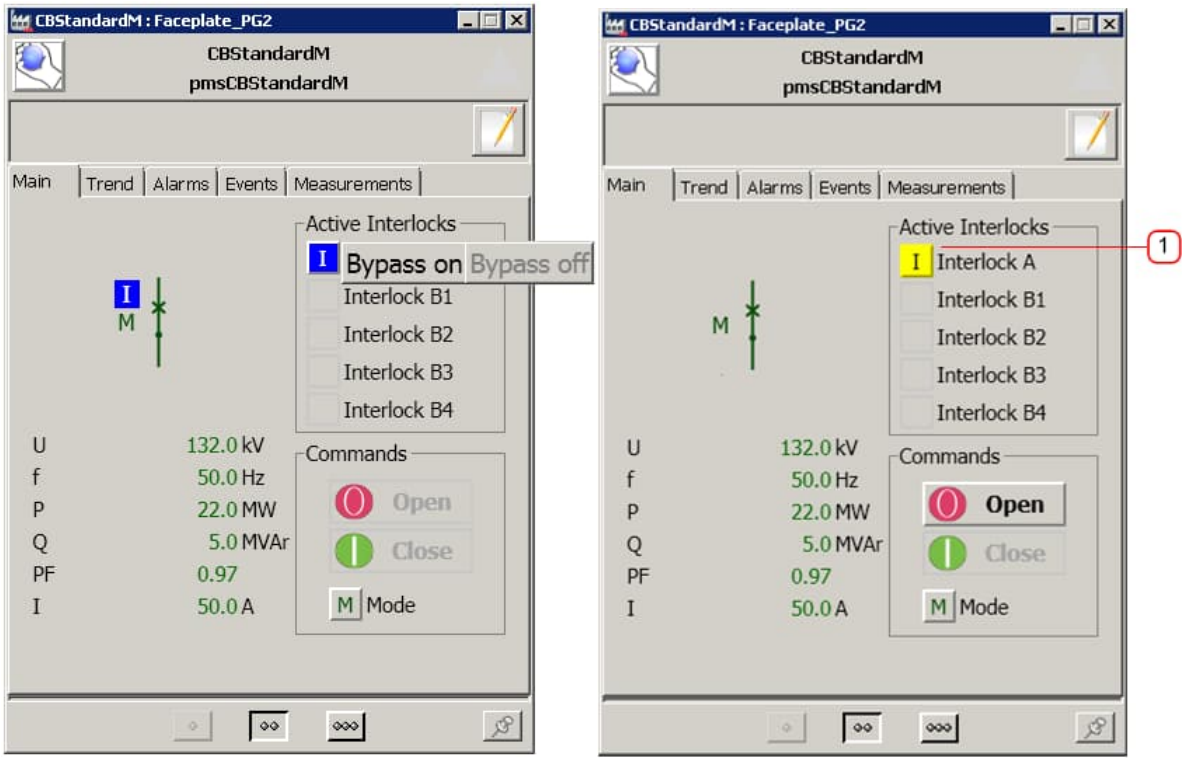


Figure 8 Override of interlock A

Table 13 Faceplate configuration for overriding an interlock

Field	Indication	Configuration method	Description
1	Bypass	Option button	Override of interlock A

The override of interlock A can be automatically reset, after a timer has elapsed while the faceplate is selected for control (via the object-lock icon). The configuration is done via the *IlockPar*, as shown in Table 14. In this way, the override function will not be active continuously, but only when an operation is required.

Table 14 Parameter configuration for interlock time-out

Item	Parameter configuration	Description
1	*IlockPar.IlockAtimed*	If parameter is true, then the reset is enabled by timeout or selection.
2	*IlockPar.IlockAtimeout*	Timer duration for the override reset, if *IlockPar.IlockAtimed*= true.

The text description of the interlock conditions can be configured via the extended faceplate tab **Edit** > **Interlocks**, as shown in Figure 9.

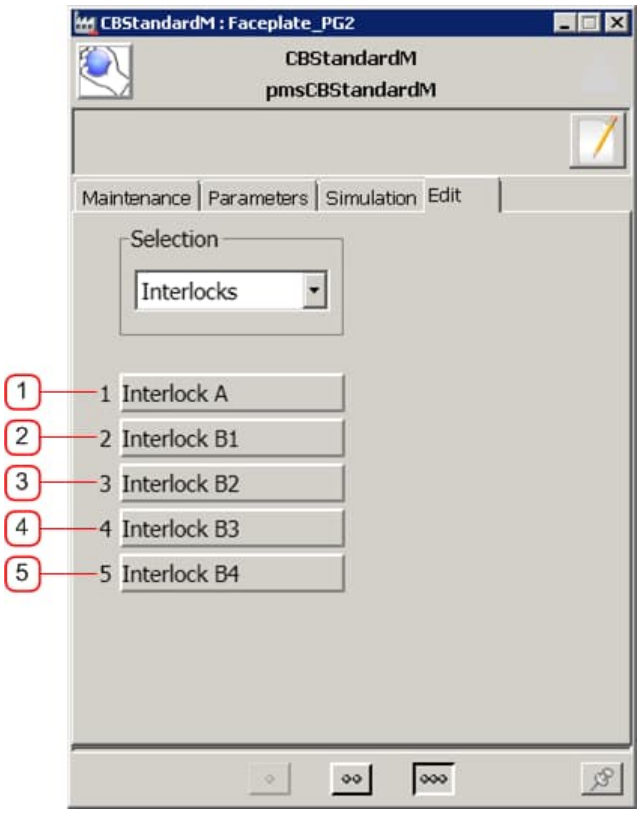


Figure 9 Faceplate tab Edit for Interlocks

Table 15 Configuration parameters for interlock

Field	Indication	Configuration method	Description
1	Interlock A	Text input field	Interlock description. Empty field hides the interlock from faceplate.
2	Interlock B1	Text input field	Interlock description. Empty field hides the interlock from faceplate.
3	Interlock B2	Text input field	Interlock description. Empty field hides the interlock from faceplate.
4	Interlock B3	Text input field	Interlock description. Empty field hides the interlock from faceplate.
5	Interlock B4	Text input field	Interlock description. Empty field hides the interlock from faceplate.

2.2.8 Point of Control

The circuit breaker can be controlled from two different levels, either locally or remotely:

The Local point of control is the equipment-level. This is any kind of panel located locally at the field equipment.

The Remote point of control is the PMS-level of control. This is the OperateIT graphical aspects of the control module provided by ABB's PMS Library.

When the parameter *IOPar.POCLoc.Value* is True, the circuit breaker is expected to be locally controlled (e.g. via local panel).

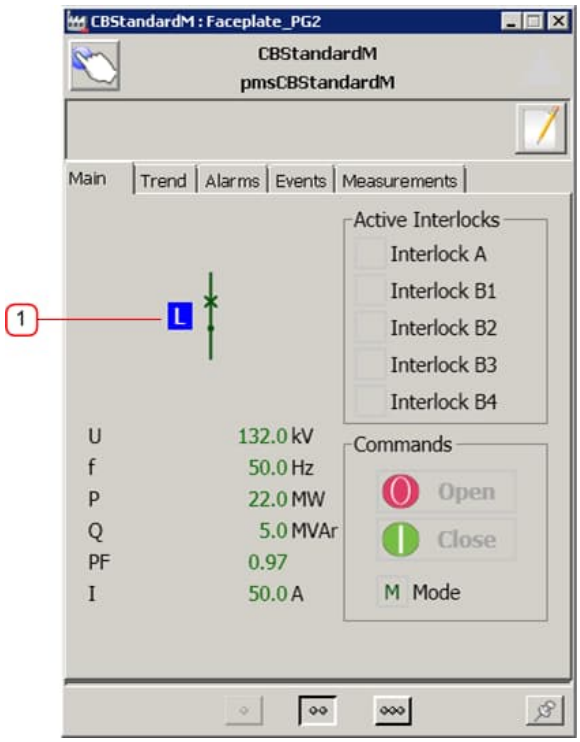


Figure 10 Local point of control

Table 16 Parameter and faceplate configuration for local point of control

Field	Indication	Configuration method	Description
1	Local icon	*IOPar.POCLoc.Value*	When *IOPar.POCLoc.Value* = True, the breaker is in local point of control and a graphic symbol is shown in the faceplate.

2.2.9 Control modes

The circuit breaker supports the following control modes (listed in order of priority):

- Maintenance mode
- Simulation mode
- Auto mode
- Manual mode

2.2.9.1 Maintenance Mode

If the circuit breaker is being serviced by an electrician, unnecessary alarms can be inhibited and operational commands can be blocked by activating the maintenance mode. This mode is enabled from the faceplate tab **Block**, as shown in Figure 11. It is also possible to block the control/alarms/events, without enabling the maintenance mode, by utilizing the **Block control**, **Block alarms** and **Block events** check boxes.

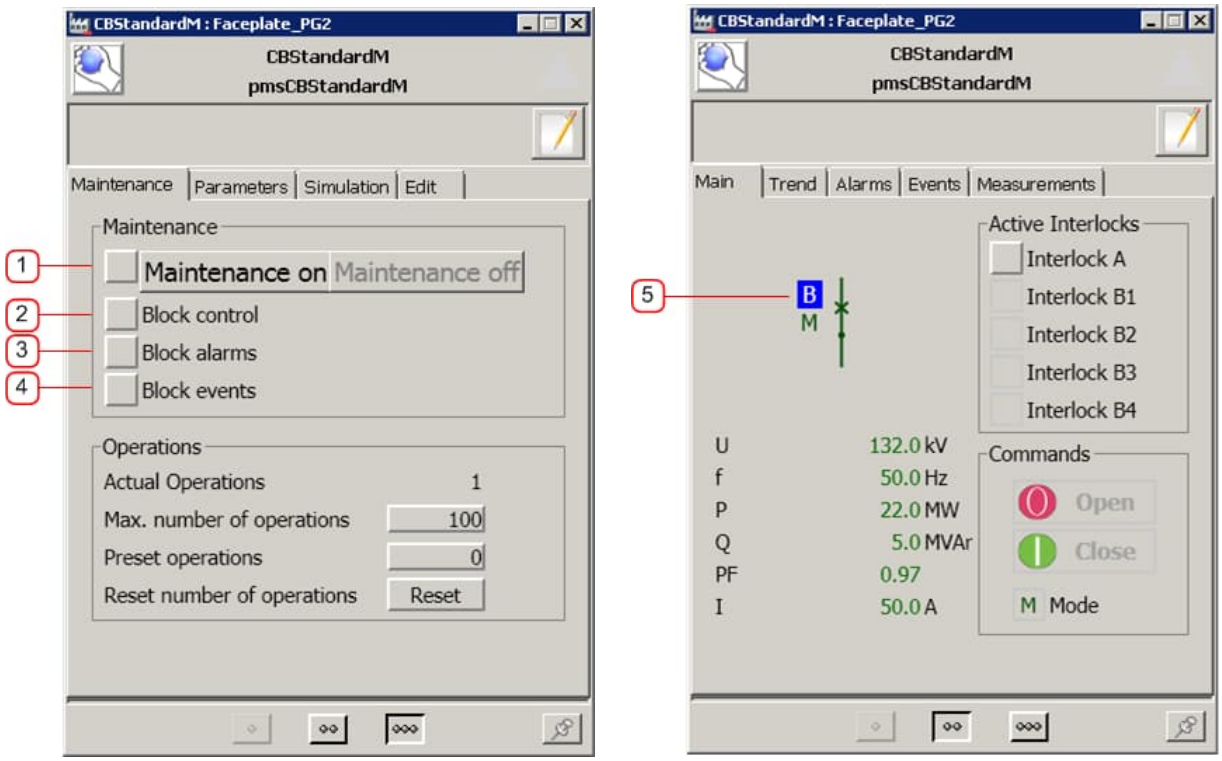


Figure 11 Extended faceplate, maintenance mode

Table 17 Faceplate configuration for Maintenance mode

Field	Indication	Parameter configuration	Description
1	Maintenance mode	Option button	Enables/disables the maintenance mode.
2	Block control	Option button	Enables/disables the Block control.
3	Block alarms	Option button	Enables/disables the Block alarms.
4	Block events	Option button	Enables/disables the Block events.
5	Maintenance icon	Graphic symbol	Indication that maintenance mode is active.

2.2.9.2 Simulation Mode

The simulation is a practical mode that allows software functionality testing in a controlled environment (for example during Factory Acceptance Test) without creating application logic outside the control module. The simulation is accessible from the faceplate tab **Simulation**, as shown in Figure 12.

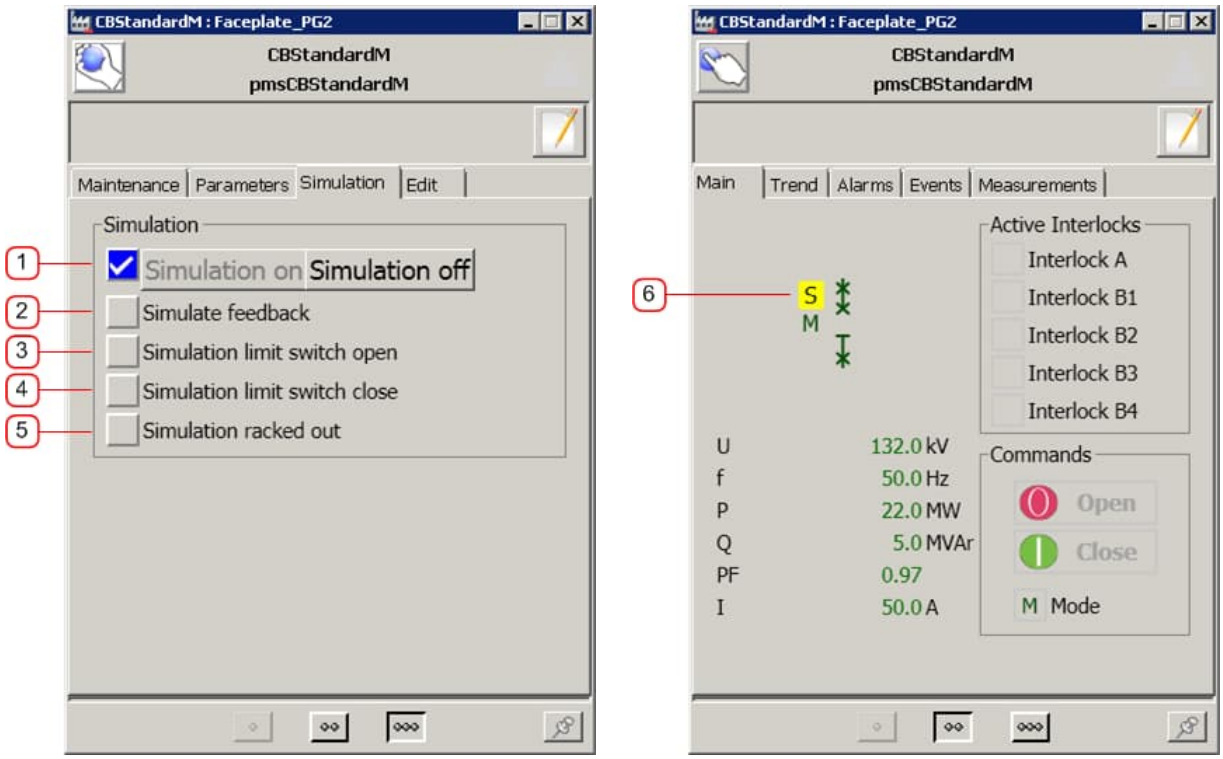


Figure 12 Faceplate tab Simulation

Table 18 Faceplate configuration for simulation mode

Field	Indication	Configuration method	Description
1	Simulation mode	Option button	Enables/disables the simulation.
2	Simulate feedback	Option button	Feedback follows issued commands.
3	Simulation limit switch Open	Option button	Selects simulated open position.
4	Simulation limit switch Close	Option button	Selects simulated closed position.
5	Simulation racked out	Option button	Selects simulated racked-out position.
6	Simulation icon	Graphic symbol	Indication that simulation mode is active.

If the **Simulate feedback** checkbox is checked, the feedback positions will follow the open/close commands. Auto or manual mode can be selected. By selecting either **Simulation limit switch Open** / **Close** / **Racked-out** the feedbacks will be forced into the desired position. This allows simulation of position error alarms. No actual commands are being issued to the circuit breaker outputs.

The simulation must not be activated during normal operation of the plant. This may lead to dangerous situations for equipment and personnel.

2.2.9.3 Auto Mode

The **Auto** mode is intended for open or close commands issued by an external code.

As long as there are no relevant interlocks active and parameter *AutoPar.AutoSel* is TRUE then parameters *AutoPar.AutoCmd0* and *AutoPar.AutoCmd1* will open or close the circuit breaker, respectively, on rising flank. Automatic open or close commands are accepted as long as the circuit breaker is in remote point of control. Open and close command push-buttons are disabled in Auto mode, as shown in Figure 14.

Auto mode can be activated from the mode option button in the faceplate or when the parameter *AutoPar.AutoSel* is set from False to TRUE. The Auto mode option will be disabled (dimmed) when the parameter *ExtPar.ExtDimAutoMode* is TRUE or if Auto mode is active.

Selecting **Auto/Manual** from faceplate does not change status on *AutoPar.AutoSel*.

Writing to *AutoPar.AutoSel*, however, changes mode indicated in the faceplate.

If mode selection shall be done via faceplate the output parameters *Status.AutoMode* and *Status.ManMode* must be connected to the input parameters *AutoPar.AutoSel* and *AutoPar.ManSel* respectively.

Ref example in Figure 13 Auto and Manual status connected back to AutoPar input.

```
pCBPar.CB18_BusTieEF.AutoPar.AutoSel      := pCBPar.CB18_BusTieEF.Status.AutoMode;
pCBPar.CB18_BusTieEF.AutoPar.ManSel       := pCBPar.CB18_BusTieEF.Status.ManMode;
```

Figure 13 Auto and Manual status connected back to AutoPar input.

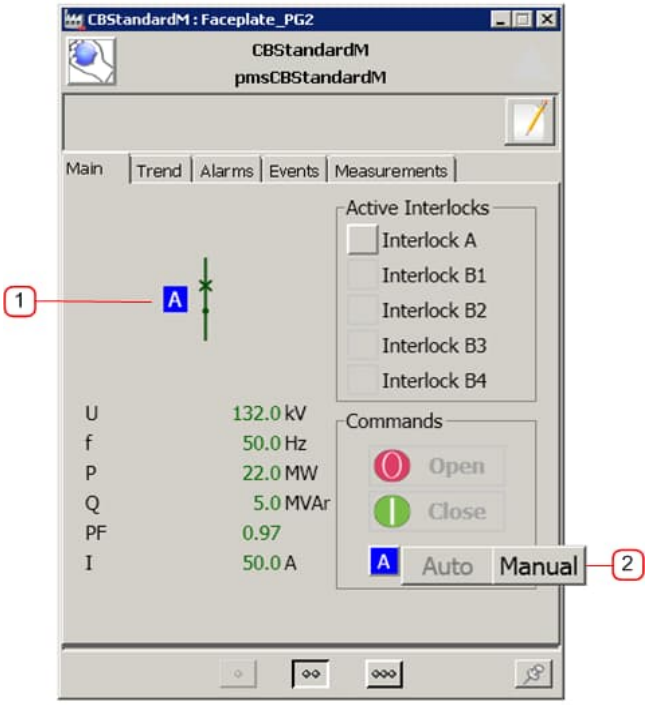


Figure 14 Main faceplate, Auto mode

Table 19 Faceplate configuration for Auto mode

Field	Indication	Configuration method	Description
1	Auto/manual icon	Graphic symbol	Indicates that Auto (A) or Manual (M) mode is active.
2	Auto/Manual	Option button	Button for selecting Auto/Manual.

2.2.9.4 Manual Mode

The Manual mode shall be used when the open or close commands are issued from the faceplate command buttons. The open or close command buttons will be enabled when the circuit breaker is in remote point of control and there is no active interlock condition.

The Manual mode can be activated from the Manual/Auto mode button in the faceplate or when the parameter *AutoPar.ManSel* is set from False to True. The Manual mode button will be disabled (dimmed) when the parameter *ExtPar.ExtDimManMode* is True or when the Manual mode is already active, as shown in Figure 15.

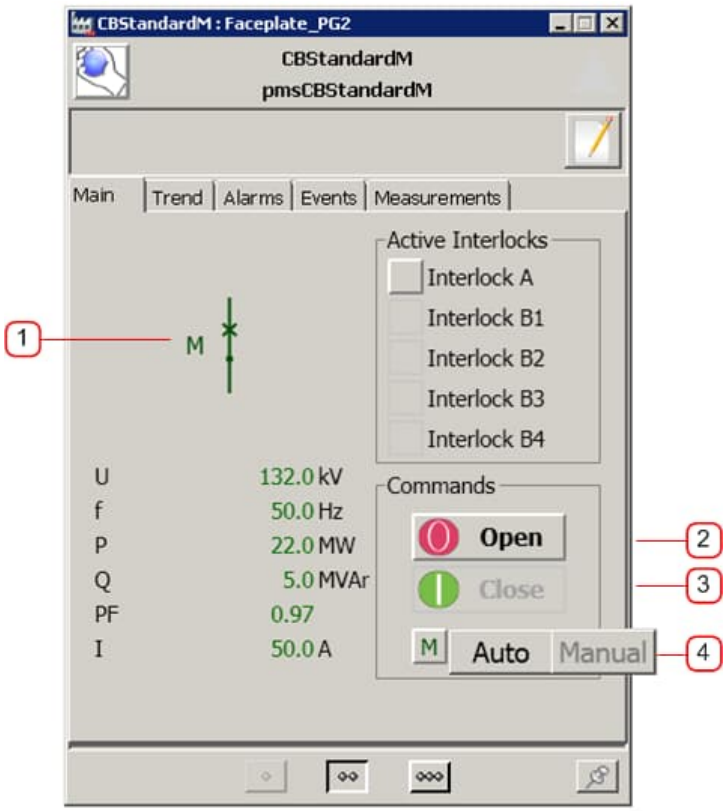


Figure 15 Main faceplate, Manual mode

Table 20 Faceplate configuration for Manual mode

Field	Indication	Configuration method	Description
1	Auto/manual icon	Graphic symbol	Indicates that Auto (A) or Manual (M) mode is active.
2	Open button	Push button	Open command button.
3	Close button	Push button	Close command button.
4	Auto/Manual	Option button	Button for selecting Auto/Manual.

2.2.10 Operation commands

The following operation features are provided the operator via the circuit breaker faceplate:

- Change of control modes (refer to section 2.2.9)
- Open and Close commands (refer to section 2.2.6)
- View the circuit breaker status (refer to section 2.2.5)
- View and override interlocks (refer to section 2.2.7)

2.2.11 Operations counter

Every time the circuit breaker is opened a counter is activated, accumulating the number of circuit breaker opening operations. A configurable limit is provided to aid in the maintenance planning. An alarm is generated, when the number of operations has been exceeded. The counter should be reset after maintenance is carried out.

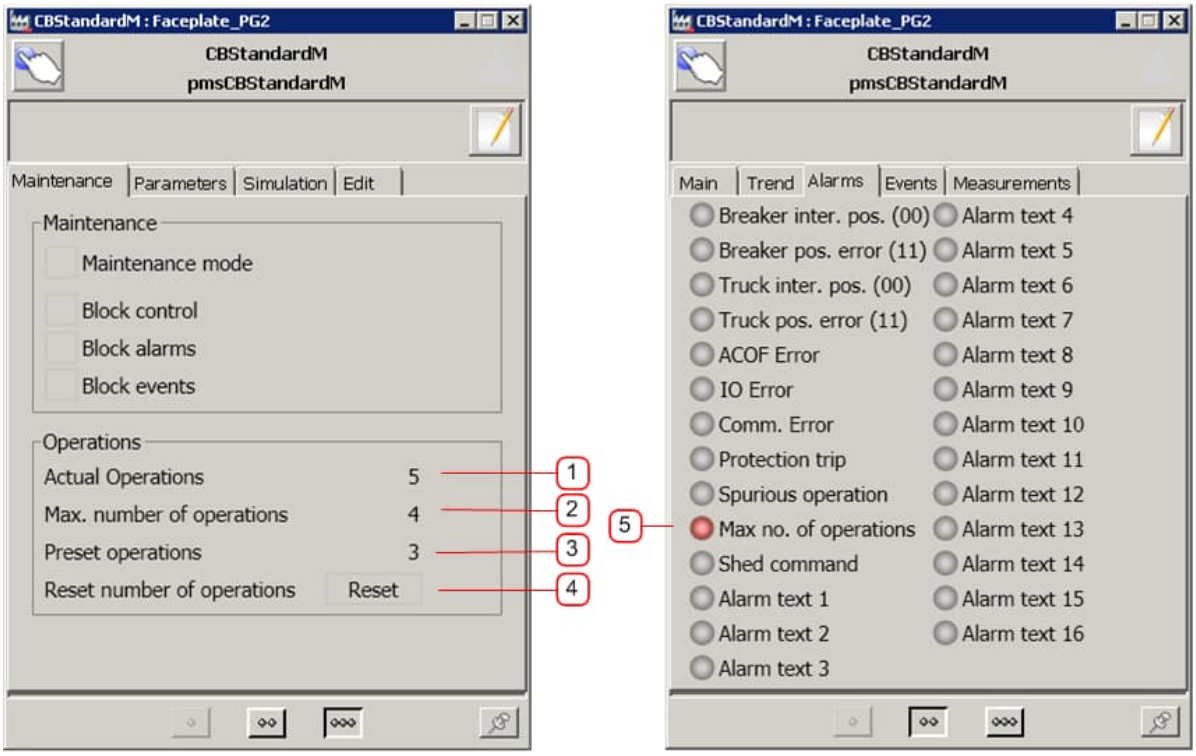


Figure 16 Faceplate tab Maintenance, Number of operations counter

Table 21 Faceplate configuration for Number of operations

Field	Indication	Configuration method	Description
1	Actual operation	Numerical field	Operations counter.
2	Max. allowed operations	Numerical input field	Limit of allowed operations.
3	Preset operations	Numerical input field	Start value of the counter after reset.
4	Reset number of operations	Push button	Resets the operations counter.
5	Max. number of operations	Status box	The limit of operations is exceeded.

2.2.12 Alarms

The control module supports standard and customized alarms:

- The standard alarms represent alarm conditions that are monitored by the internal logic of the control module.
- The customized alarms represent 16 free programmable alarm conditions that must be configured outside the control module.

Alarms presented in the tab **Alarms** of the circuit breaker faceplate, as shown in Figure 17.

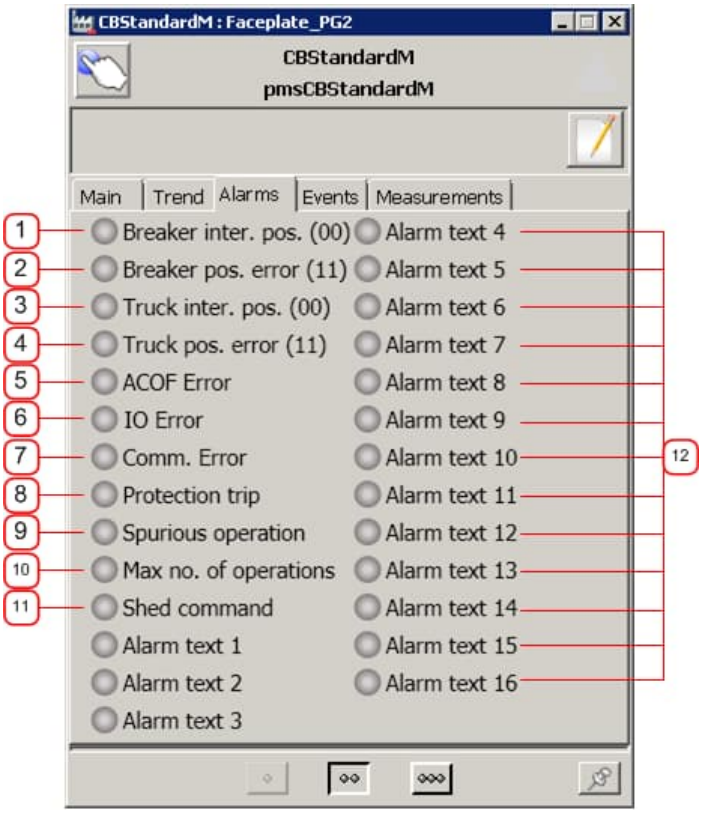


Figure 17 Faceplate tab Alarms

Table 22 List of alarms and message configuration

Field	Indication	Alarm condition	Alarm message (Resource Id)	Note
1	Intermediate position (00)	When neither the open nor the closed position feedbacks are received; the parameters *IOPar.OI.Value* and *IOPar.CI.Value* are False for more than a configurable time.	NLSID_CBPosError	
2	Position error (11)	When both the open and closed position feedbacks are received; the parameters *IOPar.OI.Value* and *IOPar.CI.Value* are True.	NLSID_CBFault	
3	Truck intermediate position (00)	When neither the service nor the test position feedbacks are received; the parameters *IOPar.SP.Value* and *IOPar.TP.Value* are False for more than a configurable time.	NLSID_CBTruckPosError	

Field	Indication	Alarm condition	Alarm message (Resource Id)	Note
4	Truck position error (11)	When both the service and test position feedbacks are received; the parameters *IOPar.SP.Value* and *IOPar.TP.Value* are True.	NLSID_CBTruckPosFault	
5	ACOF error	When a close or open command is issued and the proper change of position feedbacks has not occurred within a configurable time.	NLSID_CmdError	S
6	IO Error	The parameter *ErrPar.IOErr* is dedicated to receive any error indication from IO related to the circuit breaker. The alarm is activated when this parameter is True. The alarm is also activated when the position feedback signals are not reporting healthy status.	NLSID_IOError	
7	Communication error	The parameter *ErrPar.ComErr* is dedicated to receive any error indication from communication links related to the circuit breaker. The alarm is activated when the parameter is True.	NLSID_ComError	
8	Protection	The parameter *ErrPar.ProtTrp* is dedicated to receive any trip indication from protection relays related to the circuit breaker. The parameter *ErrPar.LO* is used for receiving the hardwired trip signal. The alarm is activated when either of the parameters is True.	NLSID_ProtectionTrip	
9	Spurious operation	When the position feedbacks are changing status without any command being issued, unless the circuit breaker is in local point of control.	NLSID_CBSpur	
10	Max. number of operations	When the circuit breaker is opened, a counter is increasing the number of operations. The alarm is activated when a configurable limit has exceeded.	NLSID_NoHL	
11	Shed command	The parameter *ErrPar.Shed* is dedicated to receive a shed indication from a load shedding application. The alarm is activated when the parameter is True.	NLSID_ShedCmd	
12	Alarm text 1 . . . Alarm text 16	*AlarmPar.UserDefAlm01stat.Signal* . . . *AlarmPar.UserDefAlm16stat.Signal*	*AlarmPar.UserDefAlm01stat.Message* . . *AlarmPar.UserDefAlm16stat.Message*	

Note: S = Supressed in Local control.

Each standard alarm can be disabled by configuring the corresponding parameter *ExtPar.DisAlmIntermedPos*…ExtPar.DisAlmShedCmd. When the value is set to True, the relevant alarm is disabled.

The parameter AlarmPar shall be used for implementing up to 16 user defined alarms. The alarm descriptions can be changed by editing the text fields in the extended faceplate tab **Edit** > **Alarms**, as shown in Figure 18.

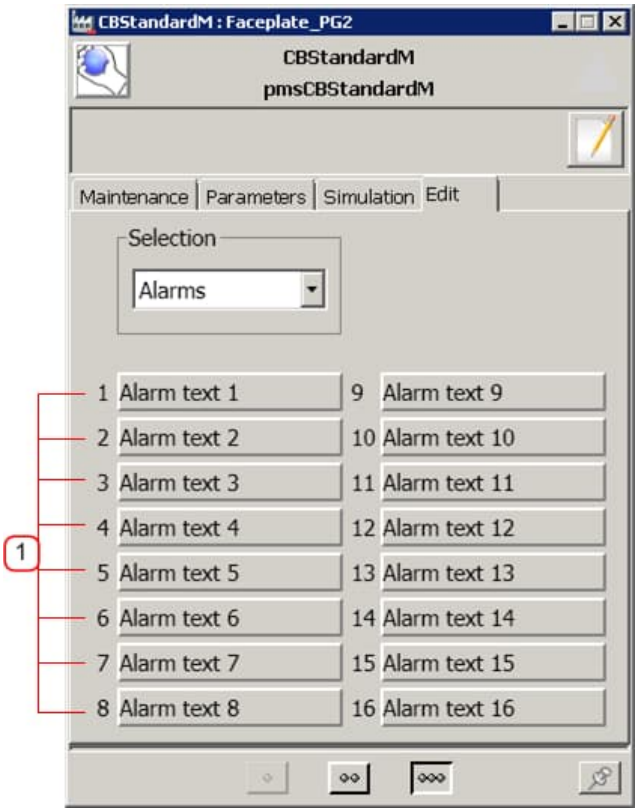


Figure 18 Faceplate tab Alarms for customized alarms

Table 23 Parameter and faceplate configuration for customized alarms

Field	Indication	Configuration method	Description
1	Alarm text 1 . . Alarm text 16	Text input field	Customized alarms description. Empty field hides the alarm from the faceplate.

2.2.13 Events

The control module supports standard and customized events:

- The standard events represent operational changes that are monitored by the internal logic of the control module.
- The customized events represent 16 free programmable status/event conditions that can be configured outside the control module.

The events are presented in the Event List. The customized events are also presented in the tab **Status** of the circuit breaker faceplate, as shown in Figure 19. The purpose of the customized events is mainly for user defined on/off type of status signals.

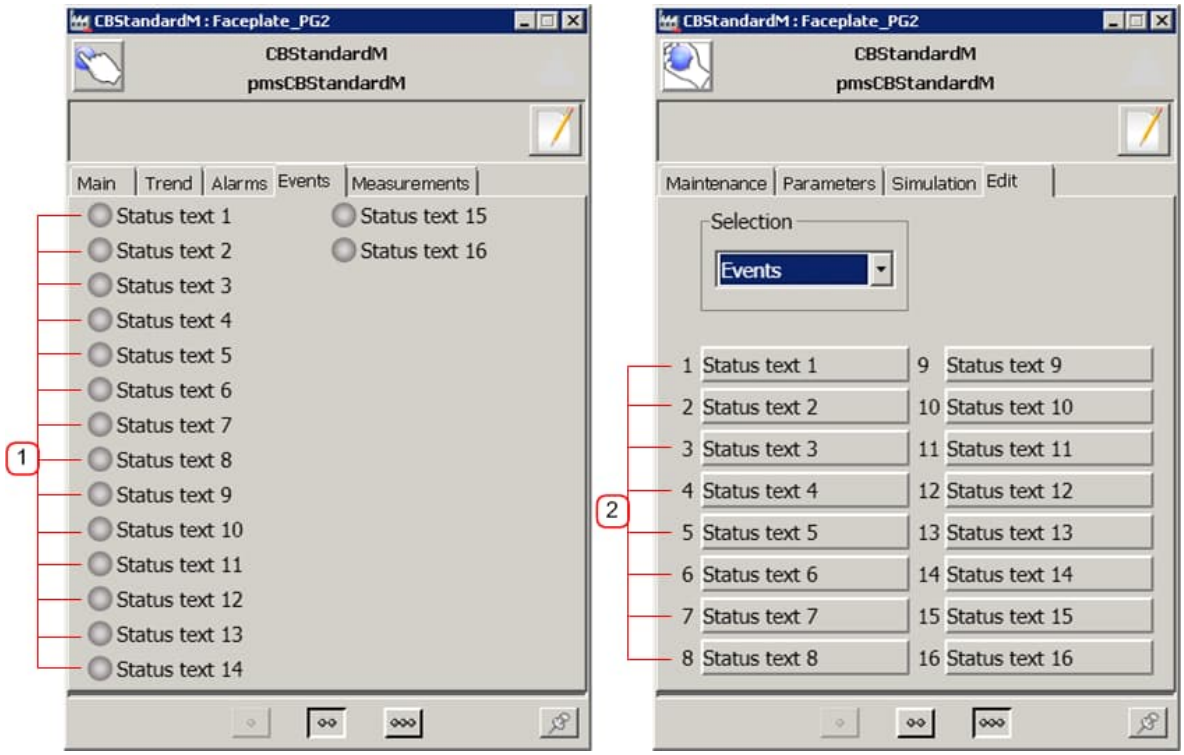


Figure 19 Faceplate tab Events / Edit for customized events

Table 24 Parameter and faceplate configuration for customized events

Field	Indication	Configuration method	Description
1	Status text 1 . . Status text 16	*EventPar.UserDefEvt01stat.Signal* . . *EventPar.UserDefEvt16stat.Signal*	Status of the event condition (i.e. On, Off).
2	Status text 1 . . Status text 16	Text input field	Customized events description. Empty field hides the event from the faceplate.

The text messages (i.e. in Event List) for the standard events are configurable via the Alarm and Event Translator aspect in Plant Explorer under **Library Structure** > **Preferences & Customizations** > **PMS_Alarm&Event**. The messages can be changed from English language to another language by modifying the text description of a relevant Resource Id (NLSID_), as shown in Figure 12, to a desired message (a text string up to 60 characters).

Table 25 List of standard events and message configuration

No.	Indication	Event condition	Event message On
1	Opened	Position feedback opened	NLSID_OpenPosition+ NLSID_EventOn (or NLSID_EventOff)
2	Closed	Position feedback closed	NLSID_ClosePosition+ NLSID_EventOn (or NLSID_EventOff)
3	RackedOut	Position feedback racked-out (not in service)	NLSID_RackedOutOn (or NLSID_RackedOutOff)
4	BlkAlm	Block alarms command button	NLSID_BlkAlarmOn (or NLSID_BlkAlarmOff)
5	BlkEvent	Block events command button	NLSID_BlkEventOn (or NLSID_BlkEventOff)
6	BlkCntrl	Block control command button	NLSID_BlkControlOn (or NLSID_BlkControlOff)
7	POC	Local point of control	NLSID_POCNumber+NLSID_Local (or NLSID_POCNumber+NLSID_CentralPortal)
8	RstOpCnt	Reset the number of operations counter	NLSID_RstOpCounter
9	SelMode	Mode change to Manual, Auto, Maintenance.	NLSID_Manual or NLSID_Auto or NLSID_Maintenance
10	OpenCmd	Open circuit breaker command button	NLSID_CmdOpen
11	CloseCmd	Close circuit breaker command button	NLSID_CmdClose
12	IntlBypass	Inhibit interlock A check box	NLSID_InterLockByPassOn (or NLSID_InterLockByPassOff)
13	IlockAact	Interlock A active	NLSID_IlockA+NLSID_EventOn (or NLSID_EventOff)
14	IlockB1act	Interlock B1 active	NLSID_IlockB1+NLSID_EventOn (or NLSID_EventOff)
15	IlockB2act	Interlock B2 active	NLSID_IlockB2+NLSID_EventOn (or NLSID_EventOff)
16	IlockB3act	Interlock B3 active	NLSID_IlockB3+NLSID_EventOn (or NLSID_EventOff)
17	IlockB4act	Interlock B4 active	NLSID_IlockB4+NLSID_EventOn (or NLSID_EventOff)

It is possible to suppress each standard event from appearing in the Event List. This configuration is done via the input parameter *ExtPar* and the data type components starting with *DisEvt* (e.g. when the parameter *ExtPar.DisEvtOpenCmd* is set to true, the event for circuit breaker open command is disabled).

It is possible to assign another interlock event message, different from the standard, via the input parameter *ExtPar.ExtIlockEvtMsg*.

2.2.14 Required I/O

An overview of the *IOPar* components is listed in Table 26, with respect to significance when setting up the interface connections for the circuit breaker 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.

Table 26 Significance of IOPar components

Field	IO_Input	Importance	Description
1	*IOPar.CI*	Mandatory	Closed position
2	*IOPar.OI*	Optional	Opened position
3	*IOPar.SP*	Optional	Racked-In position
4	*IOPar.TP*	Optional	Racked-Out position
5	*IOPar.FBE*	Optional	Earthed position
6	*IOPar.DeadNetRelease*	Optional	Dead net release condition
7	*IOPar. POCLoc*	Optional	Local point of control
8	*IOPar.LO*	Optional	Lock-out condition
9	*IOPar.Cmd0Edge*	Mandatory	Open command
10	*IOPar.Cmd1Edge*	Mandatory	Close command
11	*IOPar.Cmd0Level*	Optional	Open command
12	*IOPar.Cmd1Level*	Optional	Close command
13	*IOPar.MeaInput.ActPow*	Optional	Active Power
14	*IOPar.MeaInput.RePow*	Optional	Reactive Power
15	*IOPar.MeaInput.Voltage*	Optional	Voltage
16	*IOPar.MeaInput.Freq*	Optional	Frequency
17	*IOPar.MeaInput.Cur*	Optional	Current

2.2.15 Trend

The **Trend** tab is used to monitor and display the historical data for the 6 main measurements:

- Active power
- Reactive power
- Voltage
- Current
- Frequency
- Power factor

It is possible to set which measurements to be displayed in the trend area. The check boxes shall show/hide the measurement signals, as shown in Table 27. A user with *Operator* role and *Operate* permission rights can perform the configuration of these parameters.

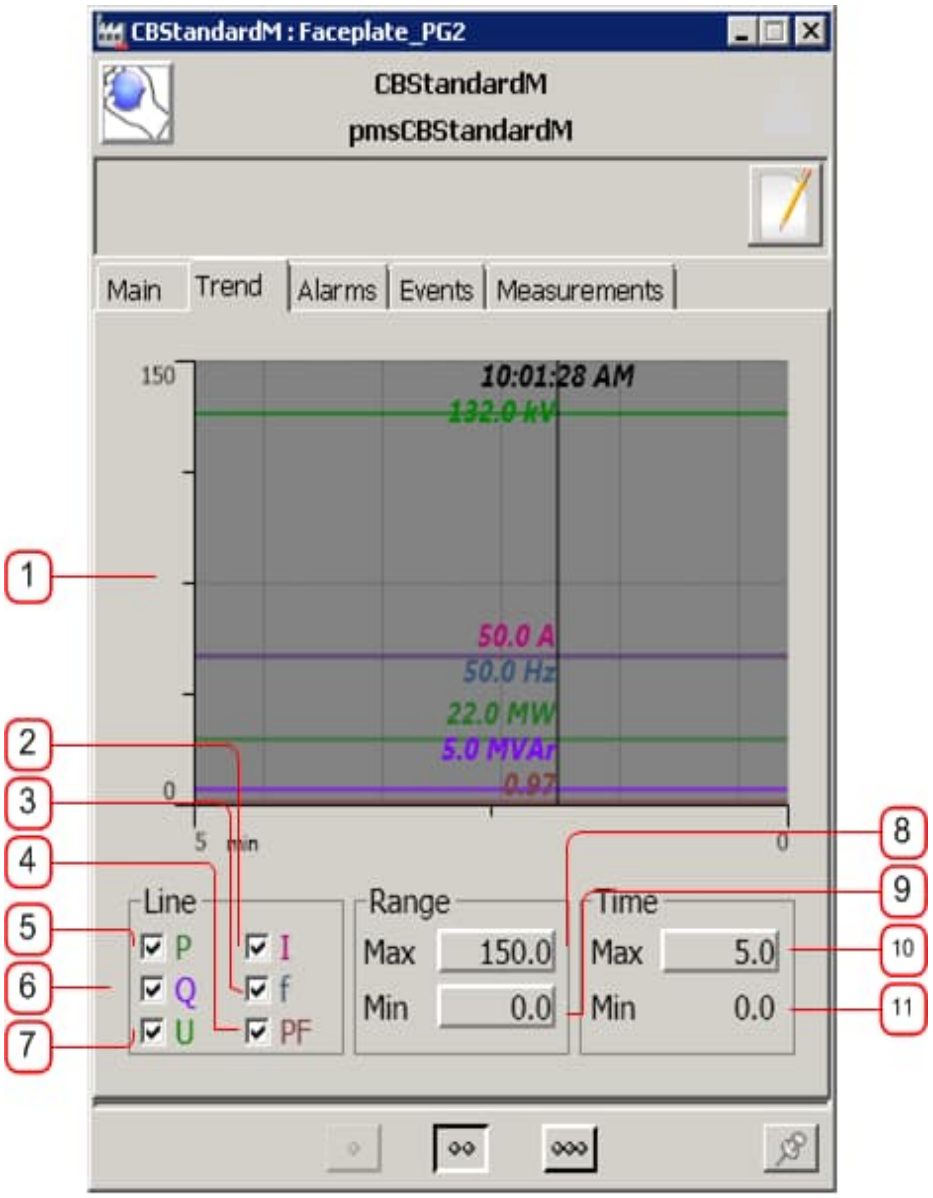


Figure 20 Faceplate tab Trend

Table 27 Parameter and faceplate configuration for Trend

Field	Indication	Configuration method	Description
1	Trend	Trend field	Used to display the historical data
2	Current	Check box	Show/hide the trace pen for I in the Trend field
3	Frequency	Check box	Show/hide the trace pen for F in the Trend field
4	Power factor	Check box	Show/hide the trace pen for Pf in the Trend field
5	Active power	Check box	Show/hide the trace pen for P in the Trend field
6	Reactive power	Check box	Show/hide the trace pen for Q in the Trend field
7	Voltage	Check box	Show/hide the trace pen for U in the Trend field
8	Max range	Input field	Y max margin
9	Min range	Input field	Y min margin
10	Max time	Input field	Max time value visible in the trend
11	Min time	Text field	Min time value visible in the trend

2.3 Parameters

This chapter describes the parameters and configuration settings for the control module *pmsCBStandardM*.

Table 28 Parameters of pmsCBStandardM

	Name	Type	Initial value	Description
1	Name	string[30]	'Name'	IN EDIT:Name of the object
2	Description	string[40]	'Description'	IN EDIT:Description of the object
3	VoltageLevel	dint	1	IN EDIT:Voltage level [1..10], for object colouring
4	CBType	dint	1	IN EDIT:[1=Circuit Breaker] [3=Disconnector] [11=Circuit Breaker w/Earth] [13= Disconnector w/Earth]
5	FBConfig	dint	0	IN EDIT:Configuration of position feedbacks
6	NormalMode	dint	1	IN EDIT: [1=Manual][2=Auto][3=Local]
7	FollowLocalFB	bool	false	IN EDIT: Configuration of Cmd0\Cmd1Level output
8	AlSeverity	dint	900	IN EDIT:Alarm severity
9	EvSeverity	dint	400	IN EDIT:Event severity
10	Class	dint	50	IN EDIT:Alarm and Event Class
11	IOPar	pmsCBIOPar	default	IN_OUT:Circuit Breaker I/O signals
12	AutoPar	pmsCBAutoPar	default	IN:Parameters for Auto mode control
13	AlarmPar	pmsExtAll	default	IN:For Extended Alarm indication In Faceplate
14	EventPar	pmsExtEvt	default	IN:For Extended Event indication in Faceplate
15	IlockPar	pmsILockPar	default	IN:Interlock input signals and configuration
16	ErrPar	pmsErrPar	default	IN:Error Indication
17	MeasPar	pmsExtIO	default	IN:For Extended Measurements in Faceplate
18	ExtPar	pmsCBExtPar	default	IN:External parameters, for application interaction
19	Status	pmsCBstatus	default	OUT:Circuit Breaker status

2.3.1 Parameter details

2.3.1.1 Name and Description

Table 29 Name and description

	Name	Type	Initial value	Description
1	Name	string[30]	'pmsCBStandardM'	IN EDIT:Name of the object
2	Description	string[40]	'pmsCBStandardM'	IN EDIT:Description of the object

The parameters Name and Description of the control module must be unique in the project. The text can be assigned directly.

e.g. : Name : 'CB3401A'

: Description : 'Circuit breaker 3401A'

2.3.1.2 Voltage level

Table 30 Voltage Level

	Name	Type	Initial value	Description
3	VoltageLevel	Dint	1	IN EDIT VoltageLevel [1-10]

The VoltageLevel is used for the colour of the circuit breaker graphic object in 800xA displays.

e.g. : VoltageLevel: 3

In this example the colour of the breaker will be light green.

2.3.1.3 CBType and FBConfig

Table 31 CBType and FBConfig

	Name	Type	Initial value	Description
4	CBType	dint	1	IN EDIT:[1=CB][3=Disc][11=CB w/Earth][13=Disc. w/Earth]
5	FBConfig	dint	0	IN EDIT:[0=FB0,FB1][1=FB1][2=FB0,FB1,SP][3=FB1,SP] [4=FB0,FB1,SP,TP][5=FB1,SP,TP]

The CBType parameter is used for determining the graphical presentation of the circuit breaker object in the 800xA displays. The FBConfig parameter is used for determining the combination of position signals that are applicable for a certain breaker.

e.g. : CBType: 3

FBConfig: 0

In this example the circuit breaker will be shown as a disconnector with open and close position signals.

2.3.1.4 NormalMode

Table 32 NormalMode

	Name	Type	Initial value	Description
6	NormalMode	dint	1	IN EDIT: [1=Manual][2=Auto][3=Local]

The *NormalMode* parameter is used for determining the graphical presentation of the mode indication in the 800xA displays. The mode which is configured as normal will be indicated in green, while the two other modes which are not the normal mode will be indicated in white/blue.

i.e. : NormalMode=1: A M L

NormalMode=2: A M L

NormalMode=3: A M L

2.3.1.5 FollowLocalFB

Table 33 FollowLocalFB

	Name	Type	Initial value	Description
7	FollowLocalFB	bool	false	IN EDIT: [False = Cmd0\Cmd1Level output is reset in local, True = Cmd0\Cmd1Level output follow FB in local]

The *FollowLocalFB* parameter is used to configure the value of the steady open and close commands *IOPar.Cmd0Level* and *IOPar.Cmd1Level* when the circuit breaker is in local point of control

e.g. : FollowLocalFB: true

IOPar.POCLoc: true

In this example the circuit breaker *IOPar.Cmd0Level* and *IOPar.Cmd1Level* will follow the value of the configured position feedback signals.

2.3.1.6 EvSeverity, AlSeverity and Class

Table 34 EvSeverity, AlSeverity and Class

	Name	Type	Initial value	Description
8	EvSeverity	Dint	900	IN EDIT: Event severity
9	AlSeverity	Dint	400	IN EDIT: Alarm severity
10	Class	Dint	50	IN EDIT: Alarm and Event Class

The *EvSeverity* and *AlSeverity* parameters are used for determining the severity of the internal alarms and events. The Class parameter determines the alarm and event class in the 800xA system.

2.3.1.7 IOPar

Table 35 IOPar

	Name	Type	Initial value	Description
11	IOPar	pmsCBIOPar		IN_OUT: IO signals for Circuit breaker

The following components from the structured data type *IOPar* are used for the *pmsCBStandardM* connections to digital I/O signals:

Table 36 Digital I/O for pmsCBStandardM

POCLoc	Point of control set to Local (input)
OI	Feedback open limit switch (input)
CI	Feedback close limit switch (input)
SP	Feedback Service Position limit switch (input)
TP	Feedback Test Position limit switch (input)
FBE	Feedback Earthed limit switch (input)
LO	Locked-out indication (input)
Cmd0Edge	Command open output pulse (output)
Cmd1Edge	Command close output pulse (output)
Cmd0Level	Command open output continuous (output)
Cmd1Level	Command close output continuous (output)

The parameter *IOPar.MeaInput* is used for connecting the standard analogue measurements to the control module. The measured values are presented in the faceplate.

Table 37 Analogue Inputs for pmsCBStandardM

Voltage	Voltage, U
Freq	Frequency, f
ActPower	Active Power, P
RePow	Reactive Power, Q
PowFact	Power Factor, cos φ
Cur	Current, I

The control module must be configured for the actual available position I/O of the circuit breaker. The parameter *FBConfig* value is 0-5, representing six possible configurations, as shown in the table below.

Table 38 FBConfig values

FBConfig	OI	CI	SP	TP
0	OI	CI	-	
1	-	CI	-	
2	OI	CI	SP	
3	-	CI	SP	
4	OI	CI	SP	TP
5		CI	SP	TP

As indicated in Table 38, configuration 0 or 1 is to be implemented when there is no racked out functionality required.

The parameters Out0Puls and Out1Puls (or Out0Continous and Out1Continous) shall be used for the opening or closing commands and must be connected to the output signals of the physical breaker.

Table 39 Circuit breaker commands

Out0Puls	OUT Command Open Pulse
Out1Puls	OUT Command Close Pulse
Out0Continous	OUT Continuous Open command
Out1Continous	OUT Continuous Close command

2.3.1.8 AutoPar

Table 40 AutoPar

	Name	Type	Initial value	Description
12	AutoPar	pmsCBAutoPar		IN: Parameters for Auto mode control

The components from the parameter *AutoPar* are used for the *pmsCBStandardM* control module to create application logic for automatic open/close commands and manual/auto mode change.

Table 41 AutoPar components

AutoSel	Select Auto Mode
AutoCmd0	Auto open command
AutoCmd1	Auto close command
ManSel	Select Manual Mode

2.3.1.9 AlarmPar

The parameter *AlarmPar* contains components for up to 16 user defined alarms. These alarms will have no effect on the control module functionality.

Table 42 AlarmPar

	Name	Type	Initial value	Description
13	AlarmPar	pmsExtAll	default	IN: For Extended Alarm indication In Faceplate

Table 43 AlarmPar components

UserDefAlm01stat	Status for User defined Alarm1
UserDefAlm02stat	Status for User defined Alarm2
UserDefAlm03stat	Status for User defined Alarm3
UserDefAlm04stat	Status for User defined Alarm4
UserDefAlm05stat	Status for User defined Alarm5
UserDefAlm06stat	Status for User defined Alarm6
UserDefAlm07stat	Status for User defined Alarm7
UserDefAlm08stat	Status for User defined Alarm8
UserDefAlm09stat	Status for User defined Alarm9
UserDefAlm10stat	Status for User defined Alarm10
UserDefAlm11stat	Status for User defined Alarm11
UserDefAlm12stat	Status for User defined Alarm12
UserDefAlm13stat	Status for User defined Alarm13
UserDefAlm14stat	Status for User defined Alarm14
UserDefAlm15stat	Status for User defined Alarm15
UserDefAlm16stat	Status for User defined Alarm16

2.3.1.10 IlockPar

The circuit breaker can be interlocked for operation by signals from supervisory programs or other objects. A total of five interlocks are available: one A-interlock and four B-interlocks.

The A-interlock or process interlock has a lower priority than safety interlocks. The operator can override (or bypass) the A-interlock. Therefore careful consideration needs to be made before an interlock is implemented as A-interlock.

B-interlocks or safety interlocks have highest priority. The operator can not override the B-interlocks.

Table 44 IlockPar

	Name	Type	Initial value	Description
15	IlockPar	pmsILockPar	default	Parameter for connecting and configuring Interlocks.

Table 45 IlockPar components

IlockAConfig	IN EDIT Interlock A Configuration
IlockB1Config	IN EDIT Interlock B1 Configuration
IlockB2Config	IN EDIT Interlock B2 Configuration
IlockB3Config	IN EDIT Interlock B3 Configuration
IlockB4Config	IN EDIT Interlock B4 Configuration
IlockA	IN Interlock A input
IlockB1	IN Interlock B1 input
IlockB2	IN Interlock B2 input
IlockB3	IN Interlock B3 input
IlockB4	IN Interlock B4 input

The interlocks must be configured to either interlock the open, close or both open/close operations of the circuit breaker. The parameter IlockXConfig value is 0-3, representing four possible configurations as shown in the table below.

Table 46 IlockConfig values

IlockXConfig	Interlock Open command	Interlock Close Command
0	-	-
1	X	-
2	-	X
3	X	X

2.3.1.11 ErrPar

It is possible to connect externally triggered error signals to the control module. These error signals only give error indications on the object and in the faceplate; no action is taken by the control module.

Table 47 ErrPar

	Name	Type	Initial value	Description
16	ErrPar	pmsErrPar	Default	Parameter for connecting Error signals.

The following components from the parameter *ErrPar* are used for the control module *pmsCBStandardM*.

Table 48 ErrPar for pmsCBStandardM

Shed	IN Load shed action by load shedding function
IOErr	IN IO Error
ComErr	IN Communication Error
ProtTrp	IN Protection trip

2.3.1.12 Status

The opened or closed status and the manual or automatic mode of the circuit breaker are indicated from the parameter *Status*.

Table 49 Status

	Name	Type	Initial value	Description
19	Status	pmsCBstatus	default	Status of breaker Checked positions.

The following components from the parameter Status are applicable for the control module *pmsCBStandardM*.

Table 50 Status parameters

OX	Checked open position
CX	Checked close position
AutoMode	Auto mode is active
ManMode	Manual mode is active

Depending on the *FBConfig* settings, the position status is determined according to the table below.

Table 51 Checked positions and position related alarms (FBConfig=3)

Open feedback IOPar.OI	Closed feedback IOPar.CI	Service Position IOPar.SP	Checked opened IOPar.OX	Checked closed IOPar.CX	Position error Alarm	Intermediate position alarm
0	0	0	1	0	0	1
1	0	0	1	0	0	0
0	1	0	1	0	0	0
1	1	0	1	0	1	0
0	0	1	0	0	0	1
1	0	1	1	0	0	0
0	1	1	0	1	0	0
1	1	1	0	0	1	0

Section 3 Control Module pmsCBIndM

The *pmsCBIndM* control module is included in the *pmsCBLib* library. A block presentation of the control module is shown in Figure 21. The parameters are briefly described in Table 52.

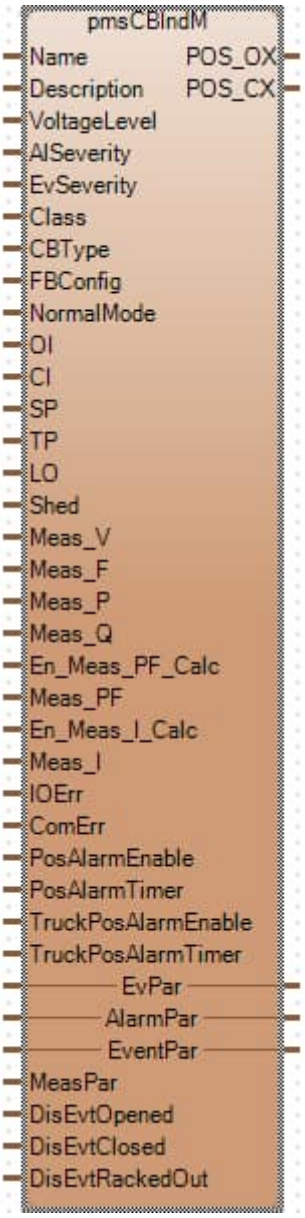


Figure 21 Control Module pmsCBIndM

Table 52 Parameters of the control module pmsCBIndM

Parameter	Significance
Name	Name of the circuit breaker. With the name upload tool of process portal, this property will be used for identifying the object in 800xA. The name will be used to group the alarms and events and to identify the faceplate of the object. The name must be unique in the project.
Description	Description of the circuit breaker. With the name upload tool of process portal, this property will be used for identifying the object in 800xA.
Voltage level	Voltage level for object colouring. This property gives the object a colour in Single Line Diagrams. Default settings for the colours are: Level 1 - RGB N(0,176,232) - D(0,126,182) - L(50,226,255) Level 2 - RGB N(232,160,168) - D(182,110,118) - L(255,210,218) Level 3 - RGB N(176,232,176) - D(126,182,126) - L(226,255,226) Level 4 - RGB N(255,255,128) - D(205,205,78) - L(255,255,178) Level 5 - RGB N(64,128,128) - D(14,78,78) - L(114,178,178) Level 6 - RGB N(198,101,0) - D(140,70,0) - L(255,154,53) Level 7 - RGB N(240,160,13) - D(182,121,10) - L(249,209,136) Level 8 - RGB N(207,204,73) - D(153,150,40) - L(227,225,149) Level 9 - RGB N(81,181,171) - D(53,125,120) - L(174,221,217) Level10- RGB N(185,157,91) - D(135,112,58) - L(223,210,181)
AlSeverity	Alarm severity. The alarm severity can be used for filtering the alarm list. Range 1-1000.
EvSeverity	Event severity. The event severity can be used for filtering the event list. Range 1-1000.
Class	Alarm and Event Class. This property can be used for grouping objects to appear in separate alarm/event lists. Range 1-9999.
CBType	The parameter is used for configuring the graphical presentation of the circuit breaker; ‘1’= circuit breaker, ‘3’= isolator (disconnector), ‘4’= circuit breaker without service position feedback.
FBConfig	Configuration parameter for the position status signals that are applicable for the circuit breaker; ‘0’= Open and Closed positions, ‘1’= Closed position, ‘2’= Open, Closed and Service positions, ‘3’= Closed and Service positions, '4'= Open, Closed, Service position and Test Position, ‘5'= Closed, Service position and Test position
NormalMode	The parameter is used for configuring the graphical presentation of the normal mode; ‘1’= Manual, ‘2’= Auto, ‘3’= Local, ‘4’= Remote.
OI	Feedback open indication.
CI	Feedback close indication.
SP	IN: Feedback service position.
TP	IN: Feedback Test position.
LO	Lockout (Trip) input.
Shed	Indication that breaker has been shed.
Meas_V	Measurement input for Voltage.
Meas_F	Measurement input for Frequency.
Meas_P	Measurement input for Active power.

Parameter	Significance
Meas_Q	Measurement input for Reactive power.
En_Meas_PF_Calc	Power factor calculated value from Meas_P and Meas_Q.
Meas_PF	Measurement input for Power factor.
En_Meas_I_Calc	Current calculated value from Meas_P, Meas_PF and Meas_V.
Meas_I	Measurement input for Current.
IOErr	Indication that an IO error is active.
CommErr	Indication that a Communication error is active.
PosAlarmEnable	Enable the position error alarms.
PosAlarmTimer	Time delay for position error alarms.
POS_OX	Checked open position.
POS_CX	Checked close position.
EvPar	Parameter for configuring external timestamp for events [NOT USED].
AlarmPar	Structured parameter for 16 user defined alarms.
EventPar	Structured parameter for 16 user defined events.
MeasPar	Structured parameter for 16 user defined analogue measurements.
DisEvtOpened	External disabling of event condition for OI.
DisEvtClosed	External disabling of event condition for CI.
DisEvtRackedOut	External disabling of event condition for SP.

3.1 Introduction

The control module pmsCBIndM is used for monitoring of non-controllable circuit breakers (i.e. no remote open/close operation). The following features are supported:

- **Measurements**

Two kinds of mesurements are featured, standard and customized:

  - Standard measurements: Important electrical available for monitoring in the main faceplate tab:
    - Voltage
    - Frequency
    - Active power
    - Reactive power
    - Power factor
    - Current
  - Customized measurements: Additionally, up to 16 customized measurements can be displayed numerically in another faceplate tab).

- **Position status**

The following feedback signals facilitates supervision of circuit breaker position status:

  - Open indication
  - Closed indication
  - Service position
  - Test position

- **Graphical Standard - IEC, ANSI**

The graphical element can be configured to follow either the IEC or ANSI graphical standard.

- **Alarms**

Alarms are divided in two categories:

  - Standard alarms: Default alarms informing the operator of alarm conditions, according to the internal logic of the control module.
  - Customized alarms: Up to 16 customized alarms can be raised through the control module although they originate from external logic.

- **Events**

Events are divided in two categories:

  - Standard events: Default events informing the operator of operational status changes.
  - Customized events: Up to 16 customized events informing the operator of status/events programmed outside the control module logic.

3.2 Detailed Engineering

Engineering details of the control module *pmsCBIndM* are similar to *pmsCBStandardM*. The following chapters will point out the differences compared to chapter 2.2

3.2.1 Measurements

The faceplate tab Main presents the standard measurements, as shown in Figure 22. These analogue signals are configured via the parameters of the control module, as shown in Table 53.

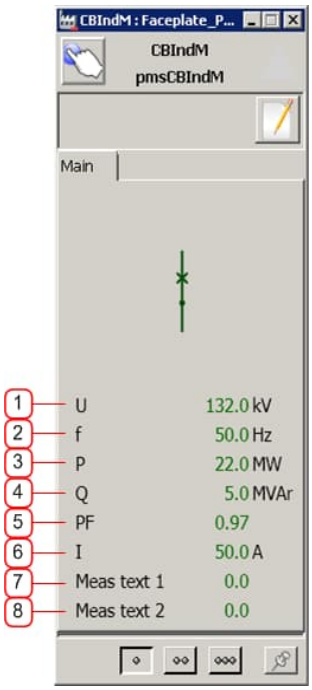


Figure 22 pmsCBIndM Faceplate tab Main

Table 53 Parameter configuration for measurement signals

Field	Indication	Parameter configuration	Description
1	Voltage	Meas_V	Voltage measurement.
2	Frequency	Meas_F	Frequency measurement.
3	Active power	Meas_P	Active power measurement.
4	Reactive power	Meas_Q	Reactive power measurement.
5	Power factor	Meas_PF	Power factor measurement. If *En_Meas_PF_Calc*=True, the power factor value will be calculated based on the parameters *Meas_P* and *Meas_Q*.
6	Current	Meas_I	Current measurement. If *En_Meas_I_Calc*=True, the Current value will be calculated based on the parameters *Meas_P*, *Meas_PF* and *Meas_V*.
7	Meas text 1	*MeasPar.UserDefMeas01*	User defined measurement 1.
8	Meas text 2	*MeasPar.UserDefMeas02*	User defined measurement 2.

3.2.2 Position status

The position status of the circuit breaker is presented by the graphic symbol of the circuit breaker in the faceplate tab **Main**.

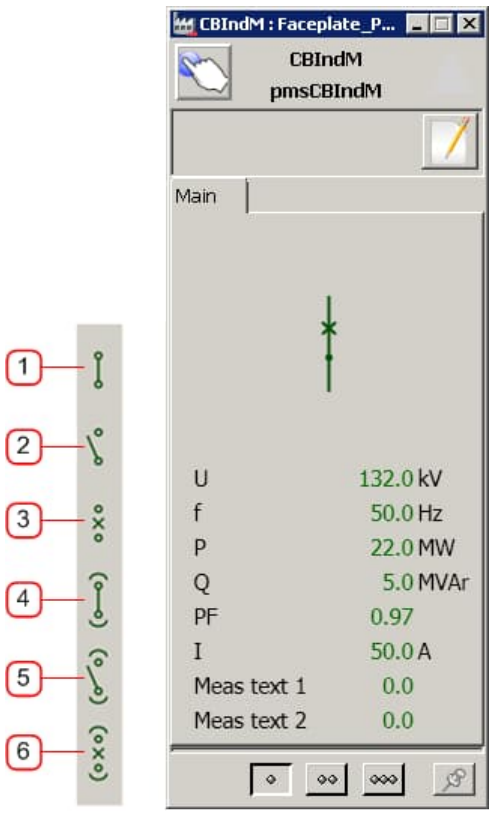


Figure 23 Position status pmsCBIndM

Table 54 Position status pmsCBIndM

Field	Parameter configuration	Description
1	CI=1 and OI=0 and SP =1	Circuit breaker closed.
2	CI=0 and OI=1 and SP =1	Circuit breaker opened.
3	CI=0 and OI=0 and SP =1	Circuit breaker intermediate position.
4	CI=1 and OI=0 and SP=0	Circuit breaker closed and racked-out.
5	CI=0 and OI=1 and SP=0	Circuit breaker open and racked-out.
6	CI=0 and OI=0 and SP=0	Circuit breaker intermediate position and racked-out.

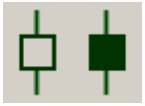
The FBConfig parameter shall be used for enabling the open and/or service position feedbacks, as shown in Table 55.

Table 55 Configuration values for the FBConfig parameter

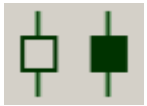
FBConfig value	Applicable feedback signals	Remarks
0	- Feedback Opened - Feedback Closed	Two limit switches are monitored; the Service Position input is not included. Note: service position is the opposite of racked out position
1	- Feedback Closed	Only closed limit switch feedback is considered.
2	- Feedback Opened - Feedback Closed - Feedback Service Position	Both opened and closed limit switches are considered in conjunction with the service position. Note: that if the service position is ‘0’, i.e. the circuit breaker is racked out; the checked open indication is always true to indicate an electrical disconnection.
3	- Feedback Closed - Feedback Service Position	The close limit switch and the service position feedbacks are monitored.
4	- Feedback Opened - Feedback Closed - Feedback Service Position - Feedback Test Position	Both opened and closed limit switches are considered in conjunction with the service position. Both the service position and the test position is monitored before the circuit breaker is considered racked out; the checked open indication is always true to indicate an electrical disconnection.
5	- Feedback Closed - Feedback Service Position - Feedback Test Position	The close limit switch and both service position and test position feedbacks are monitored.

3.2.3 Graphic Symbol Standard

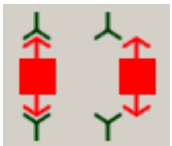
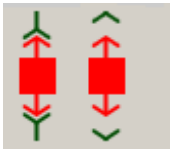
The graphic symbols standard (IEC or ANSI) used in the faceplates can be configured by setting the project constant **pmsConstants.cGraphicSymbolStd_IEC_ANSI**.

Value	Standard	Symbols
0		
1(default)	IEC(default)	
2	ANSI	

When ANSI is selected, the fill color of the symbol can be configured by setting the project constant **pmsConstants.cANSI_FillColouring**.

Value	Remarks	Symbols
0(default)	Green = Open Red = Closed	
1	Not filled = Open Filled = Closed	

The position of the breaker symbol when racked out can be configured by setting the project constant **pmsConstants.cBreaker_RackoutConfig**.

Value	Remarks	Symbols
0(default)	Move symbol outside line when racked out.	
1	Keep symbol on line when racked out.	

See Appendix A for detailed table with configuration and corresponding symbols.

3.2.4 Alarms

The control module supports standard and customized alarms:

- The standard alarms represent alarm conditions that are monitored by the internal logic of the control module.
- The customized alarms represent 16 free programmable alarm conditions that must be configured outside the control module.

All alarms are presented in the tab **Alarms** of the circuit breaker faceplate, as shown in Figure 24.

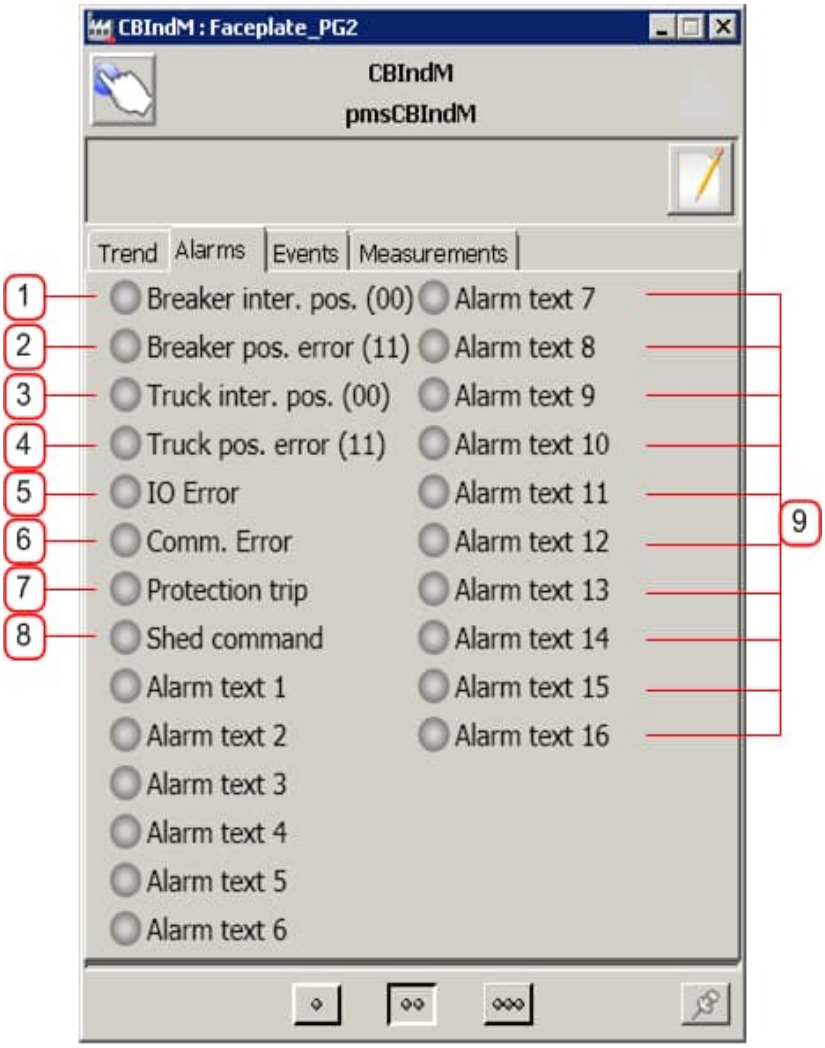


Figure 24 Faceplate tab Alarms for pmsCBIndM

The alarm for the intermediate position is enabled if the parameter *PosAlarmEnable* is set to True. An alarm delay can be configured via the parameter *PosAlarmTimer* for the allowed changeover time of the position signals.

Table 56 List of alarms and message configuration

Field	Indication	Alarm condition	Alarm message (Resource Id)
1	Intermediate position (00)	When neither the open nor the closed position feedbacks are received; the parameters *OI.Value* and *CI.Value* are false for more than a configurable time.	NLSID_CBPosError
2	Position error (11)	When both the open and closed position feedbacks are received; the parameters *OI.Value* and *CI.Value* are True.	NLSID_CBFault
3	Truck intermediate position (00)	When neither the service nor the test position feedbacks are received; the parameters *IOPar.SP.Value* and *IOPar.TP.Value* are False for more than a configurable time.	NLSID_CBTruckPosError
4	Truck position error (11)	When both the service and test position feedbacks are received; the parameters *IOPar.SP.Value* and *IOPar.TP.Value* are True.	NLSID_CBTruckPosFault
5	IO Error	The parameter *IOErr* is dedicated to receive any error indication from IO related to the circuit breaker. The alarm is activated when the parameter is True. The alarm is also activated when the position feedback signals are not reporting healthy status.	NLSID_IOError
6	Communication error	The parameter *ComErr* is dedicated to receive any error indication from communication links related to the circuit breaker. The alarm is activated when the parameter is True.	NLSID_ComError
7	Protection	The parameter *LO* is used for receiving the hardwired trip signal. The alarm is activated when the parameter is True.	NLSID_ProtectionTrip
8	Shed command	The parameter *Shed* is dedicated to receive a shed indication from a load shedding application. The alarm is activated when the parameter is True.	NLSID_ShedCmd
9	Alarm text 1 . . . Alarm text 16	*AlarmPar.UserDefAlm01stat.Signal* . . . *AlarmPar.UserDefAlm16stat.Signal*	*AlarmPar.UserDefAlm01stat.Message* . . . *AlarmPar.UserDefAlm16stat.Message*

3.2.6 Events

The control module supports standard and customized events:

- The standard events represent operational changes that are monitored by the internal logic of the control module.
- The customized events represent 16 free programmable status/event conditions that can be configured outside the control module.

The events are presented in the Event List. The purpose of the customized events is mainly for user defined on/off type of status signals.

Table 57 List of standard events and message configuration

No.	Indication	Event condition	Event message On
1	Opened	Position feedback opened.	NLSID_OpenPosition+ NLSID_EventOn (or NLSID_EventOff)
2	Closed	Position feedback closed.	NLSID_ClosePosition+ NLSID_EventOn (or NLSID_EventOff)
3	RackedOut	Position feedback racked-out (not in service).	NLSID_RackedOutOn (or NLSID_RackedOutOff)

3.3 Parameters

This chapter describes the parameters and configuration settings for the control module *pmsCBIndM*. In practice the *pmsCBIndM* is a simplified version of the *pmsCBStandardM* module therefore only the differences will be highlighted.

Table 58 Parameters of pmsCBIndM

	Name	Type	Initial value	Description
1	Name	string[30]	'pmsCBIndM'	IN EDIT: Name of the object
2	Description	string[40]	'pmsCBIndM'	IN EDIT: Description of the object
3	VoltageLevel	dint	1	IN EDIT: Voltage level for object colouring [1..10]
4	AlSeverity	dint	900	IN EDIT: Alarm severity
5	EvSeverity	dint	400	IN EDIT: Event severity
6	Class	dint	50	IN EDIT: Alarm and Event Class
7	CBType	dint	1	IN EDIT: [1=CB] [3=Disconnector, no SP] [4=CB, no SP]
8	FBConfig	dint	0	IN EDIT: [0=FB1,FB0] [1=FB1] [2=FB1,FB0,SP] [3=FB1,SP] [4=FB1,FB0,SP,TP] [5=FB1,SP,TP]
9	NormalMode	dint	3	IN EDIT: [1=Manual][2=Auto][3=Local][4=Remote]
10	OI	BoolIO	default	IN: Feedback open
11	CI	BoolIO	default	IN: Feedback closed

	Name	Type	Initial value	Description
12	SP	BoolIO	default	IN: Feedback service position
13	TP	BoolIO	default	IN: Feedback Test position [NOT USED]
14	LO	BoolIO	default	IN: Trip Input, Lockout
15	Shed	bool	default	IN: Load shed action by load shedding function
16	Meas_V	RealIO	default	IN: Measurement Voltage
17	Meas_F	RealIO	default	IN: Measurement Frequency
18	Meas_P	RealIO	default	IN: Measurement Power
19	Meas_Q	RealIO	default	IN: Measurement Reactive Power
20	En_Meas_PF_Calc	bool	false	IN EDIT: Enable PF calculated out of P, Q, PF: P / {sqrt[(P)^2 + (Q)^2]}
21	Meas_PF	RealIO	default	IN: Measurement Power factor
22	En_Meas_I_Calc	bool	false	IN EDIT: Enable I calculated out of P, PF, V: I = P / (PF x V x sqrt(3))
23	Meas_I	RealIO	default	IN: Measurement Current
24	IOErr	bool	default	IN: IO Error
25	ComErr	bool	default	IN: Communication Error
26	PosAlarmEnable	bool	true	IN: Enable alarm condition
27	PosAlarmTimer	time	5s	IN: Time setting for alarm condition
28	TruckPosAlarmEnable	bool	true	IN: Enable alarm condition
29	TruckPosAlarmTimer	time	5s	IN: Time setting for alarm condition
30	POS_OX	bool	default	OUT: Circuit Breaker position open checked
31	POS_CX	bool	default	OUT: Circuit Breaker position closed checked
32	EvPar	pmsCustom EvPar	default	IN_OUT: Circuit Breaker custom defined SOE events [NOT USED]
33	AlarmPar	pmsExtAll	default	IN: For Extended Alarm indication in Faceplate
34	EventPar	pmsExtEvt	default	IN: For Extended Event indication in Faceplate
35	MeasPar	pmsExtIO	default	IN: For Extended Measurements indication in Faceplate
36	DisEvtOpened	bool	false	IN: External disabling of event condition for CI
37	DisEvtClosed	bool	false	IN: External disabling of event condition for OI
38	DisEvtRackedOut	bool	false	IN: External disabling of event condition for RO

3.3.1 Parameter details

3.3.1.1 Position status

Table 59 Position feedbacks for pmsCBIndM

	Name	Type	Initial value	Description
1	OI	BoolIO	default	IN: Feedback open limit switch
2	CI	BoolIO	default	IN: Feedback close limit switch
3	SP	BoolIO	default	IN: Feedback service position limit switch
4	TP	BoolIO	default	IN: Feedback test position limit switch

These position feedbacks are normally connected to digital I/O signals. They shall be handled in the same manner as the relevant components found in the parameter IOPar of the *pmsCBStandardM* control module.

Example:

Global variable: IO (structured type) with component CB4301A (type pmsCBIndPar)

- OI : IO.CB4301A.OI
- CI : IO.CB4301A.CI
- SP : IO.CB4301A.SP
- TP : IO.CB4301A.TP

3.3.1.2 Measurements

Table 60 Measurement connections

	Name	Type	Initial value	Description
5	Meas_V	RealIO	default	IN: Measurement Voltage
6	Meas_F	RealIO	default	IN: Measurement Frequency
7	Meas_P	RealIO	default	IN: Measurement Power
9	Meas_Q	RealIO	default	IN: Measurement Reactive Power
10	Meas_PF	RealIO	default	IN: Measurement Power factor
11	Meas_I	RealIO	default	IN: Measurement Current

These input measurements are typically connected to analogue I/O signals. They shall be handled in the same manner as the relevant components found in the parameter *IOPar.MeaInput* of the *pmsCBStandardM* control module

Example:

Global variable: IO (structured type) with component CB4301A (type pmsCBIndPar)

Meas_V : IO.CB4301A.Meas_V

Meas_F : IO.CB4301A.Meas_F

Meas_P : IO.CB4301A.Meas_P

Meas_Q : IO.CB4301A.Meas_Q

Meas_PF : IO.CB4301A.Meas_PF

Meas_I : IO.CB4301A.Meas_I

3.3.1.3 Error parameters

Table 61 Error signals

	Name	Type	Initial value	Description
12	LO	BoolIO	default	IN: Trip Input, Lockout
13	Shed	bool	default	IN: Load shed action by load shedding function
14	IOErr	bool	default	IN: IO Error
15	ComErr	bool	default	IN: Communication Error

Example:

Global variable: IO (structured type) with component CB4301A (type *pmsCBIndPar*).

The parameter *Shed* should be connected to a Load Shedding function.

e.g.

Shed : IO.CB4301A.Shed

The parameter *IOErr* should be a summation of the signal errors applicable for the circuit breaker.

e.g.

IO.CB4301A.IOErr := IO.CB4301A. Meas_F.Status ≠ 16#C0 or

IO.CB4301A. Meas_P.Status ≠ 16#C0 or

IO.CB4301A.Meas_V.Status ≠ 16#C0;

The *CommErr* can be used to monitor the MMS communication status and/or serial link communication status to protection relays.

e.g.

CommErr : IO.CB4301A. CommErr

3.3.1.4 Status

Table 62 Status (output)

	Name	Type	Initial value	Description
16	POS_OX	bool	default	OUT: Circuit breaker pos open checked
17	POS_CX	bool	default	OUT: Circuit breaker pos closed checked

These outputs indicate the confirmed open or closed position of the circuit breaker for use by other control modules or programs. They shall be handled in the same manner as the parameters *Status.OX* and *Status.CX* of the *pmsCBStandardM* control module.

Example:

Global variable: IO (structured type) with component CB4301A (type pmsCBIndPar)

POS_CX : IO.CB4301A.POS_CX

POS_OX : IO.CB4301A.POS_OX

Section 4 Control Module pmsCBSyncM

The *pmsCBSyncM* control module is included in the *pmsCBLib* library. A block presentation of the control module is shown in Figure 25. The parameters are briefly described in Table 63.

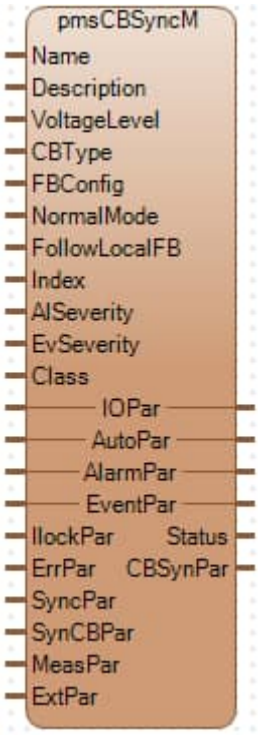


Figure 25 Control module pmsCBSyncM

Table 63 Control module pmsCBSyncM parameters

Parameter	Significance
Name	Name of the circuit breaker. With the name upload tool of process portal, this property will be used to identify the object in 800xA. The name will be used to group the alarms and events and for identifying the faceplate of the object. The name must be unique in the project.
Description	Description of the circuit breaker. With the name upload tool of process portal, this property will be used for identifying the object in 800xA.
Voltage level	Voltage level for object colouring. This property gives the object a colour in Single Line Diagrams. Default settings for the colours are: Level 1 - RGB N(0,176,232) - D(0,126,182) - L(50,226,255) Level 2 - RGB N(232,160,168) - D(182,110,118) - L(255,210,218) Level 3 - RGB N(176,232,176) - D(126,182,126) - L(226,255,226) Level 4 - RGB N(255,255,128) - D(205,205,78) - L(255,255,178) Level 5 - RGB N(64,128,128) - D(14,78,78) - L(114,178,178) Level 6 - RGB N(198,101,0) - D(140,70,0) - L(255,154,53) Level 7 - RGB N(240,160,13) - D(182,121,10) - L(249,209,136) Level 8 - RGB N(207,204,73) - D(153,150,40) - L(227,225,149) Level 9 - RGB N(81,181,171) - D(53,125,120) - L(174,221,217) Level10- RGB N(185,157,91) - D(135,112,58) - L(223,210,181)

Parameter	Significance
CBType	The parameter is used for configuring the graphical presentation of the circuit breaker; ‘1’= circuit breaker, ‘2’= circuit breaker synch, ‘11’= circuit breaker with earthing, ‘12’= circuit breaker synch. with earthing.
FBConfig	Configuration parameter for the position status signals that are applicable for the circuit breaker; ‘0’= Open and Closed positions, ‘1’= Closed position, ‘2’= Open, Closed and Service position, ‘3’= Closed and Service position, ‘4’= Open, Closed and Service position and Test position, ‘5’= Closed and Service position and Test position.
NormalMode	The parameter is used for configuring the graphical presentation of the normal mode; ‘1’= Manual, ‘2’= Auto, ‘3’= Local.
FollowLocalFB	Configuration parameter for the circuit breaker when in local point of control ‘False’= Cmd0\Cmd1Level output is reset in local, ‘True’ = Cmd0\Cmd1Level follows FB in local.
Index	The index shall be unique for each circuit breaker in the synchronization function. This parameter shall identify the breaker to the Synchronization module (pmsSNSyncSuperv) from the pmsSNLib library.
AISeverity	Alarm severity. The alarm severity can be used for filtering the alarm list. Range 1-1000.
EvSeverity	Event severity. The event severity can be used for filtering the event list. Range 1-1000.
Class	Alarm and Event Class. This property can be used for grouping objects to appear in separate alarm/event lists. Range 1-9999.
IOPar	Input/Output signals. This parameter is used for connecting the I/O signals to the object. This parameter is a structured data type.
AutoPar	Structured parameter for connecting auto open/close commands to the circuit breaker.
AlarmPar	Structured parameter for 16 user defined alarms.
EventPar	Structured parameter for 16 user defined events.
IlockPar	Structured parameter for and configuring interlock signals.
ErrPar	Structured parameter for error signals to the circuit breaker.
SyncPar	Configuration settings for the network determination.
SynCBPar	Structured parameter for receiving data from the Synchronization module.
MeasPar	Structured parameter for 16 user defined analogue measurements.
ExtPar	External parameters for application interaction. With this parameter it is possible to disable standard alarms and to disable the mode command buttons of the faceplate.
Status	Status indication for the checked closed/open position and the manual/auto mode of the breaker.
CBSynPar	Structured parameter for sending data to the Synchronization module.

4.1 Introduction

The control module type pmsCBSyncM is used for the control and supervision of circuit breakers involved in a synchronization scheme. The following features are supported:

- **Measurements**

Two kinds of mesurements are featured, standard and customized:

  - Standard measurements: Important electrical available for monitoring in the main faceplate tab:
    - Voltage
    - Frequency
    - Active power
    - Reactive power
    - Power factor
    - Current
  - Customized measurements: Additionally, up to 16 customized measurements can be displayed numerically in another faceplate tab

- **Position status**

The following feedback signals facilitates supervision of circuit breaker position status:

  - Open indication
  - Closed indication
  - Service position
  - Test position
  - Earthed position

- **Graphical Standard - IEC, ANSI**

The graphical element can be configured to follow either the IEC or ANSI graphical standard.

- **Outputs**

Open and close commands can be issued as pulsed or as steady outputs:

  - Open command (level)
  - Open command (edge)
  - Close command (level)
  - Close command (edge)

The pulsed outputs remain high for a configurable time period. The steady outputs remain active until the opposite command is initiated. The control module checks for discrepancies between output commands and position status. The conflicts are generating alarms after a configurable timeout setting.

- **Interlocking**

The circuit breaker can be interlocked for operation by conditions received from supervisory programs or other objects. Five interlocks are available; one A-interlock (which can be overridden) and four B-interlocks.

- **Point of Control (PoC)**

The circuit breaker can be controlled from two locations:

  - Remote point of control: PMS-level of control via ABB's graphical aspects.
  - Local point of control: equipment-level of control via vendor's local panel.

- **Control modes**

Different control modes affect the operability:

  - Maintenance mode: No operation commands are allowed.
  - Simulation mode: The operation commands are simulated.
  - Auto mode: Operation commands are controlled by application logic.
  - Manual mode: Operation commands are issued via the faceplate.

- **Operation commands**

Following operations are available to the operator via the circuit breaker faceplate:

  - Change of control modes
  - Open/Close commands
  - Initiate synchronization
  - Override interlock

- **Operations counter**

A counter is provided to calculate how many times the circuit breaker is operated. It only counts when the circuit breaker is opened and it does not count when the maintenance or simulation mode are activated.

- **Alarms**

Alarms are divided in two categories:

  - Standard alarms: Default alarms informing the operator of alarm conditions, according to the internal logic of the control module.
  - Customized alarms: Up to 16 customized alarms can be raised through the control module although they originate from external logic.

- **Events**

  - Events are divided in two categories:
  - Standard events: Default events informing the operator of operational status changes according to internal logic of the control module.
  - Customized events: Up to 16 customized events informing the operator of status/events programmed outside the control module logic.

4.2 Detailed Engineering

The control module *pmsCBSyncM* includes the same functionality implemented in the *pmsCBStandardM* module. In addition, the *pmsCBSyncM* module supports the synchronization function.

The features related to the synchronization function are described in a separate document “User Manual, Synchronization”, 3BNP100234-0338.

Section 5 Capacity & Performance

Table 64 Firmware version downloaded on the utilized 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)

5.1 Heap Utilization

5.1.1 pmsCBStandardM

Table 65 Heap utilization of pmsCBStandardM

	First instance	2nd and following instances
Heap utilization(MB) in PM866	0.185	0.123
Heap utilization(MB) in PM891	0.187	0.125

5.1.2 pmsCBIndM

Table 66 Heap utilization of pmsCBIndM

	First instance	2nd and following instances
Heap utilization(MB) in PM866	0.159	0.113
Heap utilization(MB) in PM891	0.16	0.113

5.1.3 pmsCBSyncM

Table 67 Heap utilization of pmsCBSyncM

	First instance	2nd and following instances
Heap utilization(MB) in PM866	0.188	0.125
Heap utilization(MB) in PM891	0.19	0.124

5.2 Execution Time

5.2.1 pmsCBStandardM

Table 68 Execution time of pmsCBStandardM

Execution time (ms)	Notes
0.6 ms	For one instance in PM866
0.4 ms	For one instance in PM891

5.2.2 pmsCBIndM

Table 69 Execution time of pmsCBIndM

Execution time (ms)	Notes
0.3 ms	For one instance in PM866
0.25 ms	For one instance in PM891

5.2.3 pmsCBSyncM

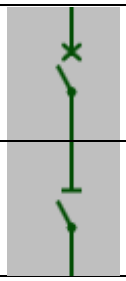
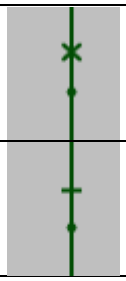
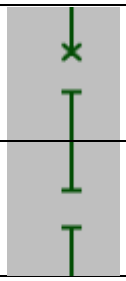
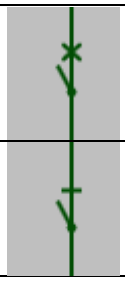
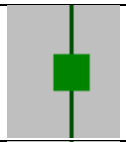
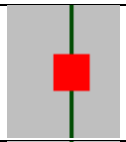
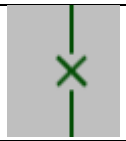
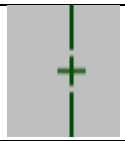
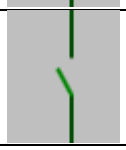
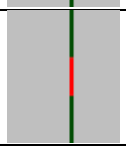
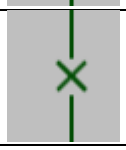
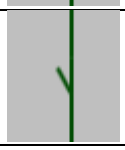
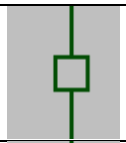
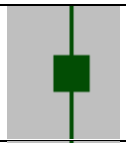
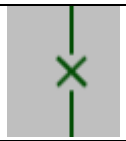
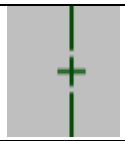
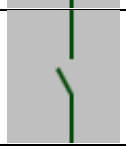
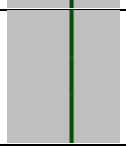
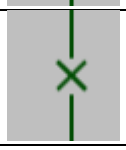
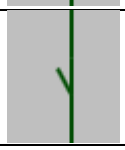
Table 70 Execution time of pmsCBSyncM

Execution time (ms)	Notes
0.7 ms	For one instance in PM866
0.44 ms	For one instance in PM891

Appendix A Appendix1

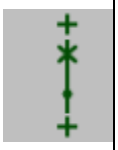
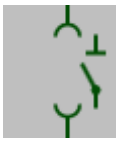
A.1 Breaker Open/Closed indications

Table 71 Breaker open/closed indications

	Open	Closed	Inter-mediate	Faulty
IOPar.OI.Value	True	False	False	True
IOPar.CI.Value	False	True	False	True
IEC				
CBType = 1 or 11Circuit Breaker				
CBType = 3 or 13 Disconnector				
ANSI cAnsi_FillColouring = 0				
CBType = 1 or 11 Circuit Breaker				
CBType = 3 or 13 Disconnector				
ANSI cAnsi_FillColouring = 1				
CBType = 1 or 11 Circuit Breaker				
CBType = 3 or 13 Disconnector				

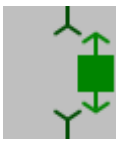
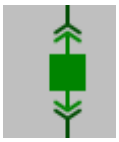
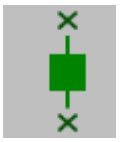
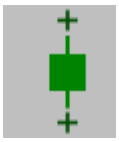
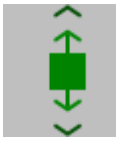
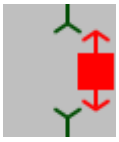
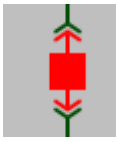
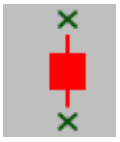
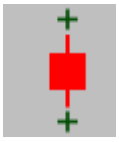
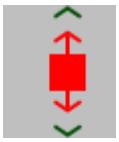
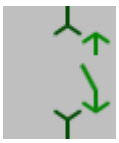
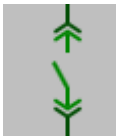
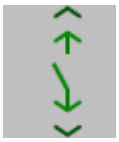
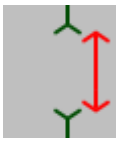
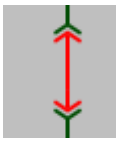
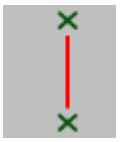
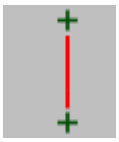
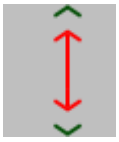
A.3 Truck Position Indications

Table 72 Truck position indications, IEC

IEC					
	Racked Out	**Racked In**	**Inter-mediate**	**Faulty**	
IOPar.SP.Value	False	True	False	True	
IOPar.TP.Value	True	False	False	True	
cBreaker_RackoutConfig = 0					Circuit Breaker Open
cBreaker_RackoutConfig = 1					
cBreaker_RackoutConfig = 0					Circuit Breaker Closed
cBreaker_RackoutConfig = 1					
cBreaker_RackoutConfig = 0					Isolator Open
cBreaker_RackoutConfig = 1					
cBreaker_RackoutConfig = 0					Isolator Closed
cBreaker_RackoutConfig = 1					

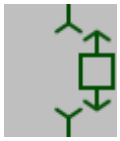
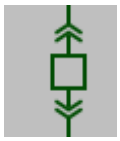
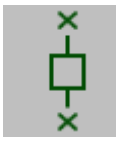
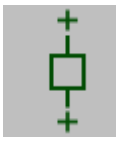
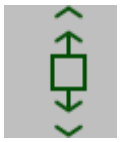
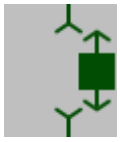
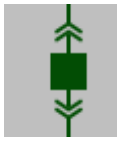
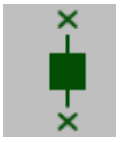
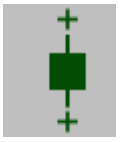
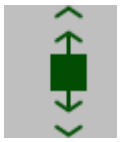
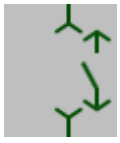
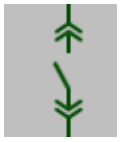
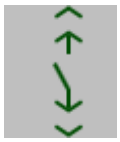
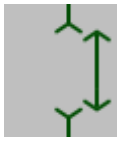
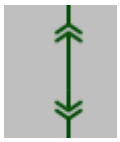
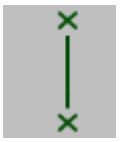
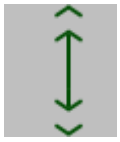
A.4 Truck Position Indications

Table 73 Truck position indications, ANSI

ANSI cBreaker_ANSI_FillColouring = 0					
	Racked Out	**Racked In**	**Inter-mediate**	**Faulty**	
IOPar.SP.Value	False	True	False	True	
IOPar.TP.Value	True	False	False	True	
cBreaker_RackoutConfig = 0					Circuit Breaker Open
cBreaker_RackoutConfig = 1					
cBreaker_RackoutConfig = 0					Circuit Breaker Closed
cBreaker_RackoutConfig = 1					
cBreaker_RackoutConfig = 0					Isolator Open
cBreaker_RackoutConfig = 1					
cBreaker_RackoutConfig = 0					Isolator Closed
cBreaker_RackoutConfig = 1					

A.5 Truck Position Indications

Table 74 Truck position indications, ANSI

ANSI cBreaker_ANSI_FillColouring = 1					
	Racked Out	**Racked In**	**Inter-mediate**	**Faulty**	
IOPar.SP.Value	False	True	False	True	
IOPar.TP.Value	True	False	False	True	
cBreaker_RackoutConfig = 0					Circuit Breaker Open
cBreaker_RackoutConfig = 1					
cBreaker_RackoutConfig = 0					Circuit Breaker Closed
cBreaker_RackoutConfig = 1					
cBreaker_RackoutConfig = 0					Isolator Open
cBreaker_RackoutConfig = 1					
cBreaker_RackoutConfig = 0					Isolator Closed
cBreaker_RackoutConfig = 1					

Appendix A Revision table

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

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