APPLICATION NOTE

New Structure of CB Monitoring in SIPROTEC 5

APN-095, Edition 2

SIEMENS

SIPROTEC 5 Application

New Structure of CB Monitoring in SIPROTEC 5

APN-095, Edition 2

Content

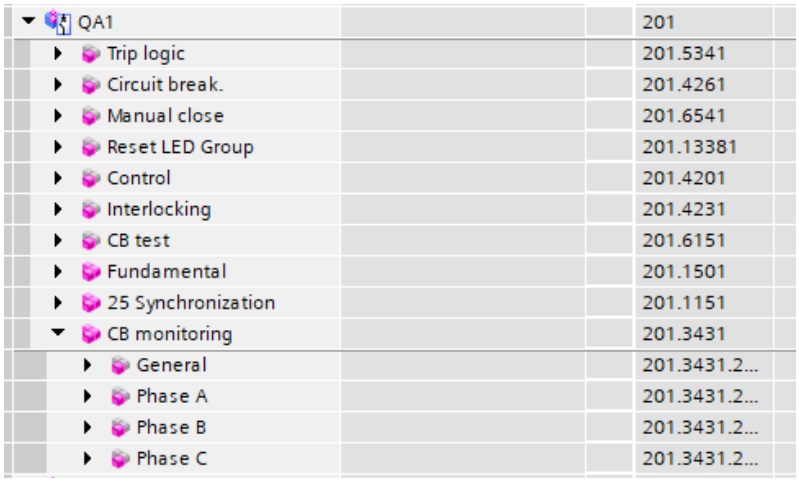
1 New structure of CB monitoring

1.1 Introduction

Starting in SIPROTEC 5 Version V9.30, the circuit breaker monitoring functionality is innovated. Due to adaptations in IEC 61850 standard, the modeling of the circuit breaker monitoring has changed. In the realization in SIPROTEC 5, it means that a new Function (FN) for the CB monitoring was created. This application note explains the new approach and the differences to the old approach. In Edition 2 of this application note, the new functionalities are explained which have been added until V9.80.

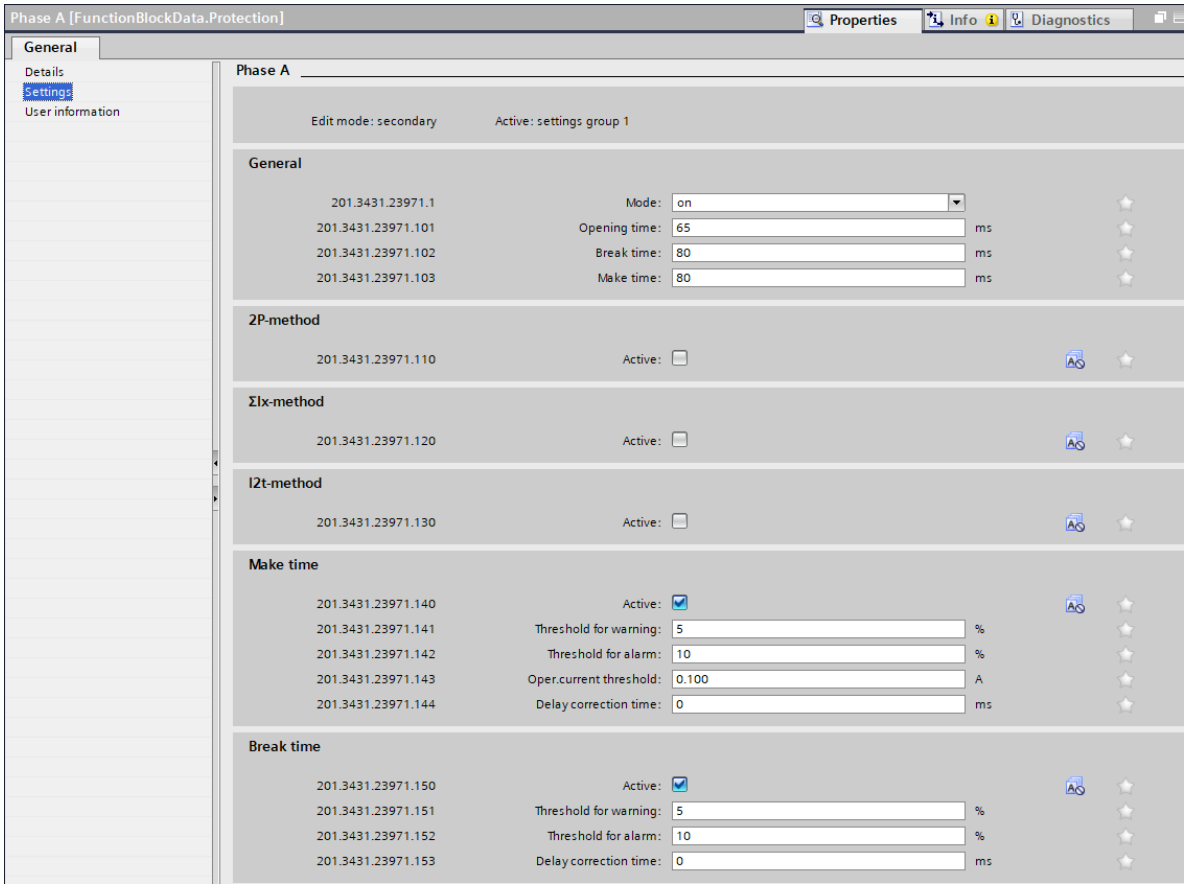
1.2 Structure of CB Monitoring from V9.30 on

The structure of the SIPROTEC 5 CB Monitoring is re-organized into the 3 Phases, according to definition in the IEC 61850-7-4 (LN SCBR). This can be seen in the representation if the FN is instantiated:

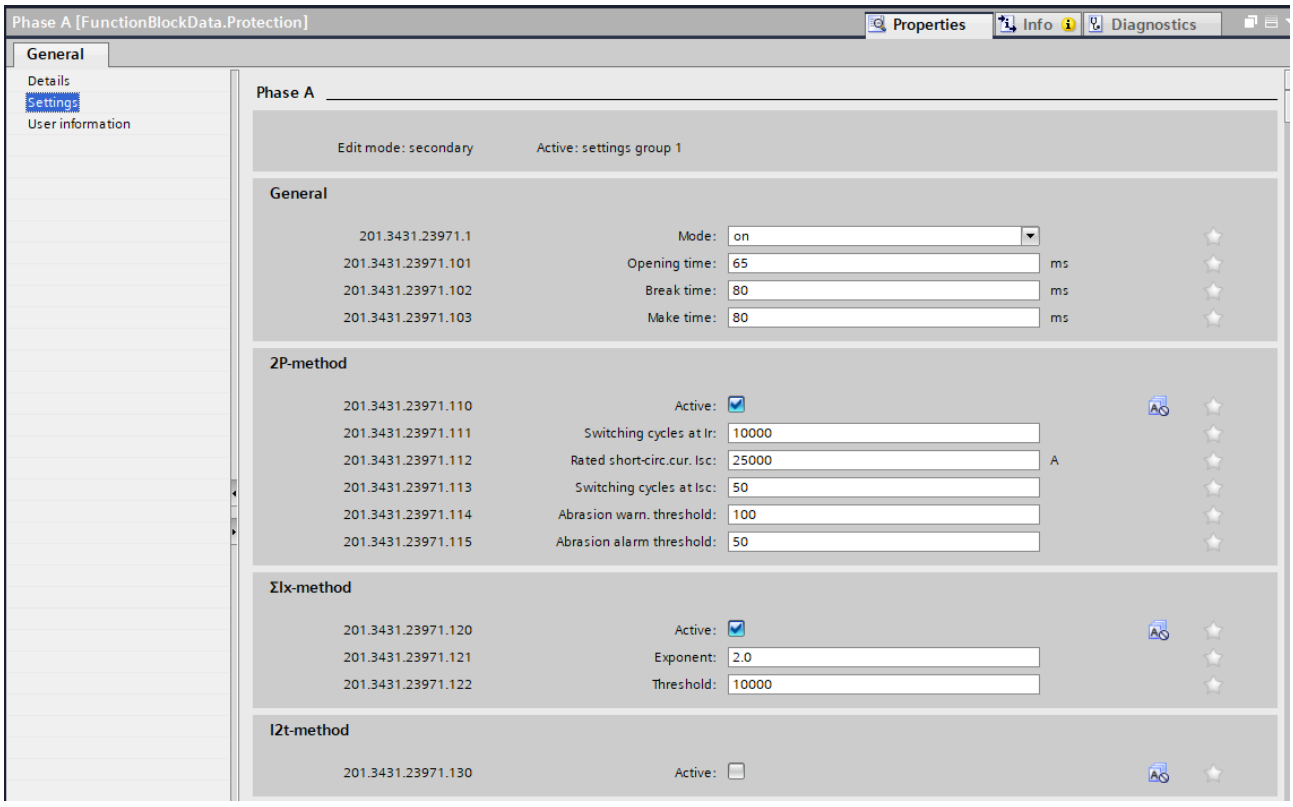


The functionality of CB Monitoring is now visible and configurable as settings of the Stages of the FB “CB monitoring”:

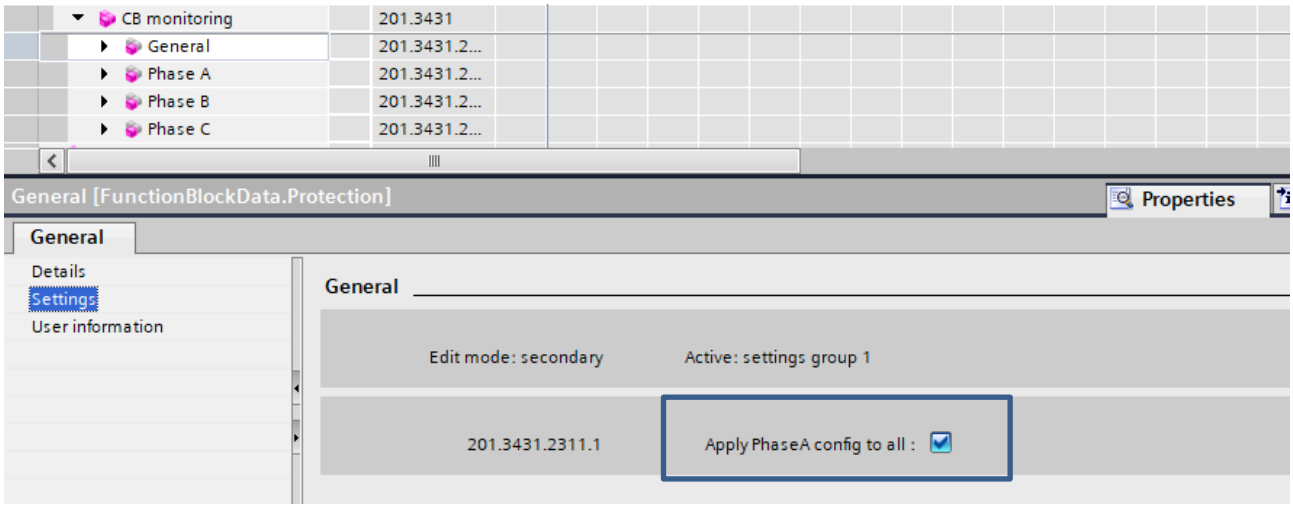
New structure of CB monitoring



The individual functionality like 2P method, I2t method etc can be activated, then DIGSI shows all available settings to configure the functionality. For more details on available functions, see chapter 1.4.



The settings can be individually set for each phase; if this is not required, then the settings of all three phases can be synchronized by the respective setting in the stage “General”:



The new functionality (break time since V9.30) is added only in the new FB “CB monitoring”, not in the old “CB wear monitoring”. This will be valid also for future extensions of the CB monitoring functionality.

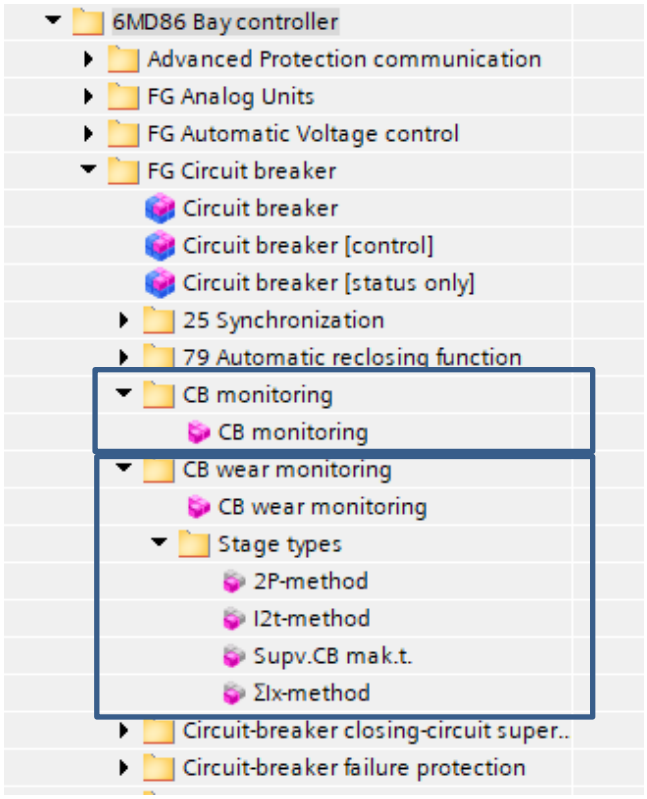
1.3 Handling of the two versions of CB Monitoring

The old and the new Function (FN) Circuit Breaker Monitoring have different names to be able to distinguish:

New FB: CB monitoring

Old FB: CB wear monitoring

Both FBs are available in the DIGSI 5 library if you have installed Device Drivers <= V9.20 and >= V9.30. However in new created devices (configuration version >=V9.30), only the new FB can be instantiated. In legacy devices (configuration version <= V9.20), only the old FB can be instantiated. In the DIGSI 5 library, both versions are contained (if respective DDDs are installed).



New FB (>=V9.30)

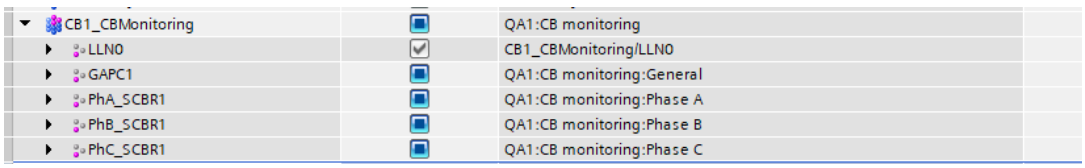
Old FB (<=V9.20)

The reason for keeping the old FB is to be able to upgrade devices from <= V9.20 to >= V9.30 (this will keep the old FB in the upgraded device).

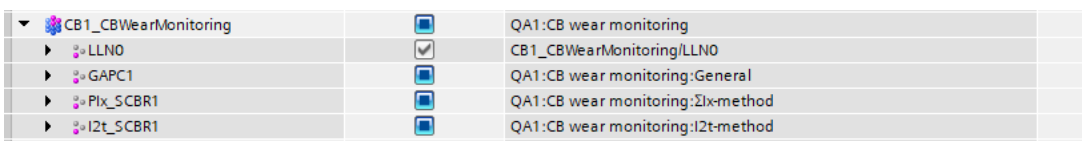
Note: If you upgrade a device from <= V9.20 to >=V9.30, and afterwards create a new Circuit Breaker in the device, you have the choice to either use the old FB or the new FB (recommended is the use of the new FB).

The difference of the two FBs can also be clearly seen in the IEC61850 modeling:

New FB:



Old FB:

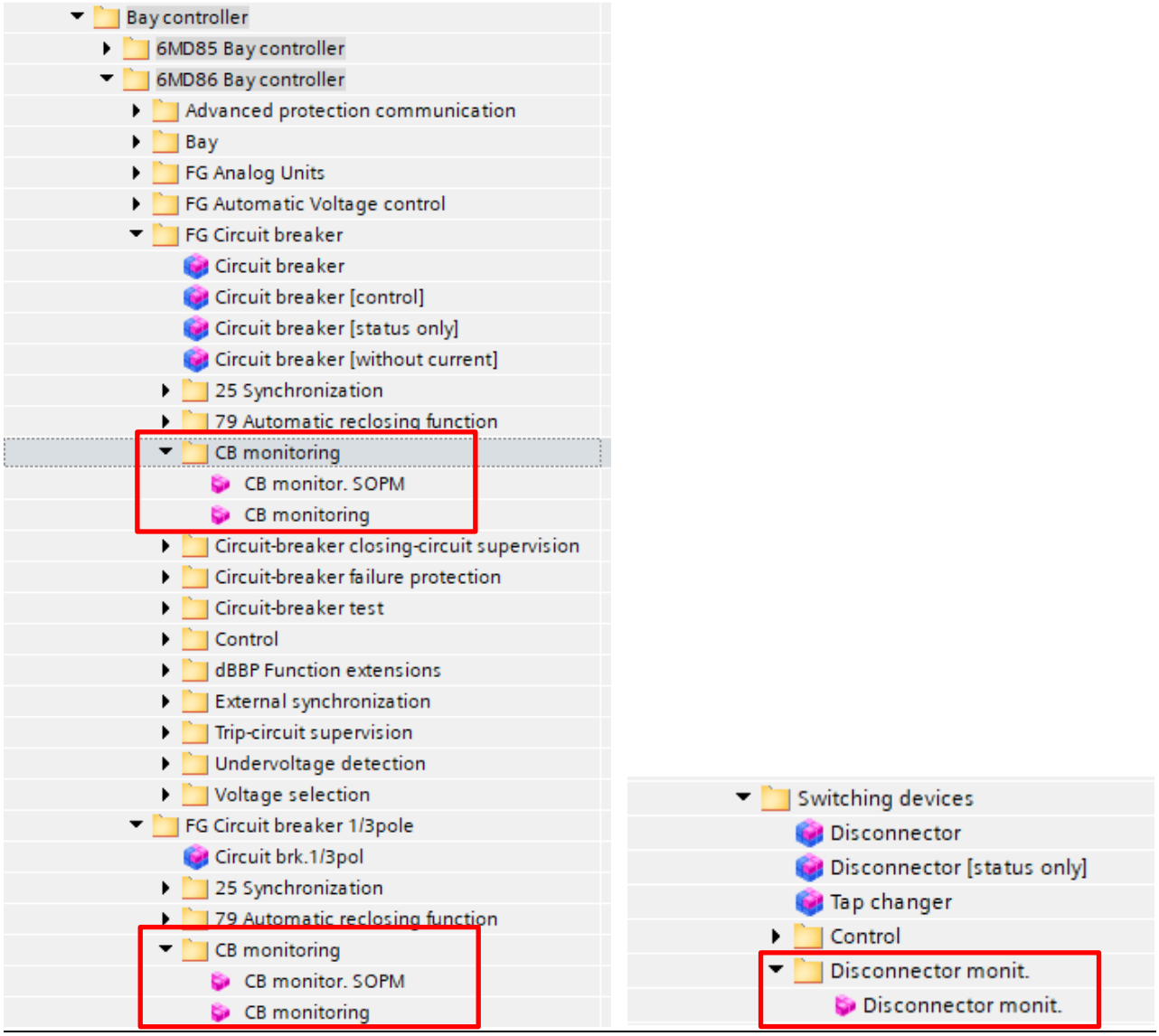


1.4 Description of the Primary Monitoring Functionalities

In this application note update (Edition 2), the functionality of the Primary Monitoring Functionality is summarized for version SIPROTEC 5 V9.80. Only the new Function Block “CB Monitoring” (>=V9.30) is described.

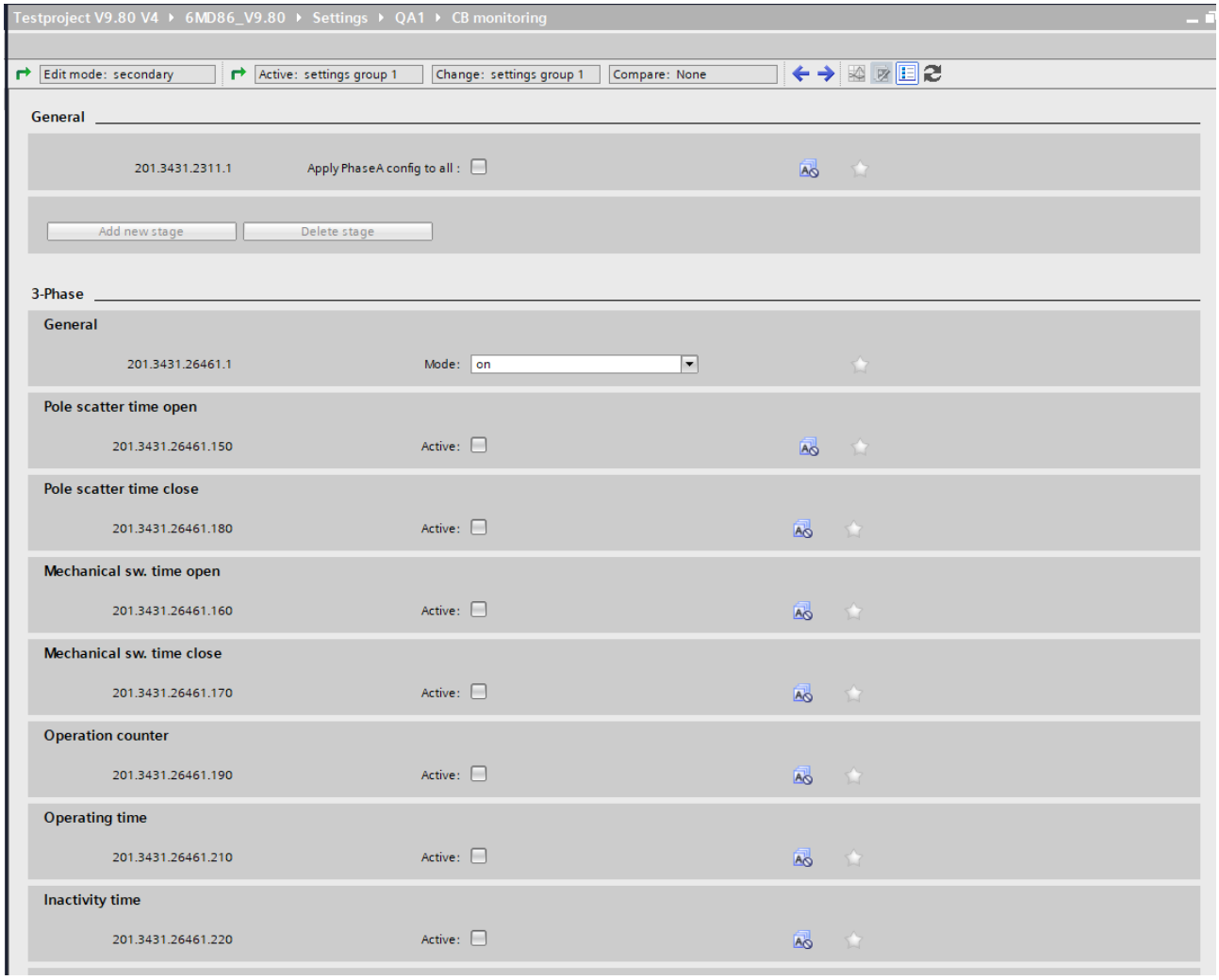
How to configure Primary Monitoring Functionalities

To configure the monitoring, drag and drop the function block “CB monitoring” or “Disconnector Monitoring” from the DIGSI library into the Function Group “Circuit Breaker” or “Disconnector” which you would like to monitor. In the FG circuit breaker, additionally the FB “CB monitoring SOPM” is available, where SOPM stands for Supervision of Operating Mechanism. (Logical Node Name from IEC61850). For the Circuit Breaker 1/3pole, additionally the function “Pole discrepancy” is available.

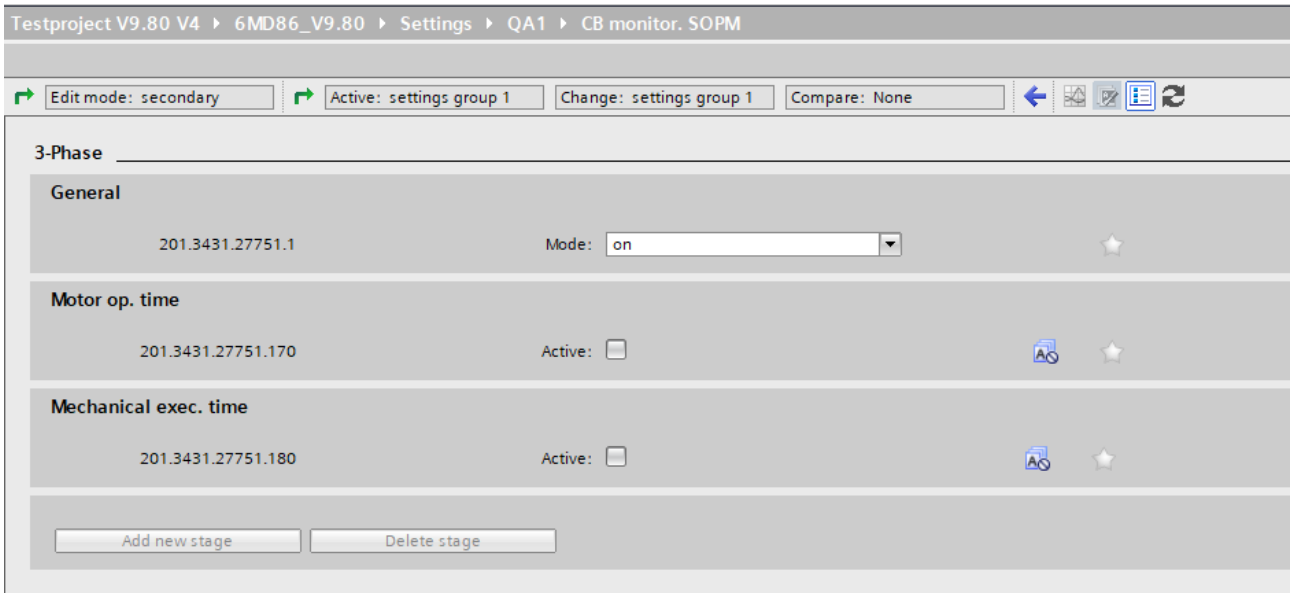


In the device settings, you are then able to select the offered monitoring functions in this function block.

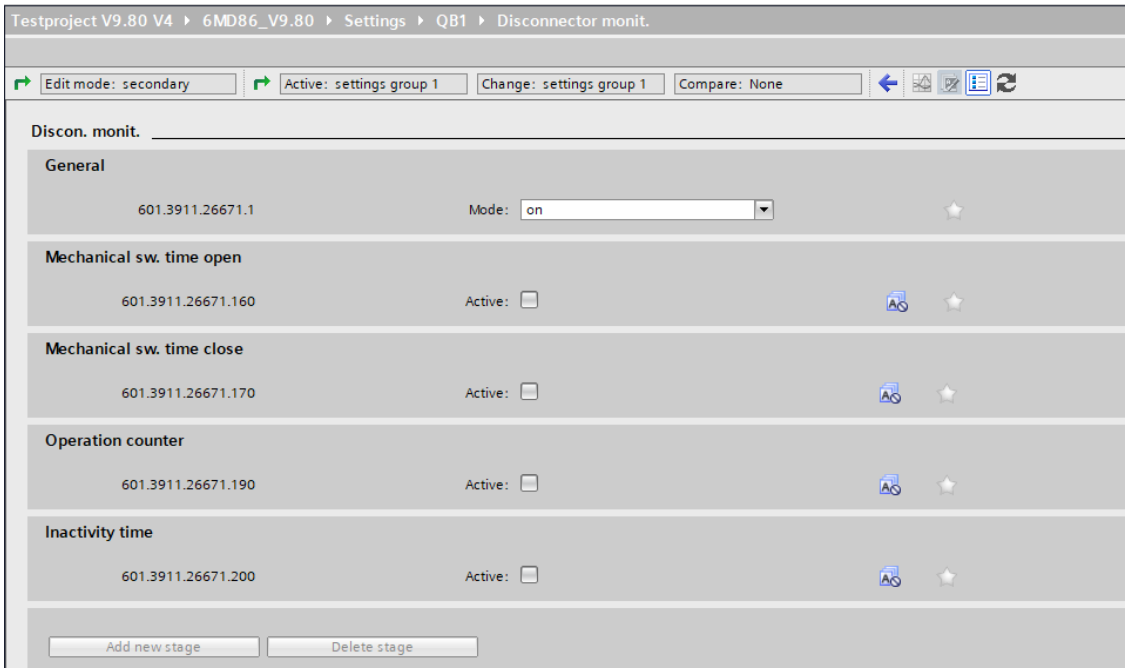
New structure of CB monitoring



Offered functionalities in FB “CB monitoring” (V9.80)



Offered functionalities in FB “CB monitoring SOPM” (V9.80)



Offered functionalities in FB “Disconnector monitoring”

The instantiation of the function blocks costs function points (FP): Per Circuit Breaker 10 FPs (independent if one or both FBs are used), per Disconnector 5 FPs. “Pole Discrepancy” costs another 5 FPs per circuit breaker.

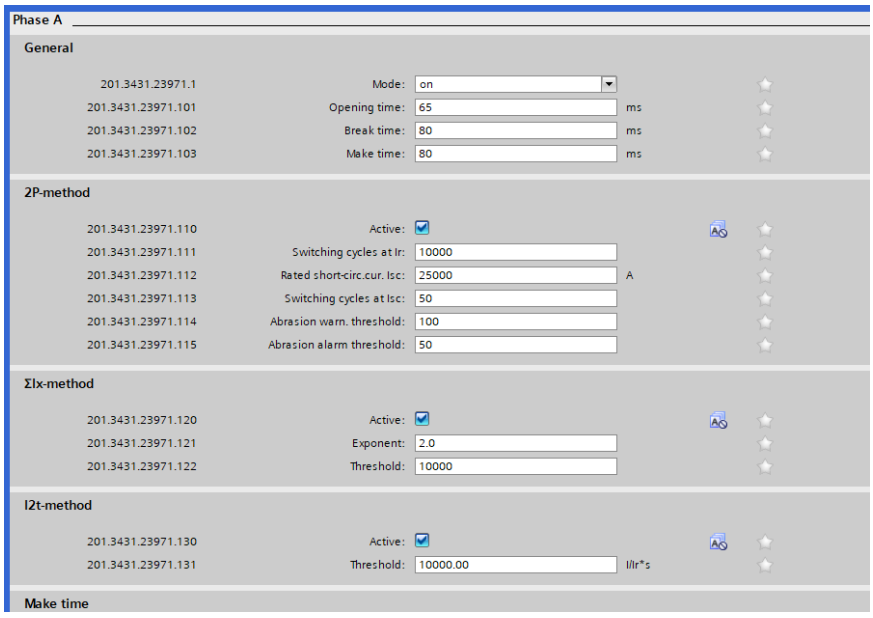
Categories of Monitoring Functions

A. Current flow based monitoring

These functions measure the current through the circuit breaker and derive the monitoring measurements from it. The following current-flow based monitoring functions are available:

A1. Circuit Breaker Wear Monitoring: 2P, ∑Ix, and I2t-Method

These functionalities have to be activated per phase in the settings (automatic copy of setting of Phase A to other phases is possible).

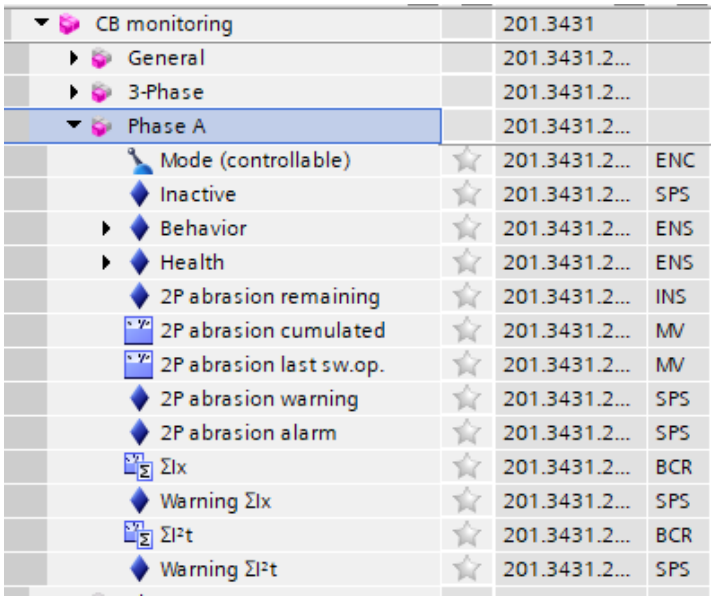


2P-Method: Calculation of remaining switching cycles

∑Ix-Method: Sum of Trip Currents per pole

I2t-Method: Sum of (Trip Currents)^2 per pole

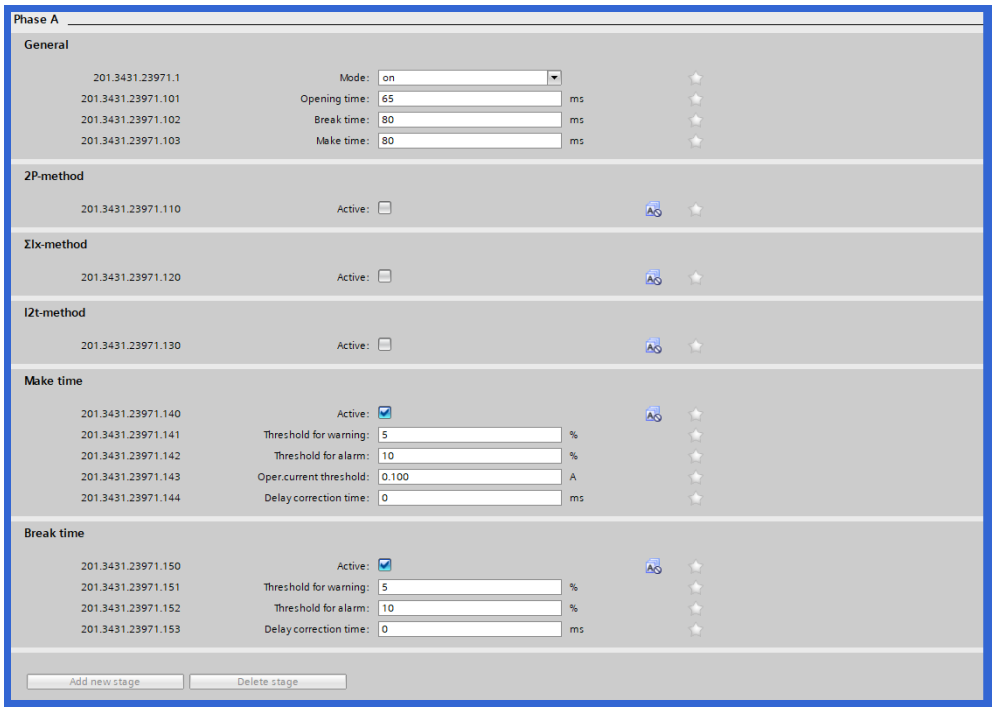
The calculated values and the respective warnings and alarms are then available in the information routing matrix.



For detailed description of the calculation methods and principles, please refer to the device manual.

A2. Electrical Make Time / Break Time

These functionalities also have to be activated per phase.



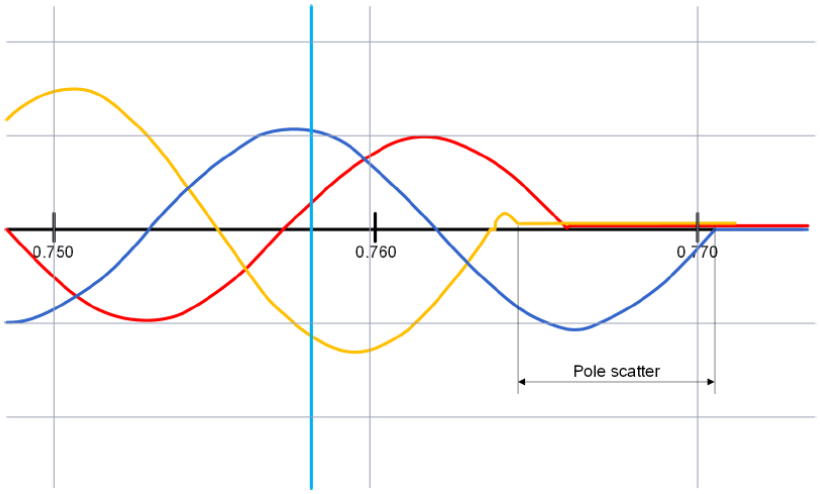
The calculated times for CB close (make time) and CB open (Break time) per phase are then visible in the information routing matrix:

CB monitoring	201.3431	
General	201.3431.2...	
3-Phase	201.3431.2...	
Phase A	201.3431.2...	
Mode (controllable)	201.3431.2...	ENC
Inactive	201.3431.2...	SPS
Behavior	201.3431.2...	ENS
Health	201.3431.2...	ENS
Make time	201.3431.2...	MV
Make-time warning	201.3431.2...	SPS
Make-time alarm	201.3431.2...	SPS
Break time	201.3431.2...	MV
Break-time warning	201.3431.2...	SPS
Break-time alarm	201.3431.2...	SPS

For further description of the calculation principle and the inputs of this function, please see the device manual.

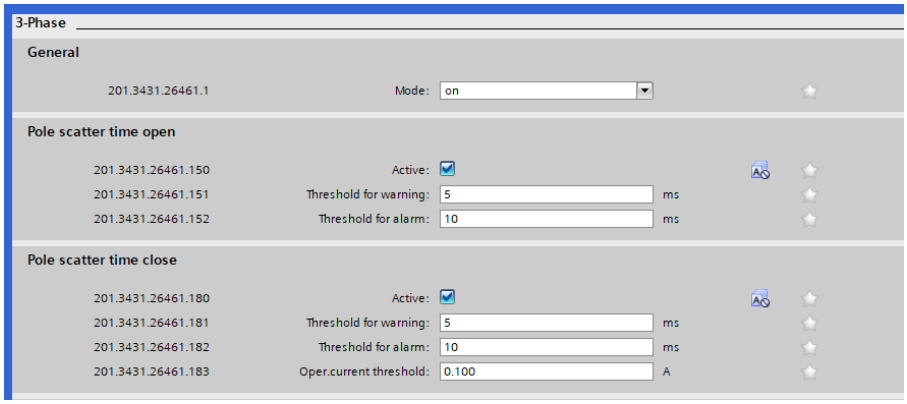
A3. Pole Scatter Open / Pole Scatter Close time monitoring

The time between the extinction of the current of the first phase until the extinction of the last phase current when opening the circuit breaker is the pole scatter open time. A greater time difference can lead to conclusions on the circuit-breaker abrasion. See following picture.

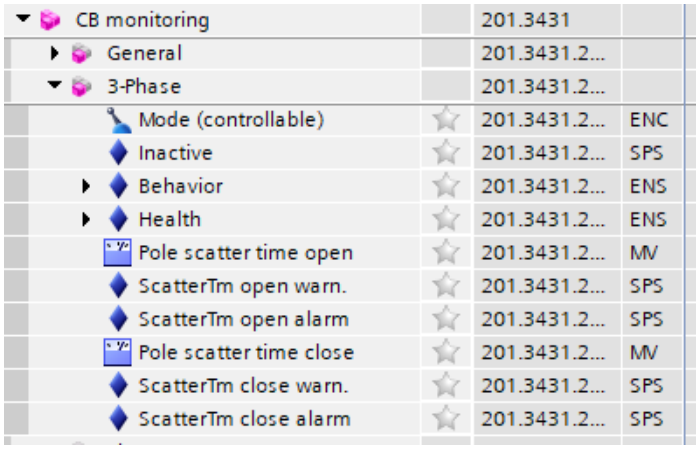


The time between reaching the operational threshold of the current of the first phase until reaching the operational threshold of the current of the last phase when closing the circuit breaker is the pole scatter close time. A greater time difference can lead to conclusions on the circuit-breaker abrasion.

The pole scatter monitoring is activated in the “3-Phase” section of the CB monitoring settings.



Also in this case, the resulting calculated values and the alarms appear in the information routing matrix.

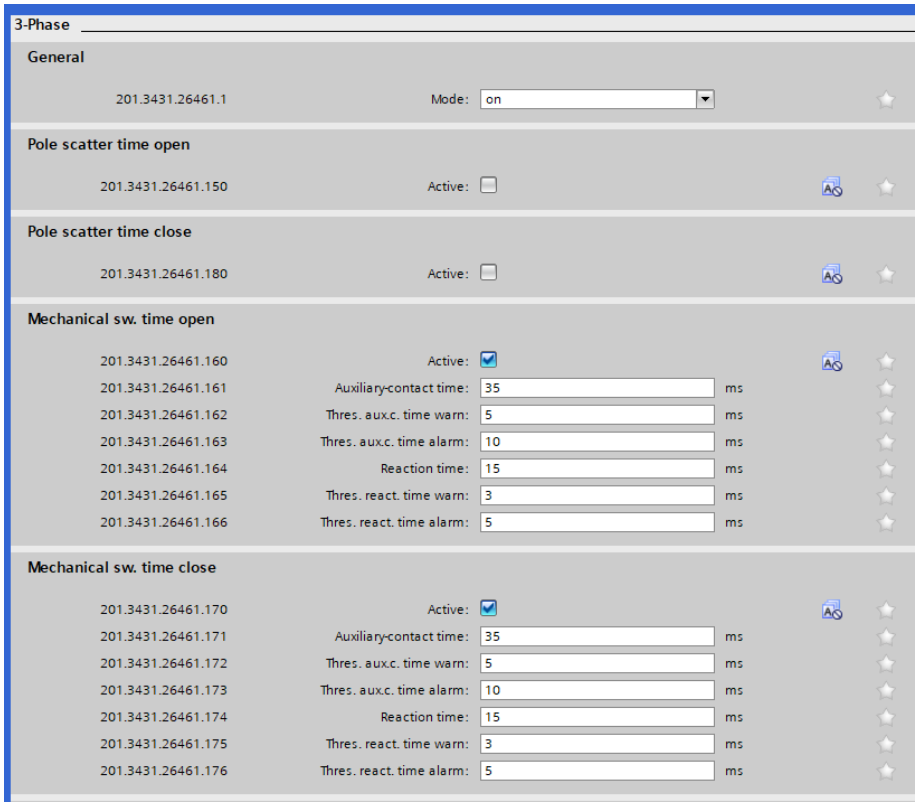


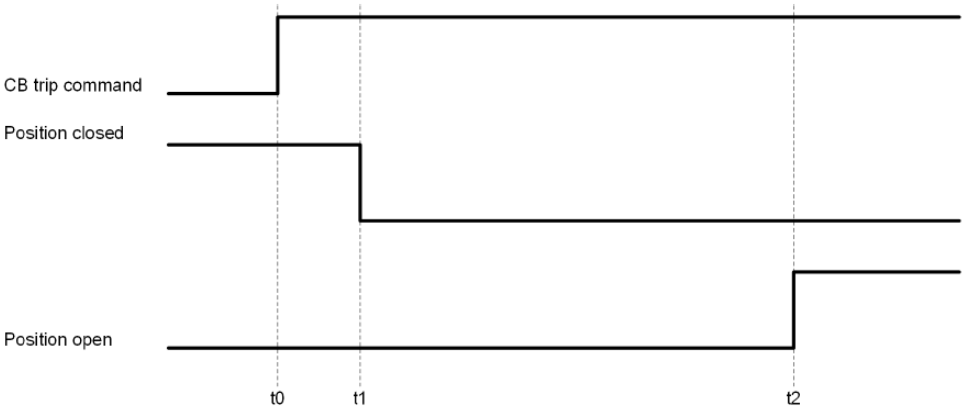
B. Auxiliary Contact based monitoring

These monitoring functions base on the supervision of the auxiliary contacts of the breaker.

B1. Mechanical Open/Close Time

This functionality calculates the circuit breaker switch time based on changes of the auxiliary contacts. It is activated in the "3-Phase" section of the CB monitoring settings.

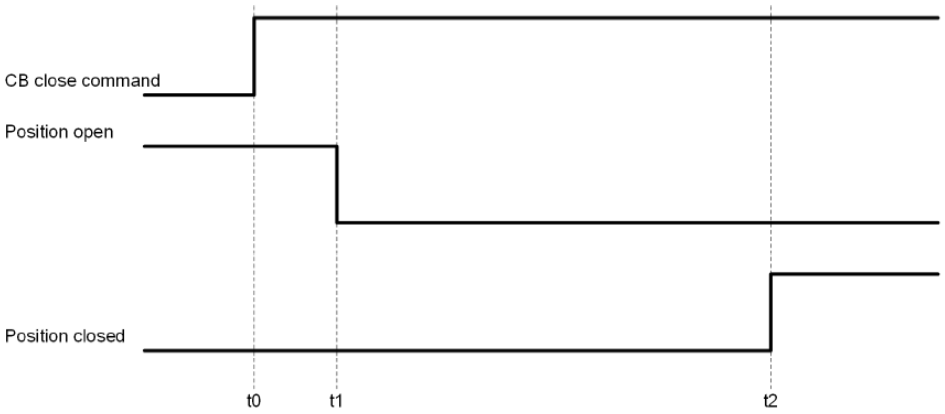




[dw_charact_cb-breaktime, 1, en_US]

t2 - t0: Auxiliary-contact time opening
t1 - t0: Response time opening
t2 - t1: Auxiliary-contact moving time opening

Principle of mechanical open time calculation



[dw_charact_cb-maketime, 1, en_US]

t2 - t0: Auxiliary-contact time closing
t1 - t0: Response time closing
t2 - t1: Auxiliary-contact moving time closing

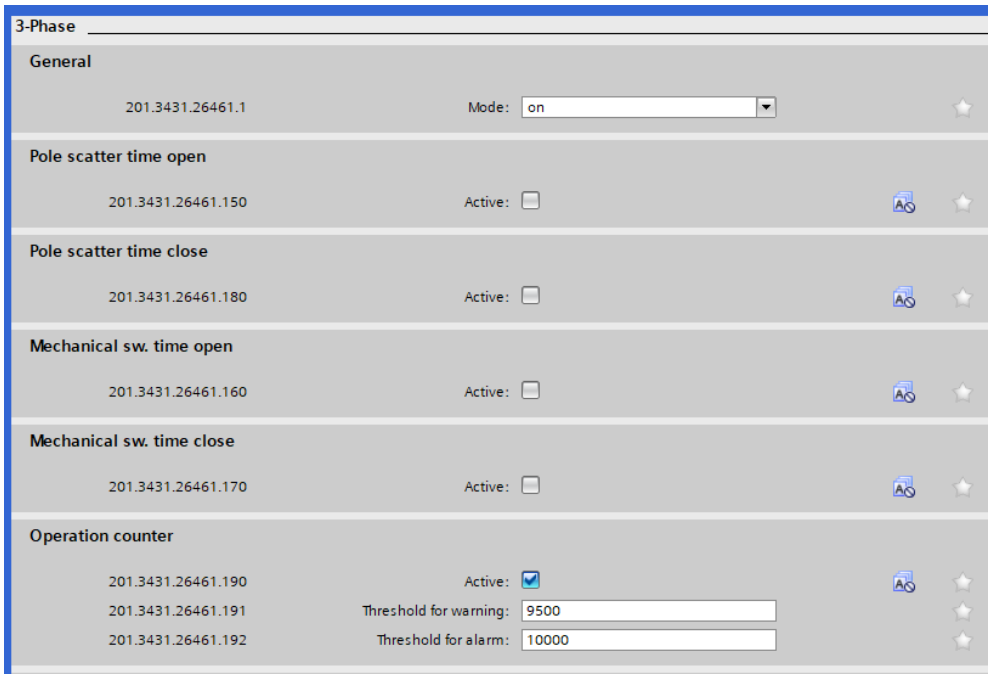
Principle of mechanical closed time calculation

You will find the values and alarms in the information routing matrix if the functions are activated in the settings.

CB monitoring	201.3431	
General	201.3431.2...	
3-Phase	201.3431.2...	
Mode (controllable)	201.3431.2...	ENC
Inactive	201.3431.2...	SPS
Behavior	201.3431.2...	ENS
Health	201.3431.2...	ENS
Aux.-contact time open	201.3431.2...	MV
Aux.c. time open warn.	201.3431.2...	SPS
Aux.c. time open alarm	201.3431.2...	SPS
Reaction time open	201.3431.2...	MV
React. time open warn.	201.3431.2...	SPS
React. time open alarm	201.3431.2...	SPS
Aux.c. travel time open	201.3431.2...	MV
Aux.-cont. time close	201.3431.2...	MV
Aux.c. time close warn.	201.3431.2...	SPS
Aux.c. time close alarm	201.3431.2...	SPS
Reaction time close	201.3431.2...	MV
React. time close warn.	201.3431.2...	SPS
React. time close alarm	201.3431.2...	SPS
Aux.c. travel time close	201.3431.2...	MV

B2. Number of open/close operations

This monitoring feature counts the number of operations of the circuit breaker. It is activated in the "3-Phase" section of the CB monitoring settings.



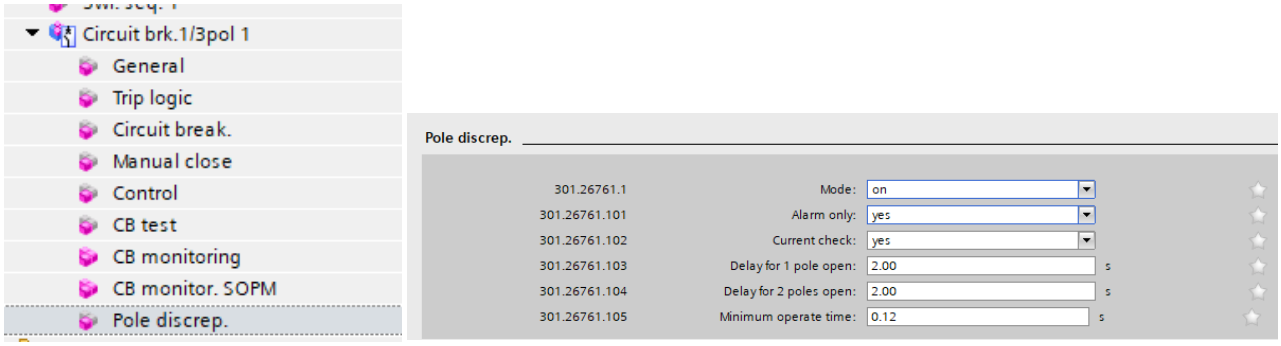
The following results and alarms appear in the information routing matrix:

C. Current flow and auxiliary contact based monitoring

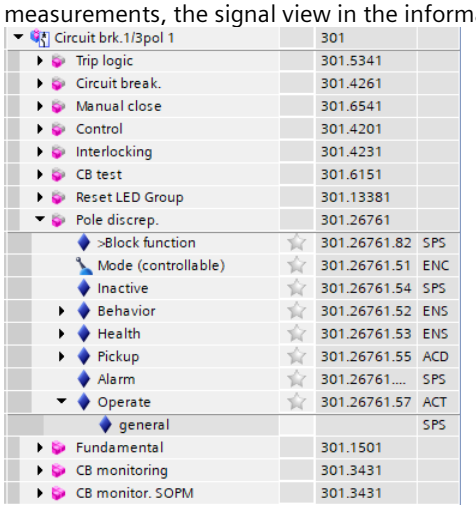
These monitoring function works with both the current measurement and the feedback of the CB position.

C1. Pole Discrepancy

This function is a special case, as it is not part of the function block "CB monitoring": It has its own function block. Additionally, it is only available in the CB 1/3pole. Therefore, it checks the auxiliary contacts for single open poles. Additionally, the current can be supervised tor that purpose. As the function can also trip the CB, it is both a monitoring and a protection function. Its instantiation in a Function Group Circuit Breaker costs 5 function points, independent of the usage of a FB "Circuit breaker monitoring".



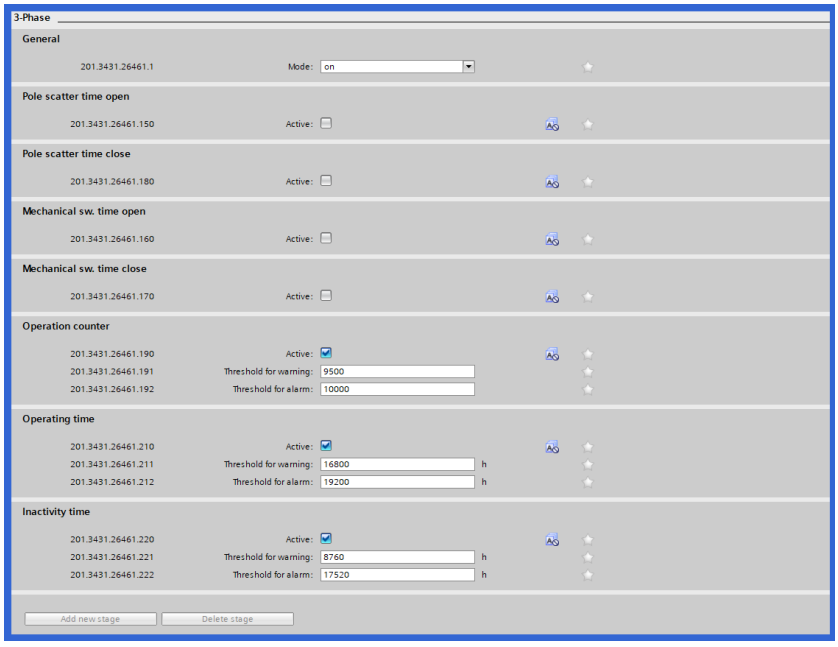
It detects whether the position of one pole is different than the position ot the other poles. As it does not generate measurements, the signal view in the information routing matrix is as follows:



D. Time Based Monitoring

D1. CB Inactivity Time, D2. CB Operating Time

Both Supervision Times can be activated in the “3Phase” section of the monitoring settings. In the 1/3phase circuit breaker, these functions work per phase.

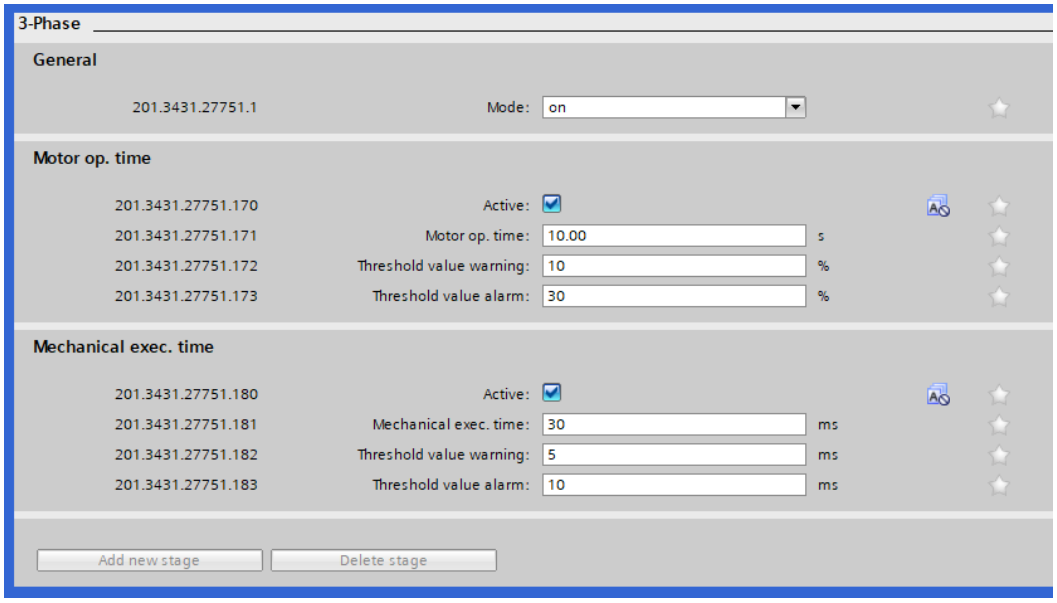


The calculated time values and alarms appear as follows in the information routing matrix:

CB monitoring		201.3431	
General		201.3431.2...	
3-Phase		201.3431.2...	
Mode (controllable)	☆	201.3431.2...	ENC
Inactive	☆	201.3431.2...	SPS
Behavior	☆	201.3431.2...	ENS
Health	☆	201.3431.2...	ENS
Operation counter	☆	201.3431.2...	INS
Oper.-counter warning	☆	201.3431.2...	SPS
Oper.-counter alarm	☆	201.3431.2...	SPS
Operating time	☆	201.3431.2...	INS
Operating-time warn.	☆	201.3431.2...	SPS
Operating-time alarm	☆	201.3431.2...	SPS
Inactivity time	☆	201.3431.2...	INS
Inactivity-time warning	☆	201.3431.2...	SPS
Inactivity-time alarm	☆	201.3431.2...	SPS
Phase A		201.3431.2...	

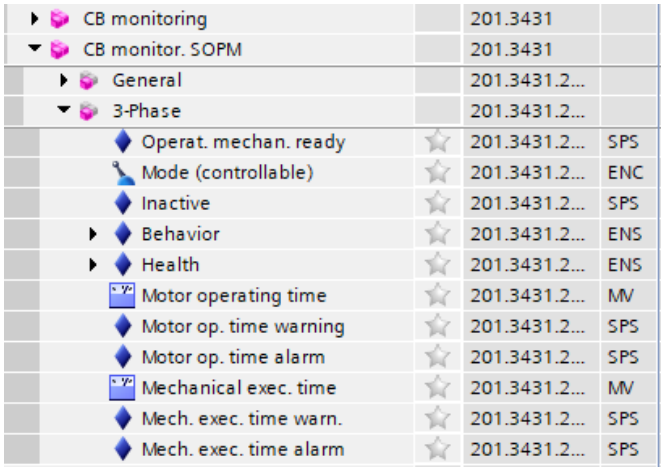
E. Supervision of the Operating Mechanism (LN SOPM)

This functionality monitors the mechanical equipment which moves the circuit breaker, especially the energy storage for the CB movement. The function is modeled by an own function block “CB monitoring SOPM”, which has its own IEC61850 LN representation SOPM. It measures the motor operation time and the mechanical execution time until the energy storage of the motor is empty.



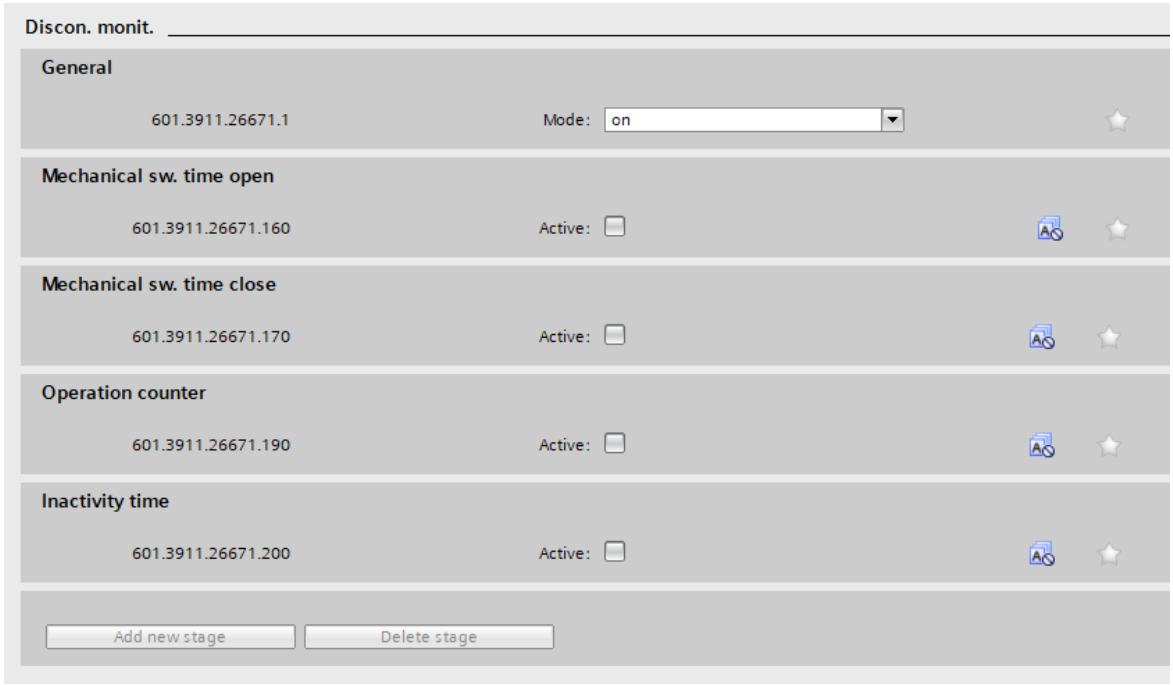
This function needs information about the status of the energy storage of the CB motor, so it has to be connected to the appropriate contact “Operation mechanism ready” (see below information list). The calculated times and respective alarms also appear here when the function is activated in the settings.

For more details, please refer to the device manual.



F. Disconnector Monitoring

The following subset of the circuit breaker monitoring functionality is available for the disconnectors:



1.5 Tips for handling of the functionality

If you need to reset or set the calculated values of the monitoring functions, for example because of exchange of the circuit breaker, you can access and set these values by three methods:

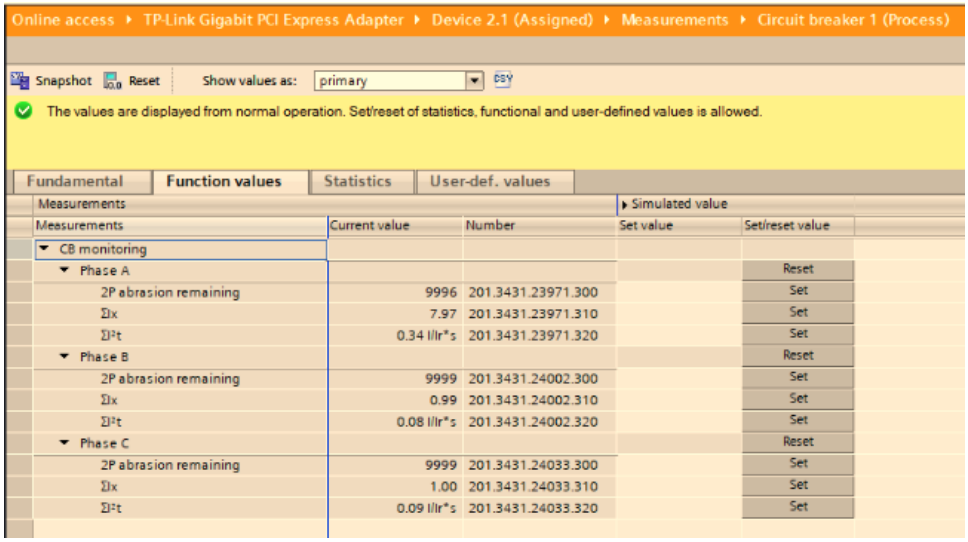
1) By Device HMI

You can access the measurements on the device display via Measurements -> Circuit Breaker -> Function Values -> CB monitoring. Example:

As you can see here in the example, the values can be changed.

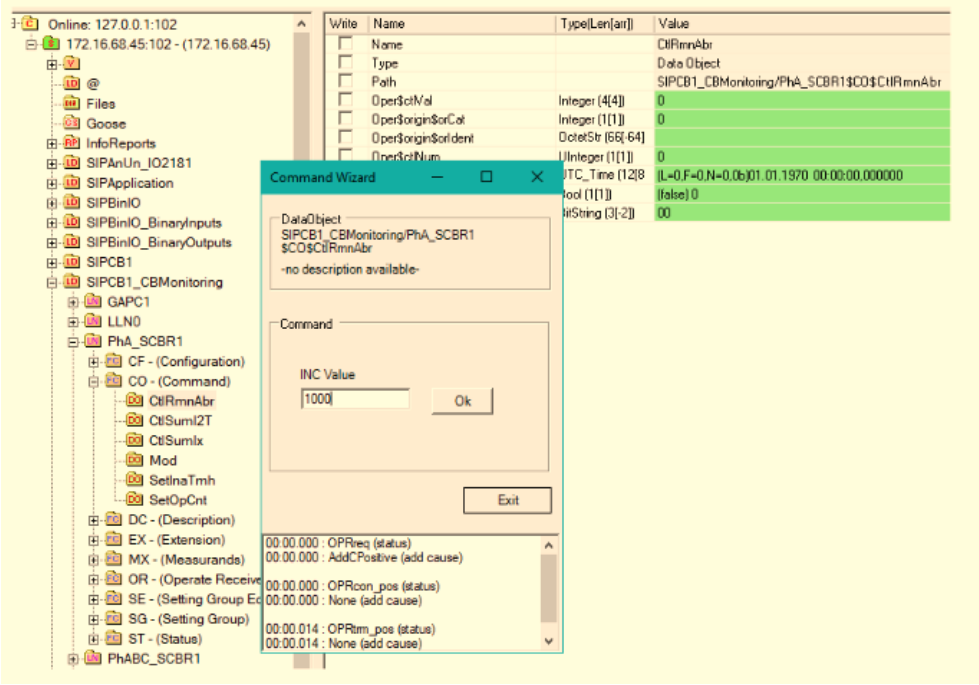
2) Via DIGSI online

The function values are also accessible and can be changed via DIGSI 5 if connected to the device:



3) Via IEC Browser

It is also possible to read and change the values of the monitoring functions with the IEC-Browser. The values are available in the Logical Nodes SCBR (Function Block Circuit Breaker Monitoring), SOPM (Function Block CB Monitoring SOPM), SSWI (Disconnector Monitoring) and PDSC (Pole Discrepancy).



1.6 Summary

The CB monitoring functionality in SIPROTEC 5 has been innovated in platform version 9.30, with the first new functionality “break time” added. As the IEC61850 modeling has changed in the standard Edition 2, a new FB was created in the SIPROTEC 5 platform. For using legacy devices, the existing FB is still available. New future functionality for CB monitoring have been added in the new FB only. This application note Edition 2 describes what has been implemented until SIPROTEC 5 V9.80.

Published by Siemens

Smart Infrastructure
Electrification & Automation
Mozartstraße 31c

91052 Erlangen, Germany

For the U.S. published by

Siemens Industry Inc.

100 Technology Drive

Alpharetta, GA 30005

United States

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For more information, please contact our

Customer Support Center.

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