



Protection and Control Devices for Medium Voltage Switchgear

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SIPROTEC 5 Application Note

SIPROTEC 5 – Application Note

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1 Protection and Control Devices for Medium Voltage Switchgear

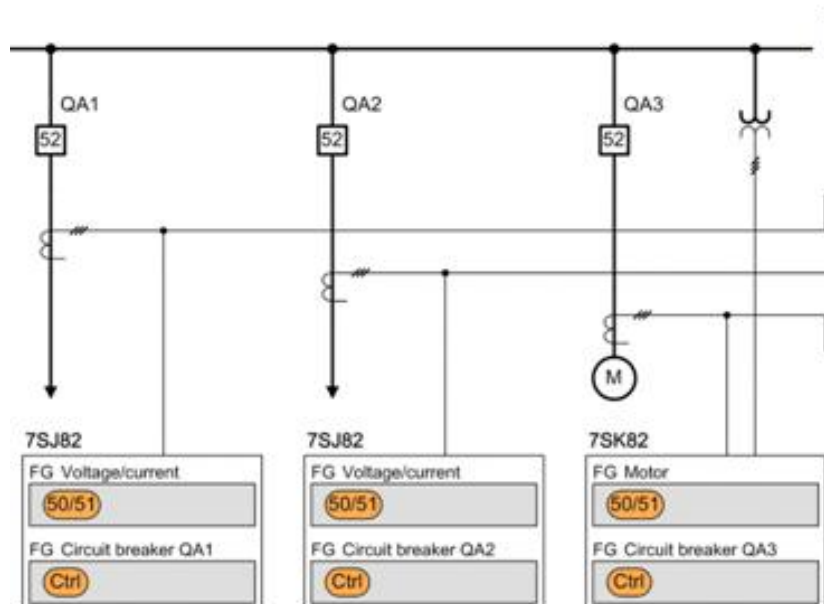
1.1 Introduction

The technological development of the intelligent electronic devices has opened a wide range of possibilities to integrate multiple functionalities in one device. Depending on the critical nature of the installation, it is also possible to increase the reliability of the solution by using only a couple of devices, which leads to an optimization of the investment.

1.2 Main Requirements

Medium voltage switchgear are mainly protected by overcurrent relays. Depending on the type of bay (feeder, tie, transformer low side, etc) additional functions as directional overcurrent, reclose and voltage protections can also be required.

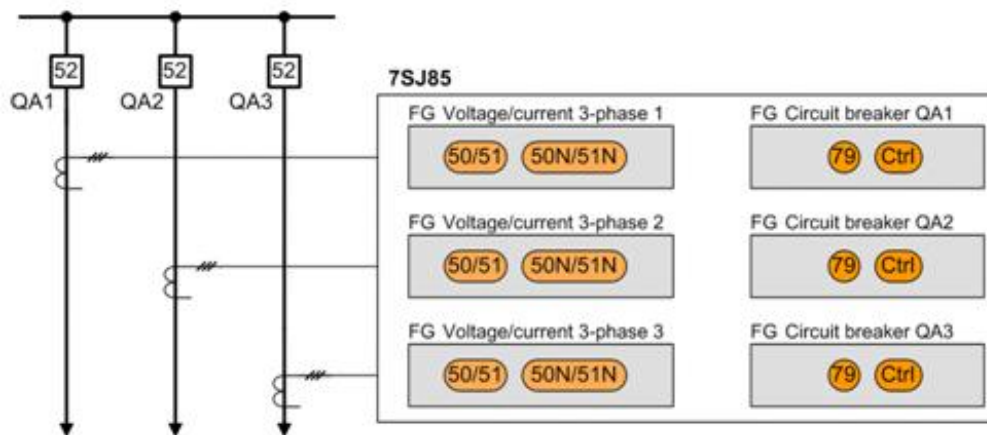
In a traditional scheme, every bay has its own protection device. This device is normally also able to perform the basic switching maneuvers by means of a graphical display, functional keys or text menus. In this way, for switchgear with two in-feeders, one tie and 6 feeders, a total of 9 control and protection devices are required when no redundancy is needed.



The new generation of protection and control devices SIPROTEC 5 allows protecting and controlling the complete switchgear (up to 9 bays) with a single device. In such a way is reduced not only the investment but also the parameterization and commissioning times.

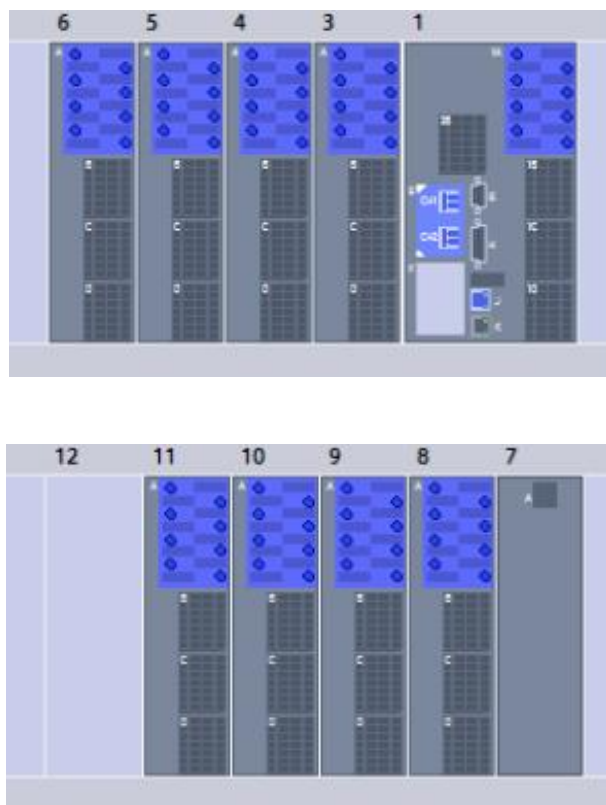
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1.3 Configuration

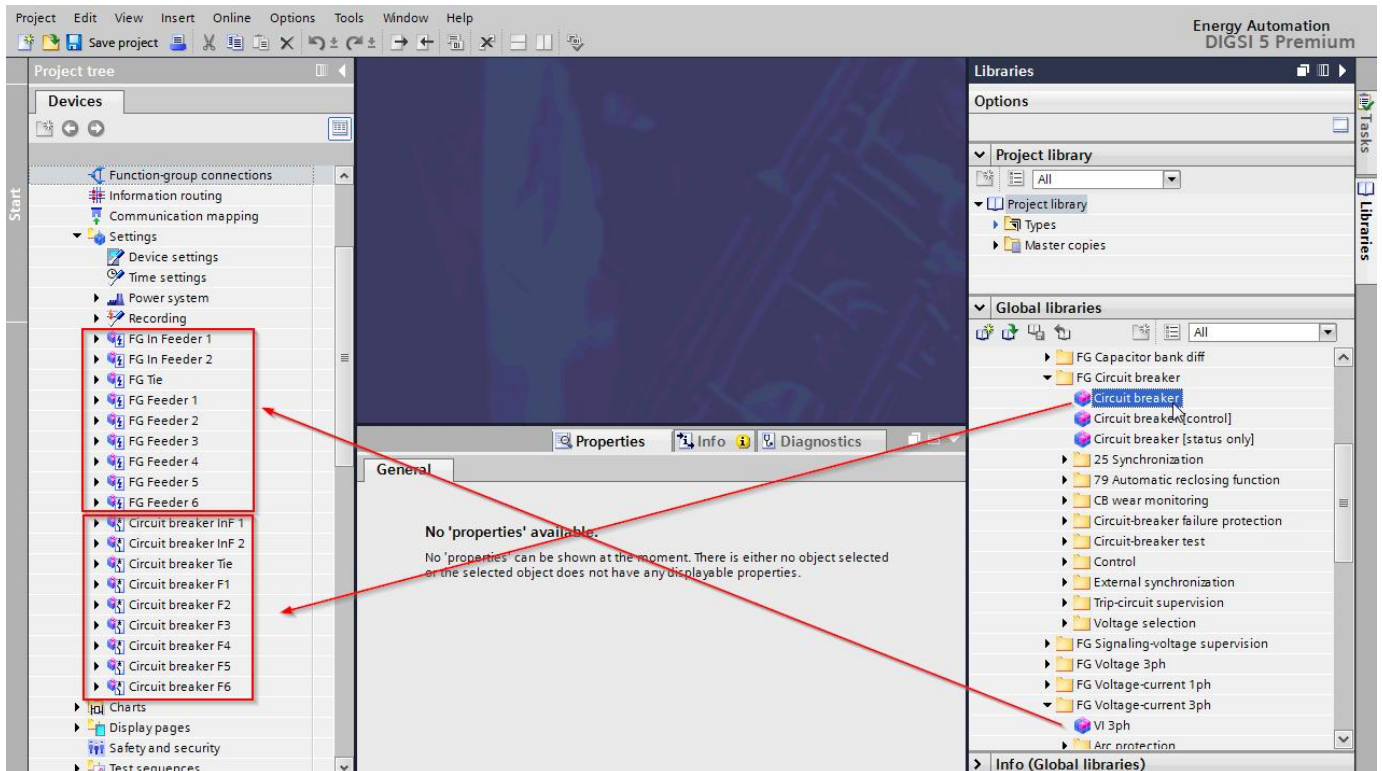
The best fit device for this solution is the 7SJ85 since it is an expandable device whose main functionality is the overcurrent protection. The device can be created in DIGSI 5 in several ways: adding the short code in the editor *Add new device*, adding the long code in the same editor, or adapting the hardware of the device (*Hardware and Protocols Editor*) to the complete switchgear requirements; that is for instance, to acquire 9 current and 2 voltage measurements.



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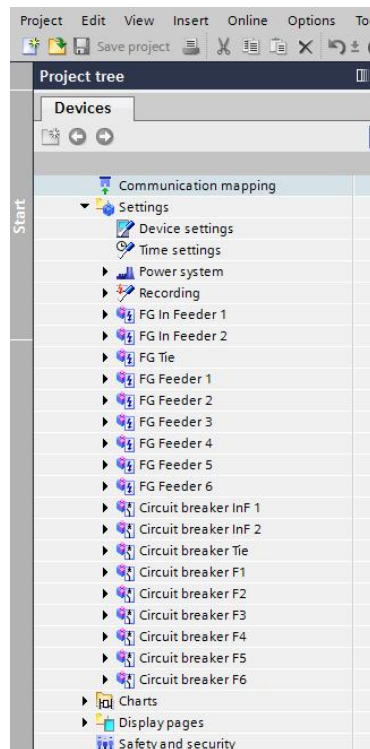
In DIGSI 5 it is possible to create the 18 independent Function Groups, 9 of them for the protection functionality related to the bays and 9 for the protection and control tasks of the associated circuit breakers. The different Function groups can be created from different editor in DIGSI 5. Commonly it will be done by dragging the FG desired from the library on the right side of the screen, and dropping it under the editor *Settings*:



Under each Function Group the corresponding protection functions must be created and configured:

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Besides the Hardware configuration and function groups, the measuring points must be created and assigned to the respective physical inputs with the *Measuring-points routing editor*.

Current-measuring points										
		Base module				Expansion module 3				
		1A				3A				
		1A1-1A2	1A3-1A4	1A5-1A6	1A7-1A8	3A1-3A2	3A3-3A4	3A5-3A6	3A7-3A8	4A1-4A2
Measuring point	Connection type	IP 1A1	IP 1A2	IP 1A3	IP 1A4	IP 3A1	IP 3A2	IP 3A3	IP 3A4	IP 4A1
(All)	(All)	(All)	(All)	(All)	(All)	(All)	(All)	(All)	(All)	(All)
MP 3I IN Feeder 1	3-phase + IN	I A	I B	I C	IN					
MP 3I IN Feeder 2	3-phase + IN					I A	I B	I C	IN	
MP 3I Tie	3-phase + IN									I A
MP 3I Feeder 1	3-phase + IN									
MP 3I Feeder 2	3-phase + IN									
MP 3I Feeder 3	3-phase + IN									
MP 3I Feeder 4	3-phase + IN									
MP 3I Feeder 5	3-phase + IN									
MP 3I Feeder 6	3-phase + IN									
Add new										

Voltage-measuring points										
		Base module				Expansion module 3				
		1B				3B				
		1B1-1B2	1B3-1B4	1B5-1B6	1B7-1B8	3B1-3B2	3B3-3B4	3B5-3B6	3B7-3B8	
Measuring point	Connection type	V 1.1	V 1.2	V 1.3	V 1.4	V 3.1	V 3.2	V 3.3	V 3.4	
(All)	(All)	(All)	(All)	(All)	(All)	(All)	(All)	(All)	(All)	
MP 3V Busbar1	3 ph-to-gnd volt. + VN	V A	V B	V C	VN					
MP 3V Busbar2	3 ph-to-gnd volt. + VN					V A	V B	V C	VN	
Add new										

When all the measurement points have been properly created it is possible to assign each of them to the corresponding function group(s) to execute the related protection and control functionality. In the graphic below is shown, for example, that the 3-Phase current measuring coming from the In Feeder 1 is assigned to

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the function group "IN feeder 1" and also to the Circuit Breaker associated to that bay ("Circuit Breaker InF 1"), since the measurement is common for both function groups.

Connect measuring points to function group					
	FG In Feeder 1		Circuit breaker InF 1		
Measuring point	V 3ph	I 3ph	V	I 3ph	V sync1
(All)	(All)	(All)	(All)	(All)	(All)
MP 3I IN Feeder 1[ID 1]		X		X	
MP 3I IN Feeder 2[ID 2]					
MP 3I Tie[ID 3]					
MP 3I Feeder 1[ID 4]					
MP 3I Feeder 2[ID 5]					
MP 3I Feeder 3[ID 6]					
MP 3I Feeder 4[ID 7]					
MP 3I Feeder 5[ID 8]					
MP 3I Feeder 6[ID 9]					
MP 3V Busbar1[ID 10]	X				
MP 3V Busbar2[ID 11]					

It is also important to notice that the trips released by every function group will act only on the corresponding circuit breaker per the configuration in DIGSI 5, that is control and protection from bays and circuit breakers completely independent from each other.

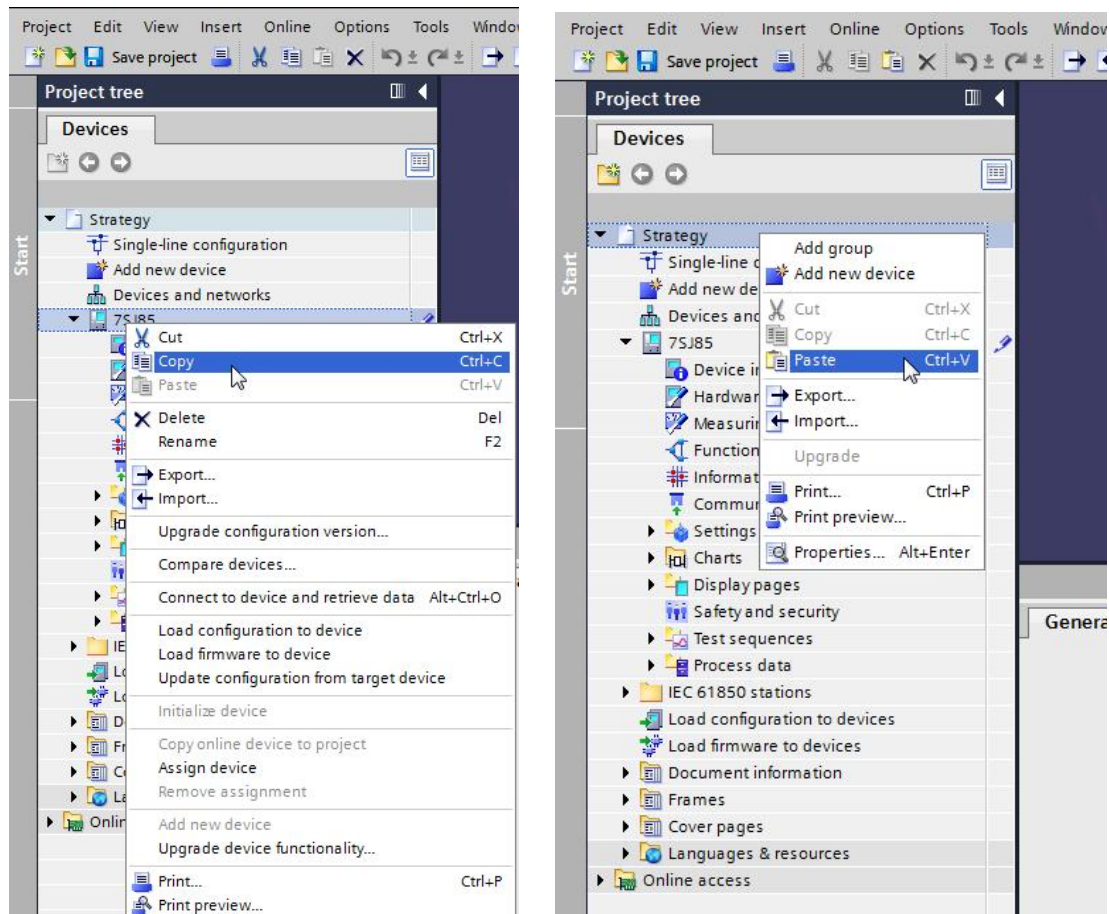
Connect function group to circuit-breaker groups						
Protection group	Circuit breaker InF 1	Circuit breaker InF 2	Circuit breaker Tie	Circuit breaker F1	Circuit breaker F2	Circuit breaker F3
(All)	(All)	(All)	(All)	(All)	(All)	(All)
FG In Feeder 1	X					
FG In Feeder 2		X				
FG Tie			X			
FG Feeder 1				X		
FG Feeder 2					X	
FG Feeder 3						X
FG Feeder 4						
FG Feeder 5						
FG Feeder 6						

1.4 Redundancy

In critical installations can be important to grant the n-1 redundancy in order to increase the availability of the system. In this case a similar device can be added as back up protection. From the configuration point of view the process is so simple as to copy the IED already created: right click on the device and select "copy" from the menu and then right click on the projects' name and select "paste". Ready!

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1.5 Summary

The state of the art with regard to intelligent electronic devices has opened a wide range of options in order to improve the availability and reliability of the substations keeping under control the initial investment. Savings are related not only to the devices but also to the engineering, testing and commissioning times. Two exactly equal devices offer the possibility to reduce the engineering effort almost by 50%, and the testing and commissioning processes can also be simplified since all the logics, inputs, outputs and others are exactly the same. In fact even the effort to create the test protocols and report documents is substantially reduced.

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