

SIPROTEC 5 Devices and Fields of Application

Bay Controllers – SIPROTEC 6MD86

Description

The SIPROTEC 6MD86 bay controller is a universal control and automation device with a protection function. It is designed for use in all voltage levels from distribution to transmission. As a part of the SIPROTEC 5 family, it allows the use of a large number of protection functions from the SIPROTEC library. Adapt the hardware and the IO quantity structure exactly to your requirements and enable future-oriented system solutions with high investment security and low operating costs.

Main function	Bay controller for medium voltage and high to extra-high voltage switchgear with integrated operation and comprehensive protection functions. Powerful automation, simple configuration with DIGSI 5.
Inputs and outputs	6 predefined standard variants with 8 current transformers, 8 voltage transformers, 11 to 75 binary inputs, 9 to 41 binary outputs
Hardware flexibility	Flexible adjustable and expandable I/O quantity structure within the scope of the SIPROTEC 5 modular system. For great requirements placed on the quantity structure, the device can be extended in the second row. For example, 240 (and more) binary inputs are possible with the IO230 (see Section Hardware).
Housing width	1/3 × 19" to 2/1 × 19"

Functions

DIGSI 5 permits all functions to be configured and combined as required.

- Integrated bay controller with versatile protection function from medium to extra-high voltage
- Control of switching devices
- Synchrocheck, switchgear interlocking protection and switch-related protection functions, such as circuit-breaker failure protection and automatic reclosing
- Integrated electrical Ethernet RJ45 for DIGSI 5 and IEC 61850 (reporting and GOOSE)
- Up to 4 pluggable communication modules usable for different and redundant protocols (IEC 61850, IEC 60870-5-103, IEC 60870-5-104, DNP3 (serial+TCP), Modbus TCP)
- Redundancy protocols PRP and HSR
- Cyber security in accordance with NERC CIP and BDWE White-paper requirements
- Arc protection
- Graphical logic editor to create powerful automation functions in the device
- Optional overcurrent protection with 3-pole tripping
- Also used in switchgear with breaker-and-a-half configuration
- Overcurrent protection also configurable as emergency function
- Secure serial protection data communication, also over great distances and all available physical media (fiber-optic cable, 2-wire connections and communication networks)



[SIP5_GD_SS_W3, 1, --, --]

Figure 2.15/4 SIPROTEC 6MD86 (1/3 device with 1/6 expansion module with key switch operation panel)

- Capturing operational measured variables and protection function measured values to evaluate the plant state, to support commissioning, and to analyze faults
- Synchrophasor measured values with IEEE C37.118 protocol integrated (PMU)
- Powerful fault recording (buffer for a max. record time of 80 s at 8 kHz or 320 s at 2 kHz)
- Auxiliary functions for simple tests and commissioning
- Flexibly adjustable I/O quantity structure within the scope of the SIPROTEC 5 modular system

Applications

The SIPROTEC 6MD86 bay controller is a universal control and automation device with a protection function based on the SIPROTEC 5 system. The standard variants of the SIPROTEC 6MD86 are delivered with instrument transformers. Furthermore, protection-class current transformers are also possible in SIPROTEC 6MD86 so that protection functions can be used. Due to its high flexibility, it is suitable as selective protection equipment for overhead lines and cables with single-ended and multi-ended infeeds when protection communication is used. The device supports all SIPROTEC 5 system properties. It enables future-oriented system solutions with high investment security and low operating costs.

Application Templates

The following application templates are available:

SIPROTEC 6MD86 standard double busbar

- Double busbar feeder with switchgear interlocking protection
- Synchrocheck for circuit breaker
- Switching sequence for automatic busbar switchover preconfigured (triggered by function key)

SIPROTEC 6MD86 breaker-and-a-half type 1

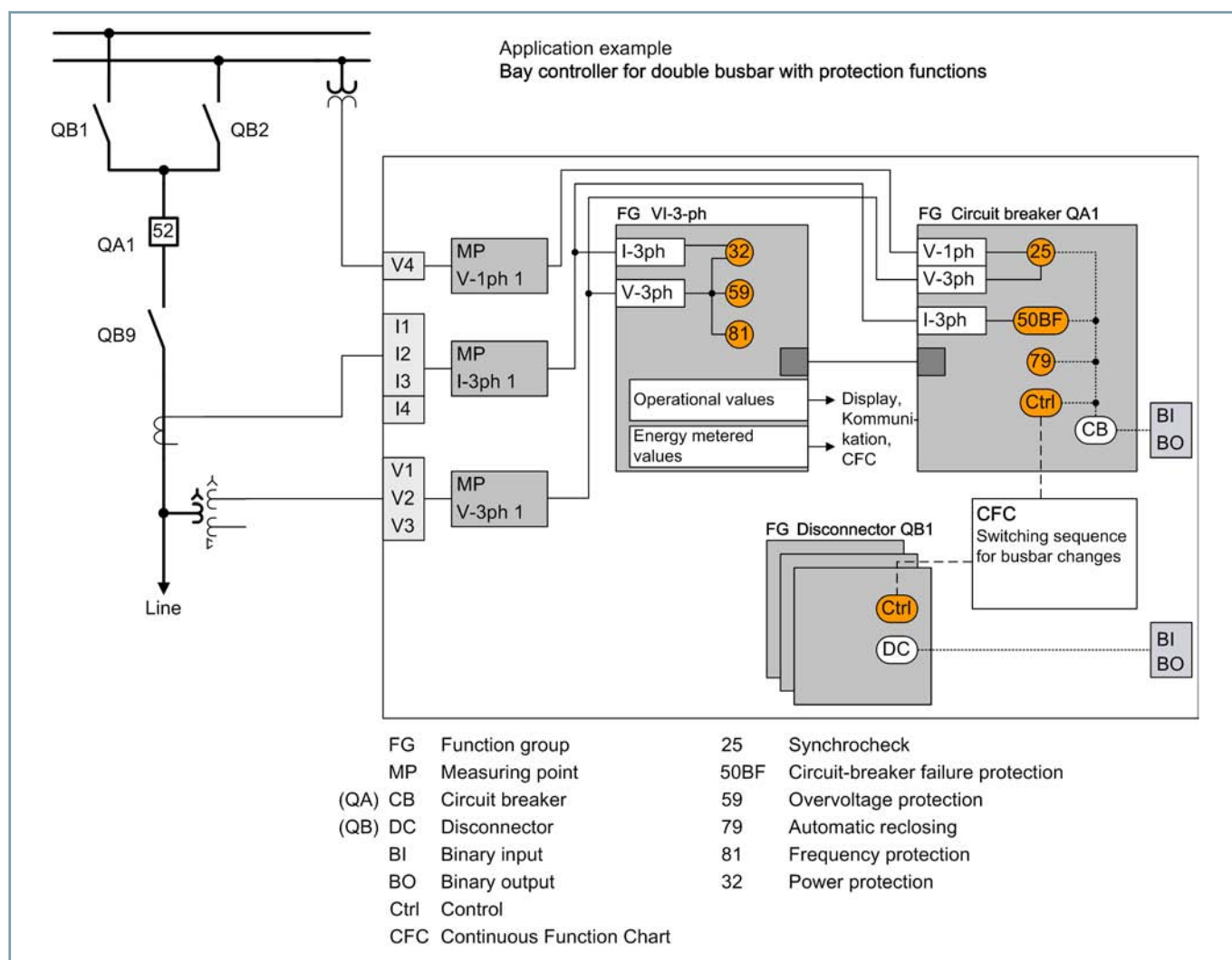
- Control of a breaker-and-a-half diameter (3 circuit breakers, 14 disconnectors)
- Synchrocheck for the three circuit breakers with dynamic measuring point switchover.

SIPROTEC 6MD86 breaker-and-a-half type 2

- Control of part of a 1 1/2 circuit-breaker layout bay
- Supports concepts with multiple bay controllers per bay
- Circuit-breaker failure protection and automatic reclosing.

Double busbar with protection functions

In **Figure 2.15/5** the double busbar feeder is controlled and also protected by a 6MD86. For this purpose, circuit-breaker failure protection and automatic reclosing are activated in the Circuit breaker function group. The function group VI_3-phase includes the protection functions overvoltage protection, frequency protection and power protection. In contrast to **Figure 2.15/3**, it is therefore connected to the circuit breaker so that the resulting trip signals have a destination. Such linkages can be quickly and flexibly created in the DIGSI editor "Function-group connections" (**Figure 2.15/6**).



[dw_6MD8-Bsp-Application-2, 1, en_US]

Figure 2.15/5 Application example: Bay controller 6MD86 for double busbar with protection functions

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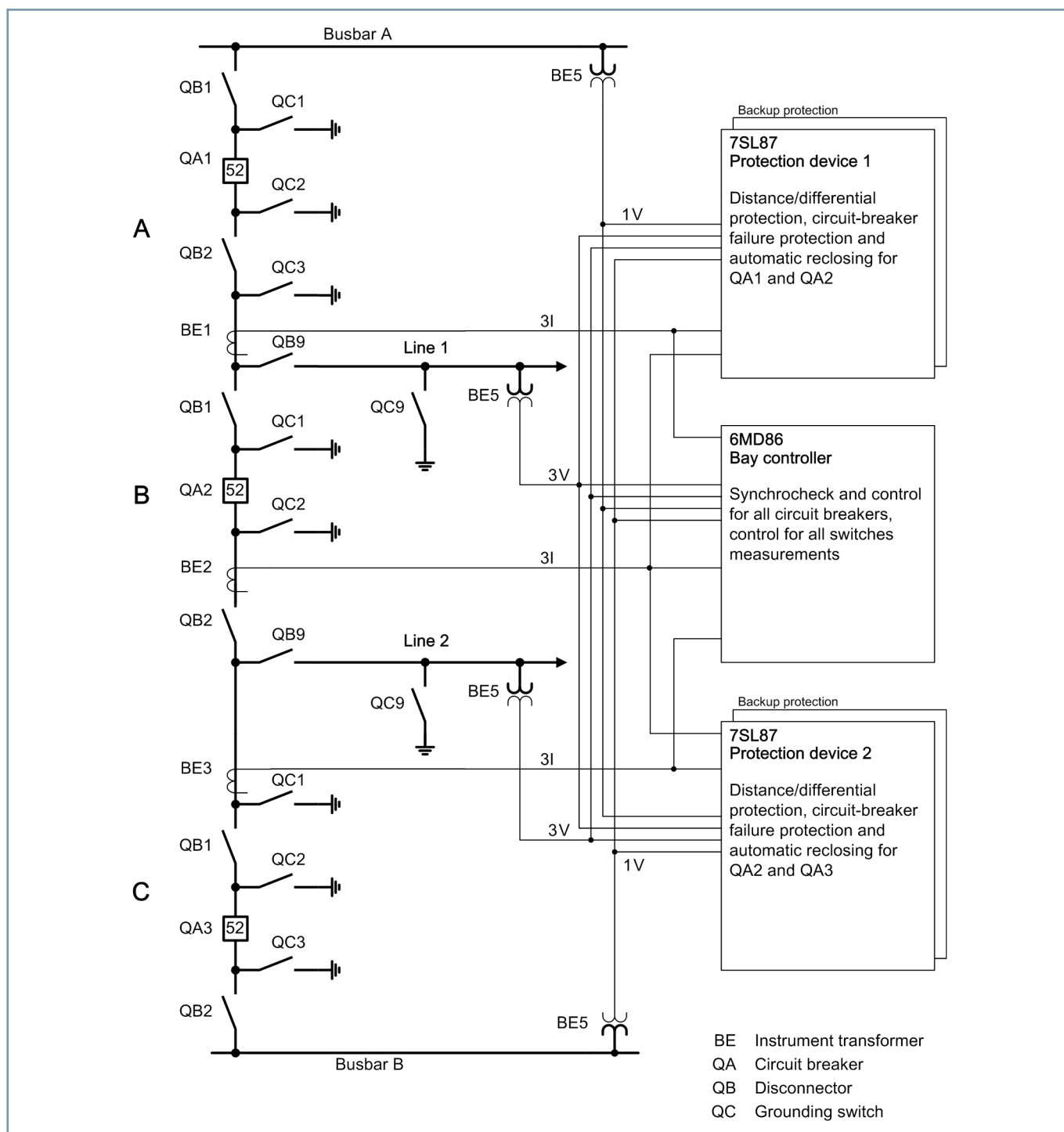
▼ Connect function group to circuit-breaker groups			
	Protection group	QA1	
	(All...)	(All...)	
	I 3ph 1		
	V 3ph 1		
	VI 3ph 1	X	
	VI 1ph 1		

[Schutzobjekt, 1, en_US]

Figure 2.15/6 Assignment of the function group with protection functions to the switch (protected object)

Breaker-and-a-half diameter with protection and control systems

Figure 2.15/7 shows a breaker-and-a-half diameter with protection and control system. Protection is ensured by two line protection devices SIPROTEC 7SL87 which also include circuit-breaker failure protection and automatic reclosing of the three circuit breakers. All switching devices and the synchrocheck of the circuit-breakers are controlled by the bay controller SIPROTEC 6MD86. **Figure 2.15/8** shows the functions of SIPROTEC 6MD86.



[dw_1-5_CB-Feldleit-, 1, en_US]

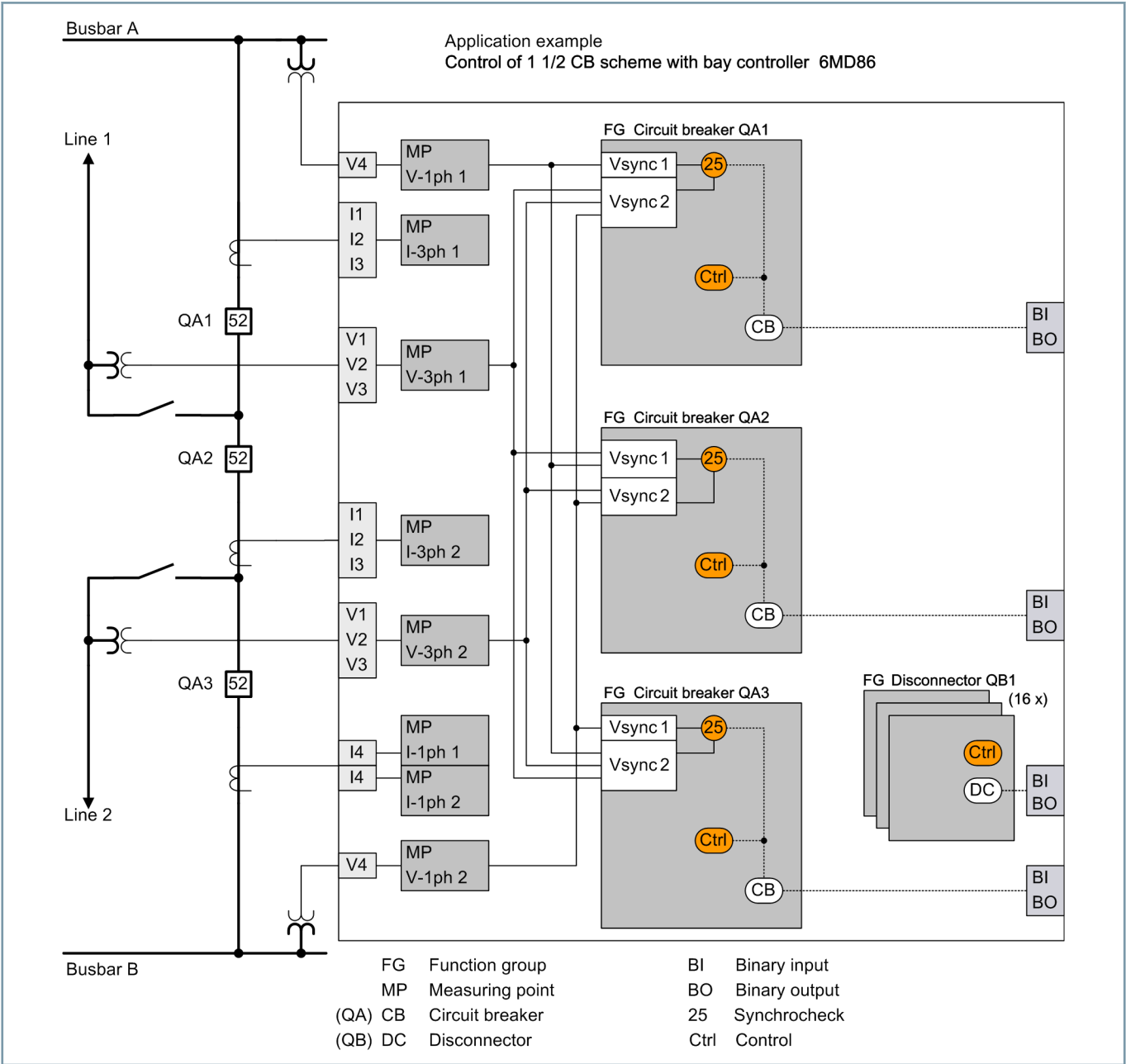
Figure 2.15/7 Application example: Breaker-and-a-half layout with one bay controller and two line protection devices (overview)

Figure 2.15/8 shows the principle of dynamic changeover of measured voltage values for the synchrocheck functions of the three circuit-breakers in the bay controller SIPROTEC 6MD86. Every synchrocheck function (ANSI number 25) requires the two voltages V_{sync1} and V_{sync2} (feeder voltage and reference voltage). For the central circuit-breaker QA2 there are two possi-

bilities each for both voltages, depending on the position of the disconnectors and the circuit-breakers. For the two exterior circuit-breakers QA1 and QA3, there is only one possibility for one voltage (that is, the adjacent busbar), whereas the other voltage is connected with one of three possibilities (also depending on the position of the switching device).

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[dw_6MD8-Bsp-Application-3, 1, en_US]

Figure 2.15/8 Application example: Breaker-and-a-half layout with one bay controller and two line protection devices (detail for bay controller)

▼ Connect measuring points to function group

Measuring point	QA1		QA2		QA3	
	V sync1	V sync2	V sync1	V sync2	V sync1	V sync2
(All...)	(All...)	(All...)	(All...)	(All...)	(All...)	(All...)
Meas.point I-3ph 1[ID 1]						
Meas.point I-3ph 2[ID 2]						
Meas.point I-1ph 1[ID 3]						
Meas.point I-1ph 2[ID 4]						
Meas.point V-3ph 1[ID 5]		X	X			X
Meas.point V-3ph 2[ID 6]		X		X		X
Meas.point V-1ph 1[ID 7]	X		X			X
Meas.point V-1ph 2[ID 8]		X		X	X	

▼ Connect function group to circuit-breaker groups

Protection group
(All...)

▼ Connect protection-function group to protection-function group

Windings
(All...)

Properties

General Compile Cross-reference Inconsistencies Search results

Result object	Indication	Opens Editor	Date	Time
6MD86_20mA			11/28/2011	9:01:13 AM
6MD85			11/28/2011	9:01:14 AM
6MD86_1_5CB			11/28/2011	9:01:15 AM
Power system/Meas.point I-3ph 1	The measuring point is not connected.	Function-gro..	11/28/2011	9:01:15 AM
Power system/Meas.point I-3ph 2	The measuring point is not connected.	Function-gro..	11/28/2011	9:01:15 AM
Power system/Meas.point I-1ph 1	The measuring point is not connected.	Function-gro..	11/28/2011	9:01:15 AM
Power system/Meas.point I-1ph 2	The measuring point is not connected.	Function-gro..	11/28/2011	9:01:15 AM

[Spannungskanäle, 1, en_US]

Figure 2.15/9 Mapping of the possible voltage channels to the three circuit-breaker function groups

Figure 2.15/9 shows the mapping in the editor "Function Group Connections". All voltages that are possible as feeder or reference voltage for the synchrocheck are assigned to the inputs Vsync1 or Vsync2.

The ID number of the measured values is used to select the presently applied operational voltages in a CFC (Figure 2.15/10).

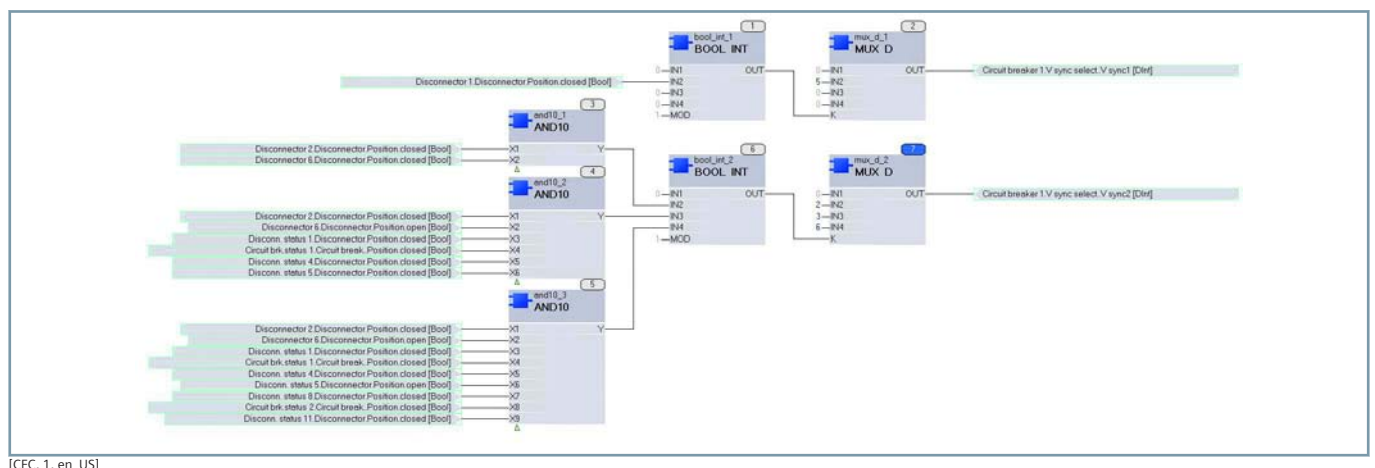


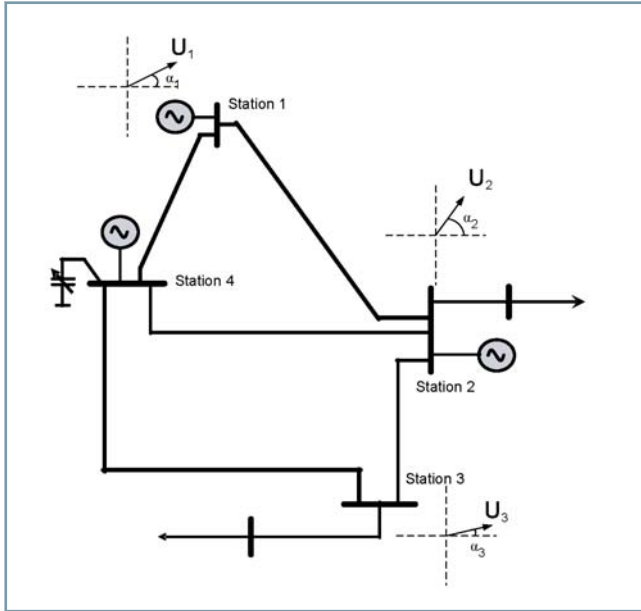
Figure 2.15/10 CFC for selection of the synchrocheck reference voltages

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Phasor Measurement Unit

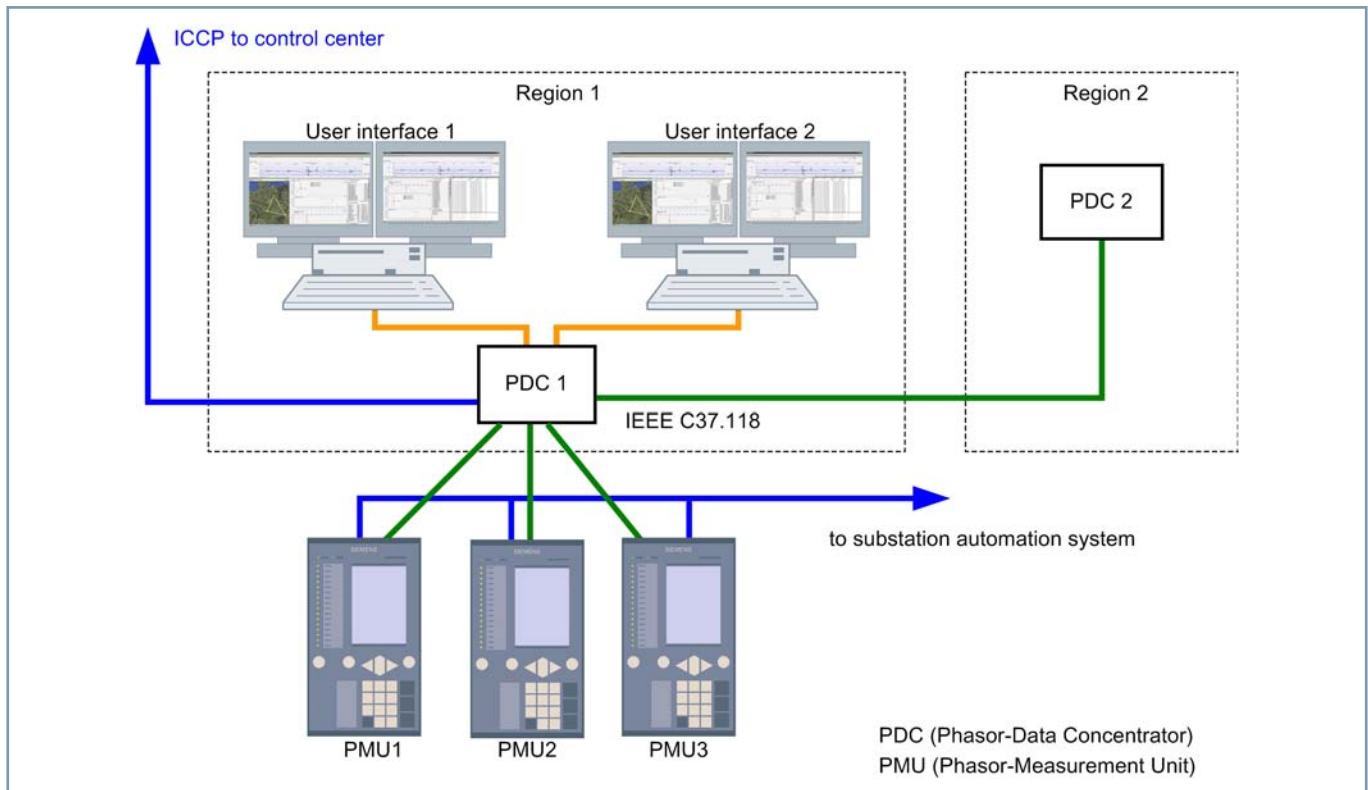
PMUs measure current and voltage by amount and phase at selected stations of the transmission system. The high-precision time synchronization (via GPS) allows comparing measured values from different substations far apart and drawing conclusions as to the system state and dynamic events such as power swing conditions.



[Zeigermessung (PMU), 1, --, --]

Figure 2.15/11 Principle of distributed phasor measurement

When selecting the option “Phasor Measurement Unit”, the devices determine current and voltage phasors, provide them with highly accurate time stamps and transmit them for analysis together with other measured values (frequency, speed of frequency change) using the IEEE C37.118 communication protocol, see **Figure 2.15/12**. Using synchrophasors and a suitable analysis program (for example SIGUARD PDP) it is possible to automatically detect power swings and trigger alarms, which are sent to the control center, for example.



[dw_struct_WAM, 1, en_US]

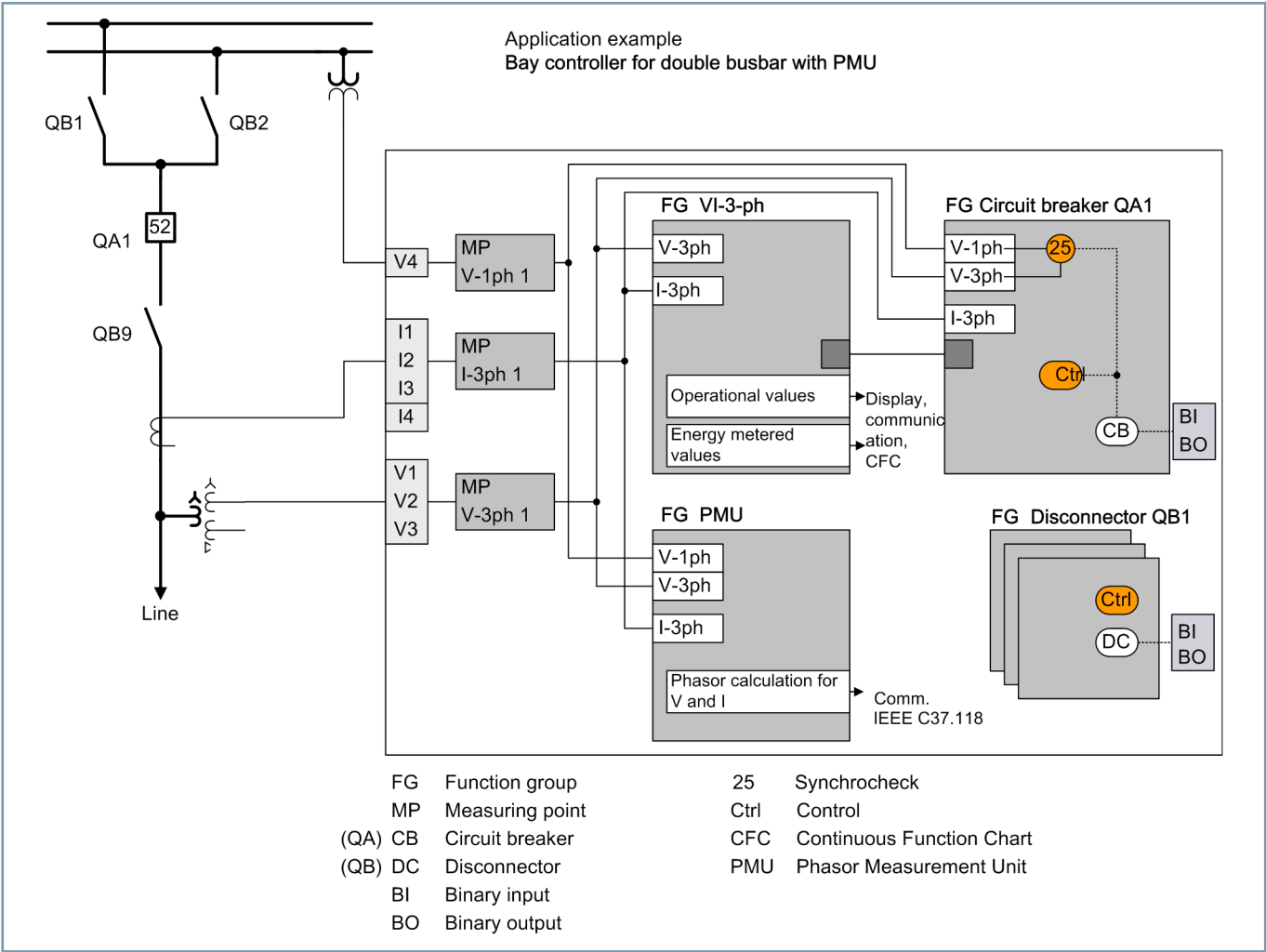
Figure 2.15/12 Connection of 3 Phasor Measurement Units with two Phasor Data Concentrators (PDCs) SIGUARD PDP

When using the PMU function, a function group "FG PMU" is created in the device. This function group calculates the phasors and analog values, conducts the time stamping and sends the data to the selected Ethernet interface using the IEEE C37.118

protocol. There, the data can be received, stored and processed by one or more clients. Up to three client IP addresses can be assigned in the device.

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[dw_6MD8-Bsp-Application-4, 1, en_US]

Figure 2.15/13 Application example: Double busbar with 6MD86, used as bay controller and Phasor Measurement Unit (PMU)

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Functions, application templates

ANSI	Functions	Abbr.	Available	Template			
				1	2	3	4
	Protection functions for 3-pole tripping	3-pole	■	■	■	■	■
	Hardware quantity structure expandable	I/O	■	■	■	■	■
25	Synchrocheck, synchronizing function	Sync	■		■	■	■
27	Undervoltage protection: "3-phase" or "universal Vx"	V<	■				
32, 37	Power protection active/reactive power	P<, Q<	■				
38	Temperature Supervision	θ>	■				
46	Negative sequence overcurrent protection	I2>	■				
49	Thermal overload protection	θ, I²t	■				
50/51 TD	Overcurrent protection, phases	I>	■		■	■	■
50N/ 51N TD	Overcurrent protection, ground	IN>	■				
50HS	High speed instantaneous overcurrent protection	I>>>	■				
	Instantaneous tripping at switch onto fault	SOTF	■				
50BF	Circuit-breaker failure protection, 3-pole	CBFP	■				■
51V	Voltage dependent overcurrent protection	t=f(I,V)	■				
59	Overvoltage protection: "3-phase" or "pos.seq. V1" or "universal Vx"	V>	■				
74TC	Trip circuit supervision	TCS	■				
79	Automatic reclosing, 3-pole	AR	■				■
81	Frequency protection: "f>" or "f<" or "df/dt"	f>, <, df/dt>, <	■				
86	Lockout		■				
90V	Automatic voltage control for 2 winding transformer		■				
90V	Automatic voltage control for 3 winding transformer		■				
90V	Automatic voltage control for grid coupling transformer		■				
PMU	Synchrophasor measurement (1 PMU can be used for max. 8 voltages and 8 currents)	PMU	■				
AFD	Arc-protection (only with plug-in module ARC-CD-3FO)		■				
	Measured values, standard		■		■	■	■
	Measured values, extended: Min, Max, Avg		■				
	Switching statistic counters		■		■	■	■
	Circuit breaker wear monitoring	ΣIx, I²t, 2P	■				
	CFC (Standard, Control)		■		■	■	■
	CFC arithmetic		■		■	■	■
	Switching sequences function		■			■	
	Inrush current detection		■				
	External trip initiation		■				
	Control		■		■	■	■
	Fault recording of analog and binary signals		■		■	■	■
	Monitoring and supervision		■		■	■	■
	Protection interface, serial		■				
	Circuit Breaker		■		■	■	■
	Disconnecter		■		■	■	■
Function-points class:				0	0	0	75
The configuration and function points for your application can be ascertained in the SIPROTEC 5 order configurator under: www.siemens.com/siprotec							

2.15

Table 2.15/3 SIPROTEC 6MD86 - Functions and application templates

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- | | |
|---|------------------------|
| 1 | Not Configured |
| 2 | 1.5 CB type1 |
| 3 | Standard Double Busbar |
| 4 | 1.5 CB type2 |