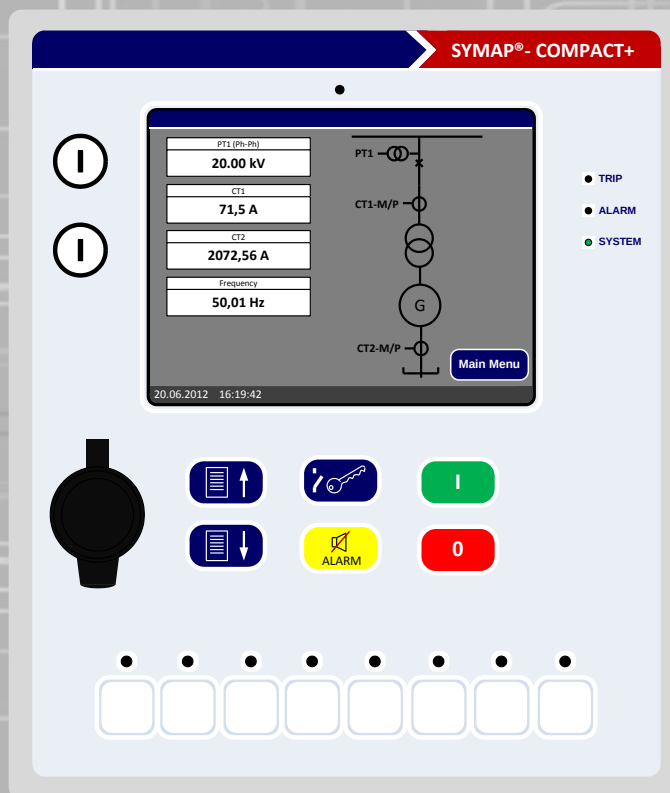
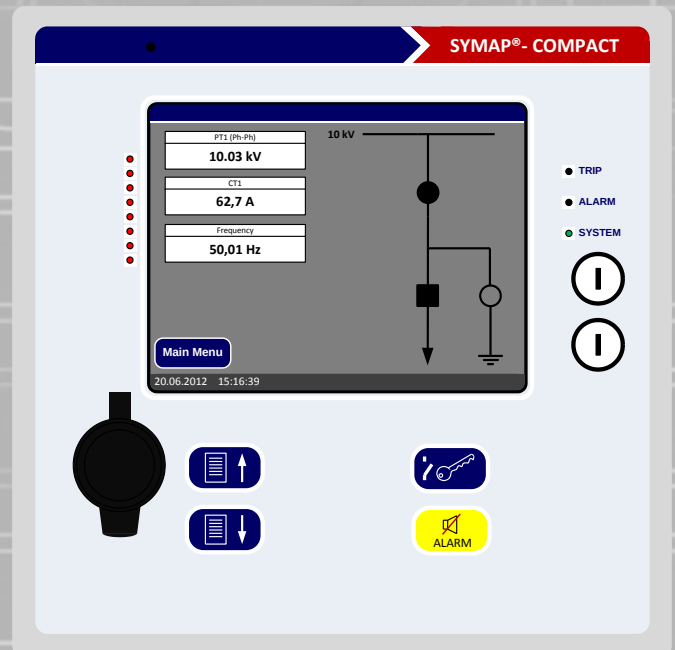


SYMAP[®]-Compact

Protection & Control



User Manual

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1 Introduction

The present manual describes the digital protection relays of the product line SYMAP[®]-Compact. The overview represents relay features, applications and functionalities.

Refer to tables 1-1 to 1-3 in section 1.3.1 for detailed information on software and hardware capacities of SYMAP[®]-Compact(+) device variants.

1.1 SYMAP[®]-Compact – General Outline

The SYMAP[®]-Compact(+) is a digital protection relay for use in low, medium and high-voltage systems and, by its integrated protective functions and its HMI interface capacities, it has proven to be an efficient and cost-effective solution for all types of switch panel. It is equipped with three high-performance micro-processors and offers a comprehensive range of protective functions for generators, motors (synchronous or asynchronous), transformers, power lines, and substations. All protection functions can be activated and used at a time and without restrictions. Both, digital and analog outputs can be connected to the controls of the main panel via SYMAP[®]-Compact(+) control unit. These features guarantee highest flexibility during commissioning and subsequent use. In addition, communication of the SYMAP[®]-Compact(+) and the SCADA system is possible via several serial ports and different data protocols.

1.2 Human machine interface (HMI)

Programming and operating a SYMAP[®]-Compact(+) device is very easy. A resistive touch screen allows menu navigation. Graphic representations, events and parameters can be individually created by PC and transferred to the SYMAP[®]-Compact(+) device. Such a customized design allows adapting the menus to your requirements.

To guarantee the highest possible safety standard, access to SYMAP[®]-Compact(+) parameters is protected by code system. Access is possible only after entry of password.

Menü navigation is to be done via touchscreen towards the main menu, which provides access to the submenus “Operating”, “Alarms & Events”, “Breaker”, “Parameters”, “Recording”, “Settings” and “Info”.

1.3 Functional scope

1.3.1 Hardware and Software equipment

The SYMAP®-Compact product line comprises *two* different *device types*:

- SYMAP®-Compact and
- SYMAP®-Compact+

The following tables 1-1 and 1-2 list the standard equipment of hardware components and software functions for all device variants.

Table 1-1 Standard equipment of SYMAP®-Compact(+) device variants – Hardware

PRODUCT LINE	SYMAP®-Compact									
DEVICE TYPE	Compact					Compact+				
DEVICE VARIANT	F0	F1	F2	F3	F4	F1	F2	F3	F4	
Application										
Portection system	☑	☑	☑	☑	☑	-	-	-	-	
Protection and Control system	-	-	-	-	-	☑	☑	☑	☑	
Dimensions										
Housing dimensions (WxHxD = (210x210x87)mm	☑	☑	☑	☑	☑	-	-	-	-	
Housing dimensions (WxHxD = (210x250x87)mm	-	-	-	-	-	☑	☑	☑	☑	
Front plate dimensions (WxHxD = (210x210x4)mm	☑	☑	☑	☑	☑	-	-	-	-	
Front plate dimensions (WxHxD = (210x250x4)mm	-	-	-	-	-	☑	☑	☑	☑	
Cutout (WxH = 192x192)mm	☑	☑	☑	☑	☑	-	-	-	-	
Cutout (WxH = 192x232)mm	-	-	-	-	-	☑	☑	☑	☑	
Front plate										
„Stucke“ Design	☑	☑	☑	☑	☑	☑	☑	☑	☑	
LED indications										
3 Status LEDs (Trip:red/ Alarm: green/ System: red/green)	☑	☑	☑	☑	☑	☑	☑	☑	☑	
8 Alarm LEDs (parametrizable; colour: red)	☑	☑	☑	☑	☑	-	-	-	-	
8 Alarm LEDs (parametrizable; colours: red/green)	-	-	-	-	-	☑	☑	☑	☑	
Membrane keyboard										
4 membrane keys (navigation/ parameter setting/reset/password)	☑	☑	☑	☑	☑	-	-	-	-	
6 membrane keys (navigation/parameter setting/reset/password/ON/OFF)	-	-	-	-	-	☑	☑	☑	☑	
Display										
Graphical LC-Display / Touchscreen (320x240 pixel)	☑	☑	☑	☑	☑	☑	☑	☑	☑	
Current measurement										
1 x CT1 (3-phase; 0–20 x In; sec. nominal current: see order code)	-	☑	☑	☑	☑	☑	☑	☑	☑	
1 x CT-GND1 (1-phase; sec. nominal current: see order code)	-	☑	☑	☑	☑	☑	☑	☑	☑	
Voltage measurement										
1 x PT1 (3-phase; meas. ranges**: 50 to 200V AC and 200 to 700 V AC)	☑	-	-	☑	☑	-	-	☑	☑	
1 x PT2 (3-phase; meas. ranges**: 50 to 200V AC and 200 to 700 V AC)	☑	-	-	-	☑	-	-	-	☑	
1 x PT3 (3-phase; meas. ranges**: 50 to 200V AC and 200 to 700 V AC)	-	-	-	-	-	-	-	-	☑	
1 x PT-GND1 (1-phase; meas. ranges**: 50 to 200V AC and 200 to 700 V AC)	☑	-	☑	☑	☑	-	☑	☑	☑	
Binary inputs										
5 pcs (10–220V DC/230V AC; rooted)	☑	☑	☑	☑	☑	-	-	-	-	
19 pcs. (10–220V DC/230V AC; rooted)	-	-	-	-	-	☑	☑	☑	☑	
Binary outputs										
5 pcs (potential-free contacts, NO)	☑	☑	☑	☑	☑	-	-	-	-	
12 pcs (potential-free contacts, NO)	-	-	-	-	-	☑	☑	☑	☑	
Communication interfaces										
1 x Mini-USB (side of housing; for parameter setting)	☑	☑	☑	☑	☑	☑	☑	☑	☑	
1 x CANBUS 0 (connection of extended boards*)	☑	☑	☑	☑	☑	☑	☑	☑	☑	
1 x RS485/422* (Modbus RTU; half- and full duplex*)	☑	☑	☑	☑	☑	☑	☑	☑	☑	
1 x USB-A (at front plate; for parameter setting)	☑	☑	☑	☑	☑	☑	☑	☑	☑	

* not available yet; ** to be set by parameter

In compliance with the standards of the American National Standards Institute (ANSI), product line SYMAP®-Compact offers different protection functions according to the device variants (SYMAP®-Compact F0 bis F4 bzw. SYMAP®-Compact+ F1 bis F4).

Table 1-2 Standard equipment of SYMAP®-Compact(+) device variants – Software functions

PRODUCT LINE		SYMAP®-Compact									
DEVICE TYPE		Compact					Compact+				
DEVICE VARIANT		F0	F1	F2	F3	F4	F1	F2	F3	F4	
Protection functions (ANSI Code)											
24	Overexcitation U/F*	-	-	-	☑	☑	-	-	☑	☑	
25	Synchronizing	☑	-	-	-	☑	-	-	-	☑	
27	Under voltage	☑	-	-	☑	☑	-	-	☑	☑	
27Q	Reactive power/Under Voltage (BDEW)	-	-	-	☑	☑	-	-	☑	☑	
27T	Under Voltage, time-dependent (BDEW; Fault ride through)	☑	-	-	☑	☑	-	-	☑	☑	
32	Directional Power	-	-	-	☑	☑	-	-	☑	☑	
37	Undercurrent*	-	☑	☑	☑	☑	☑	☑	☑	☑	
40	Loss of Field*	-	-	-	☑	☑	-	-	☑	☑	
46	Negative phase sequence I2>*	-	☑	☑	☑	☑	☑	☑	☑	☑	
47	Phase sequence / Phase balance*	-	-	-	☑	☑	-	-	☑	☑	
49	Thermal Replica*	-	☑	☑	☑	☑	☑	☑	☑	☑	
50BF	Breaker failure	-	☑	☑	☑	☑	☑	☑	☑	☑	
50/51	Time Overcurrent	-	☑	☑	☑	☑	☑	☑	☑	☑	
51LR	Locked Rotor*	-	☑	☑	☑	☑	☑	☑	☑	☑	
50/51G	Time Earth Overcurrent	-	☑	☑	☑	☑	☑	☑	☑	☑	
51/46VR	Overcurrent (voltage restrained)	-	-	-	☑	☑	-	-	☑	☑	
55	Power factor*	-	-	-	☑	☑	-	-	☑	☑	
59	Over voltage	☑	-	-	☑	☑	-	-	☑	☑	
59N/G	Neutral Voltage Displacement (NVD)	☑	-	☑	☑	☑	-	☑	☑	☑	
64REF	Restricted earth fault*	-	☑	☑	☑	☑	☑	☑	☑	☑	
66	No. Of Starts (Motor)*	-	☑	☑	☑	☑	☑	☑	☑	☑	
67	Directional Time Overcurrent	-	-	-	☑	☑	-	-	☑	☑	
67G	Directional Time Earth Overcurrent	-	-	☑	☑	☑	-	☑	☑	☑	
74TC	Trip circuit supervision	☑	☑	☑	☑	☑	☑	☑	☑	☑	
78	Vector surge	☑	-	-	☑	☑	-	-	☑	☑	
78S	Power Swing / Out-Of-Step*	-	-	-	☑	☑	-	-	☑	☑	
79	Automatic Reclose (AR)*	-	☑	☑	☑	☑	☑	☑	☑	☑	
81	Under / Over Frequency	☑	-	-	☑	☑	-	-	☑	☑	
81R	RoCoF (df/dt)	☑	-	-	☑	☑	-	-	☑	☑	
86	Lockout relay	☑	☑	☑	☑	☑	☑	☑	☑	☑	
95i	Harmonics stabilizer	-	☑	☑	☑	☑	☑	☑	☑	☑	
CLP	Cold Load Pickup*	-	☑	☑	☑	☑	☑	☑	☑	☑	
CTS	Current transformer supervision	-	☑	☑	☑	☑	☑	☑	☑	☑	
PTS	Potential transformer supervision	☑	-	-	☑	☑	-	-	☑	☑	
SOTF	Switch-On-To-Fault*	-	☑	☑	☑	☑	☑	☑	☑	☑	
YG	Neutral- Admittance-Earth-Fault	-	-	☑	☑	☑	-	☑	☑	☑	
TG	Transient/Intermittent-Earth-Fault	-	-	☑	☑	☑	-	☑	☑	☑	
Control and Interlocking											
Indirect control: 1 switching element; Field interlocking: up to 3 sw. devices)		☑	☑	☑	☑	☑	-	-	-	-	
Indirect control: 5 switching elements; Field interlocking: up to 8 sw. devices)		-	-	-	-	-	☑	☑	☑	☑	
Measurement (indication)											
Current measurement values		-	☑	☑	☑	☑	☑	☑	☑	☑	
Voltage measurement values		☑	-	-	☑	☑	-	-	☑	☑	
Power measurement values		-	-	-	☑	☑	-	-	☑	☑	
MIN*/-MAX- and average* (AVG) measuring values (statistic)		☑	☑	☑	☑	☑	☑	☑	☑	☑	
Recording functions											
Alarm control		☑	☑	☑	☑	☑	☑	☑	☑	☑	
Active Alarms/Events		☑	☑	☑	☑	☑	☑	☑	☑	☑	
Event recorder		☑	☑	☑	☑	☑	☑	☑	☑	☑	
Fault recorder		☑	☑	☑	☑	☑	☑	☑	☑	☑	
Disturbance recorder		☑	☑	☑	☑	☑	☑	☑	☑	☑	
Counters											
Operating hours		☑	☑	☑	☑	☑	☑	☑	☑	☑	
Energy counters		-	-	-	☑	☑	-	-	☑	☑	
Short circuit currents*		-	☑	☑	☑	☑	☑	☑	☑	☑	
Switching operations (breaker control)											
Monitoring functions											
Wire fault supervision: Binary inputs*		☑	☑	☑	☑	☑	☑	☑	☑	☑	
Short circuit supervision: Binary inputs*		☑	☑	☑	☑	☑	☑	☑	☑	☑	

Aux. power supervision: Binary outputs (Shunt 1 and 2 only)*	☑	☑	☑	☑	☑	☑	☑	☑	☑
Logical functions									
PLC (programmable logic control)	☑	☑	☑	☑	☑	☑	☑	☑	☑
Graphical functions									
Configurable menu pages*	☑	☑	☑	☑	☑	☑	☑	☑	☑
Trend representation of measuring values*	☑	☑	☑	☑	☑	☑	☑	☑	☑
Vektor representation of measuring values *	☑	☑	☑	☑	☑	☑	☑	☑	☑
Representation of harmonics*	☑	☑	☑	☑	☑	☑	☑	☑	☑

* not available yet

NOTE: Please note that the above mentioned table represents the availability of protection functions at the final development state. At the time, only those protective functions are available, which are described in this manual!

Tabelle 1-3 gives conclusion about all ordering options of all device variants.

Table 1-3 Ordering options for device variants of product line SYMAP®-Compact

PRODUCT LINE		SYMAP®-Compact									
DEVICE TYPE		Compact					Compact+				
DEVICE VARIANT		F0	F1	F2	F3	F4	F1	F2	F3	F4	
Ordering option	Ordering identifier										
	Phase current transformer CT1										
A	without	☑	-	-	-	-	-	-	-	-	
B	CT1: 1A sec. nominal current (0–20x In)	-	☑	☑	☑	☑	☑	☑	☑	☑	
C	CT1: 5A sec. nominal current (0–20x In)	-	☑	☑	☑	☑	☑	☑	☑	☑	
D	CT1: 1A and 5A sec. nominal current (0–20x In)	-	-	-	-	-	-	-	-	-	
E	CT1-MP: 1A sec. nominal current (0–20x In)	-	-	-	-	-	☑	☑	☑	☑	
F	CT1-MP: 5A sec. nominal current (0–20x In)	-	-	-	-	-	☑	☑	☑	☑	
	Phase current transformer CT2										
0	without	☑	-	-	-	-	-	-	-	-	
1	CT2: 1A sec. nominal current (0–20x In)	-	-	-	-	-	☑	☑	☑	☑	
2	CT2: 5A sec. nominal current (0–20x In)	-	-	-	-	-	☑	☑	☑	☑	
	Phase current transformer CT3										
A	without	☑	-	-	-	-	-	-	-	-	
B	CT3: 1A sec. nominal current (0–20x In)*	-	-	-	-	-	☑	☑	☑	☑	
C	CT3: 5A sec. nominal current (0–20x In)*	-	-	-	-	-	☑	☑	☑	☑	
	Ground current transformer CT-GND1										
0	without	☑	-	-	-	-	-	-	-	-	
1	CT-GND1: 1A sec. nominal current (0–20x In)	-	☑	☑	☑	☑	☑	☑	☑	☑	
2	CT-GND1: 5A sec. nominal current (0–20x In)	-	☑	☑	☑	☑	☑	☑	☑	☑	
3	CT-GND1: 1-3000mA sec. nominal current	-	☑	☑	☑	☑	☑	☑	☑	☑	
	Ground current transformer CT-GND2										
A	without	☑	-	-	-	-	-	-	-	-	
B	CT-GND2: 1A sec. nominal current (0–20x In)*	-	-	-	-	-	☑	☑	☑	☑	
C	CT-GND2: 5A sec. nominal current (0–20x In)*	-	-	-	-	-	☑	☑	☑	☑	
D	CT-GND2: 1-3000mA sec. nominal current *	-	-	-	-	-	☑	☑	☑	☑	
E	CT-GND2: DC current measurement*	-	-	-	-	-	☑	☑	☑	☑	
	Power supply – Device										
0	9-36 V DC; (Un: 12V DC; 24V DC)	☑	☑	☑	☑	☑	☑	☑	☑	☑	
1	40-160 V DC; (Un: 48V DC**; 60V DC; 10V DC); **:Un+20%; -16%	☑	☑	☑	☑	☑	☑	☑	☑	☑	
2	120-370 V DC; 85-264 V AC; (Un: 220V DC; 110V AC; 230V AC***); ***:Un+15%; -20%	☑	☑	☑	☑	☑	☑	☑	☑	☑	
	Binary inputs										
A	Standard (see device variant)	☑	☑	☑	☑	☑	☑	☑	☑	☑	
B	19 pcs (Standard + 14 pcs)	☑	☑	☑	☑	☑	-	-	-	-	
	Binary outputs										
0	Standard (see device variant)	☑	☑	☑	☑	☑	☑	☑	☑	☑	
1	12 pcs (Standard + 7 pcs)	☑	☑	☑	☑	☑	-	-	-	-	
	Analog Inputs and Outputs										
A	without (Standard)	☑	☑	☑	☑	☑	☑	☑	☑	☑	

B	2 pcs Analog Inputs (4–20mA)*; and 2 pcs Analog Inputs (Resistor)*; and 2 pcs Analog Outputs (4–20mA)*	-	-	-	-	-	☑	☑	☑	☑
C	2 pcs Analog Inputs (4–20mA)*; and 2 pcs Analog Inputs (Resistor)*; and 2 pcs Analog Outputs (4–20mA)*; and 2 pcs Analog Outputs (+/-20mA)*	-	-	-	-	-	☑	☑	☑	☑
E	2 pcs Analog Inputs (4–20mA)*; and 2 pcs Analog Inputs (Resistor)*; and 2 pcs Analog Outputs (4–20mA)*; and 2 pcs Analog Outputs (+/-20mA)*; and 1 pcs Analog Output (+/-10V)*	-	-	-	-	-	☑	☑	☑	☑
F	2 pcs Analog Inputs (4–20mA)*; and 2 pcs Analog Inputs (Resistor)*; and 2 pcs Analog Outputs (4–20mA)*; and 2 pcs Analog Outputs (+/-20mA)*; and 1 pcs Analog Output (PWM)*	-	-	-	-	-	☑	☑	☑	☑
Communication – Basic										
0	Standard (Modbus RTU; RS422/RS485; half and full duplex*)	☑	☑	☑	☑	☑	☑	☑	☑	☑
1	Blue Vision*; RS422/RS485; half and full duplex	-	-	-	-	-	-	-	-	-
Communication – Interfaces										
A	Standard (see device variant)	☑	☑	☑	☑	☑	☑	☑	☑	☑
B	CANBUS3* (Engine control)	-	-	-	-	-	-	-	-	-
C	USB-A (at front plate)	-	-	-	-	-	-	-	-	-
3	CANBUS3 and USB-A (at front plate); (Engine control)*	-	-	-	-	-	-	-	-	-
D	FO; line diff. prot.(2km; POF 2,5 (ST [®] plug); multimode 860 nm; diameter 65/125 um)*	-	☑	☑	☑	☑	☑	☑	☑	☑
E	FO; line diff. prot.(20km; POF 2,5 (ST [®] plug); monomode 1300 nm; diameter 9/125 um)*	-	☑	☑	☑	☑	☑	☑	☑	☑
F	RS422 (full duplex, distance: 300m); line diff. protection*	-	☑	☑	☑	☑	☑	☑	☑	☑
Communication – SCADA										
0	without (Standard)	☑	☑	☑	☑	☑	☑	☑	☑	☑
1	Profibus DP, RS485: D-SUB9	☑	☑	☑	☑	☑	☑	☑	☑	☑
2	Profibus DP, FO*	☑	☑	☑	☑	☑	☑	☑	☑	☑
3	IEC 60870-5-103, RS485	☑	☑	☑	☑	☑	☑	☑	☑	☑
4	IEC 60870-5-103, FO*	☑	☑	☑	☑	☑	☑	☑	☑	☑
5	IEC 61850, RJ45 (Ethernet, ring topology)*	☑	☑	☑	☑	☑	☑	☑	☑	☑
6	IEC 61850, RJ45 (Ethernet, star topology)*	☑	☑	☑	☑	☑	☑	☑	☑	☑
7	IEC 61850, FO (ring topology)*	☑	☑	☑	☑	☑	☑	☑	☑	☑
8	IEC 61850, FO (star topology)	☑	☑	☑	☑	☑	☑	☑	☑	☑
9	Modbus TCP/IP, RJ45 (Ethernet)*	☑	☑	☑	☑	☑	☑	☑	☑	☑
Recorder unit										
A	Standard (see device variant)	☑	☑	☑	☑	☑	☑	☑	☑	☑
B	with*, GenSet controls only!	☑	☑	☑	☑	☑	☑	☑	☑	☑
Additional protection functions										
0	without (Standard)	☑	☑	☑	☑	☑	☑	☑	☑	☑
1	ANSI 21: Distance protection*	-	-	-	☑	☑	-	-	☑	☑
2	ANSI 87: Current differential protection	-	☑	☑	☑	☑	☑	☑	☑	☑
3	G59 (ANSI 78 and 81R acc. to British GridCode)	☑	-	-	☑	☑	-	-	☑	☑
4	G59 and ANSI 87	-	-	-	☑	☑	-	-	☑	☑
Key switches										
A	without (Standard)	☑	☑	☑	☑	☑	☑	☑	☑	☑
B	3 x USB sticks, hardware-coded*	☑	☑	☑	☑	☑	☑	☑	☑	☑
C	1 key switch*	☑	☑	☑	☑	☑	☑	☑	☑	☑
D	2 key switches*	☑	☑	☑	☑	☑	☑	☑	☑	☑
Control and interlocking										
0	Standard (see device variant)	☑	☑	☑	☑	☑	☑	☑	☑	☑
1	Direct control: 8 SD via ext. power module*	-	-	-	-	-	☑	☑	☑	☑
2	Indirect control: 1 SD; Field interlocking: 3 SD	☑	☑	☑	☑	☑	-	-	-	-
Safety Device										
A	without (Standard device)	☑	☑	☑	☑	☑	☑	☑	☑	☑
B	DTOC protection (redundancy of first degree)	-	-	-	-	-	☑	☑	☑	☑
Front plate (Design)										
0	Standard ("Stucke"-Design)	☑	☑	☑	☑	☑	☑	☑	☑	☑
1	OEM-Design (on request!)	☑	☑	☑	☑	☑	☑	☑	☑	☑
Detached HMI panel										
A	without (Standard device)	☑	☑	☑	☑	☑	☑	☑	☑	☑
B	Basic device with detached HMI	☑	☑	☑	☑	☑	☑	☑	☑	☑

C	Basic device <u>without</u> detached HMI	☒	☒	☒	☒	☒	☒	☒	☒	☒
	Steckverbindung UI-Messung									
0	WEIDMÜLLER (I-measuring connector without integr. short-circuiters)	☒	☒	☒	☒	☒	☒	☒	☒	☒
1	SEOIL (I-measuring connector with integrated short-circuiters)	☒	☒	☒	☒	☒	☒	☒	☒	☒
	Melde-LEDs Frontplatte									
A	Standard (see device variant)	☒	☒	☒	☒	☒	☒	☒	☒	☒
B	16 parametrizable LEDs; (on request!)	-	-	-	-	-	☒	☒	☒	☒

* not available yet

1.4 Diagnostics and Monitoring

All of the three SYMAP[®]-Compact(+) microprocessors have an integrated system for mutual monitoring. Self supervision comprises the internal hardware components of SYMAP[®]-Compact(+), and is being done by cyclical requests and plausibility checks.

SYMAP[®]-Compact detects the following internal faults:

Table 1-4 SYMAP[®]-Compact(+) Self supervision – error detection

Symap-Compact selfsupervision description				
Type of error	Description	Cycle (ms)	Delay (sec)	Detailed reason
Serial Flash	Supervision of the Serial Flash	1000	30	Wrong return value (ID) from driver
CU Parameter file	Supervision of the Parameter file	1000	30	CRC checksum error
MU Parameter file	Supervision of the Parameter file	1000	30	CRC checksum error
GU Parameter file	Supervision of the Parameter file	1000	30	CRC checksum error
CU Unit	Supervision of the CU processor	1000	10	No Sign Of Life message
MU Unit	Supervision of the MU processor	1000	10	No Sign Of Life message
GU Unit	Supervision of the GU processor	1000	10	No Sign Of Life message
CAN intern	Supervision of the internal communication	1000	1	CAN Bus Off detected
Binary Inputs ADC	Supervision of the ADC for the Binary Inputs	100	10	ADC-Test channel deviation
Binary Outputs	Supervision of the Binary Outputs	500	10	Wrong feedbacks of the output relays

Right after detection of an internal error the measures – listed in table 1-3 – will be performed. In cast that the measures are not successful event [E9000] will be activated, which could be assigned to any binary output.

Table 1-5 SYMAP[®]-Compact(+) Self supervision – debugging and error message

Symap-Compact selfsupervision treatment		
Type of error	Measure	Activate event [E9000]
Serial Flash	Reset the Serial Flash controller	after third repetition
CU Parameter file	System reboot	after third repetition
MU Parameter file	System reboot	after third repetition
GU Parameter file	System reboot	after third repetition
CU Unit	Initialize the CAN controller again	after third repetition
MU Unit	Initialize the CAN controller again	after third repetition
GU Unit	Initialize the CAN controller again	after third repetition
CAN intern	Initialize the CAN controller again	immediately
Binary Inputs ADC	Reset, and reread of ADC (analog digital converter) values	after third repetition
Binary Outputs	Reset the relay driver. Write the relay driver again	after third repetition

CAUTION: In case of a power supply failure, all binary outputs are being deenergized! While “booting” mode the states of all binary outputs are maintained!

Following errors will not be detected by SYMAP[®]-Compact(+):

All of the three controllers monitor each other. This monitoring is no longer afforded if all of the three controllers have failed.

Monitoring of the following components is being prepared:

- Ethernet controller
- Externer CANBUS
- Serial communication channel

1.5 Terminal Connections

The SYMAP®-Compact(+) device is connected via plug connectors at the back of the device. This makes eventual device replacement simple. The terminal blocks are divided into the following groups:

- Analog inputs for measurement
- Binary inputs and outputs
- Communication interfaces

Table 1-6 System supervision events

Event	Description	Cycle (ms)	Delay (sec)	Detailed reason
9000	Common alarm of system supervision	-	-	Active if any of the system supervision events are active
9001	CU CPU communication failure	1000	-	CAN Bus OFF
9002	MU CPU communication failure	1000	30	No CAN messages
9003	GU CPU communication failure	1000	30	No CAN messages
9004	SU CPU communication failure	1000	30	No CAN messages
9010	CU DRAM error	-	-	Write-Read-Test error (@ PowerON)
9011	CU Serial Flash error	1000	30	Wrong return value (ID) from driver
9012	CU Binary Inputs ADC TLC545 error	1000	30	Test channel out of range
9013	CU Binary Outputs DAC MAX4820 error	500	20	Wrong feedback signals
9020	CU Parameter file error	1000	-	CRC error
9030	Event system feedback loop detected	1000	60	More than 500 event changes per sec during 60 seconds
9040	MU kWh counter crc error	-	-	CRC error in SRAM (@ WD reset)
9041	MU EEPROM error			Communication error (@ Systemstart)
9042	MU Calibration file crc error			CRC error in EEPROM (@ Systemstart)
9043	MU Parameter file error	6000 0	180	CRC error
9044	MU ADC0 error	1000 0	30	Wrong channel numbers from ADC
9045	MU ADC1 error	1000 0	30	Wrong channel numbers from ADC

Note: All system supervision events can only be reset with ACK.

1.5.1 Analog Inputs for Measurement

Depending on the device variant and ordering options, SYMAP®-Compact(+) provides a different number of measurement inputs for current and voltage measurement.

NOTE: The SYMAP®-Compact(+) has been designed for being operated with conventional current and potential transformers.

If current transformer plug is disconnected (SEOIL plugs only, see ordering option), circuits close automatically to preclude interruption of CT circuits. Find all possible SYMAP®-Compact(+) connections for current and potential transformers listed in the following:

- 3 current measurement inputs CT1-M/P*
- optionally**: 3 additional current measurement inputs CT2-M/P (e.g. 2-winding transformer differential protection)
- optionally**: 3 additional current measurement inputs CT3-M/P (e.g. 3-winding transformer differential protection)
- 1 current measurement input CT-GND1 (ground current)
- optionally***: 1 current measurement input CT-GND2 (e.g. second ground current)

- 3 potential measurement inputs PT1 (e.g. voltage at incoming feeder)
- 3 potential measurement inputs PT2 (e.g. voltage at busbar 1)
- 3 potential measurement inputs PT3 (e.g. voltage at busbar 2)**
- 1 potential measurement input PT-GND1 (residual voltage)

* CT1: separate terminal connections: CT1-M for measuring winding and CT1-P for protection winding of current transformers; SYMAP®-Compact+ only

** SYMAP®-Compact+

*** SYMAP®-Compact+: device variants without CT3 and CT1-M only! (not available yet!)

NOTE: In case of simultaneous use of measuring transformers on CT1-M and protective transformers on CT1-P, the protection functions process values of CT1-M for current values which are less or equal $3 \times I_n$. For higher current values the measuring values of the CT1-P will be used.
In case of a current transformer failure at CT1-M and a current-carrying CT connected to CT1-P, all current protection functions will use current values within the range of $3 \times I_n$.

CAUTION: In case that at least one voltage measurement input (e.g. PT1) is interconnected by V-connection of the voltage transformers to a power system, you must not connect anything to terminal "N"!

If combined transformers (combined sensors) are used, the SYMAP®-Compact(+) allows connection of feeding current/voltage:

- 3 current measurement inputs for feeding current
- 3 voltage measurement inputs for feeding voltage

Via analog measurement inputs the following values are measured and displayed:

- Phase-to-Phase and Phase-to-Earth voltages of incoming feeder, busbar 1 and busbar 2
- 3-phase feeding current (average/maximum)
- Frequencies of all systems (minimum/maximum)
- Ground fault current (maximum)
- Residual voltage
- Operating hours

1.5.2 Binary Inputs and Outputs

SYMAP®-Compact(+) offers the following binary inputs and relay outputs:

- 5/(19)* binary inputs
- 5/(12)* binary outputs (output relays)

* option for SYMAP®-Compact F0 to F4

1.5.3 Service communication interface

To operate the SYMAP®-Compact(+) device by using a PC/notebook, there is a USB-A interface located at the device front, and a mini-USB interface at the side of the housing.

1.5.4 Grounding Instructions

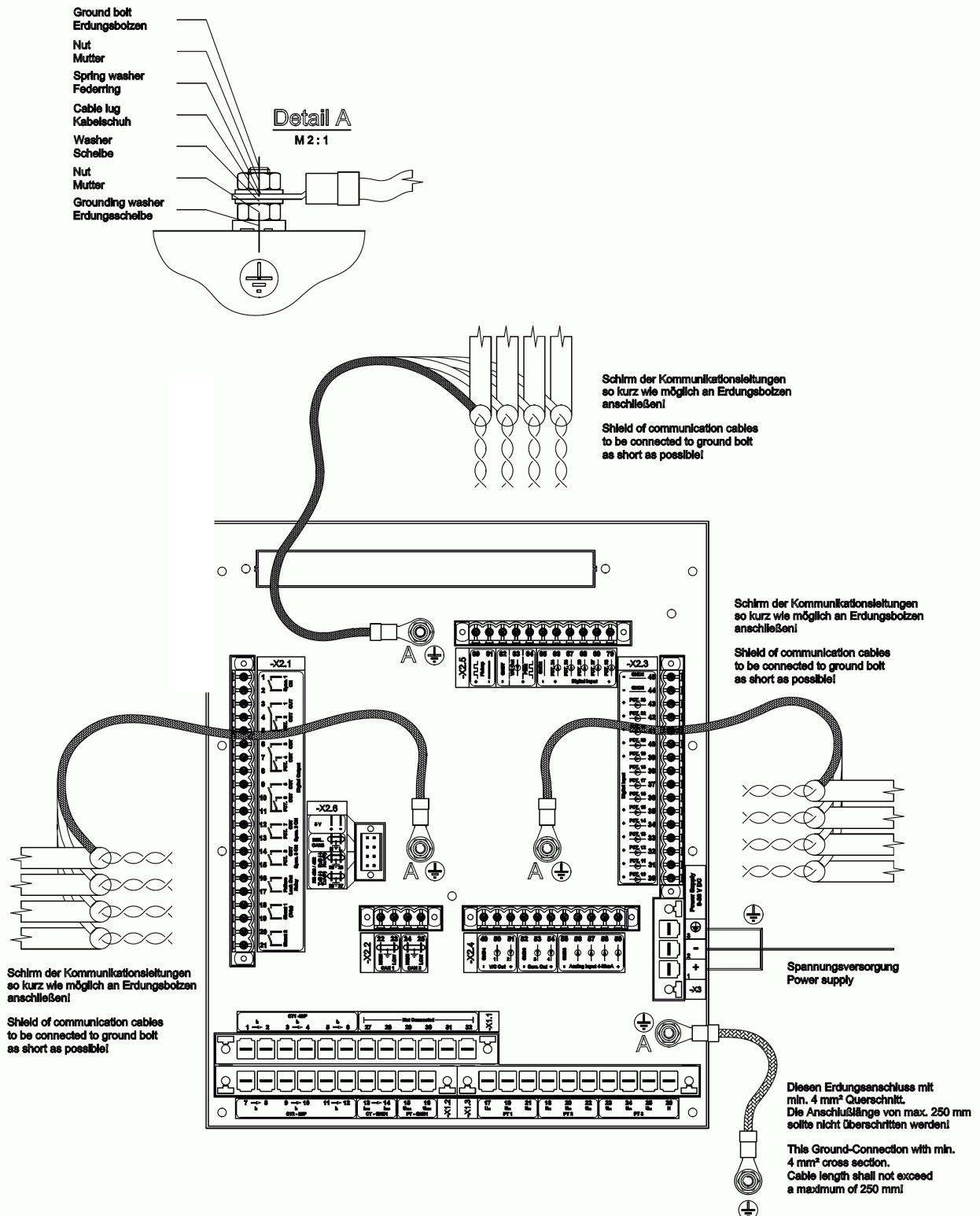


Figure 1-1 Preliminary grounding instruction for SYMAP®-Compact(+)

Ground straps of 250mm in length and above are to be used to connect the earthing connection point of SYMAP[®]-Compact(+) housing to the panel housing. The following table provides information about standard cross sections and dimensions of ground straps to be applied in dependence of their lengths.

Table 1-7 Ground straps – Standard cross sections and dimensions

Length (l) [mm]	Cross section (A) [mm ²]	Diameter of wire (d) [mm]	Dimensions (width x thickness) [mm ²]
250 – 500	6	0,16	9 x 1
500 – 750	10	0,16	14 x 1,5
750 – 1000	16	0,16	20 x 1,6

1.5.5 Connection Diagrams

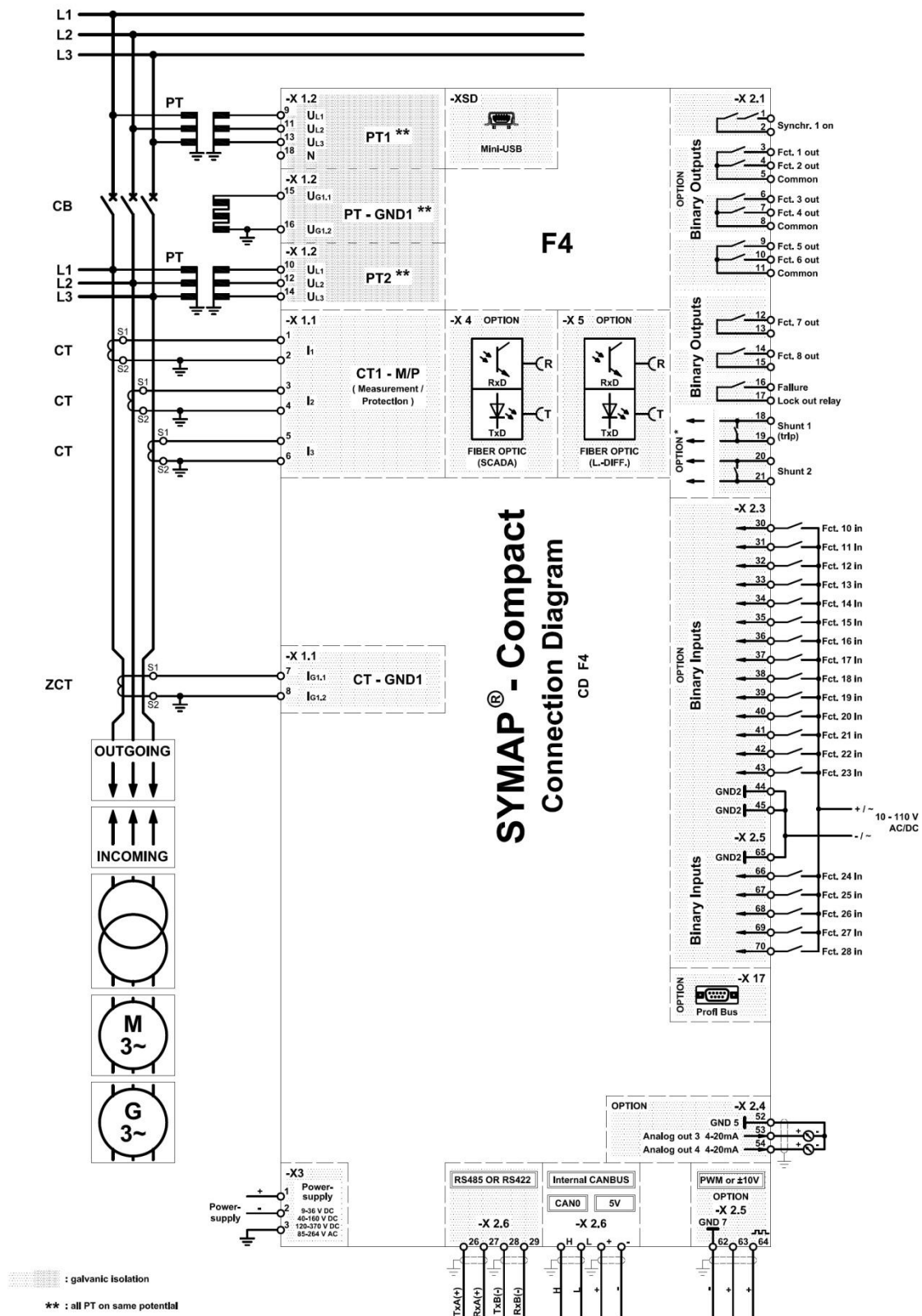


Figure 1-2 Connection diagram for SYMAP®-Compact F4

NOTE: Hardware configurations of device variants F0 to F4 see Table 1-1 to Table 1-3

SYMAP[®]-Compact

1.5.6 Plug-In Connection for Device Supply

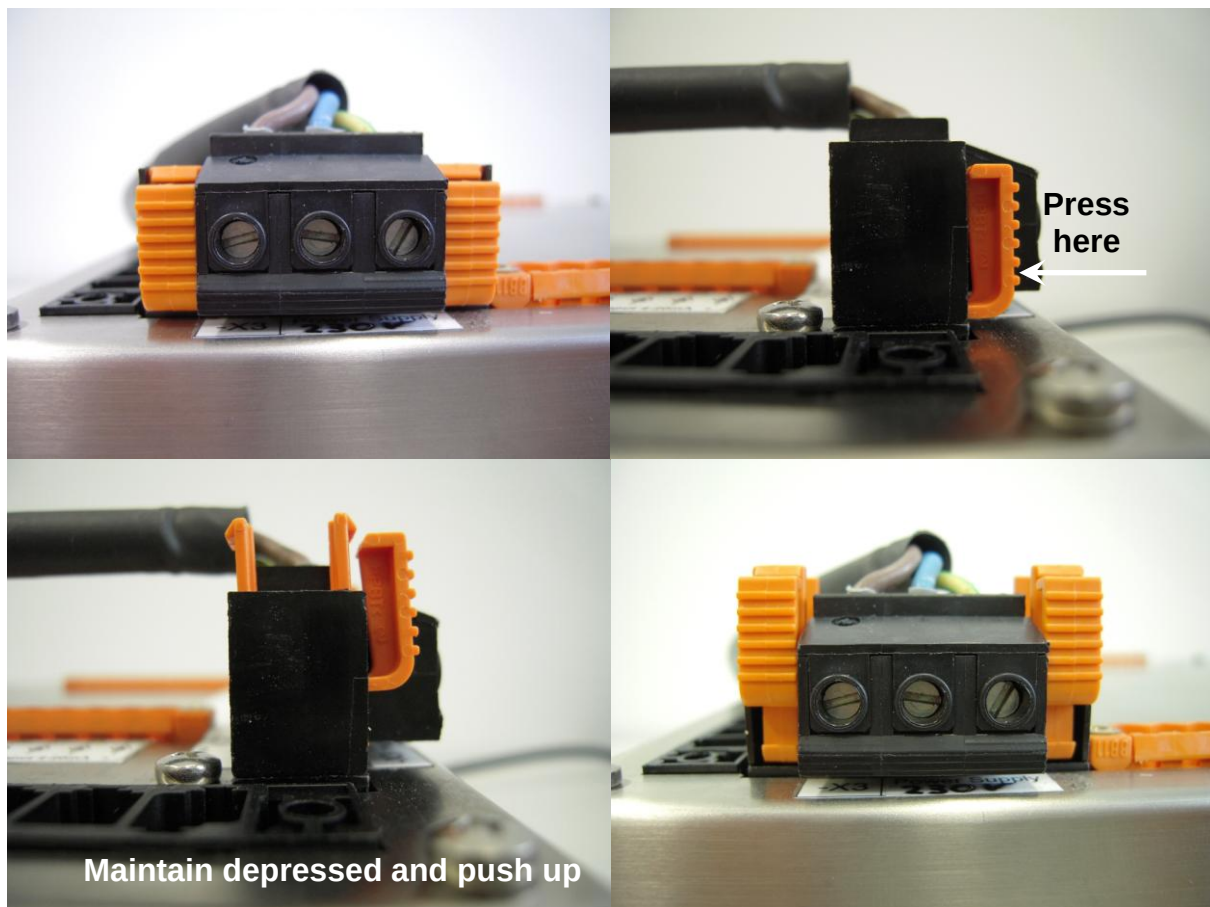


Figure 1-4 Loosen plug-in locking of device supply

NOTE: For release of the plug-in connector please press the lower area of the grooved side since the lock catches here.

2 Operation of SYMAP®-Compact(+)

This section describes the user interface (HMI) which comprises the display elements and the keypads.

2.1 Front Panel

The comfortable interface of the SYMAP®-Compact(+) consists of a large graphic LCD touchscreen. Following figures represent the two different front panels and their elements in detail.

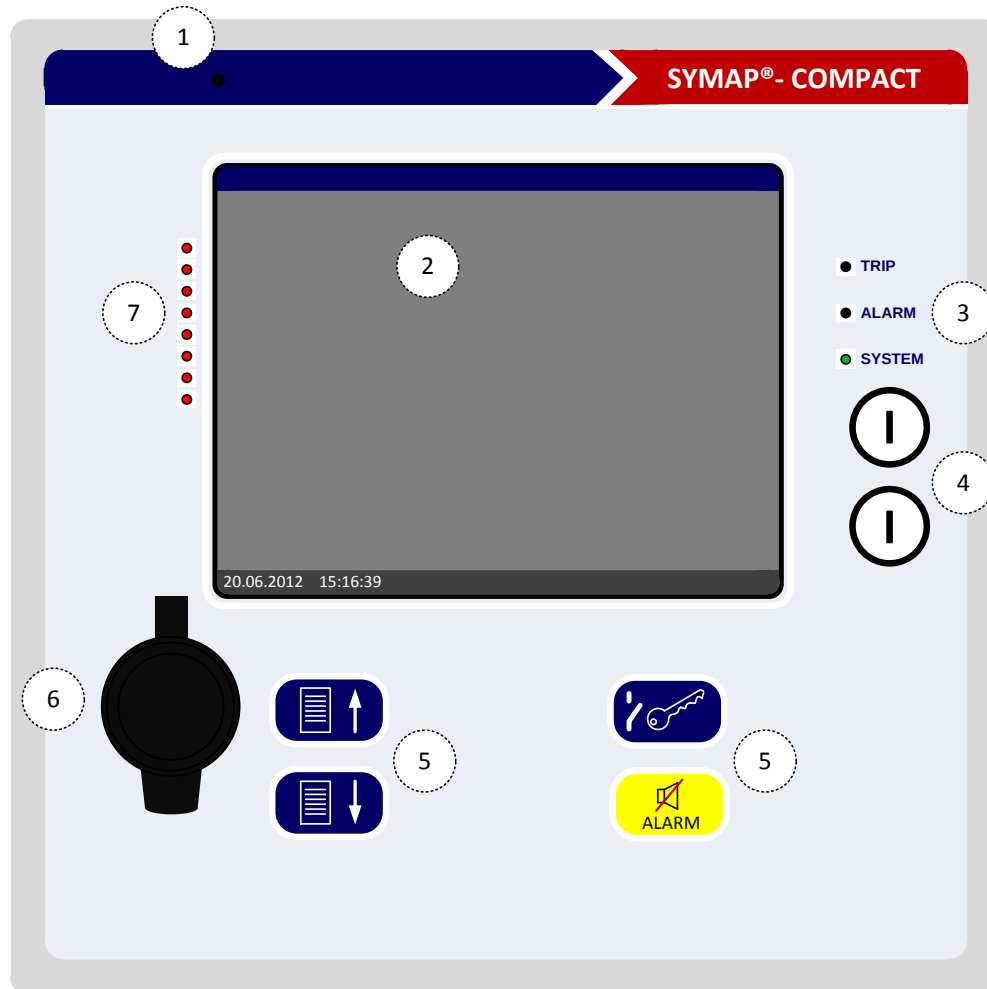


Figure 2-1 Display and operating elements – SYMAP®-Compact front panel

1. Light sensor for display brightness control (in preparation)
2. Back-lit LCD touchscreen
3. Alarm LEDs for indication of protection trip, alarms and system state
4. Key switches (ordering option) for selection of user levels
5. Parametrizable function keys
6. USB-A communication interface for PC/Notebook (SCPT software)
7. 8 parametrizable LED indications (monochrome red); plain text messages via configurable user pages

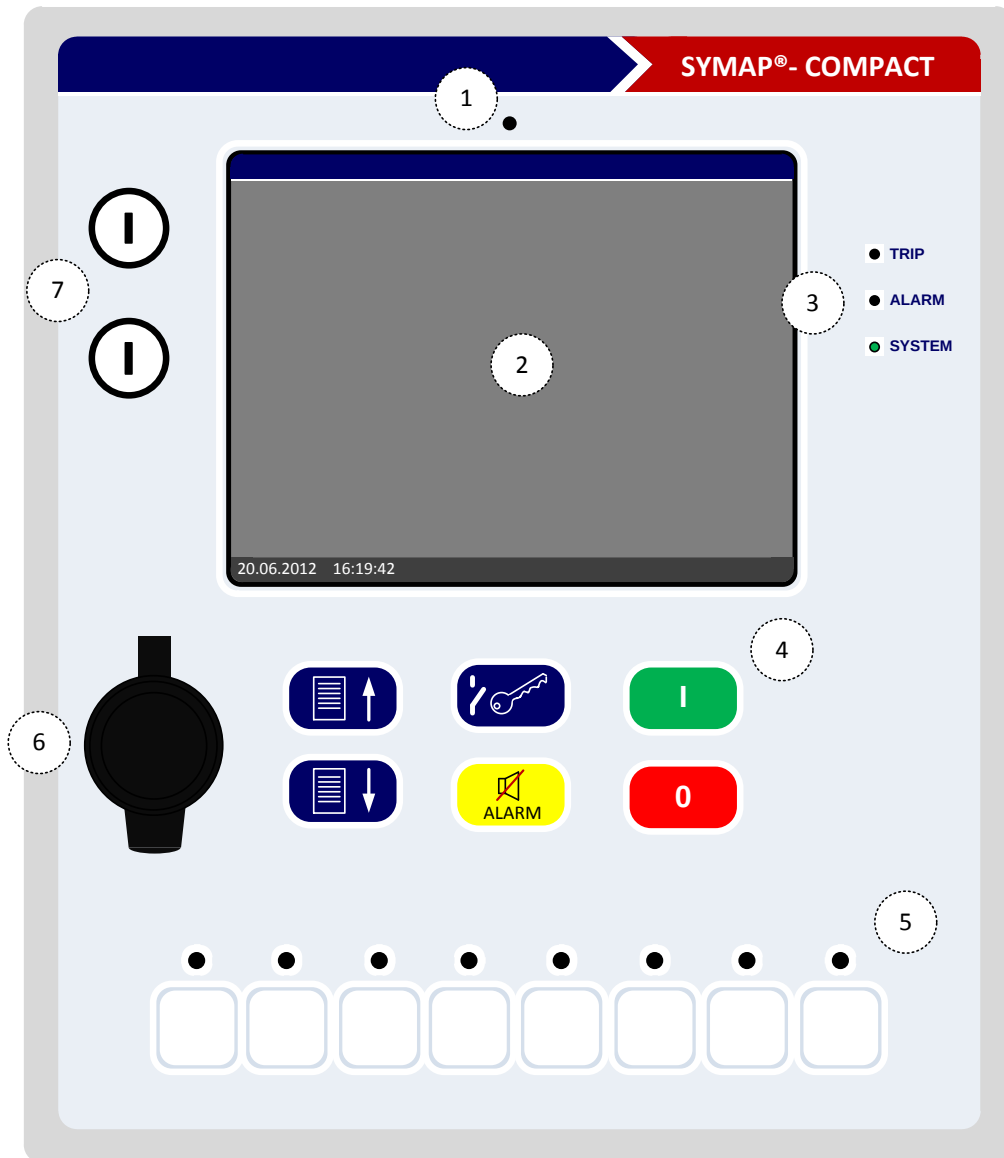


Figure 2-2 Display and operating elements – SYMAP®-Compact+ front panel

1. Light sensor for display brightness control (in preparation)
2. Back-lit LCD touchscreen
3. Alarm LEDs for indication of protection trip, alarms and system state
4. Parametrizable function keys
5. 8 parametrizable LED indications (multi-coloured: green/red/orange) and labelling area for LED-indications (inserted strip, see the following picture: mm as units of measure)
6. USB-A communication interface for PC/Notebook (SCPT software)
7. Key switches (ordering option) for selection of user levels

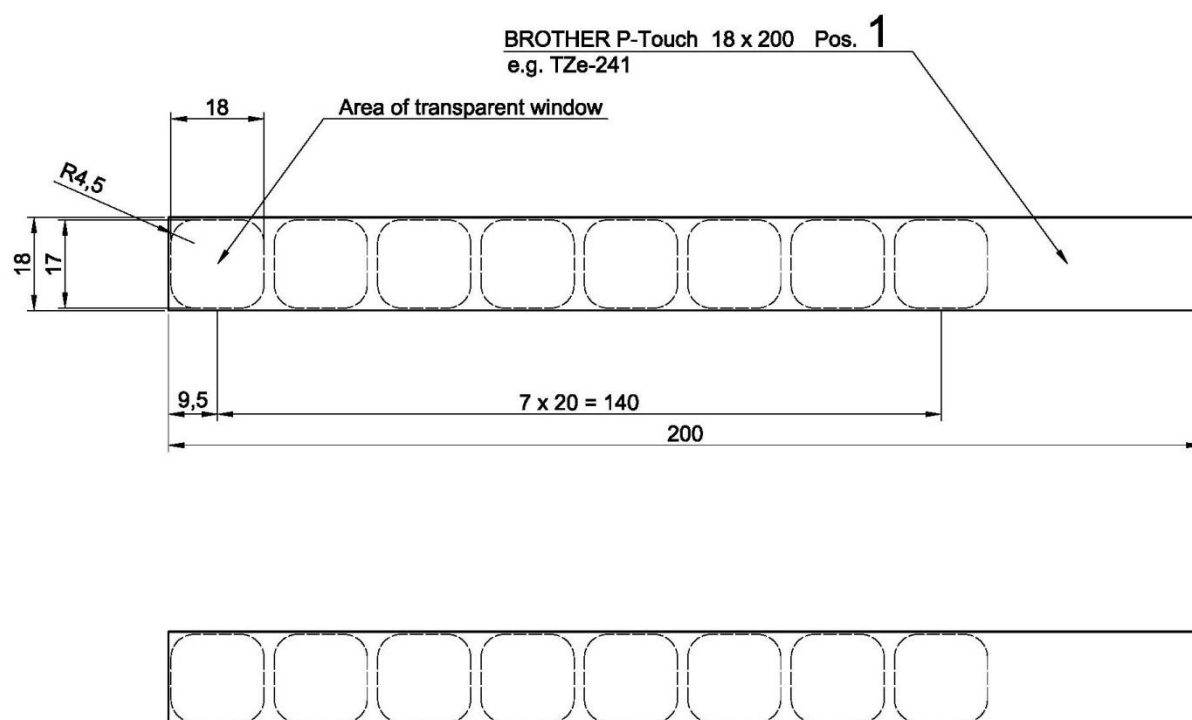


Figure 2-3 Insertable label strip for LEDs

2.2 Back Panel

2.2.1 Reference to documentation



The label “Consider documentation” at the back panel of SYMAP®-Compact(+) points to the location of an exchangeable, rechargeable battery within the device.

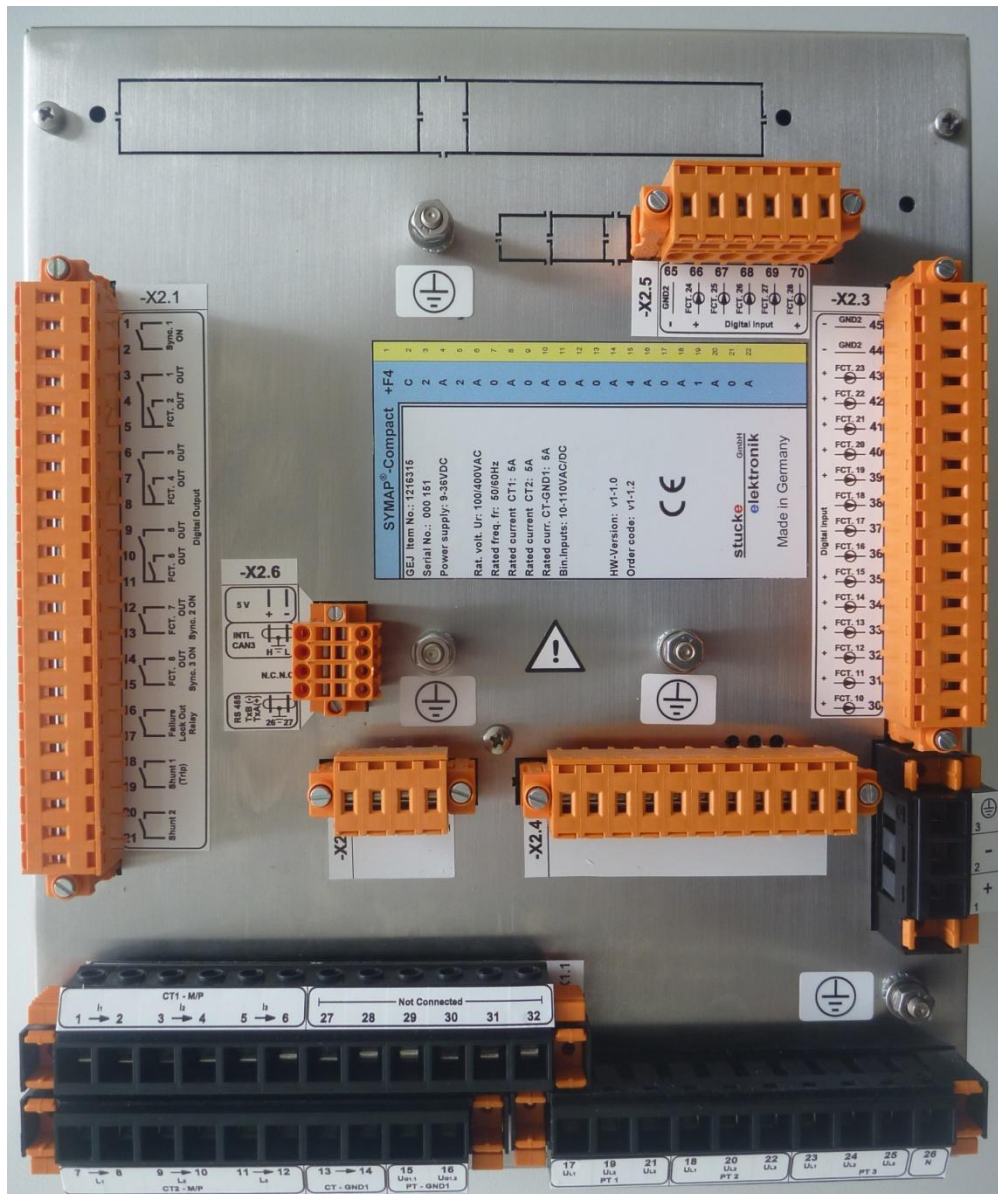


Figure 2-4 Overview back panel

2.3 Menu Structure

On its LC-display, the SYMAP[®]-Compact(+) offers several display options. Additionally, device settings and controls are shown. The user is guided through via resistive touchscreen operation. Individually, PC-created graphics, alarms and events and measured values can be transferred to the SYMAP[®]-Compact(+). The large graphic display allows having all important data at a glance.

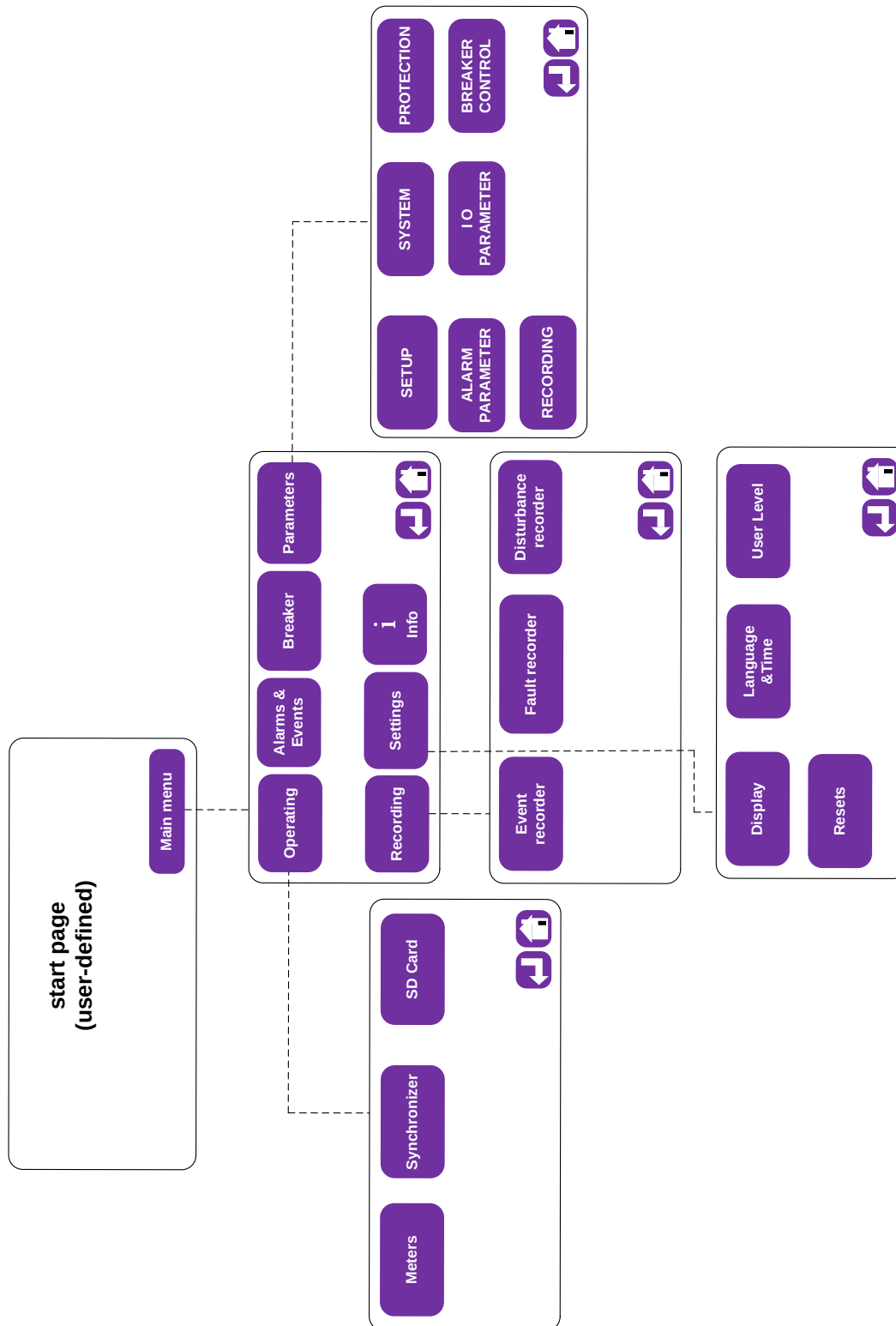


Figure 2-5 Menu tree

2.4 Start page / Main menu

In case that no userpage is assigned to the start page, the “Main Menu” appears as start page after switching ON/resetting the SYMAP®-Compact(+).

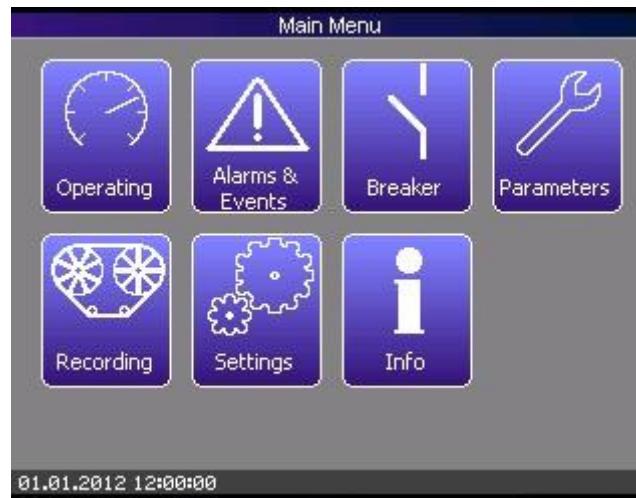


Figure 2-6 Main Menu as start page

If assigned a customer-specific user page appears as start page.

NOTE: Up to 4 different user page can be configured by configuration software “SYMAP®-Compact Parameter Tool (SCPT)”.

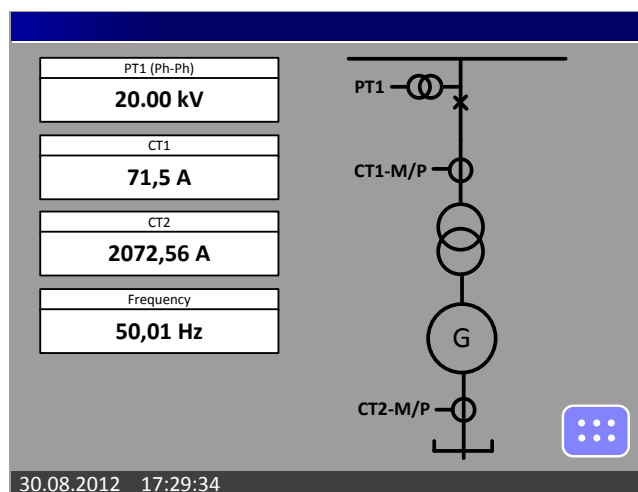


Figure 2-7 User Page as start page – example

To navigate to the main menu it is necessary to implement a hotkey into the userpage which is assigned to the start page. For this, a pre-defined hotkey “Main Menu” is available via the library of SCPT (see Figure 2-7).

Invoke menu page “Main Menu”. For reverse menu navigation, please note the following Hotkeys at touch-screen:

-  “Back”: changes to previous menu page
-  “Home”: changes directly to start page



Figure 2-8 Main menu including navigation hotkeys

2.4.1 “Operating”

Menu “Operating provides all relevant data which are being generated during operating mode of SYMAP®-Compact(+). Following operating data are available:

- measuring values of current and voltage inputs,
- measuring values during synchronizing process,
- information about SD-card.



Figure 2-9 Operating data

2.4.1.1 “Meters”

For representation of detailed measuring values there are several measured value pages, such as:



Figure 2-10 Operating – Meters

Meters \ Voltage/Frequency

In dependence of the SYMAP[®]-Compact(+) device variant and, thus, according to the number of voltage measuring inputs PT1, PT2 and PT3, phase-to-earth voltages and phase-to-phase voltages will be displayed phase-selectively. Displayed frequency values refer to the voltage measuring inputs.

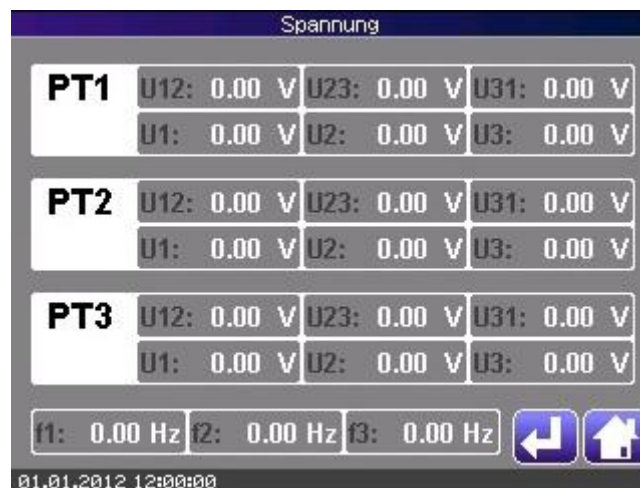


Figure 2-11 Operating measurements – Voltage/Frequency

Meters \ Current

This page displays information on current values. In addition to the currently measured values, changes from previous current values are calculated and the maximum value saved. Differential currents are displayed only for devices with differential current input.

The bargraphs indicate the current trends as percentage of the nominal value. Depending on the set values of the bargraphs' color thresholds (parameters), the bargraphs show the colors green, orange or red.

Displayed maximum values can be reset by operating touch-screen button “Reset Max”.



Figure 2-12 Operating measurements – Current

Meters \ Power

Display of power values accords to the selected current measurement input by touchscreen hotkey “Ref”. This selection-hotkey determines which current and voltage measurement input are used for power value display.

The first row displays total power measurement values; above, it follows a phase-selective representation according to phases L1, L2 and L3. Measured quantities are as follows:

- Active Power P [kW]
- Reactive Power Q [kvar]
- Power Factor PF
- Apparent Power S [kVA]



Figure 2-13 Operating measurements – Power

Referencing of displayed power measurement values by selection hotkey “Ref”:

Displayed power measurement values of the system (active power P, reactive power Q, apparent power S and power factor PF) are deducted from measured phase currents and voltages.

Depending on which measuring inputs are used to measure phase currents and voltages, there are different selection options of hotkey “Ref” for referencing the power values:

- “CT1”: Displayed power measurement values bases on phase currents measured by CT1 and measurement of the voltages by that measuring input which is assigned to Parameter “PT reference” [P9410].

- “CT2”: *Displayed power measurement values* bases on phase currents measured by CT2 **and** *measurement of the voltages* by that measuring input which is assigned to Parameter “PT reference” [P9413].

NOTE: The assignment of the voltage measurement input (PT1, PT2 or PT3) to the current measurement input CT1 or CT2) is to be done by the following parameters (as the setting options of parameter [P60000]), in the submenu “SYSTEM\Nominals\Measuring”:

- “PT reference” [P9410] for CT1 and
- “PT reference” [P9413] for CT2.

Sign definition of active power P and reactive power Q

The *positive or negative sign indication* of the measurement quantities P and Q depends on

- the *connection of the potential transformer* (as reference) **and**
- the *connection of the current transformer* **and**
- the parameter settings to *invert the direction of current measurement* per phase in CT1:
 - “Direction L1 (Measuring) [P662]“,
 - “Direction L2 (Measuring) [P663]“,
 - “Direction L3 (Measuring) [P664]“,
 - “Direction L1 (Protection) [P665]“,
 - “Direction L2 (Protection) [P666]“,
 - “Direction L3 (Protection) [P667]“, or
- the parameter settings to *invert the direction of current measurement* per phase in CT2:
 - “Direction L1 (Protection) [P671]“,
 - “Direction L2 (Protection) [P672]“,
 - “Direction L3 (Protection) [P673]“, **and**
- the setting of parameter:
 - “Definition” [P9411] to define *power direction* of “POWER CT1“ or
 - “Definition” [P9414] to define *power direction* of “POWER CT2“ **and**
- the *direction of the primary load flow* (while normal operating) in the feeder which is considered for power measurement.

NOTE: The above mentioned is only valid for a three-phase system with *clockwise field of rotation*!

The following graphic represents the sign definition for measurement quantities P and Q according to the above mentioned conditions:

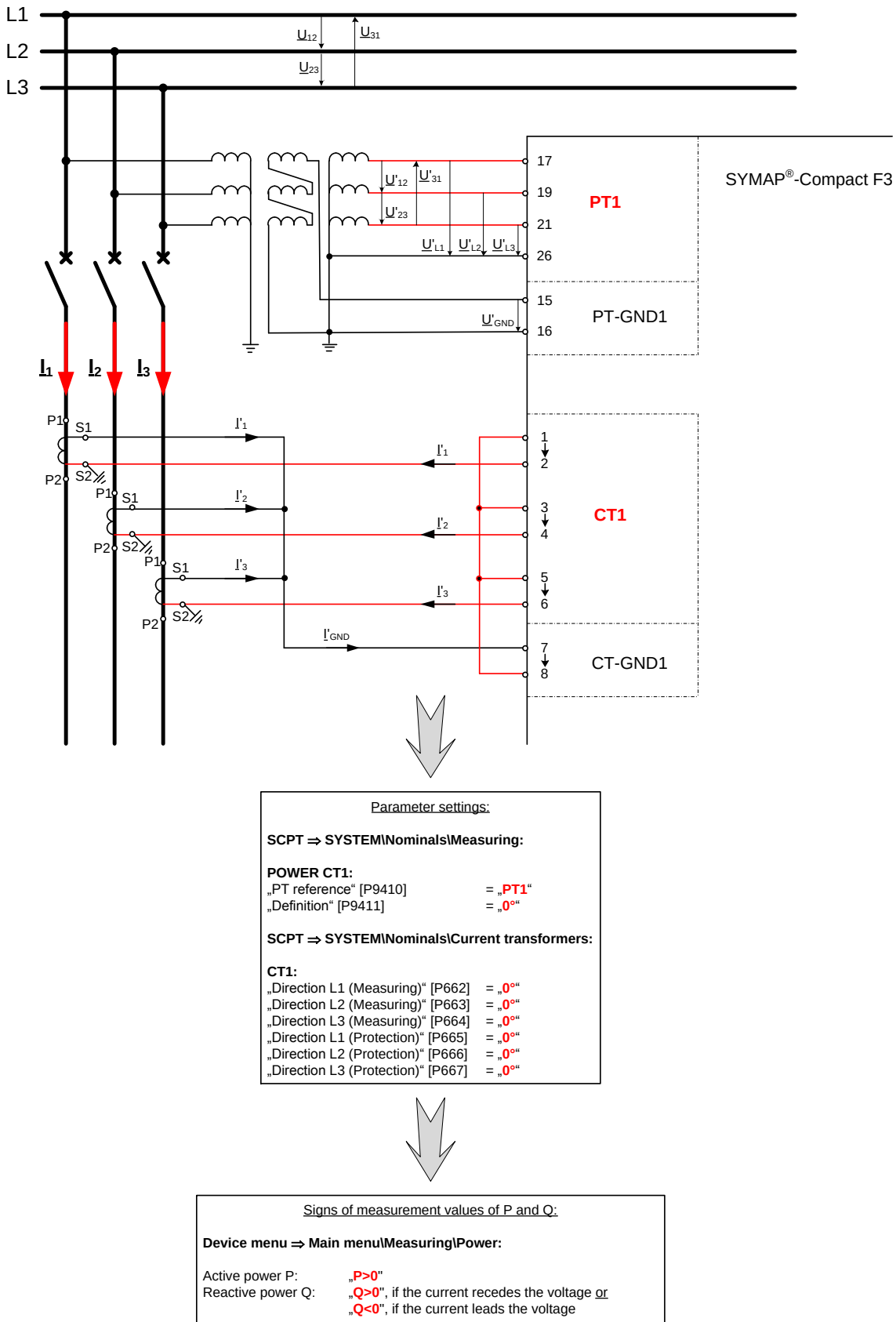


Figure 2-14 Example of power measuring – Sign definition of measuring quantities P and Q

NOTE: Any change of one of the conditions for sign definition of the measured power values will lead to a change of the sign for measured values of P and Q!

Meters \ Counter

Page "Counter" provides energy counting values and counting values of operating hours.

Energy counting

For each measuring sample the values of different power quantities are being calculated. At the end of the nominal period each power value is multiplied by the duration of the nominal period which provides the energy values for one nominal period. Displayed energy counting values represent summation of all the energy values of one nominal period individually for all the different energy quantities.

- *Absolute/Temporary energy counting values* of different power quantities:
 - positive, active power Wp+
 - negative, active power Wp-
 - positive, reactive power Wq+
 - negative, reactive power Wq-
- *Absolute/Temporary operating hours*:
 - "h": hours
 - "m": minutes
 - "s": seconds

Reset

Touch-screen button "Reset" only refer to *temporary counting values (energy values and operating hours)*. After reset of temporary counting values counting starts from start value "0". By using the reset function it is possible to have counting values for a certain time period without deleting the counting values for the total operating time.

The screenshot shows a touch-screen interface titled "Counter". It is divided into two main sections: "Absolute" and "Temporary". Each section contains four input fields for energy values (Wp+, Wp-, Wq+, Wq-) and a corresponding time display (h, m, s). The "Reset" button is located at the bottom right, along with navigation arrows. The status bar at the bottom shows the date and time: 01.01.2012 12:00:00.

Absolute		h	m	s
Wp+	0 kWh	0	0	0
Wp-	0 kWh			
Wq+	0 kvarh			
Wq-	0 kvarh			

Temporary		h	m	s
Wp+	0 kWh	0	0	0
Wp-	0 kWh			
Wq+	0 kvarh			
Wq-	0 kvarh			

01.01.2012 12:00:00

Figure 2-15 Operating measurements – Counter

Meters \ Ground

Meters-page “Ground” shows all measured and/or calculated ground values. Displayed maximum values can be reset by operating touch-screen button “Reset Max”.



Figure 2-16 Operating measurements – Ground

2.4.1.2 “Synchronizer”

While synchronizing process all relevant measurement values are being displayed at menu page “Synchronizer”. Depicted values refer to that synchronizing unit (“Sync. unit 1”, “Sync. unit 2” or “Sync. unit 3”) which was chosen to be displayed by the filter-hotkey.

Depending on parameter setting of the synchronizing units, a manual start of the foreseen synchronizing functions is possible by activating the hotkey “Manual Start”.

As soon as a synchronizing unit is activated, status information of the chosen synchronizing unit will indicate “active”.

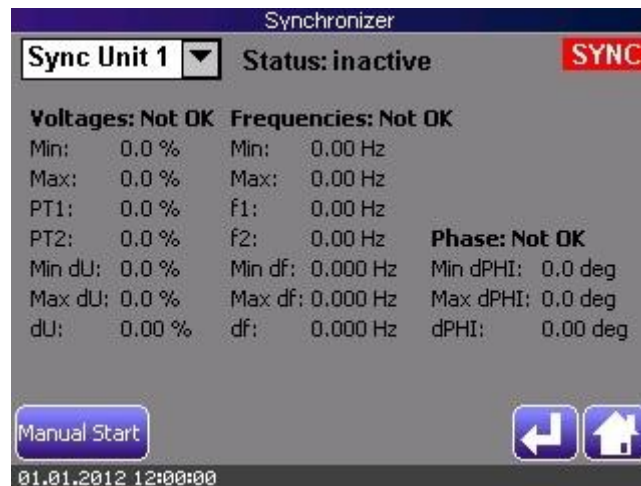


Figure 2-17 Operating – Synchronizer

2.4.1.3 “Status” (SD Card, Debug)

Figure 2-18

SD Card

This menu-page provides information about the type of the applied SD-card.



Figure 2-19 Status – SD Card

Debug

This menu-page provides information about special data of communication standard IEC 61850.



Figure 2-20 Status – Debug

2.4.2 “Alarms & Events”

With these pages, the user obtains information on the active alarm messages as well as all active events.

2.4.2.1 “Active Alarms”

Upon occurrence of an alarm, this page is automatically opened. According to the settings, the alarm number (equally serves as event number) and the alarm title are displayed. The messages appear in the order of occurrence. If the SYMAP®-Compact(+) saves more than 11 alarm messages, the list can be scrolled up or down via keys of the navigation block. Up to 449 alarms can be managed.

The quantity of active alarms is constantly visible in the status line even if the alarm page is not open.

An alarm text may consist of up to 40 characters. In addition to these texts and according to parameterization of the device, the related software LED is shown at the left in the display. An audible signal may also be activated. LED color (green, orange or red) is settable via alarm control parameters. If an alarm occurs, the LED blinks fast until acknowledged or until the alarm is no longer active. The LED blinks in a slower interval if the alarm is no longer active but not yet acknowledged. Table 2-1 describes LED and audible signal control according to the alarm status.

Table 2-1 Alarm status

Alarm status	LED	Beeper
Alarm is active (upon occurrence)	Fast blinking	Fast interval of sounds
Alarm is active and acknowledged	Permanently ON	OFF
Alarm is inactive and not acknowledged	Slow blinking	Slow interval of sounds

If the audible signal is ON, an alarm has to be acknowledged twice: first time for switching the beeper OFF and a second time for registering the alarm.

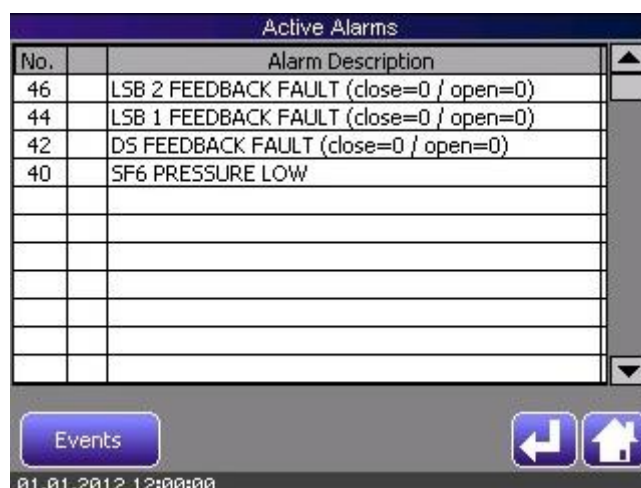


Figure 2-21 Active Alarms

Click to hotkey “Events” to open submenu “Active Events”.

2.4.2.2 “Active Events”

This page represents all active events by their numbers and the total number of active events.

Active Events									
4216	4021	44							
4219	20	46							
4223	450								
4226	1415								
5005	1422								
6115	1430								
6020	1438								
6125	1446								
6135	6802								
6040	6810								
6145	40								
1000	42								

Events:

01.01.2012 12:00:00

Figure 2-22 Active events

2.4.3 “Breaker”

Selection page “Breaker” gives an overview about the current status of switching elements used in the application.



Figure 2-23 Current breaker status

2.4.4 “Parameters”

Selection page “Parameters” provides all device settings:

- “SETUP“: Configuration of user levels, and selection of applied current and voltage measurement inputs
- “SYSTEM“: Nominals, counters, filters, communication und graphic
- “PROTECTION“: Protection settings
- “ALARMS“: Parameter number to stop Event-Historie; Alarm numbers and assigned texts of the Alarm chanel, and LED configuration
- “I/O“: Binary inputs and outputs
- “BREAKER CONTROL“: Feedback signals of switching elements, configuration of applied switching elements, and counter for switching operations
- “RECORDING“: Configuration of fault recorder and disturbance recorder

NOTE: All parameters may set only via configuration software “SYMAP®-Compact Parameter Tool (SCPT)”!



Figure 2-24 Parameter settings of SYMAP[®]-Compact(+)

2.4.4.1 “SETUP”

Menu “SETUP” can be used to adapt the device SYMAP[®]-Compact(+) variant to the application. For this, two sub-menus are provided:

- sub-menu “*User levels*” (configuration of different user levels) and
- sub-menu “*Transformers*” (enable/disable the current measurement inputs: CT1, CT2 and CT-GND1, and voltage measurement inputs: PT1, PT2, PT3, PT-GND1)



Figure 2-25 Adaption of device variant to the application

“*User levels*”

Submenu “*User levels*” provides parameters to configure individually the different user levels. Parameters refer to:

- the *activation* of the different user levels, and
- the *assignment* of certain functions to the different user levels.

“*Measuring inputs*”

Submenu “*Measuring inputs*” provides parameters to enable/disable current and voltage measurement inputs according to the application.

NOTE: Disabled measurement inputs will not provide any measurement quantities.

2.4.4.2 “SYSTEM”

Submenu “SYSTEM” provides all the system parameters of SYMAP®-Compact(+). Further information on this can be found in chapter “System settings”.

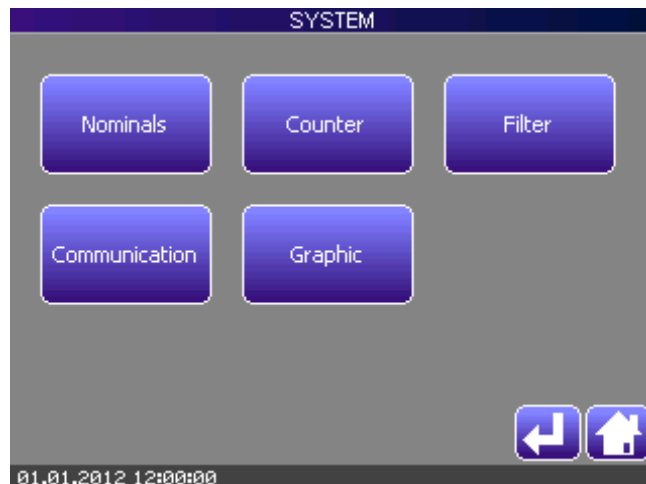


Figure 2-26 System parameters

2.4.4.3 “PROTECTION”

Submenu “PROTECTION” provides all the protection parameters of SYMAP®-Compact(+). Further information on this can be found in chapter “PROTECTION”.



Figure 2-27 Protection parameters

2.4.4.4 “ALARMS”

Submenu “ALARMS” provides all the parameters about alarms and LED configuration of SYMAP®-Compact(+). Further information on this can be found in chapter “System settings”.



Figure 2-28 Alarm parameters

2.4.4.5 “I/O”

Submenu “I/O” provides all the parameters about binary inputs and outputs of SYMAP®-Compact(+). Further information on this can be found in chapter “System settings”.

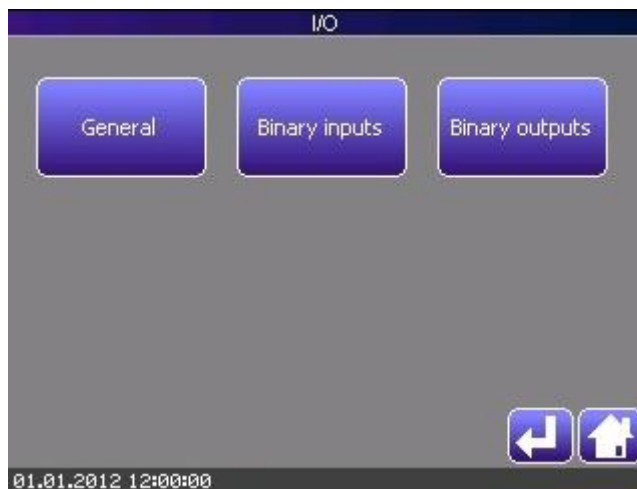


Figure 2-29 Parameters of binary inputs and outputs

2.4.4.6 “BREAKER CONTROL”

Submenu “BREAKER CONTROL” provides all the parameters about configuration of switching elements. Further information on this can be found in chapter “System settings”.



Figure 2-30 Configuration of switching elements

2.4.4.7 “RECORDING”

Submenu “RECORDING” provides all the parameters about configuration of recording functions such as “*Fault recorder*” and “*Disturbance* “. Further information on this can be found in chapter “System settings”.



Figure 2-31 Recording functions

2.4.5 “Recording” (File information and Manual trigger)

SYMAP[®]-Compact(+) device variants provide the following recording functions:

- *Event recorder*
- *Fehler recorder* and
- *Disturbance recorder*.

For each recording function a recording file can be generated. The file endings of the recording files are assigned as follows:

- Event recorder: “xxx.ser”
- Fault recorder: “xxx.sfr”
- Disturbance recorder: “xxx.sdr”

Read-out data and saving of data recordings

- It is possible to *read* the recorded data of the *event recorder* either via display of SYMAP[®]-Compact(+) or via PC/Notebook by using application software “SYMAP-Parameter Tool (SCPT)”; see SCPT menu bar “Tools”\Event recorder\executive button “Read Data”\executive button Start”.
Operating execution button “Save” of SCPT menu “File” of pop-up window “Event recorder” will generate an *event recording file* (“xxx.ser”) including the recorded data. This file can be saved via PC/notebook. Reading this file is only possible via application software “SCPT”.
- It is possible to *read* the recorded data of the *fault recorder* either via display of SYMAP[®]-Compact(+) or via PC/Notebook by using application software “SYMAP-Parameter Tool (SCPT)”; see SCPT menu bar “Tools”\Fault recorder\executive button “Read Data”\executive button Start”.
Operating execution button “Save” of SCPT menu “File” of pop-up window “Fault recorder” will generate an *fault recording file* (“xxx.sfr”) including the recorded data. This file can be saved via PC/notebook. Reading this file is only possible via application software “SCPT”.
- It is not possible to *read* the recorded data of the *disturbance recorder* via display of SYMAP[®]-Compact(+).
Triggering the data recording of the disturbance recorder either manually or by trigger event, a recording file (“xxx.sdr”) is generated at the corresponding data medium (withdrawable SD card). Saving this file can be done either via reading the file directly from the SD card or by saving function of application software “SCPT”.

NOTE: At the time, saved recording file “xxx.sdr” *cannot* be read via application software “SYMAP-Parameter Tool (SCPT)”!

2.4.5.1 “Event Recorder“

The event history saves up to 3000 events by using the first-in-first-out (FIFO) principle. Each event provides information such as:

- the consecutive number,
- the event number,
- the event text, and
- date and time stamp.

Event Recorder				
No.	Event	Text	Date	Time
0	6810	Local mode	09.09.11	10:20:11.445
1	1000	Prot. param. set1 active	09.09.11	10:20:11.445
2	9000	System Error	09.09.11	10:20:11.445
3	46	Alarm	08.09.11	14:17:21.645
4	44	Alarm	08.09.11	14:17:11.731
5	42	Alarm	08.09.11	13:24:11.329
6	5501	PLC	08.09.11	10:56:11.227
7	4021	Binary Input	08.09.11	09:27:42.649
8	9006	System Error	09.09.11	09:25:44.488

Auto Refresh: ON

01.01.2012 12:00:00

Figure 2-32 Event recorder

NOTE: In the displayed event list *active* events are highlighted light green; *inactive* events are represented with white background colour.

The latest event is always assigned to consecutive number “0”.

Events are recorded with a temporal resolution of 1 ms, and will be displayed in chronological order. The latest event is on the top of the event list. To scroll the list either use button Up/Down or the scroll bar on the left of the LC-display.

To refresh the displayed event list automatically, the button “Auto Refresh” is to be activated. The setting:

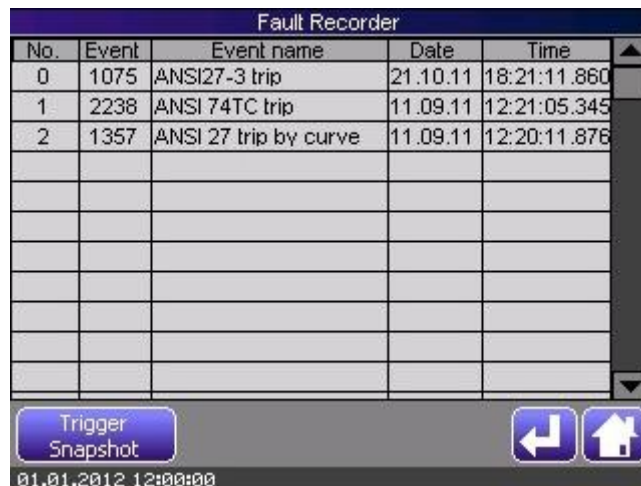
- “ON“: will activate automatic refresh; and setting
- “OFF“: will deactivate automatic refresh of the displayed event list.

NOTE: When using the scroll buttons or the scroll bar, the automatic refresh of the event list is being stopped (“Auto Refresh: OFF”).

2.4.5.2 “Fault Recorder“

When fault recording is started by the active trigger-event which is assigned to parameter “Trigger event” [P8061] (see menu: “RECORDING/**Fault recorder**“), it takes a “snapshot” of the measurement values.

Beside any trigger-event, fault recording can also be started manually via hotkey “Trigger snapshot”; if so, event [E9998] is being activated.



No.	Event	Event name	Date	Time
0	1075	ANSI27-3 trip	21.10.11	18:21:11.860
1	2238	ANSI 74TC trip	11.09.11	12:21:05.345
2	1357	ANSI 27 trip by curve	11.09.11	12:20:11.876

Trigger Snapshot

01.01.2012 12:00:00

Figure 2-33 Fault recorder – File information

At the time of activating the fault recorder records:

- all relevant file informationen (record number, trigger-event number, event text, date and time stamp) and
- all available measuring values of current, voltage and frequency (depending on the SYMAP®-Compact(+) device variant) for one record,

at the time of activating the trigger-event:

Main menu\Recorder\Fault recorder		
Fehlerrekorder		
Label	Value	Unit
Trip event		-
Event text		
Date		
Time		
Pickup source		
Fault phase		
Prot. Step no		
U1 (PT1)	0,00	V
U2 (PT1)	0,00	V
U2 (PT1)	0,00	V
U12 (PT1)	0,00	V
U23 (PT1)	0,00	V
U31 (PT1)	0,00	V
U1 (PT2)	0,00	V
U2 (PT2)	0,00	V
U2 (PT2)	0,00	V
U12 (PT2)	0,00	V
U23 (PT2)	0,00	V
U31 (PT2)	0,00	V
U1 (PT3)	0,00	V

U2 (PT3)	0,00	V
U2 (PT3)	0,00	V
U12 (PT3)	0,00	V
U23 (PT3)	0,00	V
U31 (PT3)	0,00	V
UG (PT-GND1)	0,00	V
I1 (CT1)	0,00	A
I2 (CT1)	0,00	A
I3 (CT1)	0,00	A
I1 (CT2)	0,00	A
I2 (CT2)	0,00	A
I3 (CT2)	0,00	A
IG (CT-GND1)	0,00	A
f (PT1)	0,00	Hz
f (PT2)	0,00	Hz
f (PT3)	0,00	Hz

Figure 2-34 Fault recorder – “Snapshot of measuring values”

NOTE: The recorded data of one fault recording is being saved as an individual file at the SD card.

2.4.5.3 “Disturbance Recorder”



Figure 2-35 Disturbance recorder – manual trigger

2.4.6 “Settings”

This page allows device settings of color and brightness of LC-display, menu language and time, displayed single line diagram, entering different user levels. By the submenu “Resets” all available counters and memories can be reset.



Figure 2-36 Settings

2.4.6.1 “Display”

Settings of color layout and brightness for the menu pages can be changed for the following ranges:

- Background color of menu pages (“Page Bg Color”)
- Background color of Hotkeys (“Button Bg Color”)
- Text color of Hotkeys (“Button Text Color”)

For changing settings of color scheme and brightness, please make use of the touch-screen slider controls. Colors can be adapted separately by red, green and blue. The array “Color preview” shows the adjusted color scheme. To save the settings, touch button “Apply”. For resetting the color scheme to factory settings, touch button “Restore Defaults”.

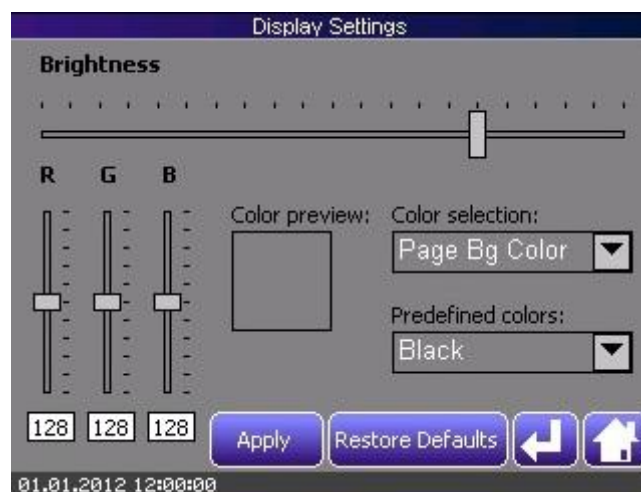


Figure 2-37 Display Settings

2.4.6.2 “Language & Time”

Setting the menu language, and date and time is possible under “Change Language & Time”.



Figure 2-38 Change Language & Time

2.4.6.3 “User Level” (Change-over via touchscreen)

Changing-over to different user levels via touchscreen is possible under “Change User Level”.



Figure 2-39 Change User Level

For this, it is required to enter a 4 digit password via the number keypad of the touchscreen. Subsequent activating of hotkey “OK” will automatically invoke the required user level. At the time user level 2, 3 or 4 is activated, a symbol of a “key” and the number of the active user level is being indicated in the date row.

19.04.2013 11:03:45

Key 2

Figure 2-40 Example: Indication of active user level “2”

The activated user level can be left by activating hotkey “Reset User Level”. Then, automatically, “user level 1” is activated.

NOTE: There is *no* symbol for active user level “1”!

2.4.6.4 “Resets”

Call-up of page “Resets” enables the resetting (erase data) of

- the event recorder,
- the fault recorder or
- all of the resettable device functions.



Figure 2-41 Resets

Right after activating one of the available hotkeys, a confirmation prompt will be displayed, asking you to confirm whether you want to carry out the reset or cancel. Button “OK” will release the reset. Button “Cancel” will not carry out the reset function, but the previous menu page is being invoked.

2.4.7 “Info”

Page “System Information” gives informationen about:

- firmware version of the device,
- hardware version of the device
- order code according to the order code version,
- order code version, and
- name of the parameter file which is saved in the device

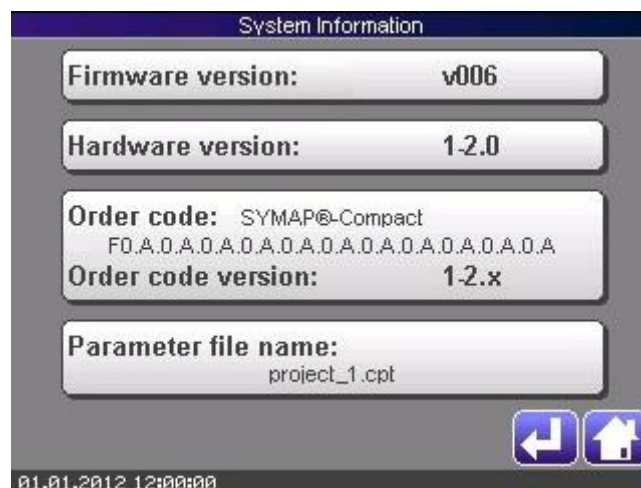


Figure 2-42 System Information

3 System settings

3.1 Introduction Event System

The event system of SYMAP®-Compact(+) allows the user to implement individual applications since events are used to activate or deactivate device functions. An event is the internal logic representation of the device process. The event system offers source and sink events.

The source events have unique and permanent event numbers. A source event will be activated (positive logic: "true") if the condition of this event is met (e.g. limit exceeded); otherwise it is inactive (positive logic: "false").

Sink events are linked to fixed processes or functions and are user-programmable. The user may connect source and sink by assigning the source number to the sink. The sink (function) will then be active as soon as the corresponding source gets active.

NOTE: Some modules are as well a source and a sink; for example all binary outputs are sinks and activated by a source event. But each binary output, however, again generates source events upon its activation. The same applies for alarm messages and all elements of the programmable logic unit (PLC). Source events can be linked via logic elements of the PLC and then generate new source events.

EXAMPLE: The overcurrent protection ANSI 50/51 is meant to open a breaker via binary output ("Shunt Trip 1"). ANSI 50/51 is a source and the binary output a sink. For instance, an event number referring to ANSI 50/51 is "ANSI50/51-1 trip" [E1425] (1st limit attained and delay time run down).

This event number has to be set to one parameter (e.g. "01" = "1425") of the binary output "Shunt Trip 1" and, as consequence, protection trip signal opens the breaker.

3.1.1 Event list

The event list summarizes all software events that are available by the device.

Table 3-1 SYMAP®-Compact(+) event list

Event No.	Name	Description	Event system	Event history
	Static event			
E0000	OFF-Event	Event is always inactive (true)	☑	-
E9999	ON-Event	Event is always active (true)	☑	-
	Alarm events 0001 – 0499			
E0001 – E0449	Alarm	Alarm channel 1 – 449	☑	☑
E0450 – E0499	Groups	Alarm groups 450 – 499	☑	☑
	Communication events E0910 – E0989			
E0910	Profibus baudrate	Profibus baudrate	☑	☑
E0911	Profibus data exchange	Profibus data exchange status	☑	☑
E0970 – E0989	Communication event	Could be set via Modbus or Profibus	☑	☑
SET1 – SET4	Protection events E1000 – E3999			
E1000	Protection parameter set 2 active			
E1001	Protection parameter set 3 active			
E1002	Protection parameter set 4 active			
E1855	ANSI25-1 Active			
E1856	ANSI25-1 Blocked			
E1857	ANSI25-1 Negative phase seq. PT1			
E1858	ANSI25-1 Negative phase seq. PT2			
E1865	ANSI25-1 SC: Blocked			
E1866	ANSI25-1 SC: PT1 > Max. voltage			

Event No.	Name	Description	Event system	Event history
E1867	ASNI25-1 SC: PT1 < Min. voltage			
E1868	ASNI25-1 SC: PT1 > Max. frequency			
E1869	ASNI25-1 SC: PT1 < Min. frequency			
E1870	ASNI25-1 SC: PT1 in range			
E1871	ASNI25-1 SC: PT2 > Max. voltage			
E1872	ASNI25-1 SC: PT2 < Min. voltage			
E1873	ASNI25-1 SC: PT2 > Max. frequency			
E1874	ASNI25-1 SC: PT2 < Min. frequency			
E1875	ASNI25-1 SC: PT2 in range			
E1876	ASNI25-1 SC: dU > Max. dU			
E1877	ASNI25-1 SC: dU < Min. dU			
E1878	ASNI25-1 SC: dU in range			
E1879	ASNI25-1 SC: df < Min. df			
E1880	ASNI25-1 SC: df > Max. df			
E1881	ASNI25-1 SC: df in range			
E1882	ASNI25-1 SC: dPHI < Min. dPHI			
E1883	ASNI25-1 SC: dPHI > Max. dPHI			
E1884	ASNI25-1 SC: dPHI in range			
E1885	ASNI25-1 SC: Synchronous pre-event			
E1886	ASNI25-1 SC: Synchronous			
E1890	ASNI25-1 VC: Blocked			
E1891	ASNI25-1 VC: PT1 > Max. voltage			
E1892	ASNI25-1 VC: PT1 < Min. voltage			
E1893	ASNI25-1 VC: PT1 > Max. frequency			
E1894	ASNI25-1 VC: PT1 < Min. frequency			
E1895	ASNI25-1 VC: PT1 in range			
E1896	ASNI25-1 VC: PT1 > No voltage limit			
E1897	ASNI25-1 VC: PT1 < No voltage limit			
E1898	ASNI25-1 VC: PT2 > Max. voltage			
E1899	ASNI25-1 VC: PT2 < Min. voltage			
E1900	ASNI25-1 VC: PT2 > Max. frequency			
E1901	ASNI25-1 VC: PT2 < Min. frequency			
E1902	ASNI25-1 VC: PT2 in range			
E1903	ASNI25-1 VC: PT2 > No voltage limit			
E1904	ASNI25-1 VC: PT2 < No voltage limit			
E1905	ASNI25-1 VC: Synchronous pre-event			
E1906	ASNI25-1 VC: Synchronous			
E2020	ANSI25-1 Frequency higher event			
E2021	ANSI25-1 Frequency lower event			
E2022	ANSI25-1 Voltage higher event			
E2013	ANSI25-1 Voltage lower event			
E1910	ANSI25-2 Active			
E1911	ANSI25-2 Blocked			
E1912	ANSI25-2 Negative phase seq. PT1			
E1913	ANSI25-2 Negative phase seq. PT3			
E1920	ANSI25-2 SC: Blocked			
E1921	ANSI25-2 SC: PT1 > Max. voltage			
E1922	ANSI25-2 SC: PT1 < Min. voltage			
E1923	ANSI25-2 SC: PT1 > Max. frequency			
E1924	ANSI25-2 SC: PT1 < Min. frequency			
E1925	ANSI25-2 SC: PT1 in range			
E1926	ANSI25-2 SC: PT3 > Max. voltage			
E1927	ANSI25-2 SC: PT3 < Min. voltage			
E1928	ANSI25-2 SC: PT3 > Max. frequency			
E1929	ANSI25-2 SC: PT3 < Min. frequency			
E1930	ANSI25-2 SC: PT3 in range			
E1931	ANSI25-2 SC: dU > Max. dU			
E1932	ANSI25-2 SC: dU < Min. dU			
E1933	ANSI25-2 SC: dU in range			
E1934	ANSI25-2 SC: df > Max. df			
E1935	ANSI25-2 SC: df < Min. df			
E1936	ANSI25-2 SC: df in range			
E1937	ANSI25-2 SC: dPHI > Max. dPHI			
E1938	ANSI25-2 SC: dPHI < Min. dPHI			
E1939	ANSI25-2 SC: dPHI in range			
E1940	ANSI25-2 SC: Synchronous pre-event			
E1941	ANSI25-2 SC: Synchronous			
E1945	ANSI25-2 VC: Blocked			
E1946	ANSI25-2 VC: PT1 > Max. voltage			
E1947	ANSI25-2 VC: PT1 < Min. voltage			
E1948	ANSI25-2 VC: PT1 > Max. frequency			
E1949	ANSI25-2 VC: PT1 < Min. frequency			

Event No.	Name	Description	Event system	Event history
E1950	ANSI25-2 VC: PT1 in range			
E1951	ANSI25-2 VC: PT1 > No voltage limit			
E1952	ANSI25-2 VC: PT1 < No voltage limit			
E1953	ANSI25-2 VC: PT3 > Max. voltage			
E1954	ANSI25-2 VC: PT3 < Min. voltage			
E1955	ANSI25-2 VC: PT3 > Max. frequency			
E1956	ANSI25-2 VC: PT3 < Min. frequency			
E1957	ANSI25-2 VC: PT3 in range			
E1958	ANSI25-2 VC: PT3 > No voltage limit			
E1959	ANSI25-2 VC: PT3 < No voltage limit			
E1960	ANSI25-2 VC: Synchronous pre-event			
E1961	ANSI25-2 VC: Synchronous			
E2025	ANSI25-2 Frequency higher event			
E2026	ANSI25-2 Frequency lower event			
E2027	ANSI25-2 Voltage higher event			
E2018	ANSI25-2 Voltage lower event			
E1965	ANSI25-3 Active			
E1966	ANSI25-3 Blocked			
E1967	ANSI25-3 Negative phase seq. PT2			
E1968	ANSI25-3 Negative phase seq. PT3			
E1975	ANSI25-3 SC: Blocked			
E1976	ANSI25-3 SC: PT2 > Max. voltage			
E1977	ANSI25-3 SC: PT2 < Min. voltage			
E1978	ANSI25-3 SC: PT2 > Max. frequency			
E1979	ANSI25-3 SC: PT2 < Min. frequency			
E1980	ANSI25-3 SC: PT2 in range			
E1981	ANSI25-3 SC: PT3 > Max. voltage			
E1982	ANSI25-3 SC: PT3 < Min. voltage			
E1983	ANSI25-3 SC: PT3 > Max. frequency			
E1984	ANSI25-3 SC: PT3 < Min. frequency			
E1985	ANSI25-3 SC: PT3 in range			
E1986	ANSI25-3 SC: dU > Max. dU			
E1987	ANSI25-3 SC: dU < Min. dU			
E1988	ANSI25-3 SC: dU in range			
E1989	ANSI25-3 SC: df > Max. df			
E1990	ANSI25-3 SC: df < Min. df			
E1991	ANSI25-3 SC: df in range			
E1992	ANSI25-3 SC: dPHI > Max. dPHI			
E1993	ANSI25-3 SC: dPHI < Min. dPHI			
E1994	ANSI25-3 SC: dPHI in range			
E1995	ANSI25-3 SC: Synchronous pre-event			
E1996	ANSI25-3 SC: Synchronous			
E2000	ANSI25-3 VC: Blocked			
E2001	ANSI25-3 VC: PT2 > Max. voltage			
E2002	ANSI25-3 VC: PT2 < Min. voltage			
E2003	ANSI25-3 VC: PT2 > Max. frequency			
E2004	ANSI25-3 VC: PT2 < Min. frequency			
E2005	ANSI25-3 VC: PT2 in range			
E2006	ANSI25-3 VC: PT2 > No voltage limit			
E2007	ANSI25-3 VC: PT2 < No voltage limit			
E2008	ANSI25-3 VC: PT3 > Max. voltage			
E2009	ANSI25-3 VC: PT3 < Min. voltage			
E2010	ANSI25-3 VC: PT3 > Max. frequency			
E2011	ANSI25-3 VC: PT3 < Min. frequency			
E2012	ANSI25-3 VC: PT3 in range			
E2013	ANSI25-3 VC: PT3 > No voltage limit			
E2014	ANSI25-3 VC: PT3 < No voltage limit			
E2015	ANSI25-3 VC: Synchronous pre-event			
E2016	ANSI25-3 VC: Synchronous			
E2030	ANSI25-3 Frequency higher event			
E2031	ANSI25-3 Frequency lower event			
E2032	ANSI25-3 Voltage higher event			
E2033	ANSI25-3 Voltage lower event			
E1050	ANSI27 module active			
E1051	ANSI27 blocked module			
E1054	ANSI27-1 step active			
E1055	ANSI27-1 blocked step			
E1056	ANSI27-1 blocked step by min. start voltage			
E1057	ANSI27-1 blocked step by min. start frequency			
E1058	ANSI27-1 pickup			
E1059	ANSI27-1 trip			
E1062	ANSI27-2 step active			

Event No.	Name	Description	Event system	Event history
E1063	ANSI27-2 blocked step			
E1064	ANSI27-2 blocked step by min. start voltage			
E1065	ANSI27-2 blocked step by min. start frequency			
E1066	ANSI27-2 pickup			
E1067	ANSI27-2 trip			
E1070	ANSI27-3 step active			
E1071	ANSI27-3 blocked step			
E1072	ANSI27-3 blocked step by min. start voltage			
E1073	ANSI27-3 blocked step by min. start frequency			
E1074	ANSI27-3 pickup			
E1075	ANSI27-3 trip			
E1078	ANSI27-4 step active			
E1079	ANSI27-4 blocked step			
E1080	ANSI27-4 blocked step by min. start voltage			
E1081	ANSI27-4 blocked step by min. start frequency			
E1082	ANSI27-4 pickup			
E1083	ANSI27-4 trip			
E1086	ANSI27-5 step active			
E1087	ANSI27-5 blocked step			
E1088	ANSI27-5 blocked step by min. start voltage			
E1089	ANSI27-5 blocked step by min. start frequency			
E1090	ANSI27-5 pickup			
E1091	ANSI27-5 trip			
E1094	ANSI27-6 step active			
E1095	ANSI27-6 blocked step			
E1096	ANSI27-6 blocked step by min. start voltage			
E1097	ANSI27-6 blocked step by min. start frequency			
E1098	ANSI27-6 pickup			
E1099	ANSI27-6 trip			
E1102	ANSI27-7 step active			
E1103	ANSI27-7 blocked step			
E1104	ANSI27-7 blocked step by min. start voltage			
E1105	ANSI27-7 blocked step by min. start frequency			
E1106	ANSI27-7 pickup			
E1107	ANSI27-7 trip			
E1110	ANSI27-8 step active			
E1111	ANSI27-8 blocked step			
E1112	ANSI27-8 blocked step by min. start voltage			
E1113	ANSI27-8 blocked step by min. start frequency			
E1114	ANSI27-8 pickup			
E1115	ANSI27-8 trip			
E1118	ANSI27-9 step active			
E1119	ANSI27-9 blocked step			
E1120	ANSI27-9 blocked step by min. start voltage			
E1121	ANSI27-9 blocked step by min. start frequency			
E1122	ANSI27-9 pickup			
E1123	ANSI27-9 trip			
E1126	ANSI27-10 step active			
E1127	ANSI27-10 blocked step			
E1128	ANSI27-10 blocked step by min. start voltage			
E1129	ANSI27-10 blocked step by min. start frequency			
E1130	ANSI27-10 pickup			
E1131	ANSI27-10 trip			
E1134	ANSI27-11 step active			
E1135	ANSI27-11 blocked step			
E1136	ANSI27-11 blocked step by min. start voltage			
E1137	ANSI27-11 blocked step by min. start frequency			
E1138	ANSI27-11 pickup			
E1139	ANSI27-11 trip			
E1142	ANSI27-12 step active			
E1143	ANSI27-12 blocked step			
E1144	ANSI27-12 blocked step by min. start voltage			
E1145	ANSI27-12 blocked step by min. start frequency			
E1146	ANSI27-12 pickup			
E1147	ANSI27-12 trip			
E1405	ANSI27Q module active			
E1406	ANSI27Q blocked module			
E1408	ANSI27Q pickup			
E1409	ANSI27Q 1st trip			
E1410	ANSI27Q 2nd trip			
E1412	ANSI27Q voltage reclosing limit reached			
E1413	ANSI27Q reclosing release			

Event No.	Name	Description	Event system	Event history
E1350	ANSI27T module active			
E1351	ANSI27T blocked module			
E1352	ANSI27T reactivate limit reached			
E1353	ANSI27T activate limit reached			
E1354	ANSI27T pickup			
E1355	ANSI27T trip			
E1356	ANSI27T trip by voltage drops count			
E1357	ANSI27T trip by curve underrun			
E1805	ANSI32 module active			
E1806	ANSI32 blocked module			
E1807	ANSI32-1 step active			
E1808	ANSI32-1 blocked step			
E1809	ANSI32-1 pickup			
E1810	ANSI32-1 trip			
E1815	ANSI32-2 step active			
E1816	ANSI32-2 blocked step			
E1817	ANSI32-2 pickup			
E1818	ANSI32-2 trip			
E1823	ANSI32-3 step active			
E1824	ANSI32-3 blocked step			
E1825	ANSI32-3 pickup			
E1826	ANSI32-3 trip			
E1831	ANSI32-4 step active			
E1832	ANSI32-4 blocked step			
E1833	ANSI32-4 pickup			
E1834	ANSI32-4 trip			
E1839	ANSI32-5 step active			
E1840	ANSI32-5 blocked step			
E1841	ANSI32-5 pickup			
E1842	ANSI32-5 trip			
E1847	ANSI32-6 step active			
E1848	ANSI32-6 blocked step			
E1849	ANSI32-6 pickup			
E1850	ANSI32-6 trip			
E1415	ANSI50/51 module active			
E1416	ANSI50/51 blocked module			
E1422	ANSI50/51-1 step active			
E1423	ANSI50/51-1 blocked step			
E1424	ANSI50/51-1 pickup			
E1425	ANSI50/51-1 trip			
E1430	ANSI50/51-2 step active			
E1431	ANSI50/51-2 blocked step			
E1432	ANSI50/51-2 pickup			
E1433	ANSI50/51-2 trip			
E1438	ANSI50/51-3 step active			
E1439	ANSI50/51-3 blocked step			
E1440	ANSI50/51-3 pickup			
E1441	ANSI50/51-3 trip			
E1446	ANSI50/51-4 step active			
E1447	ANSI50/51-4 blocked step			
E1448	ANSI50/51-4 pickup			
E1449	ANSI50/51-4 trip			
E1454	ANSI50/51-5 step active			
E1455	ANSI50/51-5 blocked step			
E1456	ANSI50/51-5 pickup			
E1457	ANSI50/51-5 trip			
E1462	ANSI50/51-6 step active			
E1463	ANSI50/51-6 blocked step			
E1464	ANSI50/51-6 pickup			
E1465	ANSI50/51-6 trip			
E2215	ANSI50BF module active			
E2216	ANSI50BF blocked module			
E2217	ANSI50BF-1 step active			
E2218	ANSI50BF-1 blocked step			
E2219	ANSI50BF-1 pickup			
E2220	ANSI50BF-1 trip			
E2223	ANSI50BF-2 step active			
E2224	ANSI50BF-2 blocked step			
E2225	ANSI50BF-2 pickup			
E2226	ANSI50BF-2 trip			
E2229	ANSI50BF-3 step active			
E2230	ANSI50BF-3 blocked step			

Event No.	Name	Description	Event system	Event history
E2231	ANSI50BF-3 pickup			
E2232	ANSI50BF-3 trip			
E1680	ANSI50G/51G module active			
E1681	ANSI50G/51G blocked module			
E1687	ANSI50G/51G-1 step active			
E1688	ANSI50G/51G-1 blocked step			
E1689	ANSI50G/51G-1 pickup			
E1690	ANSI50G/51G-1 trip			
E1695	ANSI50G/51G-2 step active			
E1696	ANSI50G/51G-2 blocked step			
E1697	ANSI50G/51G-2 pickup			
E1698	ANSI50G/51G-2 trip			
E1703	ANSI50G/51G-3 step active			
E1704	ANSI50G/51G-3 blocked step			
E1705	ANSI50G/51G-3 pickup			
E1706	ANSI50G/51G-3 trip			
E1711	ANSI50G/51G-4 step active			
E1712	ANSI50G/51G-4 blocked step			
E1713	ANSI50G/51G-4 pickup			
E1714	ANSI50G/51G-4 trip			
E1719	ANSI50G/51G-5 step active			
E1720	ANSI50G/51G-5 blocked step			
E1721	ANSI50G/51G-5 pickup			
E1722	ANSI50G/51G-5 trip			
E1727	ANSI50G/51G-6 step active			
E1728	ANSI50G/51G-6 blocked step			
E1729	ANSI50G/51G-6 pickup			
E1730	ANSI50G/51G-6 trip			
E2240	ANSI51/46VR module active			
E2241	ANSI51/46VR blocked module			
E2242	ANSI51/46VR prot.blocking			
E1151	ANSI59 blocked module			
E1154	ANSI59-1 step active			
E1155	ANSI59-1 blocked step			
E1156	ANSI59-1 pickup			
E1157	ANSI59-1 trip			
E1162	ANSI59-2 step active			
E1163	ANSI59-2 blocked step			
E1163	ANSI59-2 pickup			
E1164	ANSI59-2 trip			
E1170	ANSI59-3 step active			
E1171	ANSI59-3 blocked step			
E1172	ANSI59-3 pickup			
E1173	ANSI59-3 trip			
E1178	ANSI59-4 step active			
E1179	ANSI59-4 blocked step			
E1180	ANSI59-4 pickup			
E1181	ANSI59-4 trip			
E1186	ANSI59-5 step active			
E1187	ANSI59-5 blocked step			
E1188	ANSI59-5 pickup			
E1189	ANSI59-5 trip			
E1194	ANSI59-6 step active			
E1195	ANSI59-6 blocked step			
E1196	ANSI59-6 pickup			
E1197	ANSI59-6 trip			
E1202	ANSI59-7 step active			
E1203	ANSI59-7 blocked step			
E1204	ANSI59-7 pickup			
E1205	ANSI59-7 trip			
E1210	ANSI59-8 step active			
E1211	ANSI59-8 blocked step			
E1212	ANSI59-8 pickup			
E1213	ANSI59-8 trip			
E1218	ANSI59-9 step active			
E1219	ANSI59-9 blocked step			
E1220	ANSI59-9 pickup			
E1221	ANSI59-9 trip			
E1226	ANSI59-10 step active			
E1227	ANSI59-10 blocked step			
E1228	ANSI59-10 pickup			
E1229	ANSI59-10 trip			

Event No.	Name	Description	Event system	Event history
E1234	ANSI59-11 step active			
E1235	ANSI59-11 blocked step			
E1236	ANSI59-11 pickup			
E1237	ANSI59-11 trip			
E1242	ANSI59-12 step active			
E1243	ANSI59-12 blocked step			
E1244	ANSI59-12 pickup			
E1245	ANSI59-12 trip			
E1370	ANSI59N/G module active			
E1371	ANSI59N/G blocked module			
E1373	ANSI59N/G-1 step active			
E1374	ANSI59N/G-1 blocked step			
E1375	ANSI59N/G-1 pickup			
E1376	ANSI59N/G-1 trip			
E1381	ANSI59N/G-2 step active			
E1382	ANSI59N/G-2 blocked step			
E1383	ANSI59N/G-2 pickup			
E1384	ANSI59N/G-2 trip			
E1389	ANSI59N/G-3 step active			
E1390	ANSI59N/G-3 blocked step			
E1391	ANSI59N/G-3 pickup			
E1392	ANSI59N/G-3 trip			
E1397	ANSI59N/G-4 step active			
E1398	ANSI59N/G-4 blocked step			
E1399	ANSI59N/G-4 pickup			
E1400	ANSI59N/G-4 trip			
E1735	ANSI67 module active			
E1736	ANSI67 blocked module			
E1741	ANSI67-1 step active			
E1742	ANSI67-1 blocked step			
E1743	ANSI67-1 pickup L1			
E1744	ANSI67-1 pickup L2			
E1745	ANSI67-1 pickup L3			
E1746	ANSI67-1 pickup			
E1747	ANSI67-1 trip L1			
E1748	ANSI67-1 trip L2			
E1749	ANSI67-1 trip L3			
E1750	ANSI67-1 trip			
E1751	ANSI67-1 low voltage			
E1757	ANSI67-2 step active			
E1758	ANSI67-2 blocked step			
E1759	ANSI67-2 pickup L1			
E1760	ANSI67-2 pickup L2			
E1761	ANSI67-2 pickup L3			
E1762	ANSI67-2 pickup			
E1763	ANSI67-2 trip L1			
E1764	ANSI67-2 trip L2			
E1765	ANSI67-2 trip L3			
E1766	ANSI67-2 trip			
E1767	ANSI67-2 low voltage			
E1773	ANSI67-3 step active			
E1774	ANSI67-3 blocked step			
E1775	ANSI67-3 pickup L1			
E1776	ANSI67-3 pickup L2			
E1777	ANSI67-3 pickup L3			
E1778	ANSI67-3 pickup			
E1779	ANSI67-3 trip L1			
E1780	ANSI67-3 trip L2			
E1781	ANSI67-3 trip L3			
E1782	ANSI67-3 trip			
E1783	ANSI67-3 low voltage			
E1789	ANSI67-4 step active			
E1790	ANSI67-4 blocked step			
E1791	ANSI67-4 pickup L1			
E1792	ANSI67-4 pickup L2			
E1793	ANSI67-4 pickup L3			
E1794	ANSI67-4 pickup			
E1795	ANSI67-4 trip L1			
E1796	ANSI67-4 trip L2			
E1797	ANSI67-4 trip L3			
E1798	ANSI67-4 trip			
E1799	ANSI67-4 low voltage			

Event No.	Name	Description	Event system	Event history
E2035	ANSI67G module active			
E2036	ANSI67G blocked module			
E2038	ANSI67G-1 step active			
E2039	ANSI67G-1 blocked step			
E2040	ANSI67G-1 pickup			
E2041	ANSI67G-1 trip			
E2042	ANSI67G-1 low voltage			
E2046	ANSI67G-2 step active			
E2047	ANSI67G-2 blocked step			
E2048	ANSI67G-2 pickup			
E2049	ANSI67G-2 trip			
E2050	ANSI67G-2 low voltage			
E2054	ANSI67G-3 step active			
E2055	ANSI67G-3 blocked step			
E2056	ANSI67G-3 pickup			
E2057	ANSI67G-3 trip			
E2058	ANSI67G-3 low voltage			
E2062	ANSI67G-4 step active			
E2063	ANSI67G-4 blocked step			
E2064	ANSI67G-4 pickup			
E2065	ANSI67G-4 trip			
E2066	ANSI67G-4 low voltage			
E2235	ANSI74TC active			
E2236	ANSI74TC blocked			
E2237	ANSI74TC pickup			
E2238	ANSI74TC trip			
E1570	ANSI78 module active			
E1570	ANSI78 blocked module			
E1576	ANSI78-1 step active			
E1577	ANSI78-1 blocked step			
E1578	ANSI78-1 blocked by min. start voltage			
E1579	ANSI78-1 pickup			
E1580	ANSI78-1 trip			
E1584	ANSI78-2 step active			
E1585	ANSI78-2 blocked step			
E1586	ANSI78-2 blocked by min. start voltage			
E1587	ANSI78-2 pickup			
E1588	ANSI78-2 trip			
E1592	ANSI78-3 step active			
E1593	ANSI78-3 blocked step			
E1594	ANSI78-3 blocked by min. start voltage			
E1595	ANSI78-3 pickup			
E1596	ANSI78-3 trip			
E2160	ANSI79 Ready			
E2161	ANSI79 Blocked			
E2162	ANSI79 Locked			
E2163	ANSI79 Cycle			
E2164	ANSI79 1. Pause time			
E2165	ANSI79 2. Pause time			
E2166	ANSI79 3. Pause time			
E2167	ANSI79 4. Pause time			
E2168	ANSI79 5. Pause time			
E2169	ANSI79 6. Pause time			
E2170	ANSI79 7. Pause time			
E2171	ANSI79 8. Pause time			
E2172	ANSI79 Breaker close command			
E2173	ANSI79 Breaker close success time			
E2174	ANSI79 Success			
E2175	ANSI79 Fail			
E2176	ANSI79 Off-time			
E1250	ANSI81 module active			
E1251	ANSI81 blocked module			
E1254	ANSI81-1 step active			
E1255	ANSI81-1 blocked step			
E1256	ANSI81-1 blocked step by min. start voltage			
E1257	ANSI81-1 pickup			
E1258	ANSI81-1 trip			
E1262	ANSI81-2 step active			
E1263	ANSI81-2 blocked step			
E1264	ANSI81-2 blocked step by min. start voltage			
E1265	ANSI81-2 pickup			
E1266	ANSI81-2 trip			

Event No.	Name	Description	Event system	Event history
E1270	ANSI81-3 step active			
E1271	ANSI81-3 blocked step			
E1272	ANSI81-3 blocked step by min. start voltage			
E1273	ANSI81-3 pickup			
E1274	ANSI81-3 trip			
E1278	ANSI81-4 step active			
E1279	ANSI81-4 blocked step			
E1280	ANSI81-4 blocked step by min. start voltage			
E1281	ANSI81-4 pickup			
E1282	ANSI81-4 trip			
E1286	ANSI81-5 step active			
E1287	ANSI81-5 blocked step			
E1288	ANSI81-5 blocked step by min. start voltage			
E1289	ANSI81-5 pickup			
E1290	ANSI81-5 trip			
E1294	ANSI81-6 step active			
E1295	ANSI81-6 blocked step			
E1296	ANSI81-6 blocked step by min. start voltage			
E1297	ANSI81-6 pickup			
E1298	ANSI81-6 trip			
E1302	ANSI81-7 step active			
E1303	ANSI81-7 blocked step			
E1304	ANSI81-7 blocked step by min. start voltage			
E1305	ANSI81-7 pickup			
E1306	ANSI81-7 trip			
E1310	ANSI81-8 step active			
E1311	ANSI81-8 blocked step			
E1312	ANSI81-8 blocked step by min. start voltage			
E1313	ANSI81-8 pickup			
E1314	ANSI81-8 trip			
E1318	ANSI81-9 step active			
E1319	ANSI81-9 blocked step			
E1320	ANSI81-9 blocked step by min. start voltage			
E1321	ANSI81-9 pickup			
E1322	ANSI81-9 trip			
E1326	ANSI81-10 step active			
E1327	ANSI81-10 blocked step			
E1328	ANSI81-10 blocked step by min. start voltage			
E1329	ANSI81-10 pickup			
E1330	ANSI81-10 trip			
E1334	ANSI81-11 step active			
E1335	ANSI81-11 blocked step			
E1336	ANSI81-11 blocked step by min. start voltage			
E1337	ANSI81-11 pickup			
E1338	ANSI81-11 trip			
E1342	ANSI81-12 step active			
E1343	ANSI81-12 blocked step			
E1344	ANSI81-12 blocked step by min. start voltage			
E1345	ANSI81-12 pickup			
E1346	ANSI81-12 trip			
E1600	ANSI 81R module active			
E1601	ANSI 81R blocked module			
E1606	ANSI 81R-1 step active			
E1607	ANSI 81R-1 blocked step			
E1608	ANSI 81R-1 blocked by MSV			
E1609	ANSI 81R-1 pickup			
E1610	ANSI 81R-1 trip			
E1614	ANSI 81R-2 step active			
E1615	ANSI 81R-2 blocked step			
E1616	ANSI 81R-2 blocked by MSV			
E1617	ANSI 81R-2 pickup			
E1618	ANSI 81R-2 trip			
E1622	ANSI 81R-3 step active			
E1623	ANSI 81R-3 blocked step			
E1624	ANSI 81R-3 blocked by MSV			
E1625	ANSI 81R-3 pickup			
E1626	ANSI 81R-3 trip			
E1630	ANSI87 module active			
E1631	ANSI87 blocked module			
E1650	ANSI87-1 step active			
E1651	ANSI87-1 blocked step			
E1652	ANSI87-1 pickup			

Event No.	Name	Description	Event system	Event history
E1653	ANSI87-1 trip			
E1654	ANSI87-1 L1 blocked by CTS			
E1655	ANSI87-1 L2 blocked by CTS			
E1656	ANSI87-1 L3 blocked by CTS			
E1657	ANSI87-1 CTS supervision active			
E1670	ANSI87-2 step active			
E1671	ANSI87-2 blocked step			
E1672	ANSI87-2 pickup			
E1673	ANSI87-2 trip			
E1470	ANSI95i-CT1 module active			
E1471	ANSI95i-CT1 blocked module			
E1472	ANSI95i-CT1 blocked module by I _{max}			
E1473	ANSI95i-CT1 L1 blocked by 2H			
E1474	ANSI95i-CT1 L2 blocked by 2H			
E1475	ANSI95i-CT1 L3 blocked by 2H			
E1476	ANSI95i-CT1 L1 blocked by 5H			
E1477	ANSI95i-CT1 L2 blocked by 5H			
E1478	ANSI95i-CT1 L3 blocked by 5H			
E1479	ANSI95i-CT1 2H supervision blocked			
E1480	ANSI95i-CT1 5H supervision blocked			
E1485	ANSI95i-CT2 module active			
E1486	ANSI95i-CT2 blocked module			
E1487	ANSI95i-CT2 blocked module by I _{max}			
E1488	ANSI95i-CT2 L1 blocked by 2H			
E1489	ANSI95i-CT2 L2 blocked by 2H			
E1490	ANSI95i-CT2 L3 blocked by 2H			
E1491	ANSI95i-CT2 L1 blocked by 5H			
E1492	ANSI95i-CT2 L2 blocked by 5H			
E1493	ANSI95i-CT2 L3 blocked by 5H			
E1494	ANSI95i-CT2 2H supervision blocked			
E1495	ANSI95i-CT2 5H supervision blocked			
E1515	ANSI95i-GND1 module active			
E1516	ANSI95i-GND1 blocked module			
E1517	ANSI95i-GND1 blocked module by I _{max}			
E1518	ANSI95i-GND1 blocked by 2H			
E1519	ANSI95i-GND1 blocked by 5H			
E1520	ANSI95i-GND1 2H supervision blocked			
E1521	ANSI95i-GND1 5H supervision blocked			
E2130	CTS-1 symmetry check active			
E2131	CTS-1 symmetry check blocked			
E2132	CTS-1 symmetry fault			
E2133	CTS-1 symmetry fault delayed			
E2135	CTS-1 diff check active			
E2136	CTS-1 diff check blocked			
E2137	CTS-1 diff fault			
E2138	CTS-1 diff fault delayed			
E2140	CTS-2 symmetry check active			
E2141	CTS-2 symmetry check blocked			
E2142	CTS-2 symmetry fault			
E2143	CTS-2 symmetry fault delayed			
E2145	CTS-2 diff check active			
E2146	CTS-2 diff check blocked			
E2147	CTS-2 diff fault			
E2148	CTS-2 diff fault delayed			
E2070	PTS-1 symmetry check active			
E2071	PTS-1 symmetry check blocked			
E2072	PTS-1 symmetry failure			
E2073	PTS-1 symmetry failure delayed			
E2076	PTS-1 fuse failure check active			
E2077	PTS-1 fuse failure check blocked			
E2078	PTS-1 fuse failure 3 phase			
E2079	PTS-1 fuse failure failure			
E2080	PTS-1 fuse failure failure delayed			
E2084	PTS-1 general check active			
E2085	PTS-1 general check blocked			
E2086	PTS-1 general failure			
E2087	PTS-1 general failure delayed			
E2090	PTS-2 symmetry check active			
E2091	PTS-2 symmetry check blocked			
E2092	PTS-2 symmetry failure			
E2093	PTS-2 symmetry failure delayed			
E2096	PTS-2 fuse failure check active			

Event No.	Name	Description	Event system	Event history
E2097	PTS-2 fuse failure check blocked			
E2098	PTS-2 fuse failure 3 phase			
E2099	PTS-2 fuse failure failure			
E2100	PTS-2 fuse failure failure delayed			
E2104	PTS-2 general check active			
E2105	PTS-2 general check blocked			
E2106	PTS-2 general failure			
E2107	PTS-2 general failure delayed			
E2110	PTS-3 symmetry check active			
E2111	PTS-3 symmetry check blocked			
E2112	PTS-3 symmetry failure			
E2113	PTS-3 symmetry failure delayed			
E2116	PTS-3 fuse failure check active			
E2117	PTS-3 fuse failure check blocked			
E2118	PTS-3 fuse failure 3 phase			
E2119	PTS-3 fuse failure failure			
E2120	PTS-3 fuse failure failure delayed			
E2124	PTS-3 general check active			
E2125	PTS-3 general check blocked			
E2126	PTS-3 general failure			
E2127	PTS-3 general failure delayed			
E2180	YG active			
E2181	YG blocked			
E2185	YG-1 active			
E2186	YG-1 blocked			
E2187	YG-1 pickup			
E2188	YG-1 trip			
E2190	YG-2 active			
E2191	YG-2 blocked			
E2192	YG-2 pickup			
E2193	YG-2 trip			
E2195	YG-3 active			
E2196	YG-3 blocked			
E2197	YG-3 pickup			
E2198	YG-3 trip			
E2200	YG-4 active			
E2201	YG-4 blocked			
E2202	YG-4 pickup			
E2203	YG-4 trip			
E2205	YG-5 active			
E2206	YG-5 blocked			
E2207	YG-5 pickup			
E2208	YG-5 trip			
E2210	YG-6 active			
E2211	YG-6 blocked			
E2212	YG-6 pickup			
E2213	YG-6 trip			
	Binary input events E4000 – E4499			
E4010	Binary input "Fct. 10 In" input event	Binary input event input event	☑	☑
E4110	Binary input "Fct. 10 In" predelay event	Binary input event predelay event	☑	☑
E4210	Binary input "Fct. 10 In" inverted event	Binary input event inverted event	☑	☑
E4310	Binary input "Fct. 10 In" wirefault event	Binary input event wirefault event	☑	☑
E4410	Binary input "Fct. 10 In" shortcircuit event	Binary input event shortcircuit event	☑	☑
E4011	Binary input "Fct. 11 In" input event	Binary input event input event	☑	☑
E4111	Binary input "Fct. 11 In" predelay event	Binary input event predelay event	☑	☑
E4211	Binary input "Fct. 11 In" inverted event	Binary input event inverted event	☑	☑
E4311	Binary input "Fct. 11 In" wirefault event	Binary input event wirefault event	☑	☑
E4411	Binary input "Fct. 11 In" shortcircuit event	Binary input event shortcircuit event	☑	☑
E4012	Binary input "Fct. 12 In" input event	Binary input event input event	☑	☑
E4112	Binary input "Fct. 12 In" predelay event	Binary input event predelay event	☑	☑
E4212	Binary input "Fct. 12 In" inverted event	Binary input event inverted event	☑	☑
E4312	Binary input "Fct. 12 In" wirefault event	Binary input event wirefault event	☑	☑
E4412	Binary input "Fct. 12 In" shortcircuit event	Binary input event shortcircuit event	☑	☑
E4013	Binary input "Fct. 13 In" input event	Binary input event input event	☑	☑
E4113	Binary input "Fct. 13 In" predelay event	Binary input event predelay event	☑	☑
E4213	Binary input "Fct. 13 In" inverted event	Binary input event inverted event	☑	☑
E4313	Binary input "Fct. 13 In" wirefault event	Binary input event wirefault event	☑	☑
E4413	Binary input "Fct. 13 In" shortcircuit event	Binary input event shortcircuit event	☑	☑
E4014	Binary input "Fct. 14 In" input event	Binary input event input event	☑	☑

[illegible]

Event No.	Name	Description	Event system	Event history
E4328	Binary input "Fct. 28 In" wirefault event	Binary input event wirefault event	☒	☒
E4428	Binary input "Fct. 28 In" shortcircuit event	Binary input event shortcircuit event	☒	☒
	Binary output events E4500 – E4599			
E4500	Shunt Trip 1	Shunt Trip 1 output event	☒	☒
E4501	Shunt Trip 2	Shunt Trip 2 output event	☒	☒
E4502	Lockout relay	Lockout relay event	☒	☒
E4503	Lockout relay predelay	Lockout relay predelay event	☒	☒
E4504	Synchron relay	Synchron relay event	☒	☒
E4505	Synchron relay predelay	Synchron relay predelay event	☒	☒
E4506	Function output 1	Function output 1 event	☒	☒
E4507	Function output predelay	Function output 1 predelay event	☒	☒
E4508	Function output 2	Function output 2 event	☒	☒
E4509	Function output predelay	Function output 2 predelay event	☒	☒
E4510	Function output 3	Function output 3 event	☒	☒
E4511	Function output predelay	Function output 3 predelay event	☒	☒
E4512	Function output 4	Function output 4 event	☒	☒
E4513	Function output predelay	Function output 4 predelay event	☒	☒
E4514	Function output 5	Function output 5 event	☒	☒
E4515	Function output predelay	Function output 5 predelay event	☒	☒
E4516	Function output 6	Function output 6 event	☒	☒
E4517	Function output predelay	Function output 6 predelay event	☒	☒
E4518	Function output 7	Function output 7 event	☒	☒
E4519	Function output predelay	Function output 7 predelay event	☒	☒
E4520	Function output 8	Function output 8 event	☒	☒
E4521	Function output predelay	Function output 8 predelay event	☒	☒
	Breaker feedback events E6010 – E6085			
E6010	ON-Feedback 1	Breaker 1 (feedback)	☒	☒
E6011	OFF-Feedback 1	Breaker 1 (feedback)	☒	☒
E6012	OUT-Feedback 1	Breaker 1 (feedback)	☒	☒
E6013	IN-Feedback 1	Breaker 1 (feedback)	☒	☒
E6014	EARTH ON-Feedback 1	Breaker 1 (feedback)	☒	☒
E6015	EARTH OFF-Feedback 1	Breaker 1 (feedback)	☒	☒
E6020	ON-Feedback 2	Breaker 2 (feedback)	☒	☒
E6021	OFF-Feedback 2	Breaker 2 (feedback)	☒	☒
E6022	OUT-Feedback 2	Breaker 2 (feedback)	☒	☒
E6023	IN-Feedback 2	Breaker 2 (feedback)	☒	☒
E6024	EARTH ON-Feedback 2	Breaker 2 (feedback)	☒	☒
E6025	EARTH OFF-Feedback 2	Breaker 2 (feedback)	☒	☒
E6030	ON-Feedback 3	Breaker 3 (feedback)	☒	☒
E6031	OFF-Feedback 3	Breaker 3 (feedback)	☒	☒
E6032	OUT-Feedback 3	Breaker 3 (feedback)	☒	☒
E6033	IN-Feedback 3	Breaker 3 (feedback)	☒	☒
E6034	EARTH ON-Feedback 3	Breaker 3 (feedback)	☒	☒
E6035	EARTH OFF-Feedback 3	Breaker 3 (feedback)	☒	☒
E6040	ON-Feedback 4	Breaker 4 (feedback)	☒	☒
E6041	OFF-Feedback 4	Breaker 4 (feedback)	☒	☒
E6042	OUT-Feedback 4	Breaker 4 (feedback)	☒	☒
E6043	IN-Feedback 4	Breaker 4 (feedback)	☒	☒
E6044	EARTH ON-Feedback 4	Breaker 4 (feedback)	☒	☒
E6045	EARTH OFF-Feedback 4	Breaker 4 (feedback)	☒	☒
E6050	ON-Feedback 5	Breaker 5 (feedback)	☒	☒
E6051	OFF-Feedback 5	Breaker 5 (feedback)	☒	☒
E6052	OUT-Feedback 5	Breaker 5 (feedback)	☒	☒
E6053	IN-Feedback 5	Breaker 5 (feedback)	☒	☒
E6054	EARTH ON-Feedback 5	Breaker 5 (feedback)	☒	☒
E6055	EARTH OFF-Feedback 5	Breaker 5 (feedback)	☒	☒
E6060	ON-Feedback 6	Breaker 6 (feedback)	☒	☒
E6061	OFF-Feedback 6	Breaker 6 (feedback)	☒	☒
E6062	OUT-Feedback 6	Breaker 6 (feedback)	☒	☒
E6063	IN-Feedback 6	Breaker 6 (feedback)	☒	☒
E6064	EARTH ON-Feedback 6	Breaker 6 (feedback)	☒	☒
E6065	EARTH OFF-Feedback 6	Breaker 6 (feedback)	☒	☒
E6070	ON-Feedback 7	Breaker 7 (feedback)	☒	☒
E6071	OFF-Feedback 7	Breaker 7 (feedback)	☒	☒
E6072	OUT-Feedback 7	Breaker 7 (feedback)	☒	☒
E6073	IN-Feedback 7	Breaker 7 (feedback)	☒	☒
E6074	EARTH ON-Feedback 7	Breaker 7 (feedback)	☒	☒
E6075	EARTH OFF-Feedback 7	Breaker 7 (feedback)	☒	☒
E6080	ON-Feedback 8	Breaker 8 (feedback)	☒	☒
E6081	OFF-Feedback 8	Breaker 8 (feedback)	☒	☒
E6082	OUT-Feedback 8	Breaker 8 (feedback)	☒	☒

Event No.	Name	Description	Event system	Event history
E6083	IN-Feedback 8	Breaker 8 (feedback)	☒	☒
E6084	EARTH ON-Feedback 8	Breaker 8 (feedback)	☒	☒
E6085	EARTH OFF-Feedback 8	Breaker 8 (feedback)	☒	☒
	Breaker position events E6110 – E6187			
E6110	OPEN 1	Breaker 1 (position)	☒	☒
E6111	CLOSED 1	Breaker 1 (position)	☒	☒
E6112	OUT OPEN 1	Breaker 1 (position)	☒	☒
E6113	OUT CLOSED 1	Breaker 1 (position)	☒	☒
E6114	EARTH 1	Breaker 1 (position)	☒	☒
E6115	DIFF (Moving) 1	Breaker 1 (position)	☒	☒
E6116	FAIL 1	Breaker 1 (position)	☒	☒
E6117	OPEN ERROR 1	Breaker 1 (position)	☒	☒
E6120	OPEN 2	Breaker 2 (position)	☒	☒
E6121	CLOSED 2	Breaker 2 (position)	☒	☒
E6122	OUT OPEN 2	Breaker 2 (position)	☒	☒
E6123	OUT CLOSED 2	Breaker 2 (position)	☒	☒
E6124	EARTH 2	Breaker 2 (position)	☒	☒
E6125	DIFF (Moving) 2	Breaker 2 (position)	☒	☒
E6126	FAIL 2	Breaker 2 (position)	☒	☒
E6127	OPEN ERROR 2	Breaker 2 (position)	☒	☒
E6130	OPEN 3	Breaker 3 (position)	☒	☒
E6131	CLOSED 3	Breaker 3 (position)	☒	☒
E6132	OUT OPEN 3	Breaker 3 (position)	☒	☒
E6133	OUT CLOSED 3	Breaker 3 (position)	☒	☒
E6134	EARTH 3	Breaker 3 (position)	☒	☒
E6135	DIFF (Moving) 3	Breaker 3 (position)	☒	☒
E6136	FAIL 3	Breaker 3 (position)	☒	☒
E6137	OPEN ERROR 3	Breaker 3 (position)	☒	☒
E6140	OPEN 4	Breaker 4 (position)	☒	☒
E6141	CLOSED 4	Breaker 4 (position)	☒	☒
E6142	OUT OPEN 4	Breaker 4 (position)	☒	☒
E6143	OUT CLOSED 4	Breaker 4 (position)	☒	☒
E6144	EARTH 4	Breaker 4 (position)	☒	☒
E6145	DIFF (Moving) 4	Breaker 4 (position)	☒	☒
E6146	FAIL 4	Breaker 4 (position)	☒	☒
E6147	OPEN ERROR 4	Breaker 4 (position)	☒	☒
E6150	OPEN 5	Breaker 5 (position)	☒	☒
E6151	CLOSED 5	Breaker 5 (position)	☒	☒
E6152	OUT OPEN 5	Breaker 5 (position)	☒	☒
E6153	OUT CLOSED 5	Breaker 5 (position)	☒	☒
E6154	EARTH 5	Breaker 5 (position)	☒	☒
E6155	DIFF (Moving) 5	Breaker 5 (position)	☒	☒
E6156	FAIL 5	Breaker 5 (position)	☒	☒
E6157	OPEN ERROR 5	Breaker 5 (position)	☒	☒
E6160	OPEN 6	Breaker 6 (position)	☒	☒
E6161	CLOSED 6	Breaker 6 (position)	☒	☒
E6162	OUT OPEN 6	Breaker 6 (position)	☒	☒
E6163	OUT CLOSED 6	Breaker 6 (position)	☒	☒
E6164	EARTH 6	Breaker 6 (position)	☒	☒
E6165	DIFF (Moving) 6	Breaker 6 (position)	☒	☒
E6166	FAIL 6	Breaker 6 (position)	☒	☒
E6167	OPEN ERROR 6	Breaker 6 (position)	☒	☒
E6170	OPEN 7	Breaker 7 (position)	☒	☒
E6171	CLOSED 7	Breaker 7 (position)	☒	☒
E6172	OUT OPEN 7	Breaker 7 (position)	☒	☒
E6173	OUT CLOSED 7	Breaker 7 (position)	☒	☒
E6174	EARTH 7	Breaker 7 (position)	☒	☒
E6175	DIFF (Moving) 7	Breaker 7 (position)	☒	☒
E6176	FAIL 7	Breaker 7 (position)	☒	☒
E6177	OPEN ERROR 7	Breaker 7 (position)	☒	☒
E6180	OPEN 8	Breaker 8 (position)	☒	☒
E6181	CLOSED 8	Breaker 8 (position)	☒	☒
E6182	OUT OPEN 8	Breaker 8 (position)	☒	☒
E6183	OUT CLOSED 8	Breaker 8 (position)	☒	☒
E6184	EARTH 8	Breaker 8 (position)	☒	☒
E6185	DIFF (Moving) 8	Breaker 8 (position)	☒	☒
E6186	FAIL 8	Breaker 8 (position)	☒	☒
E6187	OPEN ERROR 8	Breaker 8 (position)	☒	☒
	Breaker counter events E6311 – E6383			
E6311	CLOSED -> OPEN cycles max 1	Breaker 1 (counter)	☒	☒

Event No.	Name	Description	Event system	Event history
E6313	OPEN -> EARTH cycles max 1	Breaker 1 (counter)	☒	☒
E6321	CLOSED -> OPEN cycles max 2	Breaker 2 (counter)	☒	☒
E6323	OPEN -> EARTH cycles max 2	Breaker 2 (counter)	☒	☒
E6331	CLOSED -> OPEN cycles max 3	Breaker 3 (counter)	☒	☒
E6333	OPEN -> EARTH cycles max 3	Breaker 3 (counter)	☒	☒
E6341	CLOSED -> OPEN cycles max 4	Breaker 4 (counter)	☒	☒
E6343	OPEN -> EARTH cycles max 4	Breaker 4 (counter)	☒	☒
E6351	CLOSED -> OPEN cycles max 5	Breaker 5 (counter)	☒	☒
E6353	OPEN -> EARTH cycles max 5	Breaker 5 (counter)	☒	☒
E6361	CLOSED -> OPEN cycles max 6	Breaker 6 (counter)	☒	☒
E6363	OPEN -> EARTH cycles max 6	Breaker 6 (counter)	☒	☒
E6371	CLOSED -> OPEN cycles max 7	Breaker 7 (counter)	☒	☒
E6373	OPEN -> EARTH cycles max 7	Breaker 7 (counter)	☒	☒
E6381	CLOSED -> OPEN cycles max 8	Breaker 8 (counter)	☒	☒
E6383	OPEN -> EARTH cycles max 8	Breaker 8 (counter)	☒	☒
	Breaker select events E6391 – E6398			
E6391	Select Breaker 1	Breaker 1 selected via touchscreen	☒	☒
E6392	Select Breaker 2	Breaker 2 selected via touchscreen	☒	☒
E6393	Select Breaker 3	Breaker 3 selected via touchscreen	☒	☒
E6394	Select Breaker 4	Breaker 4 selected via touchscreen	☒	☒
E6395	Select Breaker 5	Breaker 5 selected via touchscreen	☒	☒
E6396	Select Breaker 6	Breaker 6 selected via touchscreen	☒	☒
E6397	Select Breaker 7	Breaker 7 selected via touchscreen	☒	☒
E6398	Select Breaker 8	Breaker 8 selected via touchscreen	☒	☒
	Function key (front plate) events E6400 – E6431			
E6400	"0"		☒	☒
E6401	"1"		☒	☒
E6402	"Stop"		☒	☒
E6403	"Start"		☒	☒
E6406	"Key"	Calls up menu page "User levels"	☒	☒
E6407	"Alarm Ack"	Acknowledgement of alarms	☒	☒
E6408	"Alarm page"	Calls up menu page "Alarms"	☒	☒
E6409	"Auto/Manual"		☒	☒
E6415	"Emergency OFF 1 / Emergency OFF 2"		☒	☒
	User levels E6801 – E6804			
E6801	-	User level 1 activated		
E6802	-	User level 2 activated		
E6803	-	User level 3 activated		
E6804	-	User level 4 activated		
	GU user page events E6900 – E6963			
E6900 – E6963	GU user page button	Event activated by GU user page button	☒	☒
	Disturbance recorder E8000 – E8007			
E8000	DiREC-Ready		☒	☒
E8001	DiREC-Recording		☒	☒
E8002	DiREC-Buffer overflow		☒	☒
E8003	DiREC-Backup		☒	☒
E8004	DiREC-Full memory		☒	☒
E8005	DiREC-No memory card		☒	☒
E8006	DiREC-Memory error		☒	☒
E8007	DiREC-File error		☒	☒
	Disturbance recorder E8000 – E8007			
E9998	Manual trigger	Manual trigger of Fault recorder		
	System supervision events E9000 – E9099			
E9000	Common alarm of system supervision	Active if any of the system supervision events are active	☒	☒
E9001	CU CPU communication failure	CAN Bus OFF	☒	☒
E9002	MU CPU communication failure	No CAN messages	☒	☒
E9003	GU CPU communication failure	No CAN messages	☒	☒
E9004	SU CPU communication failure	No CAN messages	☒	☒
E9007	Firmware constellation invalid		☒	☒
E9008	Unknown parameter file		☒	☒
E9009	Unknown hardware		☒	☒
E9010	CU DRAM error	Write-Read-Test error (@ PowerON)	☒	☒
E9011	CU Serial Flash error	Wrong return value (ID) from driver	☒	☒
E9012	CU Binary Inputs ADC TLC545 error	Test channel out of range	☒	☒

Event No.	Name	Description	Event system	Event history
E9013	CU Binary Outputs DAC MAX4820 error	Wrong feedback signals	☒	☒
E9014	CU Serial Port 1 Framing error		☒	☒
E9015	CU Analog Inputs ADC AD7914 error		☒	☒
E9016	CU Profibus error		☒	☒
E9020	CU Parameter file error	CRC error	☒	☒
E9021	MU Parameter file error		☒	☒
E9022	GU Parameter file error		☒	☒
E9030	Event system feedback loop detected	More than 500 event changes per sec during 60 seconds	☒	☒
E9040	MU kWh counter crc error	CRC error in SRAM (@ WD reset)	☒	☒
E9041	MU EEPROM error	Communication error (@ Systemstart)	☒	☒
E9042	MU Calibration file crc error	CRC error in EEPROM (@ Systemstart)	☒	☒
E9043	MU Parameter file error	CRC error	☒	☒
E9044	MU ADC0 error	Wrong channel numbers from ADC	☒	☒
E9045	MU ADC1 error	Wrong channel numbers from ADC	☒	☒
	Static event			
E9999	ON-Event	Event is always active (true)	☒	-

3.2 “SETUP” (Basic device settings)

3.2.1 “User levels”

Hauptmenü\Parameter\SETUP						
User levels						
	Level 1	Level 2	Level 3	Level 4		
Events	6801	6802	6803	6804		
	Value				Unit	(Setting range)
Activation						
Priority		2	3	4	-	2/3/4
Password		1111	0	0	-	0 ... 9999
Activation time		300	0	0	s	0 ... 65000
Active by event		0	0	0	event	0 ... 9999
Block by event		0	0	0	event	0 ... 9999
Active by USB stick 1		☐	☐	☐	-	☐ / ☒
Active by USB stick 2		☐	☐	☐	-	☐ / ☒
Active by USB stick 3		☐	☐	☐	-	☐ / ☒
Active by upper key pos.1		☐	☐	☐	-	☐ / ☒
Active by upper key pos.2		☐	☐	☐	-	☐ / ☒
Active by upper key pos.3		☐	☐	☐	-	☐ / ☒
Active by lower key pos.1		☐	☐	☐	-	☐ / ☒
Active by lower key pos.2		☐	☐	☐	-	☐ / ☒
Active by lower key pos.3		☐	☐	☐	-	☐ / ☒
Functions						
Local mode [E6810]	☒	☒	☐	☐	-	☐ / ☒
Remote mode [E6811]	☐	☒	☐	☐	-	☐ / ☒
Change display settings	☒	☒	☐	☐	-	☐ / ☒
Change language/time	☒	☒	☐	☐	-	☐ / ☒
Breaker control via display	☒	☒	☐	☐	-	☐ / ☒
Start synchronizer manually	☒	☒	☐	☐	-	☐ / ☒
Reset mode: counters, histories, etc.	☒	☒	☐	☐	-	☐ / ☒
Block all histories	☐	☐	☐	☐	-	☐ / ☒
Block param upload	☐	☐	☐	☐	-	☐ / ☒
Block parameter download	☐	☐	☐	☐	-	☐ / ☒
Block view via LCD	☐	☐	☐	☐	-	☐ / ☒
Block change via LCD	☐	☐	☐	☐	-	☐ / ☒

Figure 3-1 Menu “SETUP” – Configurabel “User levels”

Event description:

E 6801
to
E 6804

Event of activated “user level 1”; as soon as one of the four user levels is effective, then, event [E6801], [E6802], [E6803] or [E6804] is being activated.

Parameter description:

“Activation“

P Priority

Priority setting of the user level against activation of other user levels; in case that simultaneously two or more user levels are activated, then, the user level is being active which is of the highest priority. According to the setting options of parameter “Priority” [P], prioritisation order is as follows:

- “2”: lowest priority
- “3”: third highest priority
- “4”: highest priority.

NOTE: User level 1 is only active, in case that none of the user levels 2, 3 and 4 is activated!

P Password

Entering of password by 4-digit code to activate the relevant user level

P Activation time

Duration for entering password; as soon as user level 2, 3 or 4 is being activated, activation time set by parameter “Activation time” [P] starts. The timer of the activation time restarts every time the touchscreen is operated. As soon as the timer has run down, SYMAP-Compact(+) automatically activates “user level 1”.

P Active by event

User level 2, 3 or 4 can be activated by any active event. For activation, the number related to this activating event has to be assigned to parameter “Active by event” [P]. Activation is only effective, however, as long as the activating event is active. As soon as the user level is active, corresponding event [E6802], [E6803] or [E6804] is being activated.

If activation of user level 2, 3 or 4 by the activating event is not required, set this parameter to “0”.

P Block by event

User level 2, 3 or 4 can be blocked by any active event. For blocking, the number related to this blocking event has to be assigned to parameter “Block by event” [P]. Blocking is only effective, however, as long as the blocking event is active.

If blocking of user level 2, 3 or 4 by the blocking event is not required, set this parameter to “0”.

P Active by USB stick 1

(function is not available yet!)

P Active by USB stick 2

(function is not available yet!)

P Active by USB stick 3

(function is not available yet!)

P Active by upper key pos.1

(function is not available yet!)

P Active by upper key pos.2

(function is not available yet!)

P Active by upper key pos.3
(function is not available yet!)

P Active by lower key pos.1
(function is not available yet!)

P Active by lower key pos.2
(function is not available yet!)

P Active by lower key pos.3
(function is not available yet!)

Funktionen („Functions“)

P Local mode [E6810]
Authorisation for operating mode “Local mode”; if this operating mode is assigned to the relevant user level and this user level is activated, then, the corresponding event “Local mode” [E6810] is being activated.

P Remote mode [E6811]
Authorisation for operating mode “Remote mode”; if this operating mode is assigned to the relevant user level and this user level is activated, then, the corresponding event “Remote mode” [E6811] is being activated.

P Change display settings
*Authorisation for setting parameters of sub-menu “Display” (Main Menu/Settings/**Display**); setting of these parameters is only permitted, if the user level which is assigned to parameter “Change display settings” [P] is activated.*

P Change language/time
*Authorisation for setting parameters of sub-menu “Language & Time” (Main Menu/Settings/**Language & Time**); setting of these parameters is only permitted, if the user level which is assigned to parameter “Change language/time” [P] is activated.*

P Breaker control via display
Authorisation for local breaker control function via touchscreen; local control of switching elements via function keys of SYMAP®-Compact(+) front plate is only permitted, if the user level which is assigned to parameter “Breaker control via display” [P] is activated.

P Start synchronizer manually
Authorisation for manual synchronisation; manual synchronisation via function keys of SYMAP®-Compact(+) front plate is only permitted, if the user level which is assigned to parameter “Start synchronizer manually” [P] is activated.

P Reset mode: counters, histories, etc.
Authorisation for resetting of recorder data and counter values; resetting of event recorder, fault recorder or counters is only permitted, if the user level which is assigned to parameter “Reset mode: counters, histories, etc.” [P] is activated.

P Block all histories
Authorisation for blocking of data recording and counting functions; blocking of data recording of event recorder, fault recorder or counting is only permitted, if the user level which is assigned to parameter “Block all histories” [P] is activated.

P Block param. upload (read)

Authorisation for blocking of reading the SYMAP[®]-Compact(+) parameter file by SCPT; reading the parameter file via SCPT is only permitted, if the user level which is assigned to parameter "Block param. upload (read)" [P] is activated.

P Block param. download (write)

Authorisation for blocking of writing the SYMAP[®]-Compact(+) parameter file by SCPT; writing the parameter file via SCPT is only permitted, if the user level which is assigned to parameter "Block param. download (read)" [P] is activated.

P Block param. view via LCD

Authorisation for blocking of entering sub-menu "Parameters" via display; entering of sub-menu "Parameters" ("Main Menu/Parameters") is blocked, if the user level which is assigned to parameter "Block param. view via LCD" [P] is activated.

P Block param. change via LCD

(function is not available yet!)

3.2.2 “Transformers”

Main Menu\Parameters\SETUP				
Transformers				
P/E No.	Name	Value	Unit	(Setting range)
Potential transformers				
P91500	PT1	Enabled	-	Enabled/Disabled
P91501	PT2	Enabled	-	Enabled/Disabled
P91502	PT3	Enabled	-	Enabled/Disabled
E91503	PT-GND1	Enabled	-	Enabled/Disabled
Current transformers				
P91510	CT1	Enabled	-	Enabled/Disabled
P91511	CT2	Enabled	-	Enabled/Disabled
P91512	CT-GND1	Enabled	-	Enabled/Disabled

Figure 3-2 Menu “SETUP” – Enable/Disable current and voltage measurement inputs

Parameter description:

Voltage measurement inputs

P91500 PT1

This parameter *enables/disables 3-phase voltage measurement input PT1* wherein:

- “Enabled”: enables or
- “Disabled”: disables the measurement input.

P91501 PT2

This parameter *enables/disables 3-phase voltage measurement input PT2* wherein:

- “Enabled”: enables or
- “Disabled”: disables the measurement input.

P91502 PT3

This parameter *enables/disables 3-phase voltage measurement input PT3* wherein:

- “Enabled”: enables or
- “Disabled”: disables the measurement input.

P91500 PT-GND1

This parameter *enables/disables 1-phase voltage measurement input PT-GND1* wherein:

- “Enabled”: enables or
- “Disabled”: disables the measurement input.

Current measurement inputs

P91510 CT1

This parameter *enables/disables 3-phase current measurement input CT1* wherein:

- “Enabled”: enables or
- “Disabled”: disables the measurement input.

P91511 CT2

This parameter *enables/disables 3-phase current measurement input CT2* wherein:

- “Enabled”: enables or
- “Disabled”: disables the measurement input.

P91510 CT-GND1

This parameter *enables/disables 1-phase current measurement input CT-GND1* wherein:

- “Enabled”: enables or
- “Disabled”: disables the measurement input.

3.3 “SYSTEM” (System parameters)

System parameters adapt the SYMAP®-Compact(+) to the system-specific periphery of the application such as voltage and current transformers (PTs and CTs), transformer, communication systems etc.. For this, please use parameters of the following submenus:

- “Nominals” (Rated values of the application)
- “Counter” (Counting functions)
- “Filter” (Filter for measurement display)
- “Communication” (Standard communication) and
- “Graphic” (Referencing and selection of displayed measurement values)

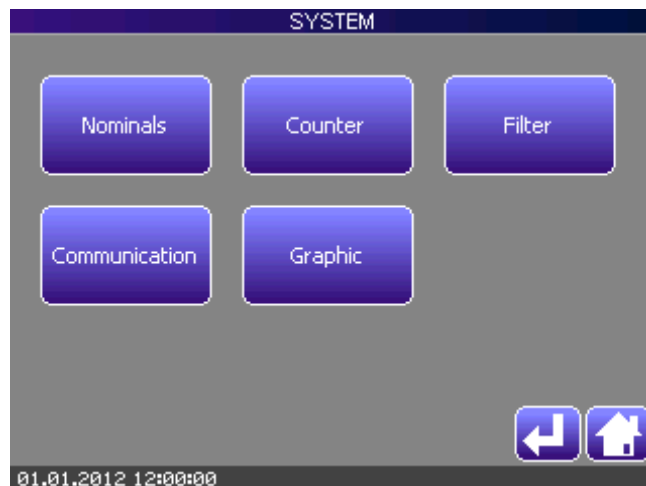


Figure 3-3 System parameters

3.3.1 “Nominals” (Rated data of the application)

Parameters of menu “Nominals” are for setting rated values of the application; these include:

- Rated data for protection functions and measurement values (Reference Values),
- PT ratios and PT assignment (Potential Transformers) and adjustment of PT measuring ranges,
- CT ratios, CT assignment and measurement direction (Current transformers)
- Coordination of voltage and current measuring inputs for power measurement and energy counters, and setting options for zero current compensation (star point grounding) and DC-filter for current measuring (submenu “Measuring”)



Figure 3-4 System parameters – Nominals

3.3.1.1 “Reference Values” (Reference values for protection settings)

Main Menu\Parameters\SYSTEM\Nominals					
Reference Values		Potential Transformers	Current Transformers		Measuring
P/E No.	Name	Value	Unit	(Setting range)	
Primary W1					
P601	Connection type	D	-	none/Y/D	
P602	Star point grounding	No	-	isolated/compensated/earthed	
P603	Voltage (L-L)	0	V	0 ... 999999	
P604	Current	1,7	A	0 ... 999999,9	
P605	Power	0	kW	0 ... 9999999	
P606	Ground voltage	0	V	0 ... 999999	
P607	Ground current	0,00	A	0 ... 99999,999	
Secondary W2					
P610	Connection type	d	-	none/y/d	
P611	Phase shift	11	deg	1/2/3/4/5/6/7/8/9/10/11	
P612	Star point grounding	No	-	isolated/compensated/earthed	
P613	Voltage (L-L)	0	V	0 ... 999999	
P614	Current	1,7	A	0 ... 999999,9	
P615	Power	0	kW	0 ... 9999999	
P616	Ground voltage	0	V	0 ... 999999	
P617	Ground current	0,00	A	0 ... 99999,999	
Tertiary W3					
P620	Connection type	d	-	none/y/d	
P621	Phase shift	11	deg	1/2/3/4/5/6/7/8/9/10/11	
P622	Star point grounding	No	-	isolated/compensated/earthed	
P623	Voltage (L-L)	0	V	0 ... 999999	
P624	Current	1,7	A	0 ... 999999,9	
P625	Power	0	kW	0 ... 9999999	
P626	Ground voltage	0	V	0 ... 999999	
P627	Ground current	0,00	A	0 ... 99999,999	
Frequency					
P630	Nominal frequency	50	Hz	50/60	

Figure 3-5 System parameters – Reference Values

Parameter description:

Primary side W1 (or transformer primary side W1)

P601 Connection type

Setting the circuit configuration of the transformer primary side W1; the circuit type of the winding strands at transformer primary side W1 can be considered as follows:

- “none”: *no present transformer* in the application,
- “Y”: the winding strands of transformer primary side W1 will be wired in *star Y connection* (starpoint does exist)
- “D”: the winding strands of transformer primary side W1 will be wired in *delta Δ connection* (starpoint does not exist)

P602 Star point grounding

Grounding of star point at transformer primary side W1, depending on the circuit type of the winding strands at transformer primary side W1, there are the following setting options:

- “isolated”: *no present transformer* in the application **or** *transformer is present*, and the circuit type of the winding strands at transformer primary side W1 will produce a neutral potential (see star Y connection). However, the star point is insulated against earth (isolated subnetwork)
- “compensated”: *transformer is present*; and the circuit type of the winding strands at transformer primary side W1 will produce a neutral potential (see star Y connection), and the star point will be wired according to one of the different kinds of neutral grounding (high impedance or compensated earthed).
- “earthed”: *transformer is present*; and the circuit type of the winding strands at transformer primary side W1 will produce a neutral potential (see star Y connection), and the star point will be wired according to one of the different kinds of neutral grounding (low impedance or solidly earthed).

P603 Voltage (L-L)

Nominal phase-to-phase voltage of the primary side W1 (or transformer primary side W1); the absolute set point is taken as reference quantity (base quantity) for measurement and percentage protection settings.

P604 Current

Nominal phase current of the primary side W1 (or transformer primary side W1); the absolute set point is taken as reference quantity (base quantity) for measurement and percentage protection settings.

P605 Power

Nominal power of the primary side W1 (or transformer primary side W1); the absolute set point is taken as reference quantity (base quantity) for measurement and percentage protection settings. The absolute set point can refer to apparent power, active or reactive power.

P606 Ground voltage

Nominal ground voltage of the primary side W1 (or transformer primary side W1); the absolute set point is taken as reference quantity (base quantity) for measurement and percentage protection settings.

P607 Ground current

Nominal ground current of the primary side W1 (or transformer primary side W1); the absolute set point is taken as reference quantity (base quantity) for measurement and percentage protection settings.

Secondary side W2 (or transformer secondary side W2)

P610 Connection type

Setting the circuit configuration of the transformer secondary side W2; the circuit type of the winding strands at transformer primary side W1 can be considered as follows:

- “none”: no present transformer in the application,
- “Y”: the winding strands of transformer secondary side W2 will be wired in star Y connection (starpoint does exist)
- “D”: the winding strands of transformer secondary side W2 will be wired in delta Δ connection (starpoint does not exist)

P611 Phase shift

Factor for phase shift between the primary side W1 and the secondary side W2 of the three-phase system; settings represent different phase shift factors as a multiple of 30°.

EXAMPLE: The setting “Phase shift [P611] = 5” means a phase shift between the primary and secondary voltage of the transformer by $5 \times 30^\circ = 150^\circ$.

P612 Star point grounding

Grounding of star point at transformer secondary side W2, depending on the circuit type of the winding strands at transformer secondary side W2, there are the following setting options:

- “isolated”: no present transformer in the application **or** transformer is present, and the circuit type of the winding strands at transformer secondary side W2 will produce a neutral potential (see star Y connection). However, the star point is insulated against earth (isolated subnetwork)
- “compensated”: transformer is present; and the circuit type of the winding strands at transformer secondary side W2 will produce a neutral potential (see star Y connection), and the star point will be wired according to one of the different kinds of neutral grounding (high impedance or compensated earthed).
- “earthed”: transformer is present; and the circuit type of the winding strands at transformer secondary side W2 will produce a neutral potential (see star Y connection), and the star point will be wired according to one of the different kinds of neutral grounding (low impedance or solidly earthed).

P613 Voltage (L-L)

Nominal phase-to-phase voltage of the secondary side W2 (or transformer secondary side W2); the absolute set point is taken as reference quantity (base quantity) for measurement and percentage protection settings.

P614 Current

Nominal phase current of the secondary side W2 (or transformer secondary side W2); the absolute set point is taken as reference quantity (base quantity) for measurement and percentage protection settings.

P615 Power

Nominal power of the secondary side W2 (or transformer secondary side W2); the absolute set point is taken as reference quantity (base quantity) for measurement and percentage protection settings. The absolute set point can refer to apparent power, active or reactive power.

P616 Ground voltage

Nominal ground voltage of the secondary side W2 (or transformer secondary side W2); the absolute set point is taken as reference quantity (base quantity) for measurement and percentage protection settings.

P617 Ground current

Nominal ground current of the secondary side W2 (or transformer secondary side W2); the absolute set point is taken as reference quantity (base quantity) for measurement and percentage protection settings.

Tertiary side W3 (or transformer tertiary side W3)

P620 Connection type

Setting the circuit configuration of the transformer tertiary side W3; the circuit type of the winding strands at transformer tertiary side W3 can be considered as follows:

- “none”: *no present transformer in the application,*
- “Y”: *the winding strands of transformer tertiary side W3 will be wired in star Y connection (starpoint does exist)*
- “D”: *the winding strands of transformer tertiary side W3 will be wired in delta Δ connection (starpoint does not exist)*

P621 Phase shift

Factor for phase shift between the primary side W1 and the tertiary side W3 of the three-phase system; settings represent different phase shift factors as a multiple of 30°.

EXAMPLE: The setting “Phase shift [P621] = 5” means a phase shift between the primary and secondary voltage of the transformer by $5 \times 30^\circ = 150^\circ$.

P622 Star point grounding

Grounding of star point at transformer tertiary side W3, depending on the circuit type of the winding strands at transformer tertiary side W3, there are the following setting options:

- “isolated”: *no present transformer in the application **or** transformer is present, and the circuit type of the winding strands at transformer tertiary side W3 will produce a neutral potential (see star Y connection). However, the star point is insulated against earth (isolated subnetwork)*
- “compensated”: *transformer is present; and the circuit type of the winding strands at transformer tertiary side W3 will produce a neutral potential (see star Y connection), and the star point will be wired according to one of the different kinds of neutral grounding (high impedance or compensated earthed).*
- “earthed”: *transformer is present; and the circuit type of the winding strands at transformer tertiary side W3 will produce a neutral potential (see star Y connection), and the star point will be wired according to one of the different kinds of neutral grounding (low impedance or solidly earthed).*

P623 Voltage (L-L)

Nominal phase-to-phase voltage of the tertiary side W3 (or transformer tertiary side W3); the absolute set point is taken as reference quantity (base quantity) for measurement and percentage protection settings.

P624 Current

Nominal phase current of the tertiary side W3 (or transformer tertiary side W3); the absolute set point is taken as reference quantity (base quantity) for measurement and percentage protection settings.

P625 Power

Nominal power of the tertiary side W3 (or transformer tertiary side W3); the absolute set point is taken as reference quantity (base quantity) for measurement and percentage protection settings. The absolute set point can refer to apparent power, active or reactive power.

P626 Ground voltage

Nominal ground voltage of the tertiary side W3 (or transformer tertiary side W3); the absolute set point is taken as reference quantity (base quantity) for measurement and percentage protection settings.

P627 Ground current

Nominal ground current of the tertiary side W3 (or transformer tertiary side W3); the absolute set point is taken as reference quantity (base quantity) for measurement and percentage protection settings.

Frequency

P630 Frequency

Nominal frequency of the three-phase system; the absolute set point is taken as reference quantity (base quantity) for measurement and percentage protection settings.

3.3.1.2 “Potential transformers” (Rated data of PTs)

Main Menu\ Parameters\SYSTEM\Nominals				
Reference Values		Potential Transformers		Measuring
P/E No.	Name	Value	Unit	(Setting range)
PT1				
P610	PT1 primary side	0	V	0 ... 999999
P611	PT1 secondary side	0	V	0 ... 999999
P612	PT1 assignment	W1	-	W1/W2/W3
PT2				
P613	PT2 primary side	0	V	0 ... 999999
P614	PT2 secondary side	0	V	0 ... 999999
P615	PT2 assignment	W2	-	W1/W2/W3
PT3				
P616	PT3 primary side	0	V	0 ... 999999
P617	PT3 secondary side	0	V	0 ... 999999
P618	PT3 assignment	W3	-	W1/W2/W3
PT-GND1				
P619	PT-GND1 primary side	0	V	0 ... 999999
P620	PT-GND1 secondary side	0	V	0 ... 999999
P621	PT-GND1 assignment	W2	-	W1/W2/W3
Measuring range PTs				
P9400	PT1 mode	100	V	none/100/400
P9401	PT2 mode	100	V	none/100/400
P9402	PT-GND1/PT3 mode	100	V	none/100/400

Figure 3-6 System parameters – Potential Transformers

Parameter description:

Potential transformer 1

P610 PT1 primary side

Primary side nominal voltage of potential transformer PT1

P611 PT1 secondary side

Secondary side nominal voltage of potential transformer PT1

P612 PT1 assignment

Assignment of the voltage level to the potential transformer PT1 (transformer winding side: W1, W2 or W3) to PT1

Potential transformer 2

P613 PT2 primary side

Primary side nominal voltage of potential transformer PT2

P614 PT2 secondary side

Secondary side nominal voltage of potential transformer PT2

P615. PT2 assignment

Assignment of the voltage level to the potential transformer PT2 (transformer winding side: W1, W2 or W3) to PT2

Potential transformer 3

P616 PT3 primary side

Primary side nominal voltage of potential transformer PT3

P617 PT3 secondary side

Secondary side nominal voltage of potential transformer PT2

P618 PT3 assignment

Assignment of the voltage level to the potential transformer PT3 (transformer winding side: W1, W2 or W3) to PT3

Potential transformer ground 1

P619 PT-GND1 primary side

Primary side nominal neutral voltage of potential transformer PT-GND1

P620 PT-GND1 secondary side

Secondary side nominal neutral voltage of potential transformer PT-GND1

P621 PT-GND1 assignment

Assignment of the voltage level to the potential transformer PT-GND1 (transformer winding side: W1, W2 or W3) to PT-GND1.

Measuring ranges PTs

Settings for measuring ranges of the potential transformers (Analog inputs)

Each of the voltage measurement inputs is equipped with two measuring ranges:

- Lower range: 50 bis 200V AC
- Upper range: 200 bis 700V AC

Depending the set values (parameters [P9400] to [P9403] of the voltage measuring inputs, the different voltage measuring inputs of SYMAP[®]-Compact(+) apply either the lower or the upper measuring range.

P9400 PT1 mode :

To set the *measuring range of voltage transformer PT1*, please note the following options:

- “none”: no voltage measuring by PT1
- “100V”: measuring input PT1 applies lower measuring range (e.g. for nominal voltages $U_n = 100V, 110V$)
- “400V”: measuring input PT1 applies upper measuring range (e.g. for nominal voltages $U_n = 400V, 690V$)

NOTE: The measuring range should always be chosen twice as much as the nominal voltage: $U_n \leq 2 \times U_{\text{Meas. range}}$

P9401 PT2 mode :

To set the *measuring range of voltage transformer PT2*, please note the following options:

- “none”: no voltage measuring by PT2
- “100V”: measuring input PT2 applies lower measuring range (e.g. for nominal voltages $U_n = 100V, 110V$)

- “400V”: measuring input PT2 applies upper measuring range
(e.g. for nominal voltages $U_n = 400V, 690V$)

NOTE: The measuring range should always be chosen twice as much as the nominal voltage: $U_n \leq 2 \times U_{\text{Meas. range}}$

P9403 PT-GND1/PT3 mode :

To set the *measuring range of voltage transformers PT-GND1 and PT3*, please note the following options:

- “none”: no voltage measuring by PT-GND1 and PT3
- “100V”: measuring inputs PT-GND1 and PT3 apply lower measuring range
(e.g. for nominal voltages $U_n = 100V, 110V$)
- “400V”: measuring inputs PT-GND1 and PT3 apply upper measuring range
(e.g. for nominal voltages $U_n = 400V, 690V$)

NOTE: The measuring range should always be chosen twice as much as the nominal voltage: $U_n \leq 2 \times U_{\text{Meas. range}}$

3.3.1.3 “Current transformers” (Rated data of CTs)

Main Menu\ Parameters\SYSTEM\Nominals				
Reference Values		Potential Transformers		Measuring
P/E No.	Name	Value	Unit	(Setting range)
CT1				
P660	Primary	0	A	0 ... 65535
P661	Secondary	0	A	0 ... 65535
P662	Direction L1 (Measuring)	0°	°	0/180
P663	Direction L2 (Measuring)	0°	°	0/180
P664	Direction L3 (Measuring)	0°	°	0/180
P665	Direction L1 (Protection)	0°	°	0/180
P666	Direction L2 (Protection)	0°	°	0/180
P667	Direction L3 (Protection)	0°	°	0/180
P668	Assignment	W1	-	W1/W2/W3
CT2				
P669	Primary	0	A	0 ... 65535
P670	Secondary	0	A	0 ... 65535
P671	Direction L1	0°	°	0/180
P672	Direction L2	0°	°	0/180
P673	Direction L3	0°	°	0/180
P674	Assignment	W2	-	W1/W2/W3
CT-GND1				
P681	Primary	0	A	0 ... 65535
P682	Secondary	0	A	0 ... 65535
P683	Direction	0°	°	0/180
P684	Assignment	W1	-	W1/W2/W3

Figure 3-7 System parameters – Current Transformers

Parameter description:

Current transformer CT1-P (connecting protection winding of the current transformer to CT1)

P660 Primary

Primary side nominal current of current transformer CT1-M/P

P661 Secondary

Secondary side nominal current of current transformer CT1-M/P

P665 Direction L1 (Protection)

Setting the *measuring direction for the phase current I_{L1} at the measurement inputs CT1-P*. With correct connection of the secondary side of the current transformer, setting “0°” means for the SYMAP®-Compact(+) a reference angle of 0° for determination of phase position of the current I_{L1} . Setting “180°” reverses the phase position of the current by 180°. In case of inversed secondary lines of the current transformer, this setting can be used to correct measuring direction without need to modify wiring.

P666 Direction L2 (Protection)

Setting the *measuring direction for the phase current I_{L2} at the measurement inputs CT1-P*. With correct connection of the secondary side of the current transformer, setting “0°” means for the SYMAP®-Compact(+) a reference angle of 0° for determination of phase position of the current I_{L2} . Setting “180°” reverses the phase position of the current by 180°. In case of inversed secondary lines of the current transformer, this setting can be used to correct measuring direction without need to modify wiring.

P667 Direction L3 (Protection)

Setting the *measuring direction for the phase current I_{L3} at the measurement inputs CT1-P*. With correct connection of the secondary side of the current transformer, setting "0°" means for the SYMAP®-Compact(+) a reference angle of 0° for determination of phase position of the current I_{L3} . Setting "180°" reverses the phase position of the current by 180°. In case of inversed secondary lines of the current transformer, this setting can be used to correct measuring direction without need to modify wiring.

P668 Assignment

Assignment of the voltage level (transformer winding side: W1, W2 or W3) to CT1-M.

Beyond the protection winding, the measurement winding of the used current transformer can be additionally connected to the SYMAP®-Compact+ for measurement purposes.

Current transformer CT1 (connecting measurement windings of current transformer to CT1)

P663 Direction L1 (Measuring)

Setting the *measuring direction for the phase current I_{L1} at the measurement inputs CT1-M*. With correct connection of the secondary side of the current transformer, setting "0°" means for the SYMAP®-Compact+ a reference angle of 0° for determination of phase position of the current I_{L1} . Setting "180°" reverses the phase position of the current by 180°. In case of inversed secondary lines of the current transformer, this setting can be used to correct measuring direction without need to modify wiring.

P663 Direction L2 (Measuring)

Setting the *measuring direction for the phase current I_{L2} at the measurement inputs CT1-M*. With correct connection of the secondary side of the current transformer, setting "0°" means for the SYMAP®-Compact+ a reference angle of 0° for determination of phase position of the current I_{L2} . Setting "180°" reverses the phase position of the current by 180°. In case of inversed secondary lines of the current transformer, this setting can be used to correct measuring direction without need to modify wiring.

P664 Direction L3 (Measuring)

Setting the *measuring direction for the phase current I_{L3} at the measurement inputs CT1-M*. With correct connection of the secondary side of the current transformer, setting "0°" means for the SYMAP®-Compact+ a reference angle of 0° for determination of phase position of the current I_{L3} . Setting "180°" reverses the phase position of the current by 180°. In case of inversed secondary lines of the current transformer, this setting can be used to correct measuring direction without need to modify wiring.

The connecting terminals for the CT2 only receive the protection winding on the SYMAP®-Compact+.

Current transformer CT2-M/P (connecting protection winding of the current transformer to CT2)

P669 Primary

Primary side nominal current of current transformer CT2-M/P

P670 Secondary

Secondary side nominal current of current transformer CT2-M/P

P671 Direction L1

Setting the *measuring direction for the phase current I_{L1} at the measurement inputs CT2-M/P*. With correct connection of the secondary side of the current transformer, setting "0°" means for the SYMAP®-Compact+ a reference angle of 0° for determination of

phase position of the current I_{L1} . Setting "180°" reverses the phase position of the current by 180°. In case of inversed secondary lines of the current transformer, this setting can be used to correct measuring direction without need to modify wiring.

P672 Direction L2

Setting the *measuring direction for the phase current I_{L2} at the measurement inputs CT2-M/P*. With correct connection of the secondary side of the current transformer, setting "0°" means for the SYMAP®-Compact+ a reference angle of 0° for determination of phase position of the current I_{L2} . Setting "180°" reverses the phase position of the current by 180°. In case of inversed secondary lines of the current transformer, this setting can be used to correct measuring direction without need to modify wiring.

P673 Direction L3

Setting the *measuring direction for the phase current I_{L3} at the measurement inputs CT2-M/P*. With correct connection of the secondary side of the current transformer, setting "0°" means for the SYMAP®-Compact+ a reference angle of 0° for determination of phase position of the current I_{L3} . Setting "180°" reverses the phase position of the current by 180°. In case of inversed secondary lines of the current transformer, this setting can be used to correct measuring direction without need to modify wiring.

P674 Assignment

Assignment of the voltage level (transformer winding side: W1, W2 or W3) to CT1-M/P.

Ground current transformer CT-GND1

P681 Primary

Primary side nominal current of the ground current transformer CT-GND1

P682 Secondary

Secondary side nominal current of the ground current transformer CT-GND1

P682 Secondary

Setting the *measuring direction for the ground current I_{GND} at the measurement input CT-GND1*. With correct connection of the secondary side of the current transformer, setting "0°" means for the SYMAP®-Compact(+) a reference angle of 0° for determination of phase position of the current I_E . Setting "180°" reverses the phase position of the current by 180°. In case of inversed secondary lines of the current transformer, this setting can be used to correct measuring direction without need to modify wiring.

P684 Assignment

Assignment of the voltage level (transformer winding side: W1, W2 or W3) to CT-GND1.

3.3.1.4 “Measuring” (Coordination of measuring channels)

Main Menu\ Parameters\SYSTEM\Nominals				
Reference Values		Potential Transformers		Measuring
P/E No.	Name	Value	Unit	(Setting range)
POWER CT1				
P9410	PT reference	PT1	-	PT1/PT2/PT3
P9411	Direction	0°	°	0/180
POWER CT2				
P9413	PT reference	PT1	-	PT1/PT2/PT3
P9414	Direction	0°	°	0/180
GND POWER CT1				
P9419	PT reference	PT-GND1	-	PT-GND1/PT1/PT2/PT3
P9420	Direction	0°	°	0/180
GND POWER CT2				
P9422	PT reference	PT-GND1	-	PT-GND1/PT1/PT2/PT3
P9423	Direction	0°	°	0/180
GND POWER CT-GND1				
P9428	PT reference	PT-GND1	-	PT-GND1/PT1/PT2/PT3
P9429	Direction	0°	°	0/180
OTHER				
P9434	kWh counter reference	Power CT1	-	Power CT1/ Power CT2
P9435	DC regulator (LSB/cycle)	1	LSB	1 ... 2048

Figure 3-8 System parameters – Measuring

Parameter description:

Assignment of voltage and current values for combined U/I measuring values (Measuring)

POWER CT1

9410 PT reference

For power measurement, this parameter determines which of the potential transformers (PT1, PT2 or PT3) cooperates with the current transformer CT1.

In dependence of the SYMAP®-Compact(+) device variant, the following options are available:

- “PT1”: current measuring by CT1, voltage measuring by PT1
- “PT2”: current measuring by CT1, voltage measuring by PT2
- “PT3”: current measuring by CT1, voltage measuring by PT3

NOTE: All protective functions whose protective criteria depends on current and voltage measurement values as well (e.g. ANSI 32, 67 etc.), could optionally refer to the setting of parameter “PT reference” [P9410] or parameter “PT reference” [P9413].

P9411 Direction

Internal adaption of metered energy flow; to define the signs of measurement values, the following setting options are available:

- “0°”: In case that the 3-phase voltage measurement input (PT1, PT2 or PT3), assigned by parameter “PT reference” [P9410], is connected equally to the connection diagram of this manual **and**

The current measurement input CT1 is connected the way that measured secondary current flow is from terminal X1.1:1 to terminal X1.1:2, from terminal X1.1:3 to terminal X1.1:4 and from terminal X1.1:5 to terminal X1.1:6 **and**

parameters “*Direction*” [P662] to [P667] are set to “0°”,

then, *active power P* and *reactive power Q* will show *positive* signs ($P > 0$, $Q > 0$) in case that current lags the voltage. In case of the same connection and setting preconditions the current leads the voltage, *active power P* will show *positive* sign ($P > 0$) and *reactive power* will show *negative* sign ($Q < 0$).

- “180°”: In case that the 3-phase voltage measurement input (PT1, PT2 or PT3), assigned by parameter “*PT reference*” [9410], is connected equally to the connection diagram of this manual **and**

The current measurement input CT1 is connected the way that measured secondary current flow is from terminal X1.1:1 to terminal X1.1:2, from terminal X1.1:3 to terminal X1.1:4 and from terminal X1.1:5 to terminal X1.1:6 **and**

parameters “*Direction*” [P662] to [P667] are set to “0°”,

then, *active power P* and *reactive power Q* will show *negative* signs ($P < 0$, $Q < 0$) in case that current lags the voltage. In case of the same connection and setting preconditions the current leads the voltage, *active power P* will show *negative* sign ($P < 0$) and *reactive power* will show *positive* sign ($Q > 0$).

POWER CT2

P9413 PT reference

For power measurement, this parameter determines which of the potential transformers (PT1, PT2 or PT3) cooperates with the current transformer CT2.

In dependence of the SYMAP®-Compact(+) device variant, the following options are available:

- “PT1”: current measuring by, voltage measuring by PT1
- “PT2”: current measuring by, voltage measuring by PT2
- “PT3”: current measuring by, voltage measuring by PT3

NOTE: All protective functions whose protective criteria depends on current and voltage measurement values as well (e.g. ANSI 32, 67 etc.), could optionally refer to the setting of parameter “*PT reference*” [P9410] or parameter “*PT reference*” [P9413].

P9414 Direction

Internal adaption of metered energy flow; to define the signs of measurement values, the following setting options are available:

- “0°”: In case that the 3-phase voltage measurement input (PT1, PT2 or PT3), assigned, by parameter “*PT reference*” [P9413] is connected equally to the connection diagram of this manual **and**

The current measurement input CT2 is connected the way that measured secondary current flow is from terminal X1.1:7 to terminal X1.1:8, from terminal X1.1:9 to terminal X1.1:10 and from terminal X1.1:11 to terminal X1.1:12 **and**

parameters “*Direction*” [P677] to [P679] are set to “0°”,

then, *active power P* and *reactive power Q* will show *positive* signs ($P > 0$, $Q > 0$) in case that current lags the voltage. In case of the same connection

and setting preconditions the current leads the voltage, *active power* P will show *positive* sign ($P > 0$) and *reactive power* will show *negative* sign ($Q < 0$).

- “180°”: In case that the 3-phase voltage measurement input (PT1, PT2 or PT3), assigned by parameter “*PT reference*” [P9413], is connected equally to the connection diagram of this manual **and**
The current measurement input CT2 is connected the way that measured secondary current flow is from terminal X1.1:7 to terminal X1.1:8, from terminal X1.1:9 to terminal X1.1:10 and from terminal X1.1:11 to terminal X1.1:12 **and**
parameters “*Direction*” [P677] to [P679] are set to “0°”,
then, *active power* P and *reactive power* Q will show *negative* signs ($P < 0$, $Q < 0$) in case that current lags the voltage. In case of the same connection and setting preconditions the current leads the voltage, *active power* P will show *negative* sign ($P < 0$) and *reactive power* will show *positive* sign ($Q > 0$).

GND POWER CT1

P9419 PT reference

For power measurement of the zero sequence system, this parameter determines which of the potential transformers (PT1, PT2, PT3 or PT-GND1) cooperates with the current transformer CT1.

In dependence of the SYMAP®-Compact(+) device variant, the following options are available:

- “PT-GND1”: calculation of I_{GND} by CT1, measuring of U_{GND} by PT-GND1
- “PT1”: calculation of I_{GND} by CT1, calculation of U_{GND} by PT1
- “PT2”: calculation of I_{GND} by CT1, calculation of U_{GND} by PT2
- “PT3”: calculation of I_{GND} by CT1, calculation of U_{GND} by PT3

NOTE: All protective functions whose protective criteria depends on current and voltage measurement values of the zero sequence system as well (e.g. ANSI 67G etc.), could optionally refer to the setting of parameter “*PT reference*” [P9419], “*PT reference*” [P9422] or parameter “*PT reference*” [P9428].

P9420 Direction

Internal adaption of metered energy flow; to define the signs of measurement values of the zero sequence system, the following setting options are available:

- “0°”: In case that the 1-phase or 3-phase voltage measurement input (PT-GND1, PT1, PT2 or PT3), assigned by parameter “*PT reference*” [P9419], is connected equally to the connection diagram of this manual **and**
the current measurement input CT1 is connected the way that measured secondary current flow is from terminal X1.1:1 to terminal X1.1:2, from terminal X1.1:3 to terminal X1.1:4 and from terminal X1.1:5 to terminal X1.1:6 **and**
parameters “*Direction*” [P662] to [P667] are set to “0°”,
then, *active ground power* P_0 and *reactive ground power* Q_0 will show *positive* signs ($P_0 > 0$, $Q_0 > 0$) in case that ground current I_{GND} lags the residual voltage U_{GND} . In case of the same connection and setting preconditions the ground current I_{GND} leads the residual voltage U_{GND} ,

active ground power P_0 will show positive sign ($P_0 > 0$) and reactive ground power will show negative sign ($Q_0 < 0$).

- „180°“: In case that the 1-phase or 3-phase voltage measurement input (PT-GND1, PT1, PT2 or PT3), assigned by parameter “PT reference” [P9419], is connected equally to the connection diagram of this manual **and** the current measurement input CT1 is connected the way that measured secondary current flow is from terminal X1.1:1 to terminal X1.1:2, from terminal X1.1:3 to terminal X1.1:4 and from terminal X1.1:5 to terminal X1.1:6 **and** parameters “Direction” [P662] to [P667] are set to “0°”, then, active ground power P_0 and reactive ground power Q_0 will show negative signs ($P_0 < 0$, $Q_0 < 0$) in case that ground current I_{GND} lags the residual voltage U_{GND} . In case of the same connection and setting preconditions the ground current leads the residual voltage U_{GND} , active ground power P_0 will show negative sign ($P_0 < 0$) and reactive ground power Q_0 will show positive sign ($Q_0 > 0$).

GND POWER CT2

P9422 PT reference

For power measurement of the zero sequence system, this parameter determines which of the potential transformers (PT1, PT2, PT3 or PT-GND1) cooperates with the current transformer CT2.

In dependence of the SYMAP®-Compact(+) device variant, the following options are available:

- “PT-GND1“: caculation of I_{GND} by CT2, measuring of U_{GND} by PT-GND1
- “PT1“: caculation of I_{GND} by CT2, caculation of U_{GND} by PT1
- “PT2“: caculation of I_{GND} by CT2, caculation of U_{GND} by PT2
- “PT3“: caculation of I_{GND} by CT2, caculation of U_{GND} by PT3

NOTE: All protective functions whose protective criteria depends on current and voltage measurement values of the zero sequence system as well (e.g. ANSI 67G etc.), could optionally refer to the setting of parameter “PT reference” [P9419], “PT reference” [P9422] or parameter “PT reference” [P9428].

P9423 Direction

Internal adaption of metered energy flow; to define the signs of measurement values of the zero sequence system, the following setting options are available:

- “0°“: In case that the 1-phase or 3-phase voltage measurement input (PT-GND1, PT1, PT2 or PT3), assigned by parameter “PT reference” [P9422], is connected equally to the connection diagram of this manual **and** the current measurement input CT2 is connected the way that measured secondary current flow is from terminal X1.1:7 to terminal X1.1:8, from terminal X1.1:9 to terminal X1.1:10 and from terminal X1.1:11 to terminal X1.1:12 **and** parameters “Direction” [P677] to [P679] are set to “0°”, then, active ground power P_0 and reactive ground power Q_0 will show positive signs ($P_0 > 0$, $Q_0 > 0$) in case that ground current I_{GND} lags the residual voltage U_{GND} . In case of the same connection and setting preconditions the ground current I_{GND} leads the residual voltage U_{GND} ,

active ground power P_0 will show positive sign ($P_0 > 0$) and reactive ground power will show negative sign ($Q_0 < 0$).

- “180°”: In case that the 1-phase or 3-phase voltage measurement input (PT-GND1, PT1, PT2 or PT3), assigned by parameter “PT reference” [P9422], is connected equally to the connection diagram of this manual **and** the current measurement input CT2 is connected the way that measured secondary current flow is from terminal X1.1:7 to terminal X1.1:8, from terminal X1.1:9 to terminal X1.1:10 and from terminal X1.1:11 to terminal X1.1:12 **and** parameters “Direction” [P662] to [P667] are set to “0°”, then, active ground power P_0 and reactive ground power Q_0 will show negative signs ($P_0 < 0$, $Q_0 < 0$) in case that ground current I_{GND} lags the residual voltage U_{GND} . In case of the same connection and setting preconditions the ground current leads the residual voltage U_{GND} , active ground power P_0 will show negative sign ($P_0 < 0$) and reactive ground power Q_0 will show positive sign ($Q_0 > 0$).

GND POWER CT-GND1

9428 PT reference

For power measurement of the zero sequence system, this parameter determines which of the potential transformers (PT1, PT2, PT3 or PT-GND1) cooperates with the ground current transformer CT-GND1.

In dependence of the SYMAP®-Compact(+) device variant, the following options are available:

- “PT-GND1”: measuring of I_{GND} by CT-GND1, measuring of U_{GND} by PT-GND1
- “PT1”: measuring of I_{GND} by CT-GND1, calculation of U_{GND} by PT1
- “PT2”: measuring of I_{GND} by CT-GND1, calculation of U_{GND} by PT2
- “PT3”: measuring of I_{GND} by CT-GND1, calculation of U_{GND} by PT3

NOTE: All protective functions whose protective criteria depends on current and voltage measurement values of the zero sequence system as well (e.g. ANSI 67G etc.), could optionally refer to the setting of parameter “PT reference” [P9419], “PT reference” [P9422] or parameter “PT reference” [P9428].

P9429 Direction

Internal adaption of metered energy flow; to define the signs of measurement values of the zero sequence system, the following setting options are available:

- “0°”: In case that the 1-phase or 3-phase voltage measurement input (PT-GND1, PT1, PT2 or PT3), assigned by parameter “PT reference” [P9428], is connected equally to the connection diagram of this manual **and** the current measurement input CT-GND1 is connected the way that measured secondary current flow is from terminal X1.1:7 to terminal X1.1:8, (SYMAP®-Compact) or from terminal X1.1:13 to terminal X1.1:14 (SYMAP®-Compact+) **and** parameter “Direction” [P683] is set to “0°”, then, active ground power P_0 and reactive ground power Q_0 will show positive signs ($P_0 > 0$, $Q_0 > 0$) in case that ground current I_{GND} lags the residual voltage U_{GND} . In case of the same connection and setting preconditions the ground current I_{GND} leads the residual voltage U_{GND} ,

active ground power P_0 will show positive sign ($P_0 > 0$) and reactive ground power will show negative sign ($Q_0 < 0$).

- “180°”: In case that the 1-phase or 3-phase voltage measurement input (PT-GND1, PT1, PT2 or PT3), assigned by parameter “PT reference” [P9428], is connected equally to the connection diagram of this manual **and** the current measurement input CT-GND1 is connected the way that measured secondary current flow is from terminal X1.1:7 to terminal X1.1:8, (SYMAP®-Compact) or from terminal X1.1:13 to terminal X1.1:14 (SYMAP®-Compact+) **and** parameter “Direction” [P683] is set to “0°”, then, active ground power P_0 and reactive ground power Q_0 will show negative signs ($P_0 < 0$, $Q_0 < 0$) in case that ground current I_{GND} lags the residual voltage U_{GND} . In case of the same connection and setting preconditions the ground current leads the residual voltage U_{GND} , active ground power P_0 will show negative sign ($P_0 < 0$) and reactive ground power Q_0 will show positive sign ($Q_0 > 0$).

OTHER

P9434 kWh counter reference

For energy counting (positive active energy: Wp+; negative active energy: Wp-; positive reactive energy: Wq+; negative reactive energy: Wq-), this parameter determines the applied current and voltage measurement inputs as well as the definition of energy direction.

- “Power CT1”: current measurement by CT1, voltage measurement by the potential transformer assigned by parameter “PT reference” [P9410] and direction definition by parameter “Direction” [P9411]
- “Power CT2”: current measurement by CT2, voltage measurement by the potential transformer assigned by parameter “PT reference” [P9413] and direction definition by parameter “Direction” [P9414].

P9435 DC regulator (LSB/cycle)

Rapidity controller for DC elimination of analog current measurement values; generally, current measurement values are measured according to TRMS (true root means square) principle. Such analog signals include harmonics as well as DC portion.

To eliminate the DC portion parameter “DC regulator (LSB/cycle)” [P9435] can be used. For this, the DC regulator modifies the TRMS signal afflicted with DC portion, with an adjustable rapidity. Here, a low set value of parameter [P9435] means slow elimination; whereas a high set value is for rapid elimination of DC portion:

For instance, a setting value of parameter “DC regulator/(LSB/cycle) = 2048 LSB” means an elimination of the DC portion after one cycle of the measured current signal.

However, a setting value of parameter “DC regulator/(LSB/cycle) = 1 LSB” means an entire elimination of the DC portion after 2048 cycles of the measured current signal.

Calculation of the DC portion is always being done once a cycle.

P9436 W1 zero compensation

This parameter activates/deactivates zero current compensation in case that protective function ANSI 87 “Transformer differential protection” is being applied; whereby:

- “OFF”: deactivates zero current compensation for winding side W1 or
- “ON”: activates zero current compensation for winding side W1.

P9437 W2 zero compensation

This parameter activates/deactivates *zero current compensation* in case that protective function ANSI 87 “Transformer differential protection” is being applied; whereby:

- “OFF”: deactivates zero current compensation for winding side W2 or
- “ON”: activates zero current compensation for winding side W2.

P9438 W3 zero compensation

This parameter activates/deactivates *zero current compensation* in case that protective function ANSI 87 “Transformer differential protection” is being applied; whereby:

- “OFF”: deactivates zero current compensation for winding side W3 or
- “ON”: activates zero current compensation for winding side W3.

3.3.2 “Counter” (Counting functions)

Main Main Menu\ Parameters\SYSTEM\Counter				
Counter				
P/E No.	Name	Value	Unit	(Setting range)
P700	Working hours counter	0	h	0 ... 999999
Energy counter				
P710	Wp+	0	kWh	0 ... 4294967296
P711	Wp-	0	kWh	0 ... 4294967296
P712	Wq+	0	kvarh	0 ... 4294967296
P713	Wq-	0	kvarh	0 ... 4294967296
ANSI 79 Automatic reclosing				
P720	Success counter	0	-	0 ... 65535
P721	Fail counter	0	-	0 ... 65535
P722	Reclosing counter	0	-	0 ... 65535
P723	Reclosing counter limit 1	0	-	0 ... 65535
P724	Reclosing counter limit 2	0	-	0 ... 65535
P725	Reset counter	0	event	0 ... 9999

Figure 3-9 System parameters – Counting functions

Parameter description:

P700 Working hours counter

Set counting value for the working hours counter; precisely at the time when the set value of parameter “Working hours counter” [P700] is saved, the working hours counter continues operating using the set counting value as new start value.

Energy counter

P710 Wp+

Set counting value for the positive, active energy counter; precisely at the time when the set value of parameter “Wp+” [P710] is saved, the positive, active energy counter continues operating using the set counting value as new start value.

P711 Wp-

Set counting value for the negative, active energy counter; precisely at the time when the set value of parameter “Wp-” [P711] is saved, the negative, active energy counter continues operating using the set counting value as new start value.

P712 Wq+

Set counting value for the positive, reactive energy counter; precisely at the time when the set value of parameter “Wq+” [P712] is saved, the positive, reactive energy counter continues operating using the set counting value as new start value.

P713 Wq-

Set counting value for the negative, reactive energy counter; precisely at the time when the set value of parameter “Wq-” [P712] is saved, the negative, reactive energy counter continues operating using the set counting value as new start value.

ANSI 79 – Automatic reclosing (AR)

P720 Success counter

Set counting value for the successful AR-cycles; precisely at the time when the set value of parameter “Success counter” [P720] is saved, the counter continues operating using the set counting value as new start value.

P721 Fail counter

Set counting value for the unsuccessful (failed) AR-cycles; precisely at the time when the set value of parameter “Fail counter” [P721] is saved, the counter continues operating using the set counting value as new start value.

P722 Reclosing counter

Set counting value for all the reclosing attempts of “Auto reclosing” function; precisely at the time when the set value of parameter “Reclosing counter” [P722] is saved, the counter continues operating using the set counting value as new start value.

P723 Reclosing counter limit 1

First maximum set counting limit for all the reclosing attempts of “Auto reclosing” function

P724 Reclosing counter limit 2

Second maximum set counting limit for all the reclosing attempts of “Auto reclosing” function

P725 Reset counter

Reset of all AR-counters; the actual counting values of all the AR-counters can be reset by any active event. For reset, the number related to this event has to be assigned to parameter [P725]. As soon as the assigned reset event is activated, counting is blocked and the counting values are being reset to the start counting values set by parameters: [P720] bis [P721]. Blocking of all the counters is only effective, however, as long as the blocking event is active. If the reset event turns inactive, counting is effective again.

If reset of all AR-counters is not required, set this parameter to “0”.

3.3.3 “Filter” (Filter functions for measurement display)

Main Menu\ Parameters\SYSTEM\Filter				
Filter				
P/E No.	Name	Value	Unit	(Setting range)
Dead band				
P800	Current	3,0	%	0 ... 6553,5
P801	Voltage	3,0	%	0 ... 6553,5
P802	Power	3,0	%	0 ... 6553,5

Figure 3-10 System parameters – Filter functions for displayed Measuring values

Parameter description:

P800 Current

Minimum limit of current measurement display; as soon as a measured current value falls below the set value of parameter “Current” [P800], the current value is displayed as NULL.

NOTE: The *minimum limit* [P800] is to be set as a percentage of the *nominal value* of the characteristic quantity (phase current). The nominal value of the characteristic quantity is to be set by parameter:

- “Current” [P604], for primary side W1 or
- “Current” [P614], for secondary side W2 or
- “Current” [P624], for tertiary side W3.

The referring parameters “Current” [P604], “Current” [P614] and “Current” [P624] are located in submenu: “SYSTEM\Nominals\Reference values”.

P801 Voltage

Minimum limit of voltage measurement display; as soon as a measured voltage value falls below the set value of parameter “Voltage” [P801], the voltage value is displayed as NULL.

NOTE: The *minimum limit* [P801] is to be set as a percentage of the *nominal value* of the characteristic quantity (phase-to-phase voltage). The nominal value of the characteristic quantity is to be set by parameter:

- “Voltage (L-L)” [P603], for primary side W1 or
- “Voltage (L-L)” [P613], for secondary side W2 or
- “Voltage (L-L)” [P623], for tertiary side W3.

The referring parameters “Voltage (L-L)” [P603], “Voltage (L-L)” [P613] and “Voltage (L-L)” [P623] are located in submenu: “SYSTEM\Nominals\Reference values”.

P802 Power

Minimum limit of power measurement display; as soon as a measured power value falls below the set value of parameter “Power” [P802], the power value is displayed as NULL.

NOTE: The *minimum limit* [P802] is to be set as a percentage of the *nominal value* of the characteristic quantity (active power, reactive power or apparent power). The nominal value of the characteristic quantity is to be set by parameter:

- “Power” [P605], for primary side W1 or
- “Power” [P615], for secondary side W2 or
- “Power” [P625], for tertiary side W3.

The referring parameters “Power” [P605], “Power” [P615] and “Power” [P625] are located in submenu: “SYSTEM\Nominals\Reference values”.

3.3.4 “Communication” (configuration of interfaces)

Each SYMAP®-Compact(+) provides a standard interface RS422/485 using the Modbus RTU data protocol. For further additional communication options, please refer to the valid order code. Besides the standard communication, the following parameter descriptions take into account all available communication options.

Standard interface – Serial port 1

Main Menu\ Parameters\SYSTEM\Communication				
Port settings				
P/E No.	Name	Value	Unit	(Setting range)
Serial port 1				
P900	Port	OFF	-	OFF/RS485/RS422
P901	Address	1	-	0 ... 255
P902	Baudrate	57600	Bd	9600/19200/38400/57600
P903	Protocol	none	-	none/Modbus
Serial port 2				
P900	Port	OFF	-	OFF/ON
P901	Address	1	-	0 ... 255
P902	Baudrate	57600	Bd	9600/19200/38400/57600
P903	Protocol	IEC 870-5-103	-	IEC 870-5-103
Profibus DP				
P910	Port	OFF	-	OFF/RS485/RS422
P911	Address	1	-	1 ... 123
P912	Byte order	Little endian	-	Little endian/Big endian
Ethernet				
P950	IP address part 1 (L)	192	-	0 ... 255
P951	IP address part 2	168	-	0 ... 255
P952	IP address part 3	0	-	0 ... 255
P953	IP address part 4	130	-	0 ... 255
P954	Subnet mask part 1 (L)	255	-	0 ... 255
P955	Subnet mask part 2	255	-	0 ... 255
P956	Subnet mask part 3	0	-	0 ... 255
P957	Subnet mask part 4	0	-	0 ... 255
P958	Gateway address 1 (L)	192	-	0 ... 255
P959	Gateway address 1	168	-	0 ... 255
P960	Gateway address 1	0	-	0 ... 255
P961	Gateway address 1	1	-	0 ... 255
SNTP				
P962	SNTP (Time synchronisation)	OFF	-	OFF/ON
P963	Daylight saving time	OFF	-	OFF/ON
P964	Local time zone	0	-	0 ... 12
P965	SNTP Server addr. part 1 (L)	192	-	0 ... 255
P966	SNTP Server addr. part 2	168	-	0 ... 255
P967	SNTP Server addr. part 3	0	-	0 ... 255
P968	SNTP Server addr. part 4	2	-	0 ... 255
IEC 61850				
P969	IEC 61850	OFF	-	OFF/ON
P970	IEDName Index (Dxxx)	1	-	0 ... 255

Figure 3-11 Communication – Standard interface “Serial port 1”

Parameter description:

P900 Port

Standard interface of SYMAP[®]-Compact(+); the physical interface provides following setting options:

- “OFF”: disabled,
- “RS485”: enabled (working principle of physical interface is RS485) or
- “RS422”: eingeschaltet (working principle of physical interface is RS485)

P901 Address

Slave address of standard interface; the setting range of slave addresses is between 0 and 255.

P902 Baudrate

Unit of the symbol rate for data transmission; the following setting options provide different symbol rates (unit: [Bd]):

- “9600”
- “19200”
- “38400”
- “57600”

NOTE: Care should be taken that the symbol rate (Baud rate) is the same for both, the sender and the receiver.

P903 Protocol

Options for data protocol of standard interface; the data protocol (Modbus RTU) of the standard interface can be:

- “none”: disabled, or
- “Modbus” enabled (standard configuration: Modbus RTU).

Standard communication – Serial port 2

Main Menu\ Parameters\SYSTEM\Communication\				
Serial port 2				
P/E No.	Name	Value	Unit	(Setting range)
Serial port 2				
P900	Port	OFF	-	OFF/ON
P901	Address	1	-	0 ... 255
P902	Baudrate	57600	Bd	9600/19200/38400/57600
P903	Protocol	IEC 870-5-103	-	IEC 870-5-103

Figure 3-12 Communication – Optional interface “Serial port 2”

Parameter description:

P900 Port

Standard interface of SYMAP[®]-Compact(+); the physical IEC 60870-5-103 interface provides following setting options:

- “OFF”: disabled or

- “ON”: enabled.

P901 Address

Slave address of standard interface; the setting range of slave addresses is between 0 and 255.

P902 Baudrate

Unit of the symbol rate for data transmission; the following setting options provide different symbol rates (unit: [Bd]):

- “9600”
- “19200”
- “38400”
- “57600”

NOTE: Care should be taken that the symbol rate (Baud rate) is the same for both, the sender and the receiver.

P903 Protocol

Options for data protocol of standard interface; the data protocol (Modbus RTU) of the standard interface can be:

- “IEC 870-5-103”: data protocol IEC 60870-5-103 is enabled.

Profibus DP

Main Menu\ Parameters\SYSTEM\Communication\				
Profibus				
P/E No.	Name	Value	Unit	(Setting range)
Profibus DP				
P910	Port	OFF	-	OFF/RS485/RS422
P911	Address	1	-	1 ... 123
P912	Byte order	Little endian	-	Little endian/Big endian

Figure 3-13 Communication – Optional interface “Profibus DP”

Parameter description:

P910 Port

Profibus interface of SYMAP[®]-Compact(+); the physical Profibus interface provides following setting options:

- “OFF”: disabled or
- “ON”: enabled

P911 Address

Slave address of Profibus interface; the setting range of slave addresses is between 1 and 123.

P912 Byte order

Byte order within a Profibus DP telegram; to define the data format (serial byte order of usage data which are to be transmitted or received), there are following setting options:

- “Little Endian“: the least significant (LSB) is at the end of the usage data range; the most significant byte (MSB) is at the beginning. This means, that the MSB will be transmitted first.
- “Big Endian“: the least significant (LSB) is at the beginning of the usage data range; the most significant byte (MSB) is at the end. This means, that the LSB will be transmitted first.

Ethernet

Main Menu\ Parameters\SYSTEM\Communication\				
Ethernet				
P/E No.	Name	Value	Unit	(Setting range)
Ethernet				
P950	IP address part 1 (L)	192	-	0 ... 255
P951	IP address part 2	168	-	0 ... 255
P952	IP address part 3	0	-	0 ... 255
P953	IP address part 4	130	-	0 ... 255
P954	Subnet mask part 1 (L)	255	-	0 ... 255
P955	Subnet mask part 2	255	-	0 ... 255
P956	Subnet mask part 3	0	-	0 ... 255
P957	Subnet mask part 4	0	-	0 ... 255
P958	Gateway address 1 (L)	192	-	0 ... 255
P959	Gateway address 2	168	-	0 ... 255
P960	Gateway address 3	0	-	0 ... 255
P961	Gateway address 4	1	-	0 ... 255

Figure 3-14 Communication – Optional interface “Ethernet”

Parameter description:

P950 IP address part 1 (L)

and

P951 IP address part 2

and

P952 IP address part 3

and

P953 IP address part 4

Via parameters [P950] to [P953] the *IP address of the SYMAP® -Compact device can be adjusted.*

Example: IP address = 192.168.1.10

P954 Subnet mask part 1 (L)

and

P955 Subnet mask part 2

and

P956 Subnet mask part 3

and

P957 Subnet mask part 4

Via parameters [P954] to [P957] the *Subnet mask of the network can be adjusted.*

Example: Subnet mask = 255.255.255.0

P958 Gateway address part 1 (L)

and

P959 Gateway address part 2

and

P960 Gateway address part 3

and

P961 Gateway address part 4

Via parameters [P958] to [P961] the *router address of the Gateway* can be adjusted.

Example: Gateway address = 255.255.255.0

SNTP

Main Menu\ Parameters\SYSTEM\Communication				
SNTP				
P/E No.	Name	Value	Unit	(Setting range)
SNTP				
P962	SNTP (Time synchronisation)	OFF	-	OFF/ON
P963	Daylight saving time	OFF	-	OFF/ON
P964	Local time zone	0	-	0 ... 12
P965	SNTP Server addr. part 1 (L)	192	-	0 ... 255
P966	SNTP Server addr. part 2	168	-	0 ... 255
P967	SNTP Server addr. part 3	0	-	0 ... 255
P968	SNTP Server addr. part 4	2	-	0 ... 255

Figure 3-15 Communication – Optional interface “SNTP”

Parameter description:

P962 SNTP (Time synchronisation)

Time synchronization via SNTP (Simple Network Time Protocol) can be activated by parameter „*SNTP (Time synchronisation)*“ [P962]:

- “OFF”: Time synchronization is *deactivated*,
- “ON”: time synchronization is *activated*.

P963 Daylight saving time

Automatic time changeover at the yearly repeating summer-wintertime dates; the automatic “Daylight saving time” switch (“+1h” at 01:00 „Coordinated Universal Time (UTC)” or „Greenwich Mean Time (GMT)” on last Sunday in March, and “-1h” at 01:00 UTC on last Sunday in October) can be deactivated/activated via parameter “*Daylight saving time*” [P963]:

- “OFF”: *automatic time changeover is deactivated*,
- “ON”: *automatic time changeover is activated*,

P964 Local time zone

The *local time zone* can be adjusted via parameter “*Local time zone*” [P964] (±12 hours offset to „Coordinated Universal Time (UTC)” or „Greenwich Mean Time (GMT)”).

P965 SNTP Server addr. part 1 (L)

and

P966 SNTP Server addr. Part 2

and

P967 SNTP Server addr. Part 3

and

P968 SNTP Server addr. Part 4

The *time server IP-address* can be set via parameters [P965] to [P968]. An Internet connection and a router (see parameters [P958] to [P961]) must exist in order to get in connection with an Internet time server. The SYMAP[®]-Compact(+) operates as a client sending periodically requests to the time server (512 sec polling interval).

The SYMAP[®]-Compact(+) accepts also SNTP broadcast messages via *Local Broadcast* or *Multicast* from a local time server (SCADA system).

In that case parameters [P965] to [P968] can be set all *to zero*, SYMAP[®]-Compact(+) will not send any requests.

IEC 61850

Main Menu\ Parameters\SYSTEM\Communication				
IEC 61850				
P/E No.	Name	Value	Unit	(Setting range)
IEC 61850				
P969	IEC 61850	OFF		OFF/ON
P970	IEDName Index (Dxxx)	1		0 ... 255

Figure 3-16 Communication – Optional interface “IEC 61850”

Parameter description:

P969 IEC 61850

The interface IEC61850 communication can be deactivated/activated via parameter “*IEC 61850*”:

- “OFF”: IEC61850 communication is *deactivated*
- “ON”: IEC61850 communication is *activated*

As soon as a link with the IEC 61850 client has established, the event [E0328] is being activated.

NOTE: More informationen about IEC61850 communication, please refer to separate document “SYMAP[®]-Compact – Appendix”.

P970 IEDName Index (Dxxx)

Index referring to the name of the applied intelligent electronic device “IED” SYMAP[®]-Compact.

NOTE: The index of one device may exist only once within the network!

3.3.5 “Graphic” (Referencing and selection of displayed measurement values)

Main Menu\ Parameters\SYSTEM\Graphic				
Graphic				
P/E No.	Name	Value	Unit	(Setting range)
Measuring				
P60001	Ground power reference (display)	GND_Power_CT-GND1	-	GND_Power_CT1/ GND_Power_CT2/ GND_Power_CT-GND1
P60005	Diff-current reference (display)	W1	-	W1/W2/W3
Button configuration				
P60010	Button 1 function	Page Up	-	none/0/1/Stop/Start/Page Up/Page Down/Key/Alarm Ack/Alarm
P60011	Button 2 function	Key	-	Page/Auto_Manual (s. “Button function 1”)
P60012	Button 3 function	Start	-	(s. “Button function 1”)
P60013	Button 4 function	Page Down	-	(s. “Button function 1”)
P60014	Button 5 function	Alarm Page	-	(s. “Button function 1”)
P60015	Button 6 function	Stop	-	(s. “Button function 1”)
Menu configuration				
P60020	Meters -> Voltage	ON	-	ON/OFF
P60021	Meters -> Current	ON	-	ON/OFF
P60022	Meters -> Power	ON	-	ON/OFF
P60023	Meters -> Counter	ON	-	ON/OFF
P60025	Meters -> Ground	ON	-	ON/OFF
P60026	Meters -> Frequency	ON	-	ON/OFF
Display configuration				
P60041	Show Phase Voltage	ON	-	ON/OFF
P60050	Time to shut off LCD	300	s	0 ... 65535
Bargraph Parameter				
P60057	Current Bargraph upper threshold Green	100	%	0 ... 150
P60058	Current Bargraph lower threshold Red	120	%	0 ... 200

Figure 3-17 System parameters – Referencing and selection of displayed measurement values

Parameter description:

Measuring

P60001 Ground power reference (display)

Referencing of displayed ground power measurement values of zero sequence system “GND1”; according to different manners of building the measurement quantities of the zero sequence system, there are following variedly generated measuring values available:

- $U_{GND PT1}$: residual voltage calculated from the phase voltages of PT1
- $U_{GND PT2}$: residual voltage calculated from the phase voltages of PT2
- $U_{GND PT3}$: residual voltage calculated from the phase voltages of PT3
- $U_{GND PT-GND1}$: residual voltage directly measured via PT-GND1

- I_{GND} CT1: ground current calculated from phase currents of CT1 ($3 \times I_{0,CT1} = I_{GND,CT1}$)
- I_{GND} CT2: ground current calculated from phase currents of CT2 ($3 \times I_{0,CT2} = I_{GND,CT2}$)
- I_{GND} CT-GND1: ground current directly measured via CT-GND1



Figure 3-18 Meters "Ground" – Zero phase sequence system "GND1"

Depending on which measuring inputs are used to build the quantities *ground current* I_{GND} and the *residual voltage* U_{GND} , there are different setting options for parameter "Ground power reference (Display)" [P60001] for referencing zero sequence power values:

- "GND_Power_CT1": Calculation of ground current by measured phase currents of CT1 **and** acquisition of the *residual voltage* by that measuring input which is assigned to Parameter "PT reference" [P9422].
- "GND_Power_CT2": Calculation of ground current by measured phase currents of CT2 **and** acquisition of the *residual voltage* by that measuring input which is assigned to Parameter "PT reference" [P9428].
- "GND_Power_CT-GND1": Direct measurement of ground current by CT-GND1 **and** acquisition of the *residual voltage* by that measuring input which is assigned to Parameter "PT reference" [P9419].

NOTE: The assignment of the voltage measurement input (PT1, PT2, PT3 or PT-GND1) to the current measurement input CT1, CT2 or CT-GND1) is to be done by the following parameters of the same name (as the options of parameter [P60001]), in the submenu "SYSTEM\Nominals\Measuring":

- "PT reference" [P9419],
- "PT reference" [P9422] and
- "PT reference" [P9428].

P60005 Diff-current reference (display)

Referencing of displayed zero phase sequence system power measurement values; displayed differential current values have to refer to one winding side of the transformer.

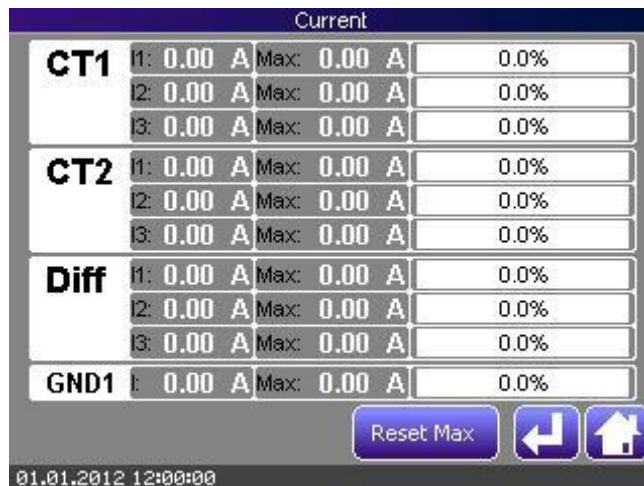


Figure 3-19 Meters “Current” – Differential currents “DIFF”

Displayed measuring values of the differential current (“DIFF”) may be referred to

- “W1”: the primary winding W1,
- “W2”: the secondary winding W2 or
- “W3”: the tertiary winding W3

of the transformer.

Configuration of selection page “Meters” – Menu configuration

Depending on the application, all “Meters” pages accessed by the selection page may be hidden individually.



Figure 3-20 Selection page “Meters”

Button Configuration

Function keys at the front plate are to be configurable individually by the following parameters. Parameter description of parameter “Button 1 functionality” [P60010] is presented as an example.

P60010 Button 1 function

Functional configuration of function key 1; there are following setting options available:

- “none”: no function. Operating function key 1 will not active any event.

- “0“: *switchgear control*: operating function key 1 will *switch off* the previously selected switching element. Operating function key 1 will active event [E6400] for at least 2 s.
- “1“: *switchgear control*: operating function key 1 will *switch on* the previously selected switching element. Operating function key 1 will active event [E6401] for at least 2 s.
- “Stop“: (*GenSet control*: function not available yet!) Operating function key 1 will active event [E6402] for at least 2 s.
- “Start“: (*GenSet control*: function not available yet!) Operating function key 1 will active event [E6403] for at least 2 s.
- “Page Up“: *Menu navigation*: operating function key 1 will *scroll up* the displayed menu page. Operating function key 1 will not active any event.
- “Page Down“: *Menu navigation*: operating function key 1 will *scroll down* the displayed menu page. Operating function key 1 will not active any event.
- “Key“: *Menu navigation*: operating function key 1 will *call up* the menu page “User level”. Operating function key 1 will active event [E6406] for at least 2 s.
- “Alarm Ack“: *Menu navigation*: operating function key 1 will *reset* all the latched, active alarms and menu page “Active Alarms” will be *displayed*. Operating function key 1 will active event [E6407] for at least 2 s.
- “Alarm Page“: *Menu navigation*: operating function key 1 will *call up* menu page “Active Alarms”. Operating function key 1 will active event [E6408] for at least 2 s.
- “Auto/Manual“: (*GenSet control*: function not available yet!) Operating function key 1 will active event [E6409] for at least 2 s.
- “Emergency Off 1“: *Function “Breaker control“*: simultaneous operating of function key 1 and second function key, which is configured with setting option “Emergency Off 2”, will switch off the circuit breaker (CB) immediately without consideration of active interlocking or user level. Simultaneous operating of function key 1 and the function key assigned with function “Emergency Off 2” will active event [E6415] for at least 2 s.
- “Emergency Off 2“: *Function “Breaker control“*: simultaneous operating of function key 1 and second function key, which is configured with setting option “Emergency Off 1”, will switch off the circuit breaker (CB) immediately without consideration of active interlocking or user level. Simultaneous operating of function key 1 and the function key assigned with function “Emergency Off 1” will active event [E6415] for at least 2 s.

P60011 Button 2 function

See description of parameter [P60010]

P60012 Button 3 function

See description of parameter [P60010]

P60013 Button 4 function

See description of parameter [P60010]

P60014 Button 5 function

See description of parameter [P60010]

P60015 Button 6 function

See description of parameter [P60010]

Menu Configuration

P60020 Meters -> Voltage

Display of "Meters" page "Voltage"; to display or to hide this page please choose among the following setting options:

- "OFF": the selection key "Voltage" and "Meters" page "Voltage" will be hidden,
- "ON": the selection key "Voltage" and "Meters" page "Voltage" will be displayed.

P60021 Meters -> Current

Display of "Meters" page "Current"; to display or to hide this page please choose among the following setting options:

- "OFF": the selection key "Current" and "Meters" page "Current" will be hidden,
- "ON": the selection key "Current" and "Meters" page "Current" will be displayed.

P60022 Meters -> Power

Display of "Meters" page "Power"; to display or to hide this page please choose among the following setting options:

- "OFF": the selection key "Power" and "Meters" page "Power" will be hidden,
- "ON": the selection key "Power" and "Meters" page "Power" will be displayed.

P60023 Meters -> Counter

Display of "Meters" page "Counter"; to display or to hide this page please choose among the following setting options:

- "OFF": the selection key "Counter" and "Meters" page "Counter" will be hidden,
- "ON": the selection key "Counter" and "Meters" page "Counter" will be displayed.

P60025 Meters -> Ground

Display of "Meters" page "Ground"; to display or to hide this page please choose among the following setting options:

- "OFF": the selection key "Ground" and "Meters" page "Ground" will be hidden,
- "ON": the selection key "Ground" and "Meters" page "Ground" will be displayed.

P60026 Meters -> Frequency

Display of "Meters" page "Frequency"; to display or to hide this page please choose among the following setting options:

- "OFF": the selection key "Frequency" and "Meters" page "Frequency" will be hidden,
- "ON": the selection key "Frequency" and "Meters" page "Frequency" will be displayed.

Display configuration

P60041 Show Phase Voltage

Display of phase voltages U1, U2 and U3 at "Meters" page "Voltage" can be enabled or disabled.

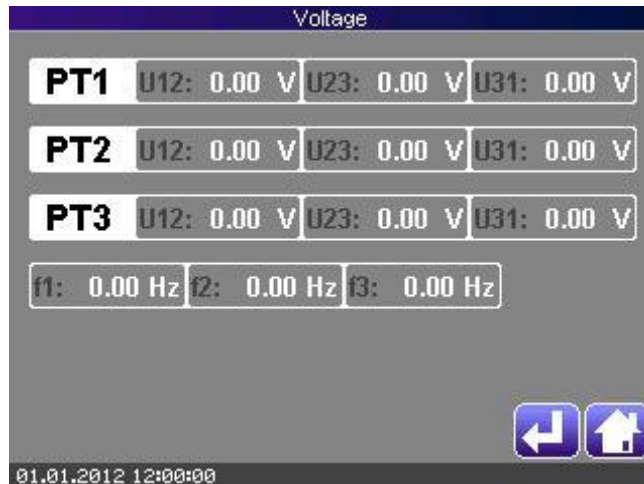


Figure 3-21 Meters “Voltage” – Display of phase voltages U1, U2, U3

Display of “Meters” page “Voltage”; to display or to hide phase measuring values of the voltages, please choose among the following setting options:

- “OFF”: display of phase voltage measuring values is disabled,
- “ON”: display of phase voltage measuring values is enabled.

NOTE: Depending on the SYMAP-Compact(+) device variant, setting options of parameter “Show Phase Voltage” [P60041] apply to all voltage measuring inputs.

P60050 Time to shut off LCD

Delay time of the LC-display to shut off; if no button was pressed or the screen was touched for the duration set by parameter “Time to shut off LCD” [P60050], the LC-display will automatically shut off. After pressing any button or touching the screen, the LC-display will operate immediately.

NOTE: The minimum setting time is 10 s!

Bargraph configuration

Besides percentage currents, the colors of the bargraphs displayed on the “Meters” page “Current” represents the application’s current load. Depending on the actual level of currents, the bargraphs show green, orange or red colors.



Figure 3-22 Meters “Current” – Display of current load by bargraphs

Different colors apply to defined scopes. The thresholds of the defined scopes are given as percentages of the phase current and ground current, referring to the nominal values of the application.

NOTE: The *scopes of colors* are to be set as a percentage of the *nominal value* of the characteristic quantities (phase current and ground current). The nominal values of the characteristic quantities are to be set by parameter:

- “Current” [P604], for primary side W1 or
- “Current” [P614], for secondary side W2 or
- “Current” [P624], for tertiary side W3, and
- “Ground current” [P607], for primary side W1 or
- “Ground current” [P617], for secondary side W2 or
- “Ground current” [P627], for tertiary side W3.

The referring parameters “Current” [P604], “Current” [P614], “Current” [P614], “Ground current” [P607], “Ground current” [P617] and “Ground current” [P627] are located in submenu: “SYSTEM\Nominals\Reference values”.

P60057 Current Bargraph upper threshold Green

Upper Limit for bargraph (phase currents and differential currents) to display color green; if the set value of parameter “Current Bargraph upper threshold Green” [P60057] is exceeded, bargraph color will change from green to orange. Color changes from orange to green in case that the current percentage falls below the set value.

P60058 Current Bargraph lower threshold Red

Upper Limit for bargraph (phase currents and differential currents) to display color red; if the set value of parameter “Current Bargraph upper threshold Green” [P60057] is exceeded, bargraph color will change from orange to red. Color changes from red to orange in case that the current percentage falls below the set value, but is above the set value of parameter “Current Bargraph upper threshold Green” [P60057].

NOTE: In case that set values are the same for both, parameter [P60057] and [P60058], color changes only between green and red.

3.4 “RECORDING”

3.4.1 “Fault Recorder“

Main Menu\ Parameters\RECORDING\				
Fault recorder				
P/E No.	Name	Value	Unit	(Setting range)
P8061	Trigger event	0	event	0 ... 9999

Figure 3-23 Fault recorder – Parameter [P]

Parameter description:

P8061 Function

Fault recording can be completely activated by any active event. For activation, the number related to this event has to be assigned to parameter “*Function*”. At the time the triggered-event is being activated, the rising signal edge of the trigger-event starts the recording (snapshot of the measuring values) Activation is only effective, however, as long as the assigned event is active. If the assigned event turns inactive, activation of fault recording is abandoned.

If fault recording is not required, set this parameter to “0”.

3.4.2 “Disturbance Recorder“

For function “Disturbance recorder” the device is equipped with a volatile 20 MB RAM-memory for buffering the measuring data. That RAM-memory can be divided in up to 10 individual memory sections (buffers for recorded data) by parameter “*Number of internal buffers*” [P8002].

Each buffer provides the following states:

- “ready“
- “recording“
- “data“
- “backup“
- “inactive“

When there are two buffers adjusted: “*Number of internal buffers* [8002] = 2”, buffer 1 assumes state “*ready*”, whereas buffer 2 assumes state “*inactive*”.

NOTE: At the time, one of the buffers claims state “ready”, event “*DiREC Ready*” [E8000] is being activated.

Then, the disturbance recorder first saves the recorded data of each sample in buffer 1. When memory capacity limit of buffer 1 is reached, the oldest recorded sample of buffer 1 will be overwritten according to the FIFO-principle (“idle mode”).

As soon as:

- one of the *assigned trigger-events* (see parameters “*Trigger*” [P8018] to [P8027]) is activated **or**
- a manual trigger of the disturbance recorder takes place by operating hotkey “*Trigger Snapshot*” via touchscreen (menu: Main Menu/Recorder/**Disturbance recorder**),

At the time, *writing/reading the memory* of the SD-card *fails* for any reason, event “*DiREC Memory error*” [E8006] is being activated.

At the time, a CRC error of a recorded file is indicated, event “*DiREC File error*” [E8007] is being activated.

Main Menu\ Parameters\RECORDING\				
Disturbance recorder				
P/E No.	Name	Value	Unit	(Setting range)
General				
P8000	Function	OFF	-	ON/OFF
P8001	Sample width	Standard	-	Standard/Development
P8002	Number of internal buffers	5	-	1 ... 10
P8004	Overwrite	OFF	-	ON/OFF
P8006	Recording time	2,0	%	0,1 ... 126,0
P8007	Pre-trigger time	25	%	0 ... 100
P8008	Follow-up time	25	%	0 ... 100
P8009	Follow-up time(manual)	25	%	0 ... 100
Trigger events				
P8018	Trigger #1	0	event	0 ... 9999
P8019	Trigger #2	0	event	0 ... 9999
P8020	Trigger #3	0	event	0 ... 9999
P8021	Trigger #4	0	event	0 ... 9999
P8022	Trigger #5	0	event	0 ... 9999
P8023	Trigger #6	0	event	0 ... 9999
P8024	Trigger #7	0	event	0 ... 9999
P8025	Trigger #8	0	event	0 ... 9999
P8026	Trigger #9	0	event	0 ... 9999
P8027	Trigger #10	0	event	0 ... 9999
Recording events				
P8028	Event #1	9999	event	0 ... 9999
P8029	Event #2	9999	event	0 ... 9999
P8030	Event #3	9999	event	0 ... 9999
P8031	Event #4	9999	event	0 ... 9999
P8032	Event #5	9999	event	0 ... 9999
P8033	Event #6	9999	event	0 ... 9999
P8034	Event #7	9999	event	0 ... 9999
P8035	Event #8	9999	event	0 ... 9999
P8036	Event #9	9999	event	0 ... 9999
P8037	Event #10	9999	event	0 ... 9999
P8038	Event #11	9999	event	0 ... 9999
P8039	Event #12	9999	event	0 ... 9999
P8040	Event #13	9999	event	0 ... 9999
P8041	Event #14	9999	event	0 ... 9999
P8042	Event #15	9999	event	0 ... 9999
P8043	Event #16	9999	event	0 ... 9999
P8044	Event #17	9999	event	0 ... 9999
P8045	Event #18	9999	event	0 ... 9999
P8046	Event #19	9999	event	0 ... 9999
P8047	Event #20	9999	event	0 ... 9999
P8048	Event #21	9999	event	0 ... 9999
P8049	Event #22	9999	event	0 ... 9999
P8050	Event #23	9999	event	0 ... 9999
P8051	Event #24	9999	event	0 ... 9999
P8052	Event #25	9999	event	0 ... 9999
P8053	Event #26	9999	event	0 ... 9999
P8054	Event #27	9999	event	0 ... 9999

P8055	Event #28	9999	event	0 ... 9999
P8056	Event #29	9999	event	0 ... 9999
P8057	Event #30	9999	event	0 ... 9999
P8058	Event #31	9999	event	0 ... 9999
P8059	Event #32	9999	event	0 ... 9999
E8000	Di-REC-Ready	-	-	-
E8001	Di-REC-Recording	-	-	-
E8002	Di-REC-Buffer overflow	-	-	-
E8003	Di-REC-Backup	-	-	-
E8004	Di-REC-Full memory	-	-	-
E8006	Di-REC-No memory card	-	-	-
E8007	Di-REC-Memory error	-	-	-
E8000	Di-REC-File error	-	-	-

Figure 3-24 Fault recorder – Parameter [P] and Events [E]

Parameter description:

“General“ parameters

P8000 Function

This parameter enables/disables disturbance recording function wherein:

- “OFF”: disables or
- “ON”: enables the disturbance recording function.

When disturbance recording function is enabled by parameter “Function” [P8000], then event “Di-REC Ready” [E8000] is being activated.

P8001 Sample width

Operating mode for selecting measurement quantities which are to be recordered; this parameter determines the group of measurement quantites recordered per sample.

- “Standard”: measurement quantities according to the following table
- (“Development“: only for manufacturer’s purposes)

Table 3-3 Analog data of disturbance recordings for parameter setting:
“Samle width [P8001] = “Standard”

Measuring quantity	Unit	Description	Remark
CT1_I1	A	Phase current I1 of measuring input CT1	
CT1_I2	A	Phase current I2 of measuring input CT1	
CT1_I3	A	Phase current I3 of measuring input CT1	
CT2_I1	A	Phase current I1 of measuring input CT2	
CT2_I2	A	Phase current I2 of measuring input CT2	
CT2_I3	A	Phase current I3 of measuring input CT2	
CT-GND1_IG	A	Ground current IG of measuring input CT-GND1	
ID1	A	Differential current of phase L1	
ID2	A	Differential current of Phase L2	
ID3	A	Differential current of L3	
PT1_U1E	V	Phase-to-earth voltage (L1 and earth) measured via PT1	
PT1_U2E	V	Phase-to-earth voltage (L2 and earth) measured via PT1	
PT1_U3E	V	Phase-to-earth voltage (L3 and earth) measured via PT1	
PT2_U1E	V	Phase-to-earth voltage (L1 and earth) measured via PT2	
PT2_U2E	V	Phase-to-earth voltage (L2 and earth) measured via PT2	
PT2_U3E	V	Phase-to-earth voltage (L3 and earth) measured via PT2	
PT3_U1E	V	Phase-to-earth voltage (L1 and earth) measured via PT3	
PT3_U2E	V	Phase-to-earth voltage (L2 and earth) measured via PT3	
PT3_U3E	V	Phase-to-earth voltage (L3 and earth) measured via PT3	
PT-GND1_UG	V	Über PT-GND1 measured residual voltage	
PT1_FL12		Frequency of phase-to-phase voltage U12 measured by PT1	

PT2_FL12		Frequency of phase-to-phase voltage U12 measured by PT2	
PT3_FL12		Frequency of phase-to-phase voltage U12 measured by PT3	
PT2_FL1N		Frequency of phase-to-neutral voltage U1 measured by PT2	„G59“ only
PT2_FL2N		Frequency of phase-to-neutral voltage U2 measured by PT2	„G59“ only
PT2_FL3N		Frequency of phase-to-neutral voltage U3 measured by PT2	„G59“ only
Parameter-Events		Events of parameters [P8028] to [P8059]	
BIO		Events of binary inputs and outputs	

Table 3-4 Binary data of disturbance recordings for parameter setting:
“Samle width [P8001] = “Standard”

Event-Nr.	Bezeichnung	Beschreibung
E4010	„Fct. 10“	Binary input „Funktion 10“
E4011	„Fct. 11“	Binary input „Funktion 11“
E4012	„Fct. 12“	Binary input „Funktion 12“
E4013	„Fct. 13“	Binary input „Funktion 13“
E4014	„Fct. 14“	Binary input „Funktion 14“
E4015	„Fct. 15“	Binary input „Funktion 15“
E4016	„Fct. 16“	Binary input „Funktion 16“
E4017	„Fct. 17“	Binary input „Funktion 17“
E4018	„Fct. 18“	Binary input „Funktion 18“
E4019	„Fct. 19“	Binary input „Funktion 19“
E4020	„Fct. 20“	Binary input „Funktion 20“
E4021	„Fct. 21“	Binary input „Funktion 21“
E4022	„Fct. 22“	Binary input „Funktion 22“
E4023	„Fct. 23“	Binary input „Funktion 23“
E4024	„Fct. 24“	Binary input „Funktion 24“
E4025	„Fct. 25“	Binary input „Funktion 25“
E4026	„Fct. 26“	Binary input „Funktion 26“
E4027	„Fct. 27“	Binary input „Funktion 27“
E4028	„Fct. 28“	Binary input „Funktion 28“
E4500	„Shunt Trip 1“	Binary output for protection trip
E4501	„Shunt Trip 2“	Binary output for protection trip
E4502	„Lockout relay“	Binary output as „Lockout relais“
E4504	„Synchron ON“	Binary output for funktion „Synchronising“
E4506	„Function 1“	Binary output for „Funktion 1“
E4508	„Function 2“	Binary output for „Funktion 2“
E4510	„Function 3“	Binary output for „Funktion 3“
E4512	„Function 4“	Binary output for „Funktion 4“
E4514	„Function 5“	Binary output for „Funktion 5“
E4516	„Function 6“	Binary output for „Funktion 6“
E4518	„Function 7“	Binary output for „Funktion 7“
E4520	„Function 8“	Binary output for „Funktion 8“

P8002 Number of internal buffers

Partitioning the RAM memory for buffering recorded data; the available RAM memory (20 MB) can be divided into a maximum of 10 individual buffers.

The more buffers there are the more trigger-events can be processed. .

Example: If there were only *one* buffer (*“Number of internal buffers = 1”*) and recording was finished successfully, the copy operation would have started to transmit recorded data from the buffer to the SD-card. As consequence, any active trigger-event could not start a further recording.

On the contrary, if there are *two* buffers (*“Number of internal buffers = 2”*), a further active trigger-event would have started another recording via saving data in the second buffer.

P8004 Overwrite

Release for overwriting the next buffer; in case that all buffers provide recorded data for saving at the SD-card and another trigger-event turns to active, then overwriting the memory section of the next buffer can be released, however, the next buffer has to provide status “data”. Setting option:

- “OFF“: deactivates the release for overwriting,
- “ON“: activates the release for overwriting.

At the time, overwriting of the next buffer starts, event “*DiREC Buffer overflow*” [E8002] is being activated.

P8006 Recording time

Reduction of the maximum recording time; the maximum recording time which is given by set value of parameter “*Number of internal buffers*” [P8002], can be reduced by parameter [P8006].

P8007 Pre-trigger time

Recording time-to-trigger; this parameter determines the recording duration before the point of time of activation:

- by the *corresponding trigger-event* [P8018] to [P8027] or
- by *manual trigger* via touchscreen (operating the hotkey “Trigger snapshot”).

P8008 Follow-up time

Recording time-after-trigger; this parameter determines the recording duration since the point of time of deactivation of the *corresponding trigger-event* [P8018] to [P8027].

NOTE: The recording time-after-trigger set by parameter “*Follow-up time*” [P8008] is only valid for the trigger-events assigned to parameters [P8018] to [P8027]!

P8009 Follow-up time (manual)

Recording time-after-manual trigger; this parameter determines the recording duration since the point of time of deactivation of the *manual trigger via touchscreen* (operating the hotkey “Trigger snapshot”).

NOTE: The recording time-after-trigger set by parameter “*Follow-up time*” [P8008] is only valid for manual trigger via touchscreen!

“Trigger events”

P8018 Trigger #1

to

P8027 Trigger #10

Data recording via disturbance recorder can be triggered by any active event. For triggering, the number related to this blocking event has to be assigned to parameter [P2876]. There are up to 10 individual trigger-events, see parameters [P8018] to [P8027].

If triggering the disturbance recording *by any trigger-event* is not required, set this parameter to “0”.

“Recording events”

P8028 Event #1

to

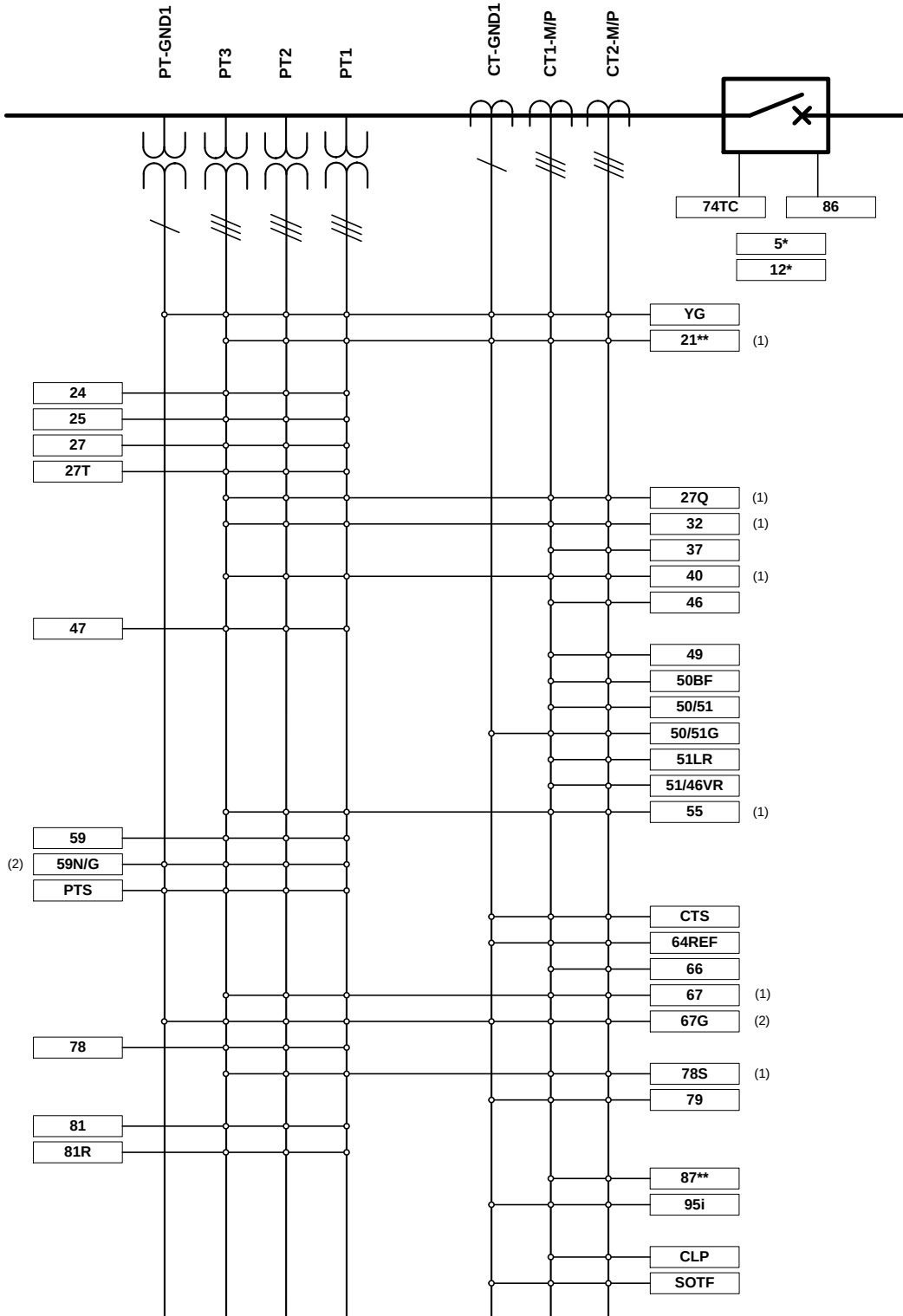
P8059 Event #32

Freely-parametrizable events as measuring data for the disturbance file; for additional recording of binary channels there are up to 32 parameters available which can be used to assign any of the available events.

If none of the binary channels as measuring data required for recording, set this parameter to “0”.

3.5 “PROTECTION”

Protective functions have been implemented in the product line SYMAP[®]-Compact according to the “American National Standard Institute” (ANSI) standard. Refer to the following figure for allocation of process variables (measured values) and protection functions.



* Gen-Set controls only (EC0 to EC3 and +EC4)

** ordering option (see order code)

(1) depending on power measurement at common changeover

(2) measured or calculated

Figure 3-25 Process variables of protection functions

3.5.1 “General” (Parameter set changeover)

The SYMAP-Compact(+) offers four, identical protection parameter sets which each represent the complete protective functionality as far as their setting options are concerned. Depending on the grid or system situation, adaptation of the protection setting to current requirements may be necessary. This demand can be met by pre-configuring up to four protection parameter sets and activating them according to specific events occurring.

General Protection Parameters

In general, one protection parameter set only is active but when using the general protection parameter, changeover to another parameter set is possible. Each protection parameter set is provided a general parameter to which a specific event required for changeover is accorded.

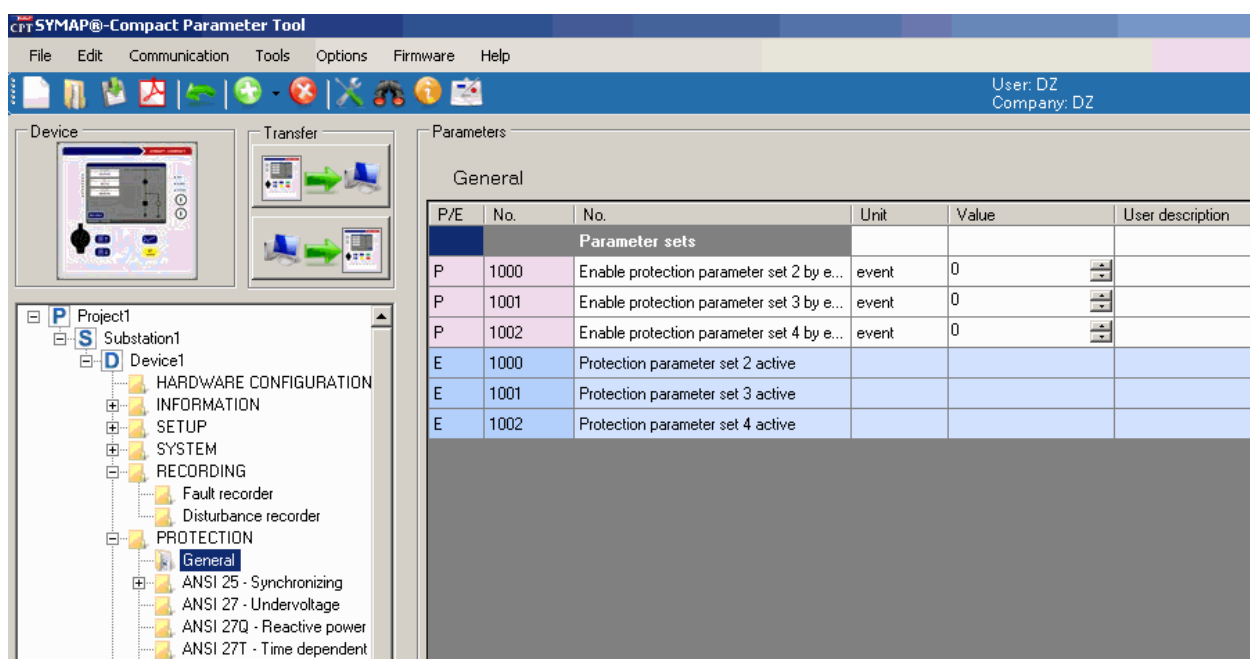


Figure 3-26 General protection parameters – Protection parameter set changeover

CAUTION: The following is determined on behalf of priority for the active protection parameter set in order to guarantee that in case of simultaneously active events only one protection parameter set is active.

Table 3-5 Parameter set changeover – Active parameter set

Event for parameter [P1000]	Event for parameter [P1001]	Event for parameter [P1002]	Active protection parameter set
inactive	inactive	inactive	Protection parameter set 1
inactive	inactive	active	Protection parameter set 4
inactive	active	inactive	Protection parameter set 3
inactive	active	active	Protection parameter set 4
active	inactive	inactive	Protection parameter set 2
active	inactive	active	Protection parameter set 4
active	active	inactive	Protection parameter set 3
active	active	active	Protection parameter set 4

Parameter description:

P1000 Enable protection parameter set 2

Protection parameter set 2 is activated by any event. For activation the number of the activating event has to be allocated to parameter [P1000]. Activation is, however, only active for the time the allocated event is active. As soon as the event turns inactive, protection parameter set 1 becomes active again.

If changeover to parameter set 2 is not required, set parameter [P1000] to "0".

Protection parameter set 2 is given the lowest priority!

P1001 Enable protection parameter set 3

Protection parameter set 3 is activated by any event. For activation the number of the activating event has to be allocated to parameter [P1001]. Activation is, however, only active for the time the allocated event is active. As soon as the event turns inactive, protection parameter set 1 becomes active again.

If changeover to parameter set 3 is not required, set parameter [P1001] to "0".

Protection parameter set 3 is given the second lowest priority!

P1002 Enable protection parameter set 4

Protection parameter set 4 is activated by any event. For activation the number of the activating event has to be allocated to parameter [P1002]. Activation is, however, only active for the time the allocated event is active. As soon as the event turns inactive, protection parameter set 1 becomes active again.

If changeover to parameter set 4 is not required, set parameter [P1002] to "0".

Protection parameter set 4 is given the highest priority!

3.5.2 ANSI 25 – Synchronizing

Depending on the device variant SYMAP[®]-Compact(+) provides up to three 3-phase voltage measurement inputs PT1, PT2 and PT3. For synchronization of two three phase systems each, function “Synchronizing ANSI 25” comprises three independent synchronizing units

- Synchronizing unit 1 (“Sync. unit 1”) for PT1 and PT2,
- Synchronizing unit 2 (“Sync. unit 2”) for PT1 and PT3
- Synchronizing unit 3 (“Sync. unit 3”) for PT2 and PT3

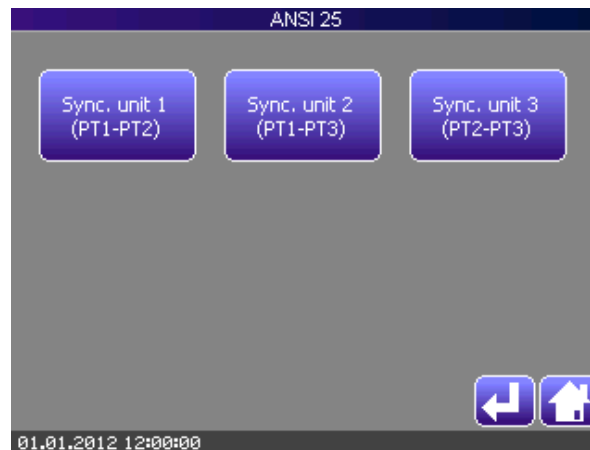


Figure 3-27 ANSI 25 – Synchronizing units 1 to 3

Each synchronizing unit provides the following sub-functions according to synchronization of two three phase power systems in each case.

- “Synchrocheck”
 - “Sync check” (synchronizing check: U , f , dU , df , $dPHI$) and
 - “Voltage check” (U , f)
- “Controller” (automatic synchronizing)

The parameters of the sub-functions relate to the following three submenus of *one* synchronizing unit:

- Submenu “General”: parameters of *all sub-functions*,
- Submenu “Synchrocheck”: parameters of *synchronizing check* and *voltage check*,
- Submenu “Controller”: parameters of *automatic synchronizing* (frequency regulation, phase angle regulation and voltage regulation)



Figure 3-28 Synchronizing unit 1 [Synch. unit 1 (PT1-PT2)] – Parameter menu of sub-functions.

Synchronizing unit 1 ("Sync. unit 1")

Main Menu\ Parameters\PROTECTION\ANSI25-50/51\ANSI25\Sync. unit 1 (PT1-PT2)						
General						
SET 1		SET 2	SET 3	SET 4		
P/E No.	Name			Value	Unit	(Setting range)
General						
P2305	Active by event			0	event	0 ... 9999
P2306	Blocking			0	event	0 ... 9999
P2307	Voltage reference			PT2	-	PT1/PT2
P2308	Max. operating time			60	s	0 ... 999999,999
P2309	Rotating field supervision			ON	-	OFF/ON
E1855	ANSI25-1 Active			-	-	-
E1856	ANSI25-1 Blocked			-	-	-
E1857	ANSI25-1 Negative phase seq. PT1			-	-	-
E1858	ANSI25-1 Negative phase seq. PT2			-	-	-

Figure 3-29 ANSI 25 – Sync. unit 1 (PT1-PT2): General parameters [P] and events [E]

Main Menu\ Parameters\PROTECTION\ANSI25-50/51\ANSI25\Sync. unit 1 (PT1-PT2)						
Synchrocheck						
SET 1	SET 2	SET 3	SET 4			
P/E No.	Name		Value	Unit	(Setting range)	
Sync check						
P2315	Function		OFF	-	OFF/ON	
P2316	Blocking		0	event	0 ... 9999	
P2317	Max. voltage		110	%	0 ... 200,0	
P2318	Min. voltage		90	%	0 ... 200,0	
P2319	Max. frequency		52	Hz	0 ... 80,00	
P2320	Min. frequency		48	Hz	0 ... 80,00	
P2321	Max. dU		2	%	-50,0 ... 50,0	
P2322	Min. dU		-2	%	-50,0 ... 50,0	
P2323	Max. df		0,02	Hz	-5,000 ... 5,000	
P2324	Min. df		0	Hz	-5,000 ... 5,000	
P2325	Max. dPHI		5	deg	-90,0 ... 90,0	
P2326	Min. dPHI		0	deg	-90,0 ... 90,0	
P2327	Correction angle		0	deg	-30,0 ... 30,0	
P2328	Delay time		0	s	0 ... 65,535	
P2329	CB closing delay		0,30	s	0 ... 65,535	
E1865	ANSI25-1 SC: Blocked		-	-	-	
E1866	ANSI25-1 SC: PT1 > Max. voltage		-	-	-	
E1867	ANSI25-1 SC: PT1 < Min. voltage		-	-	-	
E1868	ANSI25-1 SC: PT1 > Max. frequency		-	-	-	
E1869	ANSI25-1 SC: PT1 < Min. frequency		-	-	-	
E1870	ANSI25-1 SC: PT1 in range		-	-	-	
E1871	ANSI25-1 SC: PT2 > Max. voltage					
E1872	ANSI25-1 SC: PT2 < Min. voltage					
E1873	ANSI25-1 SC: PT2 > Max. frequency					
E1874	ANSI25-1 SC: PT2 < Min. frequency					
E1875	ANSI25-1 SC: PT2 in range					
E1876	ANSI25-1 SC: dU > Max. dU					
E1877	ANSI25-1 SC: dU < Min. dU					
E1878	ANSI25-1 SC: dU in range					
E1879	ANSI25-1 SC: df > Max. df					

E1880	ANSI25-1 SC: df < Min. df			
E1881	ANSI25-1 SC: df in range			
E1882	ANSI25-1 SC: dPHI > Max. dPHI			
E1883	ANSI25-1 SC: dPHI < Min. dPHI			
E1884	ANSI25-1 SC: dPHI in range			
E1885	ANSI25-1 SC: Synchronous pre-event			
E1886	ANSI25-1 SC: Synchronous			
Voltage check				
P2335	Function	Not PT1 and PT2	-	OFF/Not PT1 and PT2/PT1 and Not PT2/Not PT1 and Not PT2/Not PT1 or Not PT2
P2336	Blocking	0	event	0 ... 9999
P2337	Max. voltage	110	%	0 ... 200,0
P2338	Min. voltage	90	%	0 ... 200,0
P2339	Max. frequency	52	Hz	0 ... 80,00
P2340	Min. frequency	48	Hz	0 ... 80,00
P2341	No voltage limit	5	%	0 ... 100,0
P2342	Delay time	0	s	0 ... 65,535
E1890	ANSI25-1 VC: Blocked			
E1891	ANSI25-1 VC: PT1 > Max. voltage			
E1892	ANSI25-1 VC: PT1 < Min. voltage			
E1893	ANSI25-1 VC: PT1 > Max. frequency			
E1894	ANSI25-1 VC: PT1 < Min. frequency			
E1895	ANSI25-1 VC: PT1 in range			
E1896	ANSI25-1 VC: PT1 > No voltage limit			
E1897	ANSI25-1 VC: PT1 < No voltage limit			
E1898	ANSI25-1 VC: PT2 > Max. voltage			
E1899	ANSI25-1 VC: PT2 < Min. voltage			
E1900	ANSI25-1 VC: PT2 > Max. frequency			
E1901	ANSI25-1 VC: PT2 < Min. frequency			
E1902	ANSI25-1 VC: PT2 in range			
E1903	ANSI25-1 VC: PT2 > No voltage limit			
E1904	ANSI25-1 VC: PT2 < No voltage limit			
E1905	ANSI25-1 VC: Synchronous pre-event			
E1906	ANSI25-1 VC: Synchronous			

Figure 3-30 ANSI 25 – Sync. unit 1 (PT1-PT2): Synchrocheck parameters [P] and events [E]

Main Menu\ Parameters\PROTECTION\ANSI25-50/51\ANSI25\Sync. unit 1 (PT1-PT2)				
Controller				
SET 1	SET 2	SET 3	SET 4	
P/E No.	Name	Value	Unit	(Setting range)
Controller				
P2425	Function	OFF	-	OFF/ON
P2426	Blocking	0	event	0 ... 9999
P2427	Frequency controller interval time	2	s	0 ... 6553,5
P2428	Frequency controller max pulse time	100	s	0 ... 6553,5
P2429	Phase controller active at	0,12	Hz	0 ... 65,535
P2430	Phase controller max pulse time	1	s	0 ... 655,35
P2431	Voltage controller interval time	2	s	0 ... 6553,5
P2432	Voltage controller max pulse time	150	s	0 ... 6553,5
E2020	ANSI25-1 Frequency higher event	-	-	-
E2021	ANSI25-1 Frequency lower event	-	-	-
E2022	ANSI25-1 Voltage higher event	-	-	-
E2023	ANSI25-1 Voltage lower event	-	-	-

Figure 3-31 ANSI 25 – Sync. unit 1 (PT1-PT2): Controller parameters [P] and events [E]

Synchronizing unit 2 ("Sync. unit 2")

Main Menu\ Parameters\PROTECTION\ANSI25-50/51\ANSI25\Sync. unit 2 (PT1-PT3)					
General					
SET 1	SET 2	SET 3	SET 4		
P/E No.	Name		Value	Unit	(Setting range)
General					
P2345	Active by event		0	event	0 ... 9999
P2346	Blocking		0	event	0 ... 9999
P2347	Voltage reference		PT3	-	PT1/PT3
P2348	Max. operating time		60	s	0 ... 999999,999
P2349	Rotating field supervision		ON	-	OFF/ON
E1910	ANSI25-2 Active		-	-	-
E1911	ANSI25-2 Blocked		-	-	-
E1912	ANSI25-2 Negative phase seq. PT1		-	-	-
E1913	ANSI25-2 Negative phase seq. PT3		-	-	-

Figure 3-32 ANSI 25 – Sync. unit 2 (PT1-PT3): General parameters [P] and events [E]

Main Menu\ Parameters\PROTECTION\ANSI25-50/51\ANSI25\Sync. unit 2 (PT1-PT3)					
Syncrocheck					
SET 1	SET 2	SET 3	SET 4		
P/E No.	Name	Value		Unit	(Setting range)
Synchrocheck					
P2355	Function	OFF		-	OFF/ON
P2356	Blocking	0		event	0 ... 9999
P2357	Max. voltage	110		%	0 ... 200,0
P2358	Min. voltage	90		%	0 ... 200,0
P2359	Max. frequency	52		Hz	0 ... 80,00
P2360	Min. frequency	48		Hz	0 ... 80,00
P2361	Max. dU	2		%	-50,0 ... 50,0
P2362	Min. dU	-2		%	-50,0 ... 50,0
P2363	Max. df	0,02		Hz	-5,000 ... 5,000
P2364	Min. df	0		Hz	-5,000 ... 5,000
P2365	Max. dPHI	5		deg	-90,0 ... 90,0
P2366	Min. dPHI	0		deg	-90,0 ... 90,0
P2367	Correction angle	0		deg	-30,0 ... 30,0
P2368	Delay time	0		s	0 ... 65,535
P2369	CB closing delay	0,30		s	0 ... 65,535
E1920	ANSI25-2 SC: Blocked	-		-	-
E1921	ANSI25-2 SC: PT1 > Max. voltage	-		-	-
E1922	ANSI25-2 SC: PT1 < Min. voltage	-		-	-
E1923	ANSI25-2 SC: PT1 > Max. frequency	-		-	-
E1924	ANSI25-2 SC: PT1 < Min. frequency	-		-	-
E1925	ANSI25-2 SC: PT1 in range	-		-	-
E1926	ANSI25-2 SC: PT3 > Max. voltage	-		-	-
E1927	ANSI25-2 SC: PT3 < Min. voltage	-		-	-
E1928	ANSI25-2 SC: PT3 > Max. frequency	-		-	-
E1929	ANSI25-2 SC: PT3 < Min. frequency	-		-	-
E1930	ANSI25-2 SC: PT3 in range	-		-	-
E1931	ANSI25-2 SC: dU > Max. dU	-		-	-
E1932	ANSI25-2 SC: dU < Min. dU	-		-	-
E1933	ANSI25-2 SC: dU in range	-		-	-
E1934	ANSI25-2 SC: df > Max. df	-		-	-

E1935	ANSI25-2 SC: df < Min. df			
E1936	ANSI25-2 SC: df in range			
E1937	ANSI25-2 SC: dPHI > Max. dPHI			
E1938	ANSI25-2 SC: dPHI < Min. dPHI			
E1939	ANSI25-2 SC: dPHI in range			
E1940	ANSI25-2 SC: Synchronous pre-event			
E1941	ANSI25-2 SC: Synchronous			
Voltage check				
P2375	Function	Not PT1 and PT3	-	OFF/Not PT1 and PT3/PT1 and Not PT3/Not PT1 and Not PT3/Not PT1 or Not PT3
P2376	Blocking	0	event	0 ... 9999
P2377	Max. voltage	110	%	0 ... 200,0
P2378	Min. voltage	90	%	0 ... 200,0
P2379	Max. frequency	52	Hz	0 ... 80,00
P2380	Min. frequency	48	Hz	0 ... 80,00
P2381	No voltage limit	5	%	0 ... 100,0
P2382	Delay time	0	s	0 ... 65,535
E1945	ANSI25-2 VC: Blocked			
E1946	ANSI25-2 VC: PT1 > Max. voltage			
E1947	ANSI25-2 VC: PT1 < Min. voltage			
E1948	ANSI25-2 VC: PT1 > Max. frequency			
E1949	ANSI25-2 VC: PT1 < Min. frequency			
E1950	ANSI25-2 VC: PT1 in range			
E1951	ANSI25-2 VC: PT1 > No voltage limit			
E1952	ANSI25-2 VC: PT1 < No voltage limit			
E1953	ANSI25-2 VC: PT3 > Max. voltage			
E1954	ANSI25-2 VC: PT3 < Min. voltage			
E1955	ANSI25-2 VC: PT3 > Max. frequency			
E1956	ANSI25-2 VC: PT3 < Min. frequency			
E1957	ANSI25-2 VC: PT3 in range			
E1958	ANSI25-2 VC: PT3 > No voltage limit			
E1959	ANSI25-2 VC: PT3 < No voltage limit			
E1960	ANSI25-2 VC: Synchronous pre-event			
E1961	ANSI25-2 VC: Synchronous			

Figure 3-33 ANSI 25 – Sync. unit 2 (PT1-PT3): Synchrocheck parameters [P] and events [E]

Main Menu\ Parameters\PROTECTION\ANSI25-50/51\ANSI25\Sync. unit 2 (PT1-PT3)				
Controller				
SET 1	SET 2	SET 3	SET 4	
P/E No.	Name	Value	Unit	(Setting range)
Controller				
P2435	Function	OFF	-	OFF/ON
P2436	Blocking	0	event	0 ... 9999
P2437	Frequency controller interval time	2	s	0 ... 6553,5
P2438	Frequency controller max pulse time	100	s	0 ... 6553,5
P2439	Phase controller active at	0,12	Hz	0 ... 65,535
P2440	Phase controller max pulse time	1	s	0 ... 655,35
P2441	Voltage controller interval time	2	s	0 ... 6553,5
P2442	Voltage controller max pulse time	150	s	0 ... 6553,5
E2025	ANSI25-2 Frequency higher event	-	-	-
E2026	ANSI25-2 Frequency lower event	-	-	-
E2027	ANSI25-2 Voltage higher event	-	-	-
E2028	ANSI25-2 Voltage lower event	-	-	-

Figure 3-34 ANSI 25 – Sync. unit 2 (PT1-PT3): Controller-Parameter [P] und Events [E]

Synchronizing unit 3 ("Sync. unit 3")

Main Menu\ Parameters\PROTECTION\ANSI25-50/51\ANSI25\Sync. unit 3 (PT2-PT3)					
General					
SET 1	SET 2	SET 3	SET 4		
P/E No.	Name		Value	Unit	(Setting range)
General					
P2385	Active by event		0	event	0 ... 9999
P2386	Blocking		0	event	0 ... 9999
P2387	Voltage reference		PT3	-	PT2/PT3
P2388	Max. operating time		60	s	0 ... 999999,999
P2389	Rotating field supervision		ON	-	OFF/ON
E1965	ANSI25-3 Active		-	-	-
E1966	ANSI25-3 Blocked		-	-	-
E1967	ANSI25-3 Negative phase seq. PT2		-	-	-
E1968	ANSI25-3 Negative phase seq. PT3		-	-	-

Figure 3-35 ANSI 25 – Sync. unit 3 (PT2-PT3): General parameters [P] and events [E]

Main Menu\ Parameters\PROTECTION\ANSI25-50/51\ANSI25\Sync. unit 3 (PT2-PT3)					
Synchrocheck					
SET 1	SET 2	SET 3	SET 4		
P/E No.	Name	Value		Unit	(Setting range)
Sync check					
P2395	Function	OFF		-	OFF/ON
P2396	Blocking	0		event	0 ... 9999
P2397	Max. voltage	110		%	0 ... 200,0
P2398	Min. voltage	90		%	0 ... 200,0
P2399	Max. frequency	52		Hz	0 ... 80,00
P2400	Min. frequency	48		Hz	0 ... 80,00
P2401	Max. dU	2		%	-50,0 ... 50,0
P2402	Min. dU	-3		%	-50,0 ... 50,0
P2403	Max. df	0,02		Hz	-5,000 ... 5,000
P2404	Min. df	0		Hz	-5,000 ... 5,000
P2405	Max. dPHI	5		deg	-90,0 ... 90,0
P2406	Min. dPHI	0		deg	-90,0 ... 90,0
P2407	Correction angle	0		deg	-30,0 ... 30,0
P2408	Delay time	0		s	0 ... 65,535
P2409	CB closing delay	0,30		s	0 ... 65,535
E1975	ANSI25-3 SC: Blocked	-		-	-
E1976	ANSI25-3 SC: PT2 > Max. voltage	-		-	-
E1977	ANSI25-3 SC: PT2 < Min. voltage	-		-	-
E1978	ANSI25-3 SC: PT2 > Max. frequency	-		-	-
E1979	ANSI25-3 SC: PT2 < Min. frequency	-		-	-
E1980	ANSI25-3 SC: PT2 in range	-		-	-
E1981	ANSI25-3 SC: PT3 > Max. voltage	-		-	-
E1982	ANSI25-3 SC: PT3 < Min. voltage	-		-	-
E1983	ANSI25-3 SC: PT3 > Max. frequency	-		-	-
E1984	ANSI25-3 SC: PT3 < Min. frequency	-		-	-
E1985	ANSI25-3 SC: PT3 in range	-		-	-
E1986	ANSI25-3 SC: dU > Max. dU	-		-	-
E1987	ANSI25-3 SC: dU < Min. dU	-		-	-
E1988	ANSI25-3 SC: dU in range	-		-	-
E1989	ANSI25-3 SC: df > Max. df	-		-	-
E1990	ANSI25-3 SC: df < Min. df	-		-	-

E1991	ANSI25-3 SC: df in range			
E1992	ANSI25-3 SC: dPHI > Max. dPHI			
E1993	ANSI25-3 SC: dPHI < Min. dPHI			
E1994	ANSI25-3 SC: dPHI in range			
E1995	ANSI25-3 SC: Synchronous pre-event			
E1996	ANSI25-3 SC: Synchronous			
Voltage check				
P2415	Function	Not PT2 and PT3	-	OFF/Not PT2 and PT3/PT2 and Not PT3/Not PT2 and Not PT3/Not PT2 or Not PT3
P2416	Blocking	0	event	0 ... 9999
P2417	Max. voltage	110	%	0 ... 200,0
P2418	Min. voltage	90	%	0 ... 200,0
P2419	Max. frequency	52	Hz	0 ... 80,00
P2420	Min. frequency	48	Hz	0 ... 80,00
P2421	No voltage limit	5	%	0 ... 100,0
P2422	Delay time	0	s	0 ... 65,535
E2000	ANSI25-3 VC: Blocked			
E2001	ANSI25-3 VC: PT2 > Max. voltage			
E2002	ANSI25-3 VC: PT2 < Min. voltage			
E2003	ANSI25-3 VC: PT2 > Max. frequency			
E2004	ANSI25-3 VC: PT2 < Min. frequency			
E2005	ANSI25-3 VC: PT2 in range			
E2006	ANSI25-3 VC: PT2 > No voltage limit			
E2007	ANSI25-3 VC: PT2 < No voltage limit			
E2008	ANSI25-3 VC: PT3 > Max. voltage			
E2009	ANSI25-3 VC: PT3 < Min. voltage			
E2010	ANSI25-3 VC: PT3 > Max. frequency			
E2011	ANSI25-3 VC: PT3 < Min. frequency			
E2012	ANSI25-3 VC: PT3 in range			
E2013	ANSI25-3 VC: PT3 > No voltage limit			
E2014	ANSI25-3 VC: PT3 < No voltage limit			
E2015	ANSI25-3 VC: Synchronous pre-event			
E2016	ANSI25-3 VC: Synchronous			

Figure 3-36 ANSI 25 – Sync. unit 3 (PT2-PT3): Synchrocheck parameters [P] and events [E]

Main Menu\ Parameters\PROTECTION\ANSI25-50/51\ANSI25\Sync. unit 3 (PT2-PT3)				
Controller				
SET 1	SET 2	SET 3	SET 4	
P/E No.	Name	Value	Unit	(Setting range)
Controller				
P2445	Function	OFF	-	OFF/ON
P2446	Blocking	0	event	0 ... 9999
P2447	Frequency controller interval time	2	s	0 ... 6553,5
P2448	Frequency controller max pulse time	100	s	0 ... 6553,5
P2449	Phase controller active at	0,12	Hz	0 ... 65,535
P2450	Phase controller max pulse time	1	s	0 ... 655,35
P2451	Voltage controller interval time	2	s	0 ... 6553,5
P2452	Voltage controller max pulse time	150	s	0 ... 6553,5
E2030	ANSI25-3 Frequency higher event	-	-	-
E2031	ANSI25-3 Frequency lower event	-	-	-
E2032	ANSI25-3 Voltage higher event	-	-	-
E2033	ANSI25-3 Voltage lower event	-	-	-

Figure 3-37 ANSI 25 – Sync. unit 3 (PT2-PT3): Controller parameters [P] and events [E]

Parameter description:

The following parameter descriptions refer to all protection parameters of one parameter set.

NOTE: Each of the four parameter sets always provides the same group of protection parameters for all three synchronizing units ("Sync. unit 1" to "Sync. unit 3"). Hence, parameter descriptions of the SET PARAMETERS and the parameters of the first synchronizing unit ("Sync. unit 1") represented below, are described in the following in detail as examples.

Protection parameter set 1 (SET 1) – ANSI 25-1 "Sync. unit 1"

General Parameter (GENERAL)

The following general parameters exist only once in each of the three synchronizing units. Thus, the general parameters apply to all of the following *sub-functions* of the synchronizing units:

- "Sync check" (synchronizing check: U , f , dU , df , $dPHI$) and
- "Voltage check" (U , f)
- "Controller" (automatic synchronizing)

P2305 Active by event

Synchronizing unit 1 (Sync. unit 1) of function ANSI25 can be activated by any active event. For activation, the number related to this event has to be assigned to parameter [P2305]. Activation is only effective, however, as long as the assigned event is active. As soon as activation is active, event "ANSI25-1 Active" [E1855] is being activated. If the assigned event turns inactive, synchronizing unit 1 is being deactivated. Then, event [E1855] is being deactivated automatically.

If activation of *synchronizing unit 1* is not required, set this parameter to "0".

P2306 Blocking

Synchronizing unit 1 (Sync. unit 1) of function ANSI25 can be blocked by any active event. For blocking, the number related to this blocking event has to be assigned to parameter [P2306]. Blocking is only effective, however, as long as the blocking event is active. As soon as blocking is active, event "ANSI25-1 Blocked" [E1856] is being activated. If the blocking event turns inactive, blocking is abandoned and *synchronizing unit 1* is effective again. Then, event [E1856] is being deactivated automatically.

If blocking of *synchronizing unit 1* is not required, set this parameter to "0".

P2307 Voltage reference

Reference three phase power system for that three phase power system which is being synchronized; the reference system can be assigned either to the voltage measurement input:

- "PT1" or
- "PT2".

P2308 Max. operating time

Maximum time delay until the automatic deactivation of a manually initiated synchronization via synchronizing unit 1 (Sync. unit 1); as soon as synchronizing unit 1 is activated manually, the timer "Max. operating time" starts. In case that synchronisation hasn't stopped manually before "Max. operation time" has run down, synchronizing unit 1 is being automatically deactivated.

NOTE: Parameter "Max. operation time" [P2308] is solely valid for a manually initiated synchronization via *synchronizing unit 1* which can apply the following *sub-functions*:

- “Sync check” (synchronizing check: U , f , dU , df , $dPHI$) and/or
- “Voltage check” (U , f) and/or
- “Controller” (automatic synchronization).

To provide the possibility of a manually initiated synchronization, it is necessary to use a configurable user page and include hotkeys for “manual start” and “manual stop”

P2309 Rotating field supervision

This parameter enables/disables *rotating field supervision* (phase sequence check of both three phase power systems) wherein:

- “OFF”: disables or
- “ON”: enables rotating field supervision.

Rotating field supervision does not come into effect before:

- parameter “Rotating field supervision [P2309] = ON” **and**
- all *measured phase-to-phase voltages* of both three phase power systems (PT1 and PT2) exceed 40% the set minimum value of *nominal voltage* (“Voltage L-L”).

NOTE: The nominal value of the characteristic quantity (phase-to-phase voltage) is to be set by parameter:

- “Voltage (L-L)” [P603], for winding side W1 or
- “Voltage (L-L)” [P613], for winding side W2 or
- “Voltage (L-L)” [P623], for winding side W2.

The referring parameters “Voltage (L-L)” [P603], “Voltage (L-L)” [P613] and “Voltage (L-L)” [P623] are located in submenu: “SYSTEM\Nominals\Reference values”.

As soon as the rotating field supervision detects an *incorrect phase sequence* in either of the two threephase power systems,

- event “ANSI25-1 Negative phase seq. PT1” [E1857] and/or event “ANSI25-1 Negative phase seq. PT2” [E1858] is being activated **and**
- functions “Sync check” and “Voltage check” are being *automatically blocked!*

Synchronizing check (U , f , dU , df , $dPHI$) – “Sync check”

Function “Sync check” checks synchronism of two live three phase power systems (PT1 and PT2). When *synchronizing unit 1* (Sync. unit 1) of function ANSI 25 is activated (see parameter „Active by Event“ [P2305]), both three phase power systems are being checked whether

- the amount of the phase-to phase voltages $\underline{U}_{12}$, $\underline{U}_{23}$, and $\underline{U}_{31}$, and the
- frequencies of the phase-to phase voltages $\underline{U}_{12_{PT1}}$ and $\underline{U}_{12_{PT2}}$

meet the required *operating range* set by parameters [P2317] to [P2320]. Only when these conditions are fulfilled, *synchronizing check procedure* is started according to the synchronizing criteria:

- Amount difference ΔU of the phase-to phase voltages $\underline{U}_{12_{PT1}}$ and $\underline{U}_{12_{PT2}}$
- Frequency difference Δf of the phase-to phase voltages $\underline{U}_{12_{PT1}}$ and $\underline{U}_{12_{PT2}}$ and
- Phase angle difference $\Delta\phi$ ($dPHI$) of the phase-to phase voltages $\underline{U}_{12_{PT1}}$ and $\underline{U}_{12_{PT2}}$

As *reference system* for *synchronizing check* (“Sync check”), it is that three phase power system, which is assigned to parameter “Voltage reference” [P2307].

P2315 Function

This parameter enables/disables the *effectiveness* of synchronizing unit 1 (Sync. unit 1) for *synchronizing check* (“Sync check”: U , f , ΔU , Δf , $\Delta\phi$) wherein:

- “OFF”: disables or
- “ON”: enables the effectiveness of *synchronizing unit 1*.

Synchronizing check is only initiated when

- the effectiveness of *synchronizing unit 1* is activated (“Function [P2315] = ON”) and
- *synchronizing unit 1* is activated by the event which was assigned to parameter “Active by event” [P2305].

P2316 Blocking

Function “Sync check” (U , f , ΔU , Δf , $\Delta\phi$) of *synchronizing unit 1* (Sync. unit 1) can be blocked by any active event. For blocking, the number related to this blocking event has to be assigned to parameter [P2316]. Blocking is only effective, however, as long as the blocking event is active. As soon as blocking is active, event “ANSI25-1 SC: Blocked” [E1865] is being activated. If the blocking event turns inactive, blocking is abandoned and *synchronizing check* is effective again. Then, event [E1865] is being deactivated automatically.

If blocking of *synchronizing check* of *synchronizing unit 1* is not required, set this parameter to “0”.

Definition of operating range as condition for synchronizing check (“Sync check”: U , f , ΔU , Δf , $\Delta\phi$)

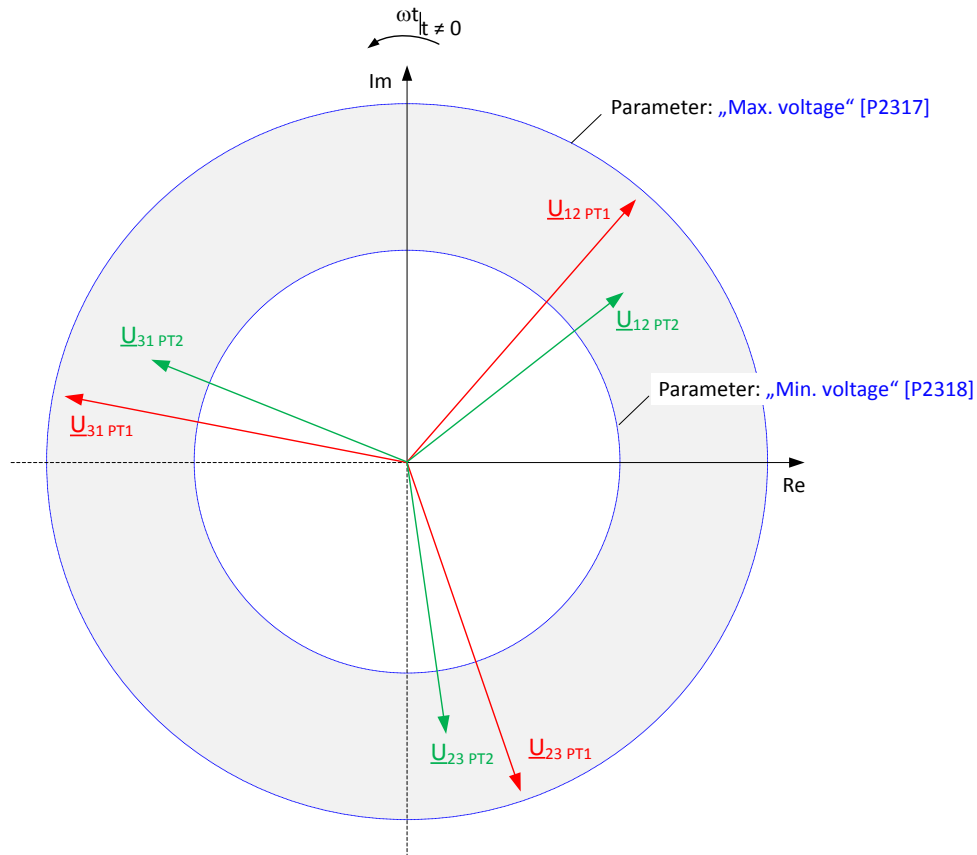


Figure 3-38 „Sync check” – operating range: phase-segregated voltage check (amount)

As soon as all *phase-to-phase voltages* and *frequencies* of *PT1* and/or *PT2* are within the operating range set by parameters:

“*Max. voltage*” [P2317] and “*Min. voltage*” [P2318], and
“*Max. frequency*” [P2319] and “*Min frequency*” [P2320],

the event:

“*ANSI25-1 SC: PT1 in range*” [E1870] and/or the event
“*ANSI25-1 SC: PT2 in range*” [E1875]

is being activated, and the *synchronizing check procedure* (dU , df , $dPHI$) is being conducted.

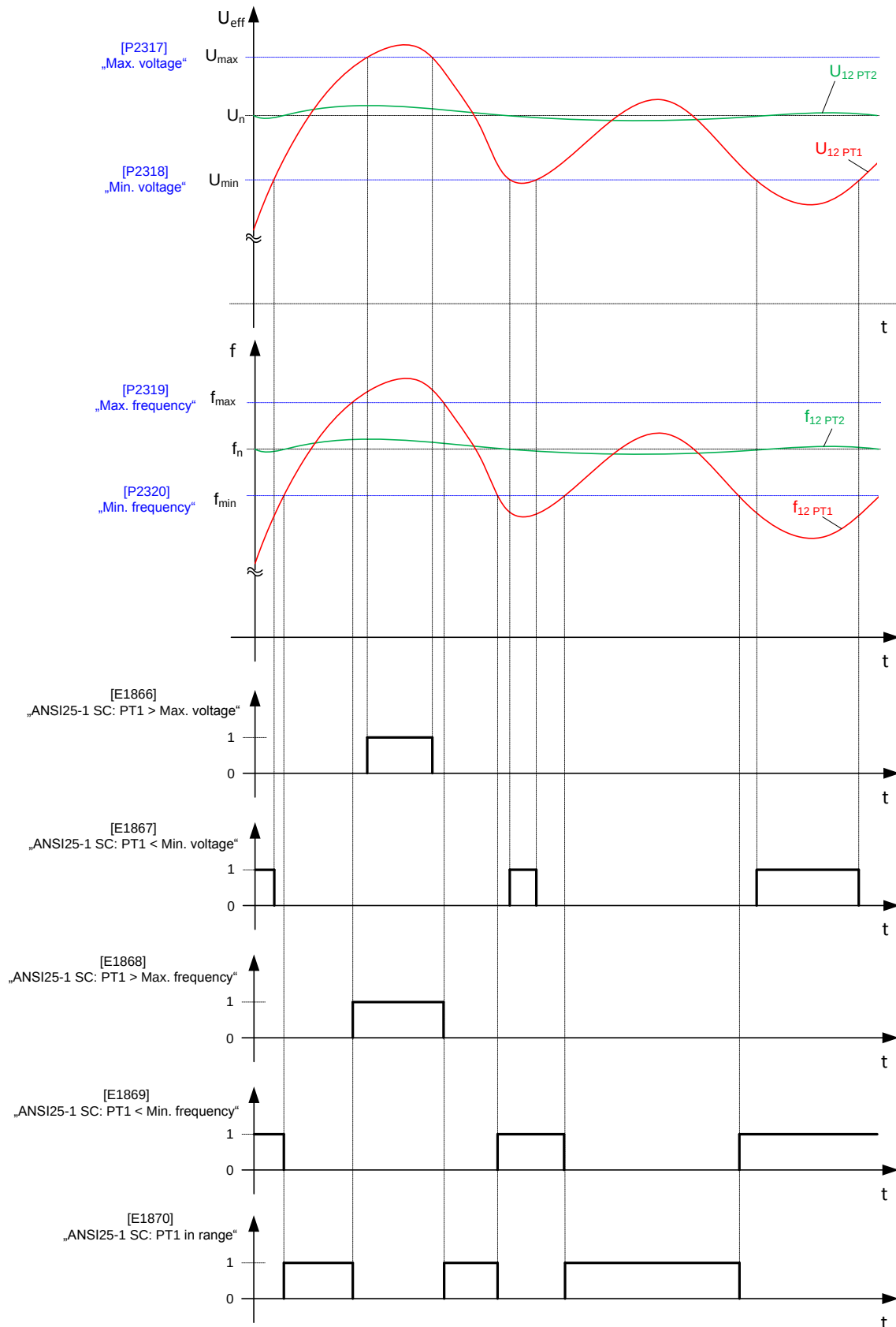


Figure 3-39 Function “Sync check” – operating range “PT1”: parameters [P] and events [E]

NOTE: Verification of compliance with the set operating range for phase-to-phase voltages and frequency of PT2 is conducted in an analogous manner to PT1

P2317 Max. voltage

Maximum voltage limit (voltage amount) of the operating range of the phase-to-phase voltages $\underline{U}_{12}$, $\underline{U}_{23}$ and $\underline{U}_{31}$ to be synchronized; for a successful synchronizing check ("Sync check": U , f , ΔU , Δf , $\Delta \phi$), voltages must not exceed the maximum voltage limit.

The *maximum voltage limit* is valid for both, three phase power system *PT1* and *PT2*.

In case that one of the measured phase-to-phase voltages of *PT1* or *PT2* exceeds the *maximum voltage limit* set by parameter "*Max. voltage*" [P2317], the event:

"ANSI25-1 SC: *PT1* > *Max. voltage*" [E1866] for *PT1* and/or

"ANSI25-1 SC: *PT2* > *Max. voltage*" [E1871] for *PT2*

is being activated.

P2318 Min. voltage

Minimum voltage limit (voltage amount) of the operating range of the phase-to-phase voltages $\underline{U}_{12}$, $\underline{U}_{23}$ and $\underline{U}_{31}$ to be synchronized; for a successful synchronizing check ("Sync check": U , f , ΔU , Δf , $\Delta \phi$), voltages must not fall below the minimum voltage limit.

The *minimum voltage limit* is valid for both, three phase power system *PT1* and *PT2*.

In case that one of the measured phase-to-phase voltages of *PT1* or *PT2* falls below the *minimum voltage limit* set by parameter "*Min. voltage*" [P2318], the event:

"ANSI25-1 SC: *PT1* < *Min. voltage*" [E1867] for *PT1* and/or

"ANSI25-1 SC: *PT2* < *Min. voltage*" [E1872] for *PT2*

is being activated.

P2319 Max. frequency

Maximum frequency limit of the operating range of the phase-to-phase voltages $\underline{U}_{12_{PT1}}$ and $\underline{U}_{12_{PT2}}$; for a successful synchronizing check ("Sync check": U , f , ΔU , Δf , $\Delta \phi$), frequencies must not exceed the maximum frequency limit.

The *maximum frequency limit* is valid for both, three phase power system *PT1* and *PT2*.

In case that the frequency of the measured phase-to-phase voltages of *PT1* or *PT2* exceeds the *maximum frequency limit* set by parameter "*Max. frequency*" [P2319], the event:

"ANSI25-1 SC: *PT1* > *Max. frequency*" [E1868] for *PT1* and/or

"ANSI25-1 SC: *PT2* > *Max. frequency*" [E1873] for *PT2*

is being activated.

P2320 Min. frequency

Minimum frequency limit of the operating range of the phase-to-phase voltages $\underline{U}_{12_{PT1}}$ and $\underline{U}_{12_{PT2}}$; for a successful synchronizing check ("Sync check": U , f , ΔU , Δf , $\Delta \phi$), frequencies must not fall below the minimum frequency limit.

The *minimum frequency limit* is valid for both, three phase power system *PT1* and *PT2*.

In case that the frequency of the measured phase-to-phase voltages of *PT1* or *PT2* falls below the *minimum frequency limit* set by parameter "*Min. frequency*" [P2320], the event:

"ANSI25-1 SC: *PT1* < *Min. frequency*" [E1869] for *PT1* and/or

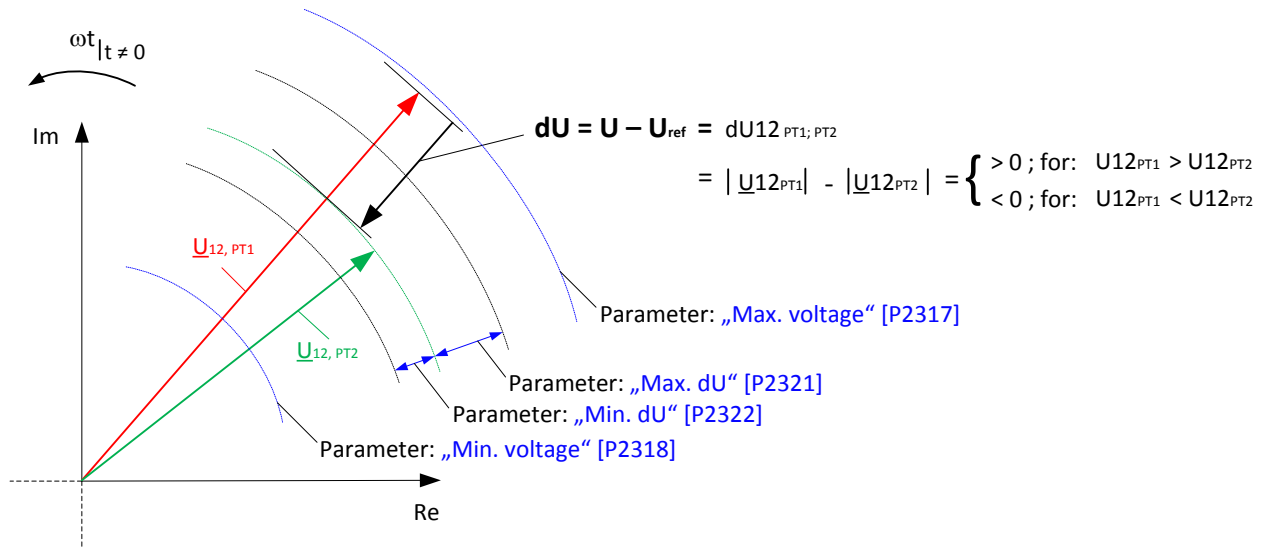
"ANSI25-1 SC: *PT2* < *Min. frequency*" [E1874] for *PT2*

is being activated.

Continuation of synchronizing check according to the synchronizing criteria ΔU , Δf and $\Delta \varphi$

The following figure represents the verification of compliance with the set voltage difference ΔU

Example: „Voltage reference“ [P2307] = „PT2“



with:

dU : Voltage difference (amount) between phase-to-phase voltages $U_{12_{PT1}}$ and $U_{12_{PT2}}$

U : Phase-to-phase voltage of the three phase power system PT1 to be synchronized

U_{ref} : Reference voltage of the three phase power system PT2, PT1 is to be synchronised to

Figure 3-40 Function “Sync check” – Verification of compliance with voltage difference ΔU

NOTE: As soon as the *voltage difference* ΔU lies within the tolerance range set by parameters “Max. dU ” [P2321] und “Min. dU ” [P2322], event “ANSI25-1 SC: dU in range” [E1878] is being activated.

P2321 Max. dU

Maximum limit of the voltage differenz ΔU (difference between phase-to-phase voltages $U_{12_{PT1}}$ and $U_{12_{PT2}}$) of a level in excess of the reference voltage U_{ref} ; for a successful synchronizing check (“Sync check”: U , f , ΔU , Δf , $\Delta \varphi$), voltages must not exceed the maximum limit of the voltage differenz ΔU .

In case that the measured *voltage differenz* ΔU exceeds the *maximum limit of the voltage differenz* ΔU set by parameter “Max. dU ” [P2321], the event “ANSI25-1 SC: $dU > \text{Max. } dU$ ” [E1876] is being activated.

P2322 Min. dU

Minimum limit of the voltage differenz ΔU (difference between phase-to-phase voltages $U_{12_{PT1}}$ and $U_{12_{PT2}}$) of a level below the reference voltage U_{ref} ; for a successful synchronizing check (“Sync check”: U , f , ΔU , Δf , $\Delta \varphi$), voltages must not fall below the minimum limit of the voltage differenz ΔU .

In case that the measured *voltage differenz* ΔU falls below the *minimum limit of the voltage differenz* ΔU set by parameter “Min. dU ” [P2322], the event “ANSI25-1 SC: $dU < \text{Min. } dU$ ” [E1877] is being activated.

The following figure represents the verification of compliance with the set voltage difference ΔU and the set frequency difference Δf .

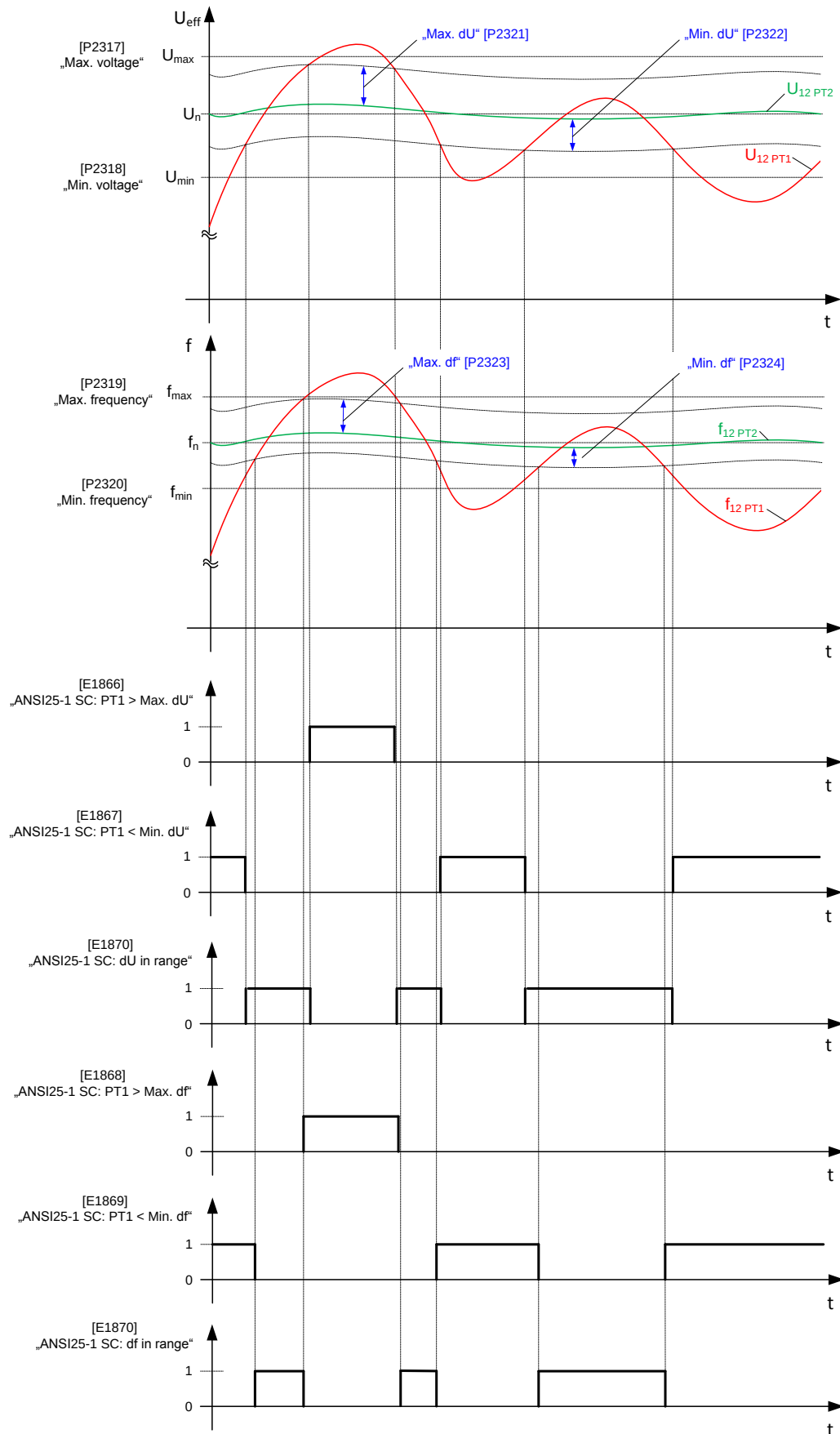


Figure 3-41 Function “Sync check” – Verification of compliance with dU and df

NOTE: As soon as the *frequency difference* Δf lies within the tolerance range set by parameters “*Max. df*” [P2323] und “*Min df*” [P2324], event “*ANSI25-1 SC: df in range*” [E1881] is being activated.

P2323 Max. df

Maximum limit of the frequency differenz Δf (difference between frequencies of phase-to-phase voltages $\underline{U}_{12_{PT1}}$ and $\underline{U}_{12_{PT2}}$); for a successful synchronizing check (“Sync check”: $U, f, \Delta U, \Delta f, \Delta \phi$), the frequency difference must not exceed the maximum limit of the frequency differenz Δf .

In case that the measured *frequency differenz* Δf exceeds the *maximum limit of the frequency differenz* Δf set by parameter “*Max.df*” [P2323], the event “*ANSI25-1 SC: df > Max. df*” [E1879] is being activated.

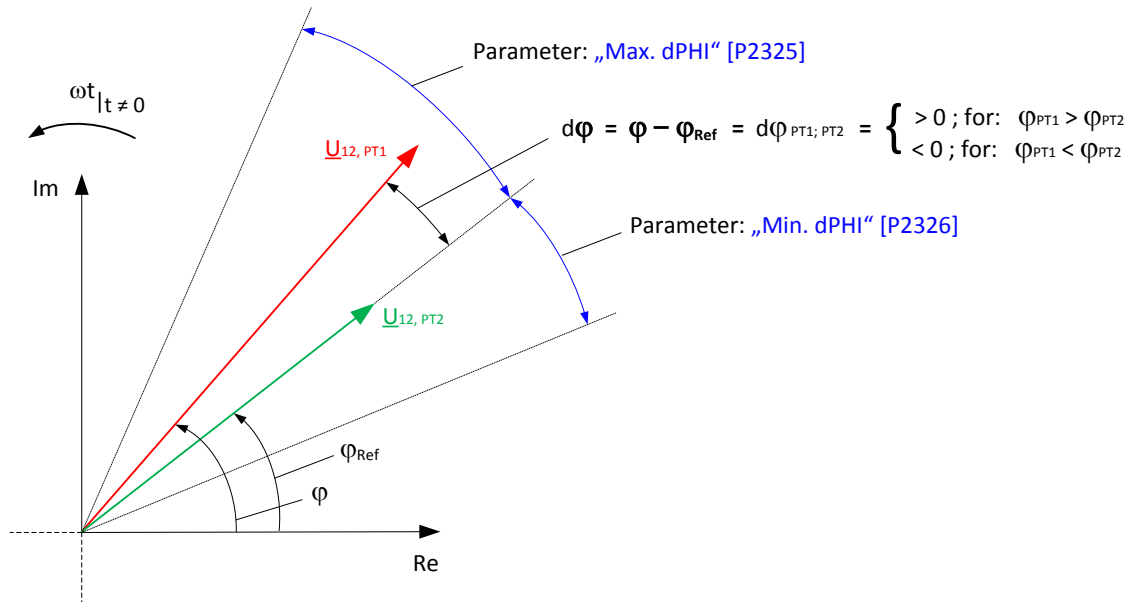
P2324 Min. df

Minimum limit of the frequency differenz Δf (difference between frequencies of phase-to-phase voltages $\underline{U}_{12_{PT1}}$ and $\underline{U}_{12_{PT2}}$); for a successful synchronizing check (“Sync check”: $U, f, \Delta U, \Delta f, \Delta \phi$), the frequency difference must not fall below the minimum limit of the frequency differenz Δf .

In case that the measured *frequency differenz* Δf falls below the *maximum limit of the frequency differenz* Δf set by parameter “*Min.df*” [P2324], the event “*ANSI25-1 SC: df < Min. df*” [E1880] is being activated.

The following figure represents the verification of compliance with the set phase angle difference $\Delta\varphi$.

Example: „Voltage reference“ [P2307] = „PT2“



with:

$\underline{U}_{12, PT1}$: Measured phase-to-phase voltage $\underline{U}_{12}$ of the three phase power system PT1 to be synchronized

$\underline{U}_{12, PT2}$: Measured phase-to-phase voltage $\underline{U}_{12}$ of the three phase power system PT2 (reference system), PT1 is to be synchronized to

$d\varphi$: Phase angle difference (dPHI) between the phase-to-phase voltages $\underline{U}_{12, PT1}$ and $\underline{U}_{12, PT2}$

φ : Phase angle of the phase-to-phase voltage $\underline{U}_{12, PT1}$ of the three phase power system PT1 to be synchronized

φ_{Ref} : Phase angle of the phase-to-phase voltage $\underline{U}_{12, PT2}$ of the three phase power system PT2 (reference system), PT1 is to be synchronized to

Figure 3-42 Function “Sync check” – Verification of compliance with phase angle difference $d\varphi$

NOTE: As soon as the *phase angle difference* $\Delta\varphi$ lies within the tolerance range set by parameters “Max. dPHI” [P2325] und “Min dPHI” [P2326], event “ANSI25-1 SC: dPHI in range” [E1884] is being activated.

P2325 Max. dPHI

Maximum limit of the phase angle difference $\Delta\varphi$ (difference between phase angles of phase-to-phase voltages $\underline{U}_{12, PT1}$ and $\underline{U}_{12, PT2}$); for a successful synchronizing check (“Sync check”: $U, f, \Delta U, \Delta f, \Delta\varphi$), the *phase angle difference* must not exceed the maximum limit of the phase angle difference $\Delta\varphi$.

In case that the measured *phase angle difference* $\Delta\varphi$ exceeds the maximum limit of the phase angle difference $\Delta\varphi$ set by parameter “Max. dPHI” [P2325], the event “ANSI25-1 SC: dPHI > Max. dPHI” [E1882] is being activated.

P2326 Min dPHI

Minimum limit of the phase angle difference $\Delta\varphi$ (difference between phase angles of phase-to-phase voltages $\underline{U}_{12, PT1}$ and $\underline{U}_{12, PT2}$); for a successful synchronizing check (“Sync check”: $U, f, \Delta U, \Delta f, \Delta\varphi$), the *phase angle difference* must not fall below the minimum limit of the phase angle difference $\Delta\varphi$.

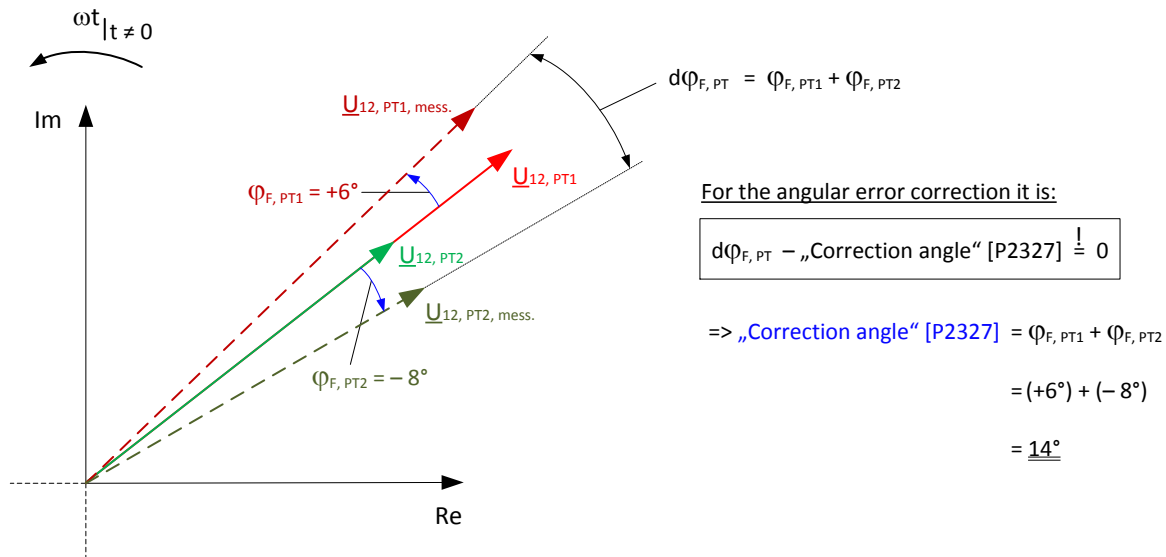
In case that the measured *phase angle difference* $\Delta\varphi$ falls below the maximum limit of the phase angle difference $\Delta\varphi$ set by parameter “Min. dPHI” [P2326], the event “ANSI25-1 SC: dPHI < Min. dPHI” [E1883] is being activated.

The following figure represents the correction of angular errors caused by connected potential transformers (PT)

For the following example, assumptions are listed below:

- the reference system is assigned to PT2 (parameter "Voltage reference [P2307] = PT2")
- the phase angle difference $\Delta\varphi$ of the phase-to-phase voltages $\underline{U}_{12_{PT1}}$ and $\underline{U}_{12_{PT2}}$ is taken to be zero

Example: „Voltage reference“ [P2307] = „PT2“



with:

- $\underline{U}_{12, PT1}$: Actual phase-to-phase voltage $\underline{U}_{12}$ of the three phase power system PT1 to be synchronized
- $\underline{U}_{12, PT2}$: Actual phase-to-phase voltage $\underline{U}_{12}$ of the three phase power system PT2, PT1 is to be synchronized to
- $\underline{U}_{12, PT1, mess.}$: Measured phase-to-phase voltage $\underline{U}_{12}$ of the three phase power system PT1 to be synchronized
- $\underline{U}_{12, PT2, mess.}$: Measured phase-to-phase voltage $\underline{U}_{12}$ of the three phase power system PT2, PT1 is to be synchronized to
- $\varphi_{F, PT1}$: Angular error of potential transformer (PT) connected to PT1
- $\varphi_{F, PT2}$: Angular error of potential transformer (PT) connected to PT2
- $d\varphi_{F, PT}$: Total angular error of potential transformers connected to PT1 and PT2

Figure 3-43 Function "Synchrocheck" – Correction of PT angle faults

NOTE: Correction of angular errors does not depend on the current phase angles of the phase-to-phase voltages $\underline{U}_{12_{PT1}}$ und $\underline{U}_{12_{PT2}}$.

P2327 Correction angle

Correction angle for eliminating the angular errors of the potential transformers (PT); measured phase angle deviations caused by measuring inaccuracy of potential transformers, can be eliminated by the set value of parameter "Correction angle" [P2327].

NOTE: The correction angle is *not* for transformer vector group matching! Vector group matching is to be set by appropriate parameter setting in submenu "SYSTEM\Nominals\Reference values".

P2328 Delay time

Delay time for activating the synchronous-event "ANSI 25-1 SC: Synchronous" [E1886]; as soon as the events:

- "ANSI25-1 SC: PT1 in range" [E1870] and
- "ANSI25-1 SC: PT2 in range" [E1875] and

- “ANSI25-1 SC: dU in range” [E1878] and
- “ANSI25-1 SC: df in range” [E1881] and
- “ANSI25-1 SC: $dPHI$ in range” [E1884]

are simultaneously activated, event “Synchronous pre-event” [E1885] is being activated, and the “Delay time” [P2328] is being started.

As soon as the delay time has run down, synchronous-event “ANSI 25-1 SC: Synchronous” [E1886] is being activated.

Consideration of operating times of additionally applied, external components

Based on synchronizing check functionality (“Sync check”), SYMAP®-Compact(+) calculates the actual time of closing the contacts of its binary output “Synchron ON”. Caused by the operating times of additional, external components such as auxiliary relays, circuit breaker etc., the actual electrical connection (at primary contacts of the CB) of the two three phase power systems PT1 and PT2 is being delayed.

Hence follows, that possibly the synchronizing criteria are no longer fulfilled. As consequence, such circumstances would lead to an unsynchronous connection of the two three phase power systems.

To avoid any asynchronous, electrical connection between the two three phase power systems, a *delay time* can be set by parameter “CB closing delay” [P2329] bringing forward the activation of:

- the synchronous-event “ANSI25-1 SC: Synchronous pre-event” [E1885], and
- – if parametrized – the start of “Delay time” [P2328] for an on-delayed activation of synchronous-event “ANSI25-1 SC: Synchronous” [E1886].

NOTE: The set value of parameter “CB closing delay” [P2329] should be equal to the sum of all operating times

Specific operating times of additionally applied, external components can be taken from the data sheets of the manufacturer

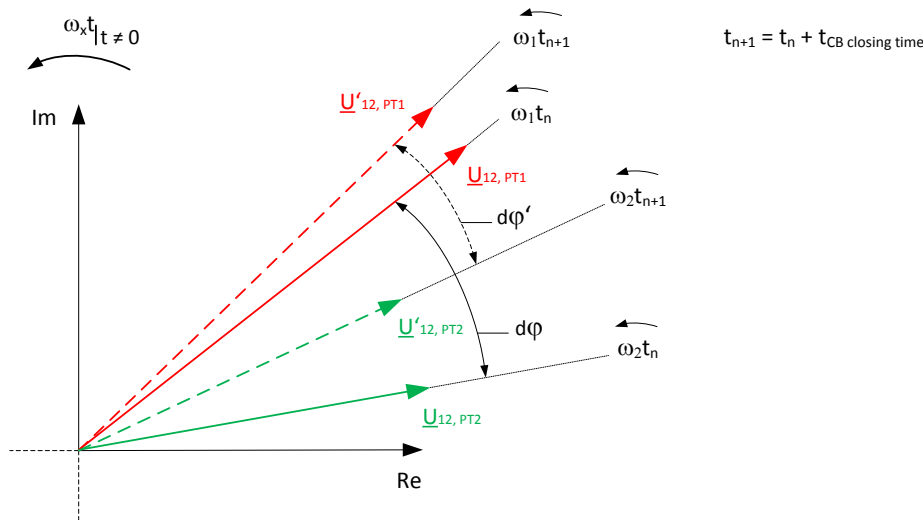
P2329 CB closing delay

Time of bringing forward the activation of the synchronous-event „ANSI25-1 SC: Synchronous pre-event“ [E1885], and the start of “Delay time” [P2328] for an on-delayed activation of synchronous-event “ANSI25-1 SC: Synchronous” [E1886];

The decision for activating synchronous-event „ANSI25-1 SC: Synchronous pre-event“ [E1885], and the start of “Delay time” [P2328] depends on the verification of compliance with the synchronizing criterion *phase angle difference* $\Delta\varphi$ between phase-to-phase voltages $\underline{U}_{12_{PT1}}$ and $\underline{U}_{12_{PT2}}$.

Based on *cyclical measuring of frequencies* f_{PT1} (phase-to-phase voltage $\underline{U}_{12_{PT1}}$) and f_{PT2} (phase-to-phase voltage $\underline{U}_{12_{PT2}}$) at a time t_n , the *phase angle difference* $\Delta\varphi$ is being calculated for the time $t_{n+1} = t_n + t_{CB \text{ closing time}}$, and compared with the tolerance range set by parameters “Max. $dPHI$ ” [P2325] und “Min. $dPHI$ ” [P2326].

Example: „Voltage reference“ [P2307] = „PT2“



with:

- $\underline{U}_{12, PT1}$: Phase-to-phase voltage $\underline{U}_{12}$ of the three phase power system PT1 to be synchronized PT1, at the time t_n
- $\underline{U}'_{12, PT1}$: Phase-to-phase voltage $\underline{U}_{12}$ of the three phase power system PT1 to be synchronized PT1, at the time t_{n+1}
- $\underline{U}_{12, PT2}$: Phase-to-phase voltage $\underline{U}_{12}$ of the three phase power system PT2, PT1 is to be synchronized to, at the time t_n
- $\underline{U}'_{12, PT2}$: Phase-to-phase voltage $\underline{U}_{12}$ of the three phase power system PT2, PT1 is to be synchronized to, at the time t_{n+1}
- $d\varphi$: Phase angle difference, at the time t_n
- $d\varphi'$: Phase angle difference, at the time t_{n+1}
- ω_1 : Angular frequency ($\omega_1 = 2 \pi f_{PT1}$) of phase-to-phase voltage $\underline{U}_{12}$ of the three phase power system PT1
- ω_2 : Angular frequency ($\omega_2 = 2 \pi f_{PT2}$) of phase-to-phase voltage $\underline{U}_{12}$ of the three phase power system PT2, PT1 is to be synchronized to

Figure 3-44 Function “Sync check” – Consideration of operating times: phasor diagram

In case that, at the time t_n the *calculated phase angle difference* $\Delta\varphi$ for the time $t_{n+1} = t_n + t_{CB \text{ closing time}}$ is within the required tolerance range, then

- synchronous-event “ANSI25-1 SC: Synchronous pre-event” [E1885] is being activated **and**
- – if parametrized – the „Delay time“ [P2328] for on-delayed of the synchronous-event “ANSI 25-1 SC: Synchronous” [E1886] is being started.

„Voltage.check“ (U, f)

Independent of function “Sync check” (U, f, ΔU , Δf , $\Delta \varphi$) function “Voltage check” (U, f) checks the *voltage conditions* of the two three phase power systems PT1 and PT2 to clearly discriminate a “live” power system from a “dead” power system.

Definition „dead” three phase power system:

All of the three phase-to-phase voltages of the three phase power system must *not exceed* a *defined voltage limit* set by parameter “No voltage limit” [P2341].

Definition “live” three phase power system:

- For all of the three phase-to-phase voltages of a three phase power system it is required to meet the *defined voltage range* set by parameters “Max.voltage” [P2337] and “Min. voltage” [P2338] **and**
- For the *frequency* of the three phase-to-phase voltages of a three phase power system it is required to meet the *defined frequency range* set by parameters “Max. frequency” [P2339] und “Min. frequency” [P2340]

When synchronizing unit 1 (Sync. Unit 1) of function ANSI 25 is activated (see parameter “Active by Event” [P2305]), function “Voltage check” of synchronizing unit 1 (Sync. Unit 1) checks, whether both three phase power systems meet the *defined operating range* set by parameters [P2337] to [P2340] according to:

- the amount of phase-to-phase voltages $\underline{U}_{12}$, $\underline{U}_{23}$, and $\underline{U}_{31}$ **and**
- the frequency of the phase-to-phase voltages $\underline{U}_{12_{PT1}}$ and $\underline{U}_{12_{PT2}}$

P2335 Function

This parameter defines the *preconditions* for the *effectiveness* of function “Voltage check” (U, f) relating to the voltage conditions of the three phase power systems PT1 and PT2 and, subsequently, the activation of synchronous-events.

Function “Voltage check” (U, f) will only be initiated when

- its *effectiveness* is activated (“Function [P2335] $\neq$ OFF”) **and**
- *synchronizing unit 1 (Sync. unit 1)* is activated by the event which is assigned to parameter “Active by event” [P2305].

Activation of synchronous-event “ANSI25-1 VC: Synchronous pre-event” [E1905] and start of “Delay time” [P2342] for on-delayed activation of synchronous-event “ANSI25-1 VC: Synchronous” [E1906] will take place under different conditions in accordance to following setting options:

- “Not PT1 and PT2”: *dead* power system PT1 (“Not PT1”) **and** *live* power system PT2 (“PT2”),
- “PT1 and Not PT2”: *live* power system PT1 (“PT1”) **and** *dead* power system PT2 (“Not PT2”),
- “Not PT1 and Not PT2”: *both* power systems are *dead*,
- “Not PT1 or Not PT2”: *dead* power system PT1 (“Not PT1”) **and** *live* power system PT2 (“PT2”) **or** *live* power system PT1 (“PT1”) **and** *dead* power system PT2 (“Not PT2”) **or** *both* power systems are *dead*.

Setting option:

- “OFF”: *deactivates function “Voltage check” (U, f).*

P2336 Blocking

Function “Voltage check” (U, f) of synchronizing unit 1 (Sync. unit 1) can be blocked by any active event. For blocking, the number related to this blocking event has to be assigned to parameter [P2336]. Blocking is only effective, however, as long as the blocking event is active. As soon as blocking is active, event “ANSI25-1 VC: Blocked” [E1890] is being activated. If the blocking event turns inactive, blocking is abandoned and synchronizing check is effective again. Then, event [E1890] is being deactivated automatically.

If blocking of function “Voltage check” (U, f) of synchronizing unit 1 is not required, set this parameter to “0”.

Definition of tolerance ranges as precondition for determination of “live2 and “dead” power systems => “Voltage check” (U, f):

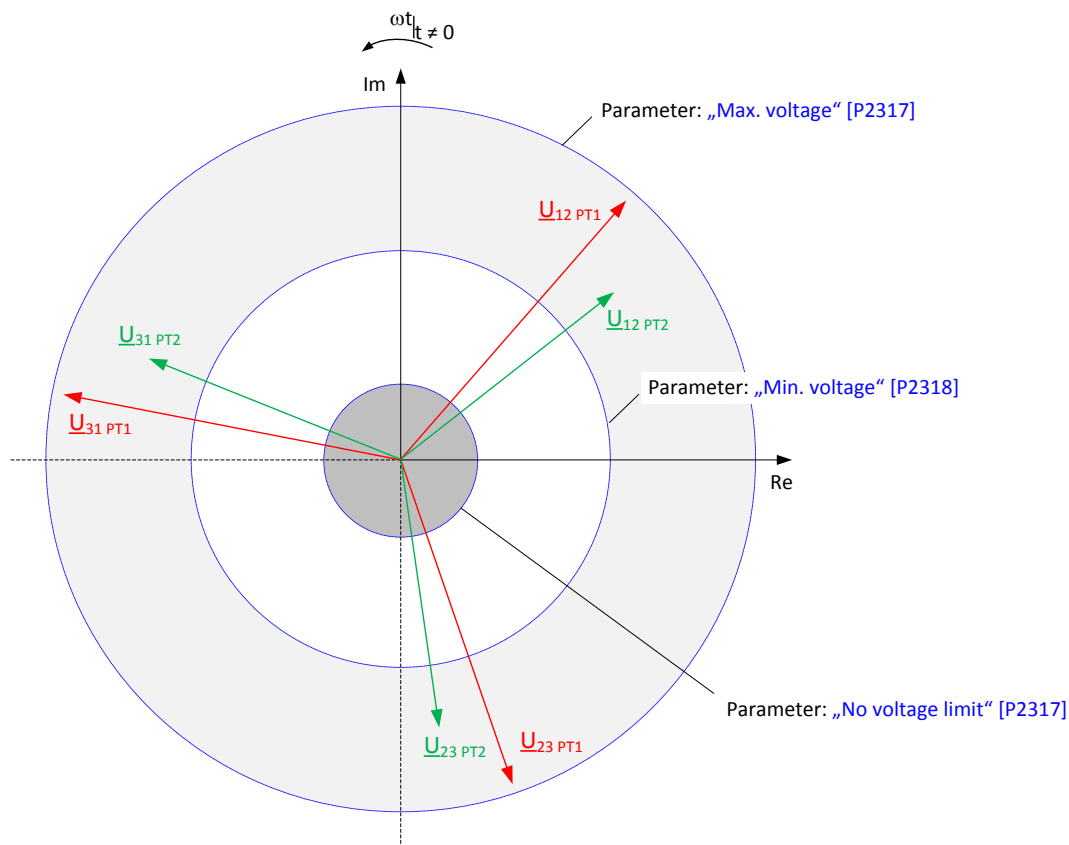


Figure 3-45 “Voltage check” – operating ranges: phase-segregated voltage check (amount)

As soon as all *phase-to-phase voltages and frequencies of PT1 and/or PT2* are within the operating range set by parameters:

“Max. voltage” [P2337] and “Min. voltage” [P2338], and
“Max. frequency” [P2339] and “Min frequency” [P2340],

the event:

“ANSI25-1 VC: PT1 in range” [E1895] and/or the event
“ANSI25-1 VC: PT2 in range” [E1902]

is being activated.

P2337 Max. voltage

Maximum voltage limit (voltage amount) of the operating range of the phase-to-phase voltages $\underline{U}_{12}$, $\underline{U}_{23}$ and $\underline{U}_{31}$ to be synchronized; for a defined "live" power system; voltages must not exceed the maximum voltage limit.

The *maximum voltage limit* is valid for both, three phase power system *PT1* and *PT2*.

In case that one of the measured phase-to-phase voltages of *PT1* and/or *PT2* exceeds the *maximum voltage limit* set by parameter "*Max. voltage*" [P2337], the event:

"ANSI25-1 VC: *PT1* > *Max. voltage*" [E1891] for *PT1* and/or

"ANSI25-1 VC: *PT2* > *Max. voltage*" [E1898] for *PT2*

is being activated.

P2338 Min. voltage

Minimum voltage limit (voltage amount) of the operating range of the phase-to-phase voltages $\underline{U}_{12}$, $\underline{U}_{23}$ and $\underline{U}_{31}$ to be synchronized; for a defined "live" power system; voltages must not fall below the minimum voltage limit.

The *minimum voltage limit* is valid for both, three phase power system *PT1* and *PT2*.

In case that one of the measured phase-to-phase voltages of *PT1* and/or *PT2* falls below the *minimum voltage limit* set by parameter "*Min. voltage*" [P2338], the event:

"ANSI25-1 VC: *PT1* < *Min. voltage*" [E1892] for *PT1* and/or

"ANSI25-1 VC: *PT2* < *Min. voltage*" [E1899] for *PT2*

is being activated.

P2339 Max. frequency

Maximum frequency limit of the operating range of the phase-to-phase voltages $\underline{U}_{12_{PT1}}$ and $\underline{U}_{12_{PT2}}$; for a defined "live" power system; frequencies must not exceed the maximum frequency limit.

The *maximum frequency limit* is valid for both, three phase power system *PT1* and *PT2*.

In case that the frequency of the measured phase-to-phase voltage $\underline{U}_{12}$ of *PT1* and/or *PT2* exceeds the *maximum frequency limit* set by parameter "*Max. frequency*" [P2339], the event:

"ANSI25-1 VC: *PT1* > *Max. frequency*" [E1893] for *PT1* and/or

"ANSI25-1 VC: *PT2* > *Max. frequency*" [E1900] for *PT2*

is being activated.

P2340 Min. frequency

Minimum frequency limit of the operating range of the phase-to-phase voltages $\underline{U}_{12_{PT1}}$ and $\underline{U}_{12_{PT2}}$; for a defined "live" power system; frequencies must not fall below the minimum frequency limit.

The *minimum frequency limit* is valid for both, three phase power system *PT1* and *PT2*.

In case that the frequency of the measured phase-to-phase voltage $\underline{U}_{12}$ of *PT1* and/or *PT2* falls below the *minimum frequency limit* set by parameter "*Max. frequency*" [P2340], the event:

"ANSI25-1 VC: *PT1* < *Min. frequency*" [E1894] for *PT1* and/or

"ANSI25-1 VC: *PT2* < *Min. frequency*" [E1901] for *PT2*

is being activated.

P2341 No voltage limit

Minimum voltage limit (voltage amount) of the measured phase-to-phase voltages for definition of a "dead" power system:

The *minimum voltage limit* is valid for both, three phase power system *PT1* and *PT2*.

In case that *all of the three* measured *phase-to-phase voltages* $\underline{U}_{12}$, $\underline{U}_{23}$ and $\underline{U}_{31}$ of a power system falls below the *minimum voltage limit* set by parameter "No voltage limit" [P2341], the event:

"ANSI25-1 VC: PT1 < Min. voltage" [E1892] for PT1 and/or

"ANSI25-1 VC: PT2 < Min. voltage" [E1899] for PT2

is being activated.

In case that *one of the three* measured *phase-to-phase voltages* $\underline{U}_{12}$, $\underline{U}_{23}$ and $\underline{U}_{31}$ of a power system falls below the *minimum voltage limit* set by parameter "No voltage limit" [P2341], the event:

"ANSI25-1 VC: PT1 > No voltage limit" [E1896] for PT1 and/or

"ANSI25-1 VC: PT2 > No voltage limit" [E1903] for PT2

is being activated.

NOTE: The *minimum voltage limit* [P2341] of *measuring voltage* is to be set as a percentage of the *nominal value* of the characteristic quantity (phase-to-phase voltage). The nominal value of the characteristic quantity is to be set by parameter:

- "Voltage (L-L)" [P603], for winding side W1 or
- "Voltage (L-L)" [P613], for winding side W2 or
- "Voltage (L-L)" [P623], for winding side W2.

The referring parameters "Voltage (L-L)" [P603], "Voltage (L-L)" [P613] and "Voltage (L-L)" [P623] are located in submenu: "SYSTEM\Nominals\Reference values".

P2342 Delay time

Delay time for on-delayed activation of synchronous-event "ANSI 25-1 VC: Synchronous" [E1906]; in case that, depending on the setting options of parameter "Function" [P2335], the followings events are being activated according to the following table:

- "Function [P2335] = Not PT1 and PT2":
"ANSI25-1 VC: PT1 < no voltage limit" [E1897] and "ANSI25-1 VC: PT2 in range" [E1902] or
- "Function [P2335] = PT1 and Not PT2":
"ANSI25-1 VC: PT1 in range" [E1895] and "ANSI25-1 VC: PT2 < no voltage limit" [E1904] or
- "Function [P2335] = Not PT1 and Not PT2":
"ANSI25-1 VC: PT1 < no voltage limit" [E1897] and "ANSI25-1 VC: PT2 < no voltage limit" [E1904] or
- "Function [P2335] = Not PT1 or Not PT2":
"ANSI25-1 VC: PT1 < no voltage limit" [E1897] and "ANSI25-1 VC: PT2 in range" [E1902] or
"ANSI25-1 VC: PT1 in range" [E1895] and "ANSI25-1 VC: PT2 < no voltage limit" [E1904] or

“ANSI25-1 VC: PT1 < no voltage limit” [E1897] and “ANSI25-1 VC: PT2 < no voltage limit” [E1904]

Then, synchronous-event *“ANSI25-1 VC: Synchronous pre-event”* [E1905] activated and the *“Dealy time”* [P2342] for on-delayed activating of synchronous-event *Synchron-Event “ANSI 25-1 VC: Synchronous”* [E1906] is being started.

Automatic synchronizing – Controller

Automatic synchronization “Controller” of synchronizing unit 1 can be applied for synchronizing the three phase power system of a generator to a three phase power system of a busbar(reference system), and, subsequently, to give a closing command to the generator circuit breaker by the binary output “Synchron ON” of SYMAP®-Compact(+) device.

According to the *synchronizing criteria*

- Frequency,
- Phase angle and
- Voltage

Automatic synchronization “Controller” provides the following *control functions*:

- Frequency control,
- Phase angle control and
- Voltage control.

The following parameters “Function” [P2425] and “Blocking” [P2426] refer to *all of the three above mentioned control functions*.

P2425 Function

This parameter enables/disables the effectiveness of *synchronizing unit 1 (Sync. unit 1)* for *automatic synchronization („Controller“: frequency control, phase angle control and voltage control)* wherein:

- “OFF”: disables or
- “ON”: enables the effectiveness of synchronizing unit 1 for *automatic synchronization*.

Automatic synchronization is only initiated when

- the effectiveness of *automatic synchronization* is activated (“Function [P2325] = ON”) and
- *synchronizing unit 1* is activated by the event which was assigned to parameter “Active by event” [P2305].

P2426 Blocking

Automatic synchronization („Controller“: frequency control, phase angle control and voltage control) of *synchronizing unit 1 (Sync. unit 1)* can be blocked by any active event. For blocking, the number related to this blocking event has to be assigned to parameter [P2426]. Blocking is only effective, however, as long as the blocking event is active. If the blocking event turns inactive, blocking is abandoned and *automatic synchronization* is effective again.

If blocking of *automatic synchronization „Controller“* of *synchronizing unit 1* is not required, set this parameter to “0”.

Frequency control

As soon as synchronizing unit 1 is activated, *frequency control* is being activated independently of functions “Voltage control” and “Phase angle control”. Function *frequency control* affects that three phase system, which is connected to PT1 (e.g. generator).

Due to the proportionality of *motor revolutions “RPM”* (e.g. Diesel motor drives generator) and *generator frequency*, fast frequency control (frequency range: Hz) is to be done by the RPM governor of the electric drive engine (motor) in a time range of milliseconds. *Small and slow frequency deviations* (frequency range: millihertz; time range: seconds to minutes) are to be equalized by function “Frequency control” of SYMAP®-Compact(+).

Function “*Frequency control*” of SYMAP[®]-Compact(+) is designed as a “three step control” including the output states: *frequency increase* and *frequency decrease*. For this, the following two control-events are provided:

- “*Frequency higher event*” [E2020]: signal to external speed governor to increase RPM ($\Rightarrow$ *Frequency increase*) and
- “*Frequency lower event*” [E2021]: signal to external speed governor to decrease RPM ($\Rightarrow$ *Frequency decrease*)

Depending on the type of motor speed governor the control events have to be assigned to:

- two different binary outputs of the SYMAP[®]-Compact(+) (*binary control*, e.g. for naval applications)

“*Frequency control*” is only effective, if frequency f_{PT1} of Power system PT1 lies within the tolerance range set by the set limits f_{min} and f_{max} .

REMARK: In view of the following statements the *momentary control deviation (frequency difference $\Delta f_{U12 PT1; PT2}$)* is given as a *percentage $\Delta f[\%]$ of the nominal frequency f_n* set by parameter “*Nominal Frequency*” [P603].

The procedure of frequency control is to be described as follows:

1. *Determination of the control direction: and control deviation $\Delta f[\text{Hz}]$:*
Depending on the circumstance, whether the frequency of power system PT1 (generator) is lower/higher than frequency of power system PT2 (busbar), *synchronizing unit 1* needs to *increase/decrease* the generator frequency.
The following rules apply:
 - a. $f_{PT1} < f_{PT2}$
The frequency of power system PT1 is smaller than the frequency of power system PT2 (reference system); according to the measuring algorithm $\Delta f_{U12 PT1; PT2} = f_{U12, PT2} - f_{U12, PT1}$, it follows a positive sign for the calculated frequency difference:
 $\Delta f[\text{Hz}] > 0 \Rightarrow$ frequency increase!
 - b. $f_{PT1} > f_{PT2}$
The frequency of power system PT1 is higher than the frequency of power system PT2 (reference system); according to the measuring algorithm $\Delta f_{U12 PT1; PT2} = f_{U12, PT2} - f_{U12, PT1}$, it follows a negative sign for the calculated frequency difference:
 $\Delta f[\text{Hz}] < 0 \Rightarrow$ frequency decrease!
2. *Determination of the control speed:*
The speed of generator *frequency control* is proportional to the level of control deviation $\Delta f[\%]$. Depending on the amount of the control deviation $\Delta f[\%]$, so-called “*pulse times*” are being calculated. The *duration of one pulse time* is equal to the period of activation of the corresponding control-event which is to increase/decrease the generator frequency. Pulse times are being recalculated right after the so-called “*break time*” has run down. The break time starts *cyclically* for a *duration* set by parameter “*Frequency controller interval time*” [P2427].

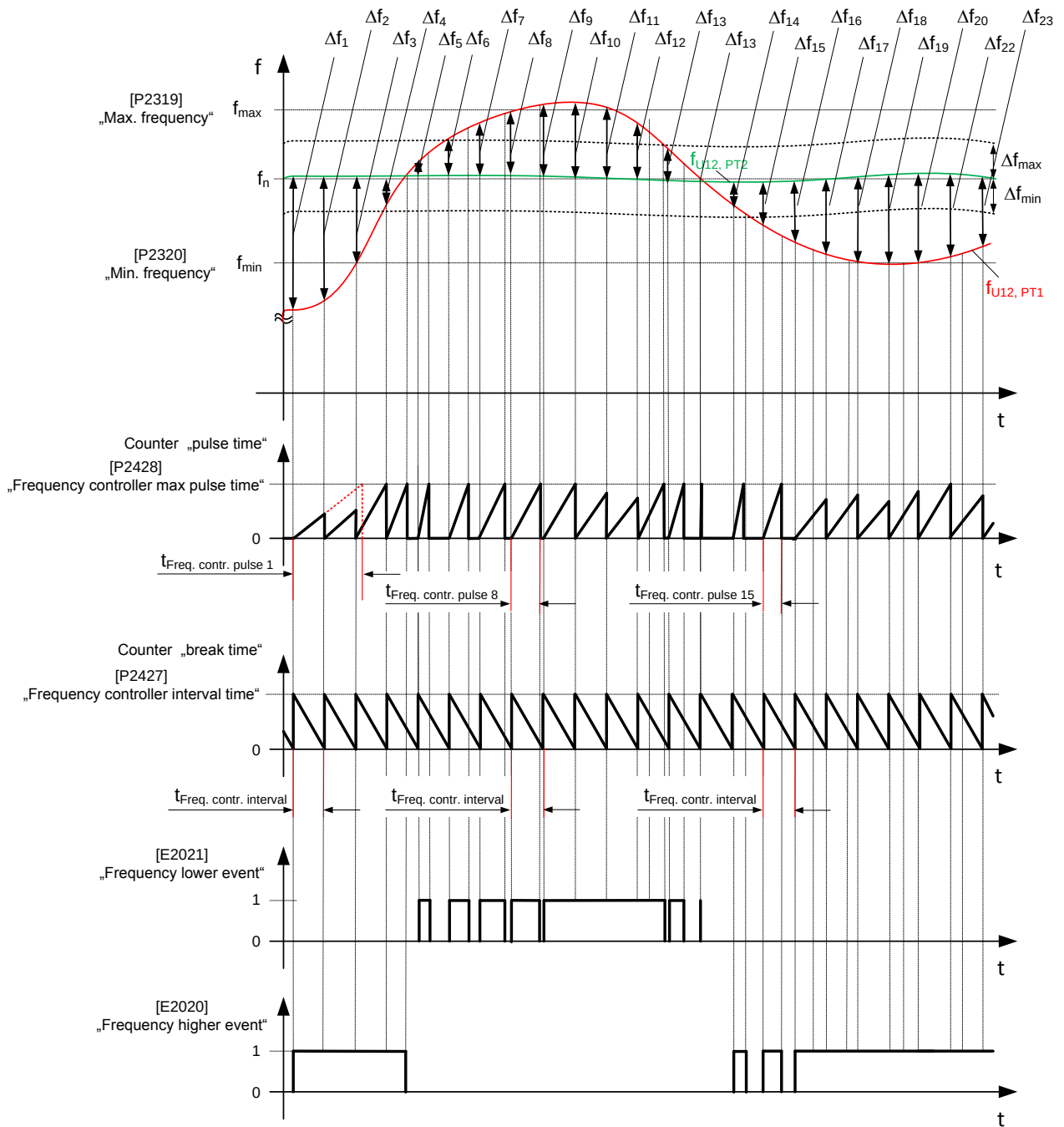


Figure 3-46 Function "Controller" – Frequency control

NOTE: In case that frequency of power system PT1 (generator) lies within the tolerance range set by Δf_{max} and Δf_{min} (parameters "Max. df " [P2323] and "Min df " [P2324]), "Frequency control" is blocked in order to avoid any overshoot of the control variable $f_{U12,PT1}$

P2427 Frequency controller interval time

Defined break time $t_{Freq. contr. interval}$ between the times of calculating the pulse times $t_{Freq. contr. pulse x_i}$; the break time always triggers the cyclic calculation of the pulse time, and restarts when it has run down (cyclical).

P2428 Frequency controller max pulse time

Fundamental value $T_{[P2428]}$ for calculating the pulse time $t_{Freq. contr. pulse x_i}$; while synchronizing, the fundamental value accords to a defined pulse time which is needed to

equalize 100% of frequency deviation referring to the nominal frequency f_n (see parameter "Nominal frequency" [P630]).

Frequency deviations less than 100% of nominal frequency f_n are being considered by individually calculated pulse times depending on the amount of the frequency difference Δf . As calculation approach, the ration of the pulse time $t_{\text{Freq. contr. pulse } x}$ to be calculated to the fundamental value $T_{[P2428]}$ is equated with the ration of the measured frequency difference $\Delta f[\text{Hz}]$ to the maximum frequency difference ($\Delta f_n[\%] = 100\% f_n$).

$$\begin{aligned} t_{\text{Freq. contr. pulse } x}[\text{s}] / T_{[P2428]}[\text{s}] &= \Delta f[\text{Hz}] / \Delta f_n[\text{Hz}] \\ &= \Delta f[\%] / 100\% \end{aligned}$$

Hence follows the formula for the calculated pulse time[s]:

$$\begin{aligned} \Rightarrow t_{\text{Freq. contr. pulse } x}[\text{s}] &= T_{[P2428]}[\text{s}] \times \Delta f[\%] / 100\% \\ &= \text{"Frequency controller max puls time"} [P2428] \times \Delta f[\%] / 100\% \end{aligned}$$

Example: Parameter "Frequency controller max puls time" [P2428] = 100 s (typical set value)

Determination of the control direction:

$$\Delta f[\text{Hz}] > 0$$

If the frequency difference Δf is positive ($f_{PT1} < f_{PT2}$), the frequency boost event "Frequency higher event" [E2020] is being activated for the duration of the calculated pulse time (RPM increase).

$$\Delta f[\text{Hz}] < 0$$

If the frequency difference Δf is negative ($f_{PT1} > f_{PT2}$), the frequency boost event "Frequency lower event" [E2021] is being activated for the duration of the calculated pulse time (RPM decrease).

Determination of the control speed:

$$\Delta f[\%] = 100\%$$

A frequency difference Δf between the generator system (PT1) and the busbar system (PT2) of 100% of the secondary nominal frequency (e.g. 50 Hz), set by parameter "Nominal frequency" [P630], will result in the calculated pulse time of: $t_{\text{Volt. contr. pulse } x}[\text{s}] = 100 \text{ s}$.

$$\Delta f[\%] = 1\%$$

A frequency difference Δf between the generator system (PT1) and the busbar system (PT2) of 1% of the secondary nominal frequency (e.g. 50 Hz), set by parameter "Nominal frequency" [P630], will result in the calculated pulse time of: $t_{\text{Volt. contr. pulse } x}[\text{s}] = 1 \text{ s}$.

NOTE: An activated control-event will only turn inactive, if the subsequent, calculated pulse time is below the set value of the set break time (parameter "Frequency controller intervall time" [P2427]) or if the control direction changes for the next calculated pulse time.

Phase angle control

For regulation of a *remaining phase angle difference* $\Delta\varphi$ between the voltage system of PT1 (generator) and the voltage system of PT2 (busbar) function "*Phase angle control*" can be activated. "*Phase angle control*" is initiated if:

- the *measured frequency difference* Δf is lower than the *maximum allowable frequency difference* $\Delta f_{\text{phase contr. max}}$, **and**
- the *measured phase angle difference* $\Delta\varphi$ is higher than the *maximum allowable phase angle difference* $\Delta\varphi_{\text{max}}$ bzw. $\Delta\varphi_{\text{min}}$.

As soon as "*Phase angle control*" is activated, "*Frequency control*" is being blocked. The *regulation of the phase angle* is done by the control of the motor RPM governor which is for changing the generator frequency. Thus, function "*Phase angle control*" operates the control-events "*Frequency higher event*" [E2020] and "*Frequency lower event*" [E2021], too.

The following figure shows as example the *interactions* between *frequency control* and *phase angle control* with the *implications for the control-events*

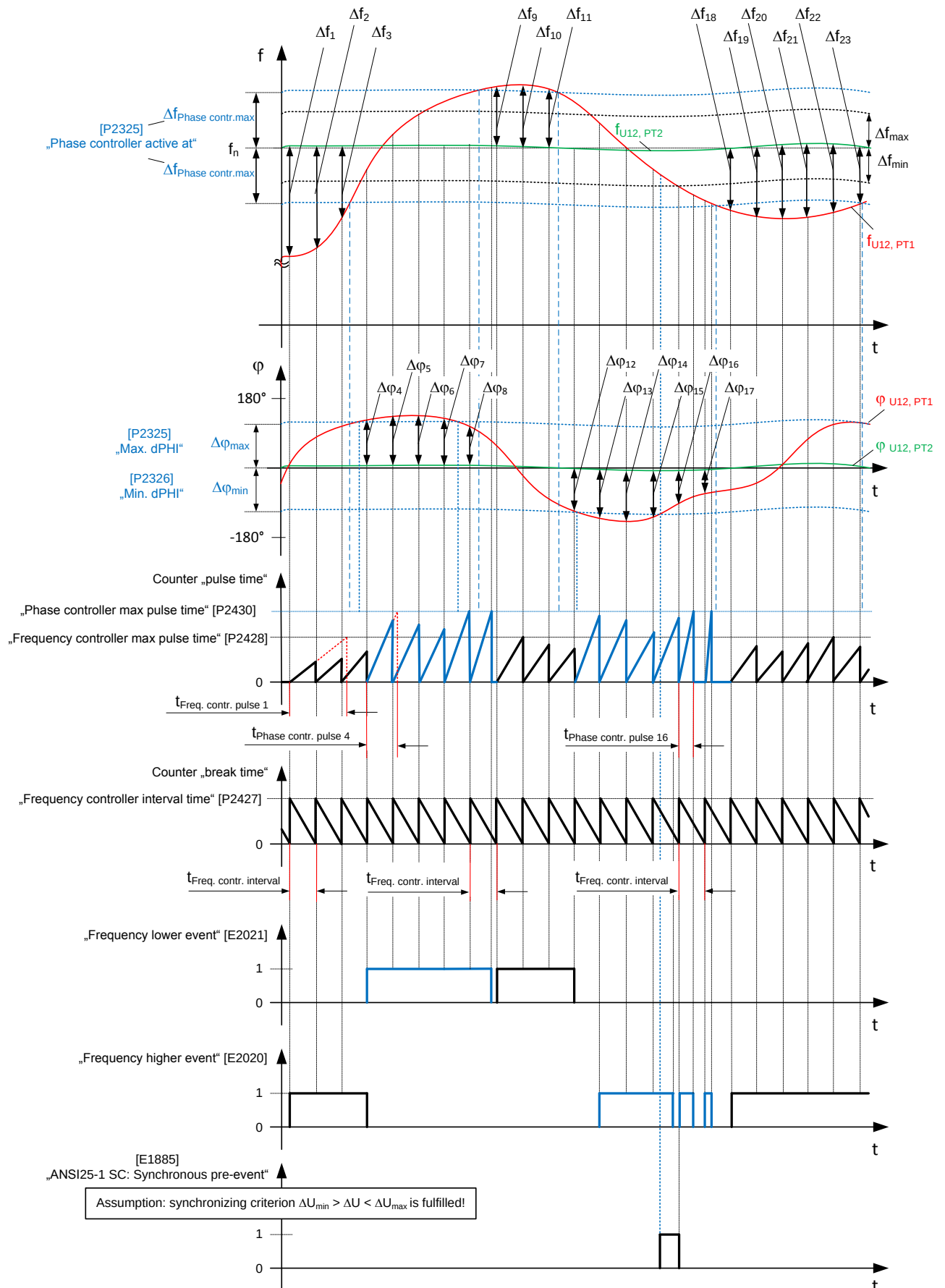


Figure 3-47 Function "Controller" – Phase angle control

P2429 Phase controller active at

Maximum limit of the frequency-difference-dependent phase angle control for power system PT1 (generator) by cyclically calculated pulse times for controlling the RPM governor (and thus, the frequency);

Function "Phase angle control" is initiated,

- if the set value of parameter "Phase controller active at" [P2429] is not equal to „0“, and
- as soon as the measured frequency difference Δf falls below the set value $\Delta f_{\text{phase contr. max}}$ of parameter "Phase controller active at" [P2429]

NOTE: For most applications it is useful to choose the same settings of parameters "Phase controller active at" [P2429] and "Max. dPHI" [P2325] respectively "Min. dPHI" [P2326]. So, it is granted that phase angle control should begin, if synchronizing criterion $\Delta f_{U12, PT1; U12, PT2} < \Delta f_{\text{max}}$ respectively $\Delta f_{U12, PT1; U12, PT2} < \Delta f_{\text{min}}$ is fulfilled.

As long as the phase angle control is activated, the frequency control is being deactivated. The corresponding control-event:

- "Frequency higher event" [E2020]: signal to external speed governor to increase RPM ($\Rightarrow$ Frequency increase) or
- "Frequency lower event" [E2021]: signal to external speed governor to decrease RPM ($\Rightarrow$ Frequency decrease)

is activated due to the cyclically calculated pulse times $t_{\text{phase contr. pulse x}}$ which depend on the set value of parameter "Phase controller max pulse time" [P2430].

As soon as the measured phase angle difference $\Delta\phi$ lies within the tolerance range ($\Delta\phi_{\text{max}}; \Delta\phi_{\text{min}}$) set by parameters „Max. dPHI" [P2325] and „Min. dPHI" [P2326], synchronizing criterion $\Delta\phi_{\text{min}} > \Delta\phi_{U12 PT1; U12 PT2} < \Delta\phi_{\text{max}}$ is fulfilled.

There are the following cases to differentiate:

1. For settings: $\Delta f_{\text{phase contr. max}} [P2429] > \Delta f_{\text{min}} [P2324]$ and $\Delta f_{\text{phase contr. max}} [P2429] > \Delta f_{\text{max}} [P2323]$ it is:
 - a. In case that at the time: $t = t[\Delta\phi_{\text{min}} > \Delta\phi_{U12 PT1; U12 PT2} < \Delta\phi_{\text{max}}]$ synchronizing conditions:
 - "synchronous frequencies": $\Delta f_{\text{min}} > \Delta f_{U12 PT1; U12 PT2} < \Delta f_{\text{max}}$ and
 - "synchronous voltages": $\Delta U_{\text{min}} > \Delta U_{12 PT1; PT2} < \Delta U_{\text{max}}$
 are fulfilled, synchronous-event "ANSI25-1 SC: Synchronous pre-event" [E1885] is activated, and – if parametrized – "Delay time" [P2328] for on-delayed activation of synchronous-event "ANSI25-1 SC: Synchronous" [E1886] is to be started.
 - b. In case that at the time: $t = t[\Delta\phi_{\text{min}} > \Delta\phi_{U12 PT1; U12 PT2} < \Delta\phi_{\text{max}}]$ only synchronizing condition:
 - synchronous voltages: $\Delta U_{\text{min}} > \Delta U_{12 PT1; PT2} < \Delta U_{\text{max}}$
 is fulfilled, activation of synchronous-event "ANSI25-1 SC: Synchronous pre-event" [E1885] and – if parametrized – the start of "Delay time" [P2328] for on-delayed activation of synchronous-event "ANSI25-1 SC: Synchronous" [E1886], is blocked.
 - c. In case that at the time: $t = t[\Delta\phi_{\text{min}} > \Delta\phi_{U12 PT1; U12 PT2} < \Delta\phi_{\text{max}}]$ only synchronizing condition:

- *synchronous frequencies*: $\Delta f_{min} > \Delta f_{U12 PT1; U12 PT2} < \Delta f_{max}$

is fulfilled, activation of synchronous-event “ANSI25-1 SC: Synchronous pre-event” [E1885] and – if parametrized – the start of “Delay time” [P2328] for on-delayed activation of synchronous-event “ANSI25-1 SC: Synchronous” [E1886], is blocked. Then, synchronizing procedure is to be continued by function “Voltage control” and/or “Frequency control”.

- d. In case that at the time: $t = t[\Delta\varphi_{min} > \Delta\varphi_{U12 PT1; U12 PT2} < \Delta\varphi_{max}]$ synchronous conditions:

- “synchronous frequencies”: $\Delta f_{min} > \Delta f_{U12 PT1; U12 PT2} < \Delta f_{max}$ and
- “synchronous voltages”: $\Delta U_{min} > \Delta U_{12 PT1; PT2} < \Delta U_{max}$

are not fulfilled, activation of synchronous-event “ANSI25-1 SC: Synchronous pre-event” [E1885] and – if parametrized – the start of “Delay time” [P2328] for on-delayed activation of synchronous-event “ANSI25-1 SC: Synchronous” [E1886], is blocked. Then, synchronizing procedure is to be continued by function “Voltage control”; synchronizing condition “synchronous frequencies” is not considered any more.

2. For setting: $\Delta f_{phase contr. max} [P2429] \leq \Delta f_{max} [P2323]$ it is:

- a. In case that at the time: $t = t[\Delta\varphi_{min} > \Delta\varphi_{U12 PT1; U12 PT2} < \Delta\varphi_{max}]$ synchronizing condition:

- “synchronous voltages”: $\Delta U_{min} > \Delta U_{12 PT1; PT2} < \Delta U_{max}$

is fulfilled, synchronous-event “ANSI25-1 SC: Synchronous pre-event” [E1885] is activated, and – if parametrized – “Delay time” [P2328] for on-delayed activation of synchronous-event “ANSI25-1 SC: Synchronous” [E1886] is to be started.

- b. In case that at the time: $t = t[\Delta\varphi_{min} > \Delta\varphi_{U12 PT1; U12 PT2} < \Delta\varphi_{max}]$ synchronizing condition:

- “synchronous voltages”: $\Delta U_{min} > \Delta U_{12 PT1; PT2} < \Delta U_{max}$

is not fulfilled, activation of synchronous-event “ANSI25-1 SC: Synchronous pre-event” [E1885] and – if parametrized – the start of “Delay time” [P2328] for on-delayed activation of synchronous-event “ANSI25-1 SC: Synchronous” [E1886], is blocked. Then, synchronizing procedure is to be continued by function “Voltage control” and/or “Frequency control”.

As soon as *measured frequency difference* Δf exceeds the set value of parameter „Phase controller active at“ [P2429], *phase angle control* is being deactivated. The *synchronizing procedure* is to be continued depending on the measuring values of process quantities, due to the above mentioned parameter settings.

If the application does not require function “frequency-difference-dependent phase angle control”, then set parameter „Phase controller active at“ [P2429] to “0”.

P2430 Phase controller max pulse time

Fundamental value $T_{[P2430]}$ for calculating the pulse time $t_{Phase contr. pulse x}$; while synchronizing, the fundamental value accords to a defined pulse time which is needed to equalize a maximum allowable phase angle deviation of 180°.

Phase angle deviations less than 180° are being considered by individually calculated pulse times depending on the amount of the *phase angle difference* $\Delta\varphi$. As calculation approach, the ration of the *pulse time* $t_{Phase contr. pulse x}$ to be calculated to the *fundamental value* $T_{[P2430]}$ is equated with the ration of the *measured phase angle difference* $\Delta\varphi[^\circ]$ to the *maximum phase angle difference* of 180°.

$$t_{Phase contr. pulse x}[s] / T_{[P1018]}[s] = \Delta\varphi[^\circ] / 180^\circ$$

Hence follows the formula for the calculated pulse time[s]:

$$\begin{aligned} \Rightarrow t_{\text{Phase contr. pulse x}}[\text{s}] &= T_{[\text{P1018}]}[\text{s}] \times \Delta\varphi[^\circ] / 180^\circ \\ &= \text{"Phase controller max pulse time"} [\text{P2430}] \times \Delta\varphi[^\circ] / 180^\circ \end{aligned}$$

Example: Parameter "Phase controller max pulse time" [P2430] = 0,5 s (typical set value)

Determination of the control direction:

$$\Delta\varphi[^\circ] > 0$$

If the phase angle difference $\Delta\varphi$ is *positive* ($\varphi_{\text{U12 PT1}} < \varphi_{\text{U12 PT2}}$), the frequency boost event "Voltage higher event" [E2022] is being activated for the duration of the calculated pulse time (RPM increase).

$$\Delta\varphi[^\circ] < 0$$

If the phase angle difference $\Delta\varphi$ is *negative* ($\varphi_{\text{U12 PT1}} > \varphi_{\text{U12 PT2}}$), the frequency boost event "Voltage lower event" [E2021] is being activated for the duration of the calculated pulse time (RPM decrease).

Determination of the control speed:

$$\Delta\varphi[^\circ] = 180^\circ$$

A phase angle difference $\Delta\varphi$ of 180° between the generator system (PT1) and the busbar system (PT2) will result in the calculated pulse time of:

$$t_{\text{Volt. contr. pulse x}}[\text{s}] = 0,25 \text{ s.}$$

$$\Delta\varphi[^\circ] = 36^\circ$$

A phase angle difference $\Delta\varphi$ of 36° between the generator system (PT1) and the busbar system (PT2) will result in the calculated pulse time of:

$$t_{\text{Volt. contr. pulse x}}[\text{s}] = 0,05 \text{ s.}$$

NOTE: An activated control-event will only turn inactive, if the subsequent, calculated pulse time is below the set value of the set break time (parameter "Frequency controller intervall time" [P2427]) or if the control direction changes for the next calculated pulse time.

Voltage regulation

As soon as synchronizing unit 1 is activated, *voltage control* is being activated independently of functions "*Frequency control*" and "*Phase angle control*". Function *voltage control* affects that three phase system, which is connected to PT1 (e.g. generator).

Function "*Voltage control*" of SYMAP®-Compact(+) is designed as a "three step control" including the output states: *voltage increase* and *voltage decrease*. For this, the following two control-events are provided:

- "*Voltage higher event*" [E2022]: signal to external voltage governor
(=>*Voltage increase*) and
- "*Voltage lower event*" [E2023]: signal to external voltage governor
(=>*Voltage decrease*)

Depending on the type of motor voltage governor the control events have to be assigned to:

- two different binary outputs of the SYMAP®-Compact(+) (*binary control*, e.g. for naval applications)

"*Voltage control*" is only effective, if voltage U_{PT1} of Power system PT1 lies within the tolerance range set by the set limits U_{min} and U_{max} .

REMARK: In view of the following statements the *momentary control deviation (voltage difference $\Delta U_{12 PT1; PT2}$)* is given as a *percentage $\Delta U[\%]$ of the nominal voltage U_n* set by parameter "*Voltage (L-L)*" [P603].

The procedure of voltage control is to be described as follows:

1. *Determination of the control direction: and control deviation $\Delta U[V]$:*
Depending on the circumstance, whether the voltage of power system PT1 (generator) is lower/higher than voltage of power system PT2 (busbar), *synchronizing unit 1* needs to *increase/decrease* the generator voltage.
The following rules apply:
 - a. $U_{PT1} < U_{PT2}$
The voltage of power system PT1 is lower than the voltage of power stem PT2 (reference system); according to the measuring algorithm $\Delta U_{12 PT1; PT2} = U_{12, PT2} - U_{12, PT1}$, it follows a positive sign for the calculated voltage difference:
 $\Delta U[V] > 0 \Rightarrow$ voltage increase!
 - b. $U_{PT1} > U_{PT2}$
The voltage of power system PT1 is higher than the voltage of power stem PT2 (reference system); according to the measuring algorithm $\Delta U_{12 PT1; PT2} = U_{12, PT2} - U_{12, PT1}$, it follows a negative sign for the calculated voltage difference:
 $\Delta U[V] < 0 \Rightarrow$ voltage decrease!

Determination of the control speed:

The speed of generator *voltage control* is proportional to the level of *control deviation $\Delta U[\%]$* . Depending on the amount of the control deviation $\Delta U[\%]$, so-called "*pulse times*" are being calculated. The *duration of one pulse time* is equal to the period of activation of the corresponding control-event which is to increase/decrease the generator voltage.

Pulse times are being recalculated right after the so-called "*break time*" has run down. The break time starts *cyclically* for a *duration* set by parameter "*Voltage controller interval time*" [P2431].

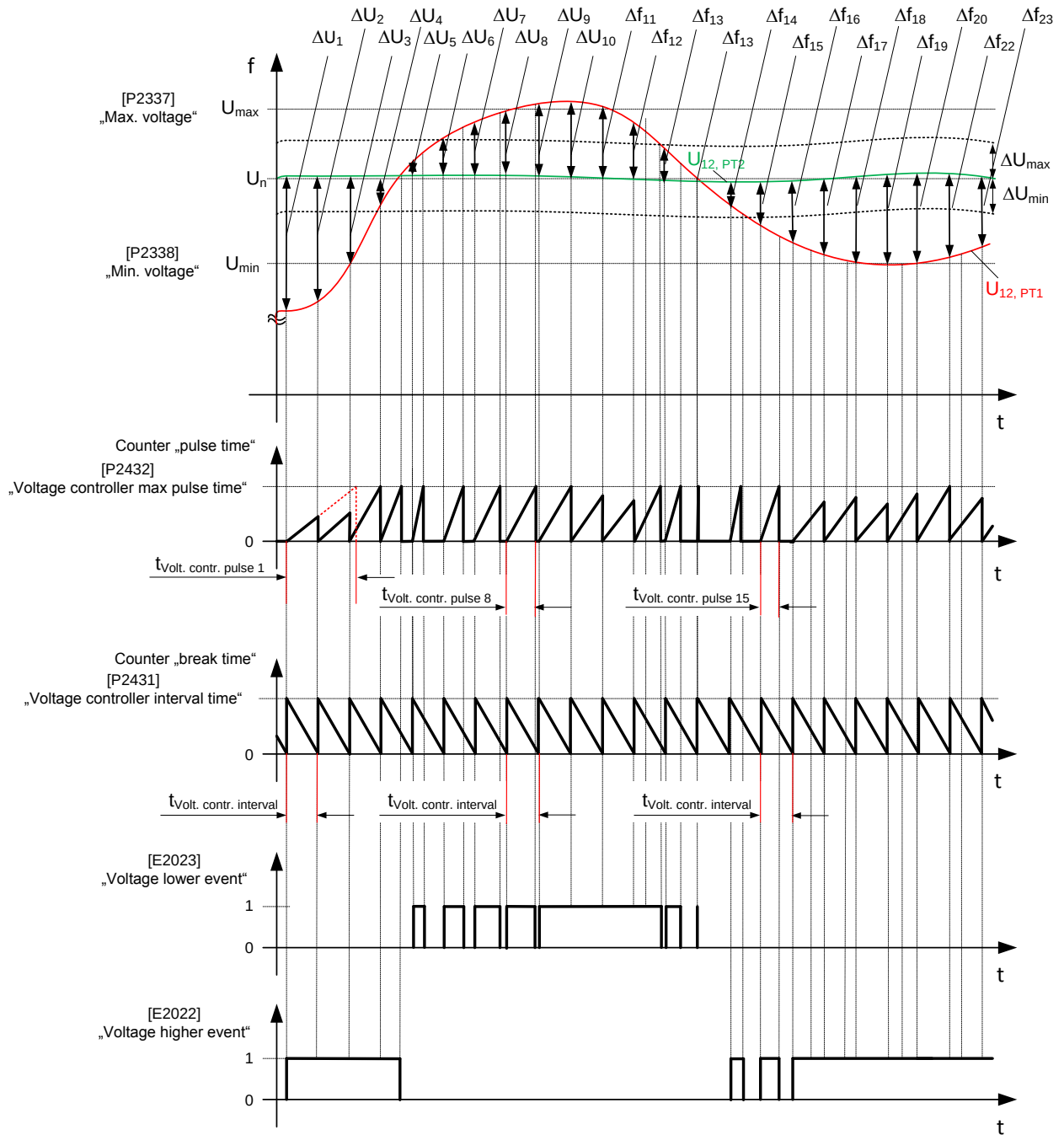


Figure 3-48 Function “Controller” – Voltage control

P2431 Voltage controller interval time

Defined break time $t_{\text{volt. contr. interval}}$ between the times of calculating the pulse times $t_{\text{volt. contr. pulse } x_i}$; the break time always triggers the cyclic calculation of the pulse time, and restarts when it has run down (cyclical).

P2432 Voltage controller max pulse time

Fundamental value $T_{[P2432]}$ for calculating the pulse time $t_{\text{freq. contr. pulse } x_i}$; while synchronizing, the fundamental value accords to a defined pulse time which is needed to equalize 100% of voltage deviation referring to the nominal voltage U_n .

Voltage deviations less than 100% of nominal voltage U_n are being considered by individually calculated pulse times depending on the amount of the voltage difference ΔU . As calculation approach, the ration of the pulse time $t_{\text{volt. contr. pulse } x}$ to be calculated to the fundamental value $T_{[P2432]}$ is equated with the ration of the measured voltage difference $\Delta U[\%]$ to the maximum voltage difference ($\Delta U_n[\%] = 100\% U_n$).

$$t_{\text{Volt.contr. pulse x}}[\text{s}] / T_{[\text{P2432}]}[\text{s}] = \Delta U[\text{V}] / \Delta U_n[\text{V}]$$

$$= \Delta U[\%] / 100\%$$

Hence follows the formula for the calculated pulse time[s]:

$$\Rightarrow t_{\text{Volt.contr. pulse x}}[\text{s}] = T_{[\text{P2432}]}[\text{s}] \times \Delta U[\%] / 100\%$$

$$= \text{"Voltage controller max puls time"} [\text{P2432}] \times \Delta U[\%] / 100\%$$

Example: Parameter "Voltage controller puls time" [P2432] = 10 s (typical set value)

Determination of the control direction:

$$\Delta U[\text{V}] > 0$$

If the voltage difference ΔU is positive ($U_{\text{PT1}} < U_{\text{PT2}}$), the voltage boost event "Voltage higher event" [E2022] is being activated for the duration of the calculated pulse time.

$$\Delta U[\text{V}] < 0$$

If the voltage difference ΔU is negative ($U_{\text{PT1}} > U_{\text{PT2}}$), the voltage boost event "Voltage lower event" [E2023] is being activated for the duration of the calculated pulse time.

Determination of the control speed:

$$\Delta U[\%] = 100\%$$

A voltage difference ΔU between the generator system (PT1) and the busbar system (PT2) of 100% of the secondary nominal voltage (e.g. 100V), set by parameter "Secondary" [P641], will result in the calculated pulse time of:

$$t_{\text{Volt.contr. pulse x}}[\text{s}] = 10 \text{ s.}$$

$$\Delta U[\%] = 1\%$$

A voltage difference ΔU between the generator system (PT1) and the busbar system (PT2) of 1% of the secondary nominal voltage (e.g. 100V), set by parameter "Secondary" [P641], will result in the calculated pulse time of:

$$t_{\text{Volt.contr. pulse x}}[\text{s}] = 0,1 \text{ s.}$$

NOTE: An activated control-event will only turn inactive, if the subsequent, calculated pulse time is below the set value of the set break time (parameter "Voltage controller interval time" [P2431]) or if the control direction changes for the next calculated pulse time.

3.5.3 ANSI 27 – Undervoltage Protection

Main Menu\ Parameters\PROTECTION\ANSI25-50/51\					
ANSI 27					
SET 1	SET 2	SET 3	SET 4		
P/E No.	Name		Value	Unit	(Setting range)
SET PARAMETERS					
P1050	Undervoltage protection		OFF	-	ON/OFF
P1051	Blocking protection module		0	event	0 ... 9999
P1052	Voltage reference		L-L	-	L-L/L-N
E1050	ANSI27 module active		-	-	-
E1051	ANSI27 blocked module		-	-	-
STEP 1					
P1056	Pick-up source		PT1	-	none/PT1/PT2/PT3
P1057	Blocking protection step		0	event	0 ... 9999
P1058	Min. start voltage		10	%	0 ... 200,0
P1059	Min. start frequency		10	Hz	0 ... 80,00
P1060	Limit		95	%	0 ... 200,0
P1061	Delay time		2	s	0 ... 999999,999
P1062	Reset limit		97	%	0 ... 200,0
P1063	Reset delay time trip		1	s	0 ... 999999,999
P1064	Reset delay time pick-up		1	s	0 ... 999999,999
E1054	ANSI27-1 step active		-	-	-
E1055	ANSI27-1 blocked step		-	-	-
E1056	ANSI27-1 blocked step by min. start voltage		-	-	-
E1057	ANSI27-1 blocked step by min. start frequency		-	-	-
E1058	ANSI27-1 pickup		-	-	-
E1059	ANSI27-1 trip		-	-	-
STEP 2					
P1068	Pick-up source		PT1	-	none/PT1/PT2/PT3
...	...		...	...	...

Figure 3-49 ANSI 27 – Protection parameters [P] and events [E] of SET 1

Parameter description:

The following parameter descriptions refer to all protection parameters of one parameter set.

NOTE: Each of the four parameter sets always provides the same group of protection parameters. Hence, the parameter descriptions of the SET PARAMETERS and the parameters of STEP 1 represented below are described in the following in detail as examples.

Protection parameters of parameter SET 1 – ANSI 27

SET PARAMETERS

The following SET PARAMETERS of the undervoltage protection exist only once in each of the four parameter sets. Thus, the SET PARAMETERS apply to all of the 12 protection STEPS of one parameter SET.

P1050. Undervoltage protection

This parameter enables/disables undervoltage protection wherein:

- “OFF”: disables or

- “ON”: enables the protective function.

NOTE: In case that no voltage measurement is possible, caused by locating the PTs below the circuit breaker, and which is open, then, undervoltage protection must be blocked by a suitable event. For this, the related number of such blocking event has to be assigned to parameter [P1051].

When undervoltage protection ANSI 27 is enabled by parameter [P1050], then event “*ANSI27 module active*” [E1050] is being activated.

P1051 Blocking protection module

Undervoltage protection can be completely blocked by any active event. For blocking, the number related to this blocking event has to be assigned to parameter [P1051]. Blocking is only effective, however, as long as the blocking event is active. As soon as blocking is active, event “*ANSI27 blocked module*” [E1050] is being activated. If the blocking event turns inactive, blocking is abandoned and protective function is effective again. Then, event [E1050] is being deactivated automatically.

If blocking of the undervoltage protection is not required, set this parameter to “0”.

P1052 Voltage reference

Reference value of protection set values for the undervoltage protection module; the settings of parameters “Limit” and “Reset limit” can be assigned by the following setting options either:

- “L-L”: to *phase-to-phase voltage* U_{L-L} as characteristic quantity or
- “L-N”: to *phase-to-neutral voltage* U_{L-N} as characteristic quantity.

Protection parameters of STEP 1

The following STEP parameters of the undervoltage protection exist only once in each of the 12 independent protection STEPS. Thus, the SET PARAMETERS apply only to one of the 12 protection STEPS of one parameter SET.

P1056 Pick-up source

Depending on the SYMAP[®]-Compact(+) device variant every protection step of undervoltage protection can be assigned to a certain voltage measurement input (PT1, PT2 or PT3). Parameter [P1056] determines the voltage measurement input which will provide measurement values as characteristic quantities (voltage) to the undervoltage protection:

- “none”: no voltage measurement; protection step is deactivated
- “PT1”: voltage input PT1
- “PT2”: voltage input PT2
- “PT3”: voltage input PT3

For settings “PT1”, “PT2” or “PT3”, event “*ANSI27-1 step active*” [E1054] is being activated.

P1057 Blocking protection step

The first step of undervoltage protection can be blocked by any active event. For blocking, the number related to this blocking event has to be assigned to parameter [P1057]. Blocking is only effective, however, as long as the blocking event is active. As soon as blocking is active, event “*ANSI27-1 blocked step*” [E1055] is being activated. If the blocking event turns inactive, blocking is abandoned and protective function is effective again. Then, event [E1055] is being deactivated automatically.

If blocking of the first step of undervoltage protection is not required, set this parameter to "0".

P1058 Min. start voltage

Minimum limit of the measuring voltage to activate undervoltage protection; the first protection step of undervoltage protection is blocked as long as the measured value of the characteristic quantity (voltage) remains below this minimum setting at least in one phase. For the duration of blocking event "ANSI27-1 blocked step by min. start voltage" [E1056] is activated.

NOTE: The *minimum limit of measuring voltage* is to be set as a percentage of the *nominal value* of the characteristic quantity (phase-to-phase voltage). The nominal value of the characteristic quantity is to be set by parameter:

- "Voltage (L-L)" [P603], for primary side W1 or
- "Voltage (L-L)" [P613], for secondary side W2 or
- "Voltage (L-L)" [P623], for tertiary side W3.

The referring parameters "Voltage (L-L)" [P603], "Voltage (L-L)" [P613] and "Voltage (L-L)" [P623] are located in submenu: "SYSTEM\Nominals\Reference values".

P1059 Min. start frequency

The first protection step of undervoltage protection is blocked as long as the measured frequency remains below this minimum setting. For the duration of blocking event "ANSI27-1 blocked step by min. start frequency" [E1057] is activated.

P1060 Limit

Pick-up value of the first undervoltage protection element. At the moment that the characteristic quantity (voltage) falls below this limit, pick-up event "ANSI27-1 pickup" [E1058] will become active, and the trip delay time ("Delay time") of the first undervoltage protection element will start.

NOTE: The *pick-up value* is to be set as a percentage of the *nominal value* of the chosen characteristic quantity (phase-to-phase voltage or phase-to-neutral voltage) by parameter "Voltage reference" [P1052]. However, the chosen characteristic value refers to the nominal value of the phase-to-phase voltage to be set by parameter:

- "Voltage (L-L)" [P603], for primary side W1 or
- "Voltage (L-L)" [P613], for secondary side W2
- "Voltage (L-L)" [P623], for tertiary side W3.

Hence, in case that the calculation of the *pick-up value* refers to the phase-to-neutral voltage, parameter "Voltage reference" [P1052] is to be set to "L-N", so that factor $\sqrt{3}$ is not necessary to be considered for calculation.

The referring parameters "Voltage (L-L)" [P603], "Voltage (L-L)" [P613] and "Voltage (L-L)" [P623] are located in submenu: "SYSTEM\Nominals\Reference values".

P1061 Delay time

Trip delay time; it is the delay time of the trip event "ANSI27-1 trip" [E1059]. As soon as the pick-up event "ANSI27-1 pickup" [E1058] is active and "Delay time" run down, trip event [E1059] will be activated. This event can be used for alarm or output control purposes.

In case that the characteristic quantity (voltage) exceeds the pick-up value ("Limit") of the first undervoltage protection step before the trip delay time ("Delay time") has run down, the timer of "Delay time" will be stopped and the counter value is being saved. If the characteristic quantity subsequently exceeds the "Reset limit", then, the "Reset delay time pick-up" timer will start and the pick-up event [E1058] will be deactivated.

P1063 Reset delay time pick-up

Pick-up reset delay time; it is the delay time for resetting the trip delay time ("Delay time").

As soon as the pick-up reset delay time ("Reset delay time pick-up") has run down the counter of the trip delay time ("Delay time") is being reset.

P1062 Reset limit

Reset limit of the first step of undervoltage protection. As soon as the trip event "ANSI27-1 trip" [E1059] is active and the characteristic quantity (voltage) exceeds the "Reset limit", the timer of the trip reset delay time ("Reset delay time trip") will start.

NOTE: The *reset limit* is to be set as a percentage of the *nominal value* of the chosen characteristic quantity (phase-to-phase voltage or phase-to-neutral voltage) by parameter "*Voltage reference*" [P1052]. However, the chosen characteristic value refers to the nominal value of the phase-to-phase voltage to be set by parameter:

- "*Voltage (L-L)*" [P603], for primary side W1 or
- "*Voltage (L-L)*" [P613], for secondary side W2
- "*Voltage (L-L)*" [P623], for tertiary side W3.

Hence, in case that the calculation of the *pick-up value* refers to the phase-to-neutral voltage, parameter "*Voltage reference*" [P1052] is to be set to "*L-N*", so that factor $\sqrt{3}$ is not necessary to be considered for calculation.

The referring parameters "*Voltage (L-L)*" [P603], "*Voltage (L-L)*" [P613] and "*Voltage (L-L)*" [P623] are located in submenu: "SYSTEM\Nominals\Reference values".

P1063 Reset delay time trip

Trip reset delay time; it is the delay time for resetting the trip event "ANSI27-1 trip" [E1059].

If the trip reset delay time ("Reset delay time trip") has run down, trip event "ANSI27-1 trip" [E1059] is being deactivated. In case that the characteristic quantity (voltage) falls below the pick-up value ("limit") of the first undervoltage protection element before the timer of "Reset delay time trip" has run down, the timer of "Reset delay time trip" will be reset. Then trip event "ANSI27-1 trip" [E1059] remains active.

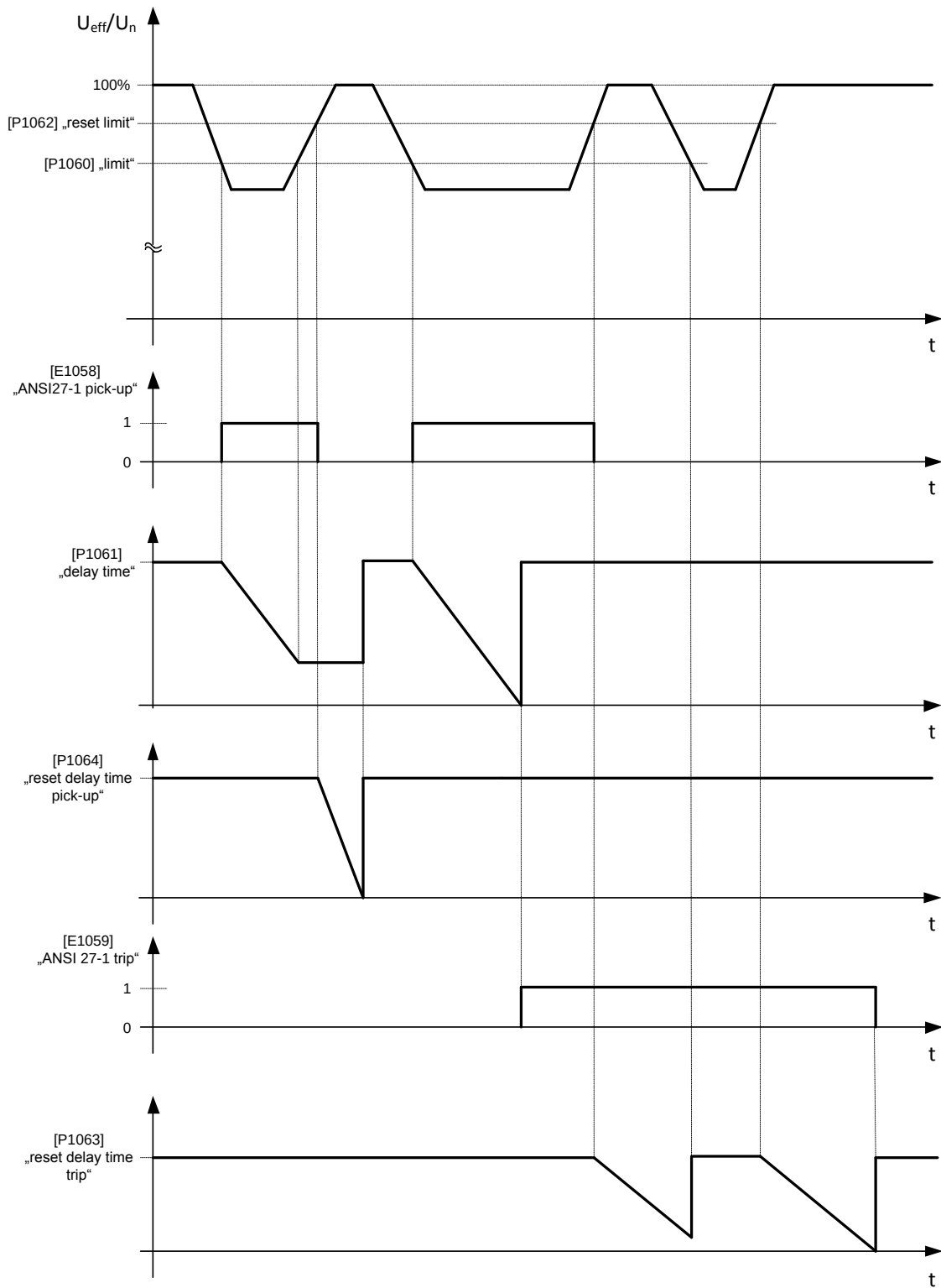


Figure 3-50 Undervoltage – Tripping and reset characteristic

3.5.4 ANSI 27Q – Undervoltage-/Reactive power protection

More and more distributed energy resources (DER) are fitted in the MV grid. The amount of controllable power reserve (active and inductive reactive power) by means of large-scale conventional plants is decreasing. Reactive power is used to maintain mains voltage stability. Faults in the grid, increasing load with reactive power requirements and changes within the network may lead to mains voltage drops.

In the event of serious voltage drops in several grid sections, such voltage instability may cause a collapse of the mains voltage by means of cutting the power supply ("blackout").

Protection equipment is of considerable importance for secure and reliable operation of networks, connection facilities and generating plants. National grid codes and regulations require that DER units feeding into MV grid have to support the mains voltage of a network failure. Therefore, the purpose of voltage and frequency protection units at machine level is to disconnect the generating units from the grid in case of faults. If a voltage drop and a inductive, reactive power flow in the direction towards the generating unit are detected at the network connection point simultaneously, then first, the affected generating unit will be switched off (disconnecting the generator circuit breaker). After an unsuccessful attempt to disconnect the generating unit, the whole DER plant will be switched off by the circuit breaker at the network connection point.

As far as the *disconnection of the affected generating unit* (generator circuit breaker) from the medium voltage network bases on one of the following protective functions:

- Undervoltage protection ($U <$, $U < <$) **or**
- Overvoltage protection ($U >$, $U > >$) **or**
- Under frequency protection ($f <$, $f < <$) **or**
- Overfrequency protection ($f >$, $f > >$)

Reclosing of the generating unit CB shall take place only if:

- the *mains voltage* is above a given minimum limit **and**
- the *mains frequency* is within a given value range.

Here, the mains voltage may not necessarily measured at the network connection point. According to the above mentioned protective functions, *reclosing of the generator CB* shall only take place after a certain, given period of time (release signal for reclosing the generator CB).

In so far as the *DER is disconnected from the grid* at the network connection point, the individual generating units are shut down, too. Consequently, *reclosing of the CB at the network connection point* does not require any mains voltage measurement. Reclosing is done manually.

- "Transmission Code 2007, Network and System Rules of the German Transmission System Operators, Version 1.1, August 2007, from the German Electricity Association (VDEW) and Association of network operator (VDN), see chapter 3.3.13.5 (6)"
- "Technical Guideline for Connection and parallel Operation of Power Generation Plants at the Medium Voltage Grid, June 2008, Federal Association of the Energy and Water Industry - BDEW, see chapter 3.2.3.2 – Reactive power-Undervoltage protection Q&U<"
- "Specification sheet Reactive power-Undervoltage protection, February 2010, Grid technology/grid operation forum (FNN) of VDE"

This U<& Q> protection is an upstream system protection. This U<& Q> protection function is implemented in the SYMAP[®]-Compact(+) devices as an autonomous protection element according to the above mentioned German regulations.

Main Menu\ Parameters\PROTECTION\ANSI25-50/51\				
ANSI 27Q				
SET 1	SET 2	SET 3	SET 4	
P/E No.	Name	Value	Unit	(Setting range)
GLOBAL				
P1580	QU-protection	OFF	-	ON/OFF
P1581	Blocking protection module	0	event	0 ... 9999
P1582	Pickup source	Power_CT1	-	POWER_CT1/Power_CT2
P1583	Reference arrow system	LRAS	-	LRAS/GRAS
PICKUP				
P1585	Voltage limit	85	%	0 ... 100,0
P1586	Current limit	10	%	0 ... 20,0
P1587	Reactive power limit	5	%	0 ... 10,0
P1589	1. delay time	1	s	0 ... 999999,999
P1590	2. delay time	1,5	s	0 ... 999999,999
P1591	1. reset delay time (1st trip)	1	s	0 ... 999999,999
P1592	2. reset delay time (2nd trip)	1,5	s	0 ... 999999,999
RECLOSING				
P1595	Voltage limit	95	%	0 ... 100,0
P1596	Min. frequency	47,5	Hz	0 ... 80,0
P1597	Max. frequency	50,5	Hz	0 ... 80,0
P1598	Delay time	2	s	0 ... 999999,999
P1599	External voltage release event	0	event	0 ... 9999
P1600	Reclosing trigger event 1	0	event	0 ... 9999
P1601	Reclosing trigger event 2	0	event	0 ... 9999
P1602	Reclosing trigger event 3	0	event	0 ... 9999
P1603	Reclosing trigger event 4	0	event	0 ... 9999
P1604	Reclosing trigger event 5	0	event	0 ... 9999
P1605	Reclosing trigger event 6	0	event	0 ... 9999
P1606	Reclosing trigger event 7	0	event	0 ... 9999
P1607	Reclosing trigger event 8	0	event	0 ... 9999
P1608	Reclosing trigger event 9	0	event	0 ... 9999
P1609	Reclosing trigger event 10	0	event	0 ... 9999
P1610	Reclosing trigger event 11	0	event	0 ... 9999
P1611	Reclosing trigger event 12	0	event	0 ... 9999
P1612	Reclosing trigger event 13	0	event	0 ... 9999
P1613	Reclosing trigger event 14	0	event	0 ... 9999
P1614	Reclosing trigger event 15	0	event	0 ... 9999
P1615	Reclosing trigger event 16	0	event	0 ... 9999
E1405	ANSI27Q module active	-	-	-
E1406	ANSI27Q blocked module	-	-	-
E1408	ANSI27Q pickup	-	-	-
E1409	ANSI27Q 1st trip	-	-	-
E1410	ANSI27Q 2nd trip	-	-	-
E1412	ANSI27Q voltage reclosing limit reached	-	-	-
E1413	ANSI27Q reclosing release	-	-	-

Figure 3-51 ANSI 27Q – Protection parameters [P] and events [E] of SET 1

Parameter description:

The following parameter descriptions refer to all protection parameters of one parameter set.

NOTE: Each of the four parameter sets always provides only one protection STEP and, as consequence, only one group of parameters. Thus, SET PARAMETERS are equal to STEP parameters. The protection parameters of SET 1 represented below are described in the following in detail as examples.

Protection parameters of parameter of SET 1 – ANSI 27Q

P1580 QU- protection

This parameter enables/disables undervoltage-/reactive power protection wherein:

- “OFF”: disables or
- “ON:” enables the protective function.

NOTE: In case that no voltage measurement is possible, caused by locating the PTs below the circuit breaker, and which is open, then, undervoltage-/reactive power protection must be blocked by a suitable event. For this, the related number of such blocking event has to be assigned to parameter [P1581].

When undervoltage-/reactive power protection ANSI 27Q is enabled by parameter [P1535], then event “ANSI27Q module active” [E1405] is being activated.

P1581 Blocking protection module

Undervoltage-/reactive power protection can be completely blocked by any active event. For blocking, the number related to this blocking event has to be assigned to parameter [P1536]. Blocking is only effective, however, as long as the blocking event is active. As soon as blocking is active, event “ANSI27Q blocked module” [E1406] is being activated. If the blocking event turns inactive, blocking is abandoned and protective function is effective again. Then, event [E1406] is being deactivated automatically.

If blocking of the undervoltage-/reactive power protection is not required, set this parameter to “0”.

P1582 Pick-up source

Depending on the SYMAP®-Compact(+) device variant undervoltage/reactive power protection can be assigned to a certain current measurement input (CT1 or CT2 – if available) and subsequently to a certain voltage measurement input (PT1, PT2 or PT3). Hence, parameter [P1582] determines the power measurement input which will provide measurement values to build the characteristic quantity (reactive power) of the undervoltage/reactive power protection:

- “Power_CT1”: current measurement by CT1 and voltage measurement by the assigned voltage transformer (PT1, PT2 or PT3)
- “Power_CT2”: current measurement by CT2 and the assigned voltage measurement input (PT1, PT2 or PT3)

NOTE: The assignment of the voltage measurement input (PT1, PT2 or PT3) to the current measurement input CT1 or CT2 is to be done by the following parameters (referring to the setting options of parameter [P1582]), in the submenu “SYSTEM\Nominals\Measuring”:

- “PT reference” [P9410], for “Power_CT1” and
- “PT reference” [P9413], for “Power_CT2”

To measure *positive sequence reactive power direction* correctly, the needed *energy flow direction* is to be defined by following parameters:

- “*Direction*” [P9411], for “Power_CT1” and
- “*Direction*” [P9414], for “Power_CT2”.

P1583 Reference arrow system

This parameter determines whether the undervoltage/reactive power protection working principle is regarded from the point of view of a utility, then the “Load reference arrow system (LRAS)” must be applied. If ANSI27Q shall operate from a viewpoint of a generator operator, the “Generator reference system (GRAS)” should have been applied. The adaption of the protective function to the required working principle can be selected by the following adjustment options.

- “LARS”: protection trip, if reactive power measurement value is positive ($Q_1 > 0$)
(*Load Reference Arrow System*)
- “GRAS”: protection trip, if reactive power measurement value is negative ($Q_1 < 0$)
(*Generator Reference Arrow System*)

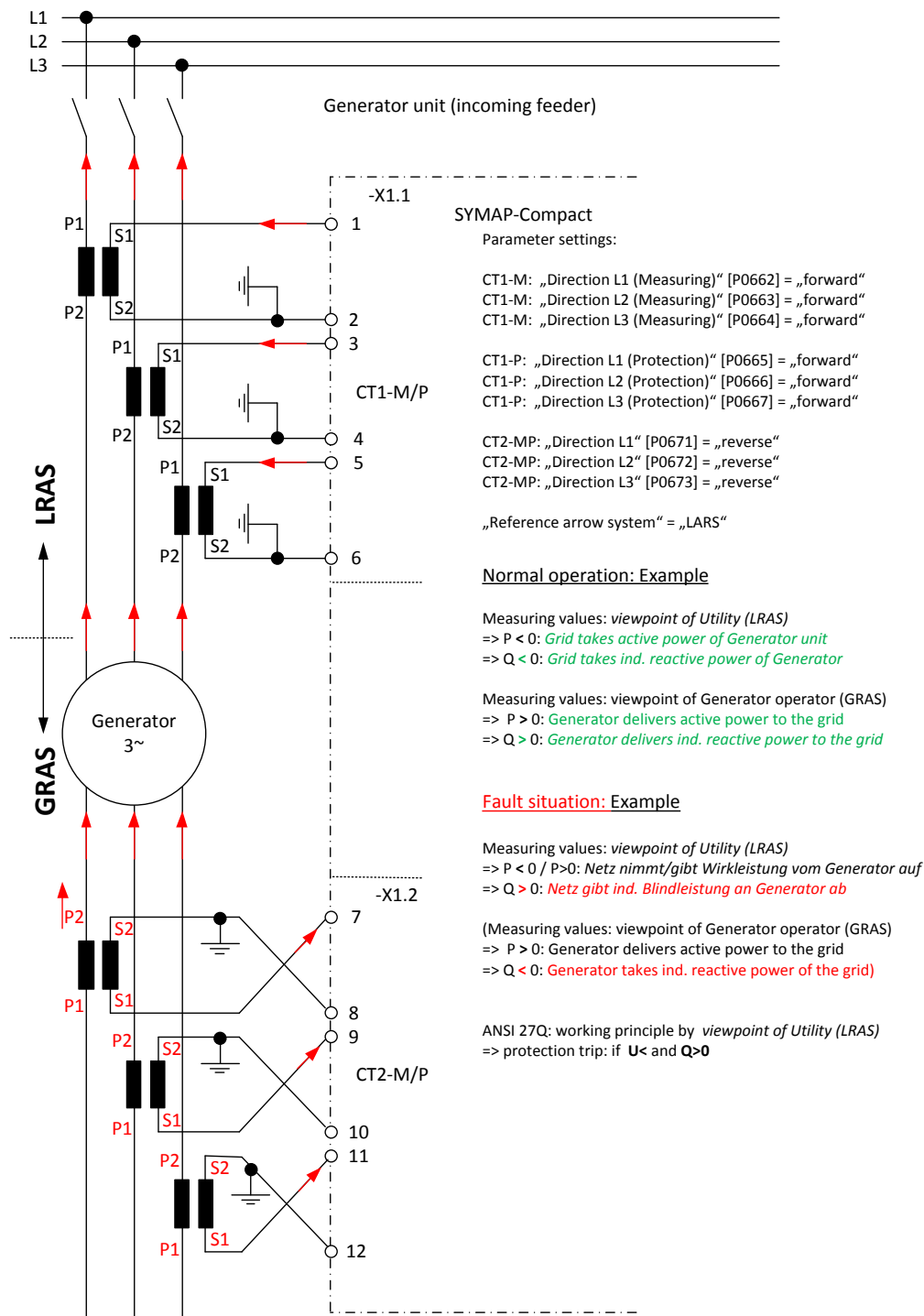


Figure 3-52 ANSI 27Q – Connection example and definition of load flow direction

Parameters for mains decoupling (PICK-UP)

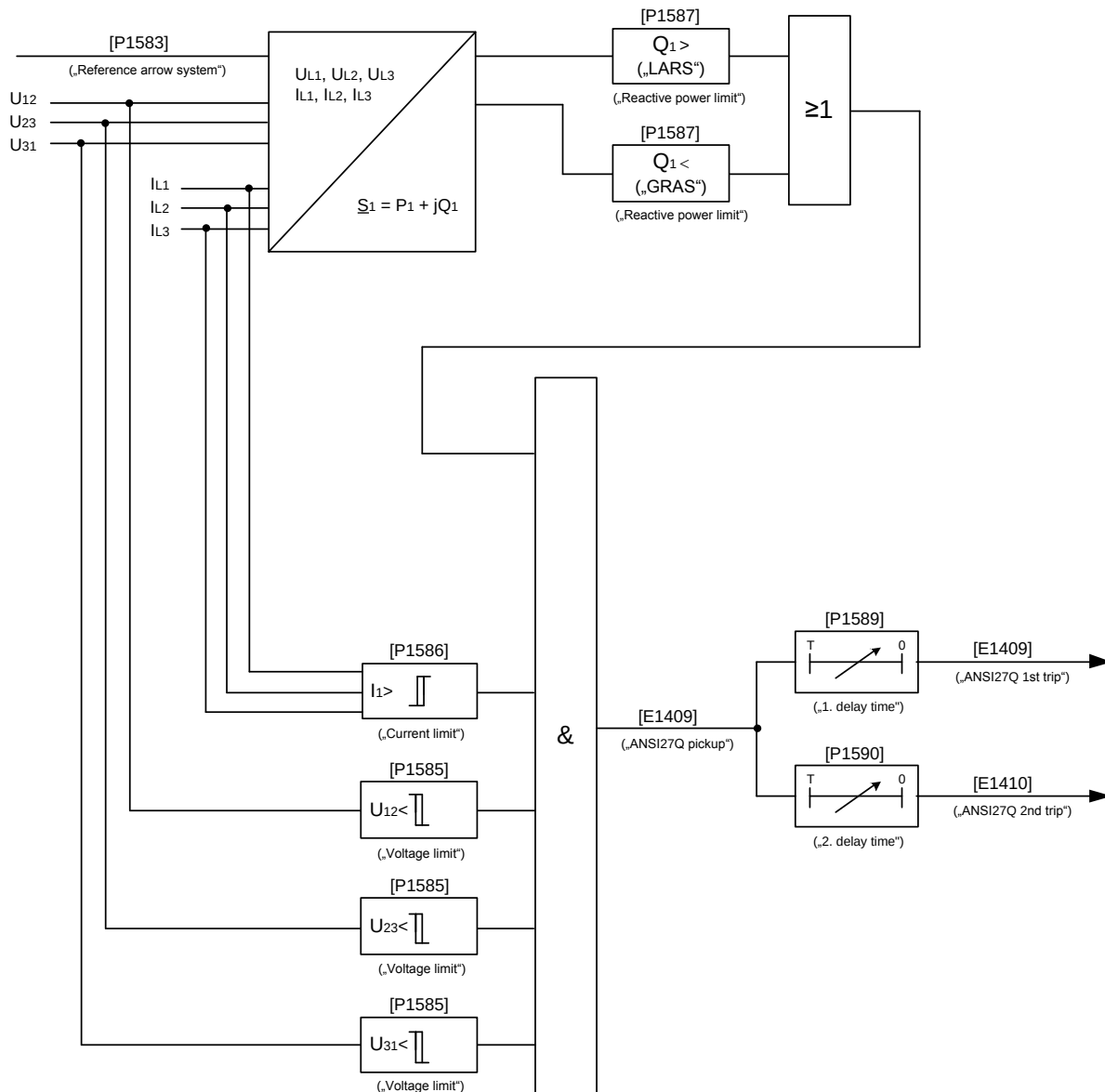


Figure 3-53 ANSI 27Q – Working priciple of Undervoltage-/Reactive power protection

P1585 Voltage limit

Pick-up value of the characteristic quantity “phase-to-phase voltage” of the undervoltage/reactive power protection function. As soon as

- all measured values of the characteristic quantity “phase-to-phase voltage” falls below the set value of parameter “*Voltage limit*“ [P1585] **and**
- the measured value of the characteristic quantity “positive sequence current I_1 “ (release current) exceeds the set value of parameter “*Current limit*“ [P1586] **and**
- the measured value of the characteristic quantity “positive sequence reactive power Q_1 “ falls below (“*Reference arrow system*“ [P1583] = “GRAS”) or exceeds (“*Reference arrow system*“ [P1583] = “LRAS”) the set value of parameter “*Reactive power limit*“ [P1587],

then, the pick-up event “ANSI27Q pickup“ [E1408] is being activated, and the counters of “1st delay time“ and “2nd delay time“ are being started. As soon as one of the above

mentioned conditions becomes untrue, pick-up event "ANSI27Q pickup" [E1408] will be deactivated.

NOTE: The "voltage limit" is to be set as a percentage of the *nominal value* of the characteristic quantity (phase-to-phase voltage). The nominal value of the characteristic quantity is to be set by parameter:

- "Voltage (L-L)" [P603], for primary side W1 or
- "Voltage (L-L)" [P613], for secondary side W2 or
- "Voltage (L-L)" [P623], for tertiary side W3.

The referring parameters "Voltage (L-L)" [P603], "Voltage (L-L)" [P613] and "Voltage (L-L)" [P623] are located in submenu: "SYSTEM\Nominals\Reference values".

P1586 Current limit

Pick-up value of the characteristic quantity "positive sequence current I_1 " of the undervoltage/reactive power protection function. As soon as

- all measured values of the characteristic quantity "phase-to-phase voltage" falls below the set value of parameter "Voltage limit" [P1585] **and**
- the measured value of the characteristic quantity "positive sequence current I_1 " (release current) exceeds the set value of parameter "Current limit" [P1586] **and**
- the measured value of the characteristic quantity "positive sequence reactive power Q_1 " falls below ("Reference arrow system" [P1583] = "GRAS") or exceeds ("Reference arrow system" [P1583] = "LRAS") the set value of parameter "Reactive power limit" [P1587],

then, the pick-up event "ANSI27Q pickup" [E1408] is being activated, and the counters of "1st delay time" and "2nd delay time" are being started. As soon as one of the above mentioned conditions becomes untrue, pick-up event "ANSI27Q pickup" [E1408] will be deactivated.

NOTE: The *current limit* is to be set as a percentage of the *nominal value* of the characteristic quantity (phase current). The nominal value of the characteristic quantity is to be set by parameter:

- "Current" [P604], for primary side W1 or
- "Current" [P614], for secondary side W2 or
- "Current" [P624], for tertiary side W3.

The referring parameters "Current" [P604], "Current" [P614] and "Current" [P624] are located in submenu: "SYSTEM\Nominals\Reference values".

P1587 Reactive power limit

Pick-up value of the characteristic quantity "positive sequence reactive power Q_1 " of the undervoltage/reactive power protection function. As soon as

- all measured values of the characteristic quantity "phase-to-phase voltage" falls below the set value of parameter "Voltage limit" [P1585] **and**
- the measured value of the characteristic quantity "positive sequence current I_1 " (release current) exceeds the set value of parameter "Current limit" [P1586] **and**
- the measured value of the characteristic quantity "positive sequence reactive power Q_1 " falls below ("Reference arrow system" [P1583] = "GRAS") or exceeds ("Reference arrow system" [P1583] = "LRAS") the set value of parameter "Reactive power limit" [P1587],

then, the pick-up event “ANSI27Q pickup” [E1408] is being activated, and the counters of “1st delay time” and “2nd delay time” are being started. As soon as one of the above mentioned conditions becomes untrue, pick-up event “ANSI27Q pickup” [E1408] will be deactivated.

NOTE: The *reactive power limit* is to be set as a percentage of the *nominal value* of the characteristic quantity (according to user’s input either as active power, reactive power or apparent power). The nominal value of the characteristic quantity is to be set by parameter:

- “Power” [P605], for primary side W1 or
- “Power” [P615], for secondary side W2.

Here, it is that winding side relating to the *directional reactive power monitoring*, which is assigned to the applied current measurement input by parameter

- „Assignment“ [P668], for current measurement input CT1 or
- „Assignment“ [P674], for current measurement input CT2.

The referring parameters “Power” [P605] and “Power” [P615] are located in submenu: “SYSTEM\Nominals\Reference values”.

The referring parameters “Assignment” [P668] and “Assignment” [P674] are located in submenu: “SYSTEM\Nominals\Current transformer”.

P1589 1. delay time

First trip delay time; it is the delay time of the trip event “ANSI27 1st trip” [E1409]. As soon as the pick-up event “ANSI27Q pickup” [E1408] is active and “1. delay time” run down, trip event [E1409] will be activated. This event can be used for alarm or output control purposes, e.g. to switch of the generator circuit breaker (generating unit).

P1590 2. delay time

Second trip delay time; it is the delay time of the trip event “ANSI27 2nd trip” [E1410]. As soon as the pick-up event “ANSI27Q pickup” [E1408] is active and “2. delay time” run down, trip event [E1410] will be activated. This event can be used for alarm or output control purposes, e.g. to switch of the circuit breaker at the network connection point (mains).

P1591 1. reset delay time (1st trip)

First trip reset delay time, it is the delay time for resetting the trip event “ANSI27 1st trip” [E1409]. As soon as the pick-up event “ANSI27Q pickup” [E1408] is being deactivated, and trip event “ANSI27Q 1st trip” [E1409] is activated, then the counter of “2 reset delay time (1st trip)” will start. If the “1. reset delay time (1st trip)” has run down, trip event “ANSI27Q 1st trip” [E1409] is being deactivated. In case that the pick-up “ANSI27Q pickup” [E1408] becomes active before the *first trip reset delay time* has run down, then counter “1. reset delay time (1st trip)” will be reset immediately.

P1592 2. reset delay time (2nd trip)

Second trip reset delay time, it is the delay time for resetting the trip event “ANSI27 2nd trip” [E1410]. As soon as the pick-up event “ANSI27Q pickup” [E1408] is being deactivated, and trip event “ANSI27Q 2nd trip” [E1410] is activated, then the counter of “2. reset delay time (2nd trip)” will start. If the “2. reset delay time (2nd trip)” has run down, trip event “ANSI27Q 2nd trip” [E1410] is being deactivated. In case that the pick-up “ANSI27Q pickup” [E1408] becomes active before the *second trip reset delay time* has run down, then counter “2. reset delay time (2nd trip)” will be reset immediately.

Reclosing parameters (RECLOSING)

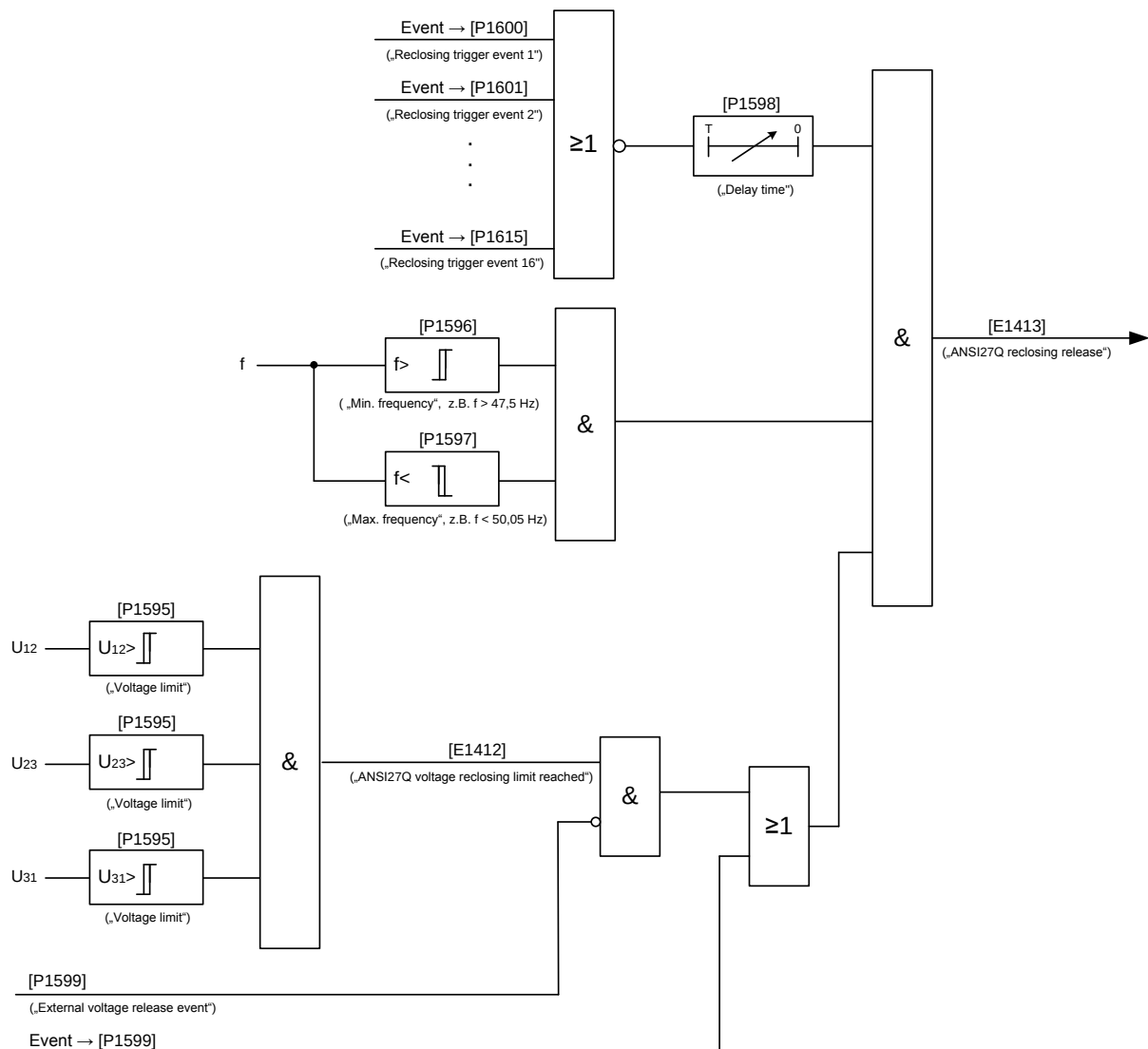


Figure 3-54 ANSI 27Q –Working principle of reclosing

P1595 Voltage limit

Minimum limit of measuring voltage at the network connection point; as soon as all three “phase-to-phase voltages” exceeds the set value of parameter “Voltage limit” [P1595], event “ANSI27Q voltage reclosing limit reached” [E1412] will be activated. This event, generated at the network connection point, can be used as an enable signal to be forwarded to protective devices of the generating units for reclosing purposes.

NOTE: Parameter [P1595] can be used to generate event “ANSI27Q voltage reclosing limit reached” [E1412] if the SYMAP®-Compact(+) is located at the network connection point. Hence, no external enable signal is necessary, since it is generated by the internal voltage monitoring function of SYMAP®-Compact(+).

NOTE: The *minimum limit of measuring voltage* is to be set as a percentage of the *nominal value* of the characteristic quantity (phase-to-phase voltage). The nominal value of the characteristic quantity is to be set by parameter:

- “Voltage (L-L)” [P603], for primary side W1 or
- “Voltage (L-L)” [P613], for secondary side W2 or

- “Voltage (L-L)” [P623], for tertiary side W3.

The referring parameters “Voltage (L-L)” [P603], “Voltage (L-L)” [P613] and “Voltage (L-L)” [P623] are located in submenu: “SYSTEM\Nominals\Reference values”.

P1596 Min. frequency

Minimum frequency value; it is needed to generate the reclosing release signal. Parameter [P1596] is to be set as an absolute value.

P1597 Max. frequency

Maximum frequency value; it allows the generation of the reclosing release signal. Parameter [P1597] is to be set as an absolute value.

P1598 Delay time

Reclosing delay time; this parameter set the delay time between voltage restoration and reclosing.

When all the trip events assigned to parameters [P1600] to [P1615] are deactivated, then the time counter of the *reclosing delay time* (“delay time”) is being started.

If the *reclosing delay time* has run down and all other conditions for reclosing (see block diagram) are fulfilled, then event “ANSI27Q reclosing release” [E1413] is being activated.

NOTE: As long as one of the trip events assigned to parameters [P1600] to [P1615] is activated, reclosing release is blocked by means of deactivating event “ANSI27Q reclosing release” [E1413].

P1599 External voltage release event

If the SYMAP®-Compact(+) uses an external enable signal for reclosing purposes, then the event number (e.g. of a binary input; in case that the signal was connected to a binary input) will have to be assigned to parameter “External voltage release event” [E1599].

P1600 Reclosing trigger event 1

This parameter specifies the trip event which triggers the protective relay for decoupling. For this, the event number of this trip event has to be assigned to parameter [P1600]. If the assigned trigger event becomes active the counter of the *reclosing delay time* (“delay time” between voltage restoration and reclosing release) will be reset and event “ANSI27Q reclosing release” [E1413] is being deactivated.

NOTE: SYMAP®-Compact(+) is able to consider up to 16 different trigger events. For this, parameters “Reclosing trigger event 1” [P1600] to “Reclosing trigger event 16” [P1615] are available.

P1601 Reclosing trigger event 2

See description of parameter [P1600]

P1602 Reclosing trigger event 3

See description of parameter [P1600]

P1603 Reclosing trigger event 4

See description of parameter [P1600]

P1604 Reclosing trigger event 5

See description of parameter [P1600]

P1605 Reclosing trigger event 6

See description of parameter [P1600]

P1606 Reclosing trigger event 7

See description of parameter [P1600]

P1607 Reclosing trigger event 8

See description of parameter [P1600]

P1608 Reclosing trigger event 9

See description of parameter [P1600]

P1609 Reclosing trigger event 10

See description of parameter [P1600]

P1610 Reclosing trigger event 11

See description of parameter [P1600]

P1611 Reclosing trigger event 12

See description of parameter [P1600]

P1612 Reclosing trigger event 13

See description of parameter [P1600]

P1613 Reclosing trigger event 14

See description of parameter [P1600]

P1614 Reclosing trigger event 15

See description of parameter [P1600]

P1615 Reclosing trigger event 16

See description of parameter [P1600]

3.5.5 ANSI 27T – Undervoltage Protection; time-dependent

According to the German Energy and Water Association (“Bundesverband der Energie- und Wasserwirtschaft e.V. BDEW”) directive on connection and parallel operation of power plants in medium-voltage grids (“Erzeugungsanlagen am Mittelspannungsnetz (Richtlinie für Anschluss und Parallelbetrieb von Erzeugungsanlagen am Mittelspannungsnetz)”), power plants being operated in parallel to operator’s medium-voltage grids have to meet certain requirements of grid support.

As far as their protection devices are concerned, such power plants shall, in case of voltage drop, contribute to grid support and thus not be disconnected from the grid. Conventional under voltage protection can thus not necessarily be used.

The time-dependent undervoltage relay ANSI 27T as used in the SYMAP®-Compact(+) fully meets the above mentioned requirement. The trigger characteristic can be freely defined by parameterizing to up to 10 characteristic points. Due to this feature, the user may configure several different time-dependent trigger areas. The number of tolerated brief voltage drops (**Number of blocked voltage drops**) can be set by parameter and is acquired by a counter. Maximum duration of counting (**Time slot for voltage drops count**) can be set.

Trigger characteristic is activated (Start of functional timer) as soon as the low limit pick-up setting for under voltage (**Activate Limit**) is fallen below and will be reset (Stop of functional timer) if grid voltage exceeds the reset value (**Reactivate limit**) for a settable duration (**Reactivate delay time**).

Protection triggering depends on the situation in the grid. Generally, two situations can be differentiated:

- 1st case: Grid voltage falls below the low trigger value set in the characteristic curve and triggers a **time-dependent** protection
- 2nd case: The counted value is exceeded and triggers an immediate time-independent protection

After the counter attains the set value, the characteristic curve will not be reset and the subsequent voltage drop triggers a protection depending on the characteristic curve.

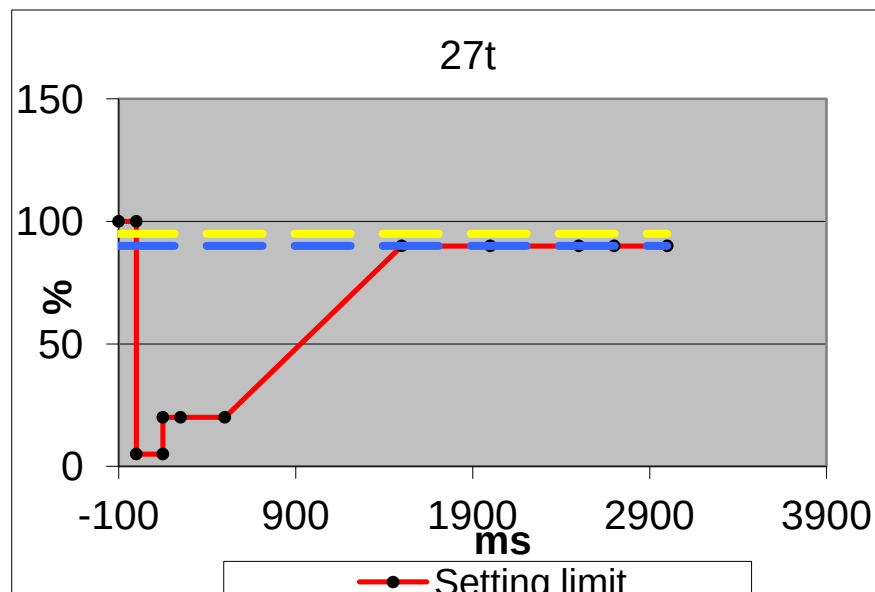


Figure 3-55 ANSI 27T – Configurable trip curve

Main Menu\ Parameters\PROTECTION\ANSI25-50/51\					
ANSI 27T					
SET 1	SET 2	SET 3	SET 4		
P/E No.	Name		Value	Unit	(Setting range)
GLOBAL					
P1475	Time dependent undervoltage protection		OFF	-	ON/OFF
P1476	Blocking protection		0	event	0 ... 9999
P1477	Pickup source		PT1	-	PT1/PT2/PT3
P1478	Number of blocked voltage drops		2	-	0 ... 10
P1479	Time slot for voltage drops count		2	s	0 ... 999999,999
P1483	Activate limit		95	%	0 ... 200,0
P1484	Reactivate limit		97	%	0 ... 200,0
P1485	Reactivate delay time		2	s	0 ... 999999,999
CURVE SETTINGS					
P1487	1. Curve limit		95	%	0 ... 200,0
P1488	1. Curve time		2	s	0 ... 999999,999
P1489	2. Curve limit		95	%	0 ... 200,0
P1490	2. Curve time		2	s	0 ... 999999,999
P1491	3. Curve limit		95	%	0 ... 200,0
P1492	3. Curve time		2	s	0 ... 999999,999
P1493	4. Curve limit		95	%	0 ... 200,0
P1494	4. Curve time		2	s	0 ... 999999,999
P1495	5. Curve limit		95	%	0 ... 200,0
P1496	5. Curve time		2	s	0 ... 999999,999
P1497	6. Curve limit		95	%	0 ... 200,0
P1498	6. Curve time		2	s	0 ... 999999,999
P1499	7. Curve limit		95	%	0 ... 200,0
P1500	7. Curve time		2	s	0 ... 999999,999
P1501	8. Curve limit		95	%	0 ... 200,0
P1502	8. Curve time		2	s	0 ... 999999,999
P1503	9. Curve limit		95	%	0 ... 200,0
P1504	9. Curve time		2	s	0 ... 999999,999
P1505	10. Curve limit		95	%	0 ... 200,0
P1506	10. Curve time		2	s	0 ... 999999,999
E1350	ANSI27T module active		-	-	-
E1351	ANSI27T blocked module		-	-	-
E1352	ANSI27T reactivate limit reached		-	-	-
E1353	ANSI27T activate limit reached		-	-	-
E1354	ANSI27T pickup		-	-	-
E1355	ANSI27T trip		-	-	-
E1356	ANSI27T trip by voltage drops count		-	-	-
E1357	ANSI27T trip by curve underrun		-	-	-

Figure 3-56 ANSI 27T – Protection parameters [P] and events [E] of SET 1

Parameter description:

The following parameter descriptions refer to all protection parameters of one parameter set.

NOTE: Each of the four parameter sets always provides only one protection STEP and, as consequence, only one group of parameters. Thus, SET PARAMETERS are equal to STEP parameters. The protection parameters of SET 1 represented below are described in the following in detail as examples.

Protection parameters of parameter of SET 1 – ANSI 27T

P1475 Time dep. Undervoltage protection

This parameter enables/disables time-dependent undervoltage protection wherein:

- “OFF”: disables or
- “ON”: enables the protective function.

NOTE: In case that no voltage measurement is possible, caused by locating the PTs below the circuit breaker, and which is open, then, time-dependent undervoltage protection must be blocked by a suitable event. For this, the related number of such blocking event has to be assigned to parameter [P1051].

When time-dependent undervoltage protection ANSI 27T is enabled by parameter [P1475], then event “ANSI27T module active” [E1350] is being activated.

P1476 Blocking protection

Time-dependent undervoltage protection can be completely blocked by any active event. For blocking, the number related to this blocking event has to be assigned to parameter [P1476]. Blocking is only effective, however, as long as the blocking event is active. As soon as blocking is active, event “ANSI27T module active” [E1351] is being activated. If the blocking event turns inactive, blocking is abandoned and protective function is effective again. Then, event [E1351] is being deactivated automatically.

If blocking of the time-dependent undervoltage protection is not required, set this parameter to “0”.

P1477 Pick-up source

Depending on the SYMAP®-Compact(+) device variant every protection step of time-dependent undervoltage protection can be assigned to a certain voltage measurement input (PT1, PT2 or PT3). Parameter [P1477] determines the voltage measurement input which will provide measurement values as characteristic quantities (voltage) to the time-dependent undervoltage protection:

- “PT1”: voltage input PT1
- “PT2”: voltage input PT2
- “PT3”: voltage input PT3

P1478 Number of blocked voltage drops

Parameter [P1478] indicates the number of tolerable pick-up events “ANSI27T pick-up” [E1354] (recognized voltage drops).

P1483 Activate limit

Pick-up value for voltage drop; if the characteristic quantity (voltage) falls below the “Activate limit” [P1483], pick-up event “ANSI27T pick-up” [E1354] is activated and the functional timer starts. Simultaneously, the timer for counting the voltage drops (“Time slot for voltage drops count”) is being started, and the pick-up event counter (voltage drops counter) is incremented.

NOTE: The *pick-up value for voltage drop* is to be set as a percentage of the *nominal value* of the characteristic quantity (phase-to-phase voltage). The nominal value of the characteristic quantity is to be set by parameter:

- “Voltage (L-L)” [P603], for primary side W1 or
- “Voltage (L-L)” [P613], for secondary side W2 or
- “Voltage (L-L)” [P623], for tertiary side W3.

The referring parameters “*Voltage (L-L)*” [P603], “*Voltage (L-L)*” [P613] and “*Voltage (L-L)*” [P623] are located in submenu: “SYSTEM\Nominals\Reference values”.

P1479 Time slot for voltage drops count

Parameter [P1479] indicates the maximum period in which the pick-up events are counted. The “*Time slot for voltage drops count*” starts with the first pick-up event “*ANSI27T pick-up*” [E1354] for the time set in parameter [P1479]. In case that:

- the number of tolerable voltage drops is exceeded (*voltage drops count*) or
- the *duration of a tolerable voltage drop exceeds the maximum permissible period of a voltage drop according to the trip curve (voltage underrun)*,

then, the trip-event “*ANSI27T trip*” [E1355] is being activated, so too does either:

- event “*ANSI27T trip by voltage drop count*” [E1356] or
- event “*ANSI27T trip by voltage underrun*” [E1357].

Also the “*Time slot for voltage drops count*” is being reset. In case that there is no further voltage drop, the attained value for counted voltage drops will be set to zero after the expiry of the “*Time slot for voltage drops count*”.

P1484 Reactivate limit

Reset limit for voltage drops; if the characteristic quantity (voltage) exceeds this limit, pick-up reset event “*ANSI27T reactive limit reached*” [E1352] is activated and the counter for *pick-up reset delay time* (“*Reactive delay time*”) will start.

NOTE: The *reset limit for voltage drops* is to be set as a percentage of the *nominal value* of the characteristic quantity (phase-to-phase voltage). The nominal value of the characteristic quantity is to be set by parameter:

- “*Voltage (L-L)*” [P603], for primary side W1 or
- “*Voltage (L-L)*” [P613], for secondary side W2 or
- “*Voltage (L-L)*” [P623], for tertiary side W3.

The referring parameters “*Voltage (L-L)*” [P603], “*Voltage (L-L)*” [P613] and “*Voltage (L-L)*” [P623] are located in submenu: “SYSTEM\Nominals\Reference values”.

P1485 Reactivate delay time

Pick-up reset delay time; if characteristic quantity (voltage) exceeds the value set in parameter “*Reactivate limit*” [P1484], the *pick-up reset delay time* will start. After the set time [P1485] has expired, the functional timer is stopped, and the pick-up event “*ANSI27T pick-up*” [E1354] is being deactivated. So too, does a possible active trip-event “*ANSI27T trip*” [E1355].

In dependence of the trip cause:

- exceeding the *tolerable number* of voltage drops (*voltage drops count*) or
- exceeding the *permissible duration* of a tolerable voltage drop (*voltage underrun*),

the event:

- “*ANSI27T trip by voltage drop count*” [E1356] or
- “*ANSI27T trip by voltage underrun*” [E1357]

is being deactivated.

P1487 1. curve limit

First limit value of trip curve at the moment of pick-up ($t=0$)

P1488 1. curve time

Moment of second limit value of the trip curve

P1489 2. curve limit

Second limit value of the trip curve

P1490 2. curve time

Moment of second limit value of the trip curve

P1491 3. curve limit

Third limit value of the trip curve

P1492 3. curve time

Moment of third limit value of the trip curve

P1493 4. curve limit

Fourth limit value of the trip curve

P1494 4. curve time

Moment of fourth limit value of the trip curve

P1495 5. curve limit

Fifth limit value of the trip curve

P1496 5. curve time

Moment of fifth limit value of the trip curve

P1497 6. curve limit

Sixth limit value of the trip curve

P1498 6. curve time

Moment of sixth limit value of the trip curve

P1499 7. curve limit

Seventh limit value of the trip curve

P1500 7. curve time

Moment of seventh limit value of the trip curve

P1501 8. curve limit

Eights limit value of the trip curve

P1502 8. curve time

Moment of eighth limit value of the trip curve

P1503 9. curve limit

Ninth limit value of the trip curve

P1504 9. curve time

Moment of ninth limit value of the trip curve

P1505 10. curve limit

Tenth limit value of the trip curve

P1506 10. curve time

Moment of tenth limit value of the trip curve

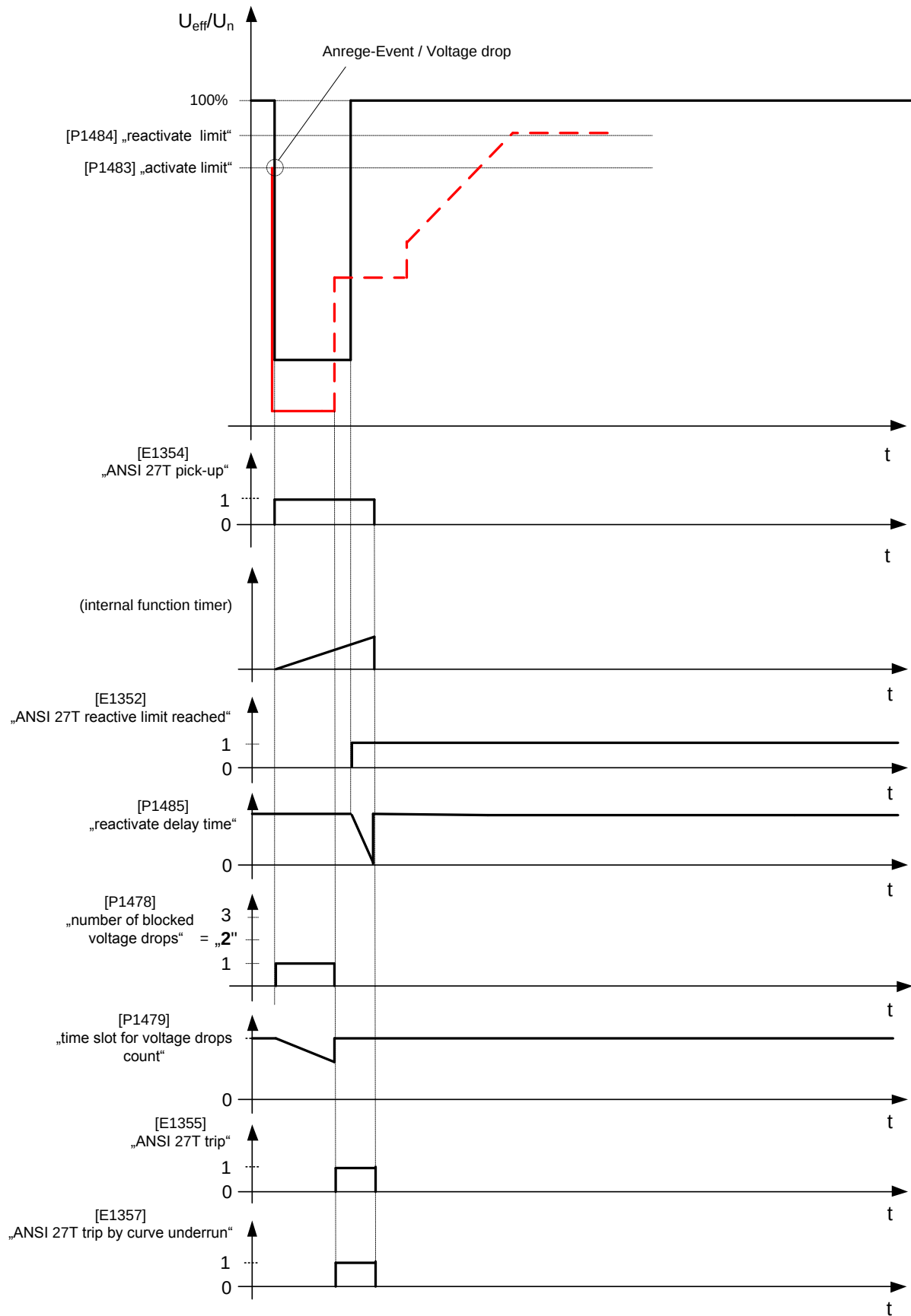


Figure 3-57 Time-dependent protection trip

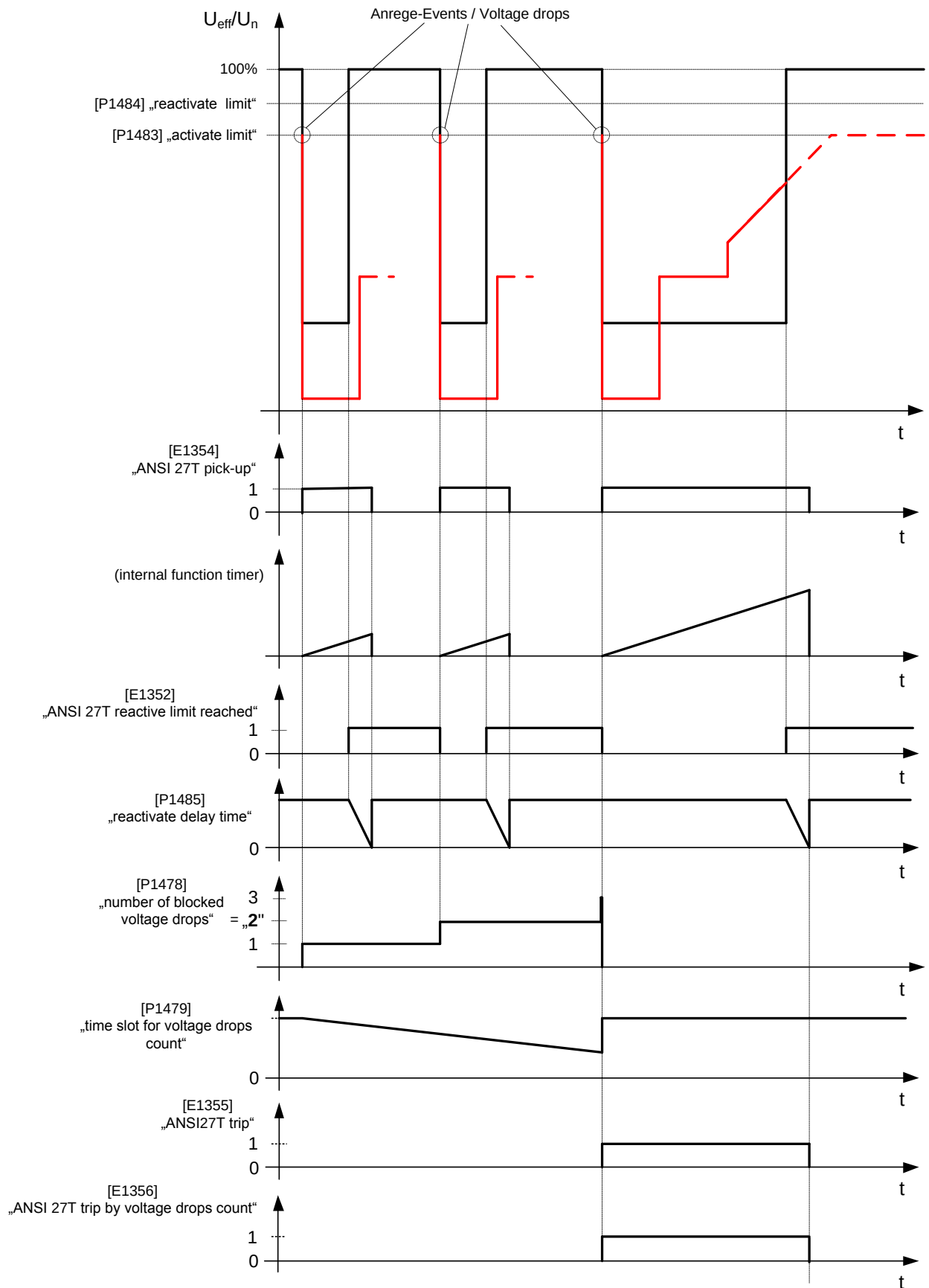


Figure 3-58 Time-independent protection trip

3.5.6 ANSI 32 – Directional Power Protection

Main Menu\ Parameters\PROTECTION\ANSI25-50/51\					
ANSI 32					
SET 1	SET 2	SET 3	SET 4		
P/E No.	Name		Value	Unit	(Setting range)
SET PARAMETERS					
P2240	Power protection		ON	-	ON/OFF
P2241	Blocking protection module		0	event	0 ... 9999
E1805	ANSI32 module active		-	-	-
E1806	ANSI32 blocked module		-	-	-
STEP 1					
P2245	Pickup source		Power_CT1	-	none/Power_CT1/Power_CT2
P2246	Blocking protection step		0	event	0 ... 9999
P2247	Mode		Qr>	-	S</S>/P</P>/Q</Q>/Pr</Pr>/Qr</Qr>
P2248	Limit		30	%	0 ... 65535,0
P2249	Delay time		0,5	s/-	0 ... 999999,999
P2250	Reset limit		27	%	0 ... 65535,0
P2251	Reset delay time trip		1	s/-	0 ... 999999,999
P2252	Reset delay time pickup		1	s	0 ... 999999,999
E1807	ANSI32-1 step active		-	-	-
E1808	ANSI32-1 blocked step		-	-	-
E1809	ANSI32-1 pickup		-	-	-
E1810	ANSI32-1 trip		-	-	-
STEP 2					
P2255	Pickup source		Power_CT1	-	none/Power_CT1/Power_CT2
...	...		...	...	...

Figure 3-59 ANSI 32 – Protection parameters [P] and events [E] of SET 1

Parameter description:

The following parameter descriptions refer to all protection parameters of one parameter set.

NOTE: Each of the four parameter sets always provides the same group of protection parameters. Hence, the parameter descriptions of the SET PARAMETERS and the parameters of STEP 1 represented below are described in the following in detail as examples.

Protection parameters of parameter SET 1 – ANSI 32

SET PARAMETERS

The following SET PARAMETERS of the directional power protection exist only once in each of the four parameter sets. Thus, the SET PARAMETERS apply to all of the 6 protection STEPS of one parameter SET.

P2240 Power protection

This parameter enables/disables directional power protection wherein:

- “OFF”: disables or
- “ON”: enables the protective function.

When overcurrent protection ANSI 32 is enabled by parameter [P2240], then event “ANSI32 module active” [E1805] is being activated.

P2241 Blocking protection module

Directional power protection can be completely blocked by any active event. For blocking, the number related to this blocking event has to be assigned to parameter [P2241]. Blocking is only effective, however, as long as the blocking event is active. As soon as blocking is active, event *"ANSI32 blocked module"* [E1806] is being activated. If the blocking event turns inactive, blocking is abandoned and protective function is effective again. Then, event [E1806] is being deactivated automatically.

If blocking of the directional power protection is not required, set this parameter to "0".

Protection parameters of STEP 1

The following STEP parameters of the directional power protection exist only once in each of the 6 independent protection STEPS. Thus, the SET PARAMETERS apply only to one of the 6 protection STEPS of one parameter SET.

P2245 Pick-up source

Depending on the SYMAP®-Compact(+) device variant every protection step of directional power protection can be assigned to a certain current measurement input (CT1 or CT2). Parameter [P2245] determines the current measurement input which will provide measurement values as characteristic quantities to the directional power protection:

- "none": no current measurement; protection step is deactivated
- "Power_CT1": measurement values by CT1, and the assigned voltage transformer
- "Power_CT2": measurement values by CT2, and the assigned voltage transformer

NOTE: The assignment of the voltage measurement input (PT1, PT2 or PT3) to the current measurement input CT1 or CT2 is to be done by the following parameters (referring to the setting options of parameter [P1582]), in the submenu "SYSTEM\Nominals\Measuring":

- "PT reference" [P9410], for "Power_CT1" and
- "PT reference" [P9413], for "Power_CT2"

To measure *power direction* correctly, the needed *energy flow direction* is to be defined by following parameters:

- "Direction" [P9411], for "Power_CT1" and
- "Direction" [P9414], for "Power_CT2".

For settings "Power_CT1" or "Power_CT2", event *"ANSI32-1 step active"* [E1807] is being activated.

P2246 Blocking protection step

The first step of directional power protection can be blocked by any active event. For blocking, the number related to this blocking event has to be assigned to parameter [P2246]. Blocking is only effective, however, as long as the blocking event is active. As soon as blocking is active, event *"ANSI32-1 blocked step"* [E1808] is being activated. If the blocking event turns inactive, blocking is abandoned and protective function is effective again. Then, event [E1808] is being deactivated automatically.

If blocking of the first step of directional power protection is not required, set this parameter to "0".

P2247 Mode

Selection of operating mode according to the protective criterion (characteristic quantity) of the directional power protection; the first step of of directional power protection is optionally adjustable. The set value of parameter "Limit" [P2248] refers to the

characteristic quantity of the set protective criterion of parameter "Mode" [P2247].
Following setting options of the characteristic quantity are available:

- "P<": protective function detects an alarm in case of *active power "limit" under-run*
- "P>": protective function detects an alarm in case of *active power "limit" over-run*
- "Q<": *protective function detects an alarm in case of reactive power "limit" under-run*
- "Q>": *protective function detects an alarm in case of reactive power "limit" over-run*
- "S<": *protective function detects an alarm in case of apparent power "limit" under-run*
- "S>": *protective function detects an alarm in case of apparent power "limit" over-run*
- "Pr<": *protective function detects an alarm in case of active power "limit" under-run*
- "Pr>": *protective function detects an alarm in case of reverse active power "limit" over-run*
- "Qr<": *protective function detects an alarm in case of reactive power "limit" under-run*
- "Qr>": *protective function detects an alarm in case of reverse reactive power "limit" over-run*

NOTE: Definition of reverse active power: $Pr = -P$
Definition of reverse reactive power: $Qr = -Q$

The following graphics represents all the different setting options for the applied characteristic quantity as protective criterion.

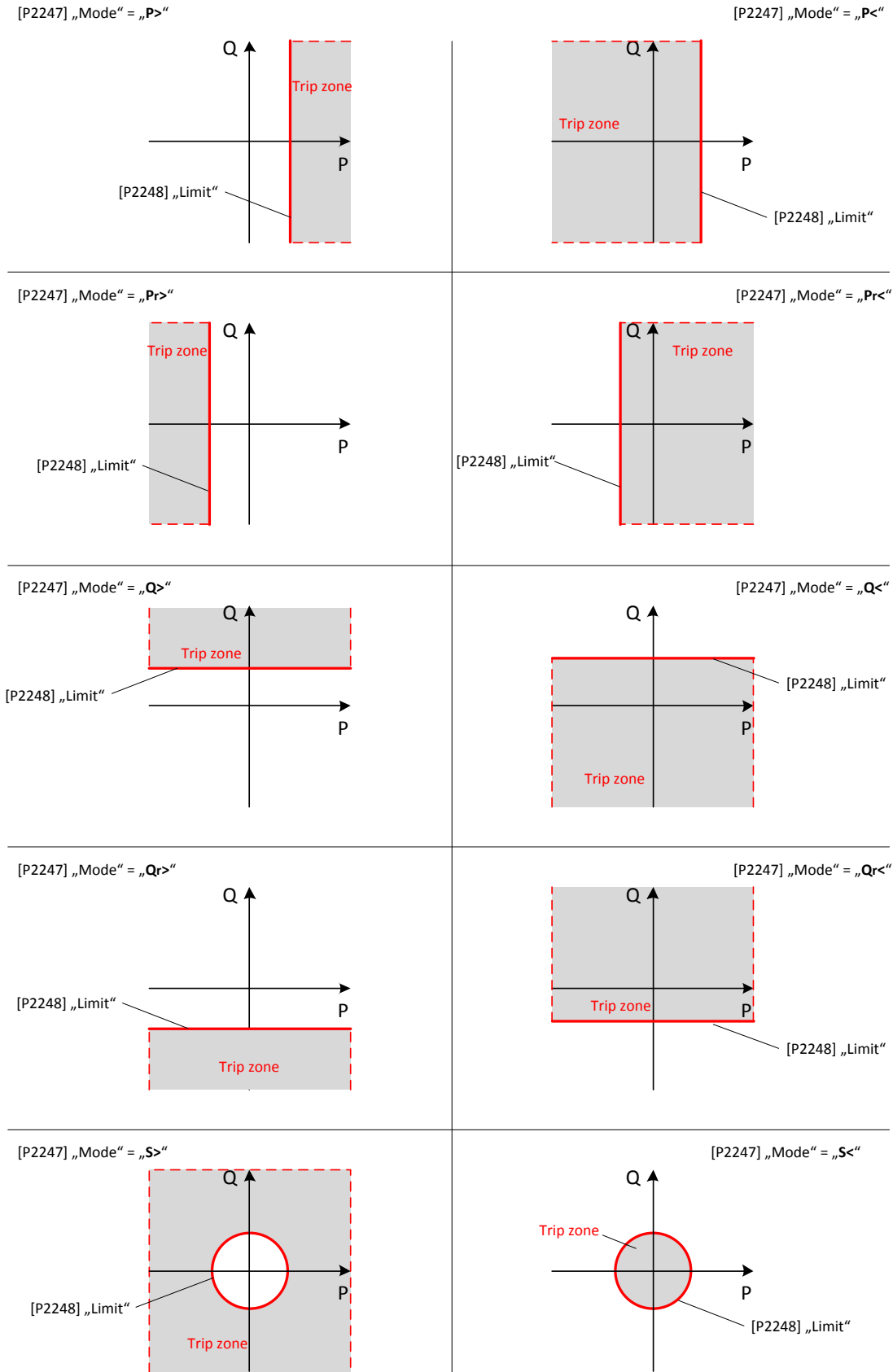


Figure 3-60 Directional power protection – Selection of protective criterion

P2248 Limit

Pick-up value of the first directional power protection element (STEP1); at the moment that the characteristic quantity – depending on the set value of parameter “Mode”

[P2247] – exceeds (or falls below) this limit, “ANSI32-1 pick-up” [E1809] will become active, and “Delay time” of the first directional power protection element will start. In case that the characteristic quantity falls below (or exceeds) the “Limit” of the first directional power protection element before “Delay time” has run down, the timer of “Delay time” will be stopped and the attained time value is being safed.

NOTE: The *pick-up value* is to be set as a percentage of the *nominal value* of the characteristic quantity (according to user’s input either as active power, reactive power or apparent power). The nominal value of the characteristic quantity is to be set by parameter:

- “Power” [P605], for primary side W1 or
- “Power” [P615], for secondary side W2.

Here, it is that winding side relating to the *directional power monitoring*, which is assigned to the applied current measurement input by parameter

- “Assignment” [P668], for current measurement input CT1 or
- “Assignment” [P674], for current measurement input CT2.

The referring parameters “Power” [P605] and “Power” [P615] are located in submenu: “SYSTEM\Nominals\Reference values”.

The referring parameters “Assignment” [P668] and “Assignment” [P674] are located in submenu: “SYSTEM\Nominals\Current transformer”.

P2249 Delay time

Trip delay time; it is the delay time of the trip event “ANSI32-1 trip” [E1810]. As soon as the pick-up event “ANSI32-1 pickup” [E1809] is active and “Delay time” run down, trip event [E1059] will be activated. This event can be used for alarm or output control purposes. In case that the characteristic quantity – depending on the set value of parameter “Mode” [P2247] – exceeds (or falls below) the pick-up value (“Limit”) of the first directional power protection step before the trip delay time (“Delay time”) has run down, the timer of “Delay time” will be stopped and the counter value is being saved. If the characteristic quantity subsequently exceeds (or falls below) the “Reset limit”, then, the “Reset delay time pick-up” timer will start and the pick-up event [E1809] will be deactivated.

P1634 Reset delay time pick-up

Pick-up reset delay time; it is the delay time for resetting the trip delay time (“Delay time”). As soon as the pick-up reset delay time (“Reset delay time pick-up”) has run down the counter of the trip delay time (“Delay time”) is being reset.

P2250 Reset limit

Reset limit of the first step of directional power protection. As soon as the trip event “ANSI32-1 trip” [E1810] is active and the characteristic quantity – depending on the set value of parameter “Mode” [P2247] – exceeds (or falls below) the “Reset limit”, the timer of the trip reset delay time (“Reset delay time trip”) will start.

NOTE: The *reset limit* is to be set as a percentage of the *nominal value* of the characteristic quantity (according to user’s input either as active power, reactive power or apparent power). The nominal value of the characteristic quantity is to be set by parameter:

- “Power” [P605], for primary side W1 or
- “Power” [P615], for secondary side W2.

Here, it is that winding side relating to the *directional power monitoring*, which is assigned to the applied current measurement input by parameter

- “Assignment” [P668], for current measurement input CT1 or
- “Assignment” [P674], for current measurement input CT2.

The referring parameters “Power” [P605] and “Power” [P615] are located in submenu: “SYSTEM\Nominals\Reference values”.

The referring parameters “Assignment” [P668] and “Assignment” [P674] are located in submenu: “SYSTEM\Nominals\Current transformer”.

P1633 Reset delay time trip

Trip reset delay time; it is the delay time for resetting the trip event “ANS/32-1 trip” [E1810].

If the trip reset delay time (“Reset delay time trip”) has run down, trip event “ANS/32-1 trip” [E1809] is being deactivated. In case that the characteristic quantity – depending on the set value of parameter “Mode” [P2247] – falls below (or exceeds) the pick-up value (“Limit”) of the first directional power protection element before the timer of “Reset delay time trip” has run down, the timer of “Reset delay time trip” will be reset. Then trip event “ANS/32-1 trip” [E1810] remains active.

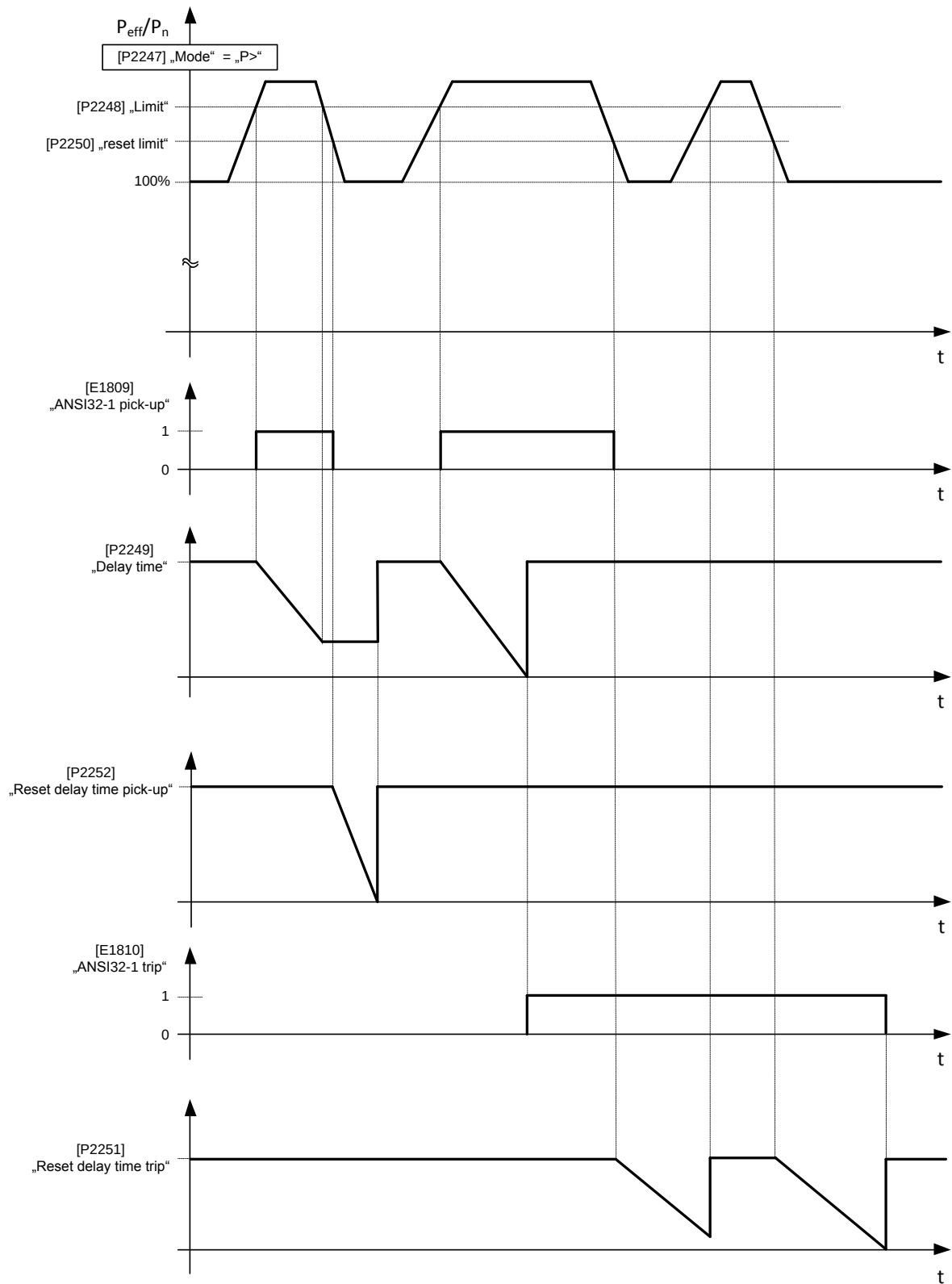


Figure 3-61 Directional power protection – Tripping and reset characteristic: over-run of “P>”

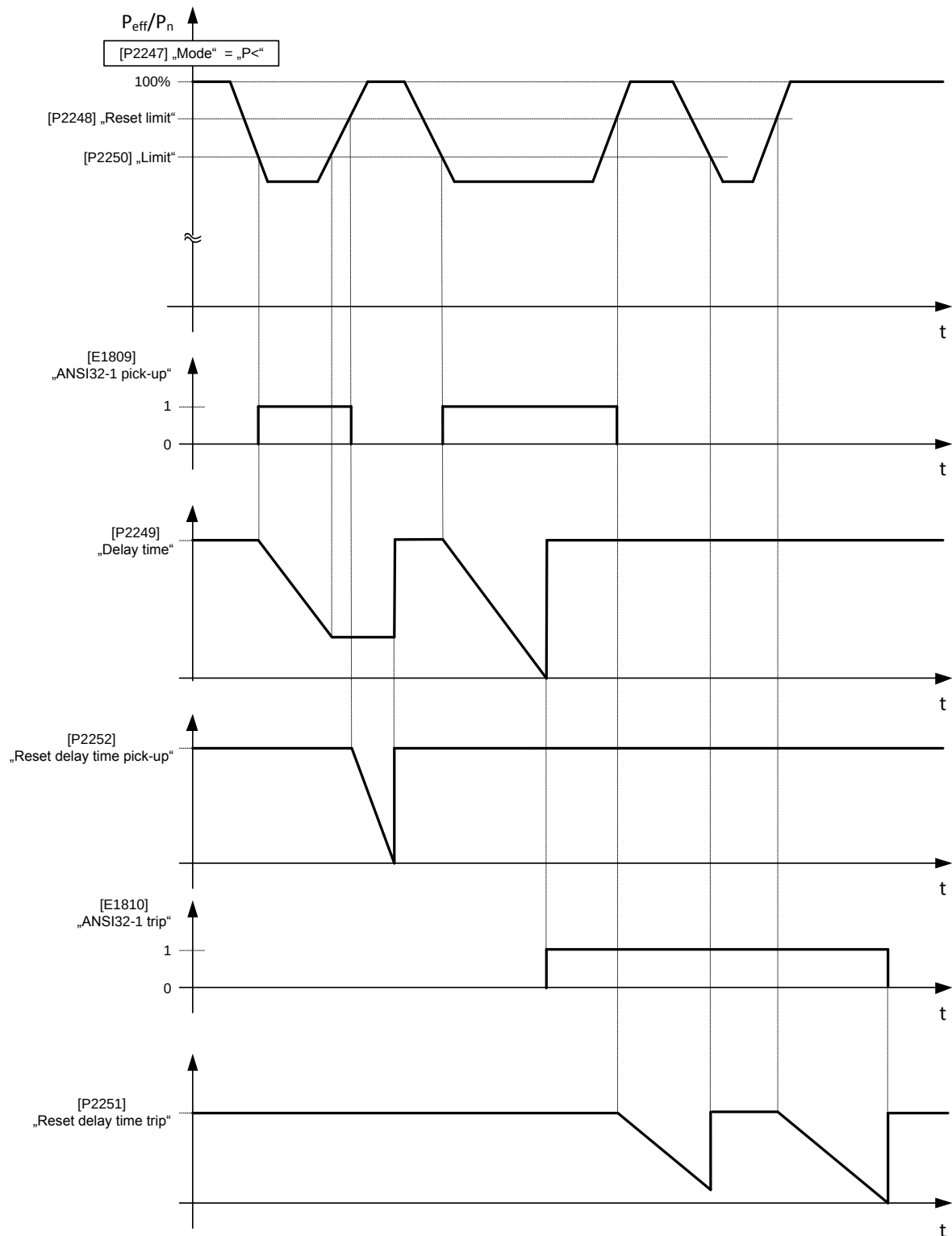


Figure 3-62 Directional power protection – Tripping and reset characteristic: under-run of “P<”

3.5.7 ANSI 50/51 – Overcurrent Protection

Main Menu\Parameters\PROTECTION\ANSI25-50/51\					
ANSI 50/51					
SET 1	SET 2	SET 3	SET 4		
P/E No.	Name	Value	Unit	(Setting range)	
SET PARAMETERS					
P1620	Overcurrent protection	ON	-	ON/OFF	
P1621	Blocking protection module	0	event	0 ... 9999	
E1415	ANSI50/51 module active	-	-	-	
E1416	ANSI50/51 blocked module	-	-	-	
STEP 1					
P1625	Pickup source	CT1	-	none/CT1/CT2	
P1626	Blocking protection step	0	event	0 ... 9999	
P1627	Pickup curve	Definite	-	Definite/ANSI NINV/ANSI VINV/ANSI EINV/ IEC NINV/IEC VINV/IEC LINV/IEC EINV	
P1628	Limit	150	%	0 ... 1999,9	
P1629	Delay time/TMS	2,5	s/-	0 ... 999999,999	
P1630	Reset curve	Definite	-	Definite/ANSI NINV/ANSI VINV/ANSI EINV/ IEC NINV/IEC VINV/IEC LINV/IEC EINV	
P1631	Reset after TRIP immediately	OFF	-	ON/OFF	
P1632	Reset limit	110	%	0 ... 1999,9	
P1633	Reset delay time trip/TMS	1	s/-	0 ... 999999,999	
P1634	Reset delay time pickup	1	s	0 ... 999999,999	
P1635	Harmonics stabilizer	OFF	-	OFF / 2H / 5H / 2H/5H	
E1422	ANSI50/51-1 step active	-	-	-	
E1423	ANSI50/51-1 blocked step	-	-	-	
E1424	ANSI50/51-1 pickup	-	-	-	
E1425	ANSI50/51-1 trip	-	-	-	
STEP 2					
P1645	Pickup source	CT1	-	none/CT1/CT2	
...	...	...	...	...	

Figure 3-63 ANSI 50/51 – Protection parameters [P] and events [E] of SET 1

Parameter description:

The following parameter descriptions refer to all protection parameters of one parameter set.

NOTE: Each of the four parameter sets always provides the same group of protection parameters. Hence, the parameter descriptions of the SET PARAMETERS and the parameters of STEP 1 represented below are described in the following in detail as examples.

Protection parameters of parameter SET 1 – ANSI 50/51

SET PARAMETERS

The following SET PARAMETERS of the overcurrent protection exist only once in each of the four parameter sets. Thus, the SET PARAMETERS apply to all of the 6 protection STEPS of one parameter SET.

P1620 Overcurrent protection

This parameter enables/disables overcurrent protection wherein:

- “OFF”: disables or
- “ON”: enables the protective function.

When overcurrent protection ANSI 50/51 is enabled by parameter [P1620], then event “ANSI50/51 module active” [E1415] is being activated.

P1621 Blocking protection module

Overcurrent protection can be completely blocked by any active event. For blocking, the number related to this blocking event has to be assigned to parameter [P1621]. Blocking is only effective, however, as long as the blocking event is active. As soon as blocking is active, event “ANSI50/51 blocked module” [E1416] is being activated. If the blocking event turns inactive, blocking is abandoned and protective function is effective again. Then, event [E1416] is being deactivated automatically.

If blocking of the overcurrent protection is not required, set this parameter to “0”.

Protection parameters of STEP 1

The following STEP parameters of the overcurrent protection exist only once in each of the 6 independent protection STEPS. Thus, the SET PARAMETERS apply only to one of the 6 protection STEPS of one parameter SET.

P1625 Pick-up source

Depending on the SYMAP[®]-Compact(+) device variant every protection step of overcurrent protection can be assigned to a certain current measurement input (CT1 or CT2). Parameter [P1625] determines the current measurement input which will provide measurement values as characteristic quantities (phase current) to the overcurrent protection:

- “none”: no current measurement; protection step is deactivated
- “CT1”: current input CT1
- “CT2”: current input CT2

For settings “CT1” or “CT2”, event “ANSI50/51-1 step active” [E1422] is being activated.

P1626 Blocking protection step

The first step of overcurrent protection can be blocked by any active event. For blocking, the number related to this blocking event has to be assigned to parameter [P1626]. Blocking is only effective, however, as long as the blocking event is active. As soon as blocking is active, event “ANSI50/51-1 blocked step” [E1423] is being activated. If the blocking event turns inactive, blocking is abandoned and protective function is effective again. Then, event [E1423] is being deactivated automatically.

If blocking of the first step of overcurrent protection is not required, set this parameter to “0”.

P1627 Pick-up curve

Tripping characteristic of „Delay time/TMS“; via parameter [P1627]; the *tripping characteristic* of the first step of overcurrent protection is optionally adjustable as:

- “Definite Time-delay overcurrent protection” (DT) or
- “Inverse Definite Minimum Time-delay protection” (IDMT)

There are up to 7 different inverse time characteristics (IDMT) available, which accords to the US standard of the „American National Standard Institute ANSI“ or the international standard of „International Electrotechnical Commission IEC“:

- “Definite”: definite time (DT)

- “ANSI NINV“: “Normal Inverse“, (ANSI)
- “ANSI VINV“: “Very Inverse“ (ANSI)
- “ANSI EINV“: “Extremely Inverse“ (ANSI)
- “IEC NINV“: “Normal Inverse“, (IEC)
- “IEC VINV“: “Very Inverse“ (IEC)
- “IEC LINV“: “Long-term Inverse“ (IEC)
- “IEC EINV“: “Extremely Inverse“ (IEC)

Table 4-3 Parameters of inverse curves (IDMT)

Curve type	Operate (trip) time			Reset time		Designating
	$t(G) = TMS \left[\frac{k}{\left(\frac{G}{G_S} \right)^{\alpha} - 1} + c \right]$			$t_r(G) = TMS \left(\frac{t_r}{1 - \left(\frac{G}{G_S} \right)^{\alpha}} \right)$		
	k [s]	c [s]	α -	t_r [s]	α -	
A	0,14	0	0,02	0,14	2	Normal Inverse
B	13,5	0	1	13,5	2	Very inverse
-	120	0	1	120	2	Long-term inverse
C	80	0	2	80	2	Extremely invers
D	0,0515	0,1140	0,02	4,85	2	IEEE normal inverse
E	19,61	0,491	2	21,6	2	IEEE very invers
F	28,2	0,1217	2	29,1	2	IEEE extremely inverse
<u>whereby:</u> $t(G)$: theoretical operate timewith constant value of G (seconds) $t_r(G)$: time setting (reset time for G=0 and TMS = 1) k, c, α : constant values which define the chosen curve shape TMS: T ime M ultiplier S etting G: measured value of the characteristic quantity G_S : setting value (start) of the characteristic quantity						

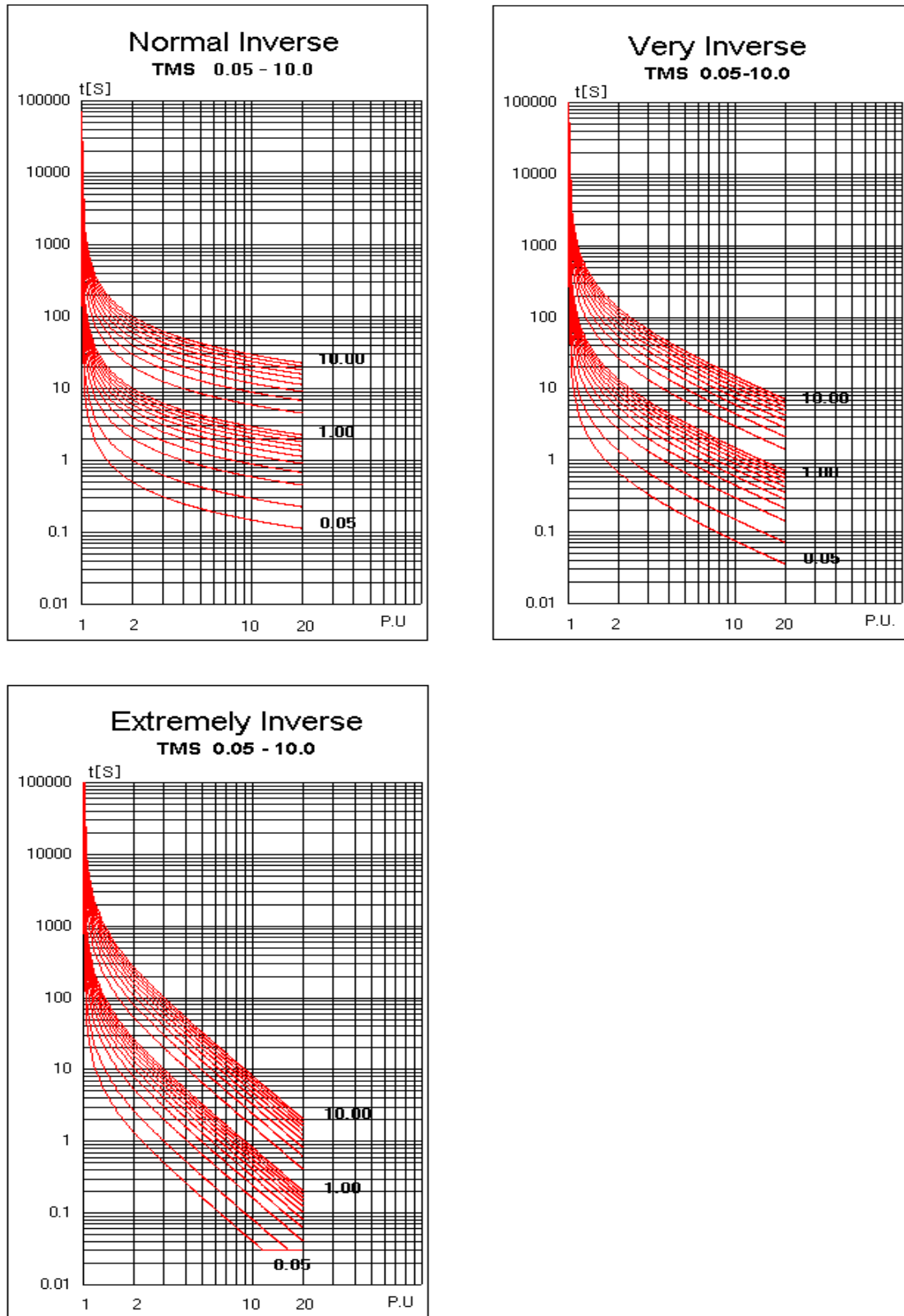


Figure 3-64 Inverse IEC curves – examples

P1628 Limit

Pick-up value of the first overcurrent protection element (STEP1); at the moment that the characteristic quantity (phase current) exceeds this limit, “ANSI50/51-1 pick-up” [E1424] will become active, and “Delay time/TMS” of the first overcurrent protection element will start.

In case that the characteristic quantity (phase current) falls below "Limit" of the first overcurrent protection element before "Delay time/TMS" has run down, the timer of "Delay time/TMS" will be stopped and the attained time value is being safed.

NOTE: The *pick-up value* is to be set as a percentage of the *nominal value* of the characteristic quantity (phase current). The nominal value of the characteristic quantity is to be set by parameter:

- "Current" [P604], for primary side W1 or
- "Current" [P614], for secondary side W2 or
- "Current" [P624], for tertiary side W3.

The referring parameters "Current" [P604], "Current" [P614] and "Current" [P614] are located in submenu: "SYSTEM\Nominals\Reference values".

P1629 Delay time/TMS

Tripping delay time of trip event "ANSI50/51-1 trip" [E1425]; the working principle of the delay time counter depends on the *tripping characteristic* set by parameter "Pickup curve" [P1627]. Hence follows that parameter "Delay Time/TMS" [P1629] takes on a different meaning, depending on the chosen tripping characteristic (DT or IDMT).

- **DT tripping characteristic:** "Pickup curve" [P1627] = "Definite"
In this case the *tripping delay time* is equal to a constant time value set by parameter "Delay time/TMS" [P1629].
- **IDMT tripping characteristic:** e.g. "Pickup curve" [P1627] = "ANSI NINV"
For this, the *tripping delay time* is not constant, but, it will be calculated cyclically, depending on the adjusted IDMT curve and the level of momentary phase current increase (characteristic quantity). Therefore, setting of parameter "Delay Time /TMS" [P1629] means a displacement with regard to the time axis of the tripping curve ("TMS": Time Multiplier Setting)

If pick-up event "ANSI50/51-1 pick-up" [E1424] is active and "Delay Time/TMS" run down, trip event "ANSI50/51-1 trip" [E1425] will be activated. This event can be used for alarm or output control purposes.

P1632 Reset limit

Pick-up reset limit of the first overcurrent protection element (STEP1); if the

- pick-up event "ANSI50/51-1 pickup" [E1424] is active **and**
- the characteristic quantity (phase current) falls below the pick-up value "Limit" **and**
- the characteristic quantity (phase current) falls below the pick-up reset value "Reset limit",

then, pick-up event [E1424] is being deactivated and the timer of the "Reset delay time pick-up" will start.

NOTE: The "Reset Limit" is to be set as a percentage of the *nominal value* of the characteristic quantity (phase current). The nominal value of the characteristic quantity is to be set by parameter:

- "Current" [P604], for primary side W1 or
- "Current" [P614], for secondary side W2 or
- "Current" [P624], for tertiary side W3.

The referring parameters "Current" [P604], "Current" [P614] and "Current" [P614] are located in submenu: "SYSTEM\Nominals\Reference values".

P1630 Reset curve

Reset characteristic of "Delay time/TMS"; via parameter [P1630] the reset characteristic of the first step of overcurrent protection is optionally adjustable as:

- "Definite Time-delay overcurrent protection" (**DT**) or
- "Inverse Definite Minimum Time-delay protection" (**IDMT**)

There are up to 7 different *inverse time characteristics* available, which accords to the US standard of the „American National Standard Institute ANSI“ or the international standard of „International Electrotechnical Commission IEC“:

- "Definite": definite time (DT)
- "ANSI NINV": "Normal Inverse" (ANSI);
- "ANSI VINV": "Very Inverse" (ANSI);
- "ANSI EINV": "Extremely Inverse" (ANSI);
- "IEC NINV": "Normal Inverse" (IEC);
- "IEC VINV": "Very Inverse" (IEC);
- "IEC LINV": "Long-term Inverse" (IEC);
- "IEC EINV": "Extremely Inverse" (IEC)

NOTE: If the *tripping characteristic of "Delay time/TMS"* is set to "Definite" (**DT**), then parameter "Reset curve" [P1630] only provides setting option "Definite" (**DT**).

If the *tripping characteristic of "Delay time/TMS"* is set to "xxx INV" (**IDMT**), then parameter "Reset curve" [P1630] provides both, setting option "Definite" (**DT**) or setting option "xxx INV" (**IDMT**).

As a result, processing of the *stored counter value* of the *tripping delay time* takes on a different working principle, depending on the *reset characteristic of "Delay time/TMS"* (DT or IDMT) to be set by parameter "Reset curve" [P1630]:

- **DT:** the *stored counter value* is to be processed according to the settings of "Reset delay time pick-up"
- **IDMT:** the *stored counter value* is to be processed according to the settings of "Reset delay time trip/TMS"

P1634 Reset delay time pick-up

Delay time to reset the stored counter value of the tripping delay time; in case that the tripping delay time ("Delay time/TMS") has not yet run down.

CAUTION: Parameter [P1634] is only valid in case of "Reset curve" [P1630] = "Definite"!

While the timer of the "Reset delay time pick-up" is running, the counter value of the *tripping delay time* maintains at a constant level.

After the "Reset delay time pick-up" has run down, the counter value of the *tripping delay time* ("Delay time/TMS") will be reset.

P1633 Reset delay time trip/TMS

Delay time to reset the trip event "ANSI50/51-1 trip" [E1425]; the operating procedure of the timer for resetting the trip event depends on the set characteristic of the reset curve. Hence follows that parameter "Reset delay time trip/TMS" [P1633] takes on a different meaning, depending on the reset characteristic of "Reset curve" (DT or IDMT) set by parameter "Reset curve" [P1630]:

- **DT reset characteristic:** “Reset curve” [P1630] = “Definite”
The delay time to reset the trip event is equal to a constant time value, to be set by parameter “Reset delay time/TMS” [P1633].
- **IDMT reset characteristic:** e.g. “Reset curve” [P1630] = “ANSI NINV”
The delay time to reset the trip event is not a constant time value, but, depending on the inverse curve shape and the measured value of the characteristic quantity (phase current) it will be cyclically re-calculated. When applying any inverse curve (IDMT) to the reset curve, this means the setting of parameter “Reset delay time trip/TMS” [P1633] takes on a displacement of the inverse curve shape with regard to the time axis (“TMS”: **T**ime **M**ultiplier **S**etting).

If trip event “ANSI50/51-1 trip” [E1425] is activated and “Reset delay time trip/TMS” has run down, the trip event “ANSI50/51-1 trip” [E1425] will be deactivated.

NOTE: In dependence of the set value of parameter “Reset after TRIP immediately” [P1631], deactivating of trip event “ANSI50/51-1 trip” [E1425] takes on a different working principle.

P1631 Reset after TRIP immediately

Immediate reset of trip event “ANSI50/51-1 trip” [E1425]; in case that the reset curve is assigned an inverse characteristic (IDMT), then the „Reset after TRIP immediately“ can be activated/deactivated by parameter [P1631] as soon as the characteristic quantity falls below the “Reset Limit“.

- “OFF”: Immediate reset of trip event “ANSI50/51-1 trip” [E1425] is deactivated
- “ON”: Immediate reset of trip event “ANSI50/51-1 trip” [E1425] is activated

NOTE: If the reset curve of the first protection element (STEP1) is assigned a *definite time (DT)* characteristic (parameter “Reset curve” [P1630] = „Definite“), and the trip event “ANSI50/51-1 trip” [E1425] should immediately be reset, then set parameter “Reset Delay time/TMS” [P1633] = “0”.

P1635 Harmonics stabilizer

Blocking of protection element (STEP1) of overcurrent protection by “harmonics stabilizer ANSI 95i” function for measuring values of CT1; according to the settings of the “harmonics stabilizer ANSI 95i” function, the overcurrent protection may be temporarily blocked upon exceeding of defined contents of the 2nd and/or 5th harmonic ($I_{100\text{Hz}}$ and/or $I_{250\text{Hz}}$) in the phase current:

- “OFF”: blocking of ANSI 50/51-1 by ANSI 95i is deactivated
- “2H”: blocking of ANSI 50/51-1 by ANSI 95i in case of 2nd harmonic
- “5H”: blocking of ANSI 50/51-1 by ANSI 95i in case of 5th harmonic
- “2H/5H”: blocking of ANSI 50/51-1 by ANSI 95i in case of 2nd or 5th harmonic

NOTE: Appropriate settings of the corresponding parameters of ANSI95i are to be done in the submenu: “PROTECTION\95i Harmonics stabilizer”.

P1637 Voltage restrained

Voltage restraint modification of the pick-up value (“Limit”) and the reset value (“Reset Limit”) of the first protection element (STEP1) overcurrent protection by function “Voltage restrained ANSI 51/46VR”; according to the settings of the “Voltage restrained ANSI 51/46VR” function, the overcurrent protection may automatically be sensitised.

- “OFF”: Sensitization of ANSI 50/51-1 by 51/46VR is deactivated
- “ON”: Sensitization of ANSI 50/51-1 by 51/46VR is activated

NOTE: Appropriate settings of the corresponding parameters of function “*Voltage restrained ANSI 51/46VR*” are to be done in the submenu: “**PROTECTION\51/46VR Voltage restrained**”.

P1642 Min. delay time

NOTE: This parameter only applies for inverse trip characteristics (IDMT curves)!

Minimum trip delaytime for inverse trip curves; in case of high.current faults the tripping delay time could be too less for the application. To avoid this, a minimum trip delaytime can be set by parameter „Min. delay time“ [P1642]

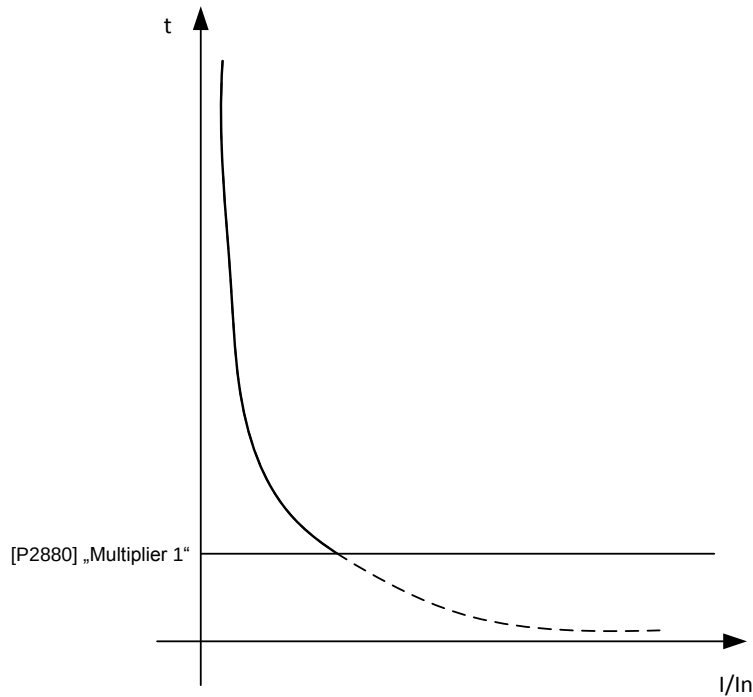


Figure 3-65 IDMT Trip characteristic– minimum trip delay time

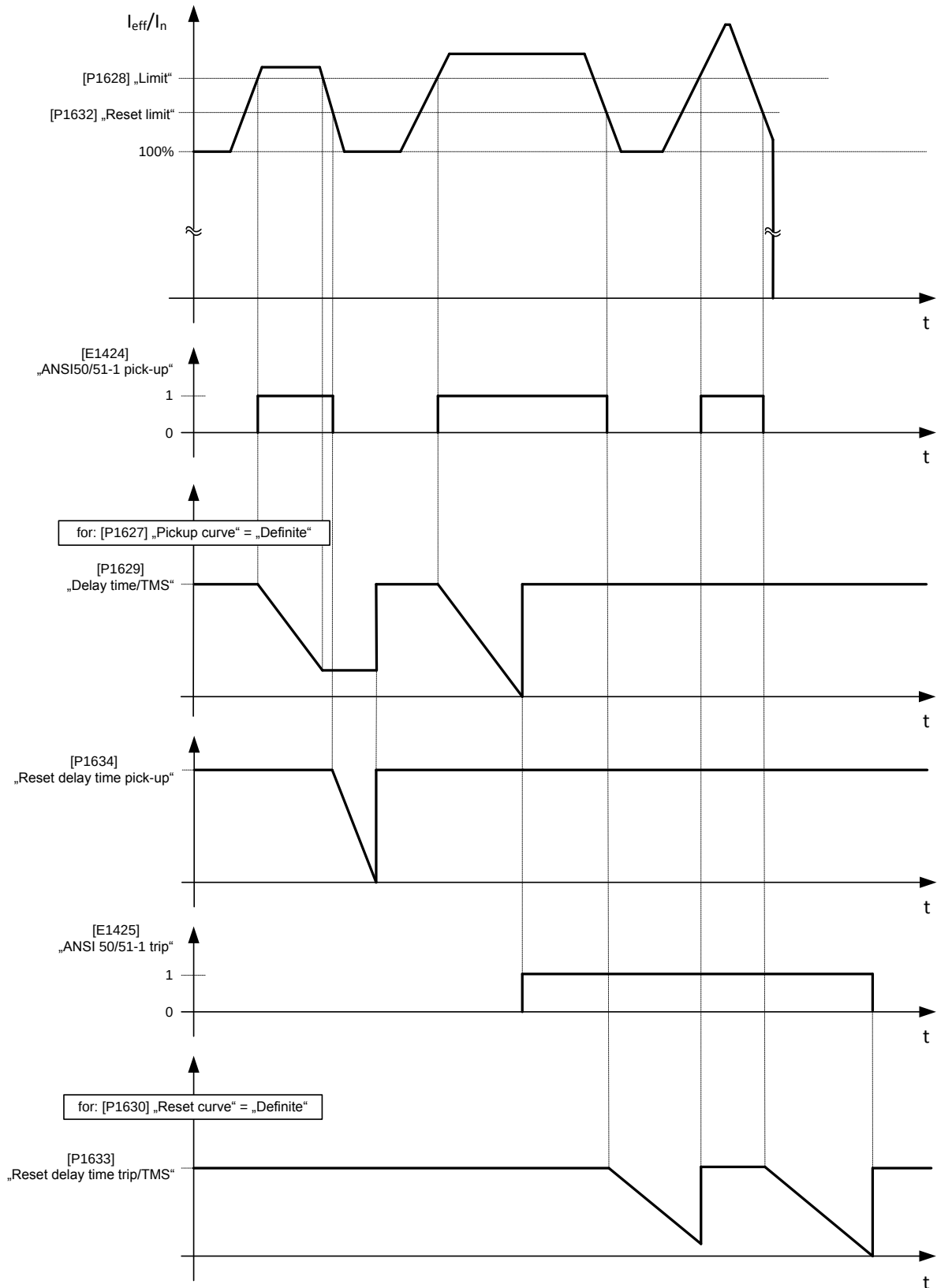


Figure 3-66 Overcurrent protection – Trip characteristic (DT) and Reset characteristic (DT)

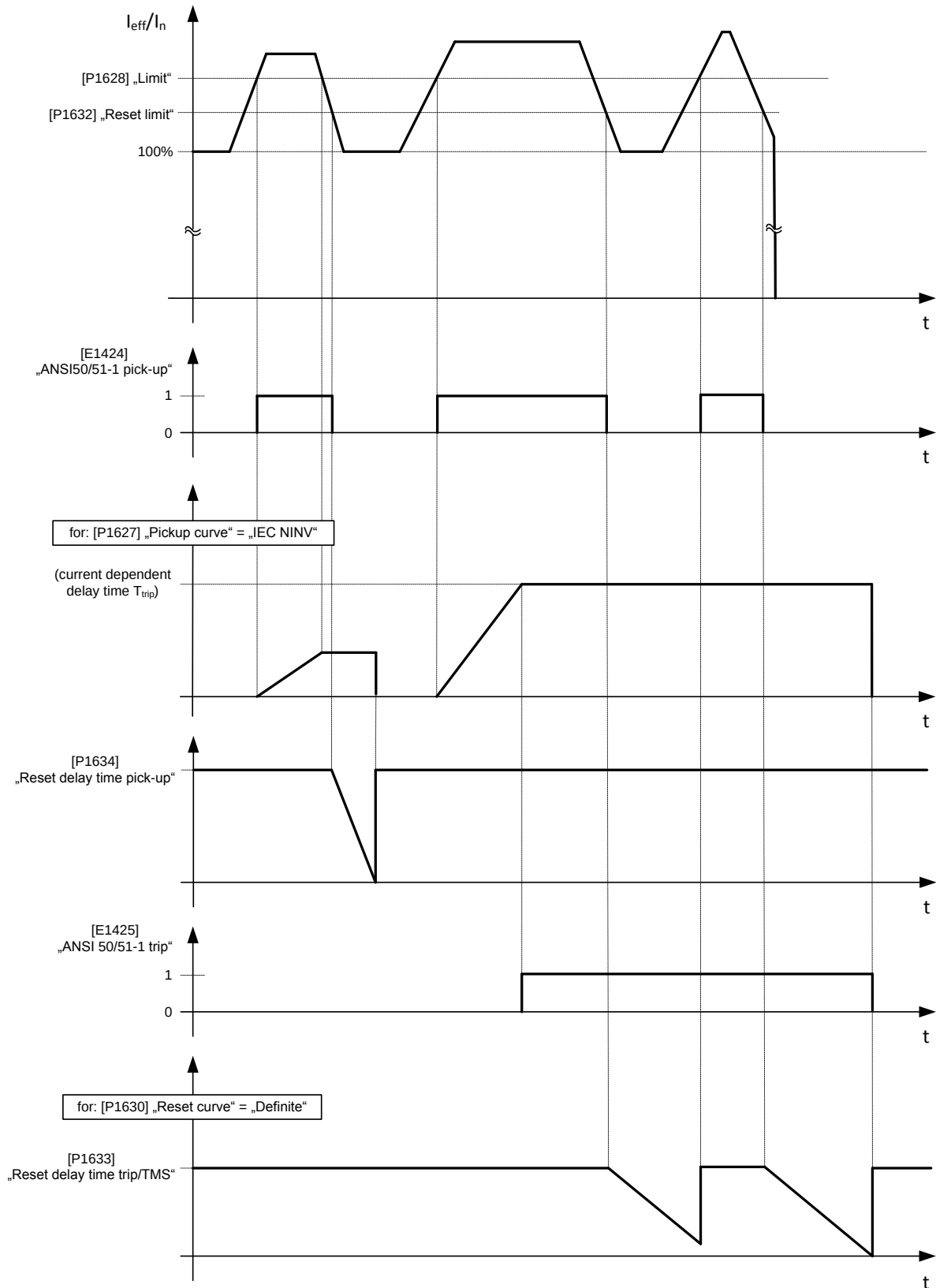


Figure 3-67 Overcurrent protection – Trip characteristic (IDMT) and Reset characteristic (DT)

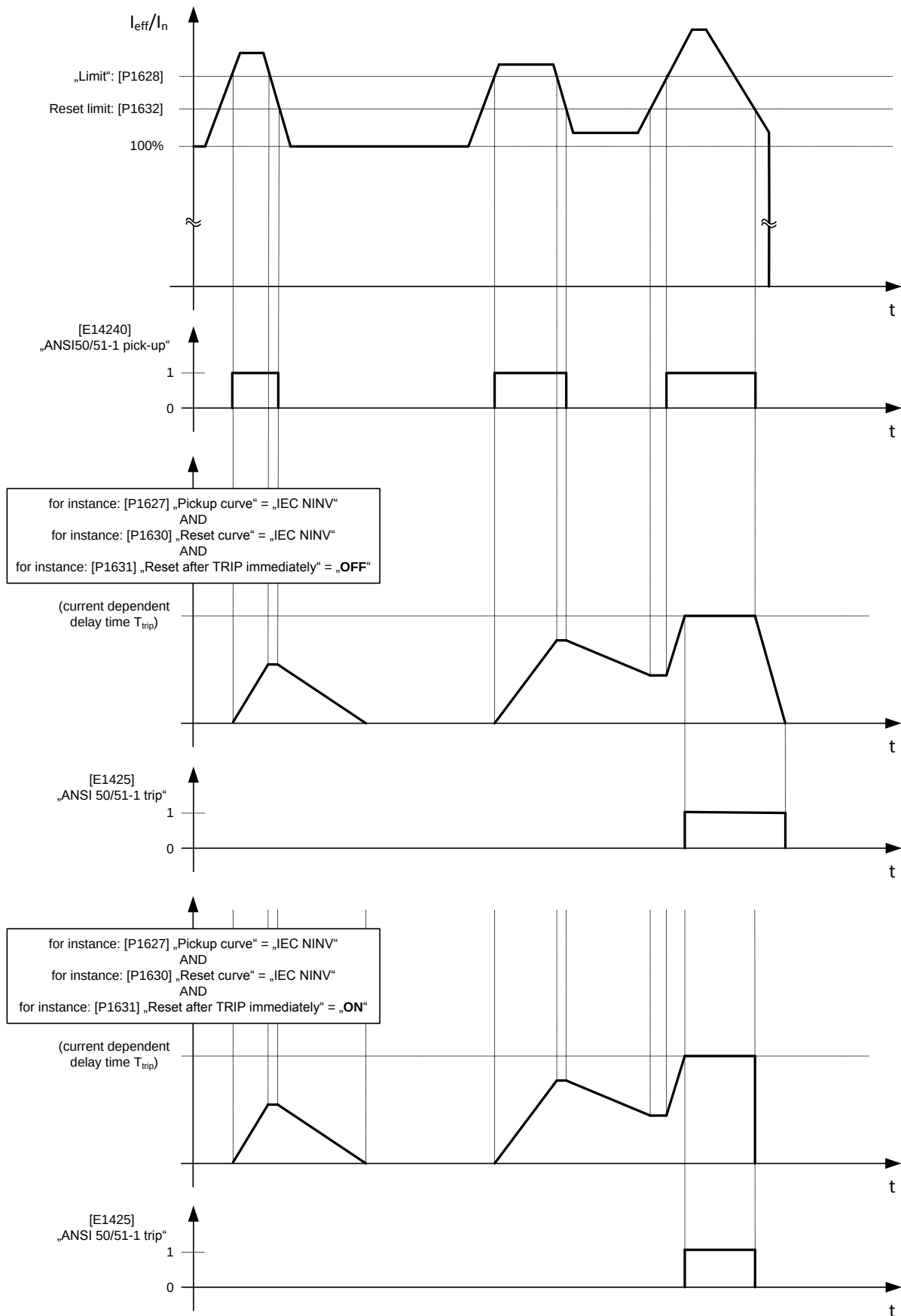


Figure 3-68 Overcurrent protection – Trip characteristic (IDMT) and Reset characteristic (IDMT)

3.5.8 ANSI 50BF – Breaker Failure Protection

Main Menu\Parameters\PROTECTION\ANSI25-50/51\					
ANSI 50BF					
SET 1	SET 2	SET 3	SET 4		
P/E No.	Name	Value	Unit	(Setting range)	
SET PARAMETERS					
P2835	Breaker failure protection	ON	-	ON/OFF	
P2836	Blocking protection module	0	event	0 ... 9999	
E2215	ANSI50BF module active	-	-	-	
E2216	ANSI50BF blocked module	-	-	-	
STEP 1					
P2838	Pickup source	CT1	-	none/CT1/CT2	
P2839	Blocking protection step	0	event	0 ... 9999	
P2840	Trigger	0	event	0 ... 9999	
P2841	Limit	10	%	0 ... 1999,9	
P2842	Delay time	2,5	s	0 ... 999999,999	
P2843	Reset limit	15	%	0 ... 1999,9	
P2844	Reset delay time trip	1	s	0 ... 999999,999	
P2845	Reset delay time pickup	1	s	0 ... 999999,999	
E2217	ANSI50BF-1 step active	-	-	-	
E2218	ANSI50BF-1 blocked step	-	-	-	
E2219	ANSI50BF-1 pickup	-	-	-	
E2220	ANSI50BF-1 trip	-	-	-	
STEP 2					
P2847	Pickup source	CT1	-	none/CT1/CT2	
...	...	...	...	...	

Figure 3-69 ANSI 50BF – Protection parameters [P] and events [E] of SET 1

Parameter description:

The following parameter descriptions refer to all protection parameters of one parameter set.

NOTE: Each of the four parameter sets always provides the same group of protection parameters. Hence, the parameter descriptions of the SET PARAMETERS and the parameters of STEP 1 represented below are described in the following in detail as examples.

Protection parameters of parameter SET 1 – ANSI 50BF

SET PARAMETERS

The following SET PARAMETERS of the breaker failure protection exist only once in each of the four parameter sets. Thus, the SET PARAMETERS apply to all of the 3 protection STEPS of one parameter SET.

P2835 Breaker failure protection

This parameter enables/disables breaker failure protection wherein:

- “OFF”: disables or
- “ON”: enables the protective function.

When breaker failure protection ANSI 50BF is enabled by parameter [P2835], then event “ANSI50BF module active” [E2215] is being activated.

P2836 Blocking protection module

Breaker failure protection can be completely blocked by any active event. For blocking, the number related to this blocking event has to be assigned to parameter [P2836].

Blocking is only effective, however, as long as the blocking event is active. As soon as blocking is active, event *"ANSI50BF blocked module"* [E2216] is being activated. If the blocking event turns inactive, blocking is abandoned and protective function is effective again. Then, event [E2216] is being deactivated automatically.

If blocking of the breaker failure protection is not required, set this parameter to **"0"**.

Protection parameters of STEP 1

The following STEP parameters of the breaker failure protection exist only once in each of the 3 independent protection STEPS. Thus, the SET PARAMETERS apply only to one of the 3 protection STEPS of one parameter SET.

P2838 Pick-up source

Depending on the SYMAP[®]-Compact(+) device variant every protection step of breaker failure protection can be assigned to a certain current measurement input (CT1 or CT2). Parameter [P2838] determines the current measurement input which will provide measurement values as characteristic quantities (phase current) to the breaker failure protection:

- "none": no current measurement; protection step is deactivated
- "CT1": current input CT1
- "CT2": current input CT2

For settings "CT1" or "CT2", event *"ANSI50BF-1 step active"* [E2217] is being activated.

P2839 Blocking protection step

The first step of breaker failure protection can be blocked by any active event. For blocking, the number related to this blocking event has to be assigned to parameter [P2839]. Blocking is only effective, however, as long as the blocking event is active. As soon as blocking is active, event *"ANSI50BF-1 blocked step"* [E2218] is being activated. If the blocking event turns inactive, blocking is abandoned and protective function is effective again. Then, event [E2218] is being deactivated automatically.

If blocking of the first step of breaker failure protection is not required, set this parameter to **"0"**.

P2840 Trigger

The first step of breaker failure protection can be triggered by any active event. For blocking, the number related to this blocking event has to be assigned to parameter [P2840].

NOTE: Usually, those *trlp*-events of the current protection functions are used for the trigger-event. The trips events can be combined by a logical function of function "PLC". If so, output-event of the logical function can be assigned to parameter *"Trigger"* [P2840].

External tripping signals which are to be processed by binary inputs, for instance, the events of the binary inputs are to be used as trigger-events.

If activating of the first step of breaker failure protection is not required, set this parameter to **"0"**.

P2841 Limit

Pick-up value of the first breaker failure protection element (STEP1); at the moment that the characteristic quantity (phase current) exceeds this limit and the trigger-event

assigned to parameter *“Trigger”* [2840] is active, then *“ANSI50BF-1 pick-up”* [E2219] will become active, and *“Delay time”* of the first breaker failure protection element will start.

In case that the characteristic quantity (phase current) falls below *“Limit”* of the first overcurrent protection element before *“Delay time/TMS”* has run down, the timer of *“Delay time/TMS”* will be stopped and the attained time value is being saved.

NOTE: The *pick-up value* is to be set as a percentage of the *nominal value* of the characteristic quantity (phase current). The nominal value of the characteristic quantity is to be set by parameter:

- *“Current”* [P604], for primary side W1 or
- *“Current”* [P614], for secondary side W2 or
- *“Current”* [P624], for tertiary side W3.

The referring parameters *“Current”* [P604], *“Current”* [P614] and *“Current”* [P614] are located in submenu: *“SYSTEM\Nominals\Reference values”*.

P2842 Delay time

Trip delay time; it is the delay time of the trip event *“ANSI50BF-1 trip”* [E2220].

As soon as the pick-up event *“ANSI50BF-1 pick-up”* [E2219] is active and *“Delay time”* run down, trip event [E2220] will be activated. This event can be used for alarm or output control purposes.

In case that the characteristic quantity (phase current) falls below the pick-up value (*“Limit”*) of the first breaker failure protection step before the trip delay time (*“Delay time”*) has run down, the timer of *“Delay time”* will be stopped and the counter value is being saved. If the characteristic quantity subsequently exceeds the *“Reset limit”*, then, the *“Reset delay time pick-up”* timer will start and the pick-up event [E2219] will be deactivated.

P2843 Reset limit

Pick-up reset limit of the first breaker failure protection element (STEP1); if the

- pick-up event *“ANSI50BF-1 pick-up”* [E2219] is active **and**
- the characteristic quantity (phase current) falls below the pick-up reset value *“Reset limit”*,

then, pick-up event [E2219] is being deactivated and the timer of the *“Reset delay time pick-up”* will start.

NOTE: The *“Reset Limit”* is to be set as a percentage of the *nominal value* of the characteristic quantity (phase current). The nominal value of the characteristic quantity is to be set by parameter:

- *“Current”* [P604], for primary side W1 or
- *“Current”* [P614], for secondary side W2 or
- *“Current”* [P624], for tertiary side W3.

The referring parameters *“Current”* [P604], *“Current”* [P614] and *“Current”* [P614] are located in submenu: *“SYSTEM\Nominals\Reference values”*.

P2844 Reset delay time pick-up

Delay time to reset the stored counter value of the tripping delay time; in case that the tripping delay time (*“Delay time/TMS”*) has not yet run down.

While the timer of the *“Reset delay time pick-up”* is running, the counter value of the *tripping delay time* maintains at a constant level.

After the “Reset delay time pick-up” has run down, the counter value of the *tripping delay time* (“Delay time/TMS”) will be reset.

P2845 Reset delay time trip

Trip reset delay time; it is the delay time for resetting the trip event “ANSI50BF-1 trip” [E2220].

If the trip-event trip “ANSI50BF-1 trip” [E2220] is active and the reset delay time (“Reset delay time trip”) has run down, trip event [E2220] is being deactivated.

In case that the characteristic quantity (phase current) exceeds the “Reset limit” before the timer of “Reset delay time trip” has run down, the timer of “Reset delay time trip” will be reset. Then trip event “ANSI50BF-1 trip” [E2220] remains active.

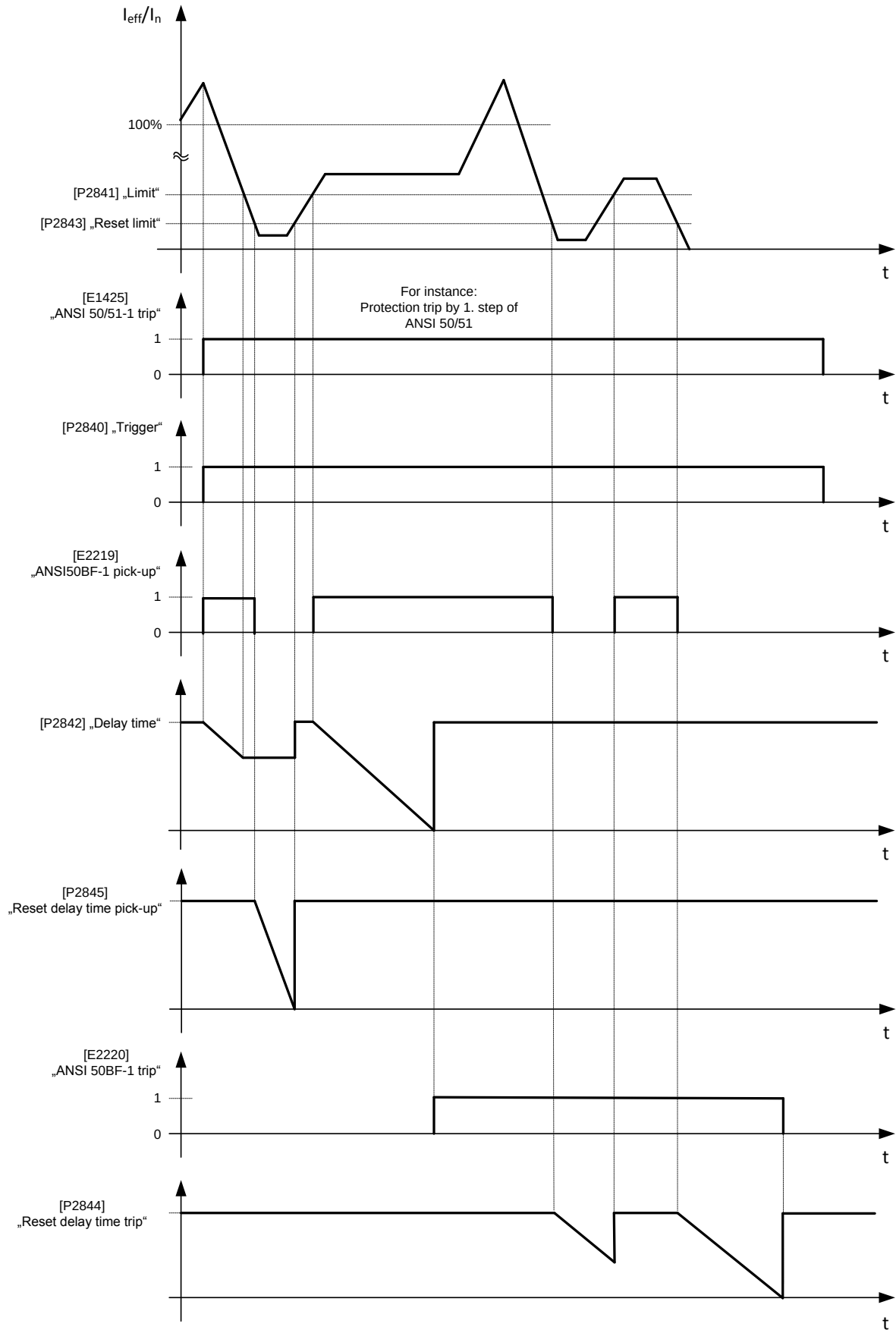


Figure 3-70 ANSI 50BF – Trip and reset characteristic

3.5.9 ANSI 50G/51G – Ground Overcurrent Protection

Main Menu\Parameters\PROTECTION\ANSI25-50/51\					
ANSI 50G/51G					
SET 1	SET 2	SET 3	SET 4		
P/E No.	Name		Value	Unit	(Setting range)
SET PARAMETERS					
P2030	Ground overcurrent protection		ON	-	ON/OFF
P2031	Blocking protection module		0	event	0 ... 9999
E1680	ANSI50G/51G module active		-	-	-
E1681	ANSI50G/51G blocked module		-	-	-
STEP 1					
P2035	Pickup source		CT1	-	none/CT-GND1/CT1/CT2
P2036	Blocking protection step		0	event	0 ... 9999
P2037	Pickup curve		Definite	-	Definite/ANSI NINV/ANSI VINV/ANSI EINV/ IEC NINV/IEC VINV/IEC LINV/IEC EINV
P2038	Limit		150	%	0 ... 1999,9
P2039	Delay time/TMS		2,5	s/-	0 ... 999999,999
P2040	Reset curve		Definite	-	Definite/ANSI NINV/ANSI VINV/ANSI EINV/ IEC NINV/IEC VINV/IEC LINV/IEC EINV
P2041	Reset after TRIP immediately		OFF	-	ON/OFF
P2042	Reset limit		110	%	0 ... 1999,9
P2043	Reset delay time trip/TMS		1	s/-	0 ... 999999,999
P2044	Reset delay time pickup		1	s	0 ... 999999,999
P2045	Harmonics stabilizer		OFF	-	OFF / 2H / 5H / 2H/5H
E1687	ANSI50G/51G-1 step active		-	-	-
E1688	ANSI50G/51G-1 blocked step		-	-	-
E1689	ANSI50G/51G-1 pickup		-	-	-
E1690	ANSI50G/51G-1 trip		-	-	-
STEP 2					
P2055	Pickup source		CT1	-	none/CT-GND1/CT1/CT2
...	...		...	...	...

Figure 3-71 ANSI 50G/51G – Protection parameters [P] and events [E] of SET 1

Parameter description:

The following parameter descriptions refer to all protection parameters of one parameter set.

NOTE: Each of the four parameter sets always provides the same group of protection parameters. Hence, the parameter descriptions of the SET PARAMETERS and the parameters of STEP 1 represented below are described in the following in detail as examples.

Protection parameters of parameter SET 1 – ANSI 50G/51G

SET PARAMETERS

The following SET PARAMETERS of the ground overcurrent protection exist only once in each of the four parameter sets. Thus, the SET PARAMETERS apply to all of the 6 protection STEPS of one parameter SET.

P2030 Ground overcurrent protection

This parameter enables/disables ground overcurrent protection wherein:

- “OFF”: disables or
- “ON”: enables the protective function.

When ground overcurrent protection ANSI 50G/51G is enabled by parameter [P2030], then event “ANSI50G/51G module active” [E1680] is being activated.

P2031 Blocking protection module

Ground overcurrent protection can be completely blocked by any active event. For blocking, the number related to this blocking event has to be assigned to parameter [P2031]. Blocking is only effective, however, as long as the blocking event is active. As soon as blocking is active, event “ANSI50G/51G blocked module” [E1681] is being activated. If the blocking event turns inactive, blocking is abandoned and protective function is effective again. Then, event [E1681] is being deactivated automatically.

If blocking of the ground overcurrent protection is not required, set this parameter to “0”.

Protection parameters of STEP 1

The following STEP parameters of the ground overcurrent protection exist only once in each of the 6 independent protection STEPS. Thus, the SET PARAMETERS apply only to one of the 6 protection STEPS of one parameter SET.

P2035 Pick-up source

Depending on the SYMAP®-Compact(+) device variant every protection step of ground overcurrent protection can be assigned to a certain current measurement input (CT-GND1, CT1 or CT2). Parameter [P2035] determines the current measurement input which will provide measurement values as characteristic quantity (ground current) to the first step of ground overcurrent protection:

- “none”: no ground current measurement; protection step is deactivated
- “CT-GND1”: measured ground current I_{GND} by CT-GND1
- “CT1”: calculated ground current: $I_{GND} = 3 \times I_0 = I_1 + I_2 + I_3$ from the phase currents, which are to be measured by CT1
- “CT2”: calculated ground current: $I_{GND} = 3 \times I_0 = I_1 + I_2 + I_3$ from the phase currents, which are to be measured by CT2

For settings “CT1” or “CT2”, event “ANSI50G/51G-1 step active” [E1687] is being activated.

P2036 Blocking protection step

The first step of ground overcurrent protection can be blocked by any active event. For blocking, the number related to this blocking event has to be assigned to parameter [P2036]. Blocking is only effective, however, as long as the blocking event is active. As soon as blocking is active, event “ANSI50G/51G-1 blocked step” [E1688] is being activated. If the blocking event turns inactive, blocking is abandoned and protective function is effective again. Then, event [E1688] is being deactivated automatically.

If blocking of the first step of ground overcurrent protection is not required, set this parameter to “0”.

P2037 Pick-up curve

Tripping characteristic of „Delay time/TMS“; via parameter [P2037]; the tripping characteristic of the first step of ground overcurrent protection is optionally adjustable as:

- “Definite Time-delay ground overcurrent protection” (DT) or
- “Inverse Definite Minimum Time-delay protection” (IDMT)

There are up to 7 different inverse time characteristics (IDMT) available, which accords to the US standard of the „American National Standard Institute ANSI“ or the international standard of „International Electrotechnical Commission IEC“:

- “Definite“: definite time (DT)
- “ANSI NINV“: “Normal Inverse“, (ANSI)
- “ANSI VINV“: “Very Inverse“ (ANSI)
- “ANSI EINV“: “Extremely Inverse“ (ANSI)
- “IEC NINV“: “Normal Inverse“, (IEC)
- “IEC VINV“: “Very Inverse“ (IEC)
- “IEC LINV“: “Long-term Inverse“ (IEC)
- “IEC EINV“: “Extremely Inverse“ (IEC)

Table 4-3 Parameters of inverse curves (IDMT)

Curve type	Operate (trip) time			Reset time		Designating
	$t(G) = TMS \left[\frac{k}{\left(\frac{G}{G_S} \right)^{\alpha} - 1} + c \right]$			$t_r(G) = TMS \left(\frac{t_r}{1 - \left(\frac{G}{G_S} \right)^{\alpha}} \right)$		
	k [s]	c [s]	α -	t_r [s]	α -	
A	0,14	0	0,02	0,14	2	Normal Inverse
B	13,5	0	1	13,5	2	Very inverse
-	120	0	1	120	2	Long-term inverse
C	80	0	2	80	2	Extremely invers
D	0,0515	0,1140	0,02	4,85	2	IEEE normal inverse
E	19,61	0,491	2	21,6	2	IEEE very invers
F	28,2	0,1217	2	29,1	2	IEEE extremely inverse
<u>whereby:</u> $t(G)$: theoretical operate timewith constant value of G (seconds) $t_r(G)$: time setting (reset time for G=0 and TMS = 1) k, c, α : constant values which define the chosen curve shape TMS: T ime M ultiplier S etting G: measured value of the characteristic quantity G_S : setting value (start) of the characteristic quantity						

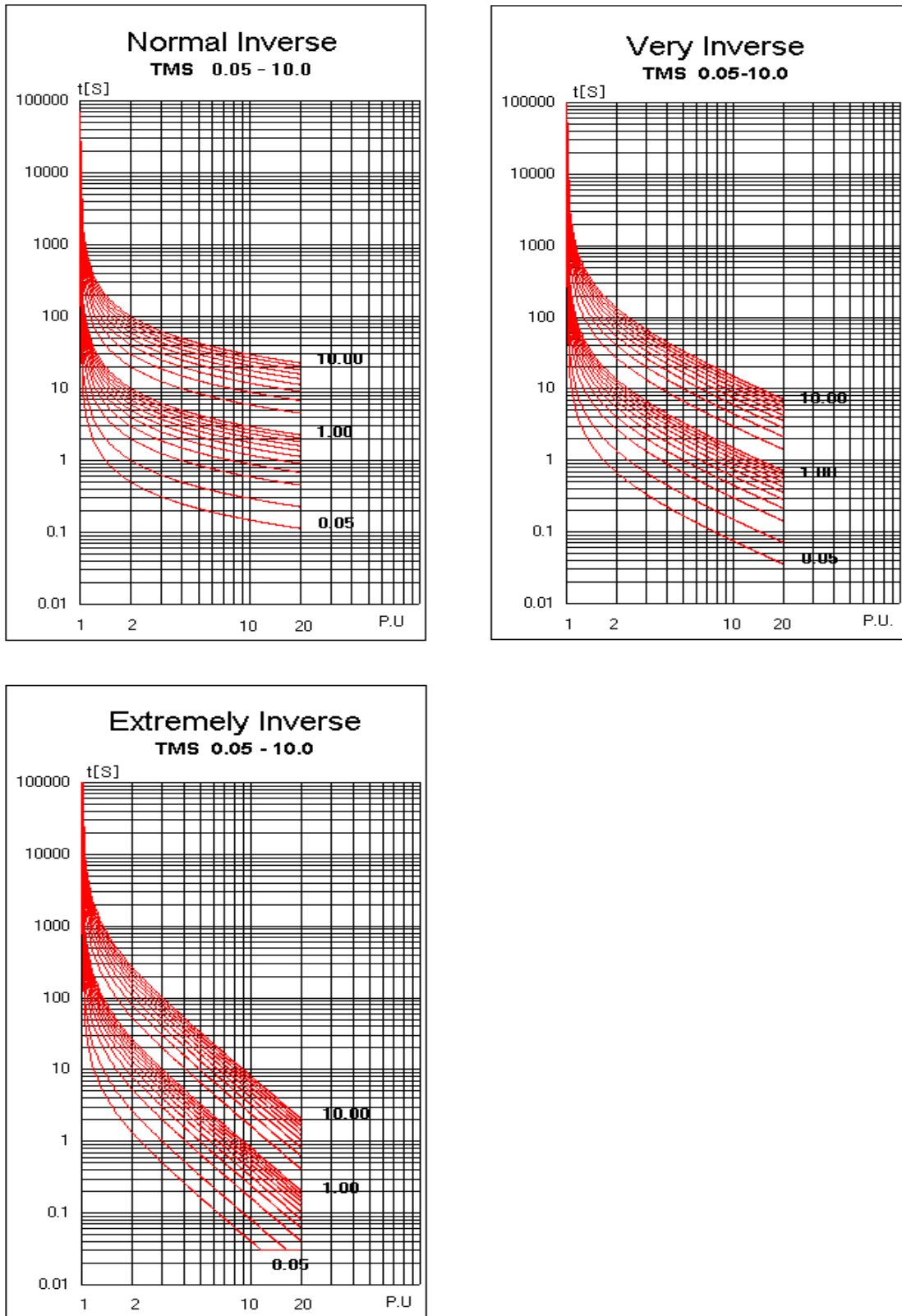


Figure 3-72 Inverse IEC curves – examples

P2038 Limit

Pick-up value of the first ground overcurrent protection element (STEP1); at the moment that the characteristic quantity (ground current) exceeds this limit, “ANSI/50G/51G-1 pick-up” [E1689] will become active, and “Delay time/TMS” of the first ground overcurrent protection element will start.

In case that the characteristic quantity (ground current) falls below "Limit" of the first ground overcurrent protection element before "Delay time/TMS" has run down, the timer of "Delay time/TMS" will be stopped and the attained time value is being safed.

NOTE: The *pick-up value* is to be set as a percentage of the *nominal value* of the characteristic quantity (ground current I_{GND}). The nominal value of the characteristic quantity is to be set by parameter:

- "Ground current" [P607], for primary side W1 or
- "Ground current" [P617], for secondary side W2 or
- "Ground current" [P627], for tertiary side W3.

The referring parameters "Ground current" [P607], "Ground current" [P617] and "Ground current" [P627] are located in submenu: "SYSTEM\Nominals\Reference values".

P2039 Delay time/TMS

Tripping delay time of trip event "ANSI50G/51G-1 trip" [E1690]; the working principle of the delay time counter depends on the *tripping characteristic* set by parameter "Pickup curve" [P2037]. Hence follows that parameter "Delay Time/TMS" [P2039] takes on a different meaning, depending on the chosen tripping characteristic (DT or IDMT).

- **DT tripping characteristic:** "Pickup curve" [P2037] = "Definite"
In this case the *tripping delay time* is equal to a constant time value set by parameter "Delay time/TMS" [P2039].
- **IDMT tripping characteristic:** e.g. "Pickup curve" [P2037] = "ANSI NINV"
For this, the *tripping delay time* is not constant, but, it will be calculated cyclically, depending on the adjusted IDMT curve and the level of momentary phase current increase (characteristic quantity). Therefore, setting of parameter "Delay Time /TMS" [P2039] means a displacement with regard to the time axis of the tripping curve ("TMS": Time Multiplier Setting)

If pick-up event "ANSI50G/51G-1 pick-up" [E1689] is active and "Delay Time/TMS" run down, trip event "ANSI50G/51G-1 trip" [E1690] will be activated. This event can be used for alarm or output control purposes.

P2042 Reset limit

Pick-up reset limit of the first ground overcurrent protection element (STEP1); if the

- pick-up event "ANSI50G/51G-1 pickup" [E1689] is active **and**
- the characteristic quantity (ground current) falls below the pick-up value "Limit" **and**
- the characteristic quantity (ground current) falls below the pick-up reset value "Reset limit",

then, pick-up event [E1689] is being deactivated and the timer of the "Reset delay time pick-up" will start.

NOTE: The "Reset limit" is to be set as a percentage of the *nominal value* of the characteristic quantity (ground current I_{GND}). The nominal value of the characteristic quantity is to be set by parameter:

- "Ground current" [P607], for primary side W1 or
- "Ground current" [P617], for secondary side W2 or
- "Ground current" [P627], for tertiary side W3.

The referring parameters “Ground current” [P607], “Ground current” [P617] and “Ground current” [P627] are located in submenu: “SYSTEM\Nominals\Reference values”.

P2040 Reset curve

Reset characteristic of “Delay time/TMS”; via parameter [P2040] the *reset characteristic* of the first step of ground overcurrent protection is optionally adjustable as:

- “Definite Time-delay ground overcurrent protection” (DT) or
- “Inverse Definite Minimum Time-delay protection” (IDMT)

There are up to 7 different *inverse time characteristics* available, which accords to the US standard of the “American National Standard Institute ANSI” or the international standard of “International Electrotechnical Commission IEC”:

- “Definite”: definite time (DT)
- “ANSI NINV”: “Normal Inverse”, (ANSI)
- “ANSI VINV”: “Very Inverse” (ANSI)
- “ANSI EINV”: “Extremely Inverse” (ANSI)
- “IEC NINV”: “Normal Inverse”, (IEC)
- “IEC VINV”: “Very Inverse” (IEC)
- “IEC LINV”: “Long-term Inverse” (IEC)
- “IEC EINV”: “Extremely Inverse” (IEC)

NOTE: If the *tripping characteristic* of “Delay time/TMS” is set to “Definite” (DT), then parameter “Reset curve” [P2040] only provides setting option “Definite” (DT).

If the *tripping characteristic* of “Delay time/TMS” is set to “xxx INV” (IDMT), then parameter “Reset curve” [P2040] provides both, setting option “Definite” (DT) or setting option “xxx INV” (IDMT).

P2044 Reset delay time pick-up

Delay time to reset the stored counter value of the tripping delay time; in case that the tripping delay time (“Delay time/TMS”) has not yet run down.

CAUTION: Parameter [P2044] is only valid in case of “Reset curve” [P2040] = “Definite”!

While the timer of the “Reset delay time pick-up” is running, the counter value of the *tripping delay time* maintains at a constant level.

After the “Reset delay time pick-up” has run down, the counter value of the *tripping delay time* (“Delay time/TMS”) will be reset.

P2043 Reset delay time trip/TMS

Delay time to reset the trip event “ANSI50G/51G-1 trip” [E1690]; the operating procedure of the timer for resetting the trip event depends on the set characteristic of the *reset curve*. Hence follows that parameter “Reset delay time trip/TMS” [P2043] takes on a different meaning, depending on the *reset characteristic* of “Reset curve” (DT or IDMT) set by parameter “Reset curve” [P2040]:

- **DT reset characteristic:** “Reset curve” [P2040] = “Definite”
The *delay time to reset the trip event* is equal to a constant time value, to be set by parameter “Reset **delay time trip/TMS**” [P2043].
- **IDMT reset characteristic:** e.g. “Reset curve” [P2040] = “ANSI NINV”
The *delay time to reset the trip event* is not a constant time value, but, depending on the inverse curve shape and the measured value of the characteristic quantity

(ground current) it will be cyclically re-calculated. When applying any inverse curve (IDMT) to the reset curve, this means the setting of parameter *“Reset delay time trip/TMS”* [P2043] takes on a displacement of the inverse curve shape with regard to the time axis (*“TMS”: Time Multiplier Setting*).

If trip event *“ANSI50G/51G-1 trip”* [E1690] is activated and *“Reset delay time trip/TMS”* has run down, the trip event *“ANSI50G/51G-1 trip”* [E1690] will be deactivated.

NOTE: In dependence of the set value of parameter *“Reset after TRIP immediately”* [P2041], deactivating of trip event *“ANSI50G/51G-1 trip”* [E1690] takes on a different working principle.

P2041 Reset after TRIP immediately

Immediate reset of trip event “ANSI50G/51G-1 trip” [E1690]; in case that the *reset curve* is assigned an inverse characteristic (IDMT), then „Reset after TRIP immediately“ can be activated/deactivated by parameter [P2041] as soon as the characteristic quantity (ground current) falls below the *“Reset Limit”*.

- *“OFF”:* *Immediate reset of trip event “ANSI50G/51G-1 trip”* [E1690] is deactivated
- *“ON”:* *Immediate reset of trip event “ANSI50G/51G-1 trip”* [E1690] is activated

NOTE: If the *reset curve* of the first protection element (STEP1) is assigned a *definite time (DT)* characteristic (parameter *“Reset curve”* [P2040] = „Definite“), and the trip event *“ANSI50G/51G-1 trip”* [E1690] should immediately be reset, then set parameter *“Reset Delay time/TMS”* [P2043] = *“0”*.

P2045 Harmonics stabilizer

Blocking of the first protection element (STEP1) of ground overcurrent protection by “harmonics stabilizer ANSI 95i” function for measuring values of CT1; according to the settings of the “harmonics stabilizer ANSI 95i” function, the ground overcurrent protection may be temporarily blocked upon exceeding of defined contents of the 2nd and/or 5th harmonic ($I_{100\text{Hz}}$ and/or $I_{250\text{Hz}}$) in the phase current:

- *“OFF”:* blocking of *ANSI 50G/51G-1* by ANSI 95i is deactivated
- *“2H”:* blocking of *ANSI 50G/51G-1* by ANSI 95i in case of 2nd harmonic
- *“5H”:* blocking of *ANSI 50G/51G-1* by ANSI 95i in case of 5th harmonic
- *“2H/5H”:* blocking of *ANSI 50G/51G-1* by ANSI 95i in case of 2nd or 5th harmonic

NOTE: Appropriate settings of the corresponding parameters of ANSI95i are to be done in the submenu: **“PROTECTION\95i Harmonics stabilizer”**.

P2052 Min. delay time

NOTE: This parameter only applies for inverse trip characteristics (IDMT curves)!

Minimum trip delaytime for inverse trip curves; in case of high.current faults the tripping delay time could be too less for the application. To avoid this, a minimum trip delaytime can be set by parameter *“Min. delay time”* [P2052]

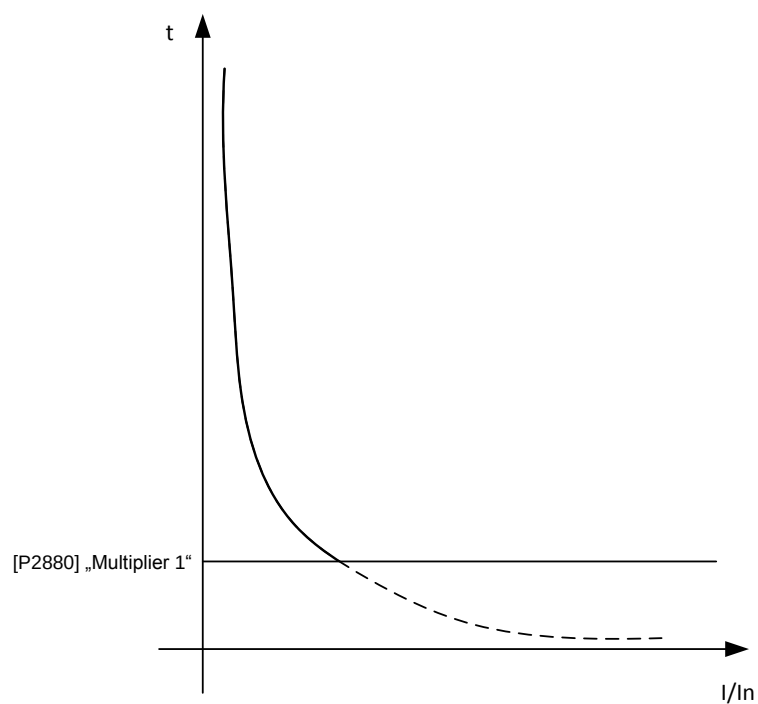


Figure 3-73 IDMT Trip characteristic– minimum trip delay time

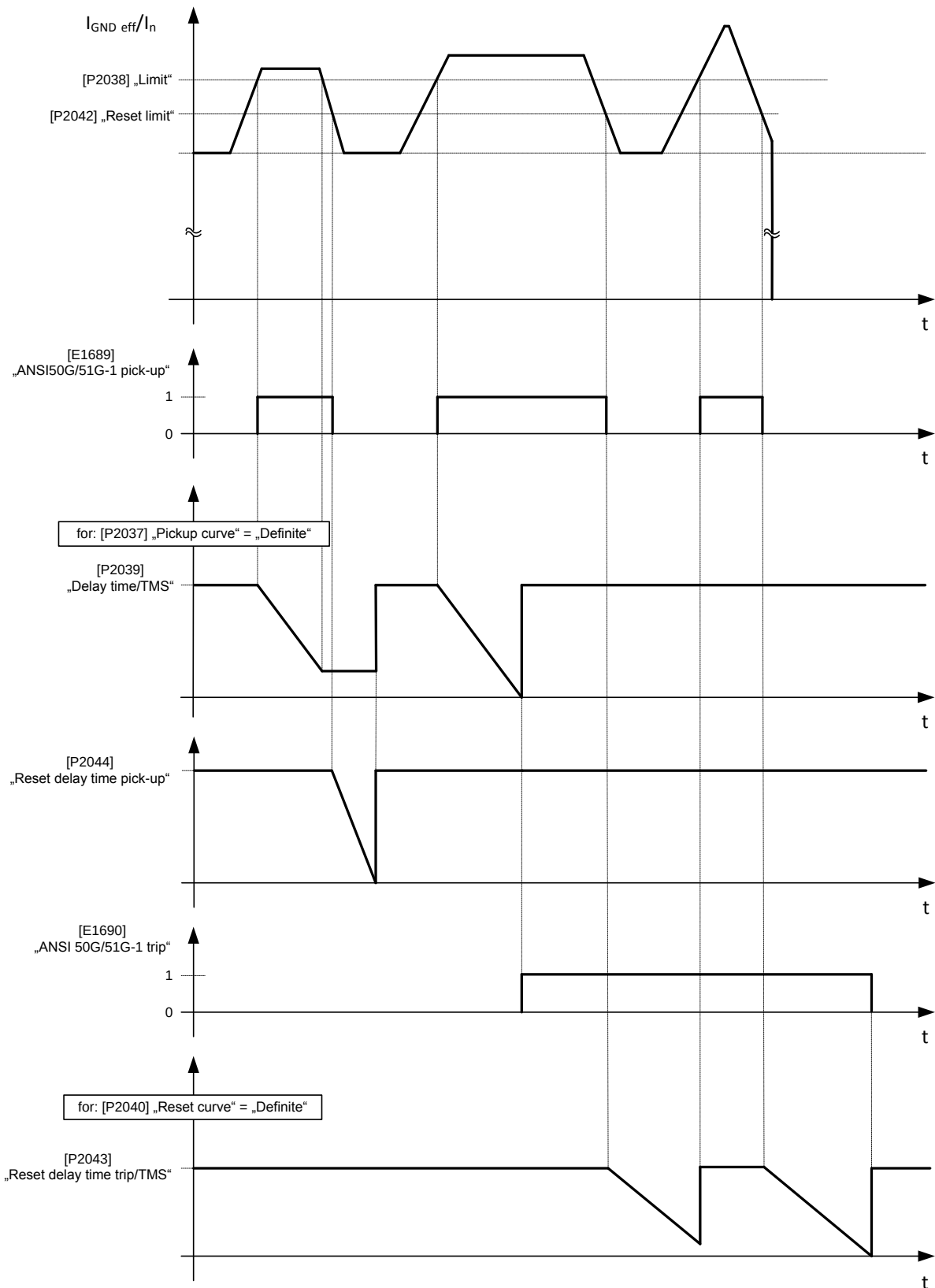


Figure 3-74 Ground overcurrent prot. – Trip characteristic (DT) and Reset characteristic (DT)

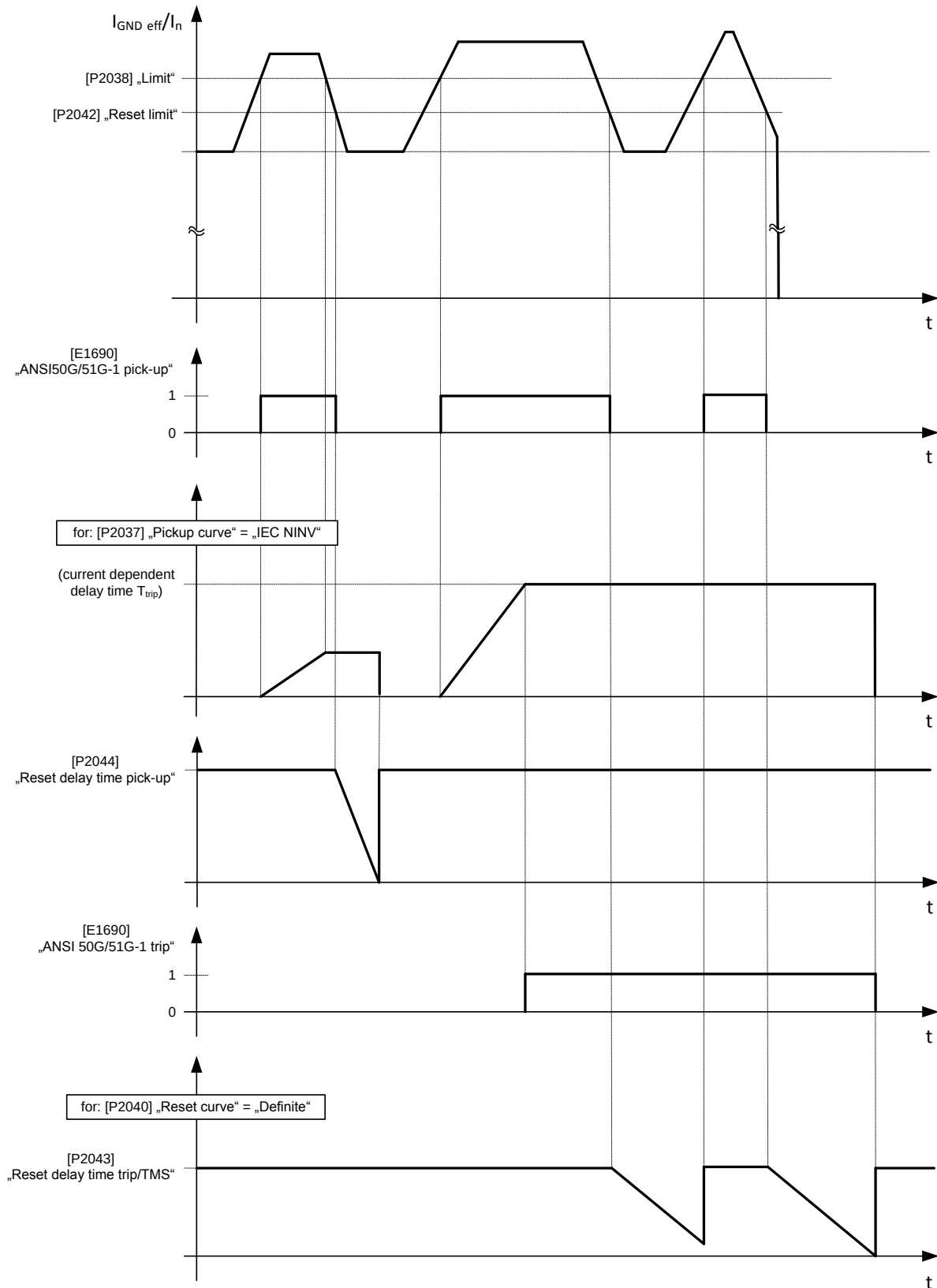


Figure 3-75 Ground overcurrent prot. – Trip characteristic (IDMT) and Reset characteristic (DT)

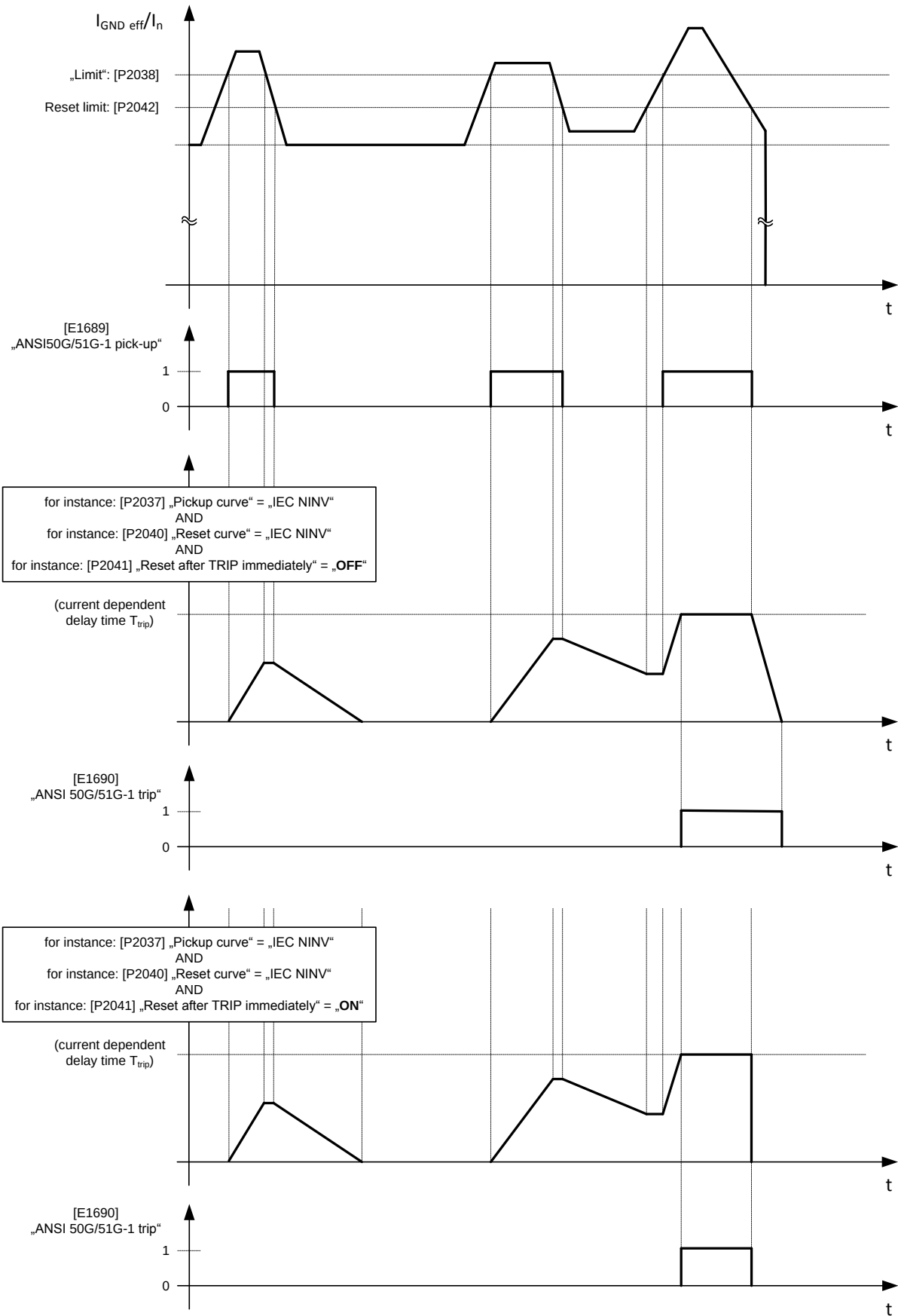


Figure 3-76 Ground overcurrent prot. – Trip characteristic (IDMT) and Reset characteristic (IDMT)

3.5.10 ANSI 51/46 VR – Voltage restraint

Main Menu\Parameters\PROTECTION\ANSI25-50/51\					
ANSI 51/46VR					
SET 1	SET 2	SET 3	SET 4		
P/E No.	Name		Value	Unit	(Setting range)
SET PARAMETERS					
P2875	Function		OFF	-	ON/OFF
P2876	Blocking		0	event	0 ... 9999
P2877	Voltage reference		L-L	-	L-L/L-N
P2878	Limit 1		10	%	0 ... 200
P2879	Multiplier 1		0,1	s	0 ... 1
P2880	Limit 2		0	s	0 ... 200
P2881	Multiplier 2		1		0 ... 1
P2882	Blocking protection		OFF		ON/OFF
E2240	ANSI51/46VR active		-	-	-
E2241	ANSI51/46VR blocked		-	-	-
E2242	ANSI51/46VR prot. blocking		-	-	-

Figure 3-77 ANSI 51/46 VR – Protection parameters [P] and events [E] of SET 1

Parameter description:

The following parameter descriptions refer to all protection parameters of one parameter set.

NOTE: Each of the four parameter sets always provides only one protection STEP and, as consequence, only one group of parameters. Thus, SET PARAMETERS of SET 1 represented below are described in the following in detail as examples.

Protection parameters of parameter of SET 1 – ANSI 51/46 VR

P2875 Function

This parameter enables/disables voltage restraint overcurrent protection wherein:

- “OFF”: disables or
- “ON”: enables the protective function.

When overvoltage protection ANSI 51/46 VR is enabled by parameter [P2875], then event “ANSI51/46VR active” [E2240] is being activated.

P2876 Blocking protection

Voltage restraint overcurrent protection can be completely blocked by any active event. For blocking, the number related to this blocking event has to be assigned to parameter [P2876]. Blocking is only effective, however, as long as the blocking event is active. As soon as blocking is active, event “ANSI51/46VR blocked” [E2241] is being activated. If the blocking event turns inactive, blocking is abandoned and protective function is effective again. Then, event [E2241] is being deactivated automatically.

If blocking of the voltage restraint overcurrent protection is not required, set this parameter to “0”.

P2877 Voltage reference

Reference value of protection set values for the voltage restraint overcurrent protection module; calculation the settings of parameters “Limit” and “Reset limit” of the overcurrent protection ANSI 50/51 can be assigned by the following setting options either:

- “L-L”: to phase-to-phase voltage U_{L-L} as characteristic quantity or
- “L-N”: to phase-to-neutral voltage U_{L-N} as characteristic quantity.

Setting the voltage restraint curve for calculating the multiplier for adaption of pick-up value “Limit and the “Reset limit”

Each protective element of overcurrent protection ANSI 50/51 provides an additional parameter “Voltage restrained” [Pxxxx] for activating the voltage restrained adaption of the pick-up value “Limit and the “Reset limit”. These limits are to be multiplied by a calculated factor (Multiplier).

The multiplier is proportional to the voltage ratio U/U_n . The curve for calculating the multiplier is to be set by the following four parameters.

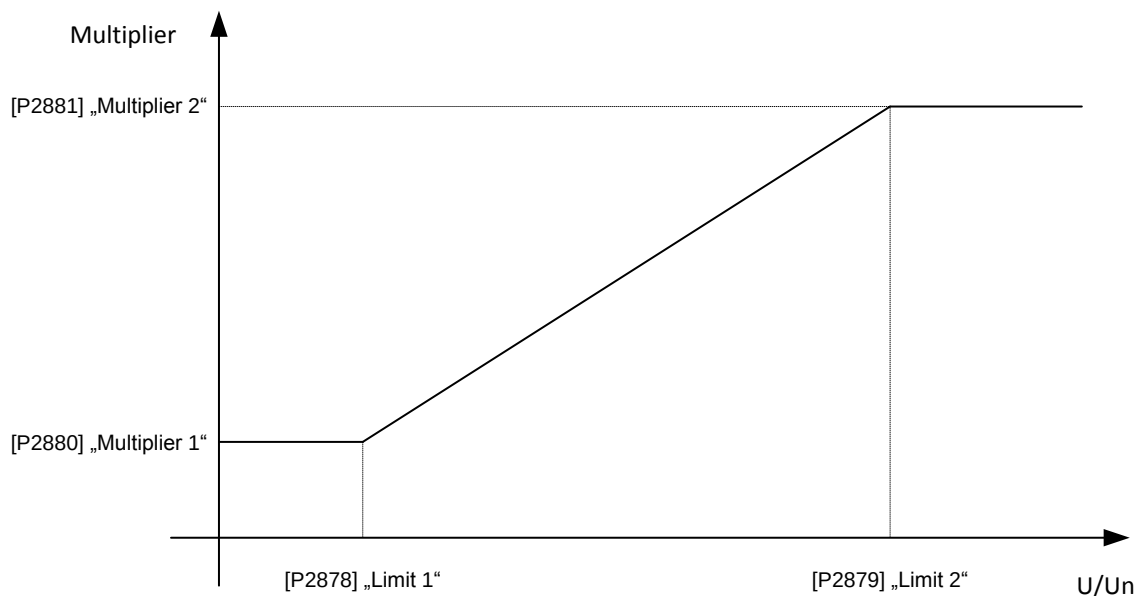


Figure 3-78 ANSI 51/46VR – Voltage-dependent curve for calculation of the multiplier

P2878 Limit 1

Start value of the voltage ration U/U_n to define the voltage stabilising curve; together with parameter “Multiplier 1” [P2879] the set vaule of parameter [P2878] determines the beginning of the voltage-stabilized curve.

P2879 Multiplier 1

Start value of the multiplier to define the voltage stabilising curve; together with parameter “Limit 1” [P2878] the set vaule of parameter [P2879] determines the beginning of the voltage-stabilized curve,

P2880 Limit 2

Maximum value of the voltage ration U/U_n to define the voltage stabilising curve; together with parameter “Multiplier 2” [P2881] the set vaule of parameter [P2880] determines the end of the voltage-stabilized curve, and as consequence, the maximum adaption of the pick-up value “Limit and the “Reset limit”.

P2881 Multiplier 2

Maximum value of the voltage ration U/U_n to define the voltage stabilising curve; together with parameter “Limit 2” [P2880] the set vaule of parameter [P2881] determines

the *end of the voltage-stabilized curve*, and as consequence, the maximum adaption of the *pick-up value* "*Limit*" and the "*Reset limit*".

P2882 Blocking protection

Blocking of a voltage restrained overcurrent protection step; whereas:

- "OFF": disables "Blocking protection" or
- "ON": enables "Blocking protection".

If:

- function „Blocking protection“ *is activated and*
- the *voltage ratio* U/U_n exceeds the set value of parameter "*Limit 2*" [P2880],

all the *voltage restrained overcurrent protection steps* ("*Voltage restrained [Pxxxx] = ON*") of function "Overcurrent protection ANSI 50/51" automatically will be blocked.

3.5.11 ANSI 59 – Overvoltage Protection

Main Menu\Parameters\PROTECTION\ANSI59-95i\					
ANSI 59					
SET 1	SET 2	SET 3	SET 4		
P/E No.	Name		Value	Unit	(Setting range)
SET PARAMETERS					
P1200	Overvoltage protection		OFF	-	ON/OFF
P1201	Blocking protection module		0	event	0 ... 9999
P1202	Voltage reference		L-L	-	L-L/L-N
E1150	ANSI59 module active		-	-	-
E1151	ANSI59 blocked module		-	-	-
STEP 1					
P1205	Pickup source		PT1	-	none/PT1/PT2/PT3
P1206	Blocking protection step		0	event	0 ... 9999
P1207	Limit		110	%	0 ... 200
P1208	Delay time		2	s	0 ... 999999,999
P1209	Reset limit		105	%	0 ... 200
P1210	Reset delay time trip		1	s	0 ... 999999,999
P1211	Reset delay time pickup		1	s	0 ... 999999,999
E1154	ANSI59-1 step active		-	-	-
E1155	ANSI59-1 blocked step		-	-	-
E1156	ANSI59-1 pickup		-	-	-
E1157	ANSI59-1 trip		-	-	-
STEP 2					
P1215	Pickup source		PT1	-	none/PT1/PT2/PT3
...	...		...	...	...

Figure 3-79 ANSI 59 – Protection parameters [P] and events [E] of SET 1

Parameter description:

The following parameter descriptions refer to all protection parameters of one parameter set.

NOTE: Each of the four parameter sets always provides the same group of protection parameters. Hence, the parameter descriptions of the SET PARAMETERS and the parameters of STEP 1 represented below are described in the following in detail as examples.

Protection parameters of parameter SET 1 – ANSI 59

SET PARAMETERS

The following SET PARAMETERS of the overvoltage protection exist only once in each of the four parameter sets. Thus, the SET PARAMETERS apply to all of the 12 protection STEPS of one parameter SET.

P1200 Overvoltage protection

This parameter enables/disables overvoltage protection wherein:

- “OFF”: disables or
- “ON”: enables the protective function.

When overvoltage protection ANSI 59 is enabled by parameter [P1200], then event “ANSI59 module active” [E1150] is being activated.

P1201 Blocking protection module

Overvoltage protection can be completely blocked by any active event. For blocking, the number related to this blocking event has to be assigned to parameter [P1201]. Blocking is only effective, however, as long as the blocking event is active. As soon as blocking is active, event “ANSI59 blocked module” [E1151] is being activated. If the blocking event turns inactive, blocking is abandoned and protective function is effective again. Then, event [E1151] is being deactivated automatically.

If blocking of the overvoltage protection is not required, set this parameter to “0”.

P1202 Voltage reference

Reference value of protection set values for the overvoltage protection module; the settings of parameters “Limit” and “Reset limit” can be assigned by the following setting options either:

- “L-L”: to phase-to-phase voltage U_{L-L} as characteristic quantity or
- “L-N”: to phase-to-neutral voltage U_{L-N} as characteristic quantity.

Protection parameters of STEP 1

The following STEP parameters of the overvoltage protection exist only once in each of the 12 independent protection STEPS. Thus, the SET PARAMETERS apply only to one of the 12 protection STEPS of one parameter SET.

P1205 Pick-up source

Depending on the SYMAP®-Compact(+) device variant every protection step of overvoltage protection can be assigned to a certain voltage measurement input (PT1, PT2 or PT3). Parameter [P1205] determines the voltage measurement input which will provide measurement values as characteristic quantities (voltage) to the overvoltage protection:

- “none”: no voltage measurement; protection step is deactivated
- “PT1”: voltage input PT1
- “PT2”: voltage input PT2
- “PT3”: voltage input PT3

For settings “PT1”, “PT2” or “PT3”, event “ANSI59-1 step active” [E1154] is being activated.

P1206 Blocking protection step

The first step of overvoltage protection can be blocked by any active event. For blocking, the number related to this blocking event has to be assigned to parameter [P1206]. Blocking is only effective, however, as long as the blocking event is active. As soon as blocking is active, event “ANSI59-1 blocked step” [E1155] is being activated. If the blocking event turns inactive, blocking is abandoned and protective function is effective again. Then, event [E1155] is being deactivated automatically.

If blocking of the first step of overvoltage protection is not required, set this parameter to “0”.

P1207 Limit

Pick-up value of the first overvoltage protection element. At the moment that the characteristic quantity (voltage) exceeds this limit, pick-up event “ANSI59-1 pickup” [E1156] will become active, and the trip delay time (“Delay time”) of the first overvoltage protection element will start.

NOTE: The *pick-up value* is to be set as a percentage of the *nominal value* of the chosen characteristic quantity (phase-to-phase voltage or phase-to-neutral voltage) by parameter “*Voltage reference*” [P1202]. However, the chosen characteristic value refers to the nominal value of the phase-to-phase voltage to be set by parameter:

- “*Voltage (L-L)*” [P603], for primary side W1 or
- “*Voltage (L-L)*” [P613], for secondary side W2 or
- “*Voltage (L-L)*” [P623], for tertiary side W3.

Hence, in case that the calculation of the *pick-up value* refers to the phase-to-neutral voltage, parameter “*Voltage reference*” [P1202] is to be set to “*L-N*”, so that factor $\sqrt{3}$ is not necessary to be considered for calculation.

The referring parameters “*Voltage (L-L)*” [P603], “*Voltage (L-L)*” [P613] and “*Voltage (L-L)*” [P623] are located in submenu: “SYSTEM\Nominals\Reference values”.

P1208 Delay time

Trip delay time; it is the delay time of the trip event “*ANSI59-1 trip*” [E1157].

As soon as the pick-up event “*ANSI59-1 pickup*” [E1156] is active and “*Delay time*” run down, trip event [E1157] will be activated. This event can be used for alarm or output control purposes.

In case that the characteristic quantity (voltage) falls below the pick-up value (“*Limit*”) of the first overvoltage protection step before the trip delay time (“*Delay time*”) has run down, the timer of “*Delay time*” will be stopped and the counter value is being saved. If the characteristic quantity subsequently falls below the “*Reset limit*”, then, the “*Reset delay time pick-up*” timer will start and the pick-up event [E1156] will be deactivated.

1211 Reset delay time pick-up

Pick-up reset delay time; it is the delay time for resetting the trip delay time (“*Delay time*”).

As soon as the pick-up reset delay time (“*Reset delay time pick-up*”) has run down the counter of the trip delay time (“*Delay time*”) is being reset.

P1209 Reset limit

Reset limit of the first step of overvoltage protection. As soon as the trip event “*ANSI59-1 trip*” [E1157] is active and the characteristic quantity (voltage) exceeds the “*Reset limit*”, the timer of the trip reset delay time (“*Reset delay time trip*”) will start.

NOTE: The *reset limit* is to be set as a percentage of the *nominal value* of the chosen characteristic quantity (phase-to-phase voltage or phase-to-neutral voltage) by parameter “*Voltage reference*” [P1202]. However, the chosen characteristic value refers to the nominal value of the phase-to-phase voltage to be set by parameter:

- “*Voltage (L-L)*” [P603], for primary side W1 or
- “*Voltage (L-L)*” [P613], for secondary side W2 or
- “*Voltage (L-L)*” [P623], for tertiary side W3.

Hence, in case that the calculation of the *pick-up value* refers to the phase-to-neutral voltage, parameter “*Voltage reference*” [P1202] is to be set to “*L-N*”, so that factor $\sqrt{3}$ is not necessary to be considered for calculation.

The referring parameters “*Voltage (L-L)*” [P603], “*Voltage (L-L)*” [P613] and “*Voltage (L-L)*” [P623] are located in submenu: “SYSTEM\Nominals\Reference values”.

P1210 Reset delay time trip

Trip reset delay time; it is the delay time for resetting the trip event “ANSI59-1 trip” [E1157].

If the trip reset delay time (“Reset delay time trip”) has run down, trip event “ANSI59-1 trip” [E1157] is being deactivated. In case that the characteristic quantity (voltage) exceeds the pick-up value (“Limit”) of the first overvoltage protection element before the timer of “Reset delay time trip” has run down, the timer of “Reset delay time trip” will be reset. Then trip event “ANSI59-1 trip” [E1157] remains active.

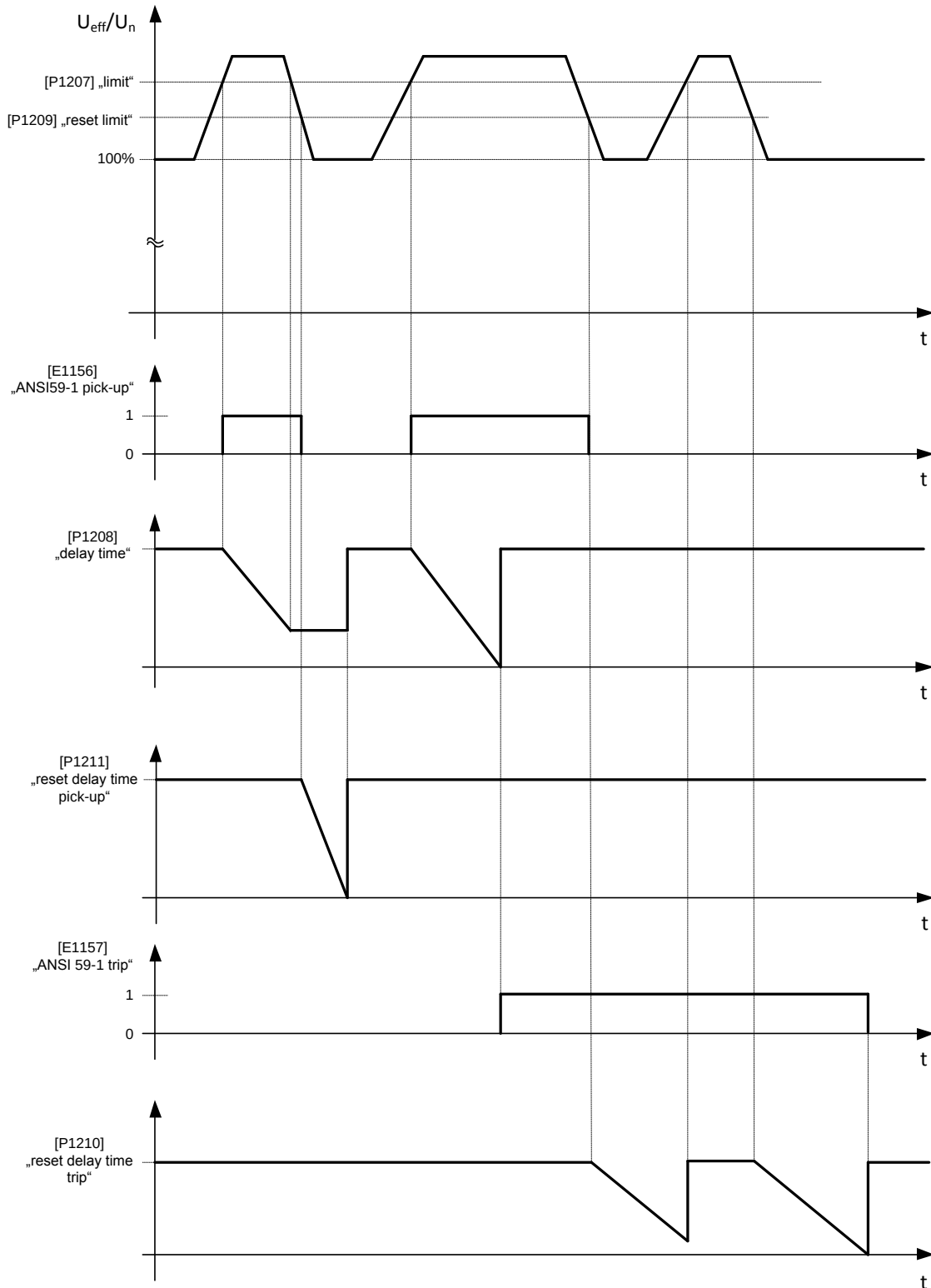


Figure 3-80 Overvoltage – Tripping and reset characteristic

3.5.12 ANSI 59N/G – Neutral Voltage Displacement (NVD)

Main Menu\Parameters\PROTECTION\ANSI59-95i\					
ANSI 59N/G					
SET 1	SET 2	SET 3	SET 4		
P/E No.	Name	Value	Unit	(Setting range)	
SET PARAMETERS					
P1535	Ground voltage protection	OFF	-	ON/OFF	
P1536	Blocking protection module	0	event	0 ... 9999	
E1370	ANSI59N/G module active	-	-	-	
E1371	ANSI59N/G blocked module	-	-	-	
STEP 1					
P1540	Pickup source	PT-GND1	-	none/PT-GND1/PT1/PT2/PT3	
P1541	Blocking protection step	0	event	0 ... 9999	
P1542	Limit	110	%	0 ... 200	
P1543	Delay time	2	s	0 ... 999999,999	
P1544	Reset limit	105	%	0 ... 200	
P1545	Reset delay time trip	1	s	0 ... 999999,999	
P1546	Reset delay time pickup	1	s	0 ... 999999,999	
E1373	ANSI59N/G-1 step active				
E1374	ANSI59N/G-1 blocked step	-	-	-	
E1375	ANSI59N/G-1 pickup	-	-	-	
E1376	ANSI59N/G-1 trip	-	-	-	
STEP 2					
P1550	Pickup source	PT-GND1	-	none/PT-GND1/PT1/PT2/PT3	
...	...	...	...	...	

Figure 3-81 ANSI 59N/G – Protection parameters [P] and events [E] of SET 1

Parameter description:

The following parameter descriptions refer to all protection parameters of one parameter set.

Note: Each of the four parameter sets always provides the same group of protection parameters. Hence, the parameter descriptions of the SET PARAMETERS and the parameters of STEP 1 represented below are described in the following in detail as examples.

Protection parameters of parameter SET 1 – ANSI 59N/G

SET PARAMETERS

The following SET PARAMETERS of the neutral voltage displacement protection exist only once in each of the four parameter sets. Thus, the SET PARAMETERS apply to all of the 4 protection STEPS of one parameter SET.

P1535 Neutral voltage protection

This parameter enables/disables neutral voltage displacement protection wherein:

- “OFF”: disables or
- “ON”: enables the protective function.

When neutral voltage displacement protection ANSI 59N/G is enabled by parameter [P1535], then event “ANSI59N/G module active” [E1150] is being activated.

P1536 Blocking protection module

Neutral voltage displacement protection can be completely blocked by any active event. For blocking, the number related to this blocking event has to be assigned to parameter [P1536]. Blocking is only effective, however, as long as the blocking event is active. As soon as blocking is active, event *"ANSI59N/G blocked module"* [E1371] is being activated. If the blocking event turns inactive, blocking is abandoned and protective function is effective again. Then, event [E1371] is being deactivated automatically.

If blocking of the neutral voltage displacement protection is not required, set this parameter to **"0"**.

Protection parameters of STEP 1

The following STEP parameters of the neutral voltage displacement protection exist only once in each of the 4 independent protection STEPS. Thus, the SET PARAMETERS apply only to one of the 4 protection STEPS of one parameter SET.

P1540 Pick-up source

Depending on the SYMAP[®]-Compact(+) device variant every protection step of neutral voltage displacement protection can be assigned to a certain voltage measurement input (PT-GND1, PT1, PT2 or PT3). Parameter [P1540] determines whether the neutral voltage is measured directly (PT-GND1), or the voltage measurement inputs will provide phase voltages for the calculation of neutral voltage displacement:

- "none": no voltage measurement; protection step is deactivated
- "PT-GND1": neutral voltage is measured by PT-GND1
- "PT1": neutral voltage is calculated by measurement values of voltage input PT1
- "PT2": neutral voltage is calculated by measurement values of voltage input PT2
- "PT3": neutral voltage is calculated by measurement values of voltage input PT3

For settings "PT-GND1", "PT1", "PT2" or "PT3", event *"ANSI59N/G-1 step active"* [E1373] is being activated.

P1541 Blocking protection step

The first step of neutral voltage displacement protection can be blocked by any active event. For blocking, the number related to this blocking event has to be assigned to parameter [P1541]. Blocking is only effective, however, as long as the blocking event is active. As soon as blocking is active, event *"ANSI59N/G-1 blocked step"* [E1374] is being activated. If the blocking event turns inactive, blocking is abandoned and protective function is effective again. Then, event [E1374] is being deactivated automatically.

If blocking of the first step of neutral voltage displacement protection is not required, set this parameter to **"0"**.

P1542 Limit

Pick-up value of the first neutral voltage displacement protection element; at the moment that the characteristic quantity (neutral voltage) exceeds this limit, pick-up event *"ANSI59N/G-1 pickup"* [E1375] will become active, and the trip delay time ("Delay time") of the first neutral voltage displacement protection step will start.

NOTE: The *pick-up value* is to be set as a percentage of the *nominal value* of the characteristic quantity (residual voltage U_{GND}). The nominal value of the characteristic quantity is to be set by parameter:

- "Ground voltage" [P606], for primary side W1 or
- "Ground voltage" [P616], for secondary side W2 or
- "Ground voltage" [P626], for tertiary side W3

The referring parameters “Ground voltage” [P606], “Ground voltage” [P616] and “Ground voltage” [P626] are located in submenu: “SYSTEM\Nominals\Reference values”.

P1543 Delay time

Trip delay time; it is the delay time of the trip event “ANSI59N/G-1 trip” [E1376]. As soon as the pick-up event “ANSI59N/G-1 pickup” [E1375] is active and “Delay time” run down, trip event [E1376] will be activated. This event can be used for alarm or output control purposes. In case that the characteristic quantity (neutral voltage) falls below the pick-up value (“Limit”) of the first neutral voltage displacement protection step before the trip delay time (“Delay time”) has run down, the timer of “Delay time” will be stopped and the counter value is being saved. If the characteristic quantity subsequently falls below the “Reset limit”, then, the “Reset delay time pick-up” timer will start and the pick-up event [E1375] will be deactivated.

P1546 Reset delay time pick-up

Pick-up reset delay time; it is the delay time for resetting the trip delay time (“Delay time”). As soon as the pick-up reset delay time (“Reset delay time pick-up”) has run down the counter of the trip delay time (“Delay time”) is being reset.

P1544 Reset limit

Trip reset limit of the first step of neutral voltage displacement protection. As soon as the trip event “ANSI59N/G-1 trip” [E1376] is active and the characteristic quantity (neutral voltage) exceeds the “Reset limit”, the timer of the trip reset delay time (“Reset delay time trip”) will start.

NOTE: The *reset limit* is to be set as a percentage of the *nominal value* of the characteristic quantity (residual voltage U_{GND}). The nominal value of the characteristic quantity is to be set by parameter:

- “Ground voltage” [P606], for primary side W1 or
- “Ground voltage” [P616], for secondary side W2 or
- “Ground voltage” [P626], for tertiary side W3

The referring parameters “Ground voltage” [P606], “Ground voltage” [P616] and “Ground voltage” [P626] are located in submenu: “SYSTEM\Nominals\Reference values”.

P1545 Reset delay time trip

Trip reset delay time; it is the delay time for resetting the trip event “ANSI59N/G-1 trip” [E1376]. If the trip reset delay time (“Reset delay time trip”) has run down, trip event „ANSI59N/G-1 trip” [E1376] is being deactivated. In case that the characteristic quantity (neutral voltage) exceeds the pick-up value (“Limit”) of the first neutral voltage displacement protection element before the timer of “Reset delay time trip” has run down, the timer of “Reset delay time trip” will be reset. Then trip event “ANSI59N/G-1 trip” [E1376] remains active.

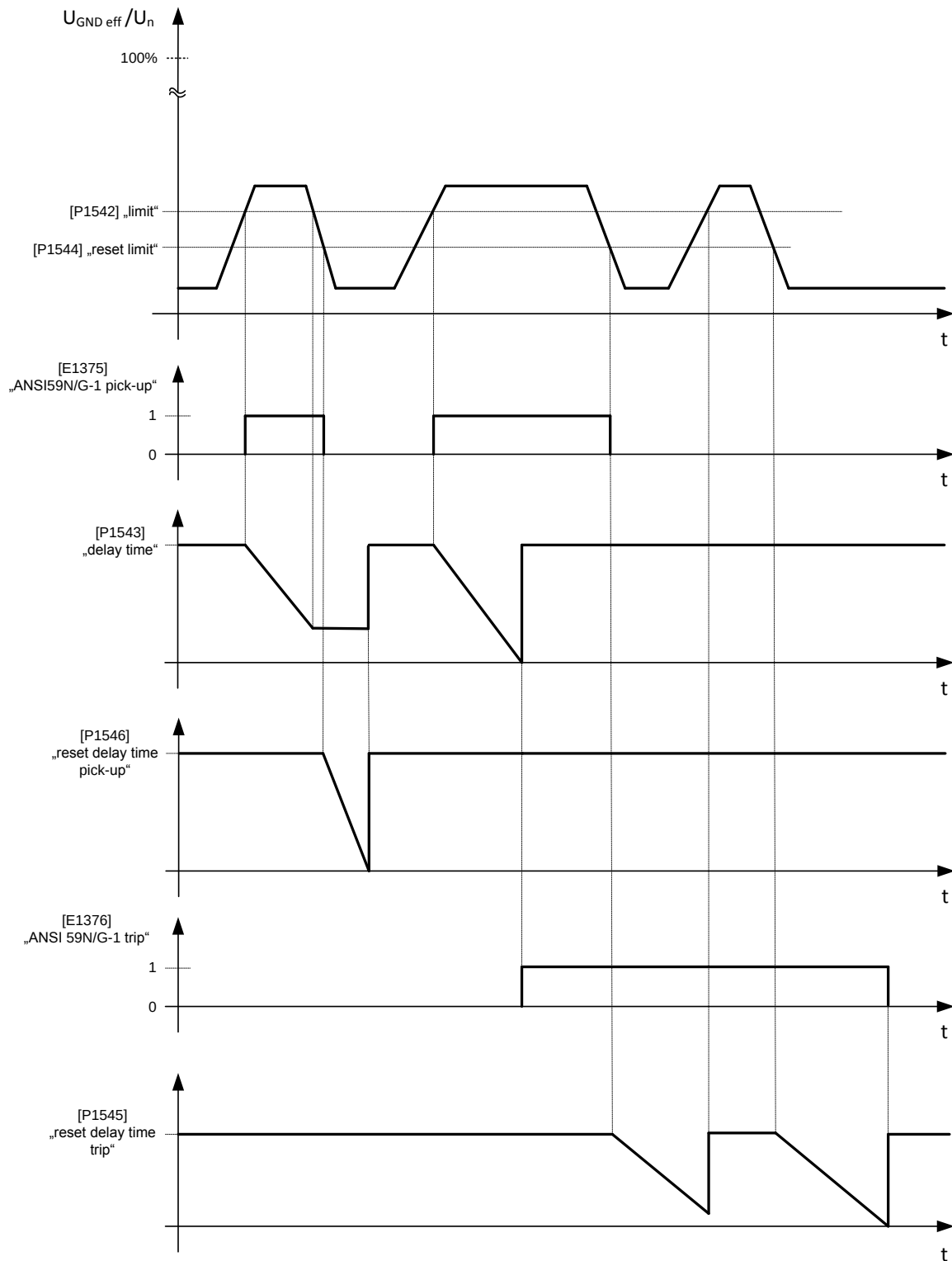


Figure 3-82 Neutral Voltage Displacement (NVD) – Tripping and reset characteristic

3.5.13 ANSI 67 – Directional Overcurrent Protection

Main Menu\Parameters\PROTECTION\ANSI59-95i\					
ANSI 67					
SET 1	SET 2	SET 3	SET 4		
P/E No.	Name	Value	Unit	(Setting range)	
SET PARAMETERS					
P2155	Directional overcurrent protection	ON	-	ON/OFF	
P2156	Blocking protection module	0	event	0 ... 9999	
E1735	ANSI67 module active	-	-	-	
E1736	ANSI67 blocked module	-	-	-	
STEP 1					
P2160	Pickup source	CT1	-	none/Power_CT1/Power_CT2	
P2161	Blocking protection step	0	event	0 ... 9999	
P2162	Pickup curve	Definite	-	Definite/ANSI NINV/ANSI VINV/ANSI EINV/ IEC NINV/IEC VINV/IEC LINV/IEC EINV	
P2163	Limit	150	%	0 ... 1999,9	
P2164	Delay time/TMS	2,5	s/-	0 ... 999999,999	
P2165	Reset curve	Definite	-	Definite/ANSI NINV/ANSI VINV/ANSI EINV/ IEC NINV/IEC VINV/IEC LINV/IEC EINV	
P2166	Reset after TRIP immediately	OFF	-	ON/OFF	
P2167	Reset limit	110	%	0 ... 1999,9	
P2168	Reset delay time trip/TMS	1	s/-	0 ... 999999,999	
P2169	Reset delay time pickup	1	s	0 ... 999999,999	
P2170	Direction mode	Forward	-	Non-directional/Forward/Backward/Angle	
P2171	Angle absolute	0	deg	0 ... 359,9	
P2172	Angle relative	60	deg	0 ... 179,9	
P2173	Harmonics stabilizer	OFF	-	OFF / 2H / 5H / 2H/5H	
P2174	Voltage low limit		%	0 ... 200,0	
P2175	Voltage low mode			Blocked/Non-directional	
E1741	ANSI67-1 step active	-	-	-	
E1742	ANSI67-1 blocked step	-	-	-	
E1743	ANSI67-1 pickup L1	-	-	-	
E1744	ANSI67-1 pickup L2	-	-	-	
E1745	ANSI67-1 pickup L3	-	-	-	
E1746	ANSI67-1 pickup	-	-	-	
E1747	ANSI67-1 trip L1	-	-	-	
E1748	ANSI67-1 trip L2	-	-	-	
E1749	ANSI67-1 trip L3	-	-	-	
E1750	ANSI67-1 trip	-	-	-	
E1751	ANSI67-1 low voltage	-	-	-	
STEP 2					
P2180	Pickup source	CT1	-	none/CT1/CT2	
...	...	...	...	...	

Figure 3-83 ANSI 67 – Protection parameters [P] and events [E] of SET 1

Parameter description:

The following parameter descriptions refer to all protection parameters of one parameter set.

NOTE: Each of the four parameter sets always provides the same group of protection parameters. Hence, the parameter descriptions of the SET PARAMETERS and the

parameters of STEP 1 represented below are described in the following in detail as examples.

Protection parameters of parameter SET 1 – ANSI 67

SET PARAMETERS

The following SET PARAMETERS of the overcurrent protection exist only once in each of the four parameter sets. Thus, the SET PARAMETERS apply to all of the 4 protection STEPS of one parameter SET.

P2155 Directional Overcurrent protection

This parameter enables/disables directional overcurrent protection wherein:

- “OFF”: disables or
- “ON”: enables the protective function.

When directional overcurrent protection ANSI 67 is enabled by parameter [P2155], then event “ANSI67 module active” [E1735] is being activated.

P2156 Blocking protection module

Directional overcurrent protection can be completely blocked by any active event. For blocking, the number related to this blocking event has to be assigned to parameter [P2156]. Blocking is only effective, however, as long as the blocking event is active. As soon as blocking is active, event “ANSI67 blocked module” [E1736] is being activated. If the blocking event turns inactive, blocking is abandoned and protective function is effective again. Then, event [E1736] is being deactivated automatically.

If blocking of the *directional overcurrent protection* is not required, set this parameter to “0”.

Protection parameters of STEP 1

The following STEP parameters of the directional overcurrent protection exist only once in each of the 4 independent protection STEPS. Thus, the SET PARAMETERS apply only to one of the 4 protection STEPS of one parameter SET.

P2160 Pick-up source

Depending on the SYMAP[®]-Compact(+) device variant each protection step of directional overcurrent protection can be assigned to a certain current measurement input (CT1 or CT2 – if available). Hence, parameter [P2160] determines the current measurement input and its assigned voltage measurement input which will provide measurement values as characteristic quantities (phase current and phase angle between phase current and reference voltage) to the directional overcurrent protection:

- “none”: no current measurement; protection step is deactivated
- “Power_CT1”: *current measurement by CT1 and calculation of current direction via voltage measurement by the assigned voltage measurement input (PT1, PT2 or PT3)*
- “Power_CT2”: *current measurement by CT2 and calculation of current direction via voltage measurement by the assigned voltage measurement input (PT1, PT2 or PT3)*

NOTE: The assignment of the voltage measurement input (PT1, PT2 or PT3) to the current measurement input CT1 or CT2 is to be done by the following parameters (referring to the setting options of parameter [P2160]), in the submenu “SYSTEM\Nominals\Measuring”:

- “PT reference” [P9410], for “Power_CT1” and

- “PT reference” [P9413], for “Power_CT2”

To measure *current direction* correctly, the needed *energy flow direction* is to be defined by following parameters:

- “Direction” [P9411], for “Power_CT1” and
- “Direction” [P9414], for “Power_CT2”.

For settings “Power_CT1” or “Power_CT2”, event “ANSI67-1 step active” [E1741] is being activated.

P2161 Blocking protection step

The first step of directional overcurrent protection can be blocked by any active event. For blocking, the number related to this blocking event has to be assigned to parameter [P2161]. Blocking is only effective, however, as long as the blocking event is active. As soon as blocking is active, event “ANSI67-1 blocked step” [E1742] is being activated. If the blocking event turns inactive, blocking is abandoned and protective function is effective again. Then, event [E1742] is being deactivated automatically.

If blocking of the first step of directional overcurrent protection is not required, set this parameter to “0”.

P2162 Pick-up curve

Tripping characteristic of “Delay time/TMS”; via parameter [P2162]; the *tripping characteristic* of the first step of directional overcurrent protection is optionally adjustable as:

- “Definite Time-delay overcurrent protection” (DT) or
- “Inverse Definite Minimum Time-delay protection” (IDMT)

There are up to 7 different inverse time characteristics (IDMT) available, which accords to the US standard of the “American National Standard Institute ANSI” or the international standard of “International Electrotechnical Commission IEC”:

- “Definite”: definite time (DT)
- “ANSI NINV”: “Normal Inverse” (ANSI);
- “ANSI VINV”: “Very Inverse” (ANSI);
- “ANSI EINV”: “Extremely Inverse” (ANSI);
- “IEC NINV”: “Normal Inverse” (IEC);
- “IEC VINV”: “Very Inverse” (IEC);
- “IEC LINV”: “Long-term Inverse” (IEC);
- “IEC EINV”: “Extremely Inverse” (IEC)

Table 4-3 Parameters of inverse curves (IDMT)

Curve type	Operate (trip) time			Reset time		Designating
	$t(G) = TMS \left[\frac{k}{\left(\frac{G}{G_S} \right)^{\alpha} - 1} + c \right]$			$t_r(G) = TMS \left(\frac{t_r}{1 - \left(\frac{G}{G_S} \right)^{\alpha}} \right)$		
	k [s]	c [s]	α -	t_r [s]	α -	
A	0,14	0	0,02	0,14	2	Normal Inverse
B	13,5	0	1	13,5	2	Very inverse
-	120	0	1	120	2	Long-term inverse
C	80	0	2	80	2	Extremely invers
D	0,0515	0,1140	0,02	4,85	2	IEEE normal inverse
E	19,61	0,491	2	21,6	2	IEEE very invers
F	28,2	0,1217	2	29,1	2	IEEE extremely inverse
<u>whereby:</u> $t(G)$: theoretical operate timewith constant value of G (seconds) $t_r(G)$: time setting (reset time for G=0 and TMS = 1) k, c, α : constant values which define the chosen curve shape TMS: Time Multiplier Setting G : measured value of the characteristic quantity G_S : setting value (start) of the characteristic quantity						

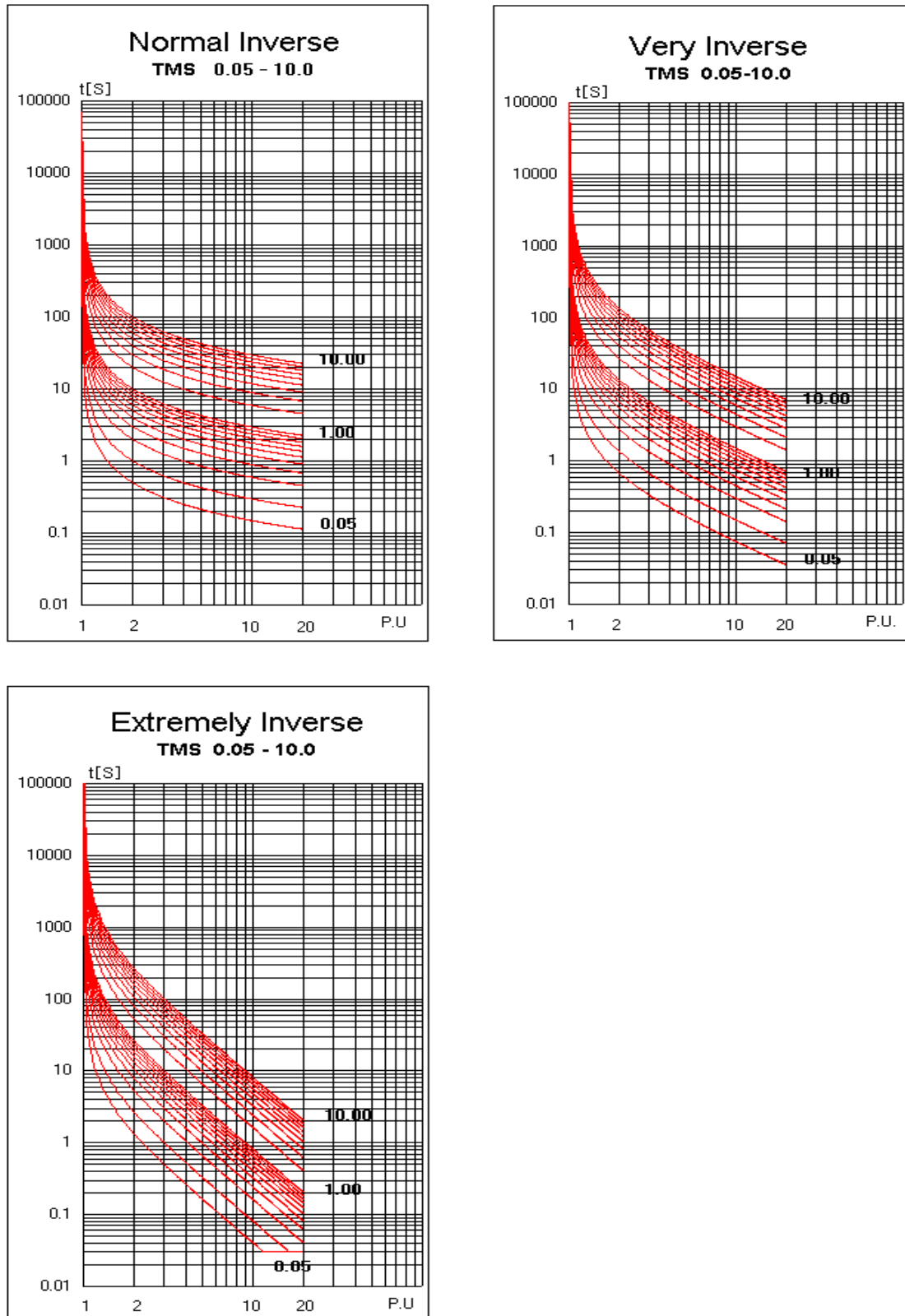


Figure 3-84 Inverse IEC curves – examples

P2163 Limit

Pick-up value of the first directional overcurrent protection element (STEP1); at the moment that the characteristic quantity (phase current) *exceeds this limit* **and** the characteristic angle between phase current I_x and reference voltage $\underline{U}_x$ (with: $x = L1; L2; L3$) is located *within the trip angle range*, “ANSI67-1 pick-up” [E1746] will become active, and “Delay time/TMS” of the first directional overcurrent protection element will start.

In case that the characteristic quantity (phase current) falls below "Limit" or the characteristic angle is out the trip angle range of the first directional overcurrent protection element before "Delay time/TMS" has run down, the timer of "Delay time/TMS" will be stopped and the attained time value is being safed.

NOTE: The *pick-up value* is to be set as a percentage of the *nominal value* of the characteristic quantity (phase current). The nominal value of the characteristic quantity is to be set by parameter:

- "Current" [P604], for primary side W1 or
- "Current" [P614], for secondary side W2 or
- "Current" [P624], for tertiary side W3.

The referring parameters "Current" [P604], "Current" [P614] and "Current" [P624] are located in submenu: "SYSTEM\Nominals\Reference values".

P2164 Delay time/TMS

Tripping delay time of trip event "ANSI67-1 trip" [E1750]; the working principle of the delay time counter depends on the *tripping characteristic* set by parameter "Pickup curve" [P2162]. Hence follows that parameter "Delay Time/TMS" [P2164] takes on a different meaning, depending on the chosen tripping characteristic (DT or IDMT).

- **DT tripping characteristic:** "Pickup curve" [P2162] = "Definite"
In this case the *tripping delay time* is equal to a constant time value set by parameter "Delay time/TMS" [P2164].
- **IDMT tripping characteristic:** e.g. "Pickup curve" [P2162] = "ANSI NINV"
For this, the *tripping delay time* is not constant, but, it will be calculated cyclically, depending on the adjusted IDMT curve and the level of momentary phase current increase (characteristic quantity). Therefore, setting of parameter "Delay Time /TMS" [P2164] means a displacement with regard to the time axis of the tripping curve ("TMS": Time Multiplier Setting)

If pick-up event "ANSI67-1 pick-up" [E1746] is active and "Delay Time/TMS" run down, trip event "ANSI67-1 trip" [E1750] will be activated. This event can be used for alarm or output control purposes.

P2167 Reset limit

Pick-up reset limit of the first directional overcurrent protection element (STEP1); if the

- pick-up event "ANSI67-1 pickup" [E1746] is active **and**
- the characteristic quantity (phase current) falls below the pick-up value "Limit" **and**
- the characteristic quantity (phase current) falls below the pick-up reset value "Reset limit",

then, pick-up event "ANSI67-1 pick-up" [E1746] is being deactivated and the timer of the "Reset delay time pick-up" will start.

NOTE: The *reset limit* is to be set as a percentage of the *nominal value* of the characteristic quantity (phase current). The nominal value of the characteristic quantity is to be set by parameter:

- "Current" [P604], for primary side W1 or
- "Current" [P614], for secondary side W2 or
- "Current" [P624], for tertiary side W3.

The referring parameters "Current" [P604], "Current" [P614] and "Current" [P624] are located in submenu: "SYSTEM\Nominals\Reference values".

P2165 Reset curve

Reset characteristic of "Delay time/TMS"; via parameter [P2165] the *reset characteristic* of the first step of directional overcurrent protection is optionally adjustable as:

- "Definite Time-delay overcurrent protection" (**DT**) or
- "Inverse Definite Minimum Time-delay protection" (**IDMT**)

There are up to 7 different *inverse time characteristics* available, which accords to the US standard of the "American National Standard Institute ANSI" or the international standard of "International Electrotechnical Commission IEC":

- "Definite": definite time (DT);
- "ANSI NINV": "Normal Inverse" (ANSI);
- "ANSI VINV": "Very Inverse" (ANSI);
- "ANSI EINV": "Extremely Inverse" (ANSI);
- "IEC NINV": "Normal Inverse" (IEC);
- "IEC VINV": "Very Inverse" (IEC);
- "IEC LINV": "Long-term Inverse" (IEC);
- "IEC EINV": "Extremely Inverse" (IEC)

NOTE: If the *tripping characteristic of "Delay time/TMS"* is set to "Definite" (**DT**), then parameter "Reset curve" [P2165] only provides setting option "Definite" (**DT**). If the *tripping characteristic of "Delay time/TMS"* is set to "xxx INV" (**IDMT**), then parameter "Reset curve" [P2165] provides both, setting option "Definite" (**DT**) or setting option "xxx INV" (**IDMT**).

As a result, processing of the *stored counter value* of the *tripping delay time* takes on a different working principle, depending on the *reset characteristic of "Delay time/TMS"* (DT or IDMT) to be set by parameter "Reset curve" [P2165]:

- **DT:** The *stored counter value* is to be processed according to the settings of "Reset delay time pick-up"
- **IDMT:** The *stored counter value* is to be processed according to the settings of "Reset delay time trip/TMS"

P2169 Reset delay time pick-up

Delay time to reset the stored counter value of the tripping delay time; in case that the tripping delay time ("Delay time/TMS") has not yet run down.

CAUTION: Parameter [P2169] is only valid in case of "Reset curve" [P2165] = "Definite"!

While the timer of the "Reset delay time pick-up" is running, the counter value of the *tripping delay time* maintains at a constant level.

After the "Reset delay time pick-up" has run down, the counter value of the *tripping delay time* ("Delay time/TMS") will be reset.

P2168 Reset delay time trip/TMS

Delay time to reset the trip event "ANSI67-1 trip" [E1750]; the operating procedure of the timer for resetting the trip event depends on the set characteristic of the *reset curve*. Hence follows that parameter "Reset delay time trip/TMS" [P2168] takes on a different meaning, depending on the *reset characteristic of "Reset curve"* (DT or IDMT) set by parameter "Reset curve" [P2165]:

- **DT reset characteristic:** “Reset curve” [P2165] = “Definite”
The delay time to reset the trip event is equal to a constant time value, to be set by parameter “Reset delay time/TMS” [P2168].
- **IDMT reset characteristic:** e.g. “Reset curve” [P2165] = “ANSI NINV”
The delay time to reset the trip event is not a constant time value, but, depending on the inverse curve shape and the measured value of the characteristic quantity (phase current) it will be cyclically re-calculated. When applying any inverse curve (IDMT) to the reset curve, this means the setting of parameter “Reset delay time trip/TMS” [P2168] takes on a displacement of the inverse curve shape with regard to the time axis (“TMS”: **T**ime **M**ultiplier **S**etting).

If trip event “ANSI67-1 trip” [E1750] is activated and “Reset delay time trip/TMS” has run down, the trip event “ANSI67-1 trip” [E1750] will be deactivated.

NOTE: In dependence of the set value of parameter “Reset after TRIP immediately” [P2168], deactivating of trip event “ANSI67-1 trip” [E1750] takes on a different working principle.

P2166 Reset after TRIP immediately

Immediate reset of trip event “ANSI67-1 trip” [E1750]; in case that the reset curve is assigned an inverse characteristic (IDMT), then the „Reset after TRIP immediately“ can be activated/deactivated by parameter [P2166] as soon as the characteristic quantity falls below the “Reset Limit“.

- “OFF”: *Immediate reset of trip event “ANSI67-1 trip” [E1750] is deactivated*
- “ON”: *Immediate reset of trip event “ANSI67-1 trip” [E1750] is activated*

NOTE: If the reset curve of the first protection element (STEP1) is assigned a *definite time (DT)* characteristic (parameter “Reset curve” [P2165] = „Definite“), and the trip event “ANSI67-1 trip” [E1425] should immediately be reset, then set parameter “Reset Delay time/TMS” [P2166] = “0”.

P2170 Direction mode

Selection of operating mode according to the direction of the directional overcurrent protection; the first step of directional overcurrent protection is optionally adjustable as:

- “Non-directional”: The protection step trips in *forward and in backward direction*
- “Forward”: The protection step trips only in *forward direction* (the absolute angle difference between *phase current I_x* and *reference voltage $\underline{U}_x$* (with: $x = L1; L2; L3$) is “0°”; the tripping range is constructed by $\pm 90^\circ$ along the absolute angle)
- “Backward”: The protection step trips only in *backward direction* (the absolute angle difference between *phase current I_x* and *reference voltage $\underline{U}_x$* (with: $x = L1; L2; L3$) is “180°”; the tripping range is constructed by $\pm 90^\circ$ along the absolute angle)
- “Angle”: The protection step trips only in that tripping range, which is determined by parameters “Angle absolute” [P2171] and “Angle relative” [P2172].

The following graphics represents all the different setting options of parameter “Direction mode” [P2170], each an example of phase L1 (phase current $\underline{I}_{L1}$ and its reference voltage $\underline{U}_1$):

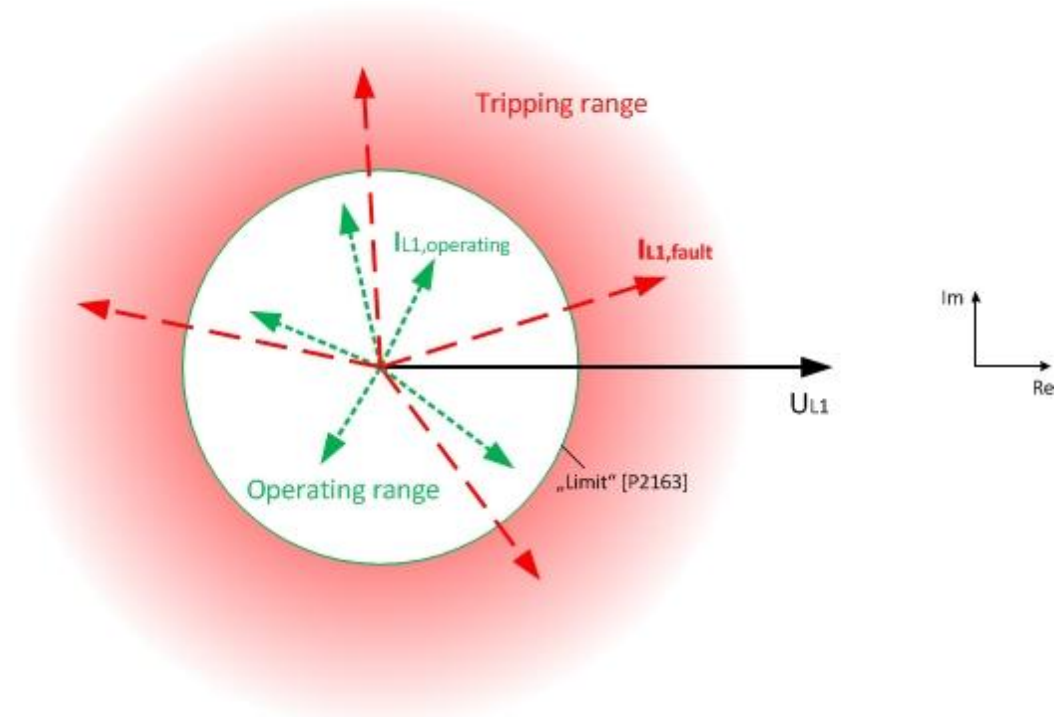


Figure 3-85 Selection of direction mode – “Non-directional”

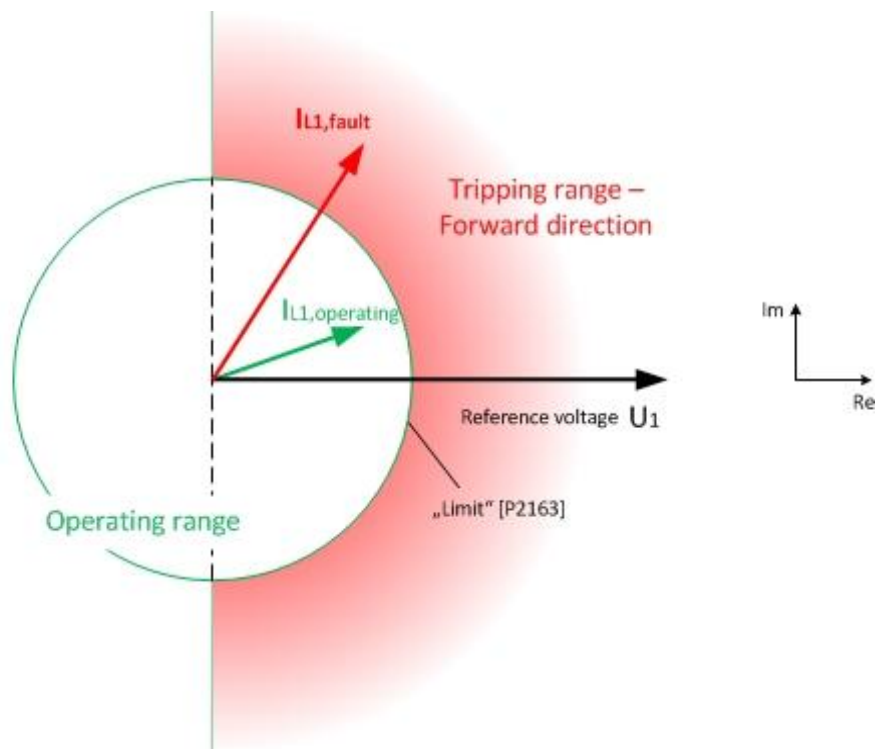


Figure 3-86 Selection of direction mode – “Forward”

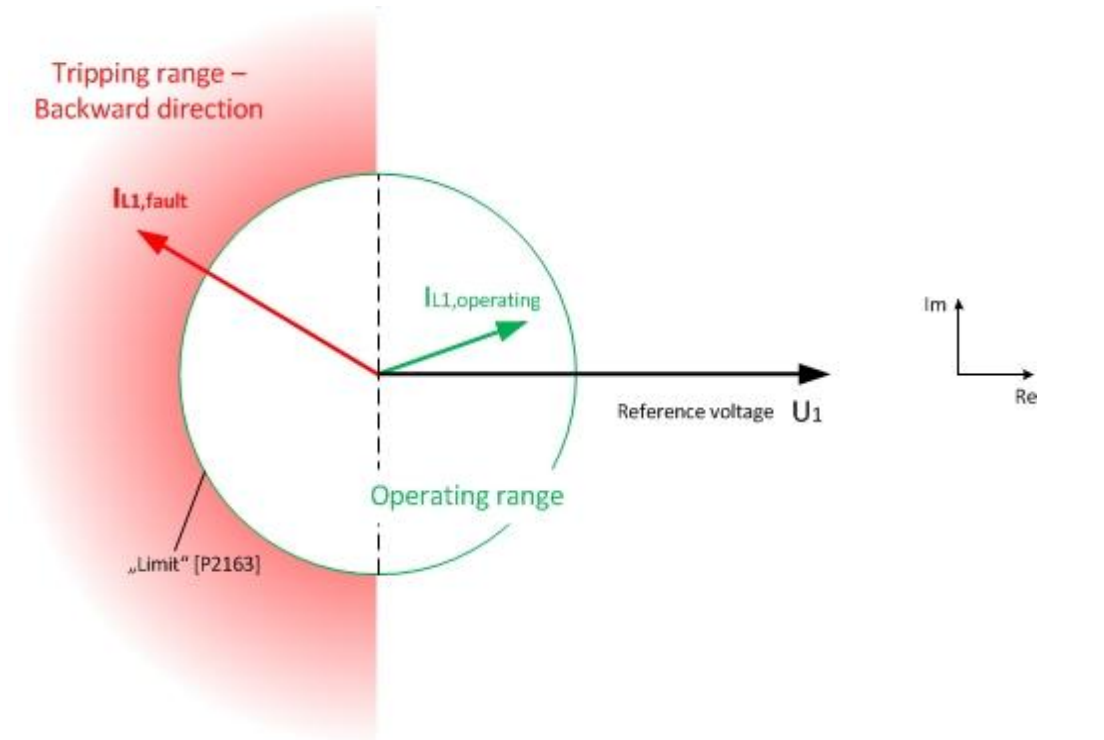


Figure 3-87 Selection of direction mode – “Backward”

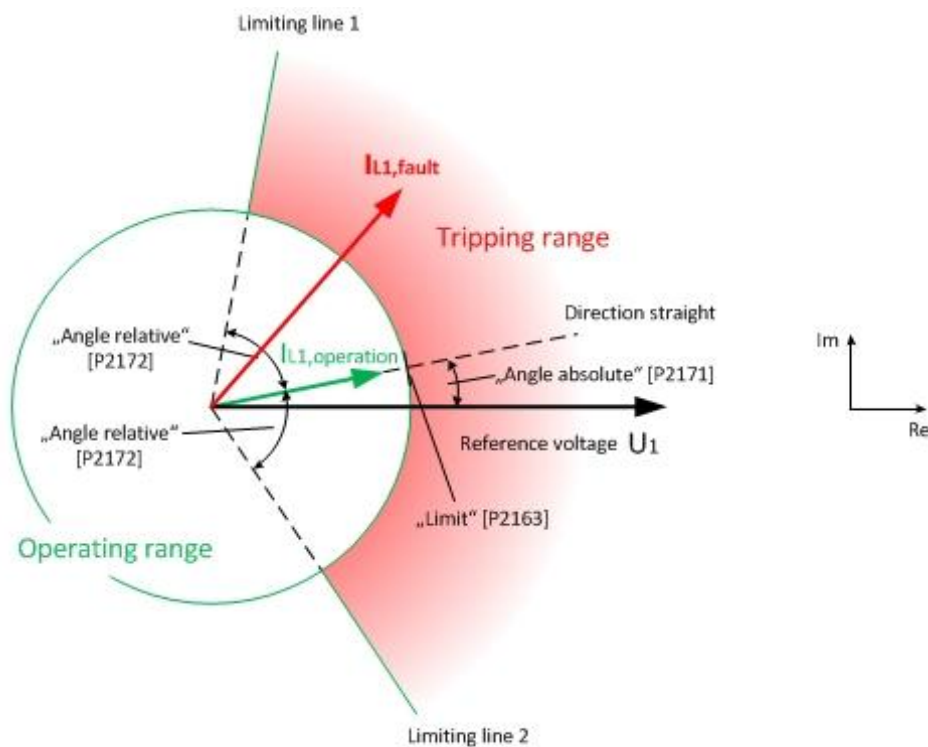


Figure 3-88 Selection of direction mode – “Angle”

P2171 Angle absolute

Absolute angle difference between phase current I_x and reference voltage U_x to define tripping direction; setting of parameter “Angle absolute” [P2171] defines the location of the direction straight which is to be used to construct the tripping angle range (by parameter “Angle relative” [P2172]).

P2172 Angle relative

Relative angle difference between the direction straight and the limiting line 1 firstly, and secondly between the direction straight and the limiting line 2; via setting of parameter "Angle absolute" [P2171] the tripping angle range is to be constructed along the direction straight set by parameter "Angle relative" [P2172].

P2173 Harmonics stabilizer

Blocking of protection element (STEP1) of directional overcurrent protection by "harmonics stabilizer ANSI 95i" function for measuring values of CT1; according to the settings of the "harmonics stabilizer ANSI 95i" function, the directional overcurrent protection may be temporarily blocked upon exceeding of defined contents of the 2nd and/or 5th harmonic ($I_{100\text{Hz}}$ and/or $I_{250\text{Hz}}$) in the phase current:

- "OFF": blocking of ANSI 67-1 by ANSI 95i is deactivated
- "2H": blocking of ANSI 67-1 by ANSI 95i in case of 2nd harmonic
- "5H": blocking of ANSI 67-1 by ANSI 95i in case of 5th harmonic
- "2H/5H": blocking of ANSI 67-1 by ANSI 95i in case of 2nd or 5th harmonic

NOTE: Appropriate settings of the corresponding parameters of ANSI95i are to be done in the submenu: "PROTECTION\95i Harmonics stabilizer".

P2174 Voltage low limit

Minimum limit of the measuring voltage to activate directional overcurrent protection; as soon as the measured reference voltage falls below this minimum setting at least in one phase, the operating mode of the first protection step of directional overcurrent protection accords to the set value of parameter "Voltage low mode" [P2175]. For the duration of the undercutting of the reference voltage low limit, event "ANSI67-1 low voltage" [E1751] is activated.

NOTE: The *minimum limit of the measuring voltage* is to be set as a percentage of the *nominal value* of the characteristic quantity (phase-to-phase voltage). The nominal value of the characteristic quantity is to be set by parameter:

- "Ground voltage" [P606], for primary side W1 or
- "Ground voltage" [P616], for secondary side W2 or
- "Ground voltage" [P626], for tertiary side W3

The referring parameters "Ground voltage" [P606], "Ground voltage" [P616] and "Ground voltage" [P626] are located in submenu: "SYSTEM\Nominals\Reference values".

P2175 Voltage low mode

Selection of operating mode in case of undercutting of the measured reference voltage low limit which is used for determination of the phase current direction; as soon as the measured reference voltage falls below this minimum setting at least in one phase, event "ANSI67-1 Voltage low mode" [E1751] will be activated, and the the operating mode of first step of directional overcurrent protection is either:

- "Blocked": protection step is blocked or
- "Non-directional": the first protection step is working non-directionally.

P2179 Min. delay time

NOTE: This parameter only applies for invers trip characteristics (IDMT curves)!

Minimum trip delaytime for inverse trip curves; in case of high.current faults the tripping delay time could be too less for the application. To avoid this, a minimum trip delaytimecan be set by parameter “Min. delay time” [P2179]

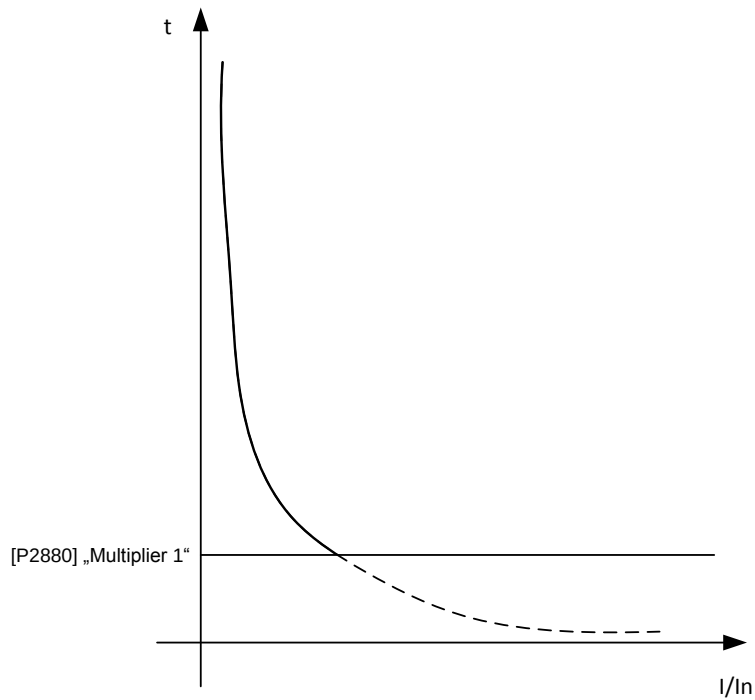


Figure 3-89 IDMT Trip characteristic– minimum trip delay time

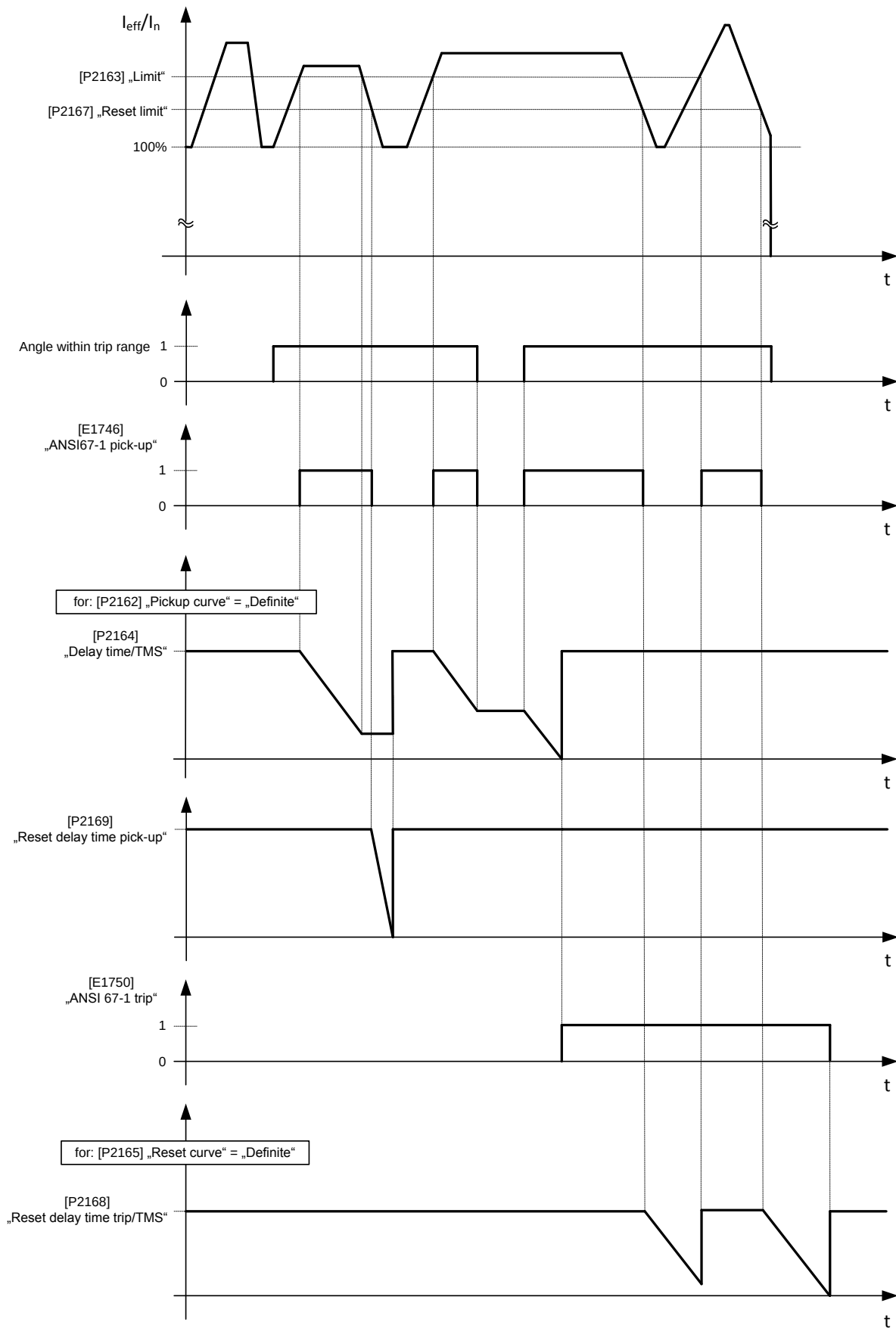


Figure 3-90 Directional overcurrent protection – Trip characteristic (DT) and Reset characteristic (DT)

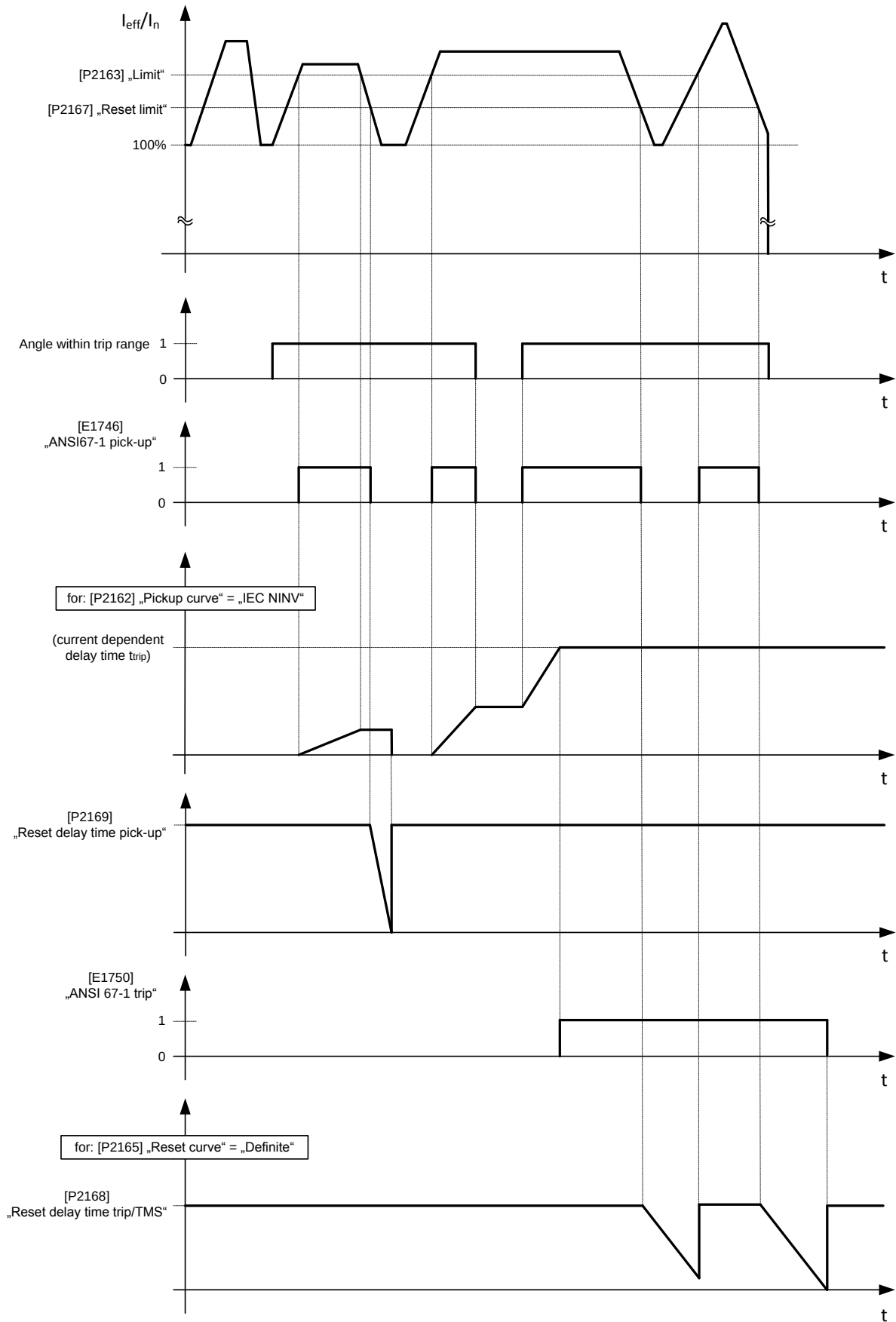


Figure 3-91 Directional overcurrent protection – Trip characteristic (IDMT) and Reset characteristic (DT)

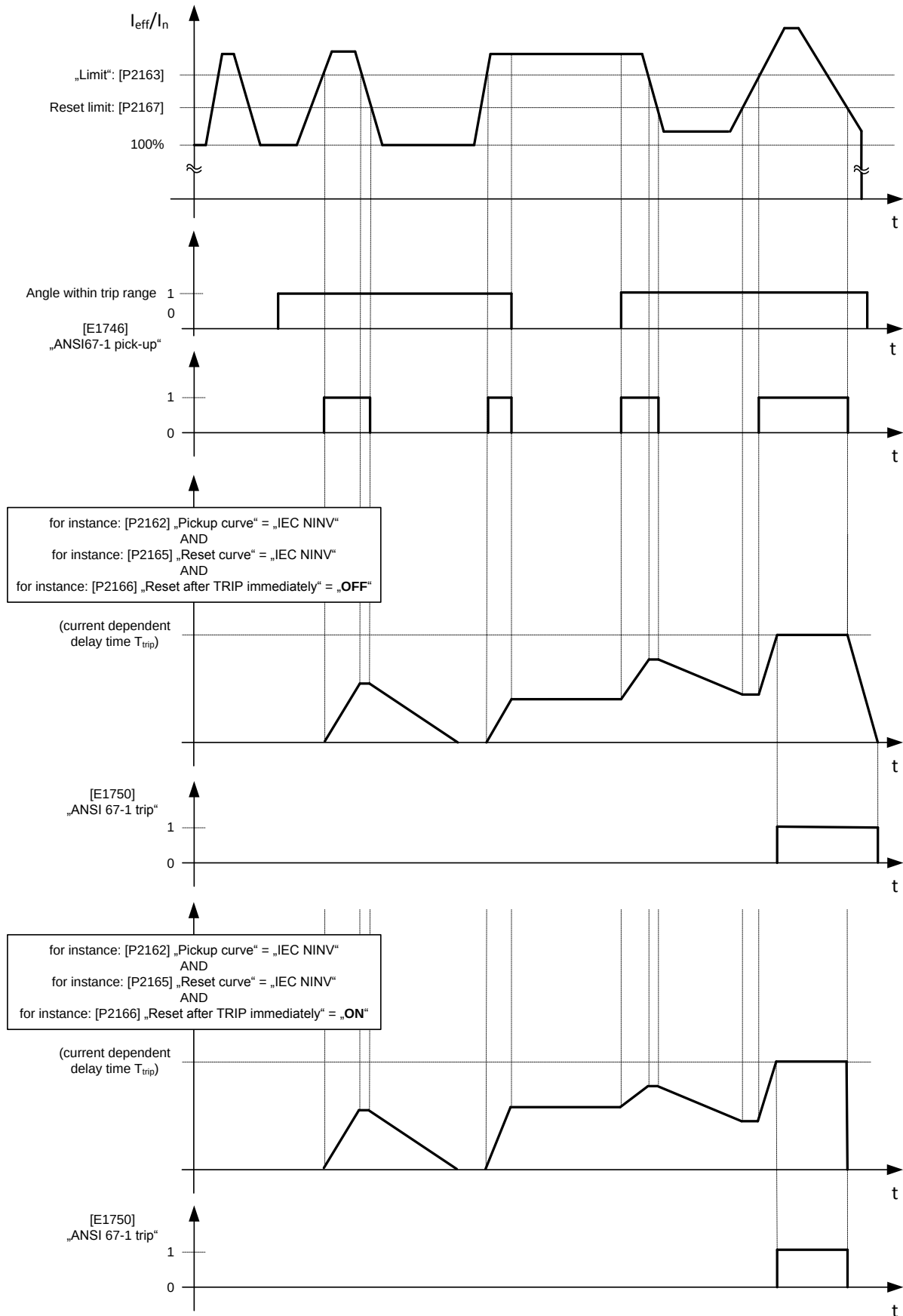


Figure 3-92 Directional overcurrent protection – Trip characteristic (IDMT) and Reset characteristic (IDMT)

3.5.14 ANSI 67G – Directional Ground Overcurrent Protection

Main Menu\Parameters\PROTECTION\ANSI59-95i\					
ANSI 67G					
SET 1	SET 2	SET 3	SET 4		
P/E No.	Name	Value	Unit	(Setting range)	
SET PARAMETERS					
P2455	Direct. ground overcurrent	OFF	-	ON/OFF	
P2456	Blocking prot. module	0	event	0 ... 9999	
E1735	ANSI67G module active	-	-	-	
E1736	ANSI67G blocked module	-	-	-	
STEP 1					
P2460	Pickup source	none	-	none/GND Power_CT1/ GND Power_CT2/GND Power CT-GND1	
P2461	Blocking protection step	0	event	0 ... 9999	
P2462	Pickup curve	Definite	-	Definite/ANSI NINV/ANSI VINV/ANSI EINV/ IEC NINV/IEC VINV/IEC LINV/IEC EINV	
P2463	Limit	150	%	0 ... 1999,9	
P2464	Delay time/TMS	2,5	s/-	0 ... 999999,999	
P2465	Reset curve	Definite	-	Definite/ANSI NINV/ANSI VINV/ANSI EINV/ IEC NINV/IEC VINV/IEC LINV/IEC EINV	
P2466	Reset after TRIP immediately	OFF	-	ON/OFF	
P2467	Reset limit	110	%	0 ... 1999,9	
P2468	Reset delay time trip/TMS	1	s/-	0 ... 999999,999	
P2469	Reset delay time pickup	1	s	0 ... 999999,999	
P2470	Direction mode	Forward	-	Non-directional/ Angle	
P2471	Angle absolute	0	deg	0 ... 359,9	
P2472	Angle relative	60	deg	0 ... 179,9	
P2473	Harmonics stabilizer	OFF	-	OFF / 2H / 5H / 2H/5H	
P2474	Voltage low limit		%	0 ... 200,0	
P2475	Voltage low mode			Blocked/Non-directional	
E2038	ANSI67G-1 step active	-	-	-	
E2039	ANSI67G-1 blocked step	-	-	-	
E2040	ANSI67G-1 pickup	-	-	-	
E2041	ANSI67G-1 trip	-	-	-	
E2042	ANSI67G-1 low voltage	-	-	-	
STEP 2					
P2480	Pickup source	none	-	none/GND Power_CT1/ GND Power_CT2/GND Power CT-GND1	
...	...	...	...	...	

Figure 3-93 ANSI 67G – Protection parameters [P] and events [E] of SET 1

Parameter description:

The following parameter descriptions refer to all protection parameters of one parameter set.

NOTE: Each of the four parameter sets always provides the same group of protection parameters. Hence, the parameter descriptions of the SET PARAMETERS and the parameters of STEP 1 represented below are described in the following in detail as examples.

Protection parameters of parameter SET 1 – ANSI 67G

SET PARAMETERS

The following SET PARAMETERS of the ground overcurrent protection exist only once in each of the four parameter sets. Thus, the SET PARAMETERS apply to all of the 4 protection STEPS of one parameter SET.

P2455 Directional Overcurrent protection

This parameter enables/disables directional ground overcurrent protection wherein:

- “OFF”: disables or
- “ON”: enables the protective function.

When directional ground overcurrent protection ANSI 67G is enabled by parameter [P2455], then event “ANSI67G module active” [E2035] is being activated.

P2456 Blocking protection module

Directional ground overcurrent protection can be completely blocked by any active event. For blocking, the number related to this blocking event has to be assigned to parameter [P2456]. Blocking is only effective, however, as long as the blocking event is active. As soon as blocking is active, event “ANSI67G blocked module” [E2036] is being activated. If the blocking event turns inactive, blocking is abandoned and protective function is effective again. Then, event [E2036] is being deactivated automatically.

If blocking of the *directional ground overcurrent protection* is not required, set this parameter to “0”.

Protection parameters of STEP 1

The following STEP parameters of the directional ground overcurrent protection exist only once in each of the 4 independent protection STEPS. Thus, the SET PARAMETERS apply only to one of the 4 protection STEPS of one parameter SET.

P2460 Pick-up source

Depending on the SYMAP®-Compact(+) device variant each protection step of directional ground overcurrent protection can be assigned to a certain current measurement input (CT1, CT2 or CT-GND1). Hence, parameter [P2460] determines the ground current measurement input and its assigned residual voltage measurement input which will provide measurement values as characteristic quantities (ground current and phase angle between ground current and residual voltage as reference voltage) to the directional ground overcurrent protection:

- “none”: no current measurement; protection step is deactivated
- “GND Power_CT1”: ground *current measurement* by CT1 => determination of *ground current* I_{GND} via calculation of total current I_0 ($I_{GND} = 3 \times I_0 = 3 \times [I_1 + I_2 + I_3]$) **and** *determination of ground current direction* by additionally measured residual voltage U_{GND} via the assigned voltage measurement input set by parameter “PT reference” [P9419].
- “GND Power_CT2”: ground *current measurement* by CT2 => determination of *ground current* I_{GND} via calculation of total current I_0 ($I_{GND} = 3 \times I_0 = 3 \times [I_1 + I_2 + I_3]$) **and** *determination of ground current direction* by additionally measured residual voltage U_{GND} via the assigned voltage measurement input set by parameter “PT reference” [P9422].
- “GND Power CT-GND1”: *ground current measurement* by CT-GND1 **and** *determination of ground current direction* by additionally measured residual voltage U_{GND} via the assigned voltage measurement input set by parameter “PT reference” [P9428].

NOTE: The assignment of the voltage measurement input (PT1, PT2, PT3 or PT-GND1) to the ground current measurement input CT1, CT2 or CT-GND1 is to be done by the following parameters (referring to the setting options of parameter [P2460]), in the submenu "SYSTEM\Nominals\Measuring":

- "PT reference" [P9419], for "GND Power_CT1"
- "PT reference" [P9422], for "GND Power_CT2" and
- "PT reference" [P9428], for "GND Power_CT-GND1"

To measure *ground current direction* correctly, the required *energy flow direction* is to be defined by following parameters:

- "Direction" [P9411], for "GND Power_CT1" and
- "Direction" [P9414], for "GND Power_CT2"
- "Direction" [P9429], for "GND Power_CT-GND1".

For settings "GND Power_CT1", "GND Power_CT2", or "GND Power_CT-GND1" event "ANSI67G-1 step active" [E2038] is being activated.

P2461 Blocking protection step

The first step of directional ground overcurrent protection can be blocked by any active event. For blocking, the number related to this blocking event has to be assigned to parameter [P2461]. Blocking is only effective, however, as long as the blocking event is active. As soon as blocking is active, event "ANSI67G-1 blocked step" [E2039] is being activated. If the blocking event turns inactive, blocking is abandoned and protective function is effective again. Then, event [E2039] is being deactivated automatically.

If blocking of the first step of directional ground overcurrent protection is not required, set this parameter to "0".

P2462 Pick-up curve

Tripping characteristic of "Delay time/TMS"; via parameter [P2462]; the *tripping characteristic* of the first step of directional ground overcurrent protection is optionally adjustable as:

- "Definite Time-delay overcurrent protection" (DT) or
- "Inverse Definite Minimum Time-delay protection" (IDMT)

There are up to 7 different inverse time characteristics (IDMT) available, which accords to the US standard of the "American National Standard Institute ANSI" or the international standard of "International Electrotechnical Commission IEC":

- "Definite": definite time (DT)
- "ANSI NINV": "Normal Inverse" (ANSI);
- "ANSI VINV": "Very Inverse" (ANSI);
- "ANSI EINV": "Extremely Inverse" (ANSI);
- "IEC NINV": "Normal Inverse" (IEC);
- "IEC VINV": "Very Inverse" (IEC);
- "IEC LINV": "Long-term Inverse" (IEC);
- "IEC EINV": "Extremely Inverse" (IEC)

Table 4-3 Parameters of inverse curves (IDMT)

Curve type	Operate (trip) time			Reset time		Designating
	$t(G) = TMS \left[\frac{k}{\left(\frac{G}{G_S} \right)^{\alpha} - 1} + c \right]$			$t_r(G) = TMS \left(\frac{t_r}{1 - \left(\frac{G}{G_S} \right)^{\alpha}} \right)$		
	k [s]	c [s]	α -	t_r [s]	α -	
A	0,14	0	0,02	0,14	2	Normal Inverse
B	13,5	0	1	13,5	2	Very inverse
-	120	0	1	120	2	Long-term inverse
C	80	0	2	80	2	Extremely invers
D	0,0515	0,1140	0,02	4,85	2	IEEE normal inverse
E	19,61	0,491	2	21,6	2	IEEE very invers
F	28,2	0,1217	2	29,1	2	IEEE extremely inverse
<u>whereby:</u> $t(G)$: theoretical operate timewith constant value of G (seconds) $t_r(G)$: time setting (reset time for G=0 and TMS = 1) k, c, α : constant values which define the chosen curve shape TMS: Time Multiplier Setting G: measured value of the characteristic quantity G_S : setting value (start) of the characteristic quantity						

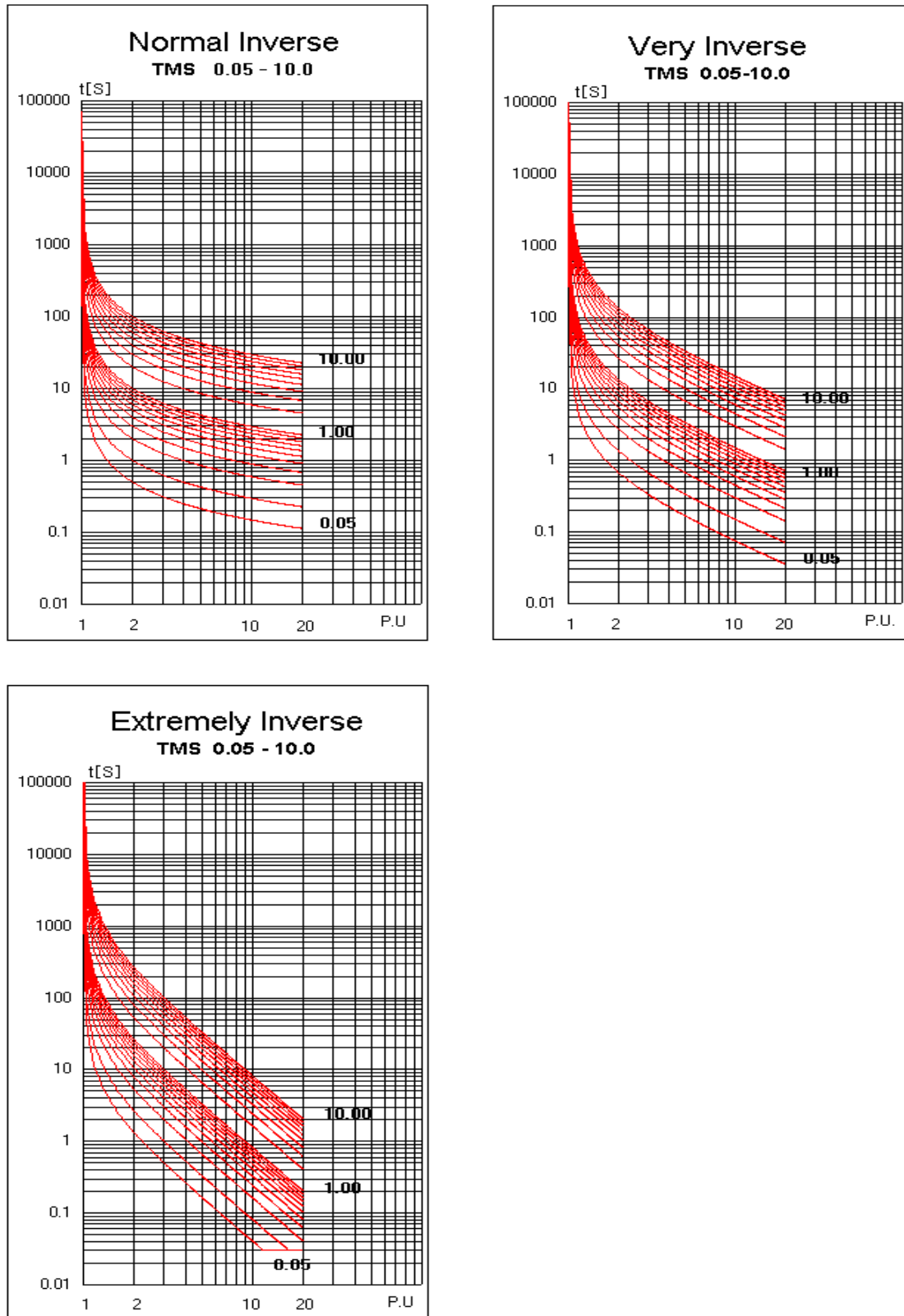


Figure 3-94 Inverse IEC curves – examples

P2463 Limit

Pick-up value of the first directional ground overcurrent protection element (STEP1); at the moment that the characteristic quantity (phase current) *exceeds this limit* **and** the characteristic angle between *ground current* and *residual voltage* as reference voltage is located *within the trip angle range*, “ANSI67G-1 pick-up” [E2040] will become active, and “Delay time/TMS” of the first directional ground overcurrent protection element will start.

In case that the characteristic quantity (ground current) falls below “Limit” **or** the characteristic angle is out the trip angle range of the first directional ground overcurrent protection element before “Delay time/TMS” has run down, the timer of “Delay time/TMS” will be stopped and the attained time value is being safed.

NOTE: The *pick-up value* is to be set as a percentage of the *nominal value* of the characteristic quantity (ground current). The nominal value of the characteristic quantity is to be set by parameter:

- “Ground current” [P607], for primary side W1 or
- “Ground current” [P617], for secondary side W2 or
- “Ground current” [P627], for tertiary side W3.

The referring parameters “Ground current” [P607], “Ground current” [P617] and “Ground current” [P627] are located in submenu: “SYSTEM\Nominals\Reference values”.

P2464 Delay time/TMS

Tripping delay time of trip event “ANSI67G-1 trip” [E2041]; the working principle of the delay time counter depends on the *tripping characteristic* set by parameter “Pickup curve” [P2462]. Hence follows that parameter “Delay Time/TMS” [P2464] takes on a different meaning, depending on the chosen tripping characteristic (DT or IDMT).

- **DT tripping characteristic:** “Pickup curve” [P2462] = “**Definite**”
In this case the *tripping delay time* is equal to a constant time value set by parameter “Delay time/TMS” [P2464].
- **IDMT tripping characteristic:** e.g. “Pickup curve” [P2462] = “ANSI NINV”
For this, the *tripping delay time* is not constant, but, it will be calculated cyclically, depending on the adjusted IDMT curve and the level of momentary phase current increase (characteristic quantity). Therefore, setting of parameter “Delay Time /TMS” [P2464] means a displacement with regard to the time axis of the tripping curve (“TMS”: Time Multiplier Setting)

If pick-up event “ANSI67G-1 pickup” [E2040] is active and “Delay Time/TMS” run down, trip event “ANSI67G-1 trip” [E2041] will be activated. This event can be used for alarm or output control purposes.

P2467 Reset limit

Pick-up reset limit of the first directional ground overcurrent protection element (STEP1); if the

- pick-up event “ANSI67G-1 pickup” [E2040] is active **and**
- the characteristic quantity (ground current) falls below the pick-up value “Limit” **and**
- the characteristic quantity (ground current) falls below the pick-up reset value “Reset limit”,

then, pick-up event “ANSI67G-1 pick-up” [E2040] is being deactivated and the timer of the “Reset delay time pick-up” will start.

NOTE: The *reset limit* is to be set as a percentage of the *nominal value* of the characteristic quantity (ground current). The nominal value of the characteristic quantity is to be set by parameter:

- “Ground current” [P607], for primary side W1 or
- “Ground current” [P617], for secondary side W2 or
- “Ground current” [P627], for tertiary side W3.

The referring parameters “Ground current” [P607], “Ground current” [P617] and “Ground current” [P627] are located in submenu: “SYSTEM\Nominals\Reference values”.

P2465 Reset curve

Reset characteristic of “Delay time/TMS”; via parameter [P2465] the *reset characteristic* of the first step of directional ground overcurrent protection is optionally adjustable as:

- “Definite Time-delay overcurrent protection” (**DT**) or
- “Inverse Definite Minimum Time-delay protection” (**IDMT**)

There are up to 7 different *inverse time characteristics* available, which accords to the US standard of the „American National Standard Institute ANSI“ or the international standard of „International Electrotechnical Commission IEC“:

- “Definite“: definite time (DT);
- “ANSI NINV“: “Normal Inverse” (ANSI);
- “ANSI VINV“: “Very Inverse” (ANSI);
- “ANSI EINV“: “Extremely Inverse” (ANSI);
- “IEC NINV“: “Normal Inverse” (IEC);
- “IEC VINV“: “Very Inverse” (IEC);
- “IEC LINV“: “Long-term Inverse” (IEC);
- “IEC EINV“: “Extremely Inverse” (IEC)

NOTE: If the *tripping characteristic* of “Delay time/TMS” is set to “Definite” (**DT**), then parameter “Reset curve” [P2465] only provides setting option “Definite” (**DT**).
If the *tripping characteristic* of “Delay time/TMS” is set to “xxx INV” (**IDMT**), then parameter “Reset curve” [P2465] provides both, setting option “Definite” (**DT**) or setting option “xxx INV” (**IDMT**).

As a result, processing of the *stored counter value* of the *tripping delay time* takes on a different working principle, depending on the *reset characteristic* of “Delay time/TMS” (DT or IDMT) to be set by parameter “Reset curve” [P2465]:

- **DT:** The *stored counter value* is to be processed according to the settings of “Reset delay time pick-up”
- **IDMT:** The *stored counter value* is to be processed according to the settings of “Reset delay time trip/TMS”

P2469 Reset delay time pick-up

Delay time to reset the stored counter value of the tripping delay time; in case that the tripping delay time (“Delay time/TMS”) has not yet run down.

CAUTION: Parameter [P2469] is only valid in case of “Reset curve” [P2465] = *Definite*!

While the timer of the “Reset delay time pick-up” is running, the counter value of the *tripping delay time* maintains at a constant level.
After the “Reset delay time pick-up” has run down, the counter value of the *tripping delay time* (“Delay time/TMS”) will be reset.

P2468 Reset delay time trip/TMS

Delay time to reset the trip event “ANSI67G-1 trip” [E2041]; the operating procedure of the timer for resetting the trip event depends on the set characteristic of the *reset curve*. Hence follows that parameter “Reset delay time trip/TMS” [P2468] takes on a different

meaning, depending on the *reset characteristic* of “Reset curve” (DT or IDMT) set by parameter “Reset curve” [P2465]:

- **DT reset characteristic:** “Reset curve” [P2465] = *Definite*
The *delay time to reset the trip event* is equal to a constant time value, to be set by parameter “Reset **delay time/TMS**” [P2468].
- **IDMT reset characteristic:** e.g. “Reset curve [P2465] = *ANSI NINV*”
The *delay time to reset the trip event* is not a constant time value, but, depending on the inverse curve shape and the measured value of the characteristic quantity (ground current) it will be cyclically re-calculated. When applying any inverse curve (IDMT) to the reset curve, this means the setting of parameter “Reset **delay time trip/TMS**” [P2468] takes on a displacement of the inverse curve shape with regard to the time axis (“**TMS**”: **T**ime **M**ultiplier **S**etting).

If trip event “ANSI67G-1 trip” [E2041] is activated and “Reset delay time trip/TMS” has run down, the trip event “ANSI67G-1 trip” [E2041] will be deactivated.

NOTE: In dependence of the set value of parameter “Reset after TRIP immediately” [P2466], deactivating of trip event “ANSI67G-1 trip” [E2041] takes on a different working principle.

P2466 Reset after TRIP immediately

Immediate reset of trip event “ANSI67G-1 trip” [E2041]; in case that the *reset curve* is assigned an inverse characteristic (**IDMT**), then the „Reset after TRIP immediately“ can be activated/deactivated by parameter [P2466] as soon as the characteristic quantity falls below the “Reset Limit“.

- “OFF”: *Immediate reset of trip event* “ANSI67G-1 trip” [E2041] is deactivated
- “ON”: *Immediate reset of trip event* “ANSI67G-1 trip” [E2041] is activated

NOTE: If the *reset curve* of the first protection element (STEP1) is assigned a *definite time* (**DT**) characteristic (parameter “Reset curve” [P2465] = „*Definite*“), and the trip event “ANSI67G-1 trip” [E2041] should immediately be reset, then set parameter “Reset **Delay time/TMS**” [P2466] = “0”.

P2470 Direction mode

Selection of operating mode according to the direction of the directional overcurrent protection; the first step of directional overcurrent protection is optionally adjustable as:

- “Non-directional”: The protection step trips in *forward and in backward direction*
- “Angle”: The protection step trips only in that tripping range, which is determined by parameters “Angle absolute” [P2471] and “Angle relative” [P2472].

The following graphics represents all the different setting options of parameter “Direction mode” [P2470], each an example of phase L1 (ground current I_{GND} and residual voltage U_{GND} as its voltage reference):

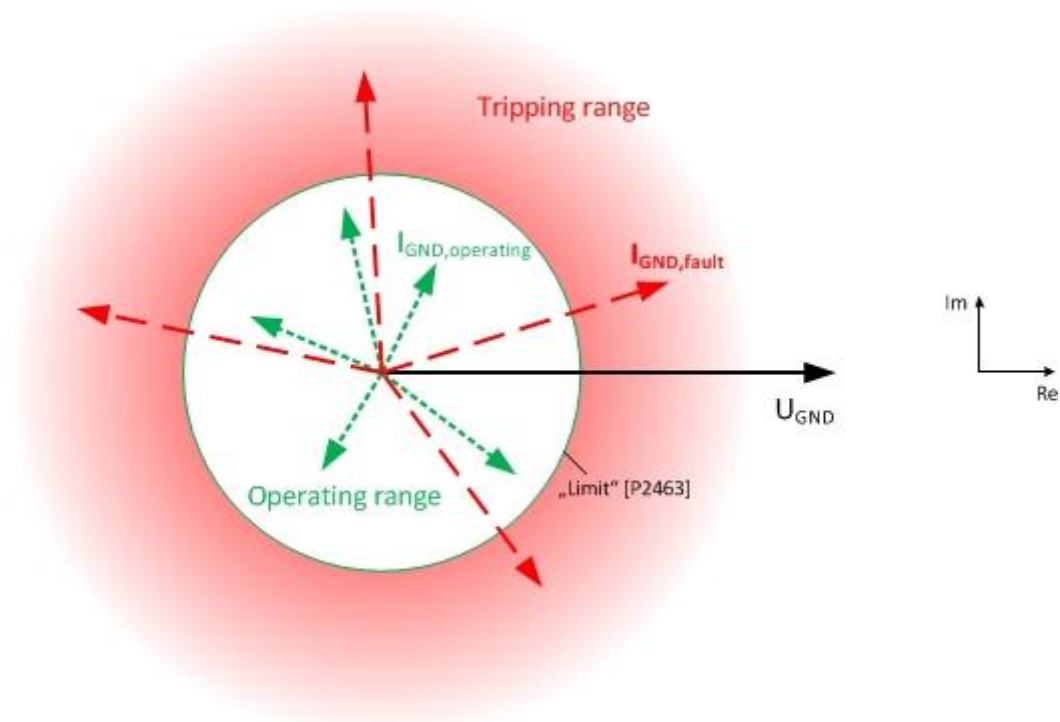


Figure 3-95 Selection of direction mode – “Non-directional”

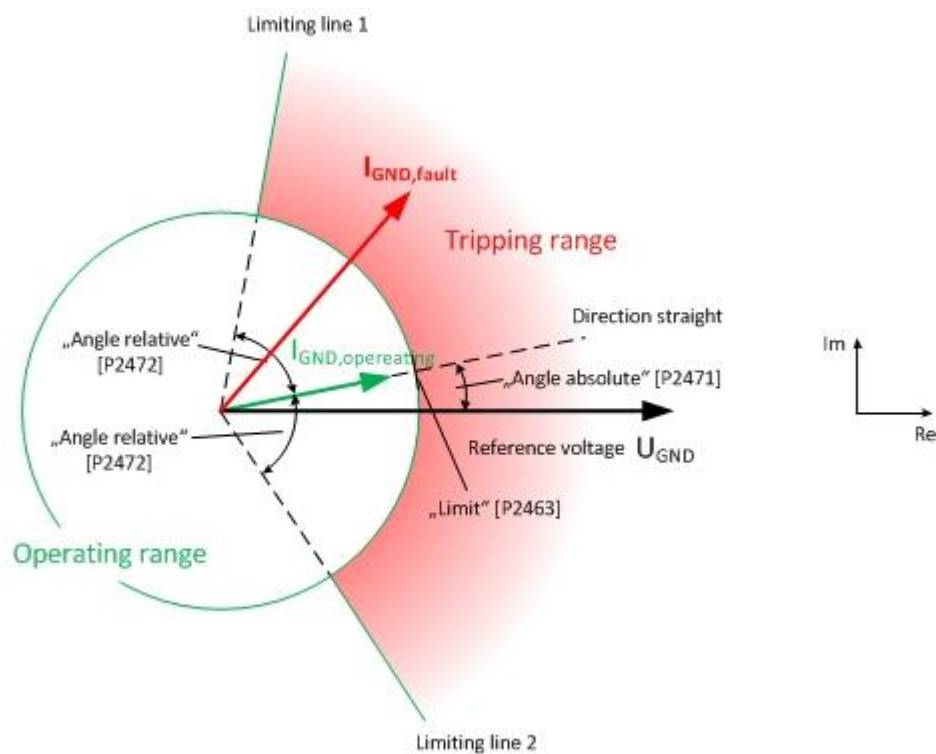


Figure 3-96 Selection of direction mode – “Angle”

P2471 Angle absolute

Absolute angle difference between ground current and residual voltage to define tripping direction; setting of parameter “Angle absolute” [P2471] defines the location of the direction straight which is to be used to construct the tripping angle range (by parameter “Angle relative” [P2472]).

P2472 Angle relative

Relative angle difference between the direction straight and the limiting line 1 firstly, and secondly between the direction straight and the limiting line 2; via setting of parameter "Angle absolute" [P2471] the tripping angle range is to be constructed along the direction straight set by parameter "Angle relative" [P2472].

P2473 Harmonics stabilizer

Blocking of protection element (STEP1) of directional ground overcurrent protection by "harmonics stabilizer ANSI 95i" function for measuring values of ground current; according to the settings of the "harmonics stabilizer ANSI 95i" function, the directional ground overcurrent protection may be temporarily blocked upon exceeding of defined contents of the 2nd and/or 5th harmonic ($I_{100\text{Hz}}$ and/or $I_{250\text{Hz}}$) in the ground current:

- "OFF": blocking of ANSI 67G-1 by ANSI 95i is deactivated
- "2H": blocking of ANSI 67G -1 by ANSI 95i in case of 2nd harmonic
- "5H": blocking of ANSI 67G -1 by ANSI 95i in case of 5th harmonic
- "2H/5H": blocking of ANSI 67G -1 by ANSI 95i in case of 2nd or 5th harmonic

NOTE: Appropriate settings of the corresponding parameters of ANSI95i are to be done in the submenu: "PROTECTION\95i Harmonics stabilizer".

P2474 Voltage low limit

Minimum limit of the measuring voltage to activate directional ground overcurrent protection; as soon as the measured reference voltage (residual voltage) falls below this minimum setting, the operating mode of the first protection step of directional ground overcurrent protection accords to the set value of parameter "Voltage low mode" [P2475]. For the duration of the undercutting of the reference voltage low limit, event "ANSI67G-1 low voltage" [E2042] is activated.

NOTE: The *minimum limit of the measuring voltage* is to be set as a percentage of the *nominal value* of the characteristic quantity (residual voltage). The nominal value of the characteristic quantity is to be set by parameter:

- "Ground voltage" [P606], for primary side W1 or
- "Ground voltage" [P616], for secondary side W2 or
- "Ground voltage" [P626], for tertiary side W3 .

The referring parameters "Ground voltage" [P606], "Ground voltage" [P616] and "Ground voltage" [P626] are located in submenu: "SYSTEM\Nominals\Reference values".

P2475 Voltage low mode

Selection of operating mode in case of undercutting of the measured reference voltage low limit which is used for determination of the ground current direction; as soon as the measured reference voltage (residual voltage) falls below this minimum setting, event "ANSI67G-1 low voltage" [E2042] will be activated, and the operating mode of first step of directional ground overcurrent protection accords either to:

- "Blocked": protection step is blocked or to
- "Non-directional": the first protection step is working non-directionally,

depending on the set value of parameter [P2475].

P2479 Min. delay time

NOTE: This parameter only applies for invers trip characteristics (IDMT curves)!

Minimum trip delaytime for inverse trip curves; in case of high.current faults the tripping delay time could be too less for the application. To avoid this, a minimum trip delaytimecan be set by parameter “Min. delay time” [P2479]

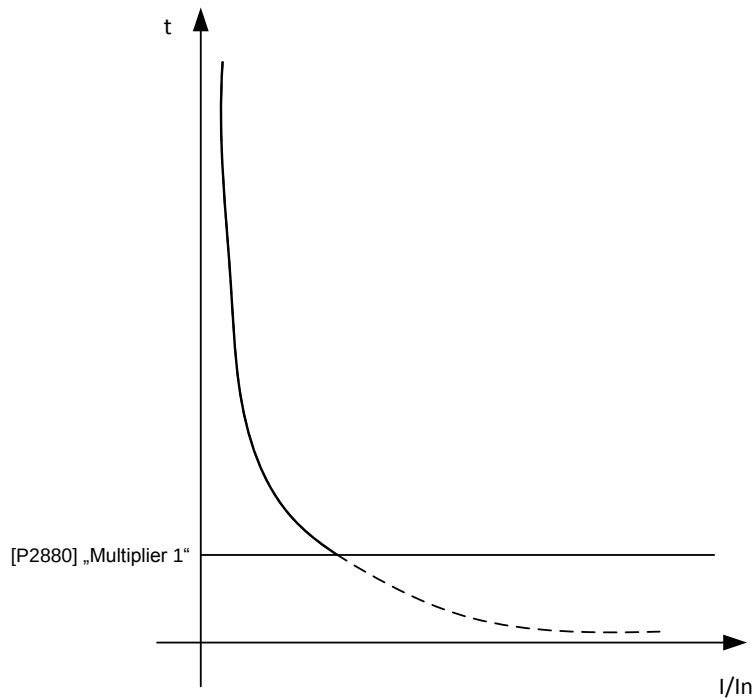


Figure 3-97 IDMT Trip characteristic– minimum trip delay time

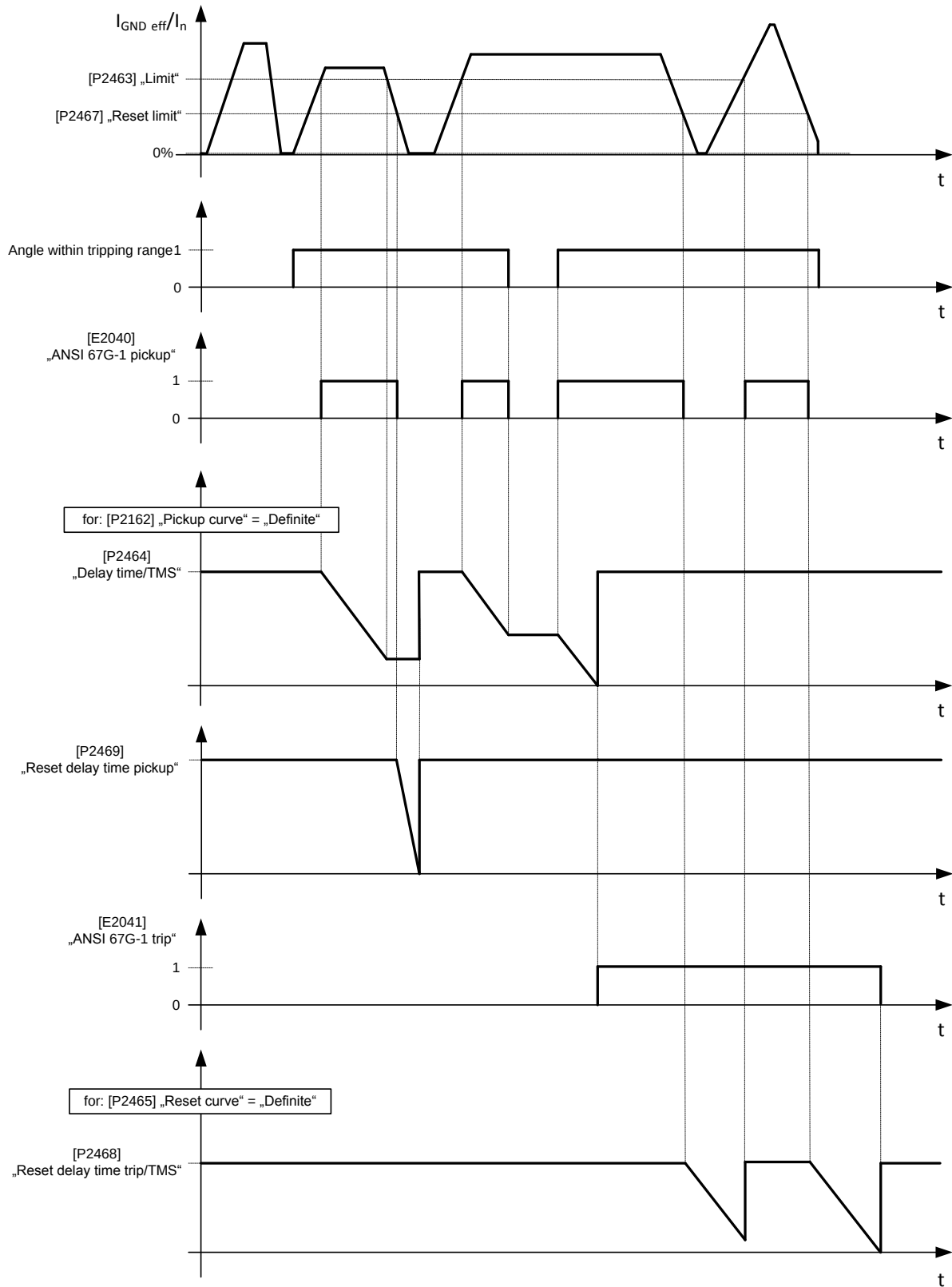


Figure 3-98 Directional ground overcurrent protection – Trip characteristic (DT) and Reset characteristic (DT)

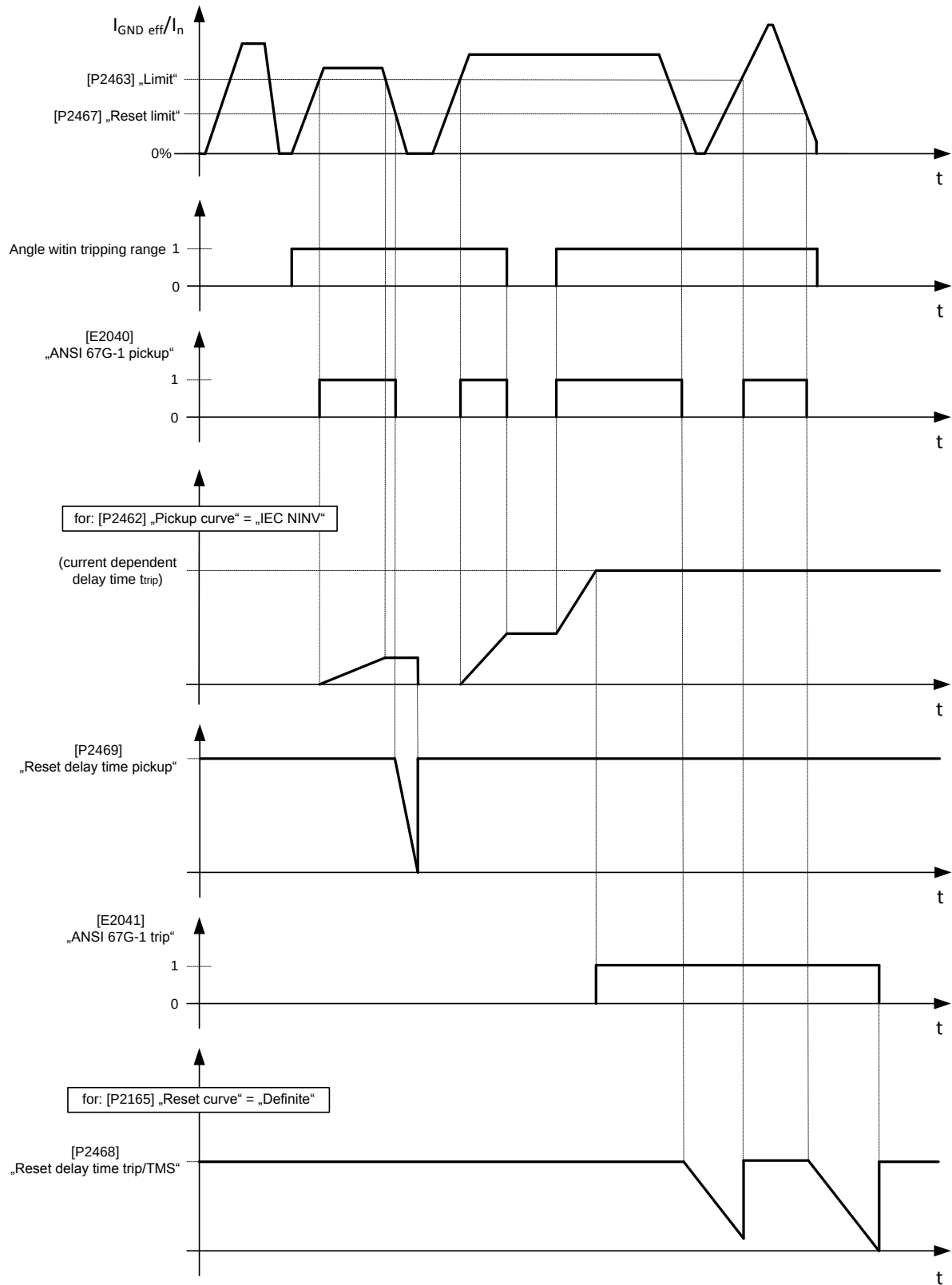


Figure 3-99 Directional ground overcurrent protection – Trip characteristic (IDMT) and Reset characteristic (DT)



3.5.15 ANSI 74TC – Trip Circuit Supervision

Main Menu\Parameters\PROTECTION\ANSI59-95i\				
ANSI 74TC				
SET 1	SET 2	SET 3	SET 4	
P/E No.	Name	Value	Unit	(Setting range)
SET PARAMETERS				
P2865	Function	OFF	-	ON/OFF
P2866	Blocking	0	event	0 ... 9999
P2867	Mode	Both	-	Both/Closed/Open
P2868	ON Feedback	6010	event	0 ... 9999
P2869	OFF Feedback	6011	event	0 ... 9999
P2670	Dealy time	5	s	0 ... 6553,5
E2235	ANSI74TC active	-	-	-
E2236	ANSI74TC blocked	-	-	-
E2237	ANSI74TC pickup	-	-	-
E2238	ANSI74TC trip	-	-	-

Figure 3-101 ANSI 74TC – Protection parameters [P] and events [E] of SET 1

Parameter description:

The following parameter descriptions refer to all protection parameters of one parameter set.

NOTE: Each of the four parameter sets always provides only one protection STEP and, as consequence, only one group of parameters. Thus, SET PARAMETERS are equal to STEP parameters. The protection parameters of SET 1 represented below are described in the following in detail as examples.

Protection parameters of parameter of SET 1 – ANSI 74TC

SET PARAMETERS

P2865 Function

This parameter enables/disables trip circuit supervision function wherein:

- “OFF”: disables or
- “ON”: enables the protective function.

When *trip circuit supervision ANSI74TC* is enabled by parameter [P2865], then event “*ANSI74TC active*” [E2235] is being activated.

P2866 Blocking

Trip circuit supervision function can be completely blocked by any active event. For blocking, the number related to this blocking event has to be assigned to parameter [P2866]. Blocking is only effective, however, as long as the blocking event is active. As soon as blocking is active, event “*ANSI74TC blocked*” [E2236] is being activated. If the blocking event turns inactive, blocking is abandoned and automatic reclosing (AR) function is effective again. Then, event [E2236] is being deactivated automatically.

If blocking of *trip circuit supervision ANSI74TC* function is not required, set this parameter to “0”.

Working principle of a Circuit breaker (CB) trip circuit supervision

For supervision of the CB trip circuit (circuit includes the binary output e.g. "Shunt 1" of the protective relays and the CB trip coil) two binary inputs are applied. Depending on the connection with the auxiliary contacts of the CB (one "normal open" aux. contact: 52-a and one "normal closed" aux. contact: 52-b) the signal states of the binary inputs give conclusion about an interrupted trip circuit.

NOTE: Function ANSI 74TC is only for trip circuit supervision of *one* breaker!

Table 3-6 Trip circuit supervision – Signal states and supervision modes

Signal state of assigned events		Supervision mode		
„ON Feedback [P2868] = [E4010]“	„OFF Feedback [P2869] = [E4024]“	„Both“	„Closed“	„Open“
0	0	☒	-	☒
0	1	-	-	-
1	0	-	-	-
1	1	☒	☒	-

See the following connection diagrams as an example:

CAUTION: For correct operating of function ANSI74TC the polarity of the connectd binary inputs must accord to the following connection diagrams!

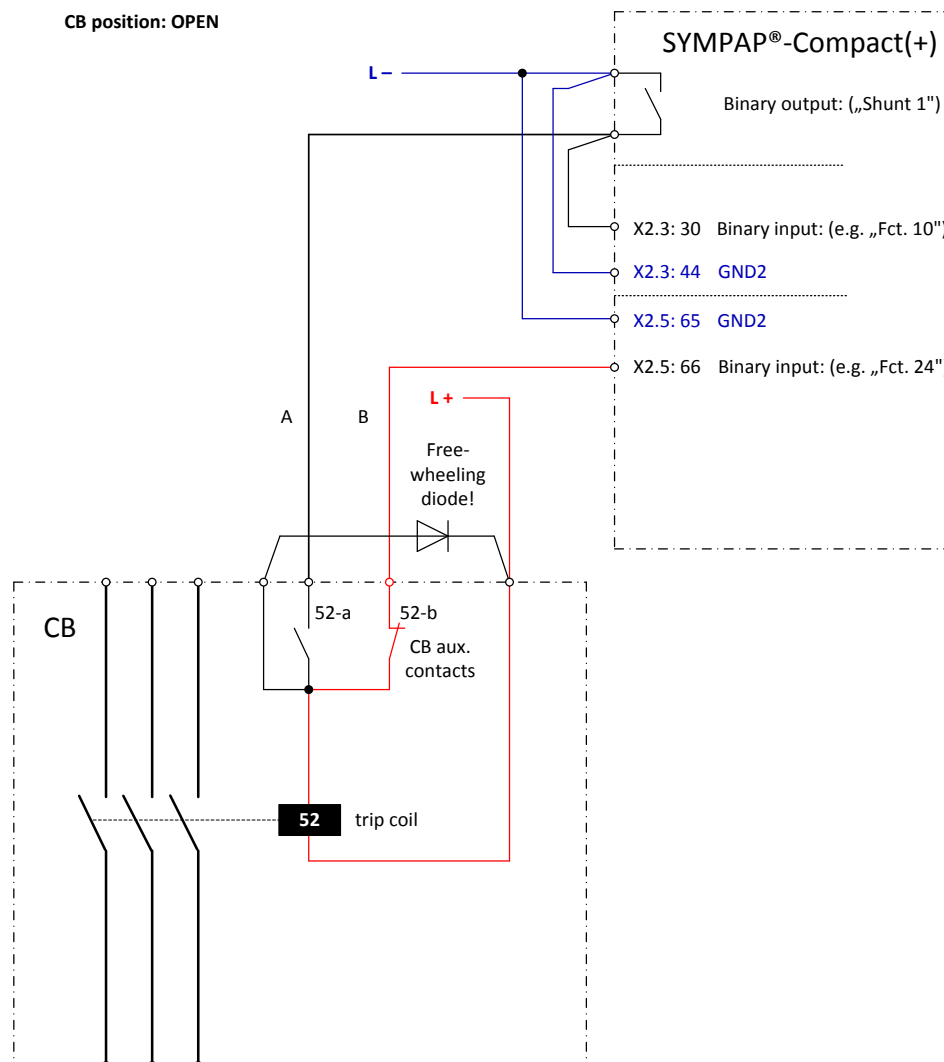


Figure 3-102 Trip circuit supervision – example of a connected trip circuit: CB open

When signal line “A” is broken while CB is open this will be indicated by function ANSI 74TC not before the CB is switched on. Wire break of line “B” will be indicated when the CB is open.

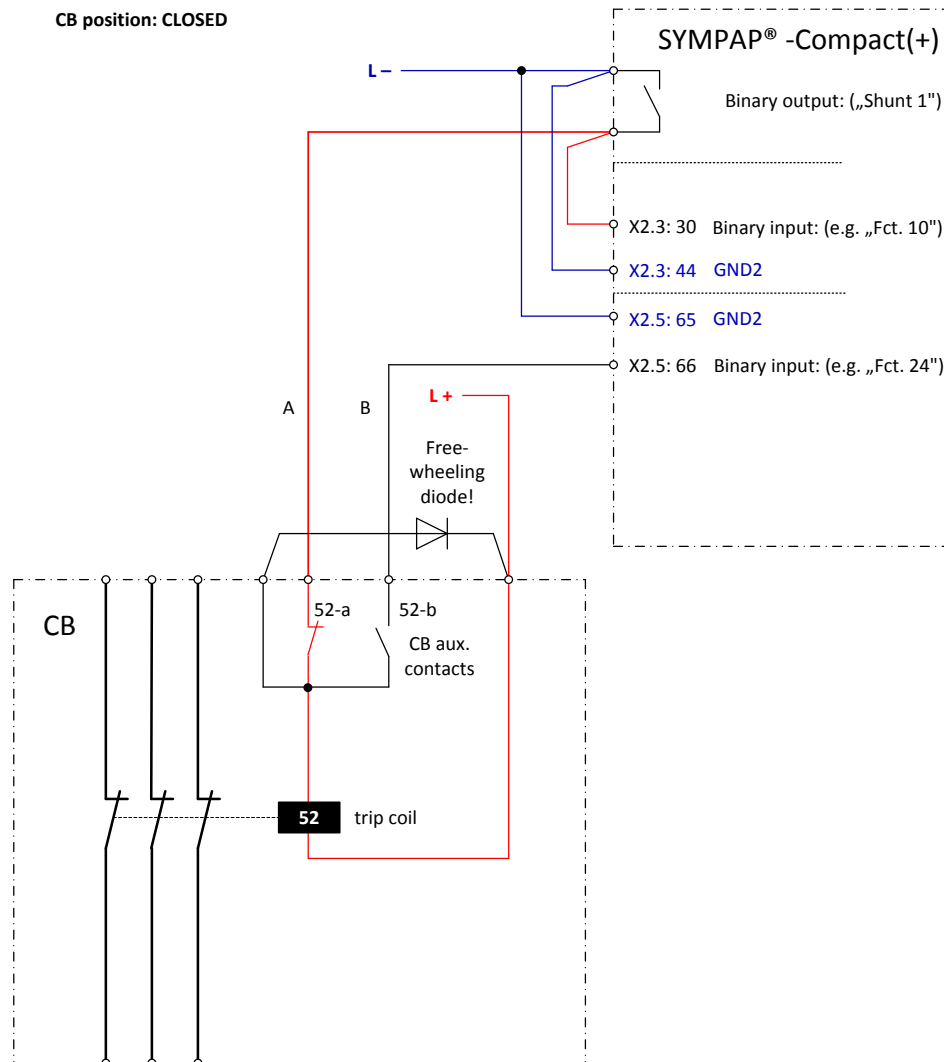


Figure 3-103 Trip circuit supervision – example of a connected trip circuit: CB closed

When signal line “A” is broken while CB is closed this will be indicated immediately by function ANSI 74TC. Wire break of line “B” will be indicated not before the CB is switched off.

CAUTION: Please ensure that the trip coil is included in the supervised circuit! To protect the hardware of SYMAP®-Compact(+) against high cut-off voltage of the CB trip coil the trip coil is to be equipped with a free-wheeling diode!

P2867 Mode

Supervision mode of the evaluation logic referring to the binary inputs; whereby setting:

- “Both”: checks the equality of signal states „0 / 0“ and „1 / 1“
- “Closed”: checks only the equality of signal states „1 / 1“
- “Open”: checks only the equality of signal states „0 / 0“

At the time the signal states “0 / 0” or “1 / 1” are detected, event “ANSI 74TC pickup” [E2237] is being activated, and the “Delay time” [P2870] is being started.

P2868 ON Feedback

Binary input to indicate the closed auxiliary contact of the CB; the event of the binary input which indicates the closed auxiliary contact of the CB is to be assigned to this parameter.

P2869 OFF Feedback

Binary input to indicate the open auxiliary contact of the CB; the event of the binary input which indicates the open auxiliary contact of the CB is to be assigned to this parameter.

P2870 Delay time

Trip delay time; it is the delay time of the trip event "ANSI74TC trip" [E2238].

As soon as:

- function "Trip circuit supervision" is activated by parameter [P2865] **and**
- signal states "0 / 0" or "1 / 1" are detected by the binary inputs **and**
- blocking of function "Trip circuit supervision" is not activated by the blocking event of parameter [P2562]

the pick-up event "ANSI 74TC pickup" [E2237] is being activated and "Delay time" is being started.

As soon as the pick-up event "ANSI 74TC pickup" [E2237] is active and "Delay time" run down, trip event [E2238] will be activated. This event can be used for alarm or output control purposes. Right after protection trip, and, as soon as faulty conditions will no longer be existent, pick-up event [E2237] and trip event [E2238] are being deactivated automatically.

3.5.16 ANSI 78 – Vector Surge

Main Menu\Parameters\PROTECTION\ANSI59-95i\					
ANSI 78					
SET 1	SET 2	SET 3	SET 4		
P/E No.	Name	Value	Unit	(Setting range)	
SET PARAMETERS					
P1860	Vector surge	OFF	-	ON/OFF	
P1861	Blocking protection module	0	event	0 ... 9999	
E1570	ANSI78 module active	-	-	-	
E1571	ANSI78 blocked module	-	-	-	
STEP 1					
P1865	Pickup source	PT1	-	none/PT1/PT2/PT3	
P1866	Blocking protection step	0	event	0 ... 9999	
P1867	Min. start voltage	15	%	15 ... 200,0	
P1868	Min. start voltage delay time	2	s	0 ... 999999,999	
P1870	Limit	6	deg	0 ... 25	
P1871	K1	1	-	0 ... 999,9	
P1873	Reset delay time trip	1	s	0 ... 999999,999	
P1874	Current source	none	-	none/CT1/CT2	
P1875	Current increase	0	%	0 ... 1999,9	
P1876	Current increase time	2	s	0 ... 999999,999	
E1576	ANSI78-1 step active	-	-	-	
E1577	ANSI78-1 blocked step	-	-	-	
E1578	ANSI78-1 blocked by min. start voltage	-	-	-	
E1579	ANSI78-1 pickup	-	-	-	
E1580	ANSI78-1 trip	-	-	-	
STEP 2					
P1880	Pickup source	PT2	-	none/PT1/PT2/PT3	
...	...	...	...	...	

Figure 3-104 ANSI 78 – Protection parameters [P] and events [E] of SET 1

Parameter description:

The following parameter descriptions refer to all protection parameters of one parameter set.

NOTE: Each of the four parameter sets always provides the same group of protection parameters. Hence, the parameter descriptions of the SET PARAMETERS and the parameters of STEP 1 represented below are described in the following in detail as examples.

Protection parameters of parameter SET 1 – ANSI 78

SET PARAMETERS

The following SET PARAMETERS of the vector surge protection exist only once in all four parameter sets. Thus, the SET PARAMETERS apply to all of the 3 protection STEPS of one parameter SET.

Protection parameters of parameter SET 1 – ANSI 78

P1860 Vector surge

This parameter enables/disables vector surge protection wherein:

- “OFF”: disables or
- “ON”: enables the protective function.

NOTE: In case that no voltage measurement is possible, caused by locating the PTs below the circuit breaker, and which is open, then, vector surge protection must be blocked by a suitable event. For this, the related number of such blocking event has to be assigned to parameter [P1861].

When *vector surge protection ANSI78* is enabled by parameter [P1860], then event “*ANSI78 module active*” [E1570] is being activated.

P1861 Blocking protection module

Vector surge protection can be completely blocked by any active event. For blocking, the number related to this blocking event has to be assigned to parameter [P1861]. Blocking is only effective, however, as long as the blocking event is active. As soon as blocking is active, event “*ANSI78 blocked module*” [E1571] is being activated. If the blocking event turns inactive, blocking is abandoned and protective function is effective again. Then, event [E1571] is being deactivated automatically.

If blocking of the vector surge protection is not required, set this parameter to “0”.

Protection parameters of STEP 1

The following STEP parameters of the vector surge protection exist only once in each of the 3 independent protection STEPS. Thus, the SET PARAMETERS apply only to one of the 3 protection STEPS of one parameter SET.

P1865 Pickup source

Depending on the SYMAP®-Compact(+) device variant every protection step of vector surge protection can be assigned to a certain voltage measurement input (PT1, PT2 or PT3). Parameter [P1865] determines the voltage measurement input which will provide measurement values as characteristic quantities (voltage angle difference $\Delta\Theta$) to the vector surge protection:

- “none”: no voltage measurement; protection step is deactivated
- “PT1”: voltage input PT1
- “PT2”: voltage input PT2
- “PT3”: voltage input PT3

For settings “PT1”, “PT2” or “PT3”, event “*ANSI78-1 step active*” [E1576] is being activated.

P1866 Blocking protection step

The first step of vector surge protection can be blocked by any active event. For blocking, the number related to this blocking event has to be assigned to parameter [P1866]. Blocking is only effective, however, as long as the blocking event is active. As soon as blocking is active, event “*ANSI78-1 blocked step*” [E1577] is being activated. If the blocking event turns inactive, blocking is abandoned and protective function is effective again. Then, event [E1577] is being deactivated automatically.

If blocking of the first step of vector surge protection is not required, set this parameter to “0”.

P1867 Min. start voltage

Minimum limit of the measuring voltage to activate vector surge protection; the first protection step of *vector surge* protection is blocked as long as the measured voltage remains below this minimum setting at least in one phase. For the duration of blocking event “*ANSI78-1 blocked step by min. start voltage*” [E1578] is activated.

NOTE: The *minimum limit of the measuring voltage* is to be set as a percentage of the *nominal value* of the characteristic quantity (phase-to-phase voltage). The nominal value of the characteristic quantity is to be set by parameter:

- “Voltage (L-L)” [P603], for primary side W1 or
- “Voltage (L-L)” [P613], for secondary side W2 or
- “Voltage (L-L)” [P623], for tertiary side W3.

The referring parameters “Voltage (L-L)” [P603], “Voltage (L-L)” [P613] and “Voltage (L-L)” [P623] are located in submenu: “SYSTEM\Nominals\Reference values”.

P1868 Min. start voltage delay time

Delay time to reset the blocking of vector surge protection after voltage restoration; as soon as the minimum limit “Min. start voltage” [P1867] is exceeded after a preceded voltage restoration, the counter “Min. start voltage delay time” [P1868] starts. Once the time has elapsed the counter is set to zero, the blocking of vector surge protection is being deactivated, and event “ANSI78-1 blocked step by min. start voltage” [E1578] is being deactivated.

Application: “Min. start voltage delay time” is used to detect a stable voltage restoration.

P1871 K1

Correction factor to adjust the maximum permissible voltage angle difference $\Delta\Theta$ (vector surge) dependent of the grid impedance; multiplication of the correction factor “K1” [P1871] by the setting of parameter “Limit” [P1870] gives the maximum permissible voltage angle difference $\Delta\Theta_{\max}$ as the limit for vector surge protection.

Max. permissible voltage angle difference $\Delta\Theta_{\max} = \text{“Limit” [P1870]} \times \text{“K1” [P1871]}$

Typical rates are:

- K1 = 1,0 Correction factor for *low* impedance grid, and
- K1 = 1,66 – 2,0 Correction factor for *high* impedance grid.

P1870 Limit

Pick-up value of vector surge protection; as soon as the characterisitic quantity (voltage angle difference $\Delta\Theta$):

- exceeds the set value of the maximum permissible voltage angle difference $\Delta\Theta_{\max}$ (parameter “Limit” [P1864] and “K1” [P1865]), **and**
- no blocking event (parameter “Blocking protection module” [P1861]) is active, **and**
- no blocking event (parameter “Blocking protection step” [P1866]) is active, **and**
- no blocking by insufficient voltage (parameter “Min. start voltage” [P1867]) is active

the pick-up event “ANSI78-1 pick-up” [E1579] is being activated. Dependent on activation/deactivation of the „Current increase monitoring“ trip event “ANSI78-1 trip” [E1580] is to be activated as follows:

- “Current increase monitoring” is deactivated: Parameter [P1874] “Current source = none”:
At the same time as activating the pick-up event [E1579], trip event “ANSI78-1 trip” [E1580] is being activated, and the counter of “Reset delay time trip” starts. This event can be used for alarm or output control purposes.
- “Current increase monitoring” is activated: Parameter [P1874] “Current source = CT1” or “CT2”:

At the same time as activating the pick-up event [E1579], the counter “*Current increase time*” [P1876] starts. While counting, the active state of the pick-up event [E1579] is being saved.

- 1st case: *The current value falls below the set value of parameter [P1875]:*
As soon as the counter “*Current increase time*” has run down, pick-up event [E1579] is being activated; trip event “*ANSI78-1 trip*” [E1580] is not being activated.
- 2nd case: *The current value exceeds the set value of parameter [P1875]:*
As soon as the counter “*Current increase time*” has run down, trip event “*ANSI78-1 trip*” [E1580] is being activated, and counter “*Reset delay time trip*” starts. After the counter “*Reset delay time trip*” has run down, the active state of pick-up event [E1579] is being reset.

P1873 Reset delay time trip

Delay time for resetting the trip event “ANSI78-1 trip” [E1580]; after the counter “Reset delay time trip” has run down, trip event [E1580] and the pick-up event [E1579] are being deactivated.

P1875 Current increase

*Minimum limit for detecting an inclining/declining phase current (current increase monitoring function as an additional criterion to the vector surge protection); a vector surge, caused by a grid fault, either leads to an increase or a decrease of the generator load flow. Thus, function “current increase monitoring” can be used to detect such vector surge safely. Here, the phase current values at the time of vector surge are compared with the phase current values after the set “*Current increase time*” [P1876] has run down. In case that the phase current difference exceeds the set value “*Current increase*” [P1875] after the “*Current increase time*” [P1876] has run down, then, trip event “ANSI78-1 trip” [E1580] is being activated.*

NOTE: The *minimum limit for detecting an inclining/declining phase current* is to be set as a percentage of the *nominal value* of the characteristic quantity (phase current). The nominal value of the characteristic quantity is to be set by parameter:

- “*Current*” [P604], for primary side W1 or
- “*Current*” [P614], for secondary side W2 or
- “*Current*” [P624], for tertiary side W3.

The referring parameters “*Current*” [P604], “*Current*” [P614] and “*Current*” [P624] are located in submenu: “SYSTEM\Nominals\Reference values”.

P1876 Current increase time

*Maximum time window of “current increase monitoring”; as soon as pick-up event “ANSI78-1 pick-up” [E1579] is activated, the counter “*Current increase time*” [P1876] starts.*

P1874 Current source

Depending on the SYMAP®-Compact(+) device variant, function “*current increase monitoring*” of every protection step can be assigned to a certain current measurement input (CT1 or CT2):

- “none”: function “current increase monitoring” is deactivated,
- “CT1”: function “current increase monitoring” is assigned to current input CT1
- “CT2”: function “current increase monitoring” is assigned to current input CT2

3.5.17 ANSI 79 – Automatic Reclose (AR)

Main Menu\Parameters\PROTECTION\ANSI59-95i\					
ANSI 79					
SET 1	SET 2	SET 3	SET 4		
P/E No.	Name	Value	Unit	(Setting range)	
GENERAL					
P2675	Enable	OFF	-	ON/OFF	
P2676	Block	0	event	0 ... 9999	
P2677	Lock	0	event	0 ... 9999	
P2678	Unlock	0	event	0 ... 9999	
SETTING 1					
P2679	Activate	0	event	0 ... 9999	
P2680	1. Pause time	0,3	s	0 ... 655,35	
P2681	2. Pause time	0,5	s	0 ... 655,35	
P2682	3. Pause time	0,8	s	0 ... 655,35	
P2683	4. Pause time	1,3	s	0 ... 655,35	
P2684	5. Pause time	1,5	s	0 ... 655,35	
P2685	6. Pause time	1,8	s	0 ... 655,35	
P2686	7. Pause time	2,3	s	0 ... 655,35	
P2687	8. Pause time	2,8	s	0 ... 655,35	
SETTING 2					
P2688	Activate	0	event	0 ... 9999	
P2689	1. Pause time	0,5	s	0 ... 655,35	
P2690	2. Pause time	1	s	0 ... 655,35	
P2691	3. Pause time	2	s	0 ... 655,35	
P2692	4. Pause time	3	s	0 ... 655,35	
P2693	5. Pause time	4	s	0 ... 655,35	
P2694	6. Pause time	5	s	0 ... 655,35	
P2695	7. Pause time	6	s	0 ... 655,35	
P2696	8. Pause time	7	s	0 ... 655,35	
RECLOSING					
P2697	Breaker close command time	0,1	s	0 ... 655,35	
P2698	Breaker close success time	0,5	s	0 ... 655,35	
P2699	Off-time	10	s	0 ... 655,35	
FEEDBACKS					
P2700	Breaker closed	6111	event	0 ... 9999	
P2701	Breaker ready	0	event	0 ... 9999	
E2160	ANSI79 ready	-	-	-	
E2160	ANSI79 blocked	-	-	-	
E2160	ANSI79 locked	-	-	-	
E2160	ANSI79 cycle	-	-	-	
E2160	ANSI79 1. Pause time	-	-	-	
E2160	ANSI79 2. Pause time	-	-	-	
E2160	ANSI79 3. Pause time	-	-	-	
E2160	ANSI79 4. Pause time	-	-	-	
E2160	ANSI79 5. Pause time	-	-	-	
E2160	ANSI79 6. Pause time	-	-	-	
E2170	ANSI79 7. Pause time	-	-	-	
E2170	ANSI79 8. Pause time	-	-	-	
E2170	ANSI79 Breaker close command	-	-	-	
E2170	ANSI79 Breake close success time	-	-	-	
E2170	ANSI79 Success	-	-	-	
E2170	ANSI79 Fail	-	-	-	
E2170	ANSI79 Off-time	-	-	-	

Figure 3-105 ANSI 79 – Parameter set 1: Protection parameters [P] and Events [E]

Parameter description:

The following parameter descriptions refer to all protection parameters of one parameter set.

NOTE: Each of the four parameter sets always provides only one protection STEP and, as consequence, only one group of parameters. Thus, SET PARAMETERS are equal to STEP parameters. The protection parameters of SET 1 represented below are described in the following in detail as examples.

Protection parameters of parameter of SET 1 – ANSI 79

General parameters (GENERAL)

General parameters apply to *activating* and *blocking* of function “Automatic Reclosing (AR)”.

P2675 Enable

This parameter enables/disables *Automatic Reclose (AR)* wherein:

- “OFF”: disables or
- “ON”: enables the protective function.

When *Automatic Reclose (AR)* ANSI 79 is enabled by parameter [P2675], then event “ANSI79 Ready” [E2160] is being activated.

P2675 Block

Automatic Reclose (AR) function can be completely blocked by any active event. For blocking, the number related to this blocking event has to be assigned to parameter [P2675]. Blocking is only effective, however, as long as the blocking event is active. As soon as blocking is active, event “ANSI79 Blocked” [E2161] is being activated. If the blocking event turns inactive, blocking is abandoned and protective function is effective again. Then, event [E2161] is being deactivated automatically.

If blocking of function *Automatic Reclose (AR)* is not required, set this parameter to “0”.

P2676 Lock

An already running AR-cycle of *Automatic Reclose (AR)* function can be interrupted (locked) by any active event. For this, the number related to this locking event has to be assigned to parameter [P2676]. As soon as locking is active, event “ANSI79 Locked” [E2161] is being activated. When the locking event turns to inactive, then the AR-cycle remains interrupted.

If locking of an AR-cycle of function *Automatic Reclose (AR)* is not required, set this parameter to “0”.

P2677 Unlock

An already active but interrupted AR-cycle of *Automatic Reclose (AR)* function can be released (unlocked) by any active event. For this, the number related to this unlocking event has to be assigned to parameter [P2677]. As soon as the release event is active, the locked AR-cycle is being continued, and event “ANSI79 Locked” [E2161] is being deactivated.

CAUTION: In the event that locking of an AR-Cycle is foreseen in the application, please ensure that a **corresponding “unlocking” event** is being assigned to parameter “Unlock” [P2677]!

Parameters of an AR-cycle e.g. for phase faults (SETTINGS 1)

The following parameters [P2678] to [P2687] apply to an AR-cycle which was **started** by the event which is assigned to parameter [P2678]

P2679 Activate

The AR-cycle of "Automatic Reclose (AR)" function can be activated by any active event. For activation, the number related to this event has to be assigned to parameter [P2679]. As soon as the assigned is active, the AR-cycle is being started and events "ANSI79 Cycle" [E2163] and "ANSI79 Fail" [2175] are being activated.

If an event-activation of an AR-cycle of function *Automatic Reclose (AR)* is not required, set this parameter to "0".

P2680 1. Pause time

First pause time between activation of the event assigned to parameter [2679] and the first automatic reclosing attempt; at the time the activation-event turns to active, the first pause time set by parameter "1. Pause time" [P2680] is being started and event "1. Pause time" [E2689] is being activated.

P2681 2. Pause time

(description is analog to description of 1.pause time)

P2682 3. Pause time

(description is analog to description of 1.pause time)

P2683 4. Pause time

(description is analog to description of 1.pause time)

P2684 5. Pause time

(description is analog to description of 1.pause time)

P2685 6. Pause time

(description is analog to description of 1.pause time)

P2686 7. Pause time

(description is analog to description of 1.pause time)

P2687 8. Pause time

(description is analog to description of 1.pause time)

Parameters of an AR-cycle e.g. for earth faults (SETTINGS 2)

The following parameters [P2688] to [P2696] apply to an AR-cycle which was started by the event which is assigned to parameter [P2688]

P2688 Activate

The AR-cycle of "Automatic Reclose (AR)" function can be activated by any active event. For activation, the number related to this event has to be assigned to parameter [P2688]. As soon as the assigned is active, the AR-cycle is being started and event "ANSI79 Cycle" [E2163] is being activated.

If an event-activation of an AR-cycle of function *Automatic Reclose (AR)* is not required, set this parameter to "0".

P2689 1. Pause time

First pause time between activation of the event assigned to parameter [2689] and the first automatic reclosing attempt; at the time the activation-event turns to active, the first pause time set by parameter "1. Pause time" [P2690] is being started and event "1. Pause time" [E2689] is being activated.

P2690 2. Pause time

(description is analog to description of 1.pause time)

P2691 3. Pause time

(description is analog to description of 1.pause time)

P2692 4. Pause time

(description is analog to description of 1.pause time)

P2693 5. Pause time

(description is analog to description of 1.pause time)

P2694 6. Pause time

(description is analog to description of 1.pause time)

P2695 7. Pause time

(description is analog to description of 1.pause time)

P2696 8. Pause time

(description is analog to description of 1.pause time)

Parameters for auto-reclosing (RECLOSING)

P2697 Breaker close command time

Impuls duration for the reclosing command to the CB; when an active pause time has run down, closing-event "ANSI79 Breaker close command" [E2172] is being activated. This event can be used for alarm or output control purposes.

Simultaneously,

- the counter of the impuls duration set by parameter "*Breaker close success time*" [P2697] **and**
- the counter of the reclosing success supervision set by parameter "*Breaker success success time*" [P2698] are being started **and**
- event "*Breaker close success time*" [E2172] is being activated.

P2698 Breaker close success time

Supervision time for a successful reclosing attempt; when the success time set by parameter [P2698] run down, function "Automatic reclosing (AR)" checks whether the CB is closed.

Hereby, the following cases have to be taken into account:

Automatic reclosing attempt was successful

The CB is closed; event "*ANSI79 Success*" [E2174] is being activated. Simultaneously, the counter of the AR-blocking-time set by parameter "*Off- time*" [P2699] and the events "*ANSI79 Off-time*" [E2176] und "*ANSI79 Success*" [E2174] are being activated.

Automatic reclosing attempt was unsuccessful

The CB is open again (by further protection trip) and – if parametrized – the second pause time set by parameter "*2. Pause time*" [P2681] is being started. The procedure for the second automatic reclosing attempt follows the rules mentioned above. In case that second AR-attempt was unsuccessful, it is concluded a permanent fault and event "*ANSI79 Ready*" [E2160] remains inactive.

NOTE: In case of a permanent fault, event "*ANSI79 Fail*" [E2175] is being activated when the AR-cycle has finished.

P2699 Off-time

Blocking time after the last AR-attempt; at the time the off-time run down, the events “ANSI79 Off-time” [E2176] and “ANSI79 Cycle” [E2163] are being deactivated and event “ANSI79 Ready” is being activated.

Event “ANSI79 Success” [E2174] can be deactivated by command “ACK” (e.g. by operating the function key at the front panel)

Parameters for indication “CB ready state” and CB position feedback of ON-position

P2700 Breaker closed

Event-parameter to indicate CB position “closed”; for this, the number related to this event has to be assigned to parameter [P2700].

NOTE: Preferably, one of the position event numbers [E6010], [E6020], [E6030], [E6040], [E6050], [E6060], [E6070] or [E6080] should be used to indicate CB position “ON-Feedback”.

P2701 Breaker ready

Additional pre-condition option for any AR-attempt; as an additional pre-condition for activating event “ANSI79 Breaker close command” [E2172], the event number of the binary input, which indicates the CB readiness for closing by signalling a “charged spring” of the CB, can be assigned to parameter [P2701].

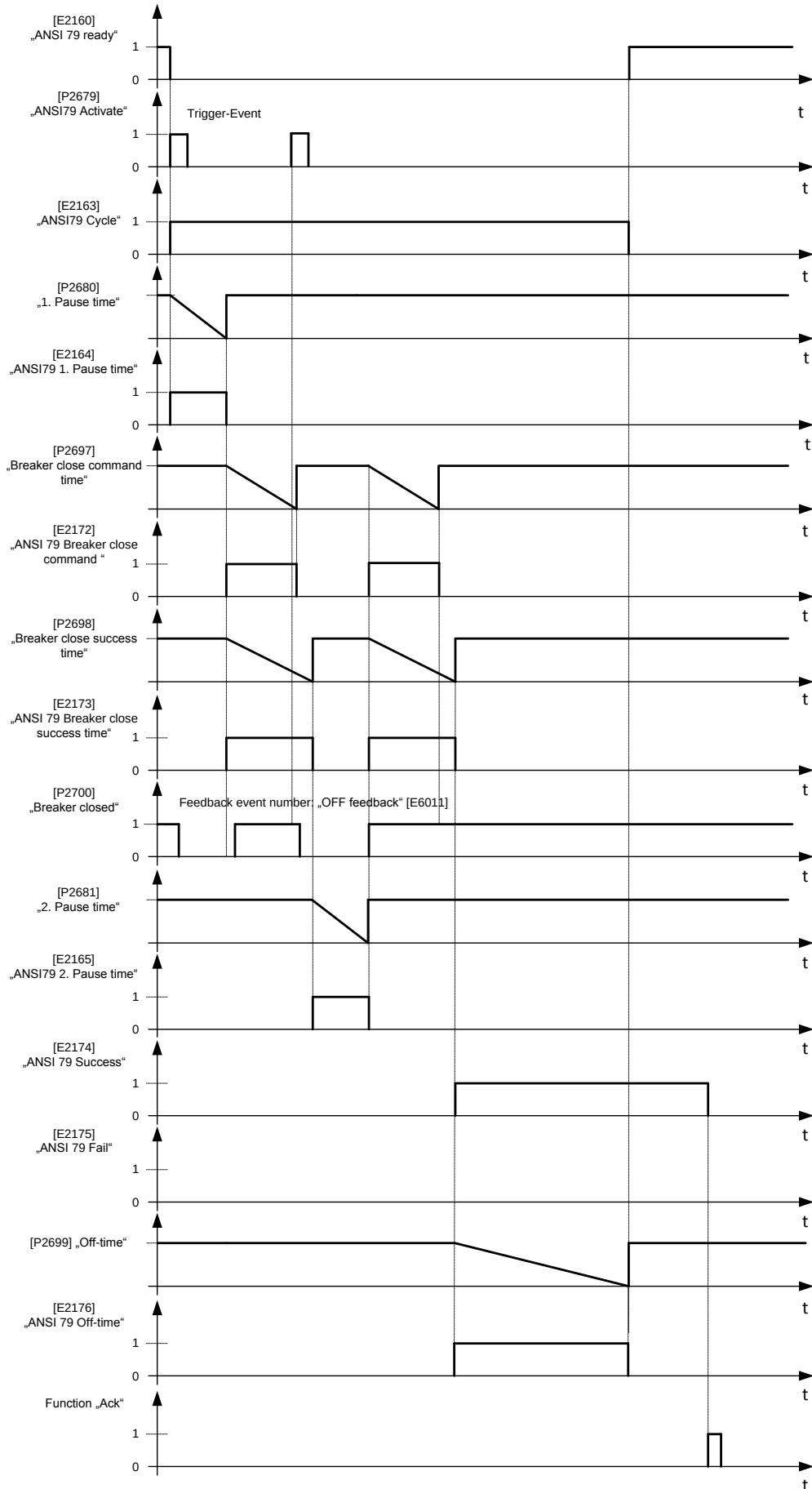


Figure 3-106 Automatic reclosing (AR) – functional scheme

3.5.18 ANSI 81 – Frequency Protection

Main Menu\Parameters\PROTECTION\ANSI59-95i\					
ANSI 81					
SET 1	SET 2	SET 3	SET 4		
P/E No.	Name		Value	Unit	(Setting range)
SET PARAMETERS					
P1325	Frequency protection		ON	-	ON/OFF
P1326	Blocking protection module		0	event	0 ... 9999
E1250	ANSI81 module active		-	-	-
E1251	ANSI81 blocked module		-	-	-
STEP 1					
P1331	Pickup source		PT1	-	none/PT1/PT2/PT3
P1332	Blocking protection step		0	event	0 ... 9999
P1333	Min. start voltage		10	%	0 ... 200,0
P1334	Limit		51	Hz	0 ... 80,00
P1335	Delay time		2	s	0 ... 999999,999
P1336	Reset limit		50,1	Hz	0 ... 80,00
P1337	Reset delay time trip		1	s	0 ... 999999,999
P1338	Reset delay time pickup		1	s	0 ... 999999,999
E1254	ANSI81-1 step active		-	-	-
E1255	ANSI81-1 blocked step		-	-	-
E1256	ANSI81-1 blocked step by min. start voltage		-	-	-
E1257	ANSI81-1 pickup				
E1258	ANSI81-1 trip				
STEP 2					
P1343	Pickup source		PT1	-	none/PT1/PT2/PT3
...	...		...	...	...

Figure 3-107 ANSI 81 – Protection parameters [P] and events [E] of SET 1

Parameter description:

The following parameter descriptions refer to all protection parameters of one parameter set.

NOTE: Each of the four parameter sets always provides the same group of protection parameters. Hence, the parameter descriptions of the SET PARAMETERS and the parameters of STEP 1 represented below are described in the following in detail as examples.

Protection parameters of parameter SET 1 – ANSI 81

SET PARAMETERS

The following SET PARAMETERS of the frequency protection exist only once in each of the four parameter sets. Thus, the SET PARAMETERS apply to all of the 12 protection STEPS of one parameter SET.

P1325 Frequency protection

This parameter enables/disables frequency protection wherein:

- “OFF”: disables or
- “ON”: enables the protective function.

NOTE: In case that no voltage measurement is possible, caused by locating the PTs below the circuit breaker, and which is open, then, undervoltage protection must be blocked by a suitable event. For this, the related number of such blocking event has to be assigned to parameter [P1326].

When frequency protection ANSI 81 is enabled by parameter [P1325], then event *"ANSI81 module active"* [E1250] is being activated.

P1326 Blocking protection module

Frequency protection can be completely blocked by any active event. For blocking, the number related to this blocking event has to be assigned to parameter [P1326]. Blocking is only effective, however, as long as the blocking event is active. As soon as blocking is active, event *"ANSI81 blocked module"* [E1251] is being activated. If the blocking event turns inactive, blocking is abandoned and protective function is effective again. Then, event [E1251] is being deactivated automatically.

If blocking of the frequency protection is not required, set this parameter to **"0"**.

Protection parameters of STEP 1

The following STEP parameters of the frequency protection exist only once in each of the 12 independent protection STEPS. Thus, the SET PARAMETERS apply only to one of the 12 protection STEPS of one parameter SET.

NOTE: The operating mode of each protection STEP can be adjusted separately either as "over frequency protection" or as "under frequency protection". Changing the option can be done by parameter *"Limit"* [P1334].

Protection STEP 1 – "Over frequency"

P1331 Pick-up source

Depending on the SYMAP[®]-Compact(+) device variant every protection step of frequency protection can be assigned to a certain voltage measurement input (PT1, PT2 or PT3). Parameter [P1331] determines the voltage measurement input which will provide measurement values as characteristic quantities (frequency) to the frequency protection:

- "none": no frequency measurement; protection step is deactivated
- "PT1": voltage input PT1
- "PT2": voltage input PT2
- "PT3": voltage input PT3

For settings "PT1", "PT2" or "PT3", event *"ANSI81-1 step active"* [E1254] is being activated.

P1332 Blocking protection step

The first step of frequency protection can be blocked by any active event. For blocking, the number related to this blocking event has to be assigned to parameter [P1332]. Blocking is only effective, however, as long as the blocking event is active. As soon as blocking is active, event *"ANSI81-1 blocked step"* [E1255] is being activated. If the blocking event turns inactive, blocking is abandoned and protective function is effective again. Then, event [E1255] is being deactivated automatically.

If blocking of the first step of over frequency protection is not required, set this parameter to **"0"**.

P1333 Min. start voltage

Minimum limit of the measuring voltage to activate frequency protection; the first protection step of frequency protection is blocked as long as the measured value of the characteristic quantity (frequency) remains below this minimum setting at least in one phase. For the duration of blocking event "ANSI81-1 blocked step by min. start voltage" [E1256] is activated.

NOTE: The *minimum limit of the measuring voltage to activate frequency protection* is to be set as a percentage of the *nominal value* of the characteristic quantity (phase-to-phase voltage). The nominal value of the characteristic quantity is to be set by parameter:

- "Voltage (L-L)" [P603], for primary side W1 or
- "Voltage (L-L)" [P613], for secondary side W2 or
- "Voltage (L-L)" [P623], for tertiary side W3.

The referring parameters "Voltage (L-L)" [P603], "Voltage (L-L)" [P613] and "Voltage (L-L)" [P623] are located in submenu: "SYSTEM\Nominals\Reference values".

P1334 Limit

Pick-up value of the first frequency protection element. At the moment that the characteristic quantity (frequency) exceeds this limit, pick-up event "ANSI81-1 pickup" [E1257] will become active, and the trip delay time ("Delay time") of the first frequency protection element will start.

P1335 Delay time

Trip delay time; it is the delay time of the trip event "ANSI81-1 trip" [E1258]. As soon as the pick-up event "ANSI81-1 pickup" [E1257] is active and "Delay time" run down, trip event [E1258] will be activated. This event can be used for alarm or output control purposes.

In case that the characteristic quantity (frequency) falls below the pick-up value ("Limit") of the first frequency protection step before the trip delay time ("Delay time") has run down, the timer of "Delay time" will be stopped and the counter value is being saved. If the characteristic quantity subsequently falls below the "Reset limit", then, the "Reset delay time pick-up" timer will start and the pick-up event [E1275] will be deactivated.

P1338 Reset delay time pick-up

Pick-up reset delay time; it is the delay time for resetting the trip delay time ("Delay time").

As soon as the pick-up reset delay time ("Reset delay time pick-up") has run down the counter of the trip delay time ("Delay time") is being reset.

P1336 Reset limit

Trip reset limit of the first step of frequency protection. As soon as the trip event "ANSI81-1 trip" [E1258] is active and the characteristic quantity (frequency) falls below the "Reset limit", the timer of the trip reset delay time ("Reset delay time trip") will start.

P1337 Reset delay time trip

Trip reset delay time; it is the delay time for resetting the trip event "ANSI81-1 trip" [E1258].

If the trip reset delay time ("Reset delay time trip") has run down, trip event "ANSI81-1 trip" [E1258] is being deactivated. In case that the characteristic quantity (frequency) exceeds the pick-up value ("Limit") of the first frequency protection element before the timer of "Reset delay time trip" has run down, the timer of "Reset delay time trip" will be reset. Then trip event "ANSI81-1 trip" [E1258] remains active.

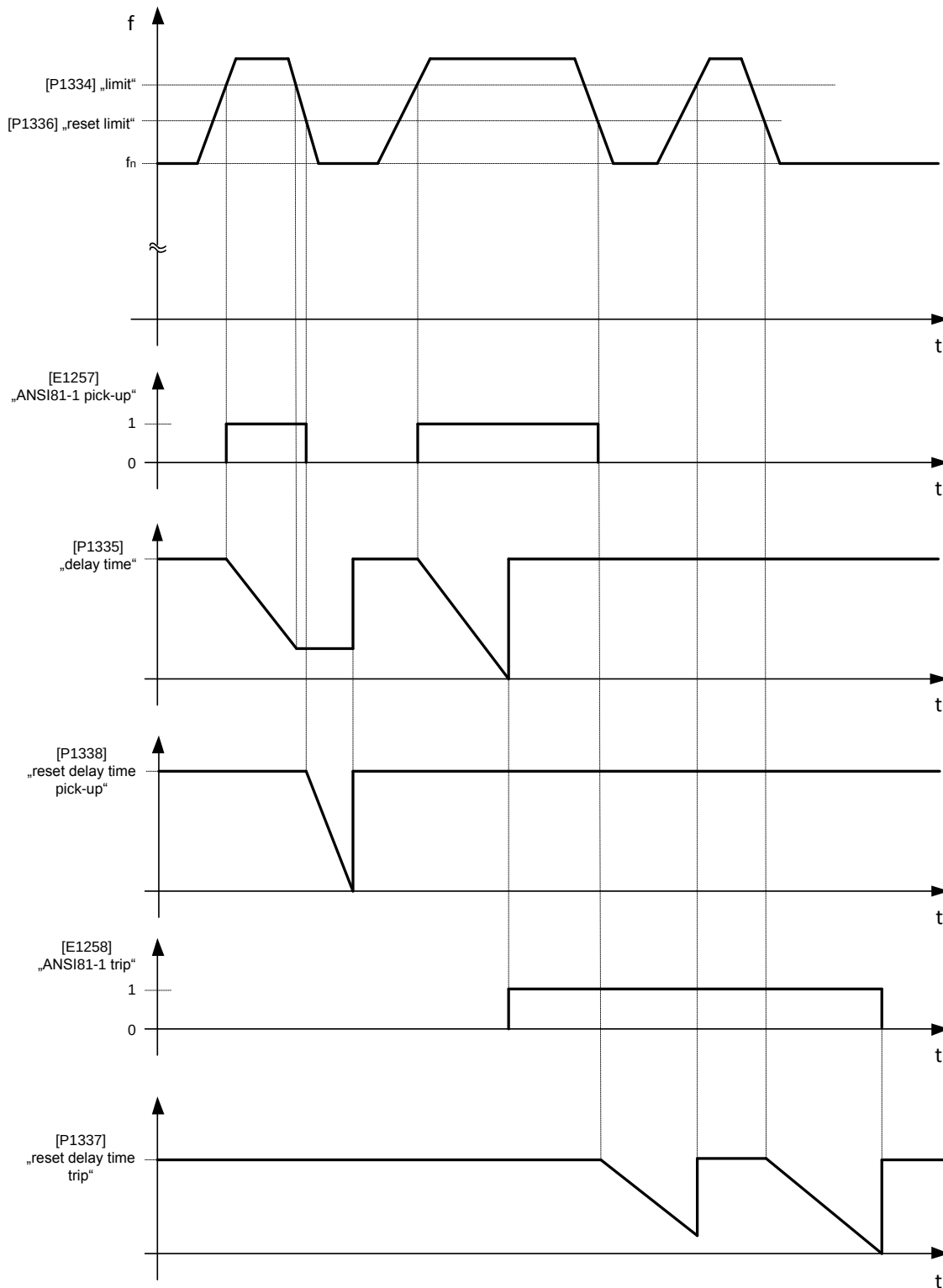


Figure 3-108 Overfrequency – tripping and reset characteristic

Protection parameter set 1

First protection element – “Over frequency”

P1331 Pick-up source

Depending on the SYMAP®-Compact(+) device variant every protection step of frequency protection can be assigned to a certain voltage measurement input (PT1, PT2 or PT3). Parameter [P1331] determines the voltage measurement input which will provide measurement values as characteristic quantity (frequency) to the frequency protection:

- “none”: no frequency measurement; protection step is deactivated
- “PT1”: voltage input PT1
- “PT2”: voltage input PT2
- “PT3”: voltage input PT3

For settings “PT1”, “PT2” or “PT3”, event “ANSI81-1 step active” [E1254] is being activated.

P1332 Blocking protection step

The first step of frequency protection can be blocked by any active event. For blocking, the number related to this blocking event has to be assigned to parameter [P1332]. Blocking is only effective, however, as long as the blocking event is active. As soon as blocking is active, event “ANSI81 blocked step” [E1255] is being activated. If the blocking event turns inactive, blocking is abandoned and protective function is effective again. Then, event [E1255] is being deactivated automatically.

If blocking of the first step of undervoltage protection is not required, set this parameter to “0”.

P1333 Min. start voltage

Minimum limit of the measuring voltage to activate frequency protection; the first protection step of frequency protection is blocked as long as the measured value of the characteristic quantity (frequency) remains below this minimum setting at least in one phase. For the duration of blocking event “ANSI81-1 blocked step by min. start voltage” [E1256] is activated.

NOTE: The *minimum limit of the measuring voltage to activate frequency protection* is to be set as a percentage of the *nominal value* of the characteristic quantity (phase-to-phase voltage). The nominal value of the characteristic quantity is to be set by parameter:

- “Voltage (L-L)” [P603], for primary side W1 or
- “Voltage (L-L)” [P613], for secondary side W2 or
- “Voltage (L-L)” [P623], for tertiary side W3.

The referring parameters “Voltage (L-L)” [P603], “Voltage (L-L)” [P613] and “Voltage (L-L)” [P623] are located in submenu: “SYSTEM\Nominals\Reference values”.

P1334 Limit

Pick-up value of the first frequency protection element, at the moment that the characteristic quantity (frequency) falls below this limit, pick-up event “ANSI81-1 pickup” [E1257] will become active, and the trip delay time (“Delay time”) of the first frequency protection element will start.

P1335 Delay time

Trip delay time; it is the delay time of the trip event “ANSI81-1 trip” [E1258].

As soon as the pick-up event “ANSI81-1 pickup” [E1257] is active and “Delay time” run down, trip event “ANSI81-1 trip” [E1258] will be activated. This event can be used for alarm or output control purposes.

In case that the characteristic quantity (frequency) exceeds the pick-up value (“Limit”) of the first frequency protection step before the trip delay time (“Delay time”) has run down, the timer of “Delay time” will be stopped and the counter value is being saved. If the characteristic quantity subsequently exceeds the “Reset limit”, then, the “Reset delay time pick-up” timer will start and the pick-up event [E1257] will be deactivated.

P1338 Reset delay time pick-up

Pick-up reset delay time; it is the delay time for resetting the trip delay time (“Delay time”).

As soon as the pick-up reset delay time (“Reset delay time pick-up”) has run down the counter of the trip delay time (“Delay time”) is being reset.

P1336 Reset limit :

Trip reset limit of the first step of frequency protection. As soon as the trip event “ANSI81-1 trip” [E1258] is active and the characteristic quantity (frequency) exceeds the “Reset limit”, the timer of the trip reset delay time (“Reset delay time trip”) will start.

P1337 Reset delay time trip :

Trip reset delay time; it is the delay time for resetting the trip event “ANSI81-1 trip” [E1258].

If the trip reset delay time (“Reset delay time trip”) has run down, trip event “ANSI81-1 trip” [E1258] is being deactivated. In case that the characteristic quantity (frequency) falls below the pick-up value (“Limit”) of the first frequency protection element before the timer of “Reset delay time trip” has run down, the timer of “Reset delay time trip” will be reset. Then trip event “ANSI81-1 trip” [E1258] remains active.

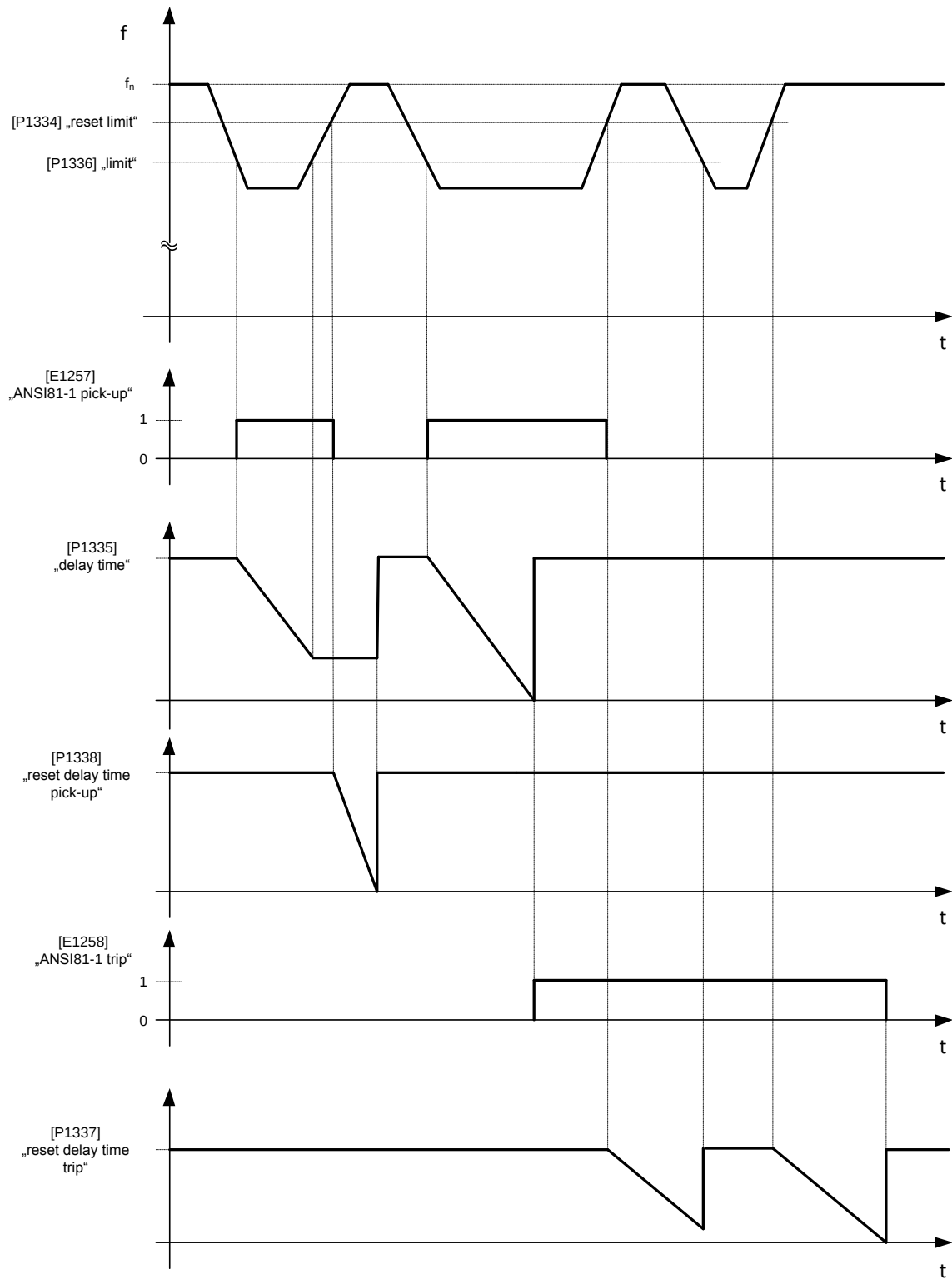


Figure 3-109 Underfrequency – tripping and reset characteristic

3.5.19 ANSI 81R – RoCoF (df/dt)

Main Menu\Parameters\PROTECTION\ANSI59-95i\					
ANSI 81R					
SET 1	SET 2	SET 3	SET 4		
P/E No.	Name	Value	Unit	(Setting range)	
SET PARAMETERS					
P1910	df/dt (ROCOF)	OFF	-	ON/OFF	
P1911	Blocking protection module	0	event	0 ... 9999	
E1600	ANSI81R module active	-	-	-	
E1601	ANSI81R blocked module	-	-	-	
STEP1					
P1915	Pickup source	PT1	-	none/PT1/PT2/PT3	
P1916	Blocking protection step	0	event	0 ... 9999	
P1917	Min. start voltage	10	%	0 ... 200,0	
P1918	Min.start voltage delay time	2	s	0 ... 999999,999	
P1920	Limit	6	Hz/s	0 ... 25	
P1921	K2	1	-	0 ... 999,9	
P1922	Hysteresis	0,000	Hz/s	0 ... 99,999	
P1923	Measuring period	4	cycle	1 ...100	
P1924	Direction	none	-	none/positive/negative	
P1925	f< limit	80,00	Hz	0 ... 80,00	
P1926	f> limit	0	Hz	0 ... 80,00	
E1606	ANSI81R-1 step active	-	-	-	
E1607	ANSI81R-1 blocked step	-	-	-	
E1608	ANSI81R-1 blocked by MSV	-	-	-	
E1609	ANSI81R-1 pickup	-	-	-	
E1610	ANSI81R-1 trip	-	-	-	
STEP2					
P1935	Pickup source	PT2	-	none/PT1/PT2/PT3	
...	...	...	...	...	

Figure 3-110 ANSI 81R – Protection parameters [P] and events [E] of SET 1

Parameter description:

The following parameter descriptions refer to all protection parameters of one parameter set.

NOTE: Each of the four parameter sets always provides the same group of protection parameters. Hence, the parameter descriptions of the SET PARAMETERS and the parameters of STEP 1 represented below are described in the following in detail as examples.

Protection parameters of parameter SET 1 – ANSI 81R

SET PARAMETERS

The following SET PARAMETERS of the rate of change of frequency (RoCoF) protection exist only once in each of the four parameter sets. Thus, the SET PARAMETERS apply to all of the 3 protection STEPS of one parameter SET.

Protection parameters of parameter SET 1 – ANSI 81R

P1910 df/dt ROCOF

This parameter enables/disables rate of change of frequency (RoCoF) protection wherein:

- “OFF”: disables or
- “ON”: enables the protective function.

NOTE: In case that no voltage measurement is possible, caused by locating the PTs below the circuit breaker, and which is open, then, rate of change of frequency (RoCoF) protection must be blocked by a suitable event. For this, the related number of such blocking event has to be assigned to parameter [P1911].

When rate of change of frequency (RoCoF) protection ANSI81R is enabled by parameter [P1910], then event “ANSI81R module active” [E1600] is being activated.

P1911 Blocking protection module

Rate of change of frequency (RoCoF) protection can be completely blocked by any active event. For blocking, the number related to this blocking event has to be assigned to parameter [P1911]. Blocking is only effective, however, as long as the blocking event is active. As soon as blocking is active, event “ANSI81R blocked module” [E1601] is being activated. If the blocking event turns inactive, blocking is abandoned and protective function is effective again. Then, event [E1601] is being deactivated automatically.

If blocking of the rate of change of frequency (RoCoF) protection is not required, set this parameter to “0”.

Protection parameters of STEP 1

The following STEP parameters of the rate of change of frequency (RoCoF) protection exist only once in each of the 3 independent protection STEPS. Thus, the SET PARAMETERS apply only to one of the 3 protection STEPS of one parameter SET.

P1915 Pickup source

Depending on the SYMAP®-Compact(+) device variant every protection step of rate of change of frequency (RoCoF) protection can be assigned to a certain voltage measurement input (PT1, PT2 or PT3). Parameter [P1915] determines the voltage measurement input which will provide measurement values as characteristic quantities (rate of change of frequency df/dt) to the vector surge protection:

- “none”: no voltage measurement; protection step is deactivated
- “PT1”: voltage input PT1
- “PT2”: voltage input PT2
- “PT3”: voltage input PT3

For settings “PT1”, “PT2” or “PT3”, event “ANSI81R-1 step active” [E1606] is being activated.

P1916 Blocking protection step

The first step of rate of change of frequency (RoCoF) protection can be blocked by any active event. For blocking, the number related to this blocking event has to be assigned to parameter [P1916]. Blocking is only effective, however, as long as the blocking event is active. As soon as blocking is active, event “ANSI81R-1 blocked step” [E1607] is being activated. If the blocking event turns inactive, blocking is abandoned and

protective function is effective again. Then, event [E1607] is being deactivated automatically.

If blocking of the first step of vector surge protection is not required, set this parameter to "0".

P1917 Min. start voltage

Minimum limit of the measuring voltage to activate rate of change of frequency (RoCoF) protection; the first protection step of rate of change of frequency (RoCoF) protection is blocked as long as the measured voltage remains below this minimum setting at least in one phase. For the duration of blocking event "ANSI81R-1 blocked step by MSV" [E1608] is activated.

NOTE: The *minimum limit of the measuring voltage to activate rate of change of frequency (RoCoF) protection* is to be set as a percentage of the *nominal value* of the characteristic quantity (phase-to-phase voltage). The nominal value of the characteristic quantity is to be set by parameter:

- "Voltage (L-L)" [P603], for primary side W1 or
- "Voltage (L-L)" [P613], for secondary side W2 or
- "Voltage (L-L)" [P623], for tertiary side W3.

The referring parameters "Voltage (L-L)" [P603], "Voltage (L-L)" [P613] and "Voltage (L-L)" [P623] are located in submenu: "SYSTEM\Nominals\Reference values".

P1918 Min. start voltage delay time

Delay time to reset the blocking of rate of change of frequency (RoCoF) protection after voltage restoration; as soon as the minimum limit "Min. start voltage" [P1917] is exceeded after a preceded voltage restoration, the counter "Min. start voltage delay time" [P1918] starts. Once the time has elapsed the counter is set to zero, the blocking of rate of change of frequency (RoCoF) protection is being deactivated, and event "ANSI81R-1 blocked step by MSV" [E1608] is being deactivated.

Application: "Min. start voltage delay time" is used to detect a stable voltage restoration.

P1921 K2

Correction factor to adjust the maximum permissible rate of change of frequency df/dt_{max} dependent of the grid impedance; multiplication of the correction factor "K2" [P1921] by the setting of parameter "Limit" [P1920] gives the maximum permissible voltage angle difference $\Delta\Theta_{max}$ as the limit for vector surge protection.

Max. permissible rate of change of frequency $df/dt_{max} = \text{"Limit" [P1920]} \times \text{"K2" [P1921]}$

Typical rates are:

- K2 = 1.0 Correction factor for low impedance grid, and
- K2 = 1.6 Correction factor for high impedance grid.

P1920 Limit

Pick-up value of rate of change of frequency (RoCoF) protection; as soon as the characteristic quantity (rate of change of frequency df/dt):

- exceeds the set value of the maximum permissible rate of change of frequency df/dt_{max} (parameter "Limit" [P1920] and "K2" [P1921]), **and**
- no blocking event (parameter "Blocking protection module" [P1911]) is active, **and**
- no blocking event (parameter "Blocking protection step" [P1916]) is active, **and**

- no blocking by insufficient voltage (parameter "*Min. start voltage*" [P1917]) is active, pick-up event "*ANSI81R-1 pick-up*" [E1609] is being activated. In case of the following setting of parameter "*Measuring period*" [P1923] = 1, also trip event "*ANSI81R-1 trip*" [E1610] is being activated. This event can be used for alarm or output control purposes.

P1922 Hysteresis

This parameter [P1923] determines the *reset limit for the pick-up event "ANSI81R-1 pickup"* [E1609] of the first protection element. At the moment the characteristic quantity (*rate of change of frequency df/dt*) falls below the reset limit, the activated pick-up event [E1609] will be deactivated:

$$(\text{reset limit}) = "K2" [P1921] \times "Limit" [P1920] - "Hysteresis" [P1922]$$

NOTE: Parameter "*Hysteresis*" [P1922] is has only to be taken into account in case that set value of parameter "*Measuring period*" $\neq 1$. Here, variation of measured values will not be considered.
In case of set values of parameter "*Measuring period*" = 1 variation of measured values will be considered neither, since after the measured period has run down, an immediate trip will occur.

P1923 Measuring Period

Number of repeated measures; one measuring period is equal to one cycle. To increase measuring accuracy, measuring can be repeated several times

P1924 Direction

Operating direction of rate of change of frequency (RoCoF) protection; the working principle in view of the frequency slope direction ($df/dt > 0 \Rightarrow$ positive slope; $df/dt < 0 \Rightarrow$ negative slope) can be chosen by the following setting options of parameter "*Direction*" [P1924]:

- "none": supervision for the of change of frequency *independent* of a positive or negative df/dt slope
- "positive": supervision for a *positive slope* of the rate of change of frequency
- "negative": supervision for a *neagative slope* of the rate of change of frequency

P1925 f< limit

Frequency limit below the nominal frequency for activating rate of change of frequency (RoCoF) protection function; the protective function set to active by parameter "*df/dt (ROCOF) [P1910] = ON*" will become active only in case that the measured frequency value falls below the set value of parameter "*f> limit*" [P1925].

P1926 f> limit

Frequency limit above the nominal frequency for activating rate of change of frequency (RoCoF) protection function; the protective function set to active by parameter "*df/dt (ROCOF) [P1910] = ON*" will become active only in case that the measured frequency value exceeds the set value of parameter "*f> limit*" [P1926].

3.5.20 ANSI 87 – Current Differential Protection

Functioning of the differential protection is based on a balance of phase currents measured at the input and output of the electrical equipment (longitudinal differential protection). The resulting variable of this current comparison is the differential current I_d as protection criterion for easy differentiating operating or fault event.

- For the operating event ideally applies: $\sum I = 0$ (Kirchhoff's law)
- In the event of fault, a differential current occurs: $\sum I \neq 0 = I_d$

This protection principle is advantageous because of the high degree of selectivity since the CTs unambiguously define the protection range on both ends of the equipment to protect. Consequently, fault finding can be effected in fast mode.

The field of application of the current differential protection generally includes protection of motors, generators and transformers as well as of overhead lines, cables and busbars. Depending on the type and the operating behaviour of the equipment to protect, certain particularities (measurement value adaptations as well as operation-relevant and transient error currents) have to be included into the protective relaying.

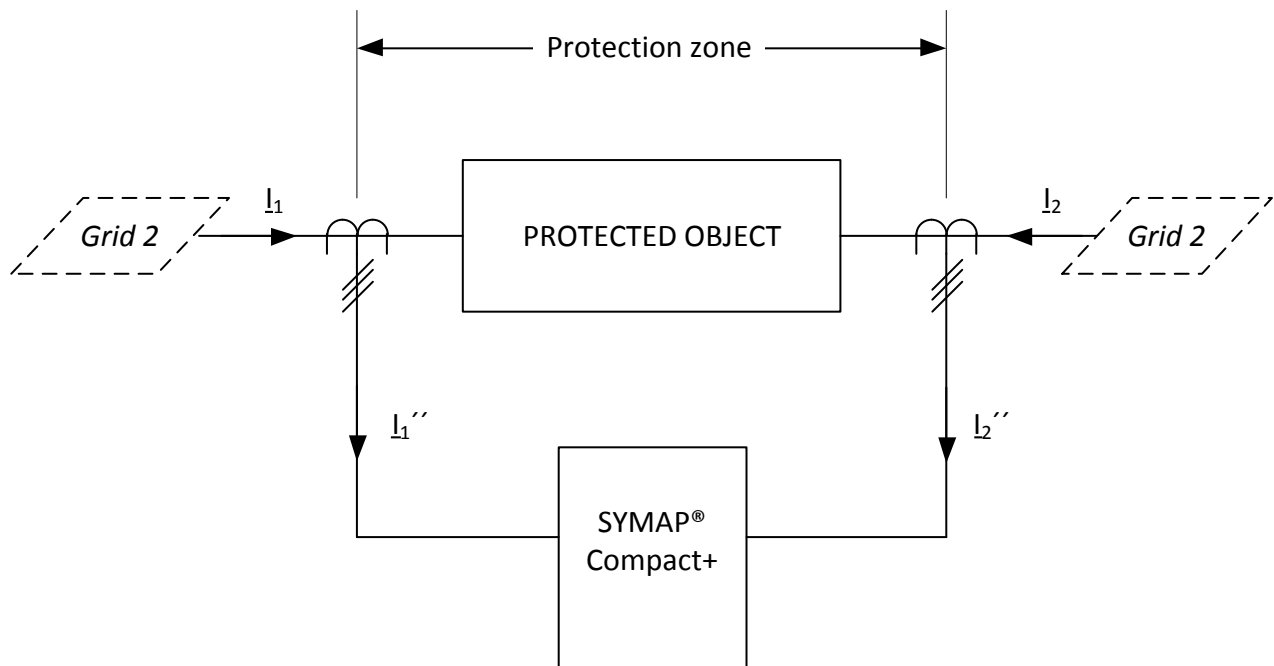


Figure 3-111 ANSI 87 – Current differential protection

The differential protection function of the SYMAP®-Compact+ has been designed for protection of motors, generators and two-winding transformers.

For *motors and generators*, the stator windings of the machine will be monitored. On the one hand, the two current transformer sets are arranged between the leads of the stator windings on the star point end of the generator and, on the other hand, at the power input end (motor) or the power output end (generator). For the *transformer differential protection*, the transformer sets will be connected each to the primary and secondary windings of the transformer.

Adaptation of the current measurement values

In order to allow comparison of the phase currents on both ends of the equipment to protect regarding their absolute values and the phasing, the current values need to be elevated to a common reference plane. And the following is to include for this purpose:

- Adaption of the current transformer ratios on both ends of the protection object (amplitude adaptation):
To adapt the current values for comparison of the phase currents, the transformation ratios ($\dot{U}_1$, $\dot{U}_2$) of the current transformers are to be taken into account (see Fig. 4-20):

$$\text{Primary side } W_1: \quad I_{1,\text{transformer}}'' = \dot{U}_1 * I_{1,\text{transformer}} \text{ or } I_{1,\text{transformer,sec}} = \dot{U}_1 * I_{1,\text{transformer,pri}}$$

$$\text{Secondary side } W_2: \quad I_{2,\text{transformer}}'' = \dot{U}_2 * I_{2,\text{transformer}} \text{ or } I_{2,\text{transformer,sec}} = \dot{U}_2 * I_{2,\text{transformer,pri}}$$

- Adaptation of possibly differing nominal currents of the current transformer sets to the transformer's transformation ratio (amplitude adaptation):
The primary nominal values of the current transformer sets on both ends of the protection object (transformer) should be determined on the transformer's nominal value. The primary nominal transformer current $I_{2n,\text{CT,pri}}$ of the current transformer set on the secondary end W_2 should, under consideration of the transformer transformation ratio W_1/W_2 , correspond to the primary nominal transformer current $I_{1n,\text{transformer,pri}}$ of the current transformer sets on the primary side W_1 :

$$I_{2n,\text{transformer,pri}} = W_1/W_2 * I_{1n,\text{transformer,pri}}$$

Should, due to incorrect transformer selection, the above condition no longer be given, the factor by which the primary nominal transformer current of the transformer current be included in the measurement value adaptation.

Example:

Transformer transformation ratio:	$W_1/W_2 = 40$
CT data at the undervoltage end:	4000/1A
=> correct adaptation: transformer data at the overvoltage end:	100/1A
selected CT: transformer data at the overvoltage end: e.g.:	200/1A

$$\Rightarrow I_{2n,\text{transformer,pri}} / I_{1n,\text{transformer,pri}} \neq W_1/W_2 \Leftrightarrow I_{2n,\text{transformer,pri}} / I_{1n,\text{transformer,pri}} = 20$$

=> Adaptation of the secondary transformer measurement values at the overvoltage end by the factor "2":

- Adaptation of the transformation ratio of a transformer (amplitude adaptation):
The transformer transformation ratio conditions occurrence of differing voltages and currents on the primary side W_1 and the secondary end W_2 . In order to adapt the current values for comparison of the currents on the secondary end, the transformer transformation ratio is to be taken into account:
Winding number of primary side / winding number of secondary end = W_1/W_2
- Adaptation of the transformer vector group (adaptation of the phasing):
Depending on the vector group of the used transformer, the phase rotation of star point voltage (and thus the current) on the secondary end shall be taken into account with regard to star point voltage of the primary side and be adapted. Phase shifting between star point and delta voltage is always 30°. Depending on the vector group, the phase rotation results in a phase angle "k", which is defined as a multiple of 30°. For clockwise rotation (L1, L2, L3 or A, B, C) applies: a positive sign for "k" corresponds to a time lag of the secondary voltage with regard to the primary voltage.

The following table shows an overview of the different transformer vector groups or phase angles:

Description		Vector diagram		Circuit		Ratio	Application	Secondary neutral point
Identifier	Vector group	primary	secondary	primary	secondary	$U_1 : U_2$		
0	Dd0					$\frac{W_1}{W_2}$		Not available
	Yy0					$\frac{W_1}{W_2}$	Small distribution transformer	Loadable up to max. 10% of rated current
	Dz0					$\frac{2 W_1}{3 W_2}$	Small distribution transformer, for three line connection	Loadable up to rated current
5	Dy5					$\frac{W_1}{\sqrt{3} W_2}$	Large distribution transformer	Loadable up to rated current
	Yd5					$\frac{\sqrt{3} W_1}{W_2}$	Power plants and substations (unit transformer, no distribution transformer)	Not available
	Yz5					$\frac{2 W_1}{\sqrt{3} W_2}$	Small distribution transformer	Loadable up to rated current
6	Dd6					$\frac{W_1}{W_2}$		Not available
	Yy6					$\frac{W_1}{W_2}$		Loadable up to max. 10% of rated current
	Dz6					$\frac{2 W_1}{3 W_2}$		Loadable up to rated current
11	Dy11					$\frac{W_1}{\sqrt{3} W_2}$		Loadable up to rated current
	Yd11					$\frac{\sqrt{3} W_1}{W_2}$	Power plants and substations (unit transformer)	Not available
	Yz11					$\frac{2 W_1}{\sqrt{3} W_2}$		Loadable up to rated current
0	Ya0					$\frac{W_1}{W_2}$	Autotransformer	Loadable up to max. 10% of rated current

Figure 3-112 Vector groups of transformer

Proceed to adaptation of current measurement values in the SYMAP[®]-Compact+ via system parameter in the menu: "SYSTEM\Nominals".

- Adaptation of the eventually differing *current transformer ratios*:

Menu: SYSTEM\Nominals**Current transformers**:

For CT1: parameter "*Primary*" [P660] and "*Secondary*" [P661], and
for CT2: parameter "*Primary*" [P669] and "*Secondary*" [P670]

Adaptation of the *transformer ratio*:

Menu: SYSTEM\Nominals**Reference values**:

For winding side W1: parameter "*Voltage (L-L)*" [P603], and
for winding side W2: parameter "*Voltage (L-L)*" [P613]

Adaptation of the *vector group of the transformer*:

Menu: SYSTEM\Nominals**Reference values**:

For winding side W1: parameter "*Connection type*" [P600], and
for winding side W2: parameter "*Connection type*" [P610] and "*Phase shift*" [P611]

Stabilization against operational error currents

In contrast to the theoretical sight on an ideal transformer, the real transformer in its stationary state shows an operational error current (difference or differential current I_d) which is due to the following causes:

- I_{F1} : Error current by idle or magnetizing current (amplitude fault)
- I_{F2} : Error current by eventual influence of a transformer tap changer on the transformation ratio of the transformer (amplitude fault)
- I_{F3} : Error current by total fault of the single CTs (amplitude and angle fault)

The single error currents I_{F1} , I_{F2} and I_{F3} add up to a total error current ΣI_F , which can be shown as differential current I_d depending on the through-current I_D as error current characteristic curve. The through-current I_D represents the power led though the object to protect i.e. in case of increased load or a fault outside the protection range the operational differential current I_d raises as well.

The error current characteristic curve may be represented by the differential protection device via tripping characteristic with double bend.

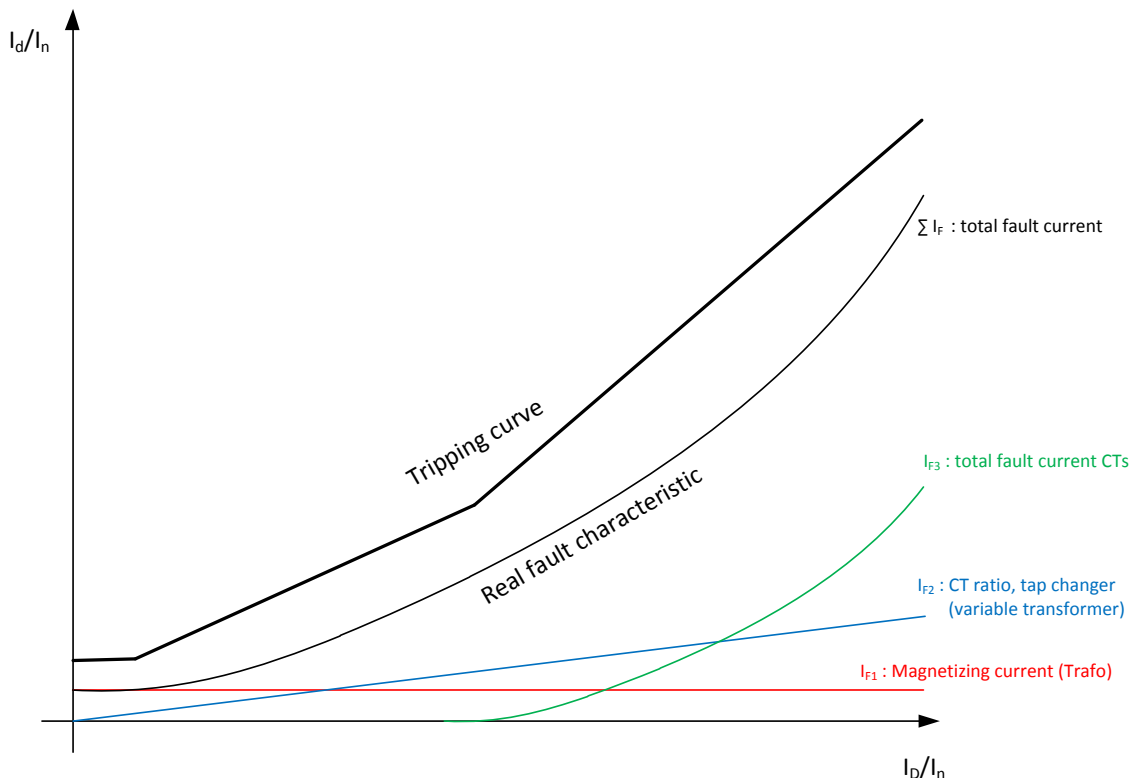


Figure 3-113 Error current and tripping characteristic curve

Since through-current I_D cannot be directly measured, the so-called stabilization current I_{stab} will be introduced which is a calculated variable. I_{stab} is calculated as follows:

$$I_{stab} = |I_1| + |I_2|$$

The difference current is calculated to form:

$$I_d = |I_1 - I_2|$$

NOTE: The reference directions of the currents I_1 and I_2 are defined according to Fig. 4-20.

The tripping characteristic of the SYMAP[®]-Compact+ differential protection function is defined by three separately settable points such that the corresponding parameterization results in three ranges with differing gradient factor of the tripping characteristic (stabilization):

- Range 1: constant tripping value (gradient factor = 0) up to a settable value for the stabilization current ("Is0 setting; "Id0 setting")
- Range 2: stabilized tripping characteristic with 1st gradient factor ("Is1 setting; "Id1 setting")
- Range 3: stabilized tripping characteristic with 2nd gradient factor ("Is2 setting; "Id2 setting")

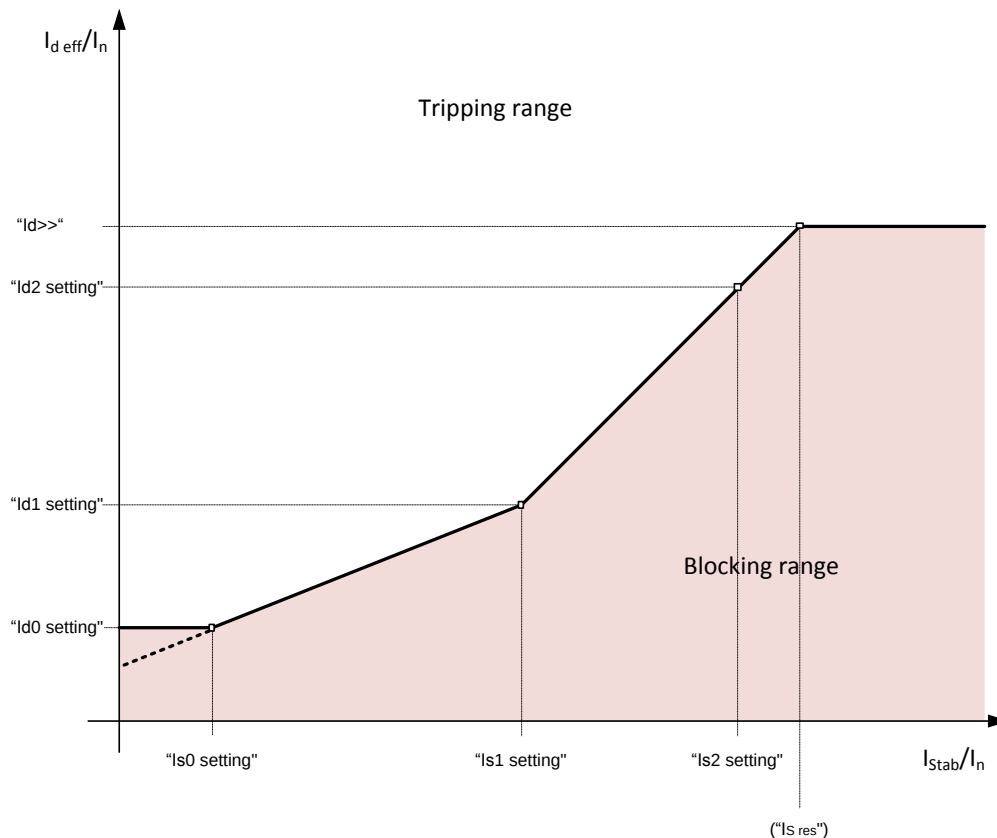


Figure 3-114 SYMAP[®]-Compact+ – ANSI 87 tripping characteristic

High current stage without stabilization ("Id >>")

The SYMAP[®]-Compact+ includes a differential high current stage which trips in case of internal high-current faults without stabilization. The differential current setting value ("Id >>") keeps to the used transformer's highest possible short-circuit current (short-circuit at the terminals of the secondary end), which is limited by the transformer's short-circuit reactance. The maximum short-circuit current is calculated to form:

$$I_K = I_n \frac{100\%}{u_K},$$

with:

u_K : relative short-circuit voltage of the transformer

Consequently, in case of an external fault, the short-circuit current caused by the transformer is never higher than the transformer's short-circuit current and the differential current thus attains a maximum value. In case of a fault outside the protection zone, the maximum differential current occurs with a single-end, total transformer saturation since, in this case, the short-circuit current caused by the transformer equals the differential current.

In case of a fault inside the protection zone (i.e. in the transformer) the short-circuit current and, consequently, the differential current as well could attain higher values. In these cases, the SYMAP®-Compact+ activates instantaneous tripping without stabilization.

The setting value of parameter " $I_{d>>}$ " [P2022] of the high-current stage should be selected according to the height of the transformer's short-circuit range.

Stabilization against inrush current

Depending on the height of remanence (remaining magnetization, remanent flux density) attained upon transformer shutdown and depending on the closing time (voltage level and voltage direction), a high (inrush) current occurs upon reclosing of a transformer in the primary winding. This magnetizing current may amount to up to 20fold of the transformer's nominal current and last for some seconds. Since this inrush current will not be transferred to the secondary end, it causes a differential current in the balance which would occasion tripping of the differential protection function.

The inrush current, however, is not to be seen as a fault event which should lead to tripping on faults but is a phenomenon against which the differential protection function should be stabilized i.e. made more insensitive. A characteristic for the inrush current is the uneven number of harmonics in the primary winding phase current. The highest contents for the inrush current are to be observed for the 1st harmonic wave (2nd harmonic).

Via Fourier analysis, the SYMAP®-Compact+ evaluates the contents of the 2nd harmonic (100Hz) and upon exceeding of a settable value for the ratio of the 2nd harmonic and the fundamental of current $I_{100\text{Hz}}/I_{50\text{Hz}}$, temporary blocking of the differential protection function is activated according to the settings of the "harmonic wave stabilization ANSI 95i" function. Blocking is maintained as long as the pick-up value for the 2nd harmonic is fallen below or the maximum time slot for blocking has elapsed.

Stabilization against overexcitation

An increased magnetizing current occurs if the transformer is operated at the high-voltage coil with overvoltage (overexcitation of the transformer). This results in heating which could damage the transformer.

In this case as well, the high magnetizing current leads to a differential current which would cause activation of the differential protection function. As the transformer withstands overexcitation for a short while, the differential protection must not trip immediately. Closure is done after given time via other protection function (over excitation protection).

An important criterion for the overexcited operation of the transformer is the 4th harmonic wave (5th harmonic) in the phase current of the primary winding.

Via Fourier analysis, the SYMAP®-Compact+ evaluates the contents of the 5th harmonic and upon exceeding of a settable value for the ratio of the 5th harmonic in relation to the fundamental of current $I_{250\text{Hz}}/I_{50\text{Hz}}$, temporary blocking of the differential protection function is activated according to the settings of the "harmonic wave stabilization ANSI 95i" function. Blocking is maintained as long as the pick-up value for the 2nd harmonic is fallen below again or the maximum time slot for blocking has elapsed.

Stabilization against transformer saturation

Saturation of the CTs causes an incorrect transformation of the primary phase current values. In case of single-end transformer saturation, in particular, a significant high differential current occurs in the current balance and would cause tripping of the differential protection function.

Causes for CT saturation are e.g.:

- A high-current fault inside the protection zone (exceeding the transformer's maximum short-circuit current)
- A high-current fault outside the protection zone (is limited by the transformer's maximum short-circuit current) in case of insufficient transformer dimensioning
- The second trial of reclosing by an AR function (heavy pre-magnetization of the transformer core)

Depending on the cause of CT saturation and the fault location (inside or outside the protection zone), the protection device has to trip or block.

In case a fault outside the protective zone forces CT saturation, the operating characteristic of differential current/stabilizing current (I_d/I_{stab}) is fundamentally different from that behaviour of a fault inside the protective zone with CT saturation. Such dynamic operating characteristic of I_d/I_{stab} can be described by a locus curve.

To detect a CT saturation SYMAP®-Compact+ evaluates the locus curve of I_d/I_{stab} . The diagrams discussed below represent different fault situations for an object to be protected, and with one-sided CT saturation.

Regarding faults inside the protective zone, differential current increases proportionally to the stabilizing current ($I_d = I_{stab}$). Hence follows, that the operating point of the locus curve, e.g. (1) to (6), proceeds along a straight line with a gradient of 100%.

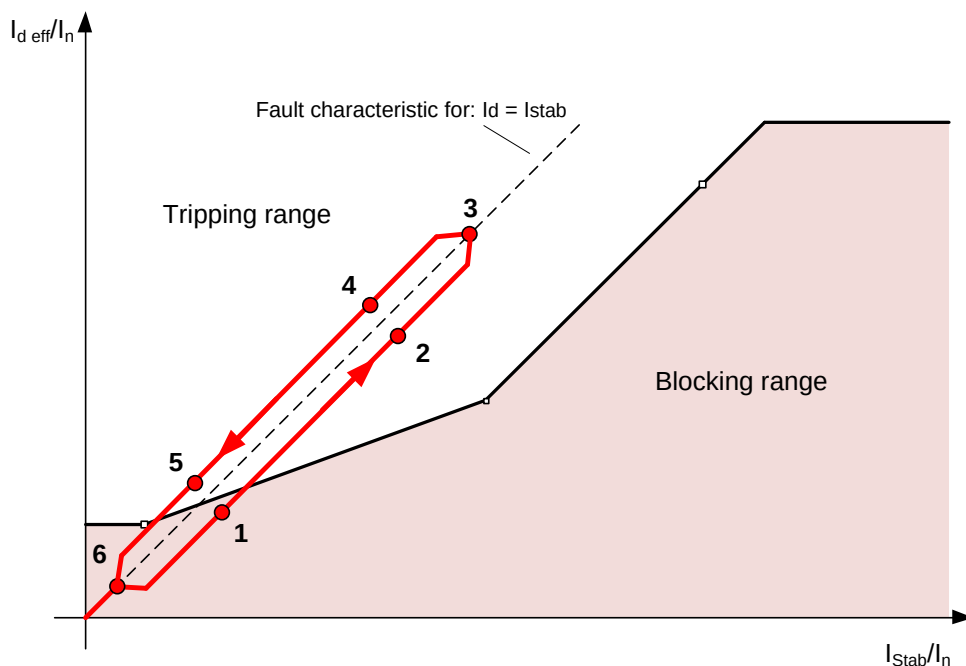


Figure 3-115 Locus diagram of fault within the protective zone, without CT saturation

Faults outside the protective zone which do not cause CT saturation yet, stabilisation current increases rapidly, whereas differential current remains quite low. As consequence, the

operating point of the locus curve, e.g. (1) to (6), proceeds along a straight line with a slight gradient (the following diagram shows an idealized locus with a gradient of 0%).

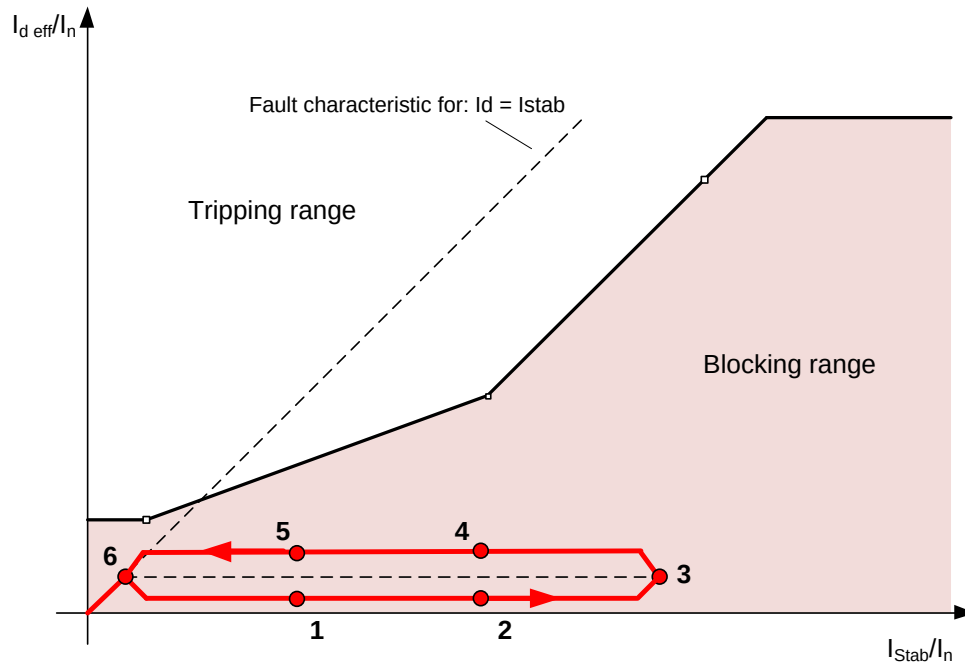


Figure 3-116 Locus diagram of fault outside the protective zone, without CT saturation

For faults outside the protective zone which do cause CT saturation, here, stabilisation current increase rapidly, too, and differential current remains at first at a low level. Hence, the operating points proceed along the straight line towards such fault curve corresponding to faults outside the protective object and without CT saturation: operating points (1) and (2). As soon as CT saturation emerges: operating point (2), stabilisation current decreases combined with an increase of differential: operating point (3). When exceeding the configured tripping curve: (4), the differential protection function will trip.

To avoid unwanted tripping, SYMAP®-Compact+ evaluates the locus curve with reference to the operating characteristic of I_d/I_{stab} in case of a fault. The locus curve displayed above, represents the fundamental criterion to detect faults outside the protective zone and causing one-sided CT saturation. The range "CT saturation stabilisation" is defined by parameters [P2005] to [P2008]. The locus curve has to enter the "CT saturation stabilisation" range definitely, before the operating point will skip ahead to the tripping zone. If this is the case, differential protection trip will be blocked. There is a maximum time window for blocking available, which is configurable by parameter "CT saturation blocking time" [P2004].

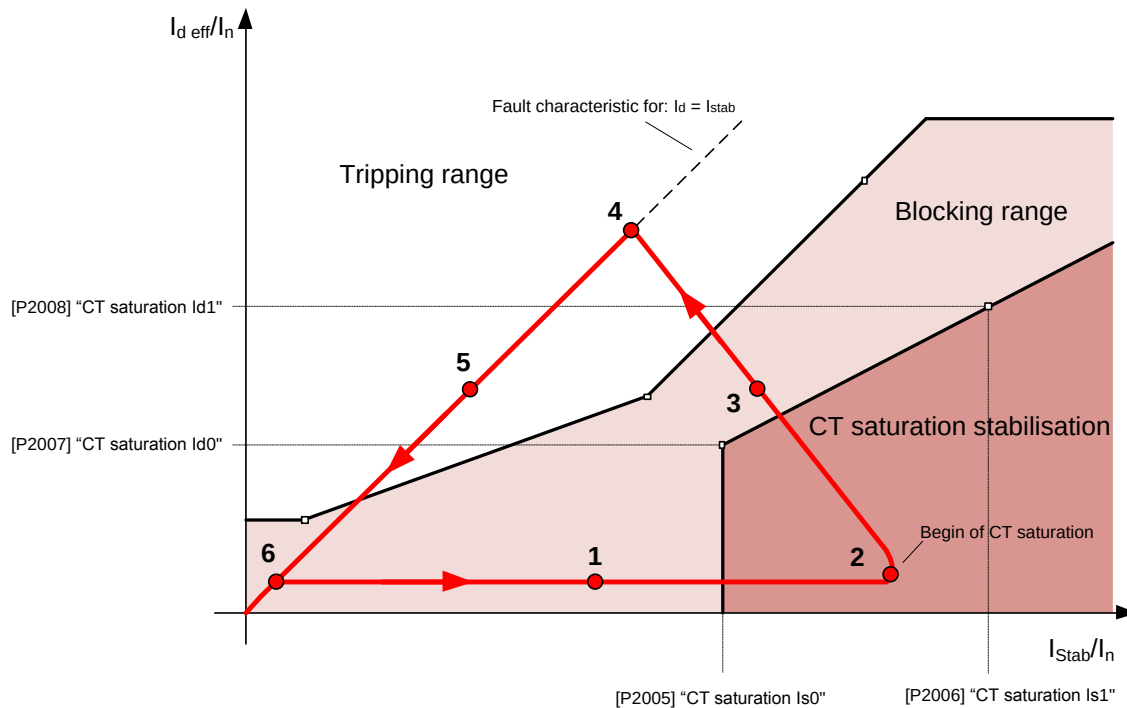


Figure 3-117 Locus diagram of fault outside the protective zone, with CT saturation

Zero current compensation

If an earth fault occurs outside the protective zone (transformer winding which holds the earthed neutral point), the zero sequence current will affect the earthed neutral point. As consequence, a differential current will lead to a nuisance tripping of the differential protection function. To prevent this happening, the zero sequence current has to be eliminated in the phase current of that transformer winding which provides the earthed neutral point.

According to the current vectors of odd-numbered transformer vector shift groups, zero current compensation is conducted automatically.

NOTE: In dependence of the transformer vector shift group, zero compensation can be activated/deactivated by the following parameters:

- “W1 zero compensation” [P9436],
- “W2 zero compensation” [P9437],
- “W3 zero compensation” [P9438].

These parameters are located in the submenu: “SYSTEM\Nominals\Reference values”.

Main Menu\Parameters\PROTECTION\ANSI59-95i\				
ANSI 87				
SET 1	SET 2	SET 3	SET 4	
P/E No.	Name	Value	Unit	(Setting range)
SET PARAMETERS				
P1975	Differential protection	OFF	-	ON/OFF
P1976	Blocking protection module	0	event	0 ... 9999
P1977	Mode	Trafo	-	Trafo / Block prot. / Mot/Gen
P1978	Hysteresis	0,0	%	0 ... 1999,9
E1630	ANSI87 module active	-	-	-
E1631	ANSI87 blocked module	-	-	-
STEP 1				
P1990	Step function	ON	-	ON/OFF
P1991	Blocking protection step	0	event	0 ... 9999
P1992	Is0 setting	80,0	%	0 ... 1999,9
P1993	Is1 setting	500,0	%	0 ... 1999,9
P1994	Is2 setting	1750,0	%	0 ... 1999,9
P1995	Id0 setting	50,0	%	0 ... 1999,9
P1996	Id1 setting	125,0	%	0 ... 1999,9
P1997	Id2 setting	750,0	%	0 ... 1999,9
P1999	Harmonics stabilizer CT1	OFF	-	OFF / 2H / 5H / 2H/5H
P2000	Harmonics stabilizer CT2	OFF	-	OFF / 2H / 5H / 2H/5H
P2002	CT saturation supervision	ON	-	ON/OFF
P2003	CT saturation mode	1-phase		1-phase/3-phase
P2004	CT saturation blocking time	0,3	s	0 ... 999999,999
P2005	CT saturation Is0	400,0	%	0 ... 1999,9
P2006	CT saturation Is1	1000,0	%	0 ... 1999,9
P2007	CT saturation Id0	100,0	%	0 ... 1999,9
P2008	CT saturation Id1	250,0	%	0 ... 1999,9
E1650	ANSI87-1 step active	-	-	-
E1651	ANSI87-1 blocked step	-	-	-
E1652	ANSI87-1 pickup	-	-	-
E1653	ANSI87-1 trip	-	-	-
E1654	ANSI87-1 L1 blocked by CTS	-	-	-
E1655	ANSI87-1 L2 blocked by CTS	-	-	-
E1656	ANSI87-1 L3 blocked by CTS	-	-	-
E1657	ANSI87-1 CTS supervision active	-	-	-
STEP 2				
P2020	Step function	OFF	-	ON/OFF
P2021	Blocking protection step	0	event	0 ... 9999
P2022	Id>>	750,0	%	0 ... 1999,9
E1670	ANSI87-2 step active	-	-	-
E1671	ANSI87-2 blocked step	-	-	-
E1672	ANSI87-2 pickup	-	-	-
E1673	ANSI87-2 trip	-	-	-

Figure 3-118 ANSI 87 – Protection parameters [P] and events [E] of SET 1

Parameter description:

The following parameter descriptions refer to all protection parameters of one parameter set.

Protection parameters of parameter SET 1 – ANSI 87

SET PARAMETERS

The following SET PARAMETERS of the current differential protection exist only once in each of the four parameter sets. Thus, the SET PARAMETERS apply to protection STEP 1 and protection STEP 2 of one parameter SET.

P1975. Differential protection :

This parameter activates/deactivates the current differential protection whereby the setting:

- “OFF”: deactivates the protection function or
- “ON”: activates the protection function.

When current differential protection ANSI 87 is enabled by parameter [P1975], then event “ANSI87 module active” [E1630] is being activated.

P1976. Blocking protection module :

Current differential protection can be completely blocked by any active event. For blocking, the number related to this blocking event has to be assigned to parameter [P1976]. Blocking is only effective, however, as long as the blocking event is active. As soon as blocking is active, event “ANSI87 blocked module” [E1630] is being activated. If the blocking event turns inactive, blocking is abandoned and protective function is effective again. Then, event [E1630] is being deactivated automatically.

If blocking of the current differential protection is not required, set this parameter to “0”.

P1977. Mode :

Application for current differential protection; in dependence of the kind of operating device to be protected by current differential protection, one of the following applications can be chosen:

- “Trafo”: application: “Transformer differential protection”
- “Block prot.”: application: “Block protection” (protective zone covers the generator and the block transformer)
- “Mot/Gen”: application: “Motor/Generator differential protection”

NOTE: For “Transformer differential protection” the *vector shift group* and possibly also *zero current compensation* (parameter “*Star point grounding*”) has to be considered. Corresponding parameters are to be found in the menu: “SYSTEM\Nominals\Reference values”

P1978. Hysteresis :

This parameter [P1978] determines the reset limit for the pick-up event “ANSI87-1 pickup” [E1652] of the stabilized current differential protection element (STEP1) or “ANSI87-2 pickup” [E1672] for the unstabilized high-set current differential protection element (STEP 2). At the moment the characteristic value (phase current) falls below the reset limit, the activated pick-up event [E1652] or [E1672] will be deactivated.

NOTE: *Stabilized differential protection element (STEP 1):*
(reset limit) = “configured trip curve” – “Hysteresis” [P1978]

High-set differential protection element (STEP 2):
(reset limit) = " $I_d >>$ " [P2022] – "*Hysteresis*" [P1978]

Protection parameters – Stabilized Differential protection element (STEP 1)

P1990 Step function

This parameter activates/deactivates the stabilized current differential protection element (STEP 1) whereby the setting:

- "OFF": deactivates the stabilized current differential protection element or
- "ON": activates the stabilized current differential protection element.

When stabilized current differential protection element is enabled by parameter [P1990], then event "*ANSI87-1 module active*" [E1650] is being activated.

P1991 Blocking protection step

Stabilized current differential protection element (STEP 1) can be completely blocked by any active event. For blocking, the number related to this blocking event has to be assigned to parameter [P1991]. Blocking is only effective, however, as long as the blocking event is active. As soon as blocking is active, event "*ANSI87-1 blocked step*" [E1651] is being activated. If the blocking event turns inactive, blocking is abandoned and protective element is effective again. Then, event [E1651] is being deactivated automatically.

If blocking of the stabilized current differential protection element (STEP 1) is not required, set this parameter to "0".

Configuration of the tripping curve

NOTE: Parameters [P1992] to [P1997] are to be set as a percentage of the *nominal value* of the characteristic quantity (phase current). The nominal value of the characteristic quantity is to be set by parameter:

- "*Current*" [P604], for primary side W1 or
- "*Current*" [P614], for secondary side W2 or
- "*Current*" [P624], for tertiary side W3.

The referring parameters "*Current*" [P604], "*Current*" [P614] and "*Current*" [P624] are located in submenu: "SYSTEM\Nominals\Reference values".

P1992 Is0 setting

*In combination with parameter "Id0 setting" [P1995] parameter [P1992] defines the first straight line segment (as well as the starting point of the second straight line segment) of the differential protection tripping curve. The first straight line segment is valid for a value range of the stabilisation current between $I_{stab} = 0$ and $I_{stab} = "Is0 setting"$, in which the tripping characteristic corresponds to the constant pick-up value of the characteristic quantity (differential current I_d) "*Id0 setting*".*

P1993 Is1 setting

In combination with parameter "Id1 setting" [P1996] parameter [P1993] defines the second straight line segment (as well as the starting point of the third straight line segment) of the differential protection tripping curve. The second straight line segment is valid for a value range of the stabilisation current between $I_{stab} = "Is0 setting"$ and $I_{stab} = "Is1 setting"$.

P1994 Is2 setting

In combination with parameter "Id2 setting" [P1997] parameter [P1994] defines the second point to determine the slope of the third straight line segment of the differential protection tripping curve. An ending point of the third straight line segment can be set by using parameter "Id>>" [P2022] which brings forth a corresponding stabilisation current ($I_{S\ res}$). Then, the third straight line segment is valid for a value range of the stabilisation current between $I_{stab} = "Is1\ setting"$ and $I_{stab} = "I_{S\ res}"$.

P1995 Id0 setting

First, constant tripping value of the differential current I_d for definition of the tripping characteristic curve; exceeds the characteristic quantity (differential current I_d), the value set for parameter [P1840] – for stabilization currents in the range between $I_{stab} = 0$ and $I_{stab} = "Is0\ setting"$ – the pick-up event "ANSI87-1 pick-up" [E1652] will be activated. If there is no active blocking of the „Harmonics stabilizer ANI95i“ or „CT saturation“, then, also trip event "ANSI87-1 trip" [E1653] is being activated. This event can be used for alarm or output control purposes.

P1996 Id1 setting

In combination with parameter "Is1 setting" [P1993] parameter [P1996] defines the second straight line segment (as well as the starting point of the third straight line segment) of the differential protection tripping curve. If the characteristic quantity (differential current I_d) exceeds the range of values set with the parameters [P1993] and [P1996] – for stabilization currents in the range between $I_{stab} = 0$ and $I_{stab} = "Is1\ setting"$ – the pick-up event "ANSI87-1 pick-up" [E1652] will be activated. If there is no active blocking of the "Harmonics stabilizer ANI95i" or "CT saturation", then, also trip event "ANSI87-1 trip" [E1653] is being activated. This event can be used for alarm or output control purposes.

P1997 Id2 setting

In combination with parameter "Is2 setting" [P1994] parameter [P1997] defines the second point to determine the slope of the third straight line segment of the differential protection tripping curve. If the characteristic variable (differential current I_d) exceeds the range of values set with the parameters [P1994] and [P1997] – for stabilization currents in the range between $I_{stab} = "Is1\ setting"$ and $I_{stab} = "Is2\ setting"$ – the pick-up event "ANSI87-1 pick-up" [E1652] will be activated. If there is no active blocking of the "Harmonics stabilizer ANI95i" or "CT saturation", then, also trip event "ANSI87-1 trip" [E1653] is being activated. This event can be used for alarm or output control purposes.

P1999 Harmonics stabilizer CT1

Blocking of current differential protection by "harmonics stabilizer ANSI 95i" function for measuring values of CT1; according to the settings of the "harmonics stabilizer ANSI 95i" function, the differential protection may be temporarily blocked upon exceeding of defined contents of the 2nd and/or 5th harmonic (I_{100Hz} and/or I_{250Hz}) in the phase current:

- "OFF": blocking of ANSI 87 by ANSI 95i is deactivated
- "2H": blocking of ANSI 87 by ANSI 95i in case of 2nd harmonic
- "5H": blocking of ANSI 87 by ANSI 95i in case of 5th harmonic
- "2H/5H": blocking of ANSI 87 by ANSI 95i in case of 2nd or 5th harmonic

NOTE: Appropriate settings of the corresponding parameters of ANSI95i are to be done in the submenu: "PROTECTION\95i Harmonics stabilizer".

P2000 Harmonics stabilizer CT2

Blocking of current differential protection by "harmonics stabilizer ANSI 95i" function for measuring values of CT2; (see description of parameter [P1999]).

P2002 CT saturation supervision

This parameter activates/deactivates function *“CT saturation supervision”* whereby the setting:

- “OFF”: deactivates the function or
- “ON”: activates the function.

When *“CT saturation supervision”* is enabled by parameter [P2002], then event *“ANSI87-1 CTS supervision active”* [E1657] is being activated.

CAUTION: Function *“CT saturation supervision”* can only be used for operating devices, without phase current shifting.

P2003 CT saturation mode

Parametrizable blocking mode:

- “1-phase”: Differential protection trip is blocked only in that phase which is affected by the CT saturation.
- “3-phase”: Although CT saturation is possibly detected in only one phase, differential protection trip is to be blocked in all three phases.

In case of CT saturation detection in one or more phases, the following event(s) is(are) to be activated:

- “ANSI87-1 L1 blocked by CTS” [E1654] and/or
- “ANSI87-1 L2 blocked by CTS” [E1655] and/or
- “ANSI87-1 L3 blocked by CTS” [E1656] aktiviert.

P2004 CT saturation blocking time

Maximum blocking time of differential protection after detecting a CT saturation.

Configuration of the range for CT saturation stabilisation

The *range* for *“CT saturation stabilisation”* is being defined by four parameters: [P2005] to [P2008].

NOTE: Parameters [P2005] to [P2008] are to be set as a percentage of the *nominal value* of the characteristic quantity (phase current). The nominal value of the characteristic quantity is to be set by parameter:

- “Current” [P604], for primary side W1 or
- “Current” [P614], for secondary side W2 or
- “Current” [P624], for tertiary side W3.

The referring parameters “Current” [P604], “Current” [P614] and “Current” [P624] are located in submenu: “SYSTEM\Nominals\Reference values”.

P2005 CT saturation Is0

If the stabilisation current value exceeds the set value of parameter “CT saturation Is0” [P2005], then, function *“CT saturation supervision”* is being activated. Corresponding parameters “CT saturation Is0” [P2005] and “CT saturation Id0” [P2007] determines the *starting point of the straight line* for the range definition of *“CT saturation stabilisation”*

P2007 CT saturation Id0

In combination with parameter “CT saturation Is0” [P2005] parameter “CT saturation Id0” [P2007] defines the *starting point of the straight line* to determine the *range* for CT saturation stabilisation.

P2006 CT saturation Is1

In combination with parameter “CT saturation Id1” [P2008] parameter “CT saturation Is1” [P2006] defines the *second point of the straight line* to determine the *range for CT saturation stabilisation*.

P2008 CT saturation Id1

In combination with parameter “CT saturation Is1” [P2006] parameter “CT saturation Id1” [P2008] defines the *second point of the straight line* to determine the *range for CT saturation stabilisation*.

Protection parameter – High-set differential protection element (STEP 2)

P2020 Step function

This parameter activates/deactivates the high-set current differential protection element (STEP 2) whereby the setting:

- “OFF”: deactivates the high-set current differential protection element or
- “ON”: activates the high-set current differential protection element.

When stabilized current differential protection element is enabled by parameter [P2020], then event “ANSI87-2 step active” [E1670] is being activated.

P2021 Blocking protection step

High-set current differential protection element (STEP 2) can be completely blocked by any active event. For blocking, the number related to this blocking event has to be assigned to parameter [P2021]. Blocking is only effective, however, as long as the blocking event is active. As soon as blocking is active, event “ANSI87-2 blocked step” [E1671] is being activated. If the blocking event turns inactive, blocking is abandoned and protective element is effective again. Then, event [E1671] is being deactivated automatically.

If blocking of the high-set current differential protection element (STEP 2) is not required, set this parameter to “0”.

P2022 Id>>

This parameter defines the *pick-up value* for the characteristic variable (differential current I_d) of the differential protection, disregarding the height of the stabilization current I_{stab} .

If the characteristic variable exceeds the value set for parameter [P2022], the trip event “ANSI87-2 trip” [E1673] will be activated disregarding the stabilized tripping characteristic. This event can be used for alarm or output control purposes.

NOTE: The *pick-up value* is to be set as a percentage of the *nominal value* of the characteristic quantity (phase current). The nominal value of the characteristic quantity is to be set by parameter:

- “Current” [P604], for primary side W1 or
- “Current” [P614], for secondary side W2
- “Current” [P624], for tertiary side W3.

The referring parameters “Current” [P604], “Current” [P614] and “Current” [P624] are located in submenu: “SYSTEM\Nominals\Reference values”.

3.5.21 ANSI 95i – Harmonics stabilizer

In dependence of the SYMAP-Compact+ device variant, function “Harmonics stabilizer ANSI 95i” is individually available for the following current measurement inputs:

- ANSI 95i-CT1: Harmonics stabilizer for current measurement input CT1
- ANSI 95i-CT2: Harmonics stabilizer for current measurement input CT2

Main Menu\Parameters\PROTECTION\ANSI59-95i\					
ANSI 95i					
SET 1	SET 2	SET 3	SET 4		
No.	Name	Value	Unit	(Setting range)	
CT1-Harmonics stabilizer					
P1745	Harmonics stabilizer	OFF	-	ON/OFF	
P1746	Blocking protection module	0	event	0 ... 9999	
P1747	Module blocking current	1500	%	0 ... 1999,9	
P1748	Mode	1-phase	-	1-phase/3-phase	
P1749	2H Limit	0	%	0 ... 1999,9	
P1750	5H Limit	0	%	0 ... 1999,9	
P1751	2H max. blocking time	5	s	0 ... 999999,999	
P1752	5H max. blocking time	5	s	0 ... 999999,999	
E1470	ANSI95i-CT1 module active	-	-	-	
E1471	ANSI95i-CT1 blocked module	-	-	-	
E1472	ANSI95i-CT1 blocked by I _{max}	-	-	-	
E1473	ANSI95i-CT1 L1 blocked by 2H	-	-	-	
E1474	ANSI95i-CT1 L2 blocked by 2H	-	-	-	
E1475	ANSI95i-CT1 L3 blocked by 2H	-	-	-	
E1476	ANSI95i-CT1 L1 blocked by 5H	-	-	-	
E1477	ANSI95i-CT1 L2 blocked by 5H	-	-	-	
E1478	ANSI95i-CT1 L3 blocked by 5H	-	-	-	
E1479	ANSI95i-CT1 2H supervision blocked	-	-	-	
E1480	ANSI95i-CT1 5H supervision blocked	-	-	-	
CT2-Harmonics stabilizer					
P1760	Harmonics stabilizer	OFF	-	ON/OFF	
P1761	Blocking protection module	0	event	0 ... 9999	
P1762	Module blocking current	1500	%	0 ... 1999,9	
P1763	Mode	1-phase	-	1-phase/3-phase	
P1764	2H Limit	0	%	0 ... 1999,9	
P1765	5H Limit	0	%	0 ... 1999,9	
P1766	2H max. blocking time	5	s	0 ... 999999,999	
P1767	5H max. blocking time	5	s	0 ... 999999,999	
E1485	ANSI95i-CT2 module active	-	-	-	
E1486	ANSI95i-CT2 blocked module	-	-	-	
E1487	ANSI95i-CT2 blocked by I _{max}	-	-	-	
E1488	ANSI95i-CT2 L1 blocked by 2H	-	-	-	
E1489	ANSI95i-CT2 L2 blocked by 2H	-	-	-	
E1490	ANSI95i-CT2 L3 blocked by 2H	-	-	-	
E1491	ANSI95i-CT2 L1 blocked by 5H	-	-	-	
E1492	ANSI95i-CT2 L2 blocked by 5H	-	-	-	
E1493	ANSI95i-CT2 L3 blocked by 5H	-	-	-	
E1494	ANSI95i-CT2 2H supervision blocked	-	-	-	
E1495	ANSI95i-CT2 5H supervision blocked	-	-	-	
GND1-Harmonics stabilizer					
P1790	Harmonics stabilizer	OFF	-	ON/OFF	
P1791	Blocking protection module	0	event	0 ... 9999	

P1792	Module blocking current	1500	%	0 ... 1999,9
P1794	2H Limit	0	%	0 ... 1999,9
P1795	5H Limit	0	%	0 ... 1999,9
P1796	2H max. blocking time	5	s	0 ... 999999,999
P1797	5H max. blocking time	5	s	0 ... 999999,999
E1515	ANSI95i-GND1 module active	-	-	-
E1516	ANSI95i-GND1 blocked module	-	-	-
E1517	ANSI95i-GND1 blocked by I _{max}	-	-	-
E1518	ANSI95i-GND1 blocked by 2H	-	-	-
E1519	ANSI95i-GND1 blocked by 5H	-	-	-
E1520	ANSI95i-GND1 2H supervision blocked	-	-	-
E1521	ANSI95i-GND1 5H supervision blocked	-	-	-

Figure 3-119 ANSI 95i – Protection parameters [P] and events [E] of SET 1

Parameter description:

The following parameter descriptions refer to all protection parameters of one parameter set.

NOTE: For functions “CT1-Harmonics stabilizer”, “CT2-Harmonics stabilizer” and “GND-Harmonics stabilizer”, each of the four parameter SETS always provides only one protection STEP and, as consequence, only one group of protection parameters. Thus, SET PARAMETERS are equal to STEP parameters. The protection parameters of function “CT1-Harmonics stabilizer” of SET 1 represented below are described in the following in detail as examples.

Protection parameters of parameter SET 1 – (ANSI 95i\CT1-Harmonics stabilizer)

P1745 Harmonics stabilizer

This parameter enables/disables function *CT1-Harmonics stabilizer* wherein:

- “OFF”: disables or
- “ON”: enables the function.

When function “*CT1-Harmonics stabilizer*” is enabled by parameter [P1745], then event “*ANSI95i-CT1 module active*” [E1470] is being activated.

P1746 Blocking module

Function *CT1-Harmonics stabilizer* can be completely blocked by any active event. For blocking, the number related to this blocking event has to be assigned to parameter [P1746]. Blocking is only effective, however, as long as the blocking event is active. As soon as blocking is active, event “*ANSI95i-CT1 blocked module*” [E1471] is being activated. If the blocking event turns inactive, blocking is abandoned and function *CT1-Harmonics stabilizer* is effective again. Then, event [E1471] is being deactivated automatically.

If blocking of function *CT1-Harmonics stabilizer* is not required, set this parameter to “0”.

P1747 Module blocking current

Maximum phase current limit for harmonics stabilisation (high-current faults); In case that in at least one phase the phase current exceeds the set value of parameter [P1746], function “*CT1-Harmonics stabilizer*” is blocked, and event “*ANSI95i-CT1 blocked by I_{max}*” [E1472] is being activated. When the current value falls below the set value, blocking of harmonics stabilization and event [E1472] is being deactivated.

NOTE: The *maximum phase current limit for harmonics stabilisation* is to be set as a percentage of the *nominal value* of the characteristic quantity (phase current). The nominal value of the characteristic quantity is to be set by parameter:

- “Current” [P604], for primary side W1 or
- “Current” [P614], for secondary side W2
- “Current” [P624], for tertiary side W3.

The referring parameters “Current” [P604], “Current” [P614] and “Current” [P624] are located in submenu: “SYSTEM\Nominals\Reference values”.

P1748 Mode

Parametrizable blocking mode:

- “1-phase”: In case that only in one phase the limit of parameter(s) “2H Limit” [P1749] or/and “5H Limit” [P1750] is(are) exceeded, then, protection trip of those protective functions with activated Harmonic stabilisation is blocked only in the affected phase.
- “3-phase”: In case that only in all three phases the limit of parameter(s) “2H Limit” [P1749] or/and “5H Limit” [P1750] is(are) exceeded, then, protection trip of those protective functions with activated Harmonic stabilisation is blocked in all three phases.

P1749 2H Limit

Pick-up value of 2. Harmonic stabilisation; when the characteristic quantity (2. harmonic portion in the phase currents) exceeds the set value of parameter [P1749] in one or more phases, then, the following corresponding blocking event(s) is(are) activated:

- “ANSI95i-CT1 L1 blocked by 2H” [E1473]
- “ANSI95i-CT1 L2 blocked by 2H” [E1474]
- “ANSI95i-CT1 L3 blocked by 2H” [E1475]

P1750 5H Limit

Pick-up value of 5. Harmonic stabilisation; when the characteristic quantity (5. harmonic portion in the phase currents) exceeds the set value of parameter [P1750] in one or more phases, then, the following corresponding blocking event(s) is(are) activated:

- “ANSI95i-CT1 L1 blocked by 5H” [E1476]
- “ANSI95i-CT1 L2 blocked by 5H” [E1477]
- “ANSI95i-CT1 L3 blocked by 5H” [E1478]

P1751 2H max. blocking time

Maximum time window for blocking those protective functions by “CT1-Harmonics stabilisation”; when in at least one phase the 2. Harmonic portion exceeds the set value of parameter “2H Limit” [P1749], then, the counter of the maximum time window starts.

In case that one of the three blocking events are continuously active, and the counter has run down, then, blocking events and blocking of the affected protective functions, and event “ANSI 95i CT1-2H supervision blocked” [E1479] are being deactivated.

P1752 5H max. blocking time

Maximum time window for blocking those protective functions by “CT1-Harmonics stabilisation”; when in at least one phase the 5. Harmonic portion exceeds the set value of parameter “5H Limit” [P1750], then, the counter of the maximum time window starts.

In case that one of the three blocking events are continuously active, and the counter has run down, then, blocking events and blocking of the affected protective functions, and event “ANSI 95i CT1-5H supervision blocked” [E1480] are being deactivated.

3.5.22 CTS – Current Transformer Supervision

Main Menu\Parameters\PROTECTION\CTS					
CT1					
SET 1	SET 2	SET 3	SET 4		
No.	Name		Value	Unit	(Setting range)
Symmetry check					
P2630	Function		OFF	-	ON/OFF
P2631	Blocking		0	event	0 ... 9999
P2632	Min. start current		50	%	0 ... 6553,5
P2633	Symmetry quotient		0,5	-	0 ... 1,000
P2634	Delay time		0	s	0 ... 999999,999
E2130	CTS-1 symmetry check active		-	-	-
E2131	CTS-1 symmetry check blocked		-	-	-
E2132	CTS-1 symmetry check fault		-	-	-
E2133	CTS-1 symmetry check fault delayed		-	-	-
Diff check					
P2638	Function / Source		OFF	-	OFF/CT-GND1
P2639	Blocking		0	event	0 ... 9999
P2640	Diff current limit		50	%	0 ... 1999,9
P2641	Delay time		1	s	0 ... 999999,999
P2642	Correction factor		0	-	0 ... 1,00
E2135	CTS-1 diff check active		-	-	-
E2136	CTS-1 diff check blocked		-	-	-
E2137	CTS-1 diff fault		-	-	-
E2138	CTS-1 diff fault delayed		-	-	-

Figure 3-120 CTS for CT1 – Parameter set 1: Protection parameters [P] & Events [E]

Main Menu\Parameters\PROTECTION\CTS					
CT2					
SET 1	SET 2	SET 3	SET 4		
No.	Name	Value	Unit	(Setting range)	
Symmetry check					
P2645	Function	OFF	-	ON/OFF	
P2646	Blocking	0	event	0 ... 9999	
P2647	Min. start current	50	%	0 ... 6553,5	
P2648	Symmetry quotient	0,5	-	0 ... 1,000	
P2649	Delay time	0	s	0 ... 999999,999	
E2140	CTS-2 symmetry check active	-	-	-	
E2141	CTS-2 symmetry check blocked	-	-	-	
E2142	CTS-2 symmetry check fault	-	-	-	
E2143	CTS-2 symmetry check fault delayed	-	-	-	
Diff check					
P2653	Function / Source	OFF	-	OFF/CT-GND1	
P2654	Blocking	0	event	0 ... 9999	
P2655	Diff current limit	50	%	0 ... 1999,9	
P2656	Delay time	1	s	0 ... 999999,999	
P2657	Correction factor	0	-	0 ... 1,00	
E2145	CTS-2 diff check active	-	-	-	
E2146	CTS-2 diff check blocked	-	-	-	
E2147	CTS-2 diff fault	-	-	-	
E2148	CTS-2 diff fault delayed	-	-	-	

Figure 3-121 CTS for CT2 – Parameter set 1: Protection parameters [P] & Events [E]

Parameter description:

The following parameter descriptions refer to all protection parameters of one parameter set.

NOTE: Each of the four parameter sets always provides the same group sub-functions such as “Symmetry check” and “Diff check”. Hence, the parameter descriptions of parameter SET 1 represented below are described in the following in detail as examples.

Protection parameters of parameter SET 1 – Current Transformer Supervision at CT1

“Symmetry check” (Supervision of current symmetry)

Function “Symmetry check” cyclically (each 2 ms) calculates the quotient between measured minimum and maximum phase currents of CT1:

$$I_Q = I_{L,min}/I_{L,max}$$

In the event that *quotient* I_Q falls below the set *minimum permitted value* $I_{Q,min,perm.}$, it may be concluded that there is a fault in one or more phase current paths of CT1.

P2630 Function

This parameter enables/disables sub-function “Symmetry check” of protective function “Current transformer supervision CTS” wherein:

- “OFF”: disables or
- “ON”: enables the supervision function.

When supervision function “Symmetry check” is enabled by parameter [P2630], then event “CTS-1 symmetry check active” [E2130] is being activated.

P2631 Blocking

Function “Symmetry check” of protective function “Current transformer supervision CTS” can be completely blocked by any active event. For blocking, the number related to this blocking event has to be assigned to parameter [P2631]. Blocking is only effective, however, as long as the blocking event is active. As soon as blocking is active, event “CTS-1 symmetry check blocked” [E2131] is being activated. If the blocking event turns inactive, blocking is abandoned and protective function is effective again. Then, event [E2131] is being deactivated automatically.

If blocking of function “Symmetry check” is not required, set this parameter to “0”.

Current check for the presence of a minimum load as first criterion to detect a faulty current transformer path of CT1

P2632 Min. start current

Minimum limit of the measuring of process quantity “phase current” to activate supervision of phase current symmetry by function “Symmetry check”; function “Symmetry check” is blocked as long as the measured values of the phase currents – needed for building the characteristic quantity (quotient of the minimum and maximum phase current $I_{L,min}/I_{L,max}$) – remain below this minimum setting at least in one phase.

NOTE: The *minimum limit of measured process quantity “phase current”* is to be set as a percentage of the nominal value of the process quantity. The nominal value of the process quantity is to be set by parameter:

- “Current” [P604], for primary side W1,
- “Current” [P614], for secondary side W2 or

- “Current” [P624], for tertiary side W3.

The referring parameters “Current” [P604], “Current” [P614] and “Current” [P624] are located in submenu: “SYSTEM\Nominals\Reference values”.

Check for current loss as second criterion to detect a faulty current transformer path of CT1

P2633 Symmetry quotient

Pick-up value $I_{Q, min.perm.}$ of the supervision function “Symmetry check”; at the moment that the characteristic quantity (quotient of the minimum and maximum phase current $I_{L, min}/I_{L, max}$) falls below this limit, it may be concluded that there is a current loss in one or more phase current paths of CT1.

P2634 Delay time

Trip delay time; it is the delay time of the trip event “CTS-1 symmetry fault delayed” [E2133].

As soon as:

- function “Symmetry check” is activated via parameter [P2630] **and**
- the calculated quotient of the minimum and maximum phase current $I_{L, min}/I_{L, max}$ falls below the set value of parameter [P2633] **and**
- blocking of function “Symmetry check” is not activated by the blocking event of parameter [P2632]

the pick-up event “CTS-1 symmetry fault” [E2132] is being activated and “Delay time” is being started.

As soon as the pick-up event “CTS-1 symmetry fault” [E2132] is active and “Delay time” run down, trip event [E2133] will be activated. This event can be used for alarm or output control purposes. Right after protection trip, and, as soon as faulty conditions will no longer be existent, pick-up event [E2132] and trip event [E2133] are being deactivated automatically.

In case that the characteristic quantity (quotient of the minimum and maximum phase current $I_{L, min}/I_{L, max}$) exceeds the pick-up value (“Symmetry quotient”) of the supervision function “Symmetry check” before the trip delay time (“Delay time”) has run down, the timer of “Delay time” will be stopped, the counter value is being reset to zero, and the pick-up event [E2132] will be deactivated.

If the characteristic quantity subsequently exceeds the pick-up value (“Symmetry quotient”), then, the pick-up event “CTS-1 symmetry fault” [E2132] is being activated and “Delay time” is being started again.

„Diff check“ (Supervision of total current difference)

Function “Symmetry check” calculates the total current difference ΔI_{Σ} between the measured ground current (CT-GND1) and the *total current* $3I_0$ calculated via the measured phase currents of CT1 ($3I_0 = I_{L1} + I_{L2} + I_{L3}$). In case that all the current paths of CT1 and CT-GND1 are in proper conditions and any CT tolerances are being neglected, it is:

$$\Delta I_{\Sigma} = I_{GND1} - 3I_0 = 0$$

In the event that *quotient* ΔI_{Σ} falls below the set *minimum permitted value* $\Delta I_{\Sigma, max, perm.}$, it may be concluded that there is a fault

- in the ground current path CT-GND1 or
- in one or more of the phase current paths of CT1.

P2638 Function / Source

This parameter enables/disables sub-function “Diff check” of protective function “Current transformer supervision CTS” to check the *total current difference between CT1 and CT-GND1*; wherein:

- “OFF”: disables or
- “CT-GND1”: enables the supervision function.

When supervision function “Diff check” is enabled by parameter [P2638], then event “CTS-1 diff check active” [E2135] is being activated.

P2639 Blocking

Function “Diff check” of protective function “Current transformer supervision CTS” can be completely blocked by any active event. For blocking, the number related to this blocking event has to be assigned to parameter [P2639]. Blocking is only effective, however, as long as the blocking event is active. As soon as blocking is active, event “CTS-1 diff check blocked” [E2136] is being activated. If the blocking event turns inactive, blocking is abandoned and protective function is effective again. Then, event [E2136] is being deactivated automatically.

If blocking of function “Diff check” is not required, set this parameter to “0”.

P2640 Diff current limit

Pick-up value $\Delta I_{\Sigma, max, perm.}$ of the supervision function “Diff check”, at the moment that the characteristic quantity (*total current difference* $\Delta I_{\Sigma} = I_{GND1} - 3I_0$) exceeds this limit, it may be concluded that there is either a fault in the ground current path CT-GND1 or in one or more of the phase current paths of CT1.

As soon as the characteristic value *total current difference* ΔI_{Σ} exceeds the pick-up value, pick-up event “CTS-1 diff fault” [E2137] is being activated and “Delay time” is being started.

P2641 Delay time

Trip delay time; it is the delay time of the trip event “CTS-1 diff fault delayed” [E2138].

As soon as:

- function “Diff check” is activated via parameter [P2638] **and**
- the calculated *total current difference* $\Delta I_{\Sigma} = I_{GND1} - 3I_0$ exceeds the set value of parameter [P2640] **and**
- blocking of function “Diff check” is not activated by the blocking event of parameter [P2639]

the pick-up event “CTS-1 diff fault” [E2137] is being activated and “Delay time” is being started.

As soon as the pick-up event “CTS-1 diff fault” [E2137] is active and “Delay time” run down, trip event [E2138] will be activated. This event can be used for alarm or output control purposes. Right after protection trip, and, as soon as faulty conditions will no longer be existent, pick-up event [E2137] and trip event [E2138] are being deactivated automatically.

In case that the characteristic quantity (*total current difference* $\Delta I_{\Sigma} = I_{GND1} - 3I_0$) exceeds the pick-up value (“Diff current limit”) of the supervision function “Diff check” before the trip delay time (“Delay time”) has run down, the timer of “Delay time” will be stopped, the counter value is being reset to zero, and the pick-up event [E2137] will be deactivated.

If the characteristic quantity subsequently exceeds the pick-up value (“Diff current limit”), then, the pick-up event “CTS-1 diff fault” [E2137] is being activated and “Delay time” is being started again.

Consideration of current-dependent CT-tolerances

P2642 Correction factor

Dynamic correction factor to adopt pick-up value $\Delta I_{\Sigma, \max, \text{perm.}}$; in case of high operating current, measuring inaccuracies of the CTs and ring core type CT can lead to a higher, absolute value of the *total current difference* ΔI_{Σ} . By using parameter “Correction factor” [P2642] the pick-up value $\Delta I_{\Sigma, \max, \text{perm.}}$ can be automatically increased according to the increasing *total current difference* ΔI_{Σ} .

$$\begin{aligned} \Delta I_{\Sigma}(I_{L \max}) &= \Delta I_{\Sigma, \max, \text{perm., dyn.}} \cdot I_{L \max} + \Delta I_{\Sigma, \max, \text{perm.}} \\ &= \text{„Correction factor“ [P2642]} \cdot I_{L \max} + \text{„Diff current limit“ [P2640]} \end{aligned}$$

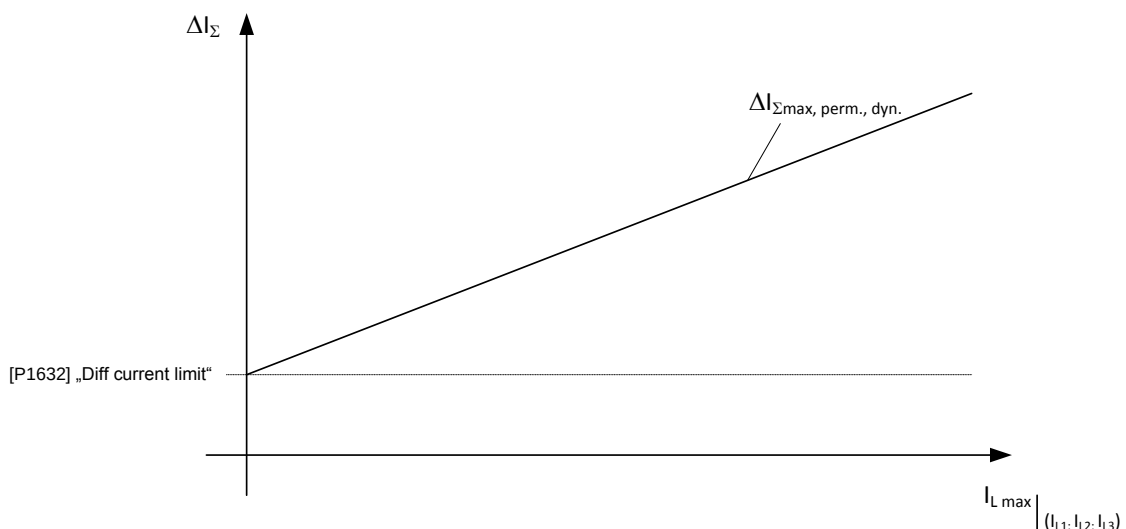


Figure 3-122 „Diff check“ – Correction of current-dependent CT-tolerances

If correction of pick-up value $\Delta I_{\Sigma, \max, \text{perm.}}$ is not required, set this parameter to “0”.

3.5.23 PTS – Potential Transformer Supervision

Main Menu\Parameters\PROTECTION\PTS					
PT1					
SET 1	SET 2	SET 3	SET 4		
No.	Name	Value	Unit	(Setting range)	
Symmetry check					
P2540	Function	OFF	-	ON/OFF	
P2541	Blocking	0	event	0 ... 9999	
P2542	Min. start voltage	50	%	0 ... 6553,5	
P2543	Symmetry quotient	0,75	%	0 ... 999999,999	
P2544	Delay time	5	s	0 ... 999999,999	
E2070	PTS-1 symmetry check active	-	-	-	
E2071	PTS-1 symmetry check blocked	-	-	-	
E2072	PTS-1 symmetry check fault	-	-	-	
E2073	PTS-1 symmetry check fault delayed	-	-	-	
Fuse failure check					
P2547	Function / Source	OFF	-	OFF/CT1/CT2/PT-GND1	
P2548	Blocking	0	event	0 ... 9999	
P2549	Symmetric current limit	10	%	0 ... 6553,5	
P2550	Min. current limit 1	10	%	0 ... 6553,5	
P2551	Asymmetric voltage limit	30	%	0 ... 200,0	
P2552	Asymmetric quotient	0,4	-	0 ... 1,00	
P2553	Voltage lost limit	15	%	0 ... 200,0	
P2554	Min. current limit 2	10	%	0 ... 6553,5	
P2555	Diff current limit	10	%	0 ... 6553,5	
P2556	Diff voltage limit	50	%	0 ... 200,0	
P2557	Delay time	10	s	0 ... 999999,999	
E2076	PTS-1 fuse failure check active	-	-	-	
E2077	PTS-1 fuse failure check blocked	-	-	-	
E2078	PTS-1 fuse failure 3 phase	-	-	-	
E2179	PTS-1 fuse faulure	-	-	-	
E2180	PTS-1 fuse failure delayed	-	-	-	
General check					
P2561	Function / Source	OFF	-	OFF/CT1/CT2	
P2562	Blocking	0	event	0 ... 9999	
P2563	CB close feedback	0	event	0 ... 9999	
P2564	Voltage limit	30	%	0 ... 200,0	
P2565	Min. current limit	15	%	0 ... 6553,5	
P2566	Max. current limit	10	%	0 ... 6553,5	
P2567	Delay time	0	s	0 ... 999999,999	
E2084	PTS-1 general check active	-	-	-	
E2085	PTS-1 general check blocked	-	-	-	
E2086	PTS-1 general check fault	-	-	-	
E2087	PTS-1 general check fault delayed	-	-	-	

Figure 3-123 PTS for PT1 – Parameter set 1: Protection parameters [P] and Events [E]

Main Menu\Parameters\PROTECTION\PTS					
PT2					
SET 1	SET 2	SET 3	SET 4		
No.	Name	Value	Unit	(Setting range)	
Symmetry check					
P2570	Function	OFF	-	ON/OFF	
P2571	Blocking	0	event	0 ... 9999	
P2572	Min. start voltage	50	%	0 ... 6553,5	
P2573	Symmetry quotient	0,75	%	0 ... 999999,999	
P2574	Delay time	5	s	0 ... 999999,999	
E2090	PTS-2 symmetry check active	-	-	-	
E2091	PTS-2 symmetry check blocked	-	-	-	
E2092	PTS-2 symmetry check fault	-	-	-	
E2093	PTS-2 symmetry check fault delayed	-	-	-	
Fuse failure check					
P2577	Function / Source	OFF	-	OFF/CT1/CT2/PT-GND1	
P2578	Blocking	0	event	0 ... 9999	
P2579	Symmetric current limit	10	%	0 ... 6553,5	
P2580	Min. current limit 1	10	%	0 ... 6553,5	
P2581	Asymmetric voltage limit	30	%	0 ... 200,0	
P2582	Asymmetric quotient	0,4	-	0 ... 1,00	
P2583	Voltage lost limit	15	%	0 ... 200,0	
P2588	Min. current limit 2	10	%	0 ... 6553,5	
P2585	Diff current limit	10	%	0 ... 6553,5	
P2586	Diff voltage limit	50	%	0 ... 200,0	
P2587	Delay time	10	s	0 ... 999999,999	
E2096	PTS-2 fuse failure check active	-	-	-	
E2097	PTS-2 fuse failure check blocked	-	-	-	
E2098	PTS-2 fuse failure 3 phase	-	-	-	
E2099	PTS-2 fuse faulure	-	-	-	
E2100	PTS-2 fuse failure delayed	-	-	-	
General check					
P2591	Function / Source	OFF	-	OFF/CT1/CT2	
P2592	Blocking	0	event	0 ... 9999	
P2593	CB close feedback	0	event	0 ... 9999	
P2594	Voltage limit	30	%	0 ... 200,0	
P2595	Min. current limit	15	%	0 ... 6553,5	
P2596	Max. current limit	10	%	0 ... 6553,5	
P2597	Delay time	0	s	0 ... 999999,999	
E2104	PTS-2 general check active	-	-	-	
E2105	PTS-2 general check blocked	-	-	-	
E2106	PTS-2 general check fault	-	-	-	
E2107	PTS-2 general check fault delayed	-	-	-	

Figure 3-124 PTS for PT2 – Parameter set 1: Protection parameters [P] and Events [E]

Main Menu\Parameters\PROTECTION\PTS				
PT3				
SET 1	SET 2	SET 3	SET 4	
No.	Name	Value	Unit	(Setting range)
Symmetry check				
P2600	Function	OFF	-	ON/OFF
P2601	Blocking	0	event	0 ... 9999
P2602	Min. start voltage	50	%	0 ... 6553,5
P2603	Symmetry quotient	0,75	%	0 ... 999999,999
P2604	Delay time	5	s	0 ... 999999,999
E2110	PTS-3 symmetry check active	-	-	-
E2111	PTS-3 symmetry check blocked	-	-	-
E2112	PTS-3 symmetry check fault	-	-	-
E2113	PTS-3 symmetry check fault delayed	-	-	-
Fuse failure check				
P2607	Function / Source	OFF	-	OFF/CT1/CT2/PT-GND1
P2608	Blocking	0	event	0 ... 9999
P2609	Symmetric current limit	10	%	0 ... 6553,5
P2610	Min. current limit 1	10	%	0 ... 6553,5
P2611	Asymmetric voltage limit	30	%	0 ... 200,0
P2612	Asymmetric quotient	0,4	-	0 ... 1,00
P2613	Voltage lost limit	15	%	0 ... 200,0
P2614	Min. current limit 2	10	%	0 ... 6553,5
P2615	Diff current limit	10	%	0 ... 6553,5
P2616	Diff voltage limit	50	%	0 ... 200,0
P2617	Delay time	10	s	0 ... 999999,999
E2116	PTS-3 fuse failure check active	-	-	-
E2117	PTS-3 fuse failure check blocked	-	-	-
E2118	PTS-3 fuse failure 3 phase	-	-	-
E2119	PTS-3 fuse failure	-	-	-
E2120	PTS-3 fuse failure delayed	-	-	-
General check				
P2621	Function / Source	OFF	-	OFF/CT1/CT2
P2622	Blocking	0	event	0 ... 9999
P2623	CB close feedback	0	event	0 ... 9999
P2624	Voltage limit	30	%	0 ... 200,0
P2625	Min. current limit	15	%	0 ... 6553,5
P2626	Max. current limit	10	%	0 ... 6553,5
P2627	Delay time	0	s	0 ... 999999,999
E2124	PTS-3 general check active	-	-	-
E2125	PTS-3 general check blocked	-	-	-
E2126	PTS-3 general check fault	-	-	-
E2127	PTS-3 general check fault delayed	-	-	-

Figure 3-125 PTS for PT3 – Parameter set 1: Protection parameters [P] and Events [E]

Parameter description:

The following parameter descriptions refer to all protection parameters of one parameter set.

NOTE: Each of the four parameter sets always provides the same group sub-functions such as “Symmetry check”, “Fuse failure check” and “General check”. Hence, the parameter descriptions of parameter SET 1 represented below are described in the following in detail as examples.

Protection parameters of parameter SET 1 – Potential Transformer Supervision at PT1

“Symmetry check” (Supervision of voltage symmetry)

Function “Symmetry check” cyclically calculates the quotient between measured minimum and maximum phase-to-phase voltages of PT1:

$$U_Q = U_{L-L, \min} / U_{L-L, \max}$$

In the event that *quotient* U_Q falls below the set *minimum permitted value* $U_{Q \min, \text{perm.}}$, it may be concluded that there is a fault in one or more phase-to-phase voltage circuits of PT1.

P2540 Function

This parameter enables/disables sub-function “Symmetry check” of protective function “Potential transformer supervision PTS” wherein:

- “OFF”: disables or
- “ON”: enables the supervision function.

NOTE: In case that no voltage measurement is possible, caused by locating the PTs below the circuit breaker, and which is open, then, *supervision of voltage symmetry* must be blocked by a suitable event. For this, the related number of such blocking event has to be assigned to parameter [P2541].

When supervision function “Symmetry check” is enabled by parameter [P2640], then event “PTS-1 symmetry check active” [E2070] is being activated.

P2541 Blocking

Function “Symmetry check” of protective function “Potential transformer supervision PTS” can be completely blocked by any active event. For blocking, the number related to this blocking event has to be assigned to parameter [P2531]. Blocking is only effective, however, as long as the blocking event is active. As soon as blocking is active, event “PTS-1 symmetry check blocked” [E2071] is being activated. If the blocking event turns inactive, blocking is abandoned and protective function is effective again. Then, event [E2071] is being deactivated automatically.

If blocking of function “Symmetry check” is not required, set this parameter to “0”.

Voltage check for the presence of a minimum measuring voltage as first criterion to detect a faulty voltage transformer circuit of PT1

P2542 Min start voltage

Minimum limit of the measuring of process quantity “phase-to-phase voltage” to activate supervision of voltage symmetry by function “Symmetry check”, function “Symmetry check” is blocked as long as the measured values of the phase-to-phase voltages – needed for building the characteristic quantity (quotient of the minimum and maximum phase-to-phase voltage $U_Q = U_{L-L, \min} / U_{L-L, \max}$) – remain below this minimum setting.

NOTE: The *minimum limit of measured process quantity “phase-to-phase voltage”* is to be set as a percentage of the nominal value of the process quantity. The nominal value of the process quantity is to be set by parameter:

- “Voltage (L-L)” [P603], for primary side W1,
- “Voltage (L-L)” [P613], for secondary side W2 or
- “Voltage (L-L)” [P623], for tertiary side W3.

The referring parameters “Voltage (L-L)” [P603], “Voltage (L-L)” [P613] and “Voltage (L-L)” [P623] are located in submenu: “SYSTEM\Nominals\Reference values”.

Check for voltage unsymmetry as second criterion to detect a faulty potential transformer circuit of PT1

P2543 Symmetry quotient

Pick-up value $U_{Q \min.perm.}$ of the supervision function “Symmetry check”; at the moment that the characteristic quantity (*quotient of the minimum and maximum phase-to-phase voltage* $U_{L-L,min}/U_{L-L,max}$) falls below this limit, it may be concluded that there is a voltage loss in one or more phase-to-phase voltage circuits of PT1.

P2544 Delay time

Trip delay time; it is the delay time of the trip event “PTS-1 symmetry fault delayed” [E2073].

As soon as:

- function „Symmetry check“ is activated via parameter [P2540] **and**
- at least one of the phase-to-phase voltages measured via PT1 exceeds the minimum voltage limit set by parameter “Voltage limit” [P2543] (voltage check) **and**
- the calculated quotient of the minimum and maximum phase-to-phase voltage $U_{L-L,min}/U_{L-L,max}$ falls below the set value of parameter [P2543] (voltage unsymmetry check) **and**
- blocking of function “Symmetry check” is not activated by the blocking event of parameter [P2541]

the pick-up event “CTS-1 symmetry fault” [E2072] is being activated and “Delay time” is being started.

As soon as the pick-up event “PTS-1 symmetry fault” [E2072] is active and “Delay time” run down, trip event [E2073] will be activated. This event can be used for alarm or output control purposes. Right after protection trip, and, as soon as faulty conditions will no longer be existent, pick-up event [E2072] and trip event [E2073] are being deactivated automatically.

In case that the characteristic quantity (*quotient of the minimum and maximum phase-to-phase voltage* $U_{L-L,min}/U_{L-L,max}$) exceeds the pick-up value (“Symmetry quotient”) of the supervision function “Symmetry check” before the trip delay time (“Delay time”) has run down, the timer of “Delay time” will be stopped, the counter value is being reset to zero, and the pick-up event [E2072] will be deactivated.

If the characteristic quantity subsequently falls below the pick-up value (“Symmetry quotient”), then, the pick-up event “PTS-1 symmetry fault” [E2072] is being activated and “Delay time” is being started again.

“Fuse failure check“

For supervision of a potential transformer fuse failure (tripping of miniature circuit breaker MCB), function „*Fuse failure check*“ provides the following sub-functions:

- Sub-function “*Asymmetric fuse failure*“: for detection of 1- phase and 2-phase faults in the secondary voltage measurement circuit of PT1
- Sub-function “*3 Phase fuse failure*“: for detection of a 3-phase fault in the secondary voltage measurement circuit of PT1 (3-pole PTfuse fail)
- Sub-function “*Voltage difference*“: for detection of 1- phase and 2-phase faults in the secondary voltage measurement circuit of PT1 or in the secondary voltage measurement circuit of PT-GND1

NOTE: Sub-functions “*Asymmetric fuse failure*“ and “*3 Phase fuse failure*“ are only being activated for the following parameter settings:

“*Function / Source [P2547] = CT1*“ or

“*Function / Source [P2547] = CT2*“!

Then, parameter [P2556] of function “*Fuse failure check*“ will not apply!

Sub-function “Asymmetric fuse failure“ (1-phase and 2-phase PT fuse failures)

At the use of *1-pole miniature circuit breakers (MCB)*, which are for protecting the secondary circuits of the potential transformers connected to PT1, function “*Asymmetric fuse failure*“ detects the tripping of one or two MCBs (non-symmetrical MCB tripping).

CAUTION: Sub-function “*Asymmetric fuse failure*“ cannot detect tripping of all of the three 1-pole MCBs (symmetric MCB tripping)

Supervision of PT secondary circuits according to *1-phase and 2-phase faults* is being conducted by:

- check of *phase current symmetry* by the characteristic quantities: *calculated total current $3I_0$* and *negative phase sequence current I_2* of symmetrical components,
- current check for a minimum load and
- check of *voltage symmetry* depending on the star point treatment (isolated, compensated or solidly earthed star point)

Ein 1-phasiger und 2-phasiger Fehler wird dann detektiert, wenn bei einer *festgestellten Mindestlast*, keine *unzulässig hohe Stromunsymmetrie* auftritt, jedoch eine *unzulässig hohe Spannungsunsymmetrie* gemessen wird.

Sub-function “3 Phase fuse failure“ (3-phase PT fuse failure)

At the use of *three 1-pole miniature circuit breakers (MCB)* or a *3-pole MCB*, which are for protecting the secondary circuits of the potential transformers connected to PT1, function “*3 Phase fuse failure*“ “ detects the symmetrical MCB tripping .

Supervision of PT secondary circuits according to a *3-phase fault* is being conducted by:

- check of voltage loss at voltage measurement input PT1 by the characteristic quantity “*phase voltage U_{Lx-E}* “ (with: $x = 1,2,3$) and
- *current check for high-current faults* such as “*short-circuit*”.

A 3-phase fault is being detected in case of an *impermissibly high voltage drop* at PT1 and if there was *no significant, impermissible current increase* at current measuring input CT1 within one measuring period.

General parameters of function "Fuse failure check"

P2547 Function / Source

This parameter enables/disables function "Fuse failure check" of protective function "Potential transformer supervision PTS" for PT1 and PT-GND1, wherein:

- "OFF": disables function "Fuse failure check" or
- "CT1": enables sub-function "Asymmetric fuse failure" and "3 Phase fuse failure" for PT1 with current check of CT1 or
- "CT2": enables sub-function "Asymmetric fuse failure" and "3 Phase fuse failure" for PT1 with current check of CT2 or
- "PT-GND1": only enables sub-function "Voltage difference" for PT1 and PT-GND1

When supervision function "Fuse failure check" is enabled by parameter [P2547], then event "PTS-1 fuse fail check active" [E2076] is being activated.

P2548 Blocking

Function "Fuse failure check" of protective function "Potential transformer supervision PTS" can be completely blocked by any active event. For blocking, the number related to this blocking event has to be assigned to parameter [P2548]. Blocking is only effective, however, as long as the blocking event is active. As soon as blocking is active, event "PTS-1 fuse failure check blocked" [E2077] is being activated. If the blocking event turns inactive, blocking is abandoned and protective function is effective again. Then, event [E2077] is being deactivated automatically.

If blocking of function "Fuse failure check" is not required, set this parameter to "0".

Check of phase current symmetry as first criterion to detect 1-phase and 2-phase tripping of miniature circuit breakers (MCB) – "Asymmetric fuse failure"

P2549 Symmetric current limit

Minimum limit for detection of no impermissible current non-symmetry; as long as

- the first characteristic quantity "residual current $3I_0$ ", calculated by measured phase currents **and**
- the first characteristic quantity "negative phase sequence current I_2 " of symmetrical components

fall below the set value of parameter "Symmetric current limit" [P2549], the first criterion for detecting 1-phase or 2-phase tripping of MCBs.

Current check for a minimum load as second criterion to detect 1-phase and 2-phase tripping of miniature circuit breakers (MCB) – "Asymmetric fuse failure"

P2550 Min. current limit 1

Minimum limit of phase currents for current check for a minimum load by CT1 or CT2; as soon as the process quantity "phase current I_{Lx} " (with: $x = 1, 2, 3$) exceeds the set value of parameter "Min current limit 1" [P2550] at least in one phase, then, second criterion to detect 1-phase and 2-phase tripping of miniature circuit breakers (MCB) is fulfilled.

NOTE: Exceeding the set value of parameter [P2565] can be interpreted as live electrical equipment, for instance a substation, so that a measurable voltage is basically provided.

Check of phase current symmetry as third criterion to detect 1-phase and 2-phase tripping of miniature circuit breakers (MCB) – “Asymmetric fuse failure”

P2551 Asymmetric voltage limit

Minimum limit for detection of no impermissible voltage non-symmetry; as long as

- the first characteristic quantity “*residual voltage $3U_0$* ”, calculated by measured phase voltages **and**
- the first characteristic quantity “*negative phase sequence voltage U_2* ” of symmetrical components

fall below the set value of parameter “*Symmetric voltage limit*” [P2551], the first criterion for detecting 1-phase or 2-phase tripping of MCBs.

CAUTION: Parameter “*Asymmetric voltage limit*” [P2551] only applies to applications providing “solidly earthed star points”; for this, the following parameter setting applies:

- for primary side W1: “*Star point grounding*” [P602] = *earthed*” or
- for secondary side W2: “*Star point grounding*” [P612] = *earthed*” or
- for tertiary side W3: “*Star point grounding*” [P622] = *earthed*”

P2552 Asymmetry quotient

Minimum limit for detection of no impermissible voltage non-symmetry; as soon as the characteristic quantity “quotient U_2/U_1 ” (ratio between the negative phase sequence voltage U_2 and the positive phase sequence voltage U_1 of symmetrical components) exceeds the set value of parameter [P1552], then, the third criterion to detect 1-phase and 2-phase tripping of miniature circuit breakers (MCB) is fulfilled.

CAUTION: Parameter “*Asymmetric voltage limit*” [P2552] only applies to applications providing “isolated or compensated star points”; for this, the following parameter setting applies:

- for primary side W1: „*Star point grounding*” [P602] = *isolated*” or
- for secondary side W2: „*Star point grounding*” [P612] = *isolated*” or
- for tertiary side W3: „*Star point grounding*” [P622] = *isolated*” or
- for primary side W1: „*Star point grounding*” [P602] = *compensated*” or
- for secondary side W2: „*Star point grounding*” [P612] = *compensated*” or
- for tertiary side W3: „*Star point grounding*” [P622] = *compensated*”.

Check of voltage loss as first criterion to detect a 3-phase tripping of miniature circuit breakers (MCB) – “3-Phase fuse failure”

P2553 Voltage lost limit

Minimum limit of phase voltages for current check for voltage loss at PT1; as soon as the process quantity “phase voltage U_{Lx-E} ” (with: $x = 1, 2, 3$) exceeds the set value of parameter “Voltage lost limit” [P2553] in all three phases, then, first criterion to detect 3-phase tripping of miniature circuit breakers (MCB) is fulfilled.

Current check for high-current faults as second criterion to detect a 3-phase tripping of miniature circuit breakers (MCB) – “3-Phase fuse failure “

NOTE: The second criterion to detect a 3-phase tripping of miniature circuit breakers (MCB) is fulfilled only if a minimum load is measured (exceeding of minimum limit set by parameter “*Min. current limit 2*” [P2554]) **and** if simultaneously, no significant current increase is detected (undercutting the set value of parameter “*Diff current limit*” [P2555])

P2554 Min current limit 2

*Minimum limit of phase currents for current check for a minimum load by CT1 or CT2; as soon as the process quantity “phase current I_{Lx} ” (with: $x = 1, 2, 3$) exceeds the set value of parameter “*Min current limit 1*” [P2550] at least in one phase, then, second criterion to detect 3-phase tripping of miniature circuit breakers (MCB) is fulfilled.*

NOTE: Exceeding the set value of parameter [P2554] can be interpreted as a live electrical equipment, for instance a substation, so that a measurable minimum load is basically provided, and voltage measuring via PT1 is possible.

P2555 Diff current limit

Minimum limit for detection of no impermissible current increase caused by high-current faults such as “short-circuit”, if the characteristic quantity “current difference” $|I_{Lx} - I_{Lx}^*|$ “ with: $x = 1, 2, 3$ (phase-segregated difference of the amount of the phase currents measured at the beginning and the end of the measuring period) remains below the set value of parameter [P2555], second criterion to detect 3-phase tripping of miniature circuit breakers (MCB) is fulfilled.

However, if the set minimum limit is being exceeded, it may be concluded that a high-current fault is present, which causes a significant voltage drop.

Sub-function **“Voltage difference”** (Supervision of residual voltage difference)

NOTE: Sub-function **“Voltage difference”** is only being activated for parameter setting:
“Function / Source [P2547] = PT-GND1”.

Then, parameters [P2549] to [P2555] of function **“Fuse failure check”** will not apply!

Function **“Voltage difference”** calculates the *residual voltage difference* ΔU_{Σ} between the measured ground voltage (PT-GND1) and the *residual current* $3U_0$ calculated via the measured phase currents of PT1 ($3U_0 = U_{L1-E} + U_{L2-E} + U_{L3-E}$). In case that all the voltage circuits of PT1 and PT-GND1 are in proper conditions and any PT tolerances are being neglected, it is:

$$\Delta U_{\Sigma} = U_{GND1} - 3U_0 = 0$$

In the event that *quotient* ΔU_{Σ} falls below the set *minimum permitted value* $\Delta U_{\Sigma, max, perm.}$, it may be concluded that there is a fault

- in the ground voltage circuit of PT-GND1 or
- in one or more of the phase voltage circuits of PT1 (*1-pole fuse fail*).

CAUTION: A 3-pole fuse failure cannot be detected by function **“Voltage difference”**!

P2556 Diff voltage limit

Pick-up value $\Delta U_{\Sigma, max, perm.}$ of the supervision function **“Voltage difference”**; at the moment that the characteristic quantity (*total residual voltage difference* $\Delta U_{\Sigma} = U_{GND1} - 3U_0$) exceeds this limit, it may be concluded that there is either a fault in the ground voltage circuit of PT-GND1 or in one or more of the phase voltage circuits of PT1.

As soon as the characteristic value *total residual voltage difference* ΔU_{Σ} exceeds the pick-up value, pick-up event **“PTS-1 fuse failure”** [E2079] is being activated and **“Delay time”** is being started.

P2557 Delay time

Trip delay time; it is the delay time of the trip event **“PTS-1 fuse failure delayed”** [E2080].

As soon as:

- function **“Fuse failure check”** is activated by assignment of the applied current measurement channel CT1 or CT2 via parameter [P2547] **or** of the applied ground voltage measurement channel PT-GND1 **and**
- **either for parameter settings:**
“Function / Source [P2562] = CT1” or **“Function / Source [P2562] = CT2”**,
all of the failure conditions of sub-function **“Asymmetric fuse failure”** **or**
all of the failure conditions of sub-function **“3-Phase fuse failure”** are fulfilled
or for parameter settings:
“Function / Source [P2562] = PT-GND1”,
all of the failure conditions of sub-function **“Voltage difference”** are fulfilled **and**
- blocking of function **“Fuse failure check”** is not activated by the blocking event of parameter [P2562]

the pick-up event **“PTS-1 fuse failure”** [E2079] is being activated and **“Delay time”** is being started.

As soon as the pick-up event **“PTS-1 fuse failure”** [E2079] is active and **“Delay time”** run down, trip event [E2080] will be activated. This event can be used for alarm or output control purposes. Right after protection trip, and, as soon as faulty conditions will no longer be existent, pick-up event [E2079] and trip event [E2080] are being deactivated automatically.

In case the voltage and current conditions fail to apply with the foregoing failure conditions before the trip delay time ("Delay time") has run down, the timer of "Delay time" will be stopped, the counter value is being reset to zero, and the pick-up event [E2079] will be deactivated.

If the failure conditions subsequently are fulfilled again, then, the pick-up event [E2079] is being activated and "Delay time" is being started again.

“General check“ (Supervision of voltage and current conditions)

P2561 Function / Source

This parameter enables/disables sub-function “General check” of protective function “Potential transformer supervision PTS” wherein:

- “OFF”: disables or
- “CT1”: enables sub-function “General check” and current check of CT1 or
- “CT2”: enables sub-function “General check” and current check of CT2.

When supervision function “General check” is enabled by parameter [P2561], then event “PTS-1 general check active” [E2084] is being activated.

P2562 Blocking

Function “General check” of protective function “Potential transformer supervision PTS” can be completely blocked by any active event. For blocking, the number related to this blocking event has to be assigned to parameter [P2562]. Blocking is only effective, however, as long as the blocking event is active. As soon as blocking is active, event “PTS-1 general check blocked” [E2085] is being activated. If the blocking event turns inactive, blocking is abandoned and protective function is effective again. Then, event [E2085] is being deactivated automatically.

If blocking of function “General check” is not required, set this parameter to “0”.

Check of voltage condition as first criterion to detect a faulty voltage transformer circuit of PT1

P2564 Voltage limit

Minimum limit of phase voltages for voltage check of PT1; at the moment that the process quantity (“phase voltage U_{Lx-E} ”; with: $x = 1,2,3$) falls below this limit, it may be concluded that there is a voltage loss in one or more phase-to-phase voltage circuits of PT1.

Current check for the presence of a minimum load as second criterion to detect a faulty voltage transformer circuit of PT1

P2565 Min. current limit

Minimum limit of phase currents for the presence of a minimum load at CT1; at the moment that the characteristic quantity (“phase current” I_{Lx} ”; with: $x = 1,2,3$) falls below this limit in all three phases, it may be concluded that there is no minimum load, and, as consequence, there is no active voltage to be measured via PT1.

NOTE: In case that phase currents of all three phase exceeds the minimum limit set by parameter [P2565], then, it may be concluded that there is an existing minimum load, and, as consequence, an active voltage which could be measured at PT1.

Current check for short circuit as third criterion to detect a faulty voltage transformer circuit of PT1

P2566 Max. current limit

Maximum limit of phase currents for short circuit check; at the moment that the characteristic quantity (“phase current” I_{Lx} ”; with: $x = 1,2,3$) measured via CT1 exceeds this limit at least in one phase, it may be concluded that a short circuit occurred, which could cause the loss of voltage measured at PT1. If so, *third criterion* to detect a faulty voltage transformer circuit of PT1 is not fulfilled.

Circuit breaker (CB) position "Closed" as an alternative to "current check for a minimum load"

P2563 CB close feedback

Feedback signal for CB position "CLOSED"; signalling of position "Closed" of the circuit breaker (CB) can be activated by any active event. For activation, the number related to this event has to be assigned to parameter [P2563].

NOTE: Position "CLOSED" of the CB is preferably indicated by assigning one of the following „*Position Event Numbers*“: E6111], [E6121], [E6131], [E6141], [E61551], [E6161], [E6171] or [E6181], to parameter [P2563].

Activation is only effective, however, as long as the assigned event is active. If the assigned event turns inactive, CB position is being interpreted as "OPEN" and – depending on the PT location – no voltage is measured at PT1. In case that measured phase voltages fall below the set limit of parameter "*Voltage limit*" [P2564, it may not be concluded that there is a faulty voltage transformer circuit of PT1.

If evaluation of the circuit breaker position "CLOSED" is not required, set this parameter to "0".

P2567 Delay time

Trip delay time; it is the delay time of the trip event "PTS-1 general failure delayed" [E2087].

As soon as:

- function „*General check*“ is activated by assignment of the applied current measurement channel CT1 or CT2 via parameter [P2561] **and**
- all of the three measured phase voltages fall below the minimum "*Voltage limit*" [P2564] (voltage check) **and**
- **either** one of the three measured phase currents of CT1 (or CT2) exceeds the minimum current limit set by parameter "*Min. current limit*" [P2565] (current check for the presence of a minimum load) **or** the circuit breaker is closed **and**
- none of the three measured phase currents of CT1 (or CT2) exceeds the maximum current limit set by parameter "*Max. current limit*" [P2566] (current check for short circuit) **and**
- blocking of function „*General check*“ is not activated by the blocking event of parameter [P2562]

the pick-up event "*PTS-1 general failure*" [E2086] is being activated and "Delay time" is being started.

As soon as the pick-up event "*PTS-1 general failure*" [E2086] is active and "Delay time" run down, trip event [E2087] will be activated. This event can be used for alarm or output control purposes. Right after protection trip, and, as soon as faulty conditions will no longer be existent, pick-up event [E2086] and trip event [E2087] are being deactivated automatically.

In case the voltage and current conditions fail to apply with the foregoing failure conditions before the trip delay time ("Delay time") has run down, the timer of "Delay time" will be stopped, the counter value is being reset to zero, and the pick-up event [E2086] will be deactivated.

If the failure conditions subsequently are fulfilled again, then, the pick-up event [E2086] is being activated and "Delay time" is being started again.

3.5.24 YG – Neutral Admittance Earth Fault Protection

Main Menu\Parameters\PROTECTION\					
YG					
SET 1	SET 2	SET 3	SET 4		
P/E No.	Name	Value	Unit	(Setting range)	
SET PARAMETERS					
P2705	Function	ON	-	ON/OFF	
P2706	Blocking	0	event	0 ... 9999	
P2707	CT source	CT1	-	CT1/CT2/CT-GND1	
P2708	PT source	PT1	-	PT1/PT2/PT3/PT-GND1	
P2709	Direction	0°	-	0°/180°	
P2710	Angle correction	0°	deg	0°... 40°	
E2180	YG active	-	-	-	
E2181	YG blocked	-	-	-	
STEP 1					
P2715	Function	OFF	-	OFF/Yo/Go/Bo	
P2716	Blocking	0	event	0 ... 9999	
P2717	Direction mode	Definite	-	Non-directional/Forward/Backward	
P2718	Admittance	1	mS	0 ... 999999,999	
P2721	Conductance forward	1	mS	0 ... 999999,999	
P2722	Conductance backward	-1	mS	0 ... 999999,999	
P2724	Susceptance forward	1	mS	0 ... 999999,999	
P2725	Susceptance backward	-1	mS	0 ... 999999,999	
P2727	Delay time	0,1	s	0 ... 999999,999	
P2728	Reset delay time	1	s/-	0 ... 999999,999	
P2729	Min. start voltage	10	%	0 ... 200,0	
P2730	Min. start current	1	%	0 ... 6553,5	
E2185	YG-1 active	-	-	-	
E2186	YG-1 blocked	-	-	-	
E2187	YG-1 pickup	-	-	-	
E2188	YG-1 trip	-	-	-	
STEP 2					
P2735	Function	OFF	-	OFF/Yo/Go/Bo	
...	...	...	...	...	

Figure 3-126 YG-Neutral Admittance Earth Fault Protection – Parameter set 1: Protection parameters [P] and Events [E]

Parameter description:

The following parameter descriptions refer to all protection parameters of one parameter set.

NOTE: Each of the four parameter sets always provides the same group of protection parameters. Hence, the parameter descriptions of the SET PARAMETERS and the parameters of STEP 1 represented below are described in the following in detail as examples.

Protection parameters of parameter SET 1 – “YG” Neutral Admittance Earth Fault Prot.

SET PARAMETERS

The following SET PARAMETERS of YG-Neutral Admittance Earth Fault Protection exist only once in each of the four parameter sets. Thus, the SET PARAMETERS apply to all of the 6 protection STEPS of one parameter SET.

P2705 Function

This parameter enables/disables YG-Neutral Admittance Earth Fault protection wherein:

- “OFF”: disables or
- “ON”: enables the protective function.

When YG-Neutral Admittance Earth Fault protection is enabled by parameter [P2705], then event “YG active” [E2180] is being activated.

P2706 Blocking

YG-Neutral Admittance Earth Fault protection can be completely blocked by any active event. For blocking, the number related to this blocking event has to be assigned to parameter [P2706]. Blocking is only effective, however, as long as the blocking event is active. As soon as blocking is active, event “YG blocked” [E2181] [E2181] is being activated. If the blocking event turns inactive, blocking is abandoned and protective function is effective again. Then, event [E2181] is being deactivated automatically.

If blocking of the YG-Neutral Admittance Earth Fault protection is not required, set this parameter to “0”.

P2707 CT source

Depending on the SYMAP®-Compact(+) device variant the YG-Neutral Admittance Earth Fault protection can be assigned to a certain current measurement input (CT1, CT2 or CT-GND1).

Parameter [P2707] determines the current measurement input which will provide the process quantity “ground current I_{GND} ” needed for building the protective criterion (characteristic quantity such as: *neutral admittance* Y_0 , *neutral conductance* G_0 or *neutral susceptance* B_0 ; see step parameters “Function” [P2715], [P2735], [P2755], [P2775], [P2795] and [P2815]) to the YG-Neutral Admittance Earth Fault protection:

- “CT1”: Calculation of residual voltage: $I_{GND} = 3 \times I_0 = I_1 + I_2 + I_3$ by phase currents measured via measurement input CT1,
- “CT2”: Calculation of residual voltage: $I_{GND} = 3 \times I_0 = I_1 + I_2 + I_3$ by phase currents measured via measurement input CT2,
- “CT-GND1”: Measurement input CT-GND1 (direct measurement of I_{GND})

P2708 PT source

Depending on the SYMAP®-Compact(+) device variant the YG-Neutral Admittance Earth Fault protection can be assigned to a certain voltage measurement input (PT1, PT2, PT3 or PT-GND1).

Parameter [P2708] determines the voltage measurement input which will provide the process quantity “residual voltage U_{GND} ” needed for building the protective criterion (characteristic quantity such as: *neutral admittance* Y_0 , *neutral conductance* G_0 or *neutral susceptance* B_0 ; see step parameters “Function” [P2715], [P2735], [P2755], [P2775], [P2795] and [P2815]) to the YG-Neutral Admittance Earth Fault protection:

- “PT1”: Calculation of residual voltage: $U_{GND} = 3 \times U_0 = U_1 + U_2 + U_3$ by phase voltages measured via measurement input PT1,
- “PT2”: Calculation of residual voltage: $U_{GND} = 3 \times U_0 = U_1 + U_2 + U_3$ by phase voltages measured via measurement input PT2,

- “PT3“: Calculation of residual voltage: $\underline{U}_{GND} = 3 \times \underline{U}_0 = \underline{U}_1 + \underline{U}_2 + \underline{U}_3$ by phase voltages measured via measurement input PT3,
- “PT-GND1“: Measurement input PT-GND1 (direct measurement of $\underline{U}_{GND}$)

P2709 Direction

Internal adaption of measured Neutral-Admittance $\underline{Y}_0$ direction; to define the sign of the complex phasor of $\underline{Y}_0$, the following setting options are available:

- „0°“: no change of sign, und
- „180°“: change of sign by 180°

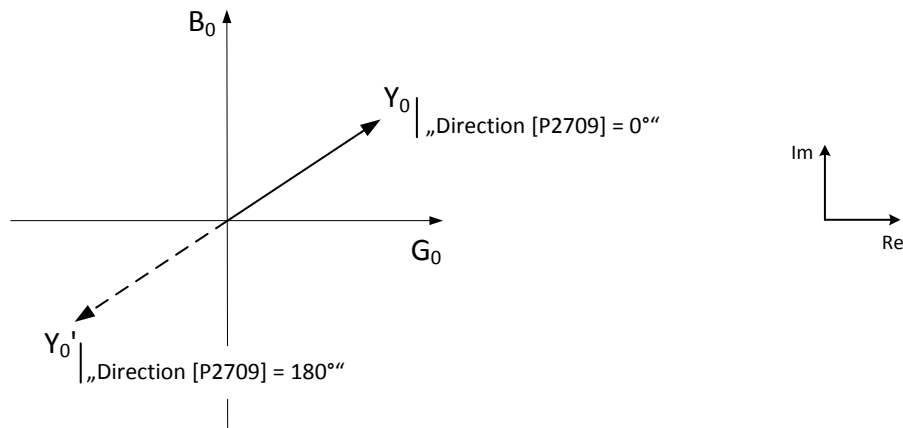


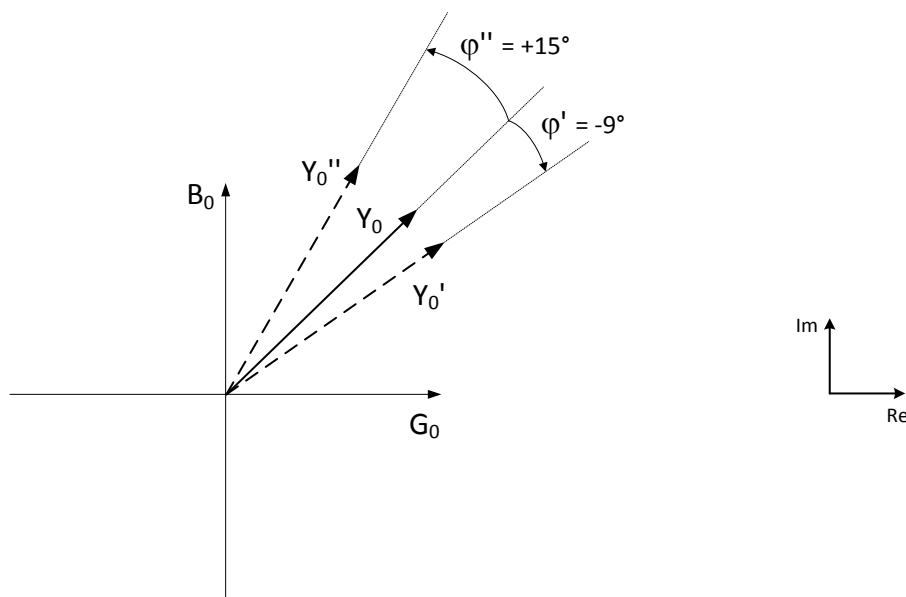
Figure 3-127 Internal adaption of Neutral-Admittance direction

P2710 Angle correction

Correction angle for eliminating the angular errors of the potential transformers (PT) and/or current transformers (CT); measured phase angle deviations caused by measuring inaccuracy of potential transformers, can be eliminated by the set value of parameter “Angle correction” [P2710].

A positive set value will turn the complex phasor $\underline{Y}_0$ anti-clockwise.

A neagitive set value will turn the complex phasor $\underline{Y}_0$ clockwise.



mit:

$\underline{Y}_0'$: „Angle correction“ [P2710] = -9°

$\underline{Y}_0''$: „Angle correction“ [P2710] = +15°

Figure 3-128 Correction of angular errors of PTs and CTs

NOTE: The correction angle is *not* for transformer vector group matching!
Vector group matching is to be set by appropriate parameter setting in submenu
“SYSTEM\Nominals\Reference values”.

Protection parameters of parameter SET 1 – YG-Neutral Admittance Earth Fault

SET PARAMETERS

The following STEP parameters of the *YG-Neutral Admittance Earth Fault* protection exist only once in each of the 6 independent protection STEPS. Thus, the SET PARAMETERS apply only to one of the 6 protection STEPS of one parameter SET.

P2715 Function

This parameter disables/enables the first step of *YG-Neutral Admittance Earth Fault* protection; enabling the first protection step is to be done by selecting the protective criterion (characteristic quantity); whereas:

- “OFF”: disables first protection step,
- “Yo”: enables first protection step => protective criterion “Neutral-Admittance”,
- “Go”: enables first protection step => protective criterion “Neutral -Conductance”,
- “Bo”: enables first protection step => protective criterion “Neutral -Susceptance”.

When first step of *YG-Neutral Admittance Earth Fault* protection is enabled by parameter [P2715], then event “YG-1 active” [E2185] is being activated.

P2716 Blocking

The first step of *YG-Neutral Admittance Earth Fault* protection can be blocked by any active event. For blocking, the number related to this blocking event has to be assigned to parameter [P2716]. Blocking is only effective, however, as long as the blocking event is active. As soon as blocking is active, event “YG-1 blocked” [E2186] is being activated. If the blocking event turns inactive, blocking is abandoned and protective function is effective again. Then, event [E2186] is being deactivated automatically.

If blocking of the first step of *YG-Neutral Admittance Earth Fault* protection is not required, set this parameter to “0”.

P2717 Direction mode

Selection of operating mode according to the direction of the YG-Neutral Admittance Earth Fault protection; the first step of of YG-Neutral Admittance Earth Fault protection is optionally adjustable as:

- “Non-directional”: The protection step trips in *forward and in backward direction*
- “Forward”: The protection step trips only in *forward direction*
- “Backward”: The protection step trips only in *backward direction*

The following figure shows the *interactions* between different setting options of parameters „Function“ [P2715] and „Direction mode“ [P2717] according to the *tripping and operating ranges* of YG-Neutral Admittance Earth Fault protection:

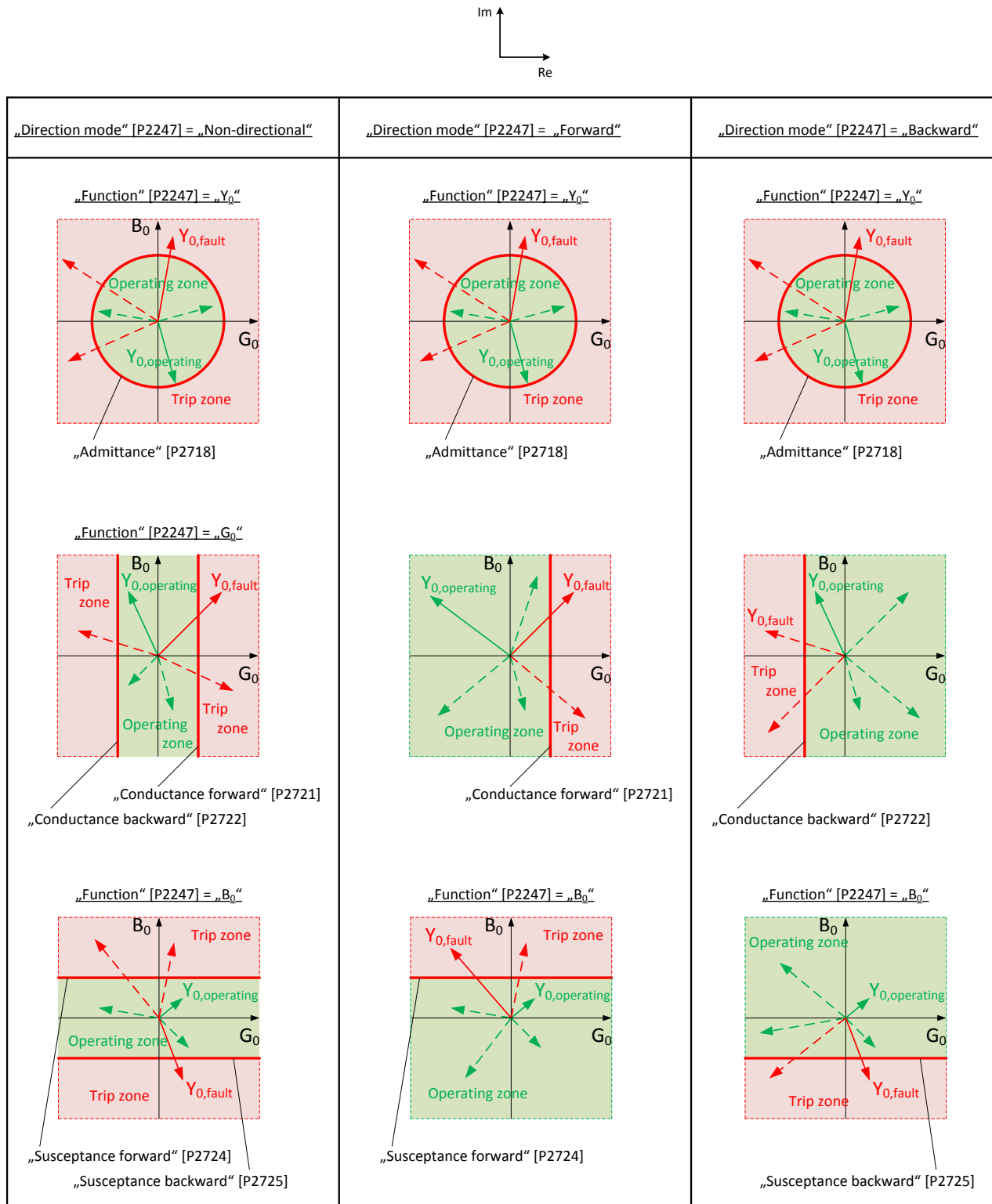


Figure 3-129 Options of direction mode and protective criterion (characteristic quantity)

Pick-up values of different protective criteria

Depending on the selected protective criterion and tripping direction of the first step of YG-Neutral Admittance Earth Fault protection, the following parameters Parameter [P2718], [P2721], [P2722], [P2724] and [P2725] apply to the pick-up value.

P2718 Admittance

Pick-up value of the first YG-Neutral Admittance Earth Fault protection element; at the moment that the characteristic quantity *Neutral-Admittance* $Y_0[mS]$ exceeds this limit, pick-up event "YG-1 pickup" [E2187] will become active, and the trip delay time, set by parameter "Delay time" [P2727], of the first YG-Neutral Admittance Earth Fault protection element will start.

P2721 Conductance forward

Pick-up value of the first YG-Neutral Admittance Earth Fault protection element; at the moment that the characteristic quantity *Neutral-Conductance* $G_0[mS]$ exceeds this limit in forward direction, pick-up event "YG-1 pickup" [E2187] will become active, and the trip delay time, set by parameter "Delay time" [P2727], of the first YG-Neutral Admittance Earth Fault protection element will start.

P2722 Conductance backward

Pick-up value of the first YG-Neutral Admittance Earth Fault protection element; at the moment that the characteristic quantity *Neutral-Conductance* $G_0[mS]$ falls below this limit in backward direction, pick-up event "YG-1 pickup" [E2187] will become active, and the trip delay time, set by parameter "Delay time" [P2727], of the first YG-Neutral Admittance Earth Fault protection element will start.

P2724 Susceptance forward

Pick-up value of the first YG-Neutral Admittance Earth Fault protection element; at the moment that the characteristic quantity *Neutral-Susceptance* $G_0[mS]$ exceeds this limit in forward direction, pick-up event "YG-1 pickup" [E2187] will become active, and the trip delay time, set by parameter "Delay time" [P2727], of the first YG-Neutral Admittance Earth Fault protection element will start.

P2725 Susceptance backward

Pick-up value of the first YG-Neutral Admittance Earth Fault protection element; at the moment that the characteristic quantity *Neutral-Susceptance* $G_0[mS]$ falls below this limit in back direction, pick-up event "YG-1 pickup" [E2187] will become active, and the trip delay time, set by parameter "Delay time" [P2727], of the first YG-Neutral Admittance Earth Fault protection element will start.

P2727 Delay time

Trip delay time; it is the delay time of the trip event "YG-1 trip" [E2188].

As soon as the pick-up event "YG-1 pickup" [E2187] is active and "Delay time" run down, trip event [E2188] will be activated. This event can be used for alarm or output control purposes.

In case that the selected characteristic quantity exceeds the set pick-up value of the first YG-Neutral Admittance Earth Fault protection step before the trip delay time ("Delay time") has run down, the timer of "Delay time" will be stopped, the counter value is being reset and pick-up event "YG-1 pickup" [E2187] is being deactivated.

If the characteristic quantity subsequently exceeds the pick-up value, then, the the pick-up event [E2187] will be activated again and timer "Delay time" will restart.

P2728 Reset delay time

Trip reset delay time; it is the delay time for resetting the trip event "YG-1 trip" [E2188]. If the trip reset delay time ("Reset delay time") has run down, trip event "YG-1 trip" [E2188] is being deactivated. In case that the selected characteristic quantity exceeds the set pick-up value of the first YG-Neutral Admittance Earth Fault protection element

before the timer of “Reset delay time” has run down, the timer of “Reset delay time” will be reset. Then trip event “YG-1 trip” [E2188] remains active.

P2729 Min. start voltage

Minimum limit of the measuring process quantity “residual voltage” to activate YG-Neutral Admittance Earth Fault protection; depending on the selected measuring method set by parameter „PT source“ [P2708], the first protection step of YG-Neutral Admittance Earth Fault protection is blocked as long as the measured process value for building the protective criterion (characteristic quantity, set by parameter „Function“ [P2715]) exceeds this minimum limit. For the duration of blocking event “YG-1 blocked “ [E1056] is activated.

NOTE: The *minimum limit of measuring process quantity “residual voltage”* is to be set as a percentage of the *nominal value* of the process quantity. The nominal value of the process quantity is to be set by parameter:

- “Ground voltage“ [P606], for primary side W1,
- “Ground voltage“ [P616], for primary side W2 or
- “Ground voltage“ [P626], for primary side W3

The referring parameters “Ground voltage“ [P606], “Ground voltage“ [P616] and “Ground voltage“ [P626] are located in submenu: “SYSTEM\Nominals\Reference values”.

P2730 Min. start current

Minimum limit of the measuring process quantity “ground current” to activate YG-Neutral Admittance Earth Fault protection; depending on the selected measuring method set by parameter „CT source“ [P2707], the first protection step of YG-Neutral Admittance Earth Fault protection is blocked as long as the measured process value for building the protective criterion (characteristic quantity, set by parameter „Function“ [P2715]) exceeds this minimum limit. For the duration of blocking event “YG-1 blocked “ [E1056] is activated.

NOTE: The *minimum limit of measuring process quantity “ground current”* is to be set as a percentage of the *nominal value* of the process quantity. The nominal value of the process quantity is to be set by parameter:

- “Ground current “ [P607], for primary side W1,
- “Ground current “ [P617], for primary side W2 or
- “Ground current “ [P627], for primary side W3

The referring parameters “Ground current “ [P607], “Ground current “ [P617] and “Ground current “ [P627] are located in submenu: “SYSTEM\Nominals\Reference values”.

3.6 “ALARMS” (Parameters of Alarm control and LEDs)

3.6.1 “General”

Main Menu\Parameters\ALARMS\				
General				
P/E No.	Name	Value	Unit	(Setting range)
Dead band				
P5950	Stop event history	0	event	0 ... 9999

Figure 3-130 Interrupt of event logging

Parameter description:

P5950 Stop event history

Event logging can be completely *interrupted* (stopped) by any active event. For stopping, the number related to this stop event has to be assigned to parameter [P5950]. Interrupt is only effective, however, as long as the stop event is active. If the stop event turns inactive, interrupting is abandoned and event logging is effective again.

If blocking of *event logging* is not required, set this parameter to “0”.

3.6.2 “Alarm channels”

Alarm message control is available by 449 different and programmable alarm channels with output event numbers [E0001] to [E0449]

Table 3-7 Alarm channels

Main Menu\Parameters\ALARMS\			
Alarm channels (No.1 to No.499)			
Designation of parameter	Setting range	Pre-setting	Unit
“Alarm text”	up to 40 characters	-	char
“Condition”	OFF / LATCHED / UNLATCHED / NO ACK	OFF	(textring)
“1. Trigger”	0 ... 9999	0	(event)
“2. Trigger”	0 ... 9999	0	(event)
“Block”	0 ... 9999	0	(event)
“Delay”	0.0 ... 6500.0	0.0	[sec]
“1. Group”	none / 450 ... 499	none	(textring)
“2. Group”	none / 450 ... 499	none	(textring)
“3. Group”	none / 450 ... 499	none	(textring)
“4. Group”	none / 450 ... 499	none	(textring)
“Option”	none / Printer	none	(textring)
“Beeper”	☐ / ☒	☐	(Auswahlkästchen)
“Trip LED”	☐ / ☒	☐	(Auswahlkästchen)
“Main Alarm LED”	☐ / ☒	☐	(Auswahlkästchen)
“LED”	OFF / Red / Yellow / Green	OFF	(textring)
“Text color”	Black / Red / Yellow/Green / Blink black/ Blink red / Blink yellow / Blink green	Black	(textring)
“Voice announcement”	none / Voice 1 / Voice 2 / Voice 3	none	(textring)
“Engine manual mode”	☐ / ☒	☐	(Auswahlkästchen)
“Engine start next”	☐ / ☒	☐	(Auswahlkästchen)
“Engine stop priority”	none / 1 ... 20	none	(textring)

Parameter description:

P Alarm text

As soon as the alarm is active, this editable alarm text appears on the alarm page.
An alarm text is restricted to 40 characters.

P Condition

At the moment that a trigger event is active the alarm event as well as the display of the alarm text will become active.

Parameter "Condition" provides the following modes for variably dealing with the alarm event and the display of the alarm text after clearance (trigger event = 0):

- "OFF": The alarm channel is disabled.
- "Latched": After clearance (trigger event = 0) the alarm event [E0001] to [E0449] and the display of the alarm text remain active. Only after operating the "ACK" key, the alarm event as well as the display of the alarm text will be deactivated.
- "Unlatched": After clearance (trigger event = 0) the alarm event [E0001] to [E0449] is immediately deactivated; however, the display of the alarm text remains active. Only after operating the "ACK" key, the display of the alarm text will be deactivated.
- "No Ack": After clearance (trigger event = 0), both, the alarm event [E0001] to [E0449] and the display of the alarm text are immediately deactivated.

Table 3-8 Parameter "Condition" – settings and state changes

Parameter		Settings	t_n [trigger event = 1]		t_{n+1} [trigger event = 0]	
			State of alarm event	State of alarm text display	State of alarm event	State of alarm text display
P	"Condition"	"OFF"	0	0	0	0
		"Latched"	1	1	1	1
		"Unlatched"	1	1	0	1
		"No Ack"	1	1	0	0

P 1. Trigger

and

P 2. Trigger

Before alarm channels can be activated by so-called trigger events (OR logic), the parameters "1. Trigger" and "2. Trigger" must be assigned the number of the events intended to signal an alarm.

P Block

The alarm channel is blocked and the alarm causing event ([E0001] to [E0449]) will remain inactive even if the trigger event is active.

P Delay

Activation of alarm channel can be delayed by the time set here.

P 1. Group

to

P 4. Group

Up to four alarm groups can be assigned to each alarm channel. Creation of up to 50 alarm groups (450 to 499) is available. Such alarm group event is activated as soon as one alarm channel of this group is active.

P Option

- “none”: no measure taken
- “Printer”: alarm sent to printer (if available).

P Beeper

Select to activate the audible alarm signal (beeper).

P Trip LED

Select to activate the graphic trip LED in the status line of the LCD.

P Main Alarm LED

Select to activate the graphic main alarm LED in the status line of the LCD.

P LED

Select this parameter to activate the individual graphic LEDs in the alarm text on the alarm page. Available colors: red, yellow and green.

P Text color

Available colors for static display: black, red yellow and green.

Available colors for blinking effect on display: black, red yellow and green

P Voice announcement

Select this parameter to activate an audible signal via integrated loudspeaker.

Priority settings allow attributing the alarm channels additional operations such as “change to manual mode”, “Start next diesel” or “Stop own unit” which will be activated as soon as the related alarm occurs.

NOTE: The following parameters are available only for devices with active **Power Management** function.

(P Engine manual mode)

“Change to manual mode”; select to activate the switch for manual mode as the alarm appears.

(P Engine start next)

“Start next diesel”; select to activate start for the next standby engine as the alarm appears.

(P Engine stop priority)

“Stop own unit”; this parameter allows initiating operations such as “immediate stop” or “standard stop” of engine as the alarm appears.

3.6.3 “LEDs” (Hardware)

Main Menu\Parameters\ALARMS\					
LEDs					
SET 1	SET 2	SET 3	SET 4		
P/E No.	Name	Value	Unit	(Setting range)	
LED 1					
-	Event number	0	event	0 ... 9999	
-	Status	OFF	-	Slow blink/Fast blink/Const on	
-	Color	red	-	red/green/yellow	
LED 2					
-	Event number	0	event	0 ... 9999	
-	Status	OFF	-	Slow blink/Fast blink/Const on	
-	Color	red	-	red/green/yellow	
LED 3					
-	Event number	0	event	0 ... 9999	
-	Status	OFF	-	Slow blink/Fast blink/Const on	
-	Color	red	-	red/green/yellow	
LED 4					
-	Event number	0	event	0 ... 9999	
-	Status	OFF	-	Slow blink/Fast blink/Const on	
-	Color	red	-	red/green/yellow	
LED 4					
-	Event number	0	event	0 ... 9999	
-	Status	OFF	-	Slow blink/Fast blink/Const on	
-	Color	red	-	red/green/yellow	
LED 6					
-	Event number	0	event	0 ... 9999	
-	Status	OFF	-	Slow blink/Fast blink/Const on	
-	Color	red	-	red/green/yellow	
LED 7					
-	Event number	0	event	0 ... 9999	
-	Status	OFF	-	Slow blink/Fast blink/Const on	
-	Color	red	-	red/green/yellow	
LED 8					
-	Event number	0	event	0 ... 9999	
-	Status	OFF	-	Slow blink/Fast blink/Const on	
-	Color	red	-	red/green/yellow	

Figure 3-131 LED configuration

Parameter description:

The following parameter descriptions refer to all LED parameters of one parameter set.

NOTE: Each of the four parameter sets as well as each of the eight LEDs always provides the same group of parameters. Hence, the LED parameter descriptions of the LED 1 represented below are described in the following in detail as examples.

LED parameters of parameter SET 1 – LED 1

P Event number

The LED indication can be activated by any active event. For activation, the number related to this event has to be assigned to parameter “Event number”. Activation is only effective, however, as long as the assigned event is active. If the event turns inactive, the LED turns off.

If LED activation is not required, set this parameter to “0”.

P Status (=> „LED mode“)

Illumination mode for LED; as soon as the event which is assigned to parameter “Event number” is activated, illumination of the LED is according to the following setting options:

- “OFF”: LED in disabled
- “Slow blink”: LED is flashing slowly: x-times per second
- “Fast blink”: LED is flashing quickly: x-times per second
- “Const on”: LED illuminates continuously

P Color

LED color during activation; as soon as the event which is assigned to parameter “Event number” is activated, the LED is illuminated either:

- “red” or
- “green” or
- “yellow” .

3.7 “I/O” (Parameters of binary/virtual inputs and outputs)

The “I/O PARAMETER” menu provides submenus for setting of the SYMAP®-Compact(+) binary inputs and outputs.

3.7.1 “General”(Settings of voltage range for binary inputs)

Main Menu\Parameters\I/O\				
General				
P/ENo.	Name	Value	Unit	(Setting range)
P4000	Binary inputs voltage range	10 – 75	V	10 – 75 / 75 – 230

Figure 3-132 Parameters – Voltage range of binary inputs

Parameter description

P4000 Binary input voltage range

This parameter allows adapting the binary inputs to the nominal voltage used. Two ranges are available for operating the binary inputs:

- “10 – 75V”: working range of rated voltages (AC/DC)
- “75 – 230V”: working range of rated voltages (AC/DC)

NOTE: The selected setting applies for all binary inputs.

3.7.2 “Binary inputs”

Main Menu\Parameters\I/O\											
Binary inputs											
No.	Input Event	Norm. Clsd.	Pre. Event	Inv. Event	Wire fault	Short circuit	Filter Ev.	ON delay (0 ... 6500 s)	OFF delay (0 ... 6500 s)	WF Lim. (0 ... 255s)	SC Lim. (0 ... 255s)
10	4010	☐	☐ 4110	☐ 4210	☐ 4310	☐ 4410	☐	0,1	0,0	20	240
11	4011	☐	☐ 4111	☐ 4211	☐ 4311	☐ 4411	☐	0,1	0,0	20	240
12	4012	☐	☐ 4112	☐ 4212	☐ 4312	☐ 4412	☐	0,1	0,0	20	240
13	4013	☐	☐ 4113	☐ 4213	☐ 4313	☐ 4413	☐	0,1	0,0	20	240
14	4014	☐	☐ 4114	☐ 4214	☐ 4314	☐ 4414	☐	0,1	0,0	20	240
15	4015	☐	☐ 4115	☐ 4215	☐ 4315	☐ 4415	☐	0,1	0,0	20	240
16	4016	☐	☐ 4116	☐ 4216	☐ 4316	☐ 4416	☐	0,1	0,0	20	240
17	4017	☐	☐ 4117	☐ 4217	☐ 4317	☐ 4417	☐	0,1	0,0	20	240
18	4018	☐	☐ 4118	☐ 4218	☐ 4318	☐ 4418	☐	0,1	0,0	20	240
19	4019	☐	☐ 4119	☐ 4219	☐ 4319	☐ 4419	☐	0,1	0,0	20	240
20	4020	☐	☐ 4120	☐ 4220	☐ 4320	☐ 4420	☐	0,1	0,0	20	240
21	4021	☐	☐ 4121	☐ 4221	☐ 4321	☐ 4421	☐	0,1	0,0	20	240
22	4022	☐	☐ 4122	☐ 4222	☐ 4322	☐ 4422	☐	0,1	0,0	20	240
23	4023	☐	☐ 4123	☐ 4223	☐ 4323	☐ 4423	☐	0,1	0,0	20	240
24	4024	☐	☐ 4124	☐ 4224	☐ 4324	☐ 4424	☐	0,1	0,0	20	240
25	4025	☐	☐ 4125	☐ 4225	☐ 4325	☐ 4425	☐	0,1	0,0	20	240
26	4026	☐	☐ 4126	☐ 4226	☐ 4326	☐ 4426	☐	0,1	0,0	20	240
27	4027	☐	☐ 4127	☐ 4227	☐ 4327	☐ 4427	☐	0,1	0,0	20	240
28	4028	☐	☐ 4128	☐ 4228	☐ 4328	☐ 4428	☐	0,1	0,0	20	240

Figure 3-133 Parameters and Events – Binary inputs

Event and Parameter description

No.

Function number of the binary Input

E Input Event

Input-Event of the binary input; the *input event* is immediately active/deactive after the binary input has been activated/deactivated with regard to any *delay time settings* (parameter “ON delay” and/or “OFF delay”).

Each input is assigned its own *input event*; see event numbers [E4010] to [E4028].

P Norm. Clsd.

Power to unlock principle („normally closed“) of the binary input; this parameter activates/deactivates the working principle „*power to unlock principle*“ of the binary input:

- ☐: do not tick the box => working principle accords to „*power to lock principle*“ („normally open“)
- ☒: do tick the box => working principle of the binary input accords to „*power to unlock principle*“ („normally closed“)

The „*power to unlock principle („normally closed“)*“ can be activated/deactivated individually for all binary inputs.

P Pre. event

Additional pre-delay event of the binary input; if selected (parameter setting by tick box), the binary input is attributed an *additional pre-delay event* [E41xx]. Independent of the settings of parameters: “ON delay” or “OFF delay”, the *additional pre-delay event* is

immediately active/deactive after the binary input has been activated/deactivated at its terminals.

To make the *additional pre-delay event* available, please tick the box in the array of the inverted event „*Pre. Event*“ [E41xx]:

- „☐ 41xx“: *do not tick the box => the additional pre-delay event of the binary input is not available*
- „☒ 41xx“: *do tick the box => the additional pre-delay event of the binary input is available*

Each input is assigned its own *additional pre-delay event*; see event numbers [E4110] to [E4128].

P Inv. event

Additional inverted event; if selected (parameter setting by tick box), the binary input is attributed an *additional inverted event* [E42xx]. The state of the *additional inverted event* is always equal to the inverted state of the *pre-delay event* [E41xx]. The *additional inverted event* is immediately activated/deactivated after the *pre-delayed event* has been deactivated/activated.

To make the *additional inverted event* available, please tick the box in the array of the inverted event „*Inv. Event*“ [E42xx]:

- „☐ 42xx“: *do not tick the box => the additional inverted event of the binary input is not available*
- „☒ 42xx“: *do tick the box => the additional inverted event of the binary input is available*

Each input is assigned its own *additional inverted event*; see event numbers [E4210] to [E4228].

P Wirefault

Wirefault supervision of the binary input; if selected (parameter setting by tick box), the external circuit of the binary input (connected pilot wire of the external switching contact) can be monitored with regard to a broken wiring. For this, an ohmic resistance ($R = 10k\Omega$) must be connected in parallel to the external switching contact.

To activate/deactivate the *wirefault supervision* of a binary input, please use the tick box in the array of the wirefault supervision events „*Wirefault*“ [E43xx]:

- „☐ 43xx“: *do not tick the box => the wirefault supervision of the binary input is not available*
- „☒ 43xx“: *do tick the box => the wirefault supervision of the binary input is available*

Each binary input is assigned its own *wirefault supervision event*; see event numbers [E4310] to [E4328].

NOTE: The general *wirefault monitoring event* [E4300] is active if one of the individual wirefault monitoring events is active. Such events may be used for triggering the alarms.

P Short circuit

Short circuit supervision of the binary input; if selected (parameter setting by tick box), the external circuit of the binary input (connected pilot wire of the external switching contact) can be monitored with regard to a short-circuited wiring.

To activate/deactivate the *short circuit supervision* of a binary input, please use the tick box in the array of the short circuit supervision events „*Short circuit*“ [E44xx]:

- „☐ 44xx“: *do not tick the box => the short circuit supervision of the binary input is not available*

- „☒ 44xx“: *do tick the box => the short circuit supervision of the binary input is available*

Each binary input is assigned its own *short circuit supervision event*; see event numbers [E4410] to [E4428]).

NOTE: The general *short circuit supervision event* [E4400] is active if one of the individual short circuit supervision events is active. Such events may be used for triggering the alarms.

P Filter event history

Filter function for processing or not processing of all available input events of the binary input in the event history; if selected (parameter setting by tick box), the input event [E40xx], the additional pre-delay event [E41xx] and the additional inverted event [E42xx] are being registered in the event history.

To activate/deactivate the *filter function* of a binary input, please use the tick box in the array of „*Filter Ev.*“:

- „☐“: *do not tick the box => the filter function of the binary input is not available*
- „☒“: *do tick the box => the filter function of the binary input is available*

The filter function „*Filter event history*“ can be activated/deactivated individually for all binary inputs.

P ON delay

Switch-on delay time of the binary input; if the binary input is activated at its terminals and the delay time, set by parameter “On delay”, run down, event [E40xx] is activated.

P OFF delay

Switch-off delay time of the binary input; if the binary input is deactivated at its terminals and the delay time, set by parameter “OFF delay”, run down, event [E40xx] is deactivated.

P WF Lim.

Minimum limit value for triggering the wirefault supervision event; if input signal of the functional input falls below this value, the related wirefault event „Wirefault“ [E43xx] is activated.

Default setting: 20 LSB

P SC Lim.

Maximum limit value for triggering the short-circuit supervision event; if input signal of the functional input exceeds this value, the related short-circuit event „Short circuit“ [E44xx] is activated.

Default setting: 240 LSB

3.7.3 “Binary outputs”



Figure 3-134 Binary outputs

Depending on the device variant SYMAP[®]-Compact(+) provides the following binary outputs:

Table 3-9 Binary outputs

Binary Output	Event-No.	additional pre-delay event	SYMAP-Compact F0 – F4	SYMAP-Compact EC0 – EC3	SYMAP-Compact+ F1 – F4 / EC4
Shunt Trip 1	4500	-	☒	☒	☒
Shunt Trip 2	4501	-	☒	☒	☒
Lockout-Relais	4502	4503	☒	☒	☒
Synchron ON	4504	4505	☒	☒	☒
Funktion 1	4506	4507	☒	☒	☒
Funktion 2	4508	4509	☒	☒	☒
Funktion 3	4510	4511	☒	☒	☒
Funktion 4	4512	4513	☒	☒	☒
Funktion 5	4514	4515	☒	☒	☒
Funktion 6	4516	4517	☒	☒	☒
Funktion 7	4518	4519	☒	☒	☒
Funktion 8	4520	4521	☒	☒	☒

☒: Standard

☒: Ordering option

3.7.3.1 “Shunt Trips” (Relay outputs)

By using selection button “*Selection*” the first relay output “*Shunt Trip 1*” can be invoked. It carries the event-number [E4500].

Shunt Trip 1

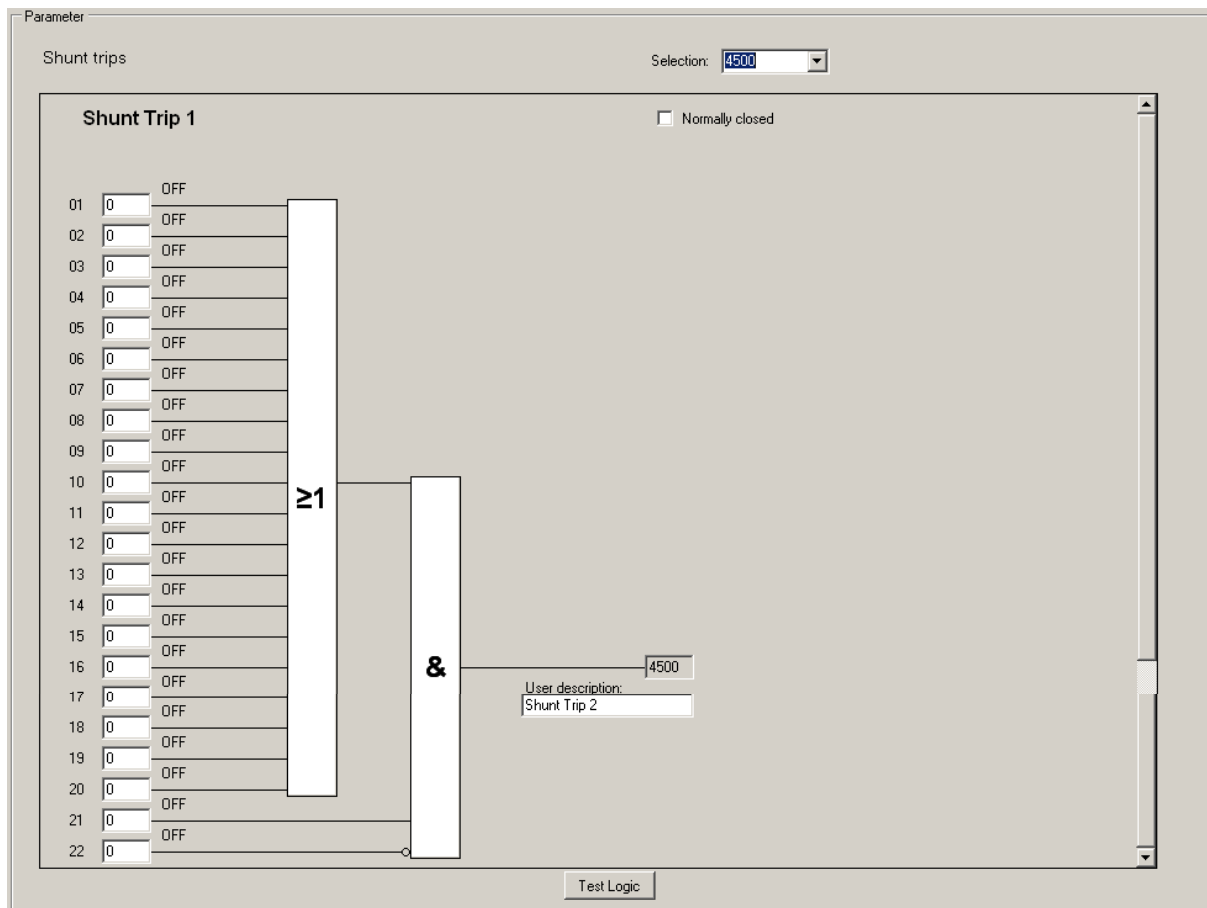


Figure 3-135 Shunt Trip 1

Parameter description:

Normally closed

Power to unlock principle („normally closed“) of the binary output; this parameter activates/deactivates the working principle „power to unlock principle“ of the binary output:

- ☐: do not tick the box => working principle of the binary output accords to „power to lock principle“ („normally open“)
- ☒: do tick the box => working principle of the binary output accords to „power to unlock principle“ („normally closed“)

NOTE: Power to unlock principle („normally closed“) is only available when selection button „Output function“ = “OFF”. The „power to unlock principle („normally closed“) can be activated/deactivated individually for all binary outputs.

01

to

22

Input elements of the logic scheme of the binary output; these parameters represent the input elements for the (positive) logic control of output “Shunt Trp 1”. Each available

event can be used as an input element; therefore the event-number has to be registered in the array besides the number of the input element.

NOTE: Setting „0“ means logical „0“ (positive logic: „untrue“)
Setting „9999“ means logical „1“ (positive logic: „true“)

By using selection button *“Selection”* the second relay output *“Shunt Trip 2”* can be invoked. It carries the event-number [E4501].

“Shunt Trip 2”

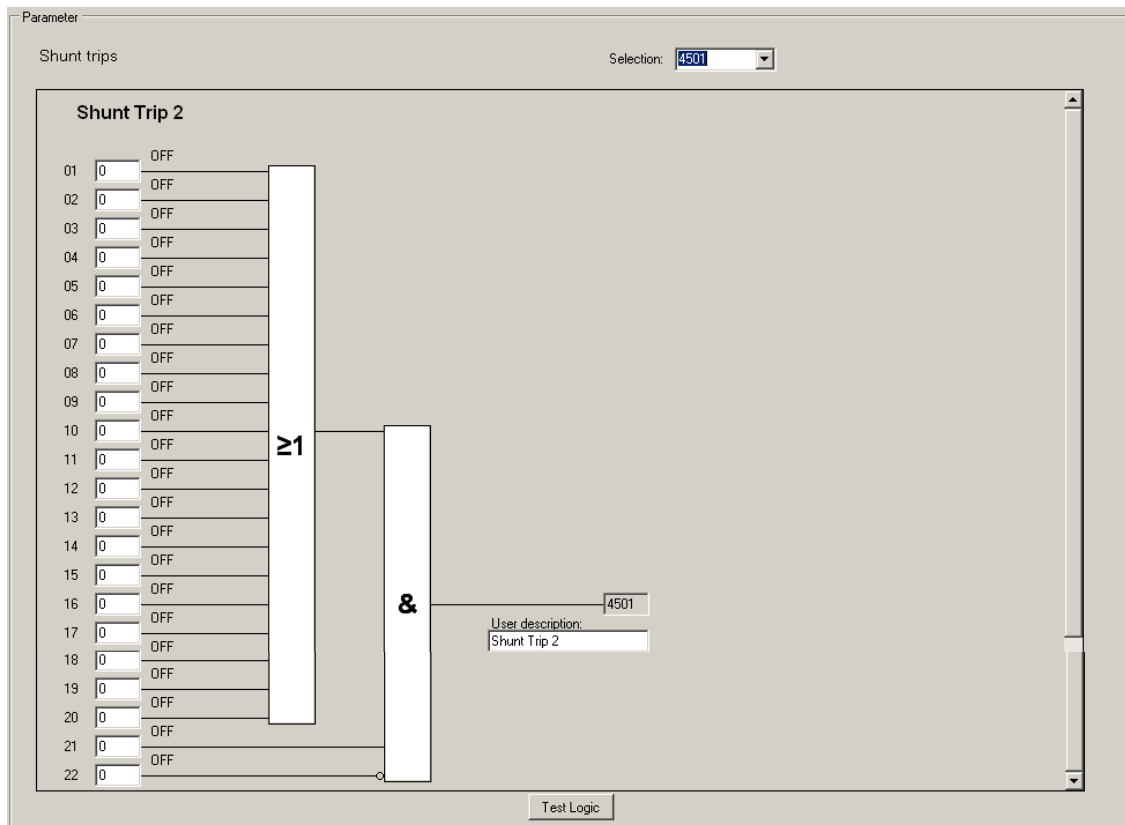


Figure 3-136 Shunt Trip 2

Parameter description:

Parameter description of binary output „Shunt Trip 2“ is equal to the binary output of the “Shunt Trip 1”.

3.7.3.2 “Lockout Relay” (Relay output)

Lockout Relay exists only once, and carries event-number [E4502].

Figure 3-137 Lockout relay

Parameter description:

Normally closed

Power to unlock principle („normally closed“) of the binary output; this parameter activates/deactivates the working principle „power to unlock principle“ of the binary output:

- “☐”: do not tick the box => working principle of the binary output accords to „power to lock principle“ („normally open“)
- “☒”: do tick the box => working principle of the binary output accords to „power to unlock principle“ („normally closed“)

NOTE: Power to unlock principle („normally closed“) is only available when selection button „Output function“ = “OFF”. The „power to unlock principle („normally closed“) can be activated/deactivated individually for all binary outputs.

Additional pre-delay event

Additional pre-delay event of the binary output; if selected (parameter setting by tick box), the binary output is attributed an *additional pre-delay event* [E4503]. Independent of the settings of parameters “Output ON delay” or “Output OFF delay”, the *additional pre-delay event* is immediately activated/deactivated after the binary output has been activated/deactivated.

To make the *additional pre-delay event* available, please tick the box besides parameter „Additional pre-delay event“ [E4503]:

- “☐”: do not tick the box => the *additional pre-delay event* of the binary input is not available

- ☒: *do tick the box =>* the additional pre-delay event of the binary input is available

NOTE: The inverted event is available only if “Output function” parameter is set to “OFF”.

Filter event history

Filter function for processing or not processing of all available output events of the binary output in the *event history*; if selected (parameter setting by tick box), the *output event* [E4502] and the “Additional pre-delay event” [E4503] are not being registered in the event history.

To activate/deactivate the *filter function* of a binary output, please use the tick box besides parameter „Filter event history“:

- ☐: *do not tick the box =>* the *filter function* of the binary output is not available
- ☒: *do tick the box =>* the *filter function* of the binary output is available

Output function

Definition of switch behavior of the binary output; in view of the temporal scale the switch behaviour of the relay contacts after or during activation of the binary output can be defined by the following setting options of parameter “Output function”:

- “PULSER”: This function generates pulses with the “ON” delay and the „OFF“ delay.
- “MONOFLOP-C”: This function generates a constant pulse (permanent = “ON“ delay).
- “MONOFLOP-I”: This function generates a pulse (permanent = “ON“ delay). Pulse is interrupted if logic turns false during “ON“ delay.

Output ON delay

Switch-on delay time of the binary output; if the binary output is activated and the delay time, set by parameter “Output On delay”, run down, event [E4502] is activated.
Setting range: 0 ... 6500 s.

Output OFF delay

Switch-off delay time of the binary output; if the binary output is deactivated and the delay time, set by parameter “Output OFF delay”, run down, event [E4502] is deactivated.
Setting range: 0 ... 6500 s.

01

to

22

Input elements of the logic scheme of the binary output; these parameters represent the input elements for the (positive) logic control of output “Lockout Relay”. Each available event can be used as an input element; therefore the event-number has to be registered in the array besides the number of the input element.

NOTE: Setting „0“ means logical „0“ (positive logic: „untrue“)
Setting „9999“ means logical „1“ (positive logic: „true“)

3.7.3.3 “Synchron ON” (Relay output)

Synchron ON Relay exists only once, and carries event-number [E4504].

NOTE: Binary output “Synchron ON” is foreseen for function “ANSI 25 – Synchronising”. Alternatively, binary output “Synchron ON” can be used as a binary output such as “Function 1” or others.

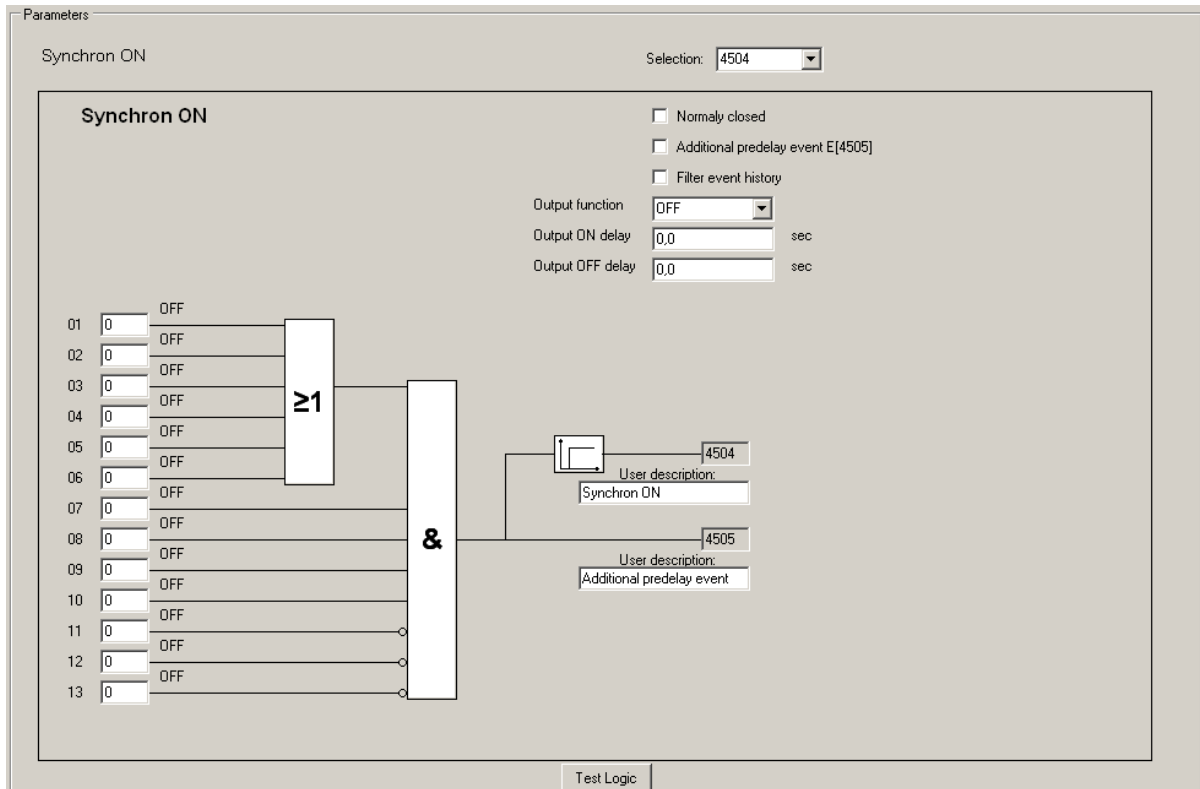


Figure 3-138 Synchron ON

Parameter description:

Parameter description of binary output „Synchron ON“ is equal to the binary output of the “Lockout Relay”.

3.7.3.4 “Function outputs” (Relay outputs)

In dependence of the device variant SYMAP®-Compact(+) provides several relay outputs (“Function 1” to “Function 8”). By using selection button “Selection” each relay output can be invoked individually.

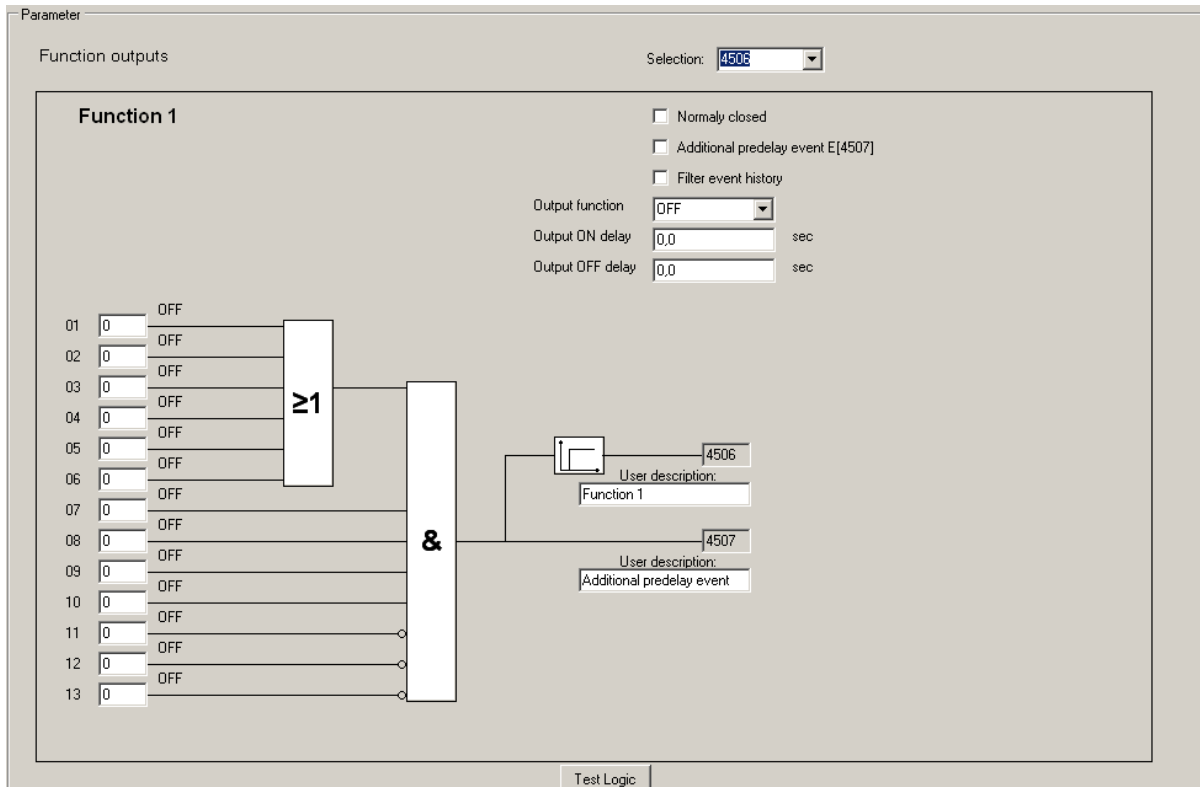


Figure 3-139 Function output 1

Parameter description:

Parameter description of binary outputs „Function 1“ to „Function 8“ is equal to the binary output of the “Lockout Relay”.

3.7.4 “Virtual I/O“ (IEC 61850)

IEC 61850 subscribers

Main Menu\ Parameters\I/O\ Virtual I/O\				
IEC 61850 subscribers				
P/E No.	Name	Value	Unit	(Setting range)
Subscribers				
P92549	Number of active subscribers	0	-	0 ... 128
Internal subscriber ID 1				
P92550	Multicast MAC address 01-0C-CD-01-	00-01	-	00-01 ... 99-99
P92551	Application ID	1	-	0 ... 65535
E9640	Subscriber in TEST mode	-	-	-
Internal subscriber ID 2				
P92549	Number of active subscribers	0	-	0 ... 128
...	...	...	..	...

Figure 3-140 IEC 61850 – “Subscribers”

Parameter description:

Subscribers

P52549 Number of active subscribers

Defines the numbers of the active, internal Subscribers Id. The maximum number is 128. If the user choose example the number 10 it will check only the first 10 in the table of the Internal Subscribers ID or to be precise the Internal Subscriber ID 1 to Internal Subscriber ID 10. If the user has set the Internal Subscriber 11 or some other after it will not check those conditions.

Internal subscriber ID 1

There are 128 Subscribers. Each Subscribers has his own definition. The definitions are divided in groups with name Internal Subscriber ID “some Number from 1 to 128”

P52550 Multicast MAC address 01-0C-CD-01-

Define the Multicast address of the subscribers. The first part is fix and it is in according of the IEC61850 standard “01-0C-CD-01”. The second part is changeable.

P52551 Application ID

This parameter defines the “Application ID” of the subscribers. The setting range is from 0 - 65535

NOTE: The combination of “Multicast MAC address” and “Application ID” must be unique in the “Internal subscriber ID table”. This combination defines the Publisher.

IEC 61850 inputs mapping

Main Menu\Parameters\I/O\ Virtual I/O\				
IEC 61850 inputs mapping				
P/E No.	Name	Value	Unit	(Setting range)
GGIO7\$ST\$Ind1 - trigger setting				
P92900	Internal subscriber ID	OFF	-	OFF/1 ... 128
P92901	Dataset position ID – StVal	OFF	-	OFF/1 ... 128
P92902	Dataset position ID – Q	OFF	-	OFF/1 ... 128
E9200	GOOSE input event 1 (stVal)	-	-	-
E9330	GOOSE input event 1 (q)	-	-	-
GGIO7\$ST\$Ind2 - trigger setting				
P92903	Internal subscriber ID	OFF	-	OFF/1 ... 128
...	...	...	..	...

Figure 3-141 IEC 61850 – “Inputs mapping”

Parameter description:

GGIO7\$ST\$Ind1 - trigger setting

GGIO7\$ST\$Ind1 - trigger setting defines the Logical node GOOSE input.

GGIO7\$ST\$Ind1- trigger setting to GGIO7\$ST\$Ind128- trigger setting defines the Ind1 to Ind 128 in logical node GGIO7.

Each trigger setting provides the following parameters and events:

P92900 Internal subscriber ID

If it is OFF it means this trigger is not in use.

Number defines what Internal Subscriber ID is used for this trigger. This is the table were are defined Internal Subscriber ID 1 to 128 with MAC address and Application ID in each.

P92901 Dataset position ID – StVal

Defines the position of the Data Ind”Number 1-128”StVal in dataset

It is possible to define 128 virtual inputs. Inputs are mapped with GIO7\$ST\$Ind1 to GIO7\$ST\$Ind128.

P92902 Dataset position ID – Q

This parameter defines the Data Quality and his position in Dataset. If the Data IndStVal is send without quality this parameter will be set to none. If the data StVal is sent with Quality this parameters will have number StVal position +1

Event description:

P9200 GOOSE input event 1 (stVal)

This Event is active when the Data Parameter “Dataset position Ind – StVal” has changed his status.

This Event can be used after in any part of the PLC, Alarms, Outputs...

“n=1...128”

P9330 GOOSE input event 1 (q)

This Event is active when the Parameter “Dataset position Ind - Q” has changed his status. If the quality is good this parameter will not be active. If the quality is Bad the

user should use this Event for defining the behavior of the Event "GOOSE Input Event "n" (stVal)" where n=1,2...128, example for blocking the Event "GOOSE Input Event "n" (stVal)" or Alarm,...

IEC 61850 outputs mapping

It is possible to define 128 virtual free programmable outputs.

GGIO6\$ST\$Ind"some number between 1 and 128"- trigger setting

GGIO6 defines the Logical node GOOSE input

GGIO6\$ST\$Ind1- trigger setting to GGIO6\$ST\$Ind128- trigger setting defines the Ind1 to Ind 128 in logical node GGIO6 in IEC61850

Main Menu\ Parameters\I/O\ Virtual I/O\				
IEC 61850 outputs mapping				
P/E No.	Name	Value	Unit	(Setting range)
GOOSE Output GGIO6\$ST\$Ind1 - trigger setting				
P92900	Trigger event	0	-	0 ... 9999
E9800	GOOSE Output Event 1	-	-	-
GOOSE Output GGIO6\$ST\$Ind2 - trigger setting				
P93301	Trigger event	0	-	0 ... 9999
...	...	...	..	...

Figure 3-142 IEC 61850 – "Outputs mapping"

Parameter description:

GOOSE Output GGIO6\$ST\$Ind1 - trigger setting

P92900 Trigger event

Defines the Event what will activate the Event "GOOSE Output Event "n"; whereby n is the number between 1 and 128. This can be any Event in the Device example Tripp event, binary input event, alarm,...

Event description:

E9800 GOOSE Output Event 1

This Event is active when the Parameter "Dataset position Ind - Q" has changed his status. If the quality is good this parameter will not be active. If the quality is Bad the user should use this Event for defining the behavior of the Event "GOOSE Input Event "n" (stVal)"; whereby n=1,2...128, example for blocking the Event "GOOSE Input Event "n" (stVal)" or Alarm,...

3.8 “BREAKER CONTROL”

A „switching operation“ of function “Breaker control” is defined as a given *control command* to a switching element which provides electrical drives for opening and closing its primary contacts (e.g. circuit breaker, disconnecter, load break switch, earthing switch, etc.). A given control command is for both, switching on and switching off the switching element.

CAUTION: Switching operations of function “Breaker control” are being conducted only under faultfree operation conditions of the switchgear. Any disconnecting due to a faulty condition is being conducted by protection tripping, which is treated separately. Disconnection of a faulty part of the electrical power system is always of higher priority than any switching operation under faultfree operation conditions.

Switching operations can be launched either locally (directly in front of the cubicle), or remotely (by SCADA or any other automation system). For reasons of personal and system protection the possibility of local and remote operation in parallel is not permitted. This requires an adjustment capability of the protection and control system SYMAP®-Compact(+) to differentiate clearly the local operation mode from the remote operation mode referring to switching operations.

Moreover, switching operations in electrical power systems underly certain authorisation, which are being defined and given by the system operator.

Hence, switching operations triggered via the protection and control system SYMAP®-Compact(+) require several, different “user levels”. Entering a certain user level can be done either by:

- hardware-coded password (such as key switches or different USB sticks) or by
- software-coded password via touchscreen (see chapter “User levels”)

of SYMAP®-Compact (+).

In order to meet the requirements mentioned above, SYMAP®-Compact (+) provides different functions ensuring the unambiguous allocation of password-protected user level and local or remote operation for function “Breaker control”.

Configuration of functional keys for switching “ON/OFF” in case of local control

Local control can be conducted either by the configurable function keys at the front plate of SYMAP®-Compact (+); see chapter “Parameter/SYSTEM/Graphic/**Button configuration**”: Parameter [P60010] to [P60015]).

Function „Emergency-OFF“

This function is required to switch off the circuit breaker locally as quick as possible, in case of a hazardous situation. The local switch-off of the circuit breaker must occur independent of the set mode for local or remote control, and independent of any active interlocking condition for the breaker.

For this, two of the function keys of SYMAP®-Compact (+) can be configured in a manner, that the circuit breaker will open when function keys are being operated simultaneously. There are two setting options for the function keys available: „Emergency 1“ and „Emergency 2“ (see menu: „Parameter/SYSTEM/Graphic/**Button configuration**”: Parameter [P60010] to [P60015]).

Configuration of "Breaker control"

For function "Breaker control" following sub.menus are available:



Figure 3-143 Menu "Breaker Control"

3.8.1 “General”

Main Menu\Parameters\BREAKER CONTROL\								
General								
Parameter	Breaker 1	Breaker 2	Breaker 3	Breaker 4	Breaker 5	Breaker 6	Breaker 7	Breaker 8
Breaker locked	0...9999	0...9999	0...9999	0...9999	0...9999	0...9999	0...9999	0...9999
Block/Cancel control	0...9999	0...9999	0...9999	0...9999	0...9999	0...9999	0...9999	0...9999

Figure 3-144 Breaker control – General parameters [P] for blocking functions

Parameter description:

“General”

The following parameters apply for all of the 8 switching elements separately.

P Breaker locked

Blocking of switching element selection for control via touchscreen; switching element selection can be blocked by any active event. For blocking, the number related to this event has to be assigned to parameter “Breaker locked” [P]. Blocking is only effective, however, as long as the assigned event is active. If the event turns inactive, blocking of switching element selection is abandoned.

If blocking of switching element selection is not required, set this parameter to “0”.

P Block/Cancel control

Blocking of switchgear control or interrupt of switching operation of the selected switching element; control or interrupt of a switching operation can be blocked by any active event. For blocking, the number related to this event has to be assigned to parameter “Block/cancel” [P]. Blocking is only effective, however, as long as the assigned event is active. If the event turns inactive, blocking/interrupt is abandoned.

If blocking of switching element selection is not required, set this parameter to “0”.

3.8.2 “Feedback Parameter”

The graphic display of the SYMAP®-Compact(+) shows the individual single line diagram of switch panel configuration. The actual displayed symbols of the switching elements correspond to the current position.

For instance, the position of a circuit breaker (CB) is acquired via two separate signal lines captured by the auxiliary contacts of the CB. They are connected each to a binary input of the SYMAP®-Compact(+). An auxiliary contact (normally open) signals ON position of the CB while the second (normally closed) signals OFF position.

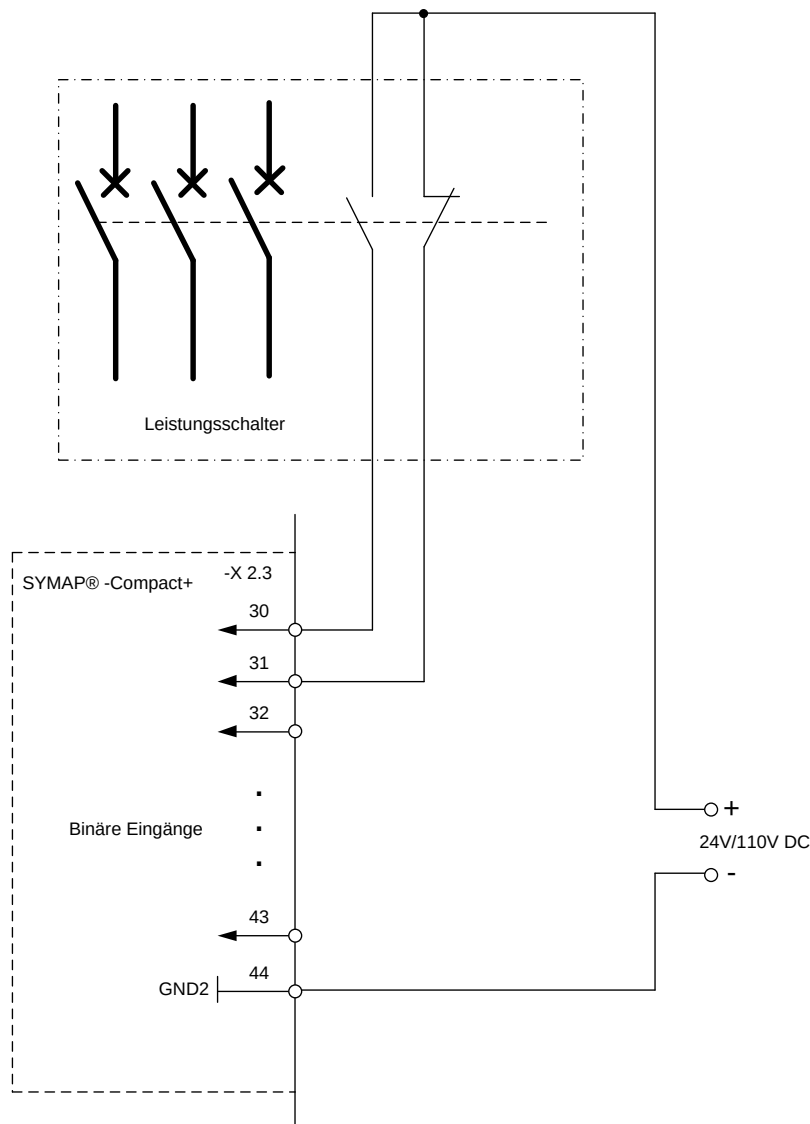


Figure 3-145 Acquisition of CB positions

Apart from the “ON”/“OFF” position, the breaker positions “DIFF” and “FAIL” may also be acquired and signaled with these two signals.

Table 3-10 CB positions

Return signal 1 (NO)	Return signal 2 (NC)	Position indication of switching element
0	1	“OFF”
1	0	“ON”
“0	0	“DIFF (Moving)”
1	1	“FAIL”

Main Menu\Parameters\BREAKER CONTROL\								
Feedback Parameter								
Parameter	Breaker 1	Breaker 2	Breaker 3	Breaker 4	Breaker 5	Breaker 6	Breaker 7	Breaker 8
Feedback/General Parameters								
ON-Feedback	0...9999	0...9999	0...9999	0...9999	0...9999	0...9999	0...9999	0...9999
OFF-Feedback	0...9999	0...9999	0...9999	0...9999	0...9999	0...9999	0...9999	0...9999
OUT-Feedback	0...9999	0...9999	0...9999	0...9999	0...9999	0...9999	0...9999	0...9999
IN-Feedback	0...9999	0...9999	0...9999	0...9999	0...9999	0...9999	0...9999	0...9999
EARTH ON-Feedback	0...9999	0...9999	0...9999	0...9999	0...9999	0...9999	0...9999	0...9999
EARTH OFF-Feedback	0...9999	0...9999	0...9999	0...9999	0...9999	0...9999	0...9999	0...9999
Blink by event	0...9999	0...9999	0...9999	0...9999	0...9999	0...9999	0...9999	0...9999
Invisible by event	0...9999	0...9999	0...9999	0...9999	0...9999	0...9999	0...9999	0...9999
Check OPEN ERROR	☐ /✓	☐ /✓	☐ /✓	☐ /✓	☐ /✓	☐ /✓	☐ /✓	☐ /✓
Feedback Event Numbers								
ON-Feedback	6010	6020	6030	6040	6050	6060	6070	6080
OFF-Feedback	6011	6021	6031	6041	6051	6061	6071	6081
OUT-Feedback	6012	6022	6032	6042	6052	6062	6072	6082
IN-Feedback	6013	6023	6033	6043	6053	6063	6073	6083
EARTH ON-Feedback	6014	6024	6034	6044	6054	6064	6074	6084
EARTH OFF-Feedback	6015	6025	6035	6045	6055	6065	6075	6085
Position Event Numbers								
OPEN	6110	6120	6130	6140	6150	6161	6170	6180
CLOSED	6111	6121	6131	6141	6151	6161	6171	6181
OUT OPEN	6112	6122	6132	6142	6152	6162	6172	6182
OUT CLOSED	6113	6123	6133	6143	6153	6163	6173	6183
EARTH	6114	6124	6134	6144	6154	6164	6174	6174
DIFF (Moving)	6115	6125	6135	6145	6155	6165	6175	6185
FAIL	6116	6126	6136	6146	6156	6166	6176	6186
OPEN ERROR	6117	6127	6137	6147	6157	6167	6177	6187

Figure 3-146 Feedback/General Parameter – feedback signals (e.g. by binary inputs)

Parameter description:

Feedback parameter

“Feedback/General parameter”

The following parameters are individually available for all 8 switching elements.

P ON – Feedback

Parameter for feedback signal for ON position; to determine the feedback signal for ON position of a switching element the event number of the applied signal is to be set to parameter “ON-Feedback” [P]. Usually, an auxiliary contact (NO) of the switching element is to be connected to a binary input of the SYMAP®-Compact(+). In that case the event number of the binary input is to be used for parameter setting.

P OFF – Feedback

Parameter for feedback signal for OFF position; to determine the feedback signal for OFF position of a switching element the event number of the applied signal is to be set to parameter “OFF-Feedback” [P]. Usually, an auxiliary contact (NC) of the switching element is to be connected to a binary input of the SYMAP®-Compact(+). In that case the event number of the binary input is to be used for parameter setting.

P OUT – Feedback

Parameter for feedback signal for OFF position of a 3-position-switch; to determine the feedback signal for OFF position of a 3-position-switch the event number of the applied signal is to be set to parameter "OUT-Feedback" [P]. Usually, an auxiliary contact (NC) of the 3-position-switch is to be connected to a binary input of the SYMAP®-Compact(+). In that case the event number of the binary input is to be used for parameter setting.

P IN – Feedback

Parameter for feedback signal for ON position of a 3-position-switch; to determine the feedback signal for ON position of a 3-position-switch the event number of the applied signal is to be set to parameter "IN-Feedback" [P]. Usually, an auxiliary contact (NO) of the 3-position-switch is to be connected to a binary input of the SYMAP®-Compact(+). In that case the event number of the binary input is to be used for parameter setting.

P EARTH ON – Feedback

Parameter for feedback signal for earthing position of a 3-position-switch; to determine the feedback signal for earthing position of a 3-position-switch the event number of the applied signal is to be set to parameter "EARTH ON-Feedback" [P]. Usually, an auxiliary contact (NO) of the 3-position-switch is to be connected to a binary input of the SYMAP®-Compact(+). In that case the event number of the binary input is to be used for parameter setting.

P EARTH OFF – Feedback

Parameter for feedback signal for non-earthing position of a 3-position-switch; to determine the feedback signal for non-earthing position of a 3-position-switch the event number of the applied signal is to be set to parameter "EARTH OFF-Feedback" [P]. Usually, an auxiliary contact (NC) of the 3-position-switch is to be connected to a binary input of the SYMAP®-Compact(+). In that case the event number of the binary input is to be used for parameter setting.

P Blink by event

Flashing mode for breaker symbol on the device display; flashing mode can be activated by any active event. For activating, the number related to this event has to be assigned to parameter "Blink by event" [P]. Activation is only effective, however, as long as the assigned event is active. If the event turns inactive, activation of the flashing mode is abandoned.

If activating of the flashing mode is not required, set this parameter to "0".

P Invisible by event

Mode for hiding the breaker symbol on the device display; hiding mode can be activated by any active event. For activating, the number related to this event has to be assigned to parameter "Invisible by event" [P]. Activation is only effective, however, as long as the assigned event is active. If the event turns inactive, activation of the hiding mode is abandoned.

If activating of the hiding mode is not required, set this parameter to "0".

P Check OPEN ERROR

Supervision mode for any out-of-control switch-off of a switching element; opening of the primary contacts of a switching element by other reason than protection trip or a given control command by SYMAP-Compact(+), is attributable, for instance, to weak switching mechanic components or even to an earthquake. Such a situation can be detected for each switching element separately by activating the supervision mode.

To activate/deactivate the supervision mode for any out-of-control switch-off of a switching element, please use the tick box besides parameter „Check OPEN ERROR“:

- „☐“: do not tick the box => the supervision mode is not activated
- „☑“: do tick the box => the supervision mode is activated

Event description:

Feedback Event Numbers

The following events are individually available for all 8 switching elements.

E ON – Feedback

Feedback event for ON position; as soon as the feedback signal of ON position – set by parameter “ON-Feedback” [P] – is active, the referring feedback event “ON-Feedback” [E] is being activated.

E OFF – Feedback

Feedback event for ON position; as soon as the feedback signal of OFF position – set by parameter “OFF-Feedback” [P] – is active, the referring feedback event “OFF-Feedback” [E] is being activated.

E OUT – Feedback

Feedback event for OFF position of a 3-position-switch; as soon as the feedback signal of OFF position – set by parameter “OUT-Feedback” [P] – is active, the referring feedback event “OUT-Feedback” [E] is being activated.

E IN – Feedback

Feedback event for OFF position of a 3-position-switch; as soon as the feedback signal of OFF position – set by parameter “OUT-Feedback” [P] – is active, the referring feedback event “OUT-Feedback” [E] is being activated.

E EARTH ON – Feedback

Feedback event for earthing position of a 3-position-switch; as soon as the feedback signal of ON position – set by parameter “EARTH ON-Feedback” [P] – is active, the referring feedback event “EARTH ON -Feedback” [E] is being activated.

E EARTH OFF – Feedback

Feedback event for non-earthing position of a 3-position-switch; as soon as the feedback signal of OFF position – set by parameter “EARTH OFF-Feedback” [P] – is active, the referring feedback event “EARTH OFF -Feedback” [E] is being activated.

Position Event Numbers

The following events are individually available for all 8 switching elements.

E OPEN

Position event for ON position; the position event “OPEN” [E] is only being activated in case that a switching element has taken a definite position. A definite position is determined by evaluating both, feedback event “ON-Feedback” [E] and feedback event “OFF-Feedback” [E]. To activate position event “OPEN” [E],

- feedback event “OFF-Feedback” [E] has to be *activated*, **and**
- feedback event “ON-Feedback” [E] has to be *deactivated*.

E CLOSED

Position event for OFF position; the position event “CLOSED” [E] is only being activated in case that a switching element has taken a definite position. A definite position is determined by evaluating both, feedback event “ON-Feedback” [E] and feedback event “OFF-Feedback” [E]. To activate position event “CLOSED” [E],

- feedback event “OFF-Feedback” [E] has to be *deactivated*, **and**
- feedback event “ON-Feedback” [E] has to be *activated*.

E OUT OPEN

Position event for "Withdrawn – CB off" position of operating device combination Truck/Circuit breaker (CB); the position event "OUT OPEN" [E] is only being activated in case that both, the truck and the CB have taken its definite position. A definite position is determined by evaluating both, feedback events of the truck "OUT-Feedback" [E] and "IN-Feedback" [E], and feedback events CB "OFF-Feedback" [E] and "ON-Feedback" [E]. To activate position event "OUT OPEN" [E],

- feedback event "OUT-Feedback" [E] of the truck has to be *activated*, **and**
- feedback event "IN-Feedback" [E] of the truck has to be *deactivated*.
- feedback event "OFF-Feedback" [E] of the circuit breaker has to be *activated*, **and**
- feedback event "ON-Feedback" [E] of the circuit breaker has to be *deactivated*.

E OUT CLOSED

Position event for "Withdrawn – CB on" position of operating device combination Truck/Circuit breaker (CB); the position event "OUT CLOSED" [E] is only being activated in case that both, the truck and the CB have taken its definite position. A definite position is determined by evaluating both, feedback events of the truck "OUT-Feedback" [E] and "IN-Feedback" [E], and feedback events CB "OFF-Feedback" [E] and "ON-Feedback" [E]. To activate position event "OUT OPEN" [E],

- feedback event "OUT-Feedback" [E] of the truck has to be *activated*, **and**
- feedback event "IN-Feedback" [E] of the truck has to be *deactivated*.
- feedback event "OFF-Feedback" [E] of the circuit breaker has to be *deactivated*, **and**
- feedback event "ON-Feedback" [E] of the circuit breaker has to be *activated*.

E EARTH

Position event for "earthing" position of a 3-position switch; the position event "EARTH" [E] is only being activated in case that 3-position switch has taken a definite position. A definite position is determined by evaluating its feedback events "EARTH ON-Feedback" [E] and "EARTH OFF-Feedback" [E] as well as "ON-Feedback" [E] and "OFF-Feedback" [E]. To activate position event "EARTH" [E],

- feedback event "EARTH OFF-Feedback" [E] has to be *deactivated*, **and**
- feedback event "EARTH ON-Feedback" [E] has to be *activated* and
- feedback event "OFF-Feedback" [E] has to be *activated*, **and**
- feedback event "ON-Feedback" [E] has to be *deactivated*.

E Diff (Moving)

Position event for Difference position; the position event "DIFF (Moving)" [E] is only being activated in case that a switching element has taken an indefinite position. An indefinite position is determined by evaluating both, feedback event "ON-Feedback" [E] and feedback event "OFF-Feedback" [E]. To activate position event "DIFF (Moving)" [E],

- feedback event "OFF-Feedback" [E] has to be *deactivated*, **and**
- feedback event "ON-Feedback" [E] has to be *deactivated* as well.

E FAIL

Position event for failure position; the position event "FAIL" [E] is only being activated in case that a switching element has taken an indefinite position. An indefinite position is determined by evaluating both, feedback event "ON-Feedback" [E] and feedback event [E "OFF-Feedback"]. To activate position event "DIFF (Moving)" [E],

- feedback event "OFF-Feedback" [E] has to be *activated*, **and**
- feedback event "ON-Feedback" [E] has to be *activated* as well.

NOTE: *Physically*, such position state is impossible; however, a defective (stuck) auxiliary contact of the switching element could cause this failure event.

E OPEN ERROR

Error-event for undefined switch-off of a switching element; as soon as the activated supervision mode (see parameter: “*Check OPEN ERROR*” [P]) detects a *switch-off of a switching element* caused by other reason than protection trip or a given control command by SYMAP-Compact(+), error-event “*OPEN ERROR*” [E] is being activated.

NOTE: The activated error-event “*OPEN ERROR*” [E] can be deactivated by a hotkey of the touchscreen or a function key of the frontplate, if the setting option “ACK” is assigned to the keys.

Reset of the activated error-event is also possible by the communication command “ACK” of the different data protocols.

3.8.3 “Breaker Control”(control & Interlocking of switching elements)

For each of the switching elements, there are two menu pages for configuring the switching conditions. Each of the two menu pages refer to the switching direction of the switching element (see parameter „Selection control“ [P]).

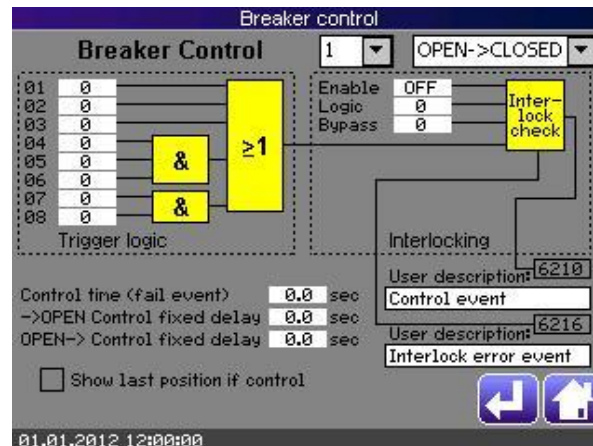


Figure 3-147 Breaker Control & Interlocking

Main Menu\Parameters\BREAKER CONTROL \				
Breaker Control				
P/E	Name	Value	Unit	(Setting range)
Selection				
P	Selection	1	-	1 ... 8
Select control				
P	Selection control	Stop	-	OPEN->CLOSED CLOSED->OPEN OPEN->OUT OUT->OPEN OPEN->EARTH EARTH->OPEN
Trigger logic (input elements)				
P	01	0	(event)	0 ... 9999
P	02	0	(event)	0 ... 9999
P	03	0	(event)	0 ... 9999
P	04	0	(event)	0 ... 9999
P	05	0	(event)	0 ... 9999
P	06	0	(event)	0 ... 9999
P	07	0	(event)	0 ... 9999
P	08	0	(event)	0 ... 9999
Interlocking				
P	Enable	OFF	-	OFF/ON
P	Logic	0	(event)	0 ... 9999
P	Bypass	0	(event)	0 ... 9999
Control timing				
P	Control time (fail event)	0	s	0,0 ... 6500,0
P	->OPEN Control fixed delay	0	s	0,0 ... 6500,0
P	OPEN-> Control fixed delay	0	s	0,0 ... 6500,0
User description (output events)				
P	6210 (Control event)	“Control event”	-	(1 ... 16 characters)
P	6216 (Interlock error event)	“Interlock error event”	-	(1 ... 16 characters)
Display				
P	Show last position if control	☐	-	☐ / ☒

Figure 3-148 Breaker Control & Interlocking – Parameters

Control Event numbers								
Parameter	Breaker 1	Breaker 2	Breaker 3	Breaker 4	Breaker 5	Breaker 6	Breaker 7	Breaker 8
OPEN->CLOSED	6210	6220	6230	6240	6250	6260	6270	6280
CLOSED->OPEN	6211	6221	6231	6241	6251	6261	6271	6281
OPEN->OUT	6212	6222	6232	6242	6252	6262	6272	6282
OUT->OPEN	6213	6223	6233	6243	6253	6263	6273	6283
OPEN->EARTH	6214	6224	6234	6244	6254	6264	6274	6284
EARTH->OPEN	6215	6225	6235	6245	6255	6265	6275	6285
Interlock error	6216	6226	6236	6246	6256	6266	6276	6286
Control fail event	6217	6227	6237	6247	6257	6267	6277	6287

Figure 3-149 Breaker Control & Interlocking – Events

Parameter description:

Breaker Control & Interlocking – Parameters

Breaker Selection

P Selection

Selection of switching element to be configured; up to 8 switching elements can be configured individually according to control and interlocking functions:

- “1”: Selection of switching element no. 1
- “2”: Selection of switching element no. 2
- “3”: Selection of switching element no. 3
- “4”: Selection of switching element no. 4
- “5”: Selection of switching element no. 5
- “6”: Selection of switching element no. 6
- “7”: Selection of switching element no. 7
- “8”: Selection of switching element no. 8

Following parameters are individually available for each of 8 switching elements.

Selection control direction

P Select control

Selection of switching direction for the switching element selected by parameter “Selection” [P]; each of the 8 switching elements can be configured individually according to its switching direction:

- “OPEN->CLOSED”: Switching direction: “OFF” to „ON“
- “CLOSED->OPEN”: Switching direction: “ON” to „OFF“
- “OPEN->OUT”: Draw-out of the *truck* while CB is open
- “OUT->OPEN”: Insertation of the *truck* while CB is open
- “OPEN->EARTH”: Switching direction of 3-position switch: “OFF” to “Earthing ON”
- “EARTH->OPEN”: Switching direction of 3-position switch: “Earthing ON” to “OFF”

The following parameters are available for all of the 8 switching elements, and moreover, for each of the selectable control directions.

Trigger logic

P 01 bis 08

Input elements (events) of the "Trigger logic" to activate the switching operation for the switching direction selected by parameter "Select control" [P]; to this parameter events are to be assigned to set preconditions for triggering the switching operation for individual switching direction.

Interlocking logic

P Enable

This parameter activates/deactivates *interlocking logic* by following setting options:

- "OFF": interlocking logic is *deactivated*,
- "ON": interlocking logic is *activated*.

P Logic

Activation of the configured interlocking logic set by programmable logic control ("PLC"); the output event of the logical function, which is configured for interlocking the selected switching direction of the selected switching element, can be released for module "Interlocking" by any active event. For the release, the number related to this blocking event has to be assigned to parameter "Logic" [P]. The release state is only effective, however, as long as the assigned event is active. If the event turns inactive, the output event of the logical function for interlocking is blocked.

If an interlocking for the selected switching direction of the selected switching element not required, set this parameter to "0".

P Bypass

Blocking of the configured interlocking logic set by programmable logic control ("PLC"); the output event of the logical function, which is configured for interlocking the selected switching direction of the selected switching element, can be blocked for module "Interlocking" by any active event. For blocking, the number related to this blocking event has to be assigned to parameter "Bypass" [P]. Blocking is only effective, however, as long as the assigned event is active. If the event turns inactive, the output event of the logical function for interlocking is effective again.

If an interlocking for the selected switching direction of the selected switching element not required, set this parameter to "0".

Control timing

P Control time (fail event)

Maximum control time for the switching direction which was chosen by parameter "Selection control" [P]; as soon as a control command is given, the assigned binary output is being activated for the duration of time set by parameter "Control time (fail event)" [P].

In case that there is no final position feedback of *switching element no. 1* within the set *maximum control time*, the assigned fail-event "Control fail event" [E6217] is being activated

P -> OPEN Control fixed delay

Open control delay time for the switching direction which was chosen by parameter "Selection control" [P]; as soon as a control command is given, the activation of the assigned binary output is being delayed for the duration of time set by parameter "->OPEN Control fixed delay" [P]. When open control delay time has run down, the binary output is being activated for the duration of time set by parameter "Control time (fail event)" [P] at maximum.

In case that there is no final position feedback of *switching element no. 1* within the set *maximum control time*, the assigned fail-event "*Control fail event*" [E6217] is being activated.

P OPEN-> Control fixed delay

*Extended control time for the switching direction which was chosen by parameter "Selection control" [P]; in case that there is no final position feedback of *switching element no. 1* within the set *maximum control time*, the deactivation of the assigned binary input is being delayed for the duration of time set by parameter "OPEN -> Control fixed delay" [P]. During this time fail -event "*Control fail event*" [E6217] remains deactivated.*

In case that there is no final position feedback of *switching element no. 1* within the set *extended control time*, the assigned fail-event "*Control fail event*" [E6217] is being activated.

User description of events

P 6210

Event (via text editor) to indicate a given control command

P 6216

Event (via text editor) to indicate an interlocking infringement

Display

P Show last position if control

Indication mode for display of static symbol of switching element during switching operating; the indication mode can be selected in case that there is only one signal wire for position feedback (auxiliary contact of switching element: "normal open").

If activated, the indication mode will remain showing the previous switch position until the switching element has reached the final position. For instance, when switching direction is "CLOSED" to "OPEN", then, whilst differential position the device display still shows position "CLOSED". When final position ("OPEN") is gained before the control supervision time set by parameter "*Control time (fail event)*" [P] has run down, device display will show symbol "OPEN".

In case of a wire-break or a stuck auxiliary contact, device display shows symbol "FAIL".

3.8.4 “Breaker Counter” (Counter and events of control operation)

Main Menu\Parameters\BREAKER CONTROL\								
Breaker Counter								
Parameter	Schalter 1	Schalter 2	Schalter 3	Schalter 4	Schalter 5	Schalter 6	Schalter 7	Schalter 8
Closed->OPEN cycles	0...65000	0...65000	0...65000	0...65000	0...65000	0...65000	0...65000	0...65000
Closed->OPEN cycles max	0...65000	0...65000	0...65000	0...65000	0...65000	0...65000	0...65000	0...65000
OPEN->EARTH cycles	0...65000	0...65000	0...65000	0...65000	0...65000	0...65000	0...65000	0...65000
OPEN->EARTH cycles max	0...65000	0...65000	0...65000	0...65000	0...65000	0...65000	0...65000	0...65000
Breaker Counter Events								
Closed->OPEN cycles max	6311	6321	6331	6341	6351	6361	6371	6381
OPEN->EARTH cycles max	6313	6323	6333	6343	6353	6363	6373	7383

Figure 3-150 Counter functions of control operations – Breaker Counter

Parameter description:

Breaker Counter – parameters of control operation counter

Following parameters are individually available for each of 8 switching elements.

P Closed->OPEN cycles

Set counting start value for all the switching operations of a switching element with switching direction “CLOSED” to “OPEN”; this counter is being incremented, if switching operation was conducted for the switching direction “CLOSED” to “OPEN”.

P Closed->OPEN cycles max

Maximum set counting limit for all the switching operations of a switching element with switching direction “CLOSED” to “OPEN”; as soon as the counter has reached the set counting limit, the event „Closed->OPEN cycles max“ [E6311] is being activated.

P OPEN->EARTH cycles

Set counting start value for all the switching operations of a 3-position switch with switching direction “OPEN” to “EARTH”; this counter is being incremented, if switching operation was conducted for the switching direction “OPEN” to “EARTH”.

P OPEN->EARTH cycles max

Maximum set counting limit for all the switching operations of a 3-position switch with switching direction “OPEN” to “EARTH”; as soon as the counter has reached the set counting limit, the event „OPEN->EARTH cycles max“ [E6313] is being activated.

Event description:

Breaker Counter – events of control operation counter

Following events are individually available for each of 8 switching elements.

E Closed->OPEN cycles max

As soon as the set counting limit for all the switching operation with switching direction “CLOSED” to “OPEN” set by parameter „Closed->OPEN cycles max“ [P] has been reached, event „Closed->OPEN cycles max“ [E6311] is being activated.

NOTE: Event [E6311] can be used for indicating the need for revising the primary contacts of the switching element.

E OPEN->EARTH cycles max

As soon as the set counting limit for all the switching operation with switching direction "OPEN" to "EARTH" set by parameter „*OPEN->EARTH cycles max*“ [P] has been reached, event „*OPEN->EARTH cycles max*“ [E6313] is being activated.

NOTE: Event [E6313] can be used for indicating the need for revising the primary contacts of the switching element.

3.9 “PLC” (Programmable logic control)

Table 3-11 Programmable logic functions

Type	Number of available logic elements	Event-No.	Number of input elements	Number of parameters
AND/OR	500	5000-5499	2-5	3
NOT (Inverter)	30	5500-5529	1	2
XOR (Exclusive OR)	20	5530-5549	2	2
Flip-Flop	20	5550-5569	2	4
Counter	20	5570-5589	4	6
Timer	80	5600-5679	1	6
Timer switch	20	5680-5699	-	6

3.9.1 “Logic elements”

3.9.1.1 “AND/OR”

By using selection button “*Selection*” the first of 500 available logic elements “AND/OR” can be invoked. It carries the event-number [E5000].

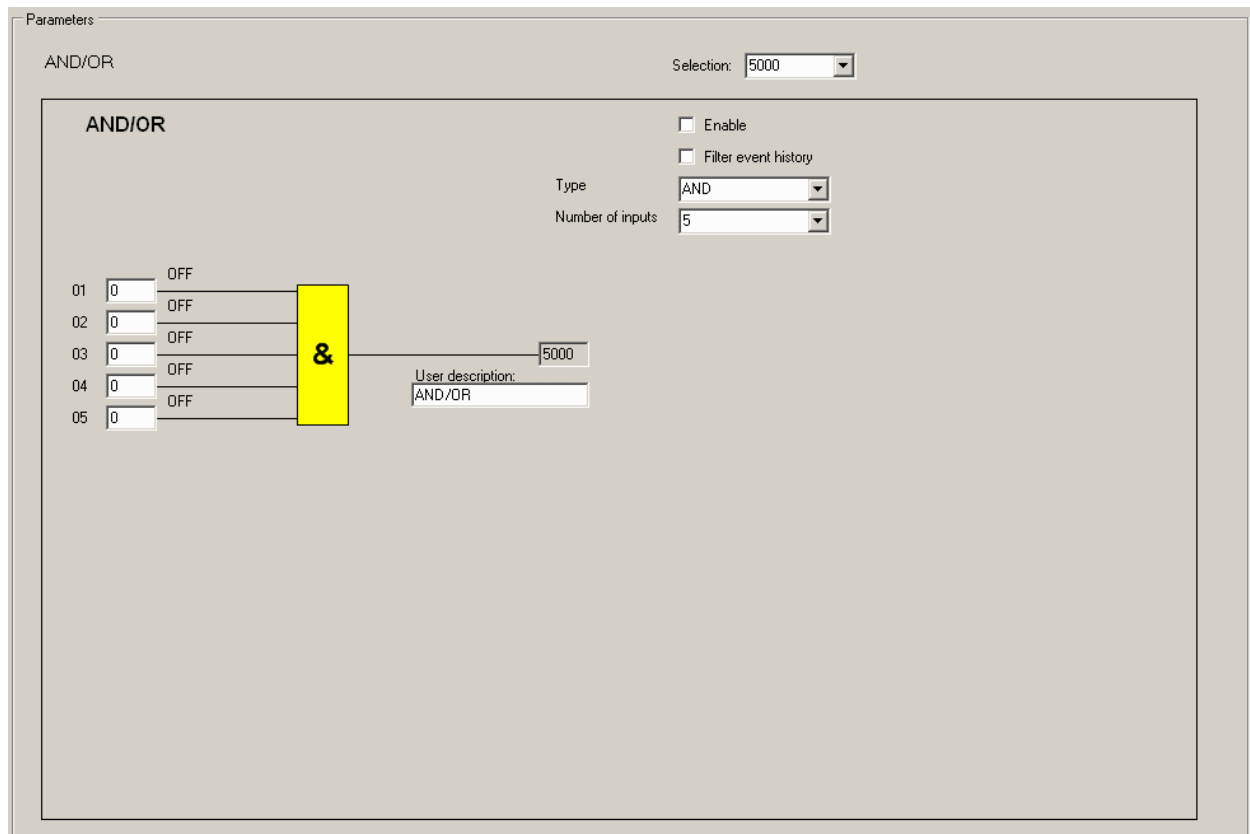


Figure 3-151 “PLC” – Logic element “AND” or “OR”

Parameter description:

NOTE: Each one of the 500 logic elements “AND/OR” always provides equal parameters. Hence, the parameter descriptions of the first logic element “AND/OR” represented below are described in the following in detail as examples.

P Enable

This Parameter *activates/deactivates* the logic element “AND/OR” invoked by selection button “Selection”.

- “☐”: *do not tick the box => logic element is deactivated*
- “☒”: *do tick the box => logic element is activated*

P Filter event history

Filter function for processing or not processing of the output event of the selected logic element “AND/OR” in the *event history*; if selected (parameter setting by tick box), the *output event* [E5000] is not being registered in the event history.

To activate/deactivate the *filter function* of a logic element, please use the tick box besides parameter „Filter event history“:

- “☐”: *do not tick the box => the filter function of the logic element is not available*
- “☒”: *do tick the box => the filter function of the logic element is available*

P Type

Assignment of the logic scheme to the selected logic element “AND/OR” via the following setting options:

- “AND”: logic scheme accords to an AND gate
- “OR”: logic scheme accords to an OR gate

P Number of inputs

Definition of the number of applied input elements of the selected logical element “AND/OR” via the following setting options:

- “2”: logic element provides two input elements,
- “3”: logic element provides three input elements,
- “4”: logic element provides four input elements,
- “5”: logic element provides five input elements.

P 01

to

P 05

Assignment of any available event to an input element of the selected logic element “AND/OR”, the number of available input elements of the logic element is being determined by parameter “Number of inputs”.

Each available event can be used as an input element; therefore the event-number has to be registered in the array besides the number of the input element.

NOTE: Setting „0“ means logical „0“ (positive logic: „untrue“)
Setting „9999“ means logical „1“ (positive logic: „true“)

Inversion of input elements and output-event

Input elements: parameters [P01] to [P05] and output-event e.g. [E5000] of logic elements “AND/OR” can be inverted separately. By double-click to the icon of the logical element a new windows appears in which inversion can be conducted.

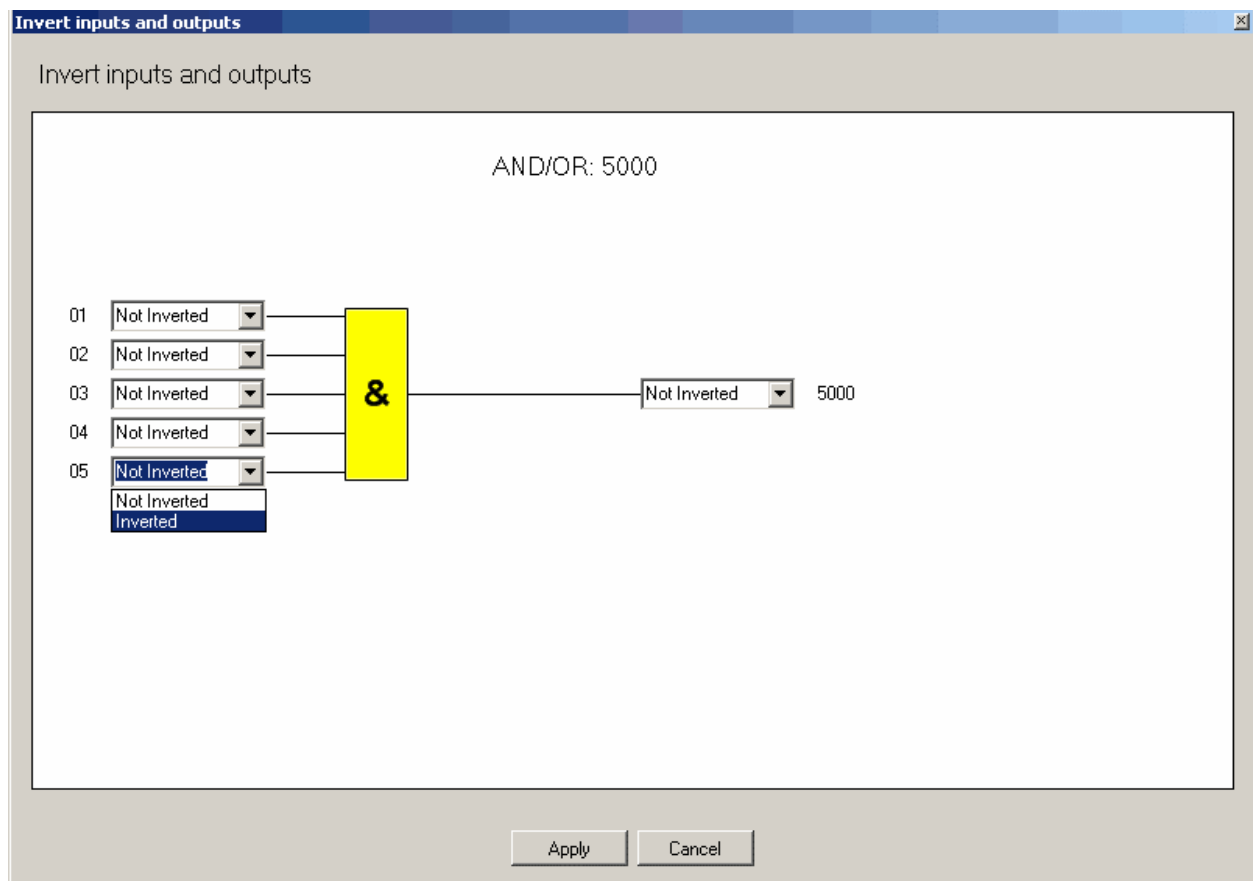


Figure 3-152 "PLC" – "AND/OR": inversion of input elements and output-event

3.9.1.2 “NOT (Inverter)”

By using selection button “*Selection*” the first of 30 available logic elements “NOT(Inverter)” can be invoked. It carries the event-number [E5500].



Figure 3-153 “PLC” – Logic element „NOT(Inverter)”

Parameter description:

NOTE: Each one of the 30 logic elements “NOT(Inverter)” always provides equal parameters. Hence, the parameter descriptions of the first logic element “NOT(Inverter)” represented below are described in the following in detail as examples.

P Enable

This Parameter *activates/deactivates* the logic element “NOT(Inverter)” invoked by selection button “Selection”.

- “☐”: *do not tick the box => logic element is deactivated*
- “☑”: *do tick the box => logic element is activated*

P Filter event history

Filter function for processing or not processing of the output event of the selected logic element “NOT(Inverter)” in the *event history*; if selected (parameter setting by tick box), the *output event* [E5500] is not being registered in the event history.

To activate/deactivate the *filter function* of a logic element, please use the tick box besides parameter „Filter event history”:

- “☐”: *do not tick the box => the filter function of the logic element is not available*
- “☑”: *do tick the box => the filter function of the logic element is available*

P 01

*Assignment of any available event to the input element of the selected logic element
"NOT(Inverter)"*

Each available event can be used as an input element; therefore the event-number has to be registered in the array besides the number of the input element.

NOTE: Setting „0“ means logical „0“ (positive logic: „untrue“)
Setting „9999“ means logical „1“ (positive logic: „true“)

3.9.1.3 “XOR (Exclusive OR)”

By using selection button “*Selection*” the first of 20 available logic elements “XOR (Exclusive OR)” can be invoked. It carries the event-number [E5530].

Table 3-12 “PLC” – Logic element “XOR (Exclusive OR)”

Parameter description:

NOTE: Each one of the 20 logic elements “XOR (Exclusive OR)” always provides equal parameters. Hence, the parameter descriptions of the first logic element “XOR (Exclusive OR)” represented below are described in the following in detail as examples.

P Enable

This Parameter *activates/deactivates* the logic element “XOR (Exclusive OR)” invoked by selection button “Selection”.

- “□”: *do not tick the box => logic element is deactivated*
- “☑”: *do tick the box => logic element is activated*

P Filter event history

Filter function for processing or not processing of the output event of the selected logic element in the *event history*; if selected (parameter setting by tick box), the *output event* [E5530] is not being registered in the event history.

To activate/deactivate the *filter function* of a logic element, please use the tick box besides parameter „Filter event history“.

- “□”: *do not tick the box => the filter function of the logic element is not available*
- “☑”: *do tick the box => the filter function of the logic element is available*

P	01
	and
P	02

*Assignment of any available event to an input element of the selected logic element
“XOR (Exclusive OR)”*

Each available event can be used as an input element; therefore the event-number has to be registered in the array besides the number of the input element.

NOTE: Setting „0“ means logical „0“ (positive logic: „untrue“)
Setting „9999“ means logical „1“ (positive logic: „true“)

Inversion of input elements and output-event

Input elements: parameters [P01] and [P02] and output-event e.g. [E5530] of logic elements “XOR(Exclusive OR)” can be inverted separately. By double-click to the icon of the logical element a new windows appears in which inversion can be conducted.

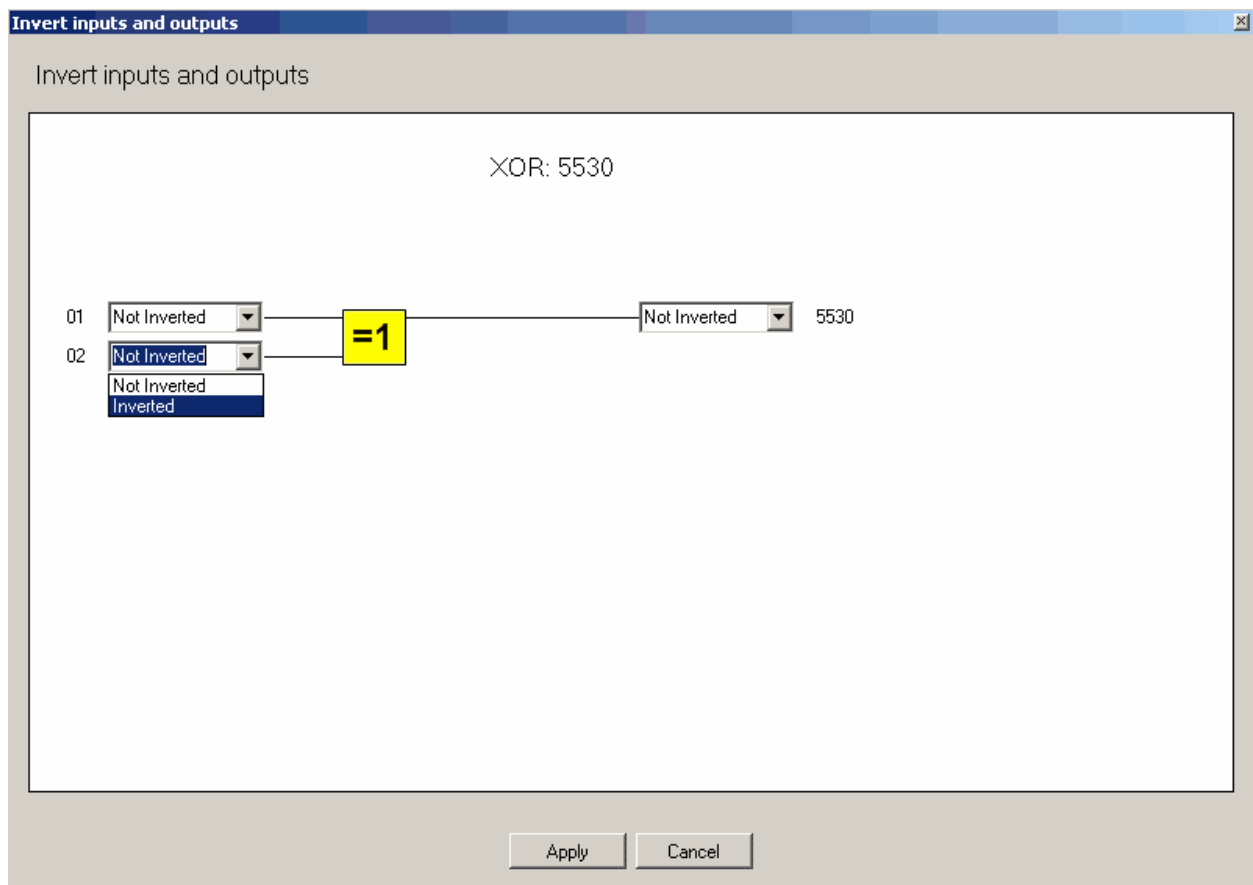


Figure 3-154 “PLC” – “XOR(Eclusive OR)”: inversion of input elements and output-event

3.9.1.4 “FlipFlops“

By using selection button “*Selection*” the first of 20 available logic elements “FlipFlop” can be invoked. It carries the event-number [E5550].

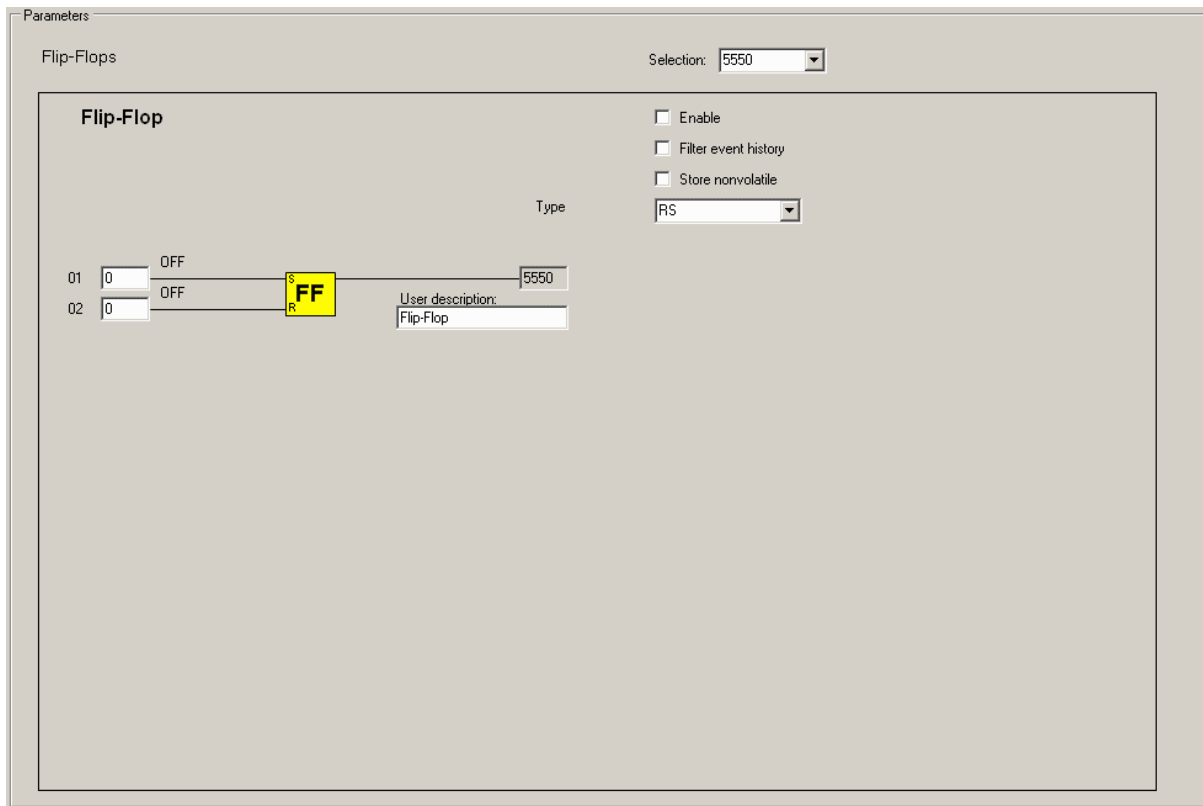


Figure 3-155 “PLC” – Logic element „FlipFlop”

Parameter description:

NOTE: Each one of the 20 logic elements “FlipFlop” always provides equal parameters. Hence, the parameter descriptions of the first logic element “FlipFlop” represented below are described in the following in detail as examples.

P Enable

This Parameter *activates/deactivates* the logic element “FlipFlop” invoked by selection button “*Selection*”.

- “□”: *do not tick the box => logic element is deactivated*
- “☑”: *do tick the box => logic element is activated*

P Filter event history

Filter function for processing or not processing of the output event of the selected logic element “FlipFlop” in the *event history*; if selected (parameter setting by tick box), the *output event* [E5550] is not being registered in the event history.

To activate/deactivate the *filter function* of a logic element, please use the tick box besides parameter „*Filter event history*“.

- “□”: *do not tick the box => the filter function of the logic element is not available*
- “☑”: *do tick the box => the filter function of the logic element is available*

P Store non-volatile

Definition of storing behaviour for the current state of the output event [E5550] of selected logic element "FlipFlop" after system reboot:

- "☐": do not tick the box => current state of output event [E5550] of selected logic element is not being saved after system reboot
- "☑": do tick the box => current state of output event [E5550] of selected logic element is being saved after system reboot

P Type

Assignment of the logic scheme to the selected logic element "FlipFlop" via the following setting options:

- "RS": logic scheme accords to "RS-FlipFlop"; domination of input element for resetting ("R") the flipflop or
- "RS-EDGE": logic scheme accords to "RS-FlipFlop"; setting of the flipflop only in by *rising edge* signal of the event assigned to the input element "S" or
- "SR": logic scheme accords to "SR-FlipFlop"; domination of input element for setting ("S") the flipflop or
- "T": logic scheme accords to "Toggle-FlipFlop"; setting of the flipflop by *rising or a falling edge signal* of the event assigned to the input element "S"

P 01

and

P 02

Assignment of any available event to an input element of the selected logic element "FlipFlop"

Each available event can be used as an input element; therefore the event-number has to be registered in the array besides the number of the input element.

NOTE: Setting „0“ means logical „0“ (positive logic: „untrue“)
Setting „9999“ means logical „1“ (positive logic: „true“)

Inversion of input elements and output-event

Input elements: parameters [P01] and [P02] and output-event e.g. [E5550] of logic elements "FlipFlop" can be inverted separately. By double-click to the icon of the logical element a new windows appears in which inversion can be conducted.

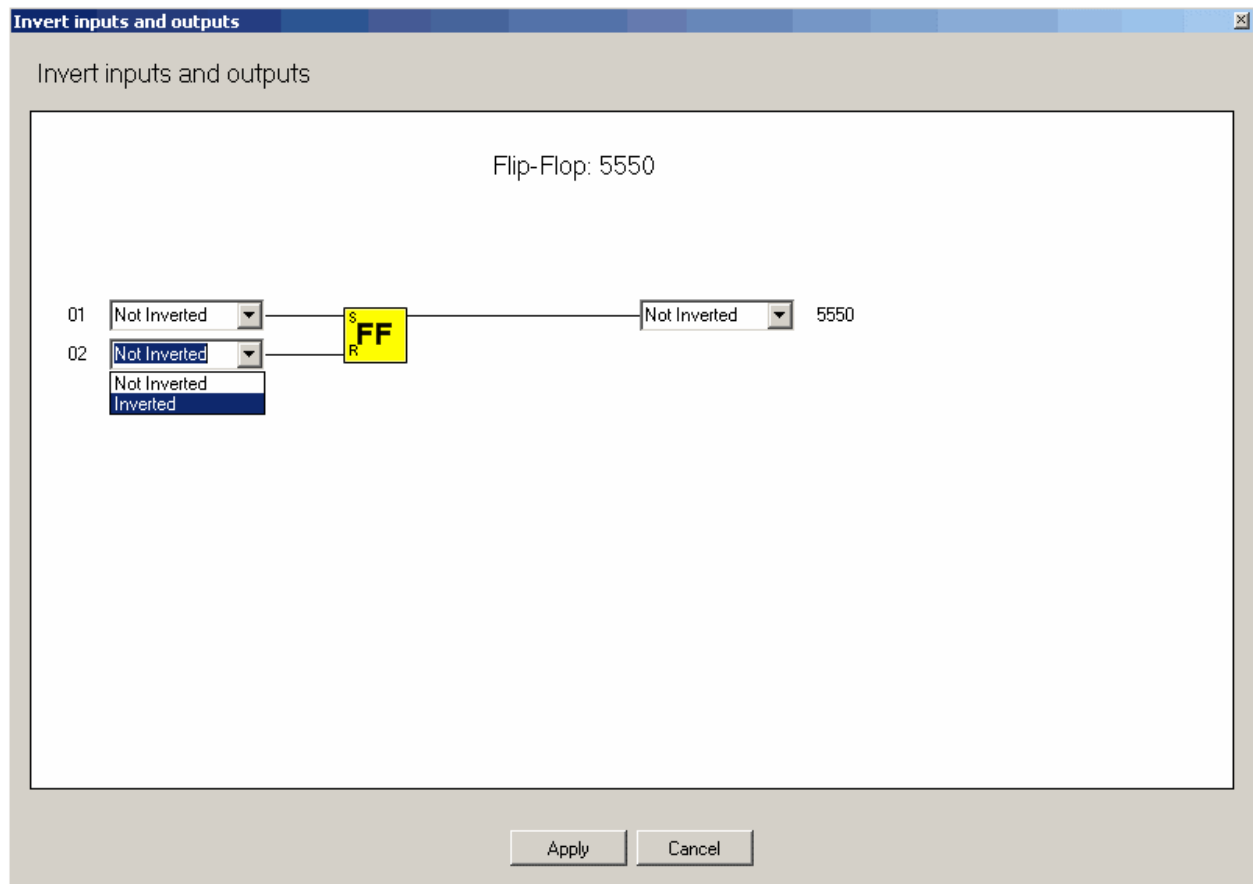


Figure 3-156 “PLC” – “FlipFlop”: inversion of input elements and output-event

3.9.1.5 “Counter“

By using selection button “*Selection*” the first of 20 available logic elements “Counter” can be invoked. It carries the event-number [E5570].

Figure 3-157 “PLC” – Logic element “Counter“

Parameter description:

NOTE: Each one of the 20 logic elements “Counter” always provides equal parameters. Hence, the parameter descriptions of the first logic element “Counter” represented below are described in the following in detail as examples.

P Enable

This Parameter *activates/deactivates* the logic element “Counter” invoked by selection button “Selection”.

- “☐”: *do not tick the box => logic element is deactivated*
- “☒”: *do tick the box => logic element is activated*

P Filter event history

Filter function for processing or not processing of the output event of the selected logic element “Counter” in the *event history*; if selected (parameter setting by tick box), the *output event* [E5570] is not being registered in the event history.

To activate/deactivate the *filter function* of a logic element, please use the tick box besides parameter „Filter event history“.

- “☐”: *do not tick the box => the filter function of the logic element is not available*
- “☒”: *do tick the box => the filter function of the logic element is available*

P Store non-volatile

Definition of storing behaviour for the current counter value of selected logic element "Counter" after system reboot:

- "☐": do not tick the box => current counter value of selected logic element is being reset to the value given by parameter "Start value"
- "☑": do tick the box => current counter value of selected logic element is being saved after system reboot

P Count edge

Definition of counting behaviour to increment/decrement the counting value of the selected logic element "Counter"; depending on the following setting options the counter value is being incremented/decremented:

- "RISING": only in case of a rising edge signal of the event assigned to the input element "Count" or
- "Falling": only in case of a falling edge signal of the event assigned to the input element "Count" or
- "ANY": only in case of arising or falling edge signal of the event assigned to the input element "Count".

P Start value

Start value of the selected logic element "Counter"; after system reboot incrementing/decrementing of the counting value starts at the set value of parameter "Start value".

P Count limit

End value of the selected logic element "Counter"; as soon as the counter has reached the set value of parameter "Count limit", counting is being stopped and the output event [E5570] is activated.

Input elements of logic element "Counter"

Each counter provides four input elements: "Count", "Block", "Reset" and "Direction". Each available event can be used as an input element; therefore the event-number has to be registered in the array besides the designation of the input element.

NOTE: Setting „0“ means logical „0“ (positive logic: „untrue“)
Setting „9999“ means logical „1“ (positive logic: „true“)

P Count

Assignment of any available event to the input element "Count" of the selected logic element "Counter" to increment/decrement the counting value; as soon as the assigned event is active, the counting value is being incremented/decremented.

NOTE: The counting behaviour of the logic element "Counter" is set by parameter "Direction".

The counting behaviour for incrementing/decrementing depends on the signal edge of the counting-event which is being set by parameter "Count edge"

P Block

Assignment of any available event to block counting procedure of selected logic element "Counter"; counting procedure can be completely blocked by any active event. For blocking, the number related to this blocking event has to be assigned to parameter "Block". Blocking is only effective, however, as long as the blocking event is active. As soon as blocking is active, counting is stopped and the current counter value is saved. If

the blocking event turns inactive, blocking is abandoned and counting is effective again – continuing with the saved value.

If blocking of counting is not required, set this parameter to “0”.

P Reset

Assignment of any available event to block counting procedure and reset of counting value to the start value of selected logic element “Counter”; counting procedure can be completely blocked by any active event. For blocking, the number related to this blocking event has to be assigned to parameter “Block”. Blocking is only effective, however, as long as the blocking event is active. As soon as blocking is active, counting is stopped and the current counter value is saved. If the blocking event turns inactive, blocking is abandoned and counting is effective again – continuing with the saved value.

If blocking of counting and resetting of counting value is not required, set this parameter to “0”.

P Direction

Definition of the counting behaviour according to incrementing/decrementing the counting value of the logic element “Counter”; depending on the setting option:

- “0”: the counter is being incremented or
- “1”: the counter is being decremented.

Inversion of input elements and output-event

Input elements: parameters [P01] to [P04] and output-event e.g. [E5570] of logic elements “Counter” can be inverted separately. By double-click to the icon of the logical element a new windows appears in which inversion can be conducted.

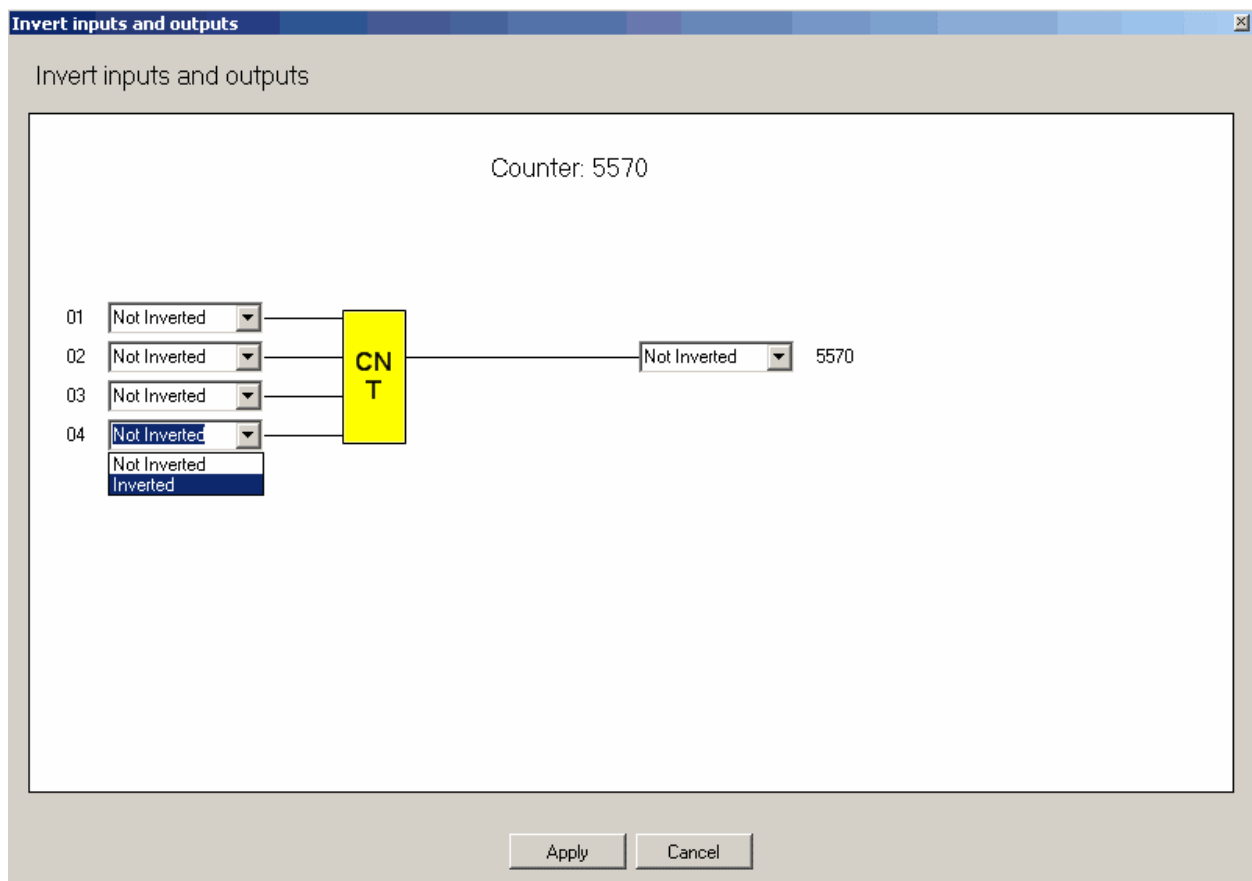


Figure 3-158 “PLC” – “Counter”: inversion of input elements and output-event

3.9.1.6 “Timer“

By using selection button “*Selection*” the first of 80 available logic elements “Timer” can be invoked. It carries the event-number [E5600].

Figure 3-159 “PLC” – Logic element “Timer”

Parameter description:

NOTE: Each one of the 80 logic elements “Timer” always provides equal parameters. Hence, the parameter descriptions of the first logic element “Timer” represented below are described in the following in detail as examples.

P Enable

This Parameter *activates/deactivates* the logic element “Timer” invoked by selection button “Selection”.

- “☐”: do not tick the box => logic element is *deactivated*
- “☒”: do tick the box => logic element is *activated*

P Filter event history

Filter function for processing or not processing of the output event of the selected logic element “Timer” in the *event history*; if selected (parameter setting by tick box), the *output event* [E5600] is not being registered in the event history.

To activate/deactivate the *filter function* of a logic element, please use the tick box besides parameter „Filter event history“.

- “☐”: do not tick the box => the *filter function* of the logic element is not available
- “☒”: do tick the box => the *filter function* of the logic element is available

P Function

Definition of working principle of the logic element „Timer“ according to the following setting options:

- “Delay“: *on-delayed/off-delayed activation of output event [E5600]; in case that the event which is assigned to the input element “01” is activated and delay time set by parameter “ON time” has run down, the output event [E5600] is being activated. As soon as the event of the input element has become deactivated and the delay time set by parameter “OFF time” has run down, the output event is being deactivated.*
- “Pulse-C“: *constant pulse duration (“C”); in case that the event which is assigned to the input element “01” is activated, output event [E5600] is being activated for the duration of time set by parameter “ON time”.*
- “Pulse-CR“: *constant pulse duration (“C”) and possibility of restart („R”); in case that the event which is assigned to the input element “01” is activated, output event [E5600] is being activated for the duration of time set by parameter “ON time”. In case that during on-time the event of the input element is activated once again (rising edge of event signal), the output event [E5600] remains active for the duration of set on-time.*
- “Pulse-I“: *pulse duration and possibility of interrupt („I”); in case that the event which is assigned to the input element “01” is activated, output event [E5600] is being activated for the duration of time set by parameter “ON time”. In case that during on-time the event of the input element is deactivated (falling edge of event signal), the on-time is stopped and output event [E5600] is being deactivated.*
- “Pulses“: *pulses of defined duty cycle; in case that the event which is assigned to the input element “01” is activated, output event [E5600] is being activated for the duration of time set by parameter “ON time”. As soon as the on-time has run down, the output event is being activated for the duration of time set by parameter “OFF time”.*

P ON time

Settable time delay of an on-delayed activation of the output event [E5600] of the logic element “Timer”

P OFF time

Settable time delay of an offn-delayed deactivation of the output event [E5600] of the logic element “Timer”

P Unit

Unit of time for setting options of parameters “ON time” and “OFF time”;

- “ms“: *millisecond*
- “sec“: *second*
- “min“: *minute*
- “h“: *hour*

NOTE: The tolerance specification is valid for the following setting options of the logical element “Timer”:

- “ms“ and „sec“: *+/- 10 ms*
- “min“ and „h“: *+/- 1 s*

P 01

Assignment of any available event to the input element of the selected logic element “Timer”

Each available event can be used as an input element; therefore the event-number has to be registered in the array besides the number of the input element.

NOTE: Setting „0“ means logical „0“ (positive logic: „untrue“)
Setting „9999“ means logical „1“ (positive logic: „true“)

Inversion of input element and output-event

Input element: parameter [P01] and output-event e.g. [E5600] of logic elements “Counter” can be inverted separately. By double-click to the icon of the logical element a new windows appears in which inversion can be conducted.

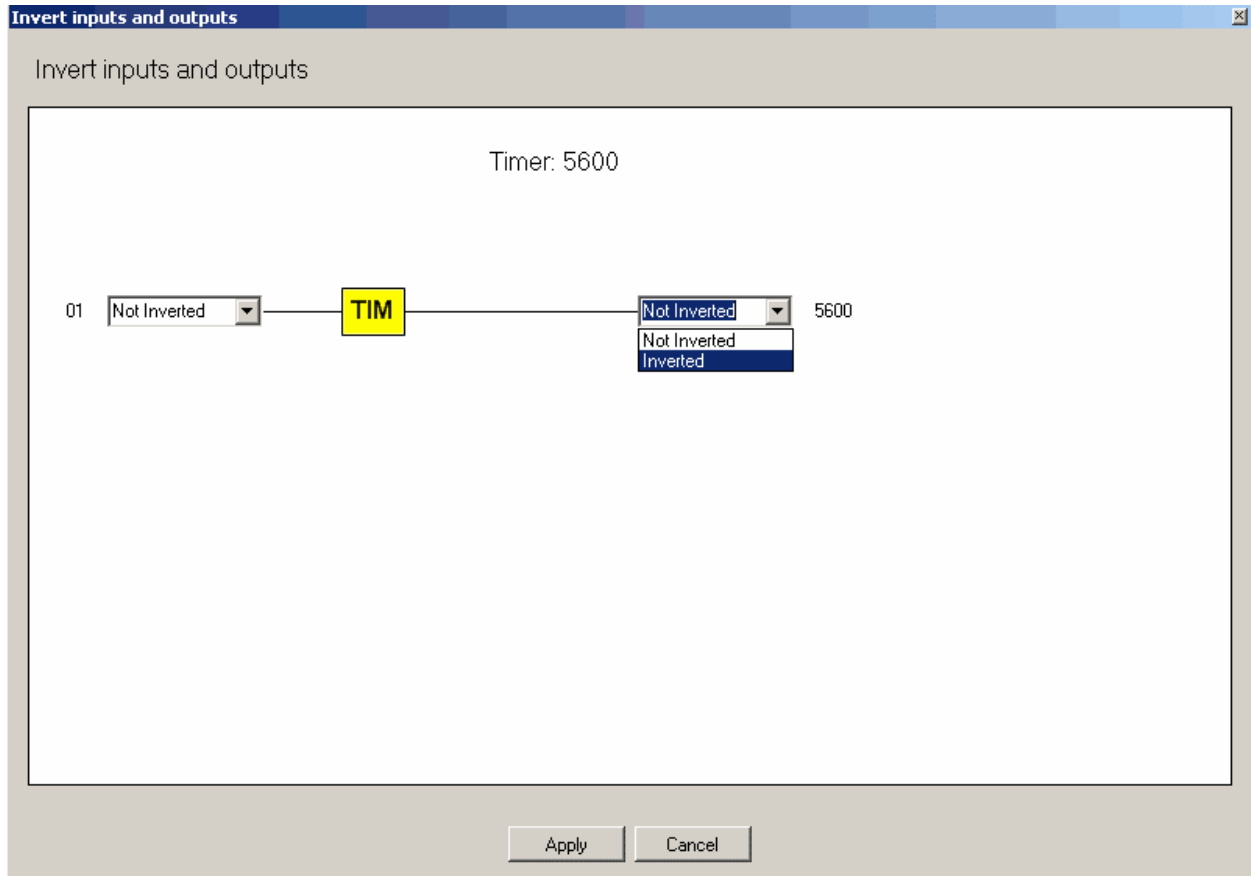


Figure 3-160 “PLC” – “Timer”: inversion of input element and output-event

3.9.1.7 “Timer switch“

By using selection button “*Selection*” the first of 20 available logic elements “Timer switch” can be invoked. It carries the event-number [E5680].

Figure 3-161 “PLC” – Logic element “Timer switch”

Parameter description:

NOTE: Each one of the 20 logic elements “Timer switch” always provides equal parameters. Hence, the parameter descriptions of the first logic element “Timer switch” represented below are described in the following in detail as examples.

P Enable

This Parameter *activates/deactivates* the logic element “Timer switch” invoked by selection button “Selection”.

- “☐”: *do not tick the box => logic element is deactivated*
- “☑”: *do tick the box => logic element is activated*

P Filter event history

Filter function for processing or not processing of the output event of the selected logic element “Timer switch” in the *event history*; if selected (parameter setting by tick box), the *output event* [E5680] is not being registered in the event history.

To activate/deactivate the *filter function* of a logic element, please use the tick box besides parameter „*Filter event history*“:

- “☐”: *do not tick the box => the filter function of the logic element is not available*
- “☑”: *do tick the box => the filter function of the logic element is available*

P Mode

Operating mode for termination of activating the output event [E5680] for a duration set by parameter "Pulse" according to following setting options:

- "Day in month": output event [E5680] is being activated on a certain day of each calendar month, at a specific time set by parameter "Time" and for a specific duration of time set by parameter "Pulse".
- "Day of week": output event [E5680] is being activated on a certain day of each week, at a specific time set by parameter "Time" and for a specific duration of time set by parameter "Pulse".
- "Weekday in month": output event [E5680] is being activated on a certain weekday of each month, at a specific time set by parameter "Time" and for a specific duration of time set by parameter "Pulse".

P Day

Termination of the day of activating the output event [E5680] in dependence of the setting options of parameter "Modus" and for a duration time set by parameter "Pulse"; According to the selected mode for the logic element "Timer switch", there are different setting options of the parameter "Day":

"Modus = Day in month":

- "1": activation of output event [E5680] occurs on the 1st calendar day of each calendar month
- "...": ...
- "31": activation of output event [E5680] occurs on the 31st calendar day of each calendar month

CAUTION: Choice of calendar day depends on the maximum number of days of the different months!

"Modus = Day of week":

- "Monday": activation of output event [E5680] occurs on Mondays
- "Tuesday": activation of output event [E5680] occurs on Tuesdays
- "Wednesday": activation of output event [E5680] occurs on Wednesdays
- "Thursday": activation of output event [E5680] occurs on Thursdays
- "Friday": activation of output event [E5680] occurs on Fridays
- "Saturday": activation of output event [E5680] occurs on Saturdays
- "Sunday": activation of output event [E5680] occurs on Sundays
- "Daily": activation of output event [E5680] occurs daily

"Modus = Weeday in month":

- "1. Monday": activation of output event [E5680] occurs on the first Monday of each month
- "...": ...
- "1. Friday": activation of output event [E5680] occurs on the first Friday of each month
- "2. Monday": activation of output event [E5680] occurs on the second Monday of each month
- "...": ...
- "2. Friday": activation of output event [E5680] occurs on the second Friday of each month
- "3. Monday": activation of output event [E5680] occurs on the third Monday of each month
- "...": ...
- "3. Friday": activation of output event [E5680] occurs on the third Friday of each month

- “4. Monday“: activation of output event [E5680] occurs on the fourth Monday of each month
-:
- “4. Friday“: activation of output event [E5680] occurs on the fourth Friday of each month
- “5. Monday“: activation of output event [E5680] occurs on the fifth Monday of each month
-:
- “5. Friday“: activation of output event [E5680] occurs on the fifth Friday of each month

P Time

Specific time at which the output event [E5680] is being activated in dependence of the selected mode and of the specific duration set by parameter “Pulse”; the set time is to be registered as “hours:minutes:seconds” = “00:00:00”

P Pulse

Specific duration of time the output event [E5680] is being activated for, in dependence of the selected mode, selected setting option of parameter “Day” and specific time set by parameter “Time”.

4 Maintenance, Servicing and Retesting

The devices of SYMAP[®]-Compact product line were designed numerically. All functions base on tested hardware and software.

Maintenance

All devices of SYMAP[®]-Compact product line are maintenance-free. However, there are some certain, life-limited components, which cause replacement according to the given replacement cycles listed in the table below. Following components are to be considered:

- *Akku, Type ML2430*; for storage of data in the RAM memory and for maintenance of counting date and time. The buffering time of a fully charged accumulator (stand-by operation) is about 50 days. Manufacturer's warranted life time of the accumulator is about 10 years.

Table 4-1 Life-limited components

Component	Type	Function	Failure consequences	Replacement cycle	Replacement
Akku	ML2430, (removable)	Storage of data in the RAM memory	Loss of data after complete discharge of the accumulator	c. every 10 years	Stucke Elektronik GmbH
		Maintenance of counting date and time after disconnecting SYMAP [®] -Compact(+) power supply	Reset of date and time to default values after complete discharge of the battery		

Servicing

All devices of the product line SYMAP[®]-Compact provide extensive self supervision functions for signalling different internal faults. Replacement of the life-limited components (see table above) may be undertaken only under ESD-conform conditions at the device manufacturer's facility.

Retesting

A repeating secondary test is mainly to check the function of the hardware including the wiring on a regular basis. Moreover, any non-documented changes of parameter settings can be detected.

Retesting intervalls are to be allocated by the user. All repeated tests for functionality checks as simplified functionality tests and secondary protection tests as complete check of the protection system fall in the scope of the regulation, which apply to valid standards for the plant area requiring the use of SYMAP[®]-Compact(+) devices.

5 Safety guidelines

CAUTION: Please take note of the following safety guidelines for the procedures listed below!

Table 5-1 SYMAP[®]-Compact(+) Safety guidelines

Procedure	Safety guidelines	Link
Load parameter file	CAUTION: If a parameter file is directly loaded in the SYMAP [®] -Compact(+), the device proceeds to new start of the system (system reboot). Booting time takes ca 4 s. During the booting time SYMAP [®] -Compact(+) does <u>not</u> provide any protective function!	Chap. 5.3
Firmware-Update	CAUTION: While being in "booting" mode SYMAP [®] -Compact(+) does not provide any device functionality – in particular <u>no</u> protective function!	Chap. 5.4

6 Trouble-shooting

Find some of the device's error messages or messages occurring during application of the configuration software „SYMAP®-Compact Parameter Tool (SCPT)“ listed in the following. Beyond that, details on the messages are given and measures for clearance suggested.

SYMAP®-Compact(+):

Table 6-1 Watchdog event

Event no.	Error message	Meaning	Measure
9000	Watchdog event	System-internal hardware error	• Hardware reset • If not successful please contact manufacturer

SYMAP®-Compact Parameter Tool (SCPT):

Table 6-2 Error messages

Error message	Meaning	Measure
Error in communication	Faulty communication	Check connection between computer/notebook and device
Error while sending data	Faulty data transmission	Re-establish connection and repeat loading procedure
Update failed (firmware)	• Communication link interrupted or • Device not operating in boot loader mode or • Faulty firmware	• Check connection between computer/notebook and device • Set device to boot loader mode again by holding depressed the key at the back of the device and proceed to hardware reset before releasing key • Repeat flashing procedure • If not successful please contact manufacturer

7 Technical Data

7.1 General Technical Data

Table 7-1 General Technical data of the SYMAP[®]-Compact(+) device variants

Description	Specification	
Design	Flush-mounted housing for front panel cutout	
Front panel dimensions (W x H x D)	SYMAP [®] -Compact:	210 x 210 x 87 (mm)
	SYMAP [®] -Compact+:	210 x 250 x 90 (mm)
Front panel cut-out (W x H)	SYMAP [®] -Compact:	192 x 192 (mm)
	SYMAP [®] -Compact+:	192 x 232 (mm)
Weight	SYMAP [®] -Compact:	ca. 2,2 kg
	SYMAP [®] -Compact+:	ca. 2,6 kg
Installation position	vertical; +/-34°	
Power supply	According to ordering options: 9-36 V DC; (Ur: 24V DC) or 40-160 V DC; (Ur: 48V DC*; 60V DC; 110V DC) or 120-370 V DC; 85-264 V AC; (Ur: 220V DC; 110V AC; 230V AC**)	
Power consumption	< 20 W	
External fuse	4A; "T-type"	
Boot phase	Duration between switching on power supply to activation of device functions (full functionality) is 10 s	
Protection type	Front panel Back housing	IP54 (IEC 60529) IP20 (IEC 60529)
Cross section, max.	Spring-loaded terminals Measuring input terminals (CT, PT)	Max. 1,5 mm Max. 6 mm

* Ur +20%/-16%

**Ur +15%/-20%

7.2 Type tests – Hardware

7.2.1 Environment

Table 7-2 Type tests – Environment

Description	Specification		Test method
Environment	Temperature/Humidity		
	Operating temperature:	-20°C to +70°C	DIN EN 60255-27: 2005
	Storage temperature:	-40°C to +70°C	
	Transport temperature:	-40°C to +70°C	
	Rel. humidity:	< 80 %	EN 60068-2-30: 2006
Mechanical strength	Vibrations, sinusoidal form		
	Frequency range:	10 Hz to 150 Hz	DIN EN 60255-21-1: 1996
	Acceleration:	1,0 g	
	Testing time per axis:	20 cycles	
	Sweep velocity:	1,0 Okt/min	
	Earthquake test		
	Frequency range:	5 Hz to 35 Hz	DIN EN 60255-21-3: 1995
	Crossover frequency:	8,1 Hz	
	Magnitude:	+/- 7,5 mm X- and Y-Achse; +/- 3,5 mm Z-Achse	
	Acceleration:	2.0 g X- and Y-Achse; 1,0 g Z-Achse	
	Testing time per axis:	Je 1 cycle	
	Sweep velocity:	1,0 Okt/min	
	Shock test		
	Shock form:	Half sinus	DIN EN 60255-21-2: 1995
	Spitzenbeschleunigung:	5,0 g	
	Schockdauer:	11 ms	
	Richtung:	+/- X; +/- Y; +/- Z	
	Temperature:	Room temperature T _R	
	No. per direction and temperature:	3	
	Total no.:	18	

7.3 Type tests – Software

7.3.1 Protective functions – Accuracy

Table 7-3 Overview of accuracies of measuring inputs concerning protection functions

Protection function ANSI	Pick-up		Measurement	Delay time	Measurement
	Range	Steps (ref. to nominal value [%])	ACCURACY (ref. to nominal [%] or absolute value)	Setting range (t_{set})	ACCURACY (ref. to nominal [%] or absolute value)
27 Undervoltage	5,0 % to 200,0 % of U_n	0,1 %	+/-0,5 %	0 s to 999999,999 s	+/-5% of t_{set} or +/- 20ms
27T Undervoltage, time-depend.	5,0 % to 99,9 % of U_n	0,1 %	+/-0,5 %	see curve	+5% of t_{set} or +25ms
27Q Undervoltage/ Reactive Power	80 % to 90 % of U_n	0,1 %	+/-0,5 %	0 s to 999999,999 s	+/-5% of t_{set} or +/- 45ms
	2% to 20% of I_n	0,1 %	+/-0,5 %		
	1% to 10% of S_n	0,1 %	+/- 0,5% of S_n and +/-20% of max. set value		
50 Instantaneous overcurrent	up to $3 \times I_n$ up to $30 \times I_n$	0,1 %	+/-0,5 % +/-1,0 %	0 s to 999999,999 s	
50G Instantaneous earth overcurrent	up to $3 \times I_n$ up to $20 \times I_n$	0,1 %	+/-0,5 % +/-1,0 %	0 s to 999999,999 s	
51 Time overcurrent	up to $3 \times I_n$ up to $30 \times I_n$	0,1 %	+/-0,5 % +/-1,0 %	0 s to 999999,999 s (DEFT) or see IDMT curve	
51G Time earth overcurrent	up to $3 \times I_n$ up to $20 \times I_n$	0,1 %	+/-0,5 % +/-1,0 %	0 s to 999999,999 s (DEFT) or see IDMT curve	
59 Overvoltage	5,0 % to 200,0 % of U_n	0,1 %	+/-0,5 %	0 s to 999999,999 s	+/-5% of t_{set} or +/- 20ms
59N/G Neutral voltage displacement (NVD)	5.0 % to 200,0 % of U_n	0,1 %	+/-0,8 %	0 s to 999999,999 s	+/-5% of t_{set} or +/- 20ms
78 Vector surge	1 to 13° 13 to 25°	0,1°	+/- 0,7° +/- 1,7°	0,5 to 999999,999s	+/- 5% of t_{set} or +/- 60ms
	-	-	-	Reset delay time trip	+/-10ms
	-	-	-	Current increase time	+/-5% of t_{set} or +/- 50ms
81 Under/Over frequency	10 Hz to 70 Hz	0,1 %	+/-10 mHz	0 s to 999999,999 s	+/-5% of t_{set} or +/- 40ms
81R RoCoF (df/dt)					
87 Current differential protection	up to $3 \times I_n$ up to $20 \times I_n$	0,1 %	+/-1,0 % +/-2,5 %		

7.4 Binary Inputs and Outputs

7.4.1 Binary Inputs

Table 7-4 Specifications of binary inputs of the SYMAP[®]-Compact(+) device variants

Description	Specification		
Allgemein	Number	5 pcs or 19 pcs (depending on device variant)	
	Voltage range	5 -230 V AC/DC	
	Max. turn-on delay	X2.3:30 (Function 10) X2.5:66 (Function 24) X2.3:31 to 43 X2.5:67 to 70	20 ms 20 ms 50 ms 50 ms
	Max. turn.off delay	X2.3:30 (Function 10) X2.5:66 (Function 24) X2.3:31 to 43 X2.5:67 to 70	< 1 ms < 1 ms 100 ms 100 ms
DC	10 – 75 V DC	Power consumption Max. current HIGH level LOW level Kurzschluss ¹ Drahtbruch	0,5 W ±30% 7 mA 5,1 mA ±10% 4,1 mA ±10% 5,9 mA < x < 6,1 mA 2 mA < x < 3 mA
	75 – 230 V DC	Power consumption Max. current HIGH level LOW level Kurzschluss Drahtbruch	0,8 W ±30% 3,5 mA 1,7 mA ±10% 1,4 mA ±10% 2,2 mA < x < 2,3 mA 0,75 mA < x < 1 mA
AC	10 – 75 V AC	Power consumption Max. current HIGH level LOW level	0,3 W ±30% 4 mA ±10% x > 2,5 mA 2,2 mA < x < 1,2 mA
	75 – 230 V AC	Power consumption Max. current HIGH level LOW level	0,5 W ±30% 2 mA x > 0,95 mA 0,6 mA < x < 0,4 mA

¹ Kurzschluss- und Drahtbruchüberwachung sind nur im DC-Spannungsbereich möglich

7.4.2 Binary Outputs

Table 7-5 Specifications of binary outputs of the SYMAP®-Compact(+) device variants

No.	Description	Specification
	General Number NOTE	5 pcs or 12 pcs (depending on device variant) For inductive loads: Make use of free wheel diodes!
"Sync. 1 ON"	Contact load Rated voltage (AC) Max. Switching voltage Continuous current Max. making current Max. breaking capacity(AC) Max. breaking capacity(DC) Contact switching times Max. turn-on delay Max. turn-off delay Mechanical contact life-cycle	250 V (AC*) 300 V DC; 400 V AC 8 A (AC/DC) 15 A (AC/DC) for 4 s 2000 VA 400 W if $U_L < 50$ V or 60 W if $U_L > 200$ V 10 ms 5 ms > 2 x 10 ⁶ Operating cycles (ON->OFF->ON, or OFF->ON->OFF)
"Shunt 1 (Trip)" "Shunt 2"	Contact load Rated voltage (AC) Max. Switching voltage Continuous current Max. making current Max. breaking capacity(AC) Max. breaking capacity(DC) Contact switching times Max. turn-on delay Max. turn-off delay Mechanical contact life-cycle	250 V (AC*) 300 V DC; 400 V AC 8 A (AC/DC) 15 A (AC/DC) for 4 s 2000 VA 240 W if $U_L < 30$ V or 20 W if $U_L > 100$ V 10 ms 5 ms > 2 x 10 ⁶ Operating cycles (ON->OFF->ON, or OFF->ON->OFF)
"LOCKOUT"	Contact load Rated voltage (AC) Max. Switching voltage Continuous current Max. making current Max. breaking capacity(AC) Max. breaking capacity(DC) Contact switching times Max. turn-on delay Max. turn-off delay Mechanical contact life-cycle	250 V (AC*) 300 V DC; 400 V AC 8 A (AC/DC) 15 A (AC/DC) for 4 s 2000 VA 240 W if $U_L < 30$ V or 75 W if $U_L > 100$ V 10 ms 5 ms > 2 x 10 ⁶ Operating cycles (ON->OFF->ON, or OFF->ON->OFF)
"Function 1" "Function 2" "Function 3" "Function 4" "Function 5"	Contact load Rated voltage (AC) Max. Switching voltage Continuous current Max. making current Max. breaking capacity(AC) Max. breaking capacity(DC) Contact switching times Max. turn-on delay Max. turn-off delay Mechanical contact life-cycle	250 V (AC*) 300 V DC; 400 V AC 6 A (AC/DC) 10 A (AC/DC) for 4 s 1500 VA 150 W if $U_L < 25$ V or 45 W if $U_L = 100$ V 12 ms 5 ms 10 x 10 ⁶ Operating cycles (ON->OFF->ON, or OFF->ON->OFF)
"Function 6" "Function 7" "Function 8"	Contact load Rated voltage (AC) Max. Switching voltage Continuous current Max. making current Max. breaking capacity(AC) Max. breaking capacity(DC) Contact switching times Max. turn-on delay Max. turn-off delay Mechanical contact life-cycle	250 V (AC*) 300 V DC; 400 V AC 8 A (AC/DC) 10 A (AC/DC) for 4 s 2000 VA 150 W if $U_L < 25$ V or 60 W if $U_L = 100$ V 7 ms 3 ms 30 x 10 ⁶ Operating cycles (ON->OFF->ON, or OFF->ON->OFF)

7.5 Measuring Inputs – Voltage and Current

Table 7-6 Specifications of the SYMAP®-Compact(+) analog inputs

No.	Description	Specification	
1	Current inputs for I-measurement	Conventional current transformer (CT)	Current measuring inputs: CT1, CT2, CT3, CT-GND1, CT-GND2, frequency: 45 Hz to 65 Hz
			Nominal current In: 1 A or 5 A
			Meas. range: 0 to 20 x In => Tolerance: 0,5% In 20 to 40 x In => Tolerance: 5% In
			Accuracy*: 0,2 % at 0 to 3 x In (M: measuring transformer); 0,5 % at 3 to 20 x In (P: protection transformer) Relative accuracy refers to full scale value (3 x In or 20 x In)!
			Accuracy of angle measurement Current/Voltage: at I < 20% In: +/- 2°
			Load per phase 1 A: at 1 x In: approx. 0,007 VA at 20 x In: approx. 2,8 VA at 100 x In: approx. 1,5 kVA Devices with differential current input (compensation) have a load of: 0,014 VA / 5,6 VA per phase
			Load per phase 5 A: at 1 x In: approx. 0,13 VA at 20 x In: approx. 45 VA at 100 x In: approx. 15 kVA Devices with differential current input (compensation) have a load of: 0,26 VA / 90 VA per phase
			AC overcurr. 1 A: 250 x In for 0,5 oscillations 100 x In, < 1 s 30 x In, < 10 s 20 x In, continuous
			AC overcurr. 5 A: 100 x In for 0,5 oscillations 50 x In, < 1 s 30 x In, < 5 s 4 x In, continuous
			Combined sensors
With a connecting cable (4 mm²; Länge:2,5 m) and a 5 A current transformer, the total load at 20 x In (5 A) amounts to 227 VA			
2	Voltage inputs for U-measurement	Conventional potential transformer (PT)	Voltage measuring inputs: PT1, PT2, PT3, PT-GND1
			Typical nominal voltages Un(AC): 100 V/110V/400V/690 V
			Measuring ranges Lower range: 50 bis 200V AC Upper range: 200 bis 700V AC
			Accuracy: 0,5 % Relative accuracy refers to full scale value (2 x Un)!
			Load per phase: at Un=100 V: approx. 0,3 VA at Un=200 V: approx. 0,6 VA at Un=400 V: approx. 1,2 VA at Un=700 V: approx. 2,4 VA
			Combined sensors
For current and voltage measurement (No. 1 + No. 2), a distortion factor k < 5% is assumed.			

* Accuracy value only applies for SYMAP®-Compact+ devices with separate measuring and protection transformers.

7.6 Communication Interfaces

Table 7-7 Specification of SYMAP®-Compact(+) communication interfaces

Description	Designation	Specification	
Service interface (side of housing)	"MSD"	Interface:	standard; mini USB; for parameter setting
Service interface (front panel)	-	Interface:	standard; USB-A; for parameter setting and optional selection of user levels
RS485 (back panel)	X2.6	Interface: Terminals, half duplex: Settable symbol rates (Baud rate): Transmission distance, max.: Data protocol: Number of users: Signal wiring: NOTE: Characteristic impedance between 108 Ohm and 132 Ohm. The A/B lines of the two devices with the maximum distance between them should be limited by a 120 Ω resistor at both ends. We recommend a maximum length of A/B lines of 10m.	standard; electrical; galvanically isolated X2.6: 26, 27 9600 Bd, 19200 Bd, 38400 Bd and 57600 Bd 1 km Modbus RTU max. 255 shielded, twisted-pair
D-SUB (back panel)	X17	Interface: Terminals: Data protocol: Number of users: max.	ordering option; electrical socket, 9-pole Profibus DP 123
IEC61850 (back panel)	X4	Interface: Terminals: Fibre type: Diameter sleeve: Diameter core: Connection type: Wavelength: Transmitter (TxD) output optical power 62,5/125 µm: Transmitter (TxD) output optical power 50/125 µm: Receiver (RxD) input optical power minimum: Transmission distance, max.: Network topology: Number of users:	ordering option; fibre optics (FO); multimode X4: 3(TxD), 4(RxD) glass fibre or plastic fibre 125µm 50µm or 62,5µm ST® 1300 nm -20dBm avg. -23,5dBm avg. -31,8dBm avg. 2 km star max. 255

8 Order Information

Order code_v1-1.3; Order information: v1.8.3		Ordering identifier				
SYMAP[®]-Compact		Ordering option				
	Device variant					
F0	Protection system: voltage relay (6 x U; 1 x U _{GND1}) ANSI: 25, 27, 27T, 47, 59, 59N/G, 74TC, 78, 81, 81R, 86, PTS					
F1	Protection system: current relay (3 x I, 1 x I _{GND1}) ANSI: 37, 46, 49, 50BF, 50/51, 50/51G, 51LR, 64REF, 66, 74TC, 79, 86, 95i, CLP, CTS, SOTF					
+F1	Protection and control system: current relay (3 x I, 1 x I _{GND1}) ANSI: 37, 46, 49, 50BF, 50/51, 50/51G, 51LR, 64REF, 66, 74TC, 79, 86, 95i, CLP, CTS, SOTF					
F2	Protection system: current relay (3 x I, 1 x I _{GND1} , 1 x U _{GND1}) ANSI: 37, 46, 49, 50BF, 50/51, 50/51G, 51LR, 59N/G, 64REF, 66, 67G, 74TC, 79, 86, 95i, CLP, CTS, SOTF, YG, TG					
+F2	Protection and control system: current relay (3 x I, 1 x I _{GND1} , 1 x U _{GND1}) ANSI: 37, 46, 49, 50BF, 50/51, 50/51G, 51LR, 59N/G, 64REF, 66, 67G, 74TC, 79, 86, 95i, CLP, CTS, SOTF, YG, TG					
F3	Protection system: current and voltage relay (3 x I, 3 x U, 1 x I _{GND1} , 1 x U _{GND1}) ANSI: 24, 27, 27Q, 27T, 32, 37, 40, 46, 47, 49, 50BF, 50/51, 50/51G, 51LR, 51/46VR, 55, 59, 59N/G, 64REF, 66, 67, 67G, 74TC, 78, 78S, 79, 81, 81R, 86, 95i, CLP, CTS, PTS, SOTF, YG, TG					
+F3	Protection and control system: current and voltage relay (3 x I, 3 x U, 1 x I _{GND1} , 1 x U _{GND1}) ANSI: 24, 27, 27Q, 27T, 32, 37, 40, 46, 47, 49, 50BF, 50/51, 50/51G, 51LR, 51/46VR, 55, 59, 59N/G, 64REF, 66, 67, 67G, 74TC, 78, 78S, 79, 81, 81R, 86, 95i, CLP, CTS, PTS, SOTF, YG, TG					
F4	Protection system: current and voltage relay (3 x I, 6 x U, 1 x I _{GND1} , 1 x U _{GND1}) ANSI: 24, 25, 27, 27Q, 27T, 32, 37, 40, 46, 47, 49, 50BF, 50/51, 50/51G, 51LR, 51/46VR, 55, 59, 59N/G, 64REF, 66, 67, 67G, 74TC, 78, 78S, 79, 81, 81R, 86, 95i, CLP, CTS, PTS, SOTF, YG, TG					
+F4	Protection and control system: current and voltage relay (3 x I, 9 x U, 1 x I _{GND1} , 1 x U _{GND1}) ANSI: 24, 25, 27, 27Q, 27T, 32, 37, 40, 46, 47, 49, 50BF, 50/51, 50/51G, 51LR, 51/46VR, 55, 59, 59N/G, 64REF, 66, 67, 67G, 74TC, 78, 78S, 79, 81, 81R, 86, 95i, CLP, CTS, PTS, SOTF, YG, TG					
EC0	Gen-Set control (without U/I measuring) ANSI: 5, 12, 15					
EC1	Gen-Set control incl. protective functions (9 x U) ANSI: 5, 12, 15, 24, 25, 27, 27T, 47, 59, 59N/G, 74TC, 78, 81, 81R, 86, PTS					
EC2	Gen-Set control incl. protective functions (3 x I, 9 x U, 1 x I _{GND1}) ANSI: 5, 12, 15, 24, 25, 25A, 27, 27Q, 27T, 32, 40, 46, 47, 49, 50BF, 50/51, 50/51G, 55, 51/46VR, 59, 59N/G, 67, 67G, 74TC, 78, 78S, 81, 81R, 86, 95i, SOTF, CLP, CTS, PTS					
EC3	Gen-Set control incl. protective functions (3 x I, 6 x U, 1 x I _{GND1} , 1 x U _{GND1}) ANSI: 5, 12, 15, 24, 25, 25A, 27, 27Q, 27T, 32, 40, 46, 47, 49, 50BF, 50/51, 50/51G, 55, 51/46VR, 59, 59N/G, 67, 67G, 74TC, 78, 78S, 81, 81R, 86, 95i, SOTF, CLP, CTS, PTS					
+EC4	Gen-Set control incl. protective functions (3 x I, 9 x U, 1 x I _{GND1} , 1 x U _{GND1}) ANSI: 5, 12, 15, 24, 25, 25A, 27, 27Q, 27T, 32, 40, 46, 47, 49, 50BF, 50/51, 50/51G, 55, 51/46VR, 59, 59N/G, 67, 67G, 74TC, 78, 78S, 79, 81, 81R, 86, 95i, SOTF, CLP, CTS, PTS					
	Phase current transformer CT1					
A	without (device variants: SYMAP [®] -Compact F0, EC0, EC1 only)					
B	CT1: 1 A secondary, rated current (0-20×In)					
C	CT1: 5 A secondary, rated current (0-20×In)					
D	CT1: 1A and 5 A secondary, rated current (1A: 0-20×In or 5A: 0-5×In), Gen-Set controls only !					
E	CT1-MP: 1 A secondary, rated current (M: 0-3×In, P: 0-20×In), SYMAP [®] -Compact+ only !					
F	CT1-MP: 5 A secondary, rated current (M: 0-3×In, P: 0-20×In), SYMAP [®] -Compact+ only !					
	Phase current transformer CT2					
0	without (Standard)					
1	CT2: 1 A secondary, rated current (0-20×In), SYMAP [®] -Compact+ only !					
2	CT2: 5 A secondary, rated current (0-20×In), SYMAP [®] -Compact+ only !					
	Phase current transformer CT3					
A	without (Standard)					
B	CT3: 1 A secondary, rated current (0-20×In), SYMAP [®] -Compact+ only !					
C	CT3: 5 A secondary, rated current (0-20×In), SYMAP [®] -Compact+ only !					
	Ground current transformer CT-GND1					
0	without (device variants: SYMAP [®] -Compact F0, EC0, EC1 only)					
1	CT-GND1: 1 A secondary, rated current (0-20×In)					
2	CT-GND1: 5 A secondary, rated current (0-20×In)					
3	CT-GND1: 1-3000mA, secondary rated current					

Ordering identifier		6	7	8	9	10	11	12	13	14
Ordering option										
	Ground current transformer CT-GND2									
A	without (Standard)									
B	CT-GND2: 1 A secondary rated current (0-20×In), SYMAP®-Compact+ only !									
C	CT-GND2: 5 A secondary rated current (0-20×In), SYMAP®-Compact+ only !									
D	CT-GND2: 1mA-3000mA secondary rated current, SYMAP®-Compact+ only !									
E	CT-GND2: 0 - 50 A DC (UL: up to 35A DC, IEC: up to 41A); SYMAP®-Compact+ without CT3 only !									
	Power supply – Device									
0	9-36 V DC; (Un: 12V DC; 24V DC)									
1	40-160 V DC; (Un: 48V DC**; 60V DC; 110V DC); **:Un+20%; -16%									
2	120-370 V DC; 85-264 V AC; (Un: 220V DC; 110V AC; 230V AC***); ***:Un+15%; -20%									
	Binary Inputs									
A	Standard (see device variant)									
B	19 pcs.; SYMAP®-Compact F0 to F4 only !									
	Binary Outputs									
0	Standard (see device variant)									
1	12 pcs.; SYMAP®-Compact F0 to F4 only !									
	Analog Inputs and Outputs									
A	without (Standard)									
B	2 pcs. Analog Inputs (4-20mA); not SYMAP®-Compact F0 to F4 ! and 2 pcs. Analog Inputs (Resistive sensor);not SYMAP®-Compact F0 to F4 ! and 2 pcs. Analog Outputs (4-20mA)									
C	2 pcs. Analog Inputs (4-20mA); not SYMAP®-Compact F0 to F4 ! and 2 pcs. Analog Inputs (Resistive sensor); not SYMAP®-Compact F0 to F4 ! and 2 pcs. Analog Outputs (4-20mA) and 2 pcs. Analog Outputs (+/-20mA); SYMAP®-Compact F0 to F4 !									
D	2 pcs. Analog Inputs (4-20mA); not SYMAP®-Compact F0 to F4 ! and 2 pcs. Analog Inputs (Resistive sensor); not SYMAP®-Compact F0 to F4 ! and 2 pcs. Analog Outputs (4-20mA) and 2 pcs. Analog Outputs (+/-20mA); not SYMAP®-Compact F0 to F4 ! and 1 pcs. Analogr Ausgang (+/-10V)									
E	2 pcs. Analog Inputs (4-20mA); not SYMAP®-Compact F0 to F4 ! and 2 pcs. Analog Inputs (Resistive sensor);not SYMAP®-Compact F0 to F4 ! and 2 pcs. Analog Outputs (4-20mA) and 2 pcs. Analog Outputs (+/-20mA); not SYMAP®-Compact F0 to F4 ! and 1 pcs. Analog Output (PWM)									
	Communication – Basic									
0	Standard (Modbus RTU; RS422/RS485; half- and full-duplex)									
1	Blue Vision; RS422/RS485 (half- and full-duplex)									
	Communication – Interfaces									
A	Standard (see device variant)									
B	CANBUS3 (Engine control); Gen-Set controls only !									
C	USB-A (at front plate); Gen-Set controls only !									
D	CANBUS3 and USB-A (at front plate); (Engine control); Gen-Set controls only !									
E	Fibre optic (FO); Line diff. protection (2km; POF 2,5 (ST plug); Multimode 860 nm; diameter 65/125 um); not SYMAP®-Compact F0 and EC0 to EC3 !									
F	Fibre optic (FO); Line diff. protection (20km; POF 2,5 (ST plug); Monomode 1300 nm; diameter 9/125 um); not SYMAP®-Compact F0 and EC0 to EC3 !									
G	RS422 (full-duplex, length of line: 300m); Line diff. protection; not SYMAP®-Compact F0 and EC0 to EC3 !									
	Communication – SCADA									
0	without (Standard)									
1	Profibus DP; RS485: D-SUB9									
2	Profibus DP; fibre optic FO; not SYMAP®-Compact EC0 to EC3 !									
3	IEC 60870-5-103; RS485; not SYMAP®-Compact EC0 to EC3 !									
4	IEC 60870-5-103; fibre optic FO; not SYMAP®-Compact EC0 to EC3 !									
5	IEC 61850; RJ45 (Ethernet, ring topology), not SYMAP®-Compact EC0 to EC3 !									
6	IEC 61850; RJ45 (Ethernet, star topology), not SYMAP®-Compact EC0 to EC3 !									
7	IEC 61850; fibre optic FO (ring topology), not SYMAP®-Compact EC0 to EC3 !									
8	IEC 61850; fibre optic FO (star topology); not SYMAP®-Compact EC0 to EC3 !									
9	Modbus TCP/IP; RJ45 (Ethernet)									
	Recorder unit									
A	Standard (see device variant)									
B	with; Gen-Set controls only !									

Ordering identifier		15	16	17	18	19	20	21	22
Ordering option									
	Additional protection function								
0	without (Standard)								
1	ANSI 21: Distance protection; SYMAP®-Compact F3, F4 und +F3, +F4 only !								
2	ANSI 87: Current differential protection; not SYMAP®-Compact F0, EC0, EC1 !								
3	G59 (ANSI 78 and 81R acc. to British GridCode); SYMAP®- Compact F0, F3, F4 and + F3, +F4 only!								
4	G59 und ANSI87; SYMAP®-Compact F3, F4 and + F3, +F4 only!								
	Key switches								
A	without (Standard)								
B	3 x USB-Stick, hardware-coded								
C	1 key switch								
D	2 key switches								
	Control and interlocking								
0	Standard (see device variant)								
1	Direct control: 8 SD, via ext. power circuit module; SYMAP®-Compact+ only !								
2	Indirect control: 1 SD; field interlocking: 3 SD; SYMAP®-Compact F0 to F4 only !								
	Safety Device								
A	without (Standard)								
B	DTOC protection (redundancy of first degree); SYMAP-Compact+ only!								
	Front plate (Design)								
0	Standard (design "Stucke")								
1	OEM design								
	Detached HMI panel								
A	without (Standard device)								
B	Basic device <u>with</u> detached HMI								
C	Basic device <u>without</u> detached HMI								
	Connectors U/I-measuring								
0	Weidmüller (I-measuring connector without integrated short- circuiters)								
1	SEOIL (I-measuring connector with integrated short- circuiters)								
	LED indications front plate								
A	Standard (see device variant)								
B	16 parametrizable LEDs; SYMAP®-Compact+ only !								

-  : Not available yet!
 : Software fct. not available yet!
 : On request!
 : So far, only SYMAP®-Compact+ !

Order code_v1-1.3; Order information: v1.8.3:

	Ordering option	Ordering identifier	
SYMAP®-Compact		1	<i>Device variant</i>
		2	<i>Phase current transformer CT1</i>
		3	<i>Phase current transformer CT2</i>
		4	<i>Phase current transformer CT3</i>
		5	<i>Ground current transformer CT-GND1</i>
		6	<i>Ground current transformer CT-GND2</i>
		7	<i>Power supply – device</i>
		8	<i>Binary Inputs</i>
		9	<i>Binary Outputs</i>
		10	<i>Analog Inputs and Outputs</i>
		11	<i>Communication – Basic</i>
		12	<i>Communication – Interfaces</i>
		13	<i>Communication – SCADA</i>
		14	<i>Recording Unit</i>
		15	<i>Additional protective function</i>
		16	<i>Key-switches</i>
		17	<i>Control and interlocking</i>
		18	<i>Safety Device (DTOC prot.; redundancy of first degree)</i>
		19	<i>Front plate (design)</i>
		20	<i>Detached HMI</i>
		21	<i>Connectors U/I-measuring</i>
		22	<i>LED indications front plate</i>



DET NORSKE VERITAS MANAGEMENT SYSTEM CERTIFICATE

Certificate No.: 95425-2011-AQ-GER-TGA

This is to certify that

stucke GmbH
elektronik

at headquarters:

Merkurring 26
22143 Hamburg - Germany

has been found to conform to the Management System Standard

ISO 9001:2008

This certificate is valid for the following product or service ranges:

**Electrical engineering company providing the development, production
and delivery of microprocessor protection relays, control units
and electrical switchgears**

Initial Certification date:

02.08.2002

This certificate is valid until:

31.07.2014

*The audit has been performed under the
supervision of*

Stephan Ekat
Lead Auditor



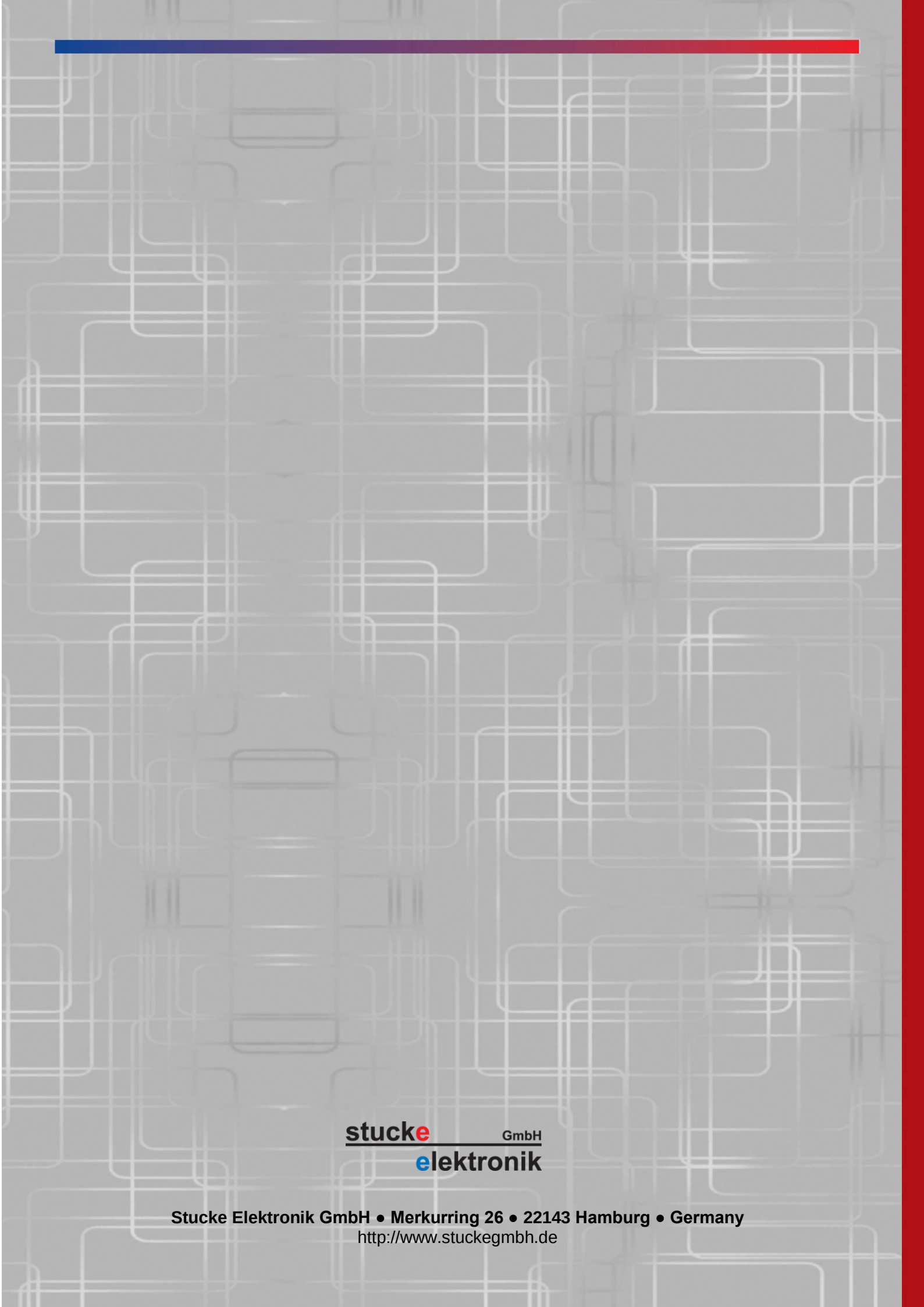
Place and date:

Essen, 01.08.2011

for the Accredited Unit:
DNV ZERTIFIZIERUNG UND UMWELTGUTACHTER GMBH

Nikolaus Kim
Management Representative

Lack of fulfilment of conditions as set out in the Certification Agreement may render this Certificate invalid.
DNV Zertifizierung und Umweltgutachter GmbH, Schnieringshof 14, 45329 Essen, Tel: +49 201 7296 300 Fax: +49 201 7296 333 - www.dnv.de/zertifizierung



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