GE
Grid Solutions

P60 Agile

P161, P162, P163

Technical Manual
Feeder Protection

Hardware version: A
Software version: 01
Publication reference: P16x/EN M/F

INTRODUCTION

CHAPTER 1

1 CHAPTER OVERVIEW

This chapter consists of the following sections:

2 INTRODUCTION

This manual describes the digital protection relays of the P60 Agile product line. This overview presents relay features, applications and functionalities.

Please see section 2.3.1 for detailed information on the protection functions of the P60 Agile variants.

2.1 General outline

The P60 Agile is a numerical relay for use in low, medium and high-voltage systems. With its integrated protective functions and HMI features, it is an efficient and cost-effective solution for protection and control. It is equipped with three high-performance micro-processors and offers a comprehensive range of protection functions for generators, motors (synchronous or asynchronous), transformers, power lines, and substations. All of the protection functions can be activated and used at any time and without restrictions.

In addition, it is possible to communicate between the P60 Agile and SCADA system via serial or Ethernet ports, with a choice of data protocols. These features guarantee the highest flexibility during commissioning and operational use.

2.2 Human machine interface (HMI)

Programming and operating a P60 Agile device is easy. A resistive touch screen allows menu navigation. Graphic representations, events and parameters can be individually created on a PC and transferred to the P60 Agile device. This customised design allows you to adapt the menus to your requirements.

To guarantee the highest possible safety standards, access to all P60 Agile settings is password protected.

The menu is navigated using the touchscreen from the main menu, which provides access to the submenus **Operating, Alarms & Events, Breaker, Parameters, Recording, Settings and Info.**

2.3 Functional scope

2.3.1 Hardware and software equipment

The P60 Agile is a full-fledged one box solutions (OBS) capable of protection, control and metering functions, whereas the P60 Agile are intended for applications where switchgear control is managed external to the protection device. The **P60 Agile** range offers different protection functions compliant with international standards. The P60 Agile has three variants and protection functions supported by each variant are shown as follows:

ANSI	FUNCTION	P161	P162	P163
21FL	Fault Locator			•
51/51N	IDMT overcurrent/earth fault protection	•	•	•
51 SEF	Sensitive Earth Fault	•	•	•
50/50N	Definite time overcurrent/earth fault protection	•	•	•
95i	Inrush Blocking	•	•	•
50BF	Breaker Failure protection	•	•	•
67	Directional overcurrent protection			•

ANSI	FUNCTION	P161	P162	P163
67N	Directional earth fault protection		•	•
YN	Neutral Admittance		•	•
59N	Residual Overvoltage		•	•
59	Overvoltage			•
27	Undervoltage			•
27T	Undervoltage,Time dependant (BDEW)			•
27Q	Reactive Power/Undervoltage (BDEW: Fault ride through)			•
81O	Overfrequency			•
81U	Underfrequency			•
78	Vector surge			•
81R	Rate of change of frequency (df/dt)			•
32	Power protection			•
79	Multishot Autoreclose	•	•	•
25	Check synchronising			•
CTS	CT supervision	•	•	•
VTS	VT supervision			•
74	Trip circuit monitoring	•	•	•
49	Thermal Overload	•	•	•
32N	Wattmetric earth fault protection		•	•
46	Negative sequence overcurrent	•	•	•
51V	Voltage dependent overcurrent (voltage restrained)			•
CLP	Cold load pick-up	•	•	•
46BC	Broken Conductor	•	•	•
64R	Restricted Earth Fault	•	•	•
SOFT	Switch On-To-Fault	•	•	•
37	Undercurrent detection (low load)	•	•	•
47	Negative sequence overvoltage			•
52	Pole discordance	•	•	•

***Note**:* *The table below represents the availability of protection functions at the final development state. Only the protective functions described in this manual are currently available.*

2.4 Diagnostics and monitoring

All three P60 Agile microprocessors have an integrated system for mutual monitoring. Self-supervision comprises the internal hardware components of P60 Agile, and is done through cyclical requests and plausibility checks.

P60 Agile detects the following internal faults:

P60 Agile Self-supervision - functions for error detection

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

Type of error	Description	Cycle (ms)	Delay (sec)	Detailed reason
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

P60 Agile self supervision – events about error detection

Event No.	Description	Cycle [ms]	Delay [s]	Detailed reason	Priority
E9000	Common alarm of system supervision	-	-	Active if any of the system supervision events are active	
E9001	Common alarm system total error	-	-	Active if a critical error is active (see column "Prio")	
E9002	CU CPU communication failure	1000	-	CAN Bus OFF	☑
E9003	MU CPU communication failure	1000	30	No CAN messages	☑
E9004	GU CPU communication failure	1000	30	No CAN messages	☑
E9005	ComU CPU communication failure	1000	30	No CAN messages	☑
E9006	CU Bad CPU communication	1000	-	iCAN Rx/Tx buffer overflow	☑
E9007	Firmware constellation invalid	1000	1	Firmware incompatible detected by one controller	☑
E9008	Unknown parameter file	1000	1	Unknown parameter file detected by one controller	☑
E9009	Unknown hardware	1000	1	Unknown hardware detected by one controller	☑
E9010	CU DRAM error	-	-	Write-Read-Test error (@ PowerON)	☑
E9011	CU Serial Flash error	1000	30	Wrong return value (ID) from driver	☑
E9012	CU Binary Inputs ADC SPI error	100	20	Test channel out of range/ Wrong channel address	☑
E9013	CU Binary Outputs DAC MAX4820 error	500	20	Wrong feedback signals	☑
E9014	CU Serial Port 1 Framing error	1000	30	Wrong Baudrate or noise	
E9015	CU Analogue Inputs ADC AD7914 error	100	20	Wrong channel numbers from ADC	
E9016	CU Profibus error	1000	20	VPC3+C Read-Test error	
E9017	CU SD card error	-	-	General SD card error	
E9018	CU Binary Inputs ADC I²C error	10	20	I²C communication error (No ACK, Bus error, etc).	☑
E9020	CU Parameter file error	1000	-	CRC error	☑
E9021	MU Parameter file error	1000	90	CRC error flag set	☑
E9022	GU Parameter file error	1000	90	CRC error flag set	☑
E9023	ComU Parameter file error	1000	90	CRC error flag set	☑
E9030	Event system feedback loop detected	1000	60	More than 500 event changes per sec during 60 seconds	☑

Event No.	Description	Cycle [ms]	Delay [s]	Detailed reason	Priority
E9040	MU kWh counter crc error	-	-	CRC error in SRAM (@ WD reset)	
E9041	MU EEPROM error	-	-	Communication error (@ system start)	☑
E9042	MU Calibration file crc error	-	-	CRC error in EEPROM (@ system start)	☑
E9043	MU Overload	-	-	CPU overload error	☑
E9044	MU ADC0 error	10000	30	Wrong channel numbers from ADC	☑
E9045	MU ADC1 error	10000	30	Wrong channel numbers from ADC	☑
E9046	MU Battery low alarm	-	-	The battery voltage falls below critical voltage level	
E9047	MU Calibration error	-	-	At least one analogue input (U/I) is not calibrated	☑
E9048	MU Battery defect	-	-	For the duration of 40 operating hours (battery charging time) the battery voltage has fallen permanently below a critical voltage level, so that a defective battery can be concluded.	

Note: System supervision events can only be reset using "ACK".

Following the detection of an internal error, the measures listed in the below table will be performed. If these measures are not successful, event [E9000] will be activated, which can be assigned to any binary output.

P60 Agile self-supervision - debugging and error message

Type of error	Measure	Activation of 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 (analogue digital converter) values	after third repetition
Binary Outputs	Reset the relay driver. Write the relay driver again	after third repetition

CAUTION: In the case of a power supply failure, all binary outputs are de-energised. While in booting mode the states of all binary outputs are maintained.

All three of the processor units monitor each other, as mentioned above. This monitoring is no longer available if two of the three processors have failed.

2.5 Terminal connections

The P60 Agile field interface is via plug-in connectors at the back of the device. This makes device replacement simple. The terminal blocks are divided into the following groups:

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

2.5.1 Analogue inputs for measurement

Depending on the device variant and ordering options, the P60 Agile provides a different number of measurement inputs for current and voltage measurement.

P60 Models	Analogue Inputs						
	Current			Voltage			
	CT1-M/P	CT1-M	CT-GND1	PT1	PT2	PT3	PT-GND1
P161	3	3*	1**	-	-	-	-
P162	3	3*	1**	-	-	-	1
P163	3	3*	1**	3	3	3	1

*   Ordering option

** Standard or SEF ordering option

-   Not available

Note: *The P60 Agile has been designed to operate with conventional current and potential transformers.*

All possible P60 Agile connections for current and potential transformers are listed below:

- Three phase current measurement inputs CT1-M/P
- Optionally, three phase current measurement inputs CT1-M*
- Single phase current measurement input CT-GND1 (ground current)
- Three-phase voltage measurement inputs PT1 (e.g. voltage at incoming feeder)
- Three-phase voltage measurement inputs PT2 (e.g. voltage at busbar 1)
- Three-phase voltage measurement inputs PT3 (e.g. voltage at busbar 2)
- Single-phase voltage measurement input PT-GND1 (residual voltage)

***** CT1: separate terminal connections: CT1-M for measuring core and CT1-P for protection core of current transformers

Note: *In the case of P60 Agile models with protection (CT1-P) and measurement (CT1-M) transformers, the protection functions process values of CT1-M for current values which are less than or equal to 2 x I_n. For higher current values the measuring values of the CT1-P are used.*

For normal operation both CT1-P and CT1-M should always be connected to the external CT.

In the 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 of CT1-P within the range of 2 x I_n.

CAUTION: If any of the voltage measurement inputs (e.g. PT1) is interconnected by V-connection of the voltage transformers to a power system, the relay terminal “N” <u>must not be connected</u> to anything.

If combined transformers (combined sensors) are used, the P60 Agile allows connection of feeding current/voltage:

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

The following values are measured via analogue inputs and displayed:

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

2.5.2 Binary inputs and outputs

The P60 Agile range offers 18x binary inputs and 12x binary outputs as standard.

2.5.3 Service port

To operate the P60 Agile device using a PC/notebook there is a USB-A interface located at the front of the device, and a mini-USB interface on the side. The side interface is useful when the relay is installed in switchgear where the panel front swings open for access.

2.5.4 Grounding instructions

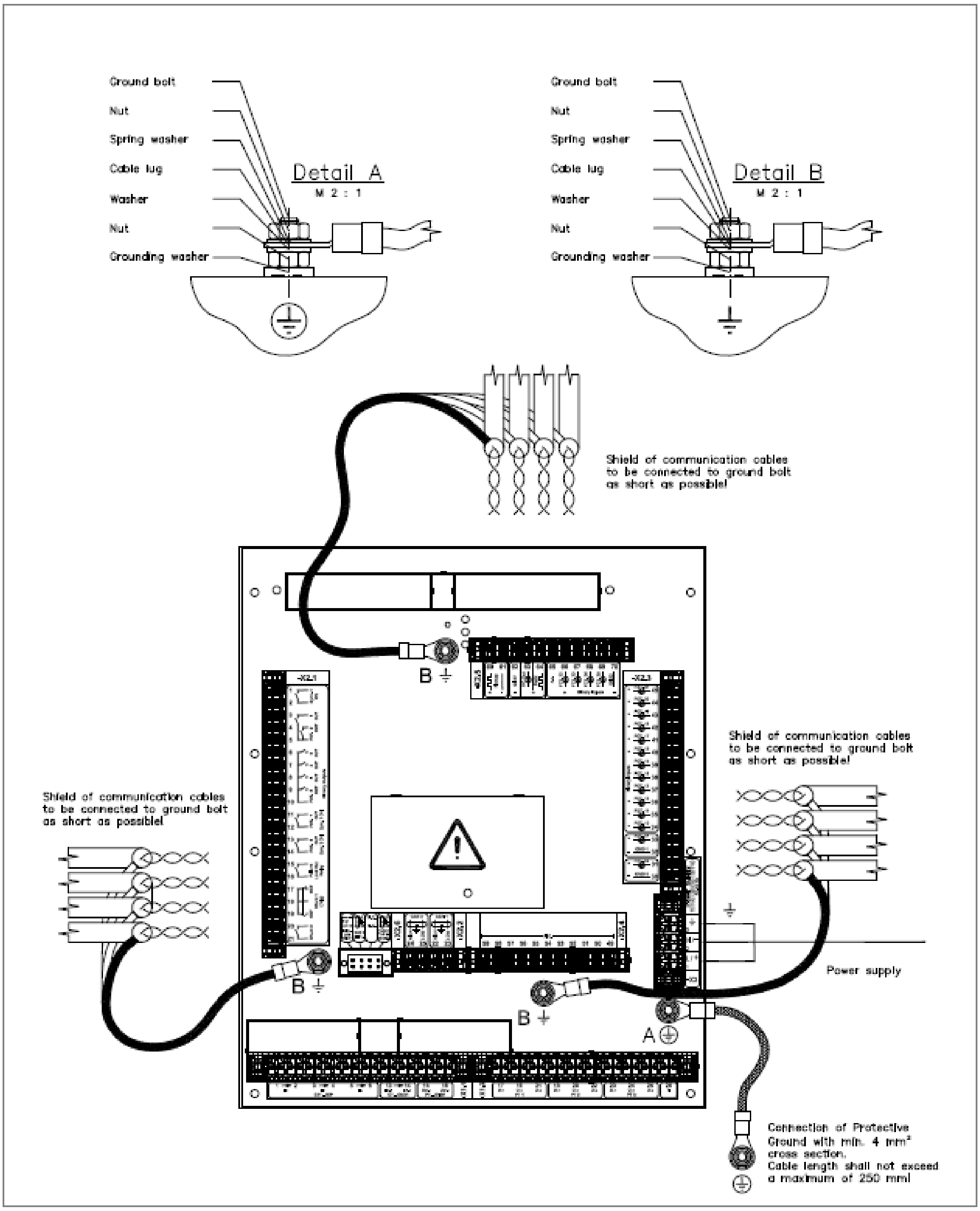


Figure 1 Grounding instructions for P60 Agile

Ground straps of 250mm in length and above are used to connect the grounding connection point of P60 Agile housing to the panel housing. The following table provides information about standard cross sections and dimensions of ground straps to be applied according to their length.

Ground straps – standard cross sections and dimensions

Length (l) [mm]	Cross section (A) [mm2]	Diameter of wire (d) [mm]	Dimensions (width x thickness) [mm2]
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

2.5.5 Connection diagrams

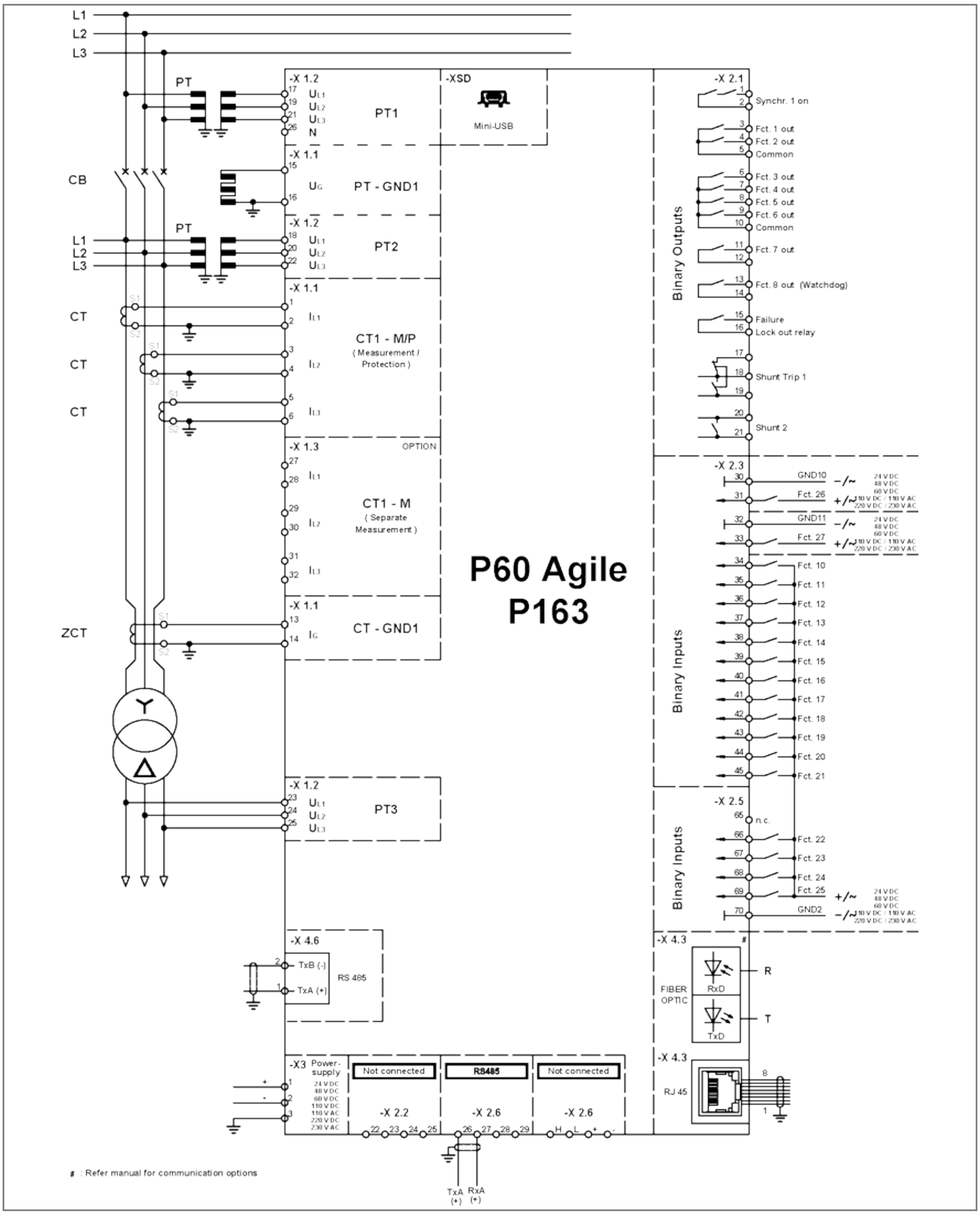


Figure 2 Connection diagram for P60 Agile P163

2.5.6 Communication interfaces (options):

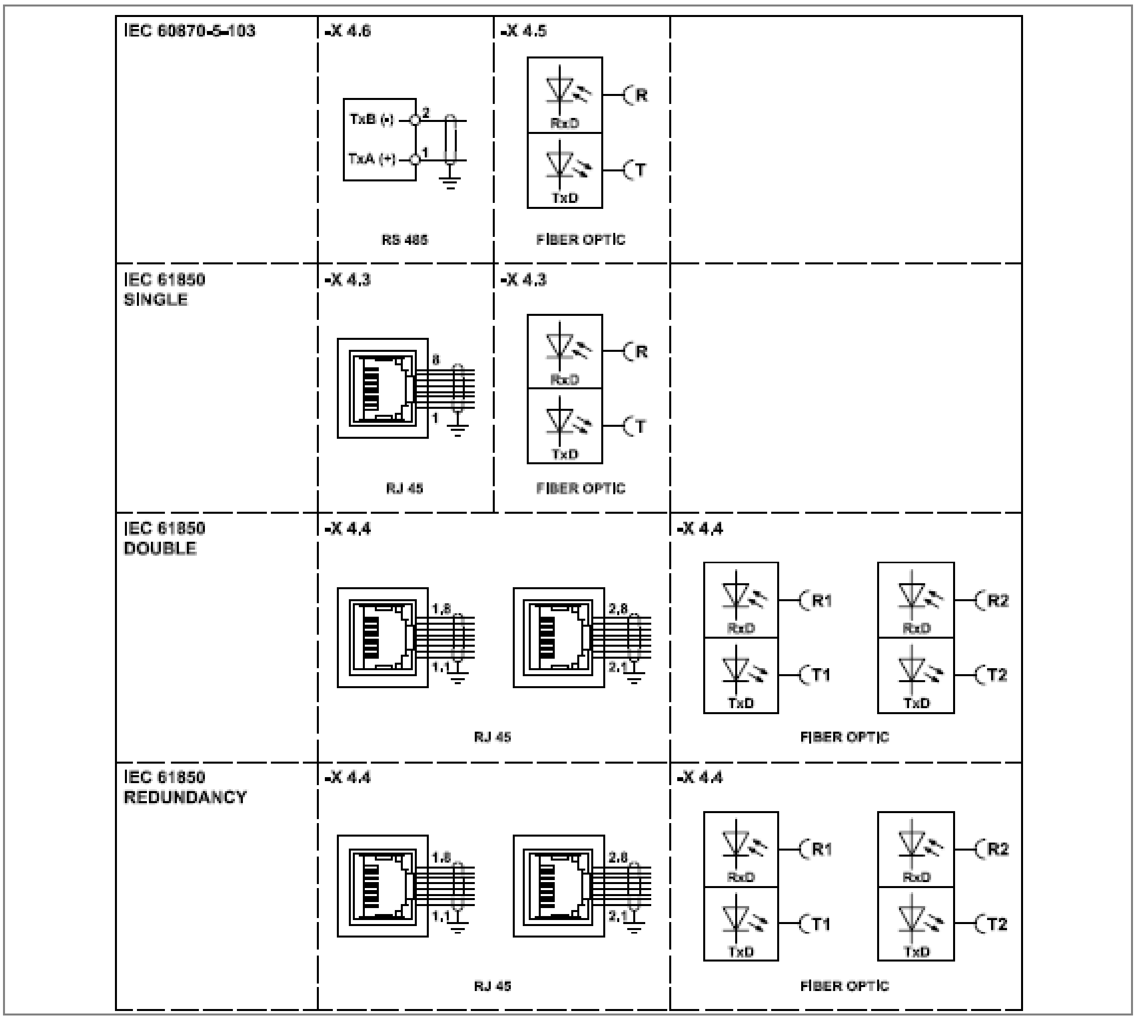


Figure 3 Connection diagram for P60 Agile: Communication interfaces (options)

Note: Communication options vary according to the ordering code.

2.5.7 Plug-In connection for auxiliary supply

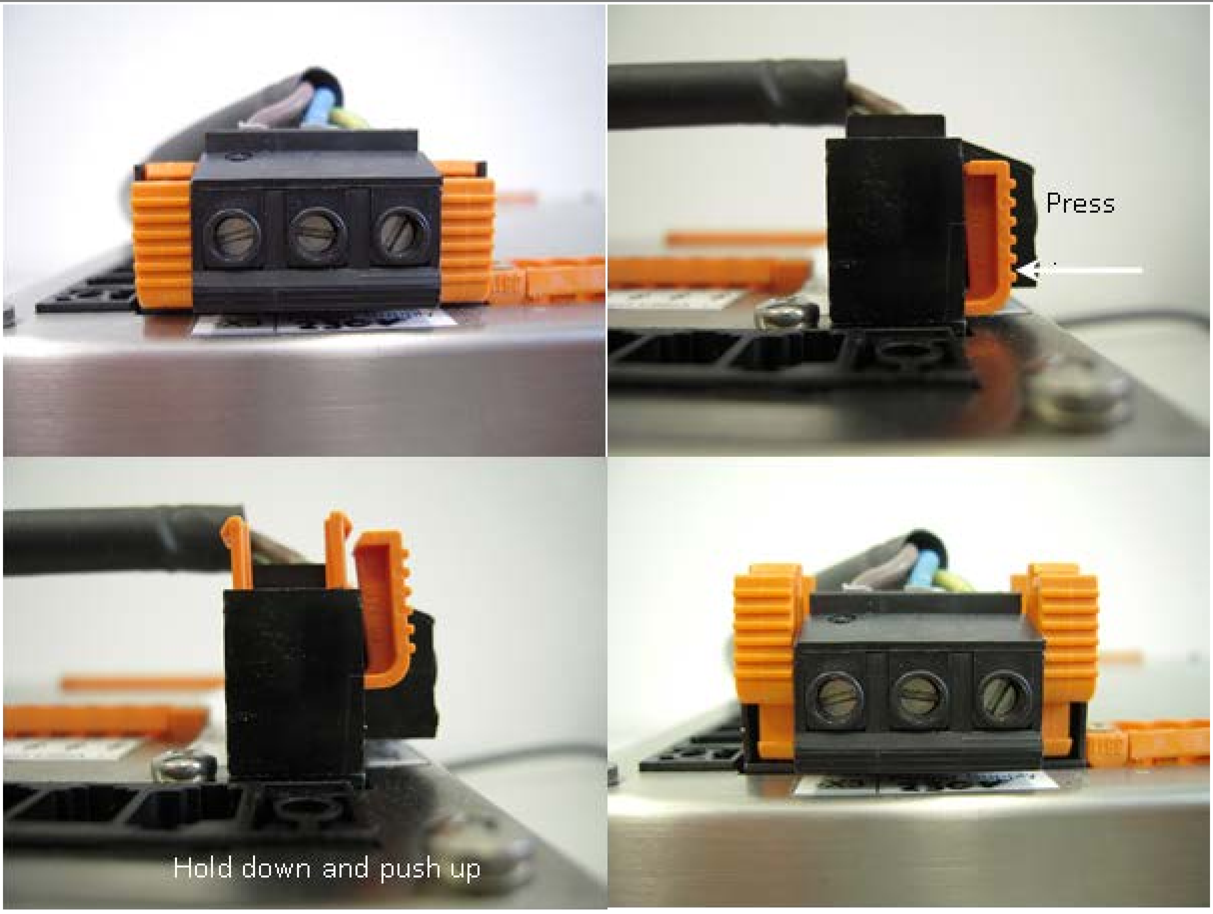


Figure 4 Releasing plug-in locking of device supply

> *Note: To release the plug-in connector, press the lower area of the grooved side where the lock catches.*

2.6 Mounting instruction

Before connecting and start-up it is necessary to install the device into a housing or switchgear cabinet. The following mounting instruction describes the installation of the P60 Agile P16x devices.

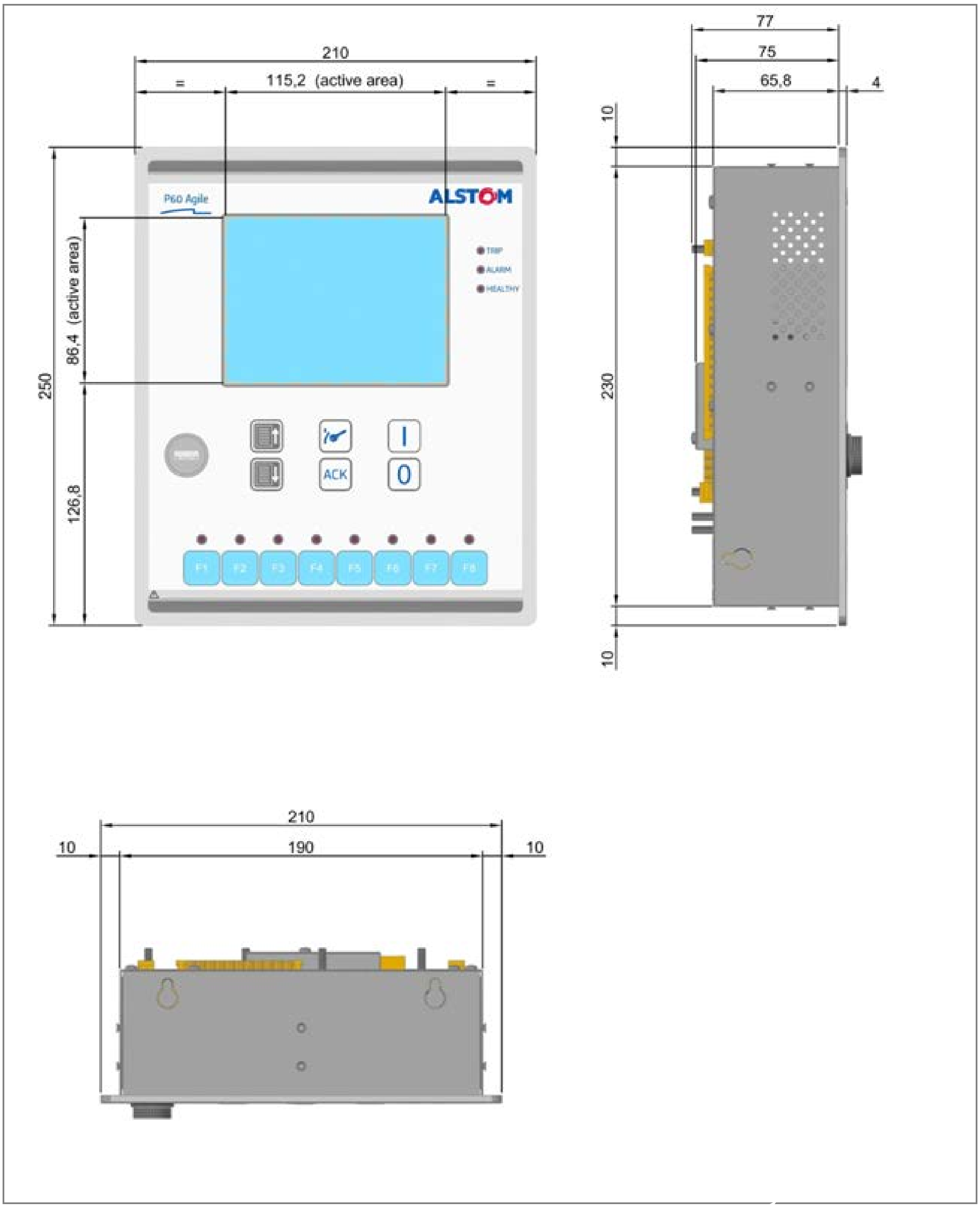


Figure 5 Detailed 3-view-drawing of P60 Agile P16x device

First, it is necessary to prepare a cut-out in the door panel of the cubicle. The only restriction regarding this is the size of the existing installation surface. This may not fall below the overall dimensions of the P60 Agile P16x device.

The figure below displays the dimensions of the device and the required cut-out:

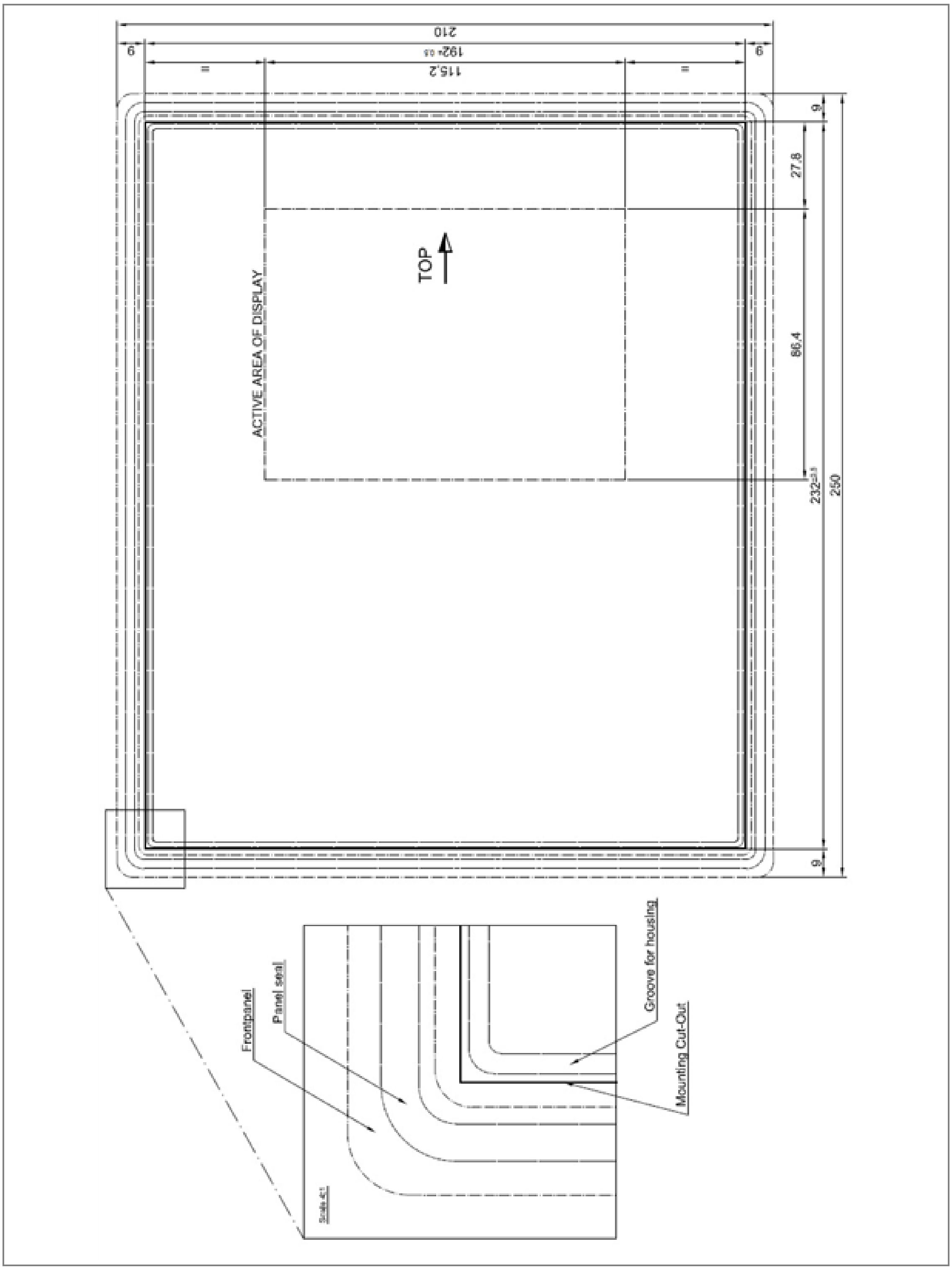


Figure 6 **Mounting and cut-out dimensions**

1. After finishing the cut-out it should look like the following example.

Figure 7 Cut-out for the P60 Agile P16x device

2. The device can now be fitted into the door panel.

Figure 8 P60 Agile P16x device placement in cut-out

3. For keeping the device position in the cut-out, employ a slight counter-pressure to the front plate of the device and look to the backside. Each side of the housing provides four bolt heads for installation of the fixing clamps:

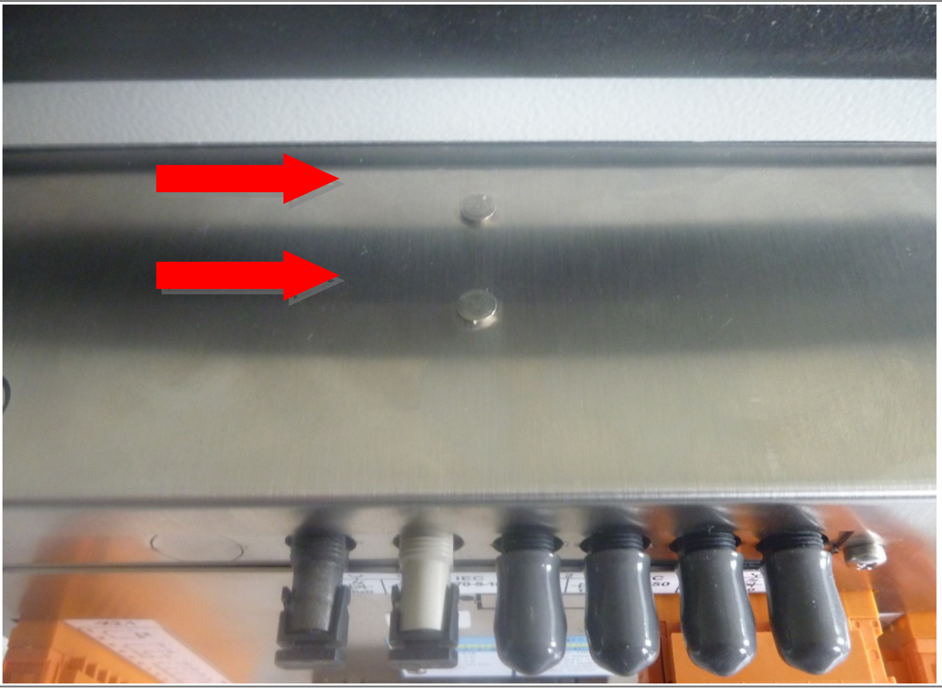


Figure 9 Bolt heads (e.g. on the top)

4. While holding the P60 Agile P16x device, click one fixing clamp to the that bolt head which is next to the rear of the housing:

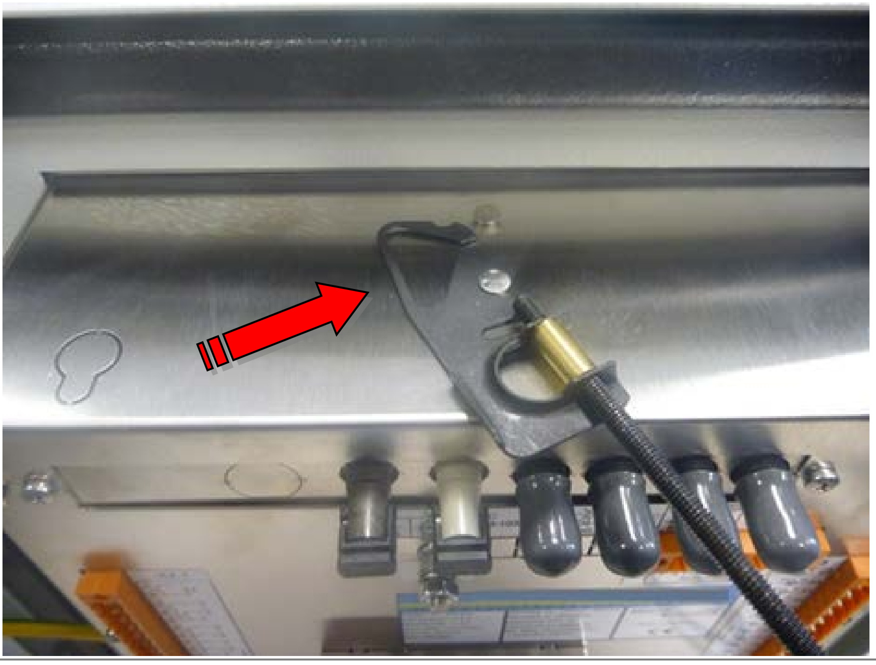


Figure 10 Installing fixing clamps

5. Now, turn the fixing clamp to the second bolt head with slight pressure. Hearing a click indicates the correct installation.

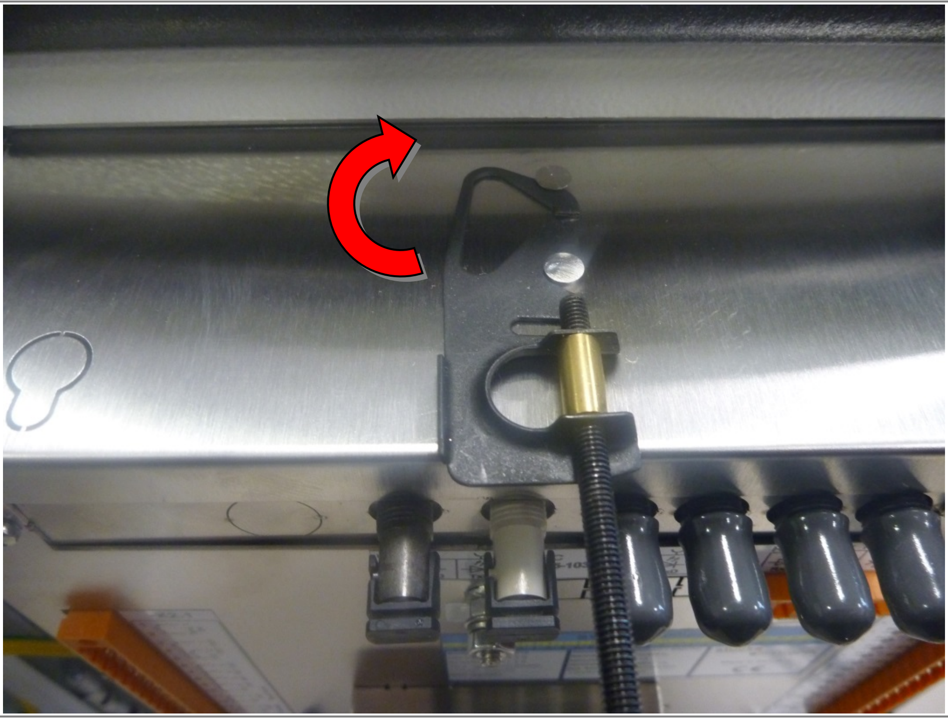


Figure 11 Fixing clamp in the bolt head

6. Thereafter, install the remaining three fixing clamps on the other sides of the housing. Now the four fastened fixing clamps can be tightened by using a screwdriver.

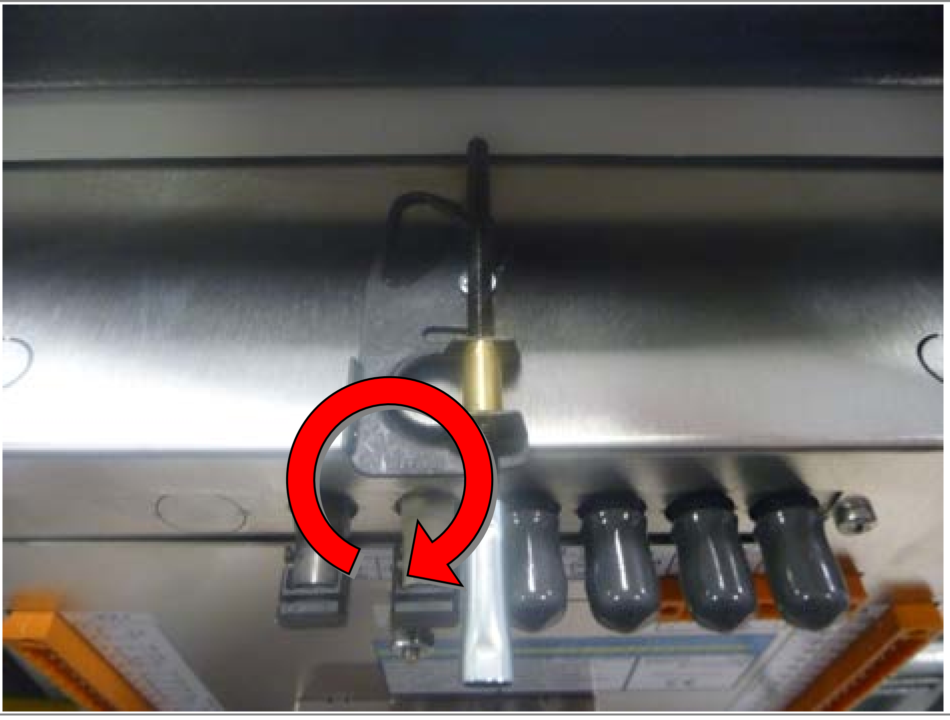


Figure 12 Finished installation

Note:	*Unmounting or changing the P60 Agile P16x device can be done in reverse order.*

OPERATION

CHAPTER 2

1 CHAPTER OVERVIEW

This chapter consists of the following sections:

2 OPERATION

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

2.1 Front panel

The interface of the P60 Agile consists of a large graphic LCD touchscreen.

The following figure represents the front panel and its elements in detail.

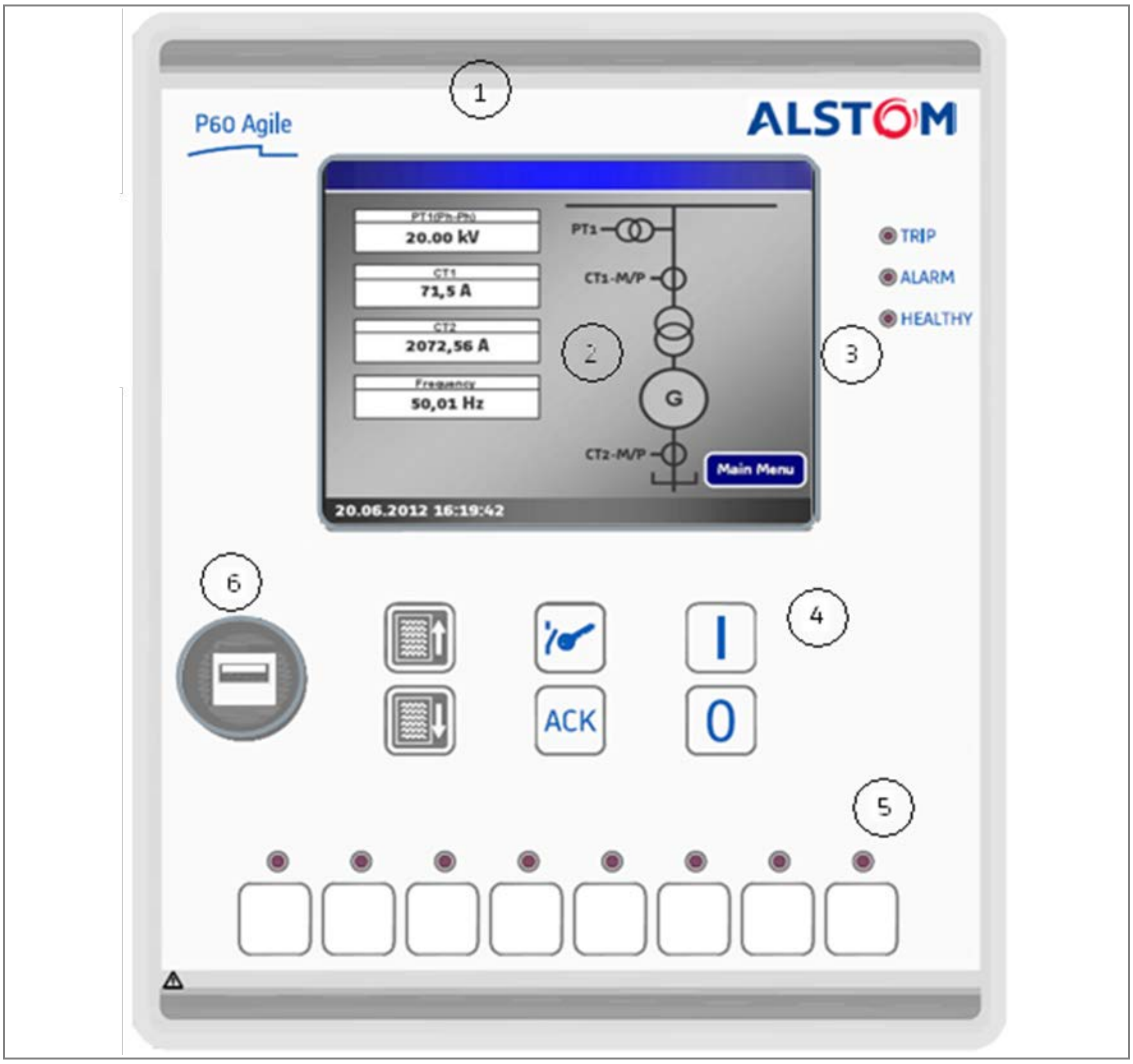


Figure 1 Display and operating elements

1. Front plate
2. Back-lit LCD touchscreen
3. Alarm LEDs for indication of protection trip, alarms and system state
4. Function keys
5. Eight configurable LED indications (multi-coloured: green/red/yellow) and labelling area for LED-indications (inserted strip, see Figure 2: mm as unit of measure)
6. USB-A communication interface for PC/Notebook (P60 Agile Configurator software)

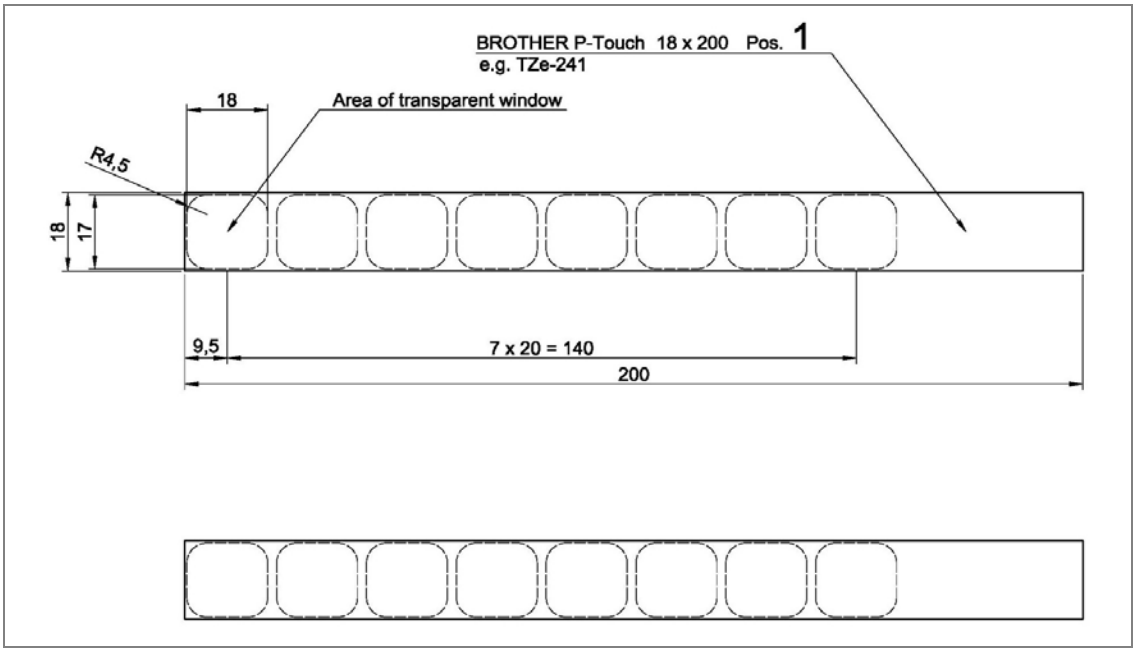


Figure 2 Insertable label strip for LEDs

2.2 Back panel

2.2.1 Reference to documentation

The label *See documentation* at the back panel of the P60 Agile points to the location of an exchangeable, rechargeable battery within the device.

Figure 3 Overview back panel

2.3 Menu structure

The P60 Agile LCD offers several display options. The device settings and controls are also shown. The user can navigate the menus using the resistive touchscreen. PC-created graphics, alarms, events, and measured values can be transferred to the P60. The large graphic display allows the user to view all important data at a glance.

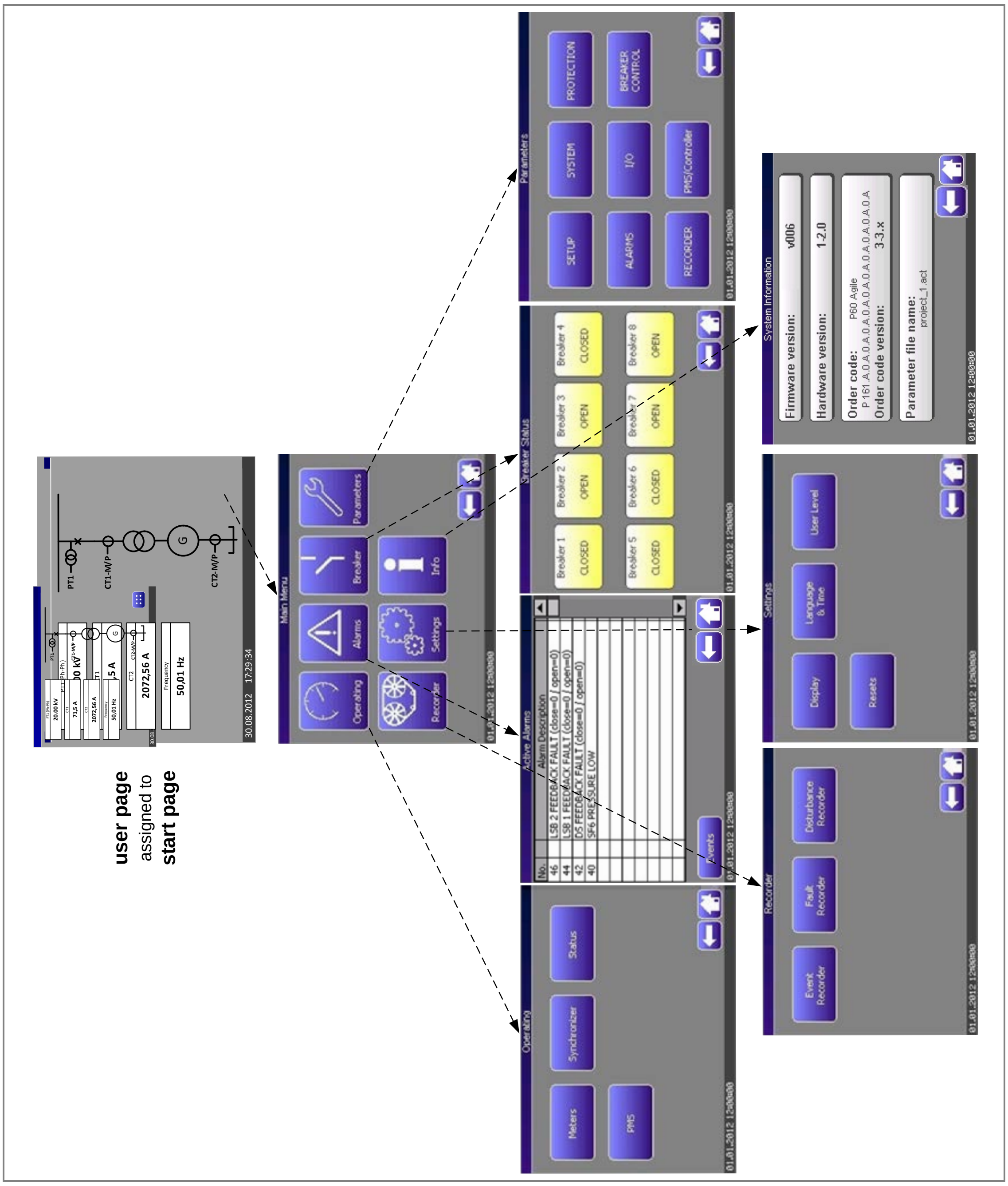
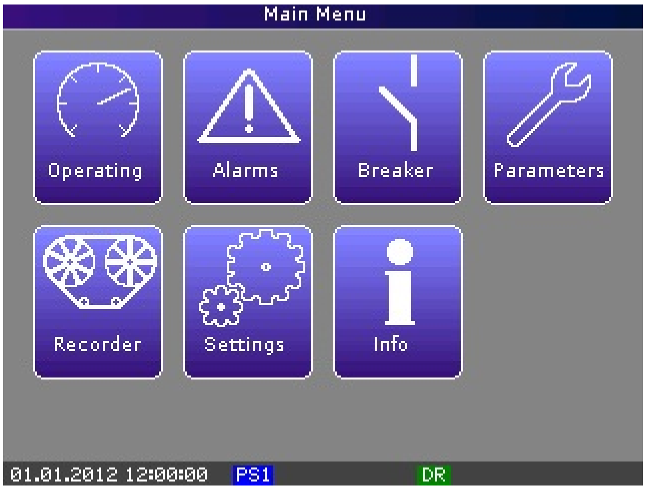


Figure 4 Menu tree

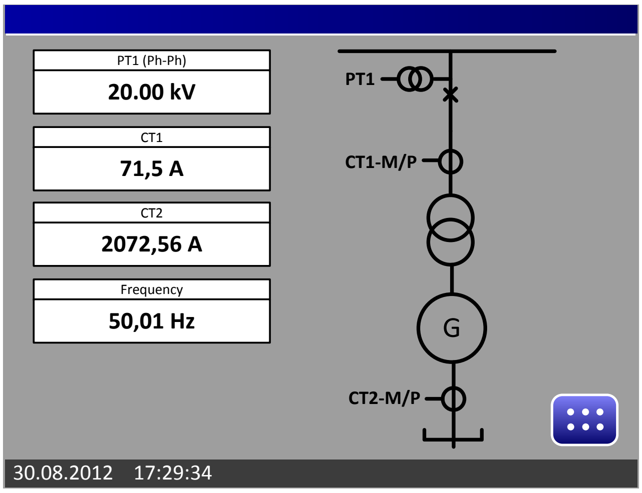
2.4 Start page/Main menu

The Main Menu appears as a start page after switching on or resetting the P60 Agile.



The start page may be changed into a configured User Page containing custom information such as a bay single line diagram or an alarm page. Up to four different user pages can be set up using P60 AGILE Configurator software.

User Page as start page – example



To navigate from a User Page to the main menu a hotkey may be set up on the User Page which is assigned to the start page. For this a pre-defined Main Menu hotkey is available via the library in P60 AGILE Configurator (see screenshot above).

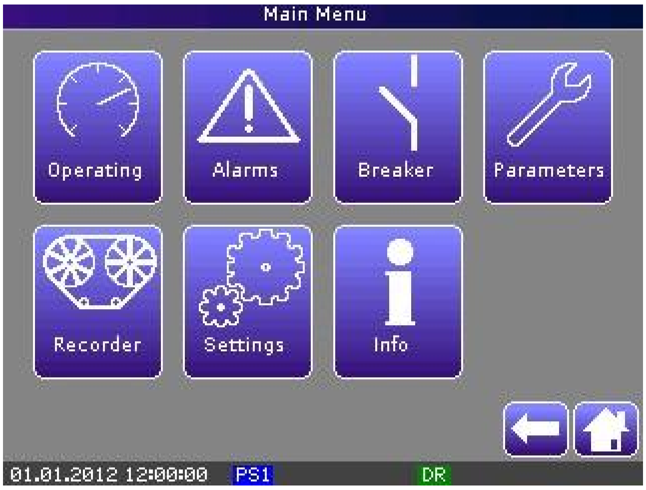
From the Main Menu page the following hotkeys are available to navigate back through the menu:

-  'Back': goes to previous menu page
-  Home': goes directly to start page
- Indications of the lower status line:
- 

Lower display status line: indicates the currently active parameter set

- DR Lower display status line: indicates effective 'Disturbance recorder'

Main menu including navigation hotkeys



2.4.1 Operating

The Operating menu provides the relevant data generated while the P60 Agile is in operating mode. The following operating data is available:

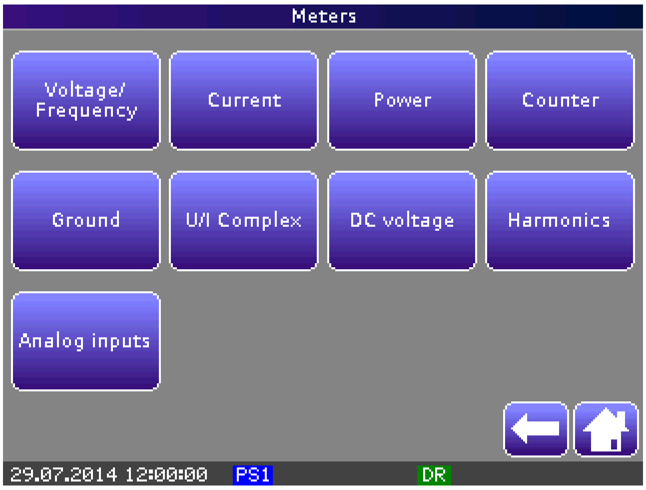
- measuring values of current and voltage inputs
- measuring values during synchronizing process and
- information about SD card and Debug menu

Operating data

2.4.1.1 Meters

There are several measured value pages which can be used to view measured values in detail, such as:

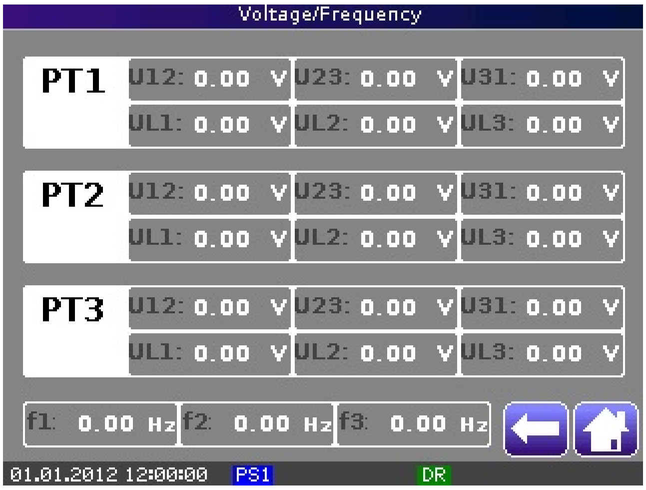
Operating – Meters



Meters\Voltage/Frequency

Depending on the P60 Agile device variant and according to the number of voltage measuring inputs PT1, PT2 and PT3, phase-to-ground voltages and phase-to-phase voltages will be displayed phase-selectively. The displayed frequency values refer to the voltage measuring inputs.

Operating measurements – Voltage/Frequency

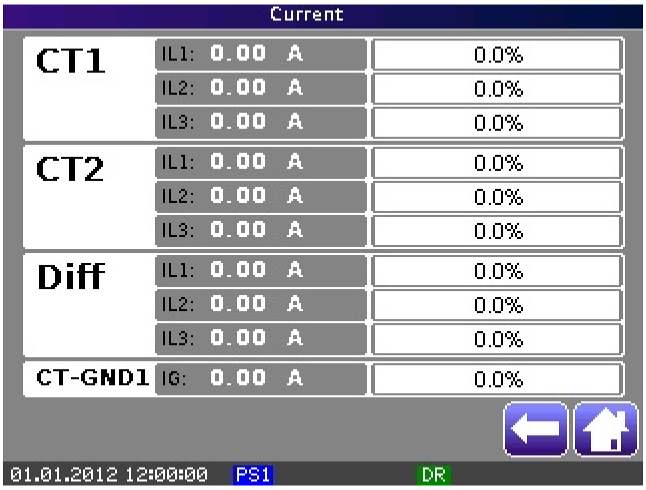


Meters\Current

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

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

Operating measurements – Current



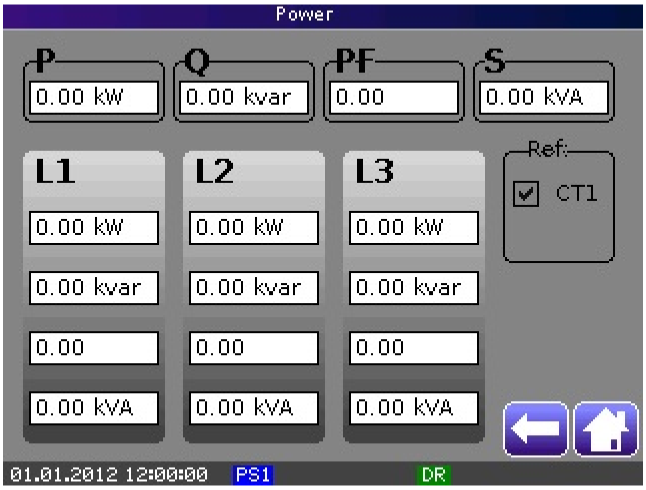
Meters\Power

The display of power values depends on the selected current measurement input by the Ref hotkey. This selection hotkey determines which current and voltage measurement input are used for power value display.

The first row displays total power measurement values; 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]

Operating measurements – Power



Referencing of displayed power measurement values using the *Ref* hotkey:

Common, device-independent sign definition of active power P, reactive power Q and power factor PF

The real power factor PF determines the ration between the amount of active power P to the apparent power S:

PF = |P| / S

with:

P: active power

S: apparent power

The *real* power factor *PF* does not carry any sign and is given in a range between 0 to 1.

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 options of the touchscreen key for referencing the displayed power values:

- CT1: Displayed power measurement values, based on phase currents measured by *CT1* **and** measurement of the voltages by that measuring input which is assigned to parameter *PT reference* [P9410].
- CT2: This option is not supported in P16x devices.

Note:	*The assignment of the voltage measurement input (PT1, PT2 or PT3) to the current measurement input CT1 should be done using the following parameters, in the submenu SYSTEM\Measuring**Power**:* *PT reference [P9410] for CT1*

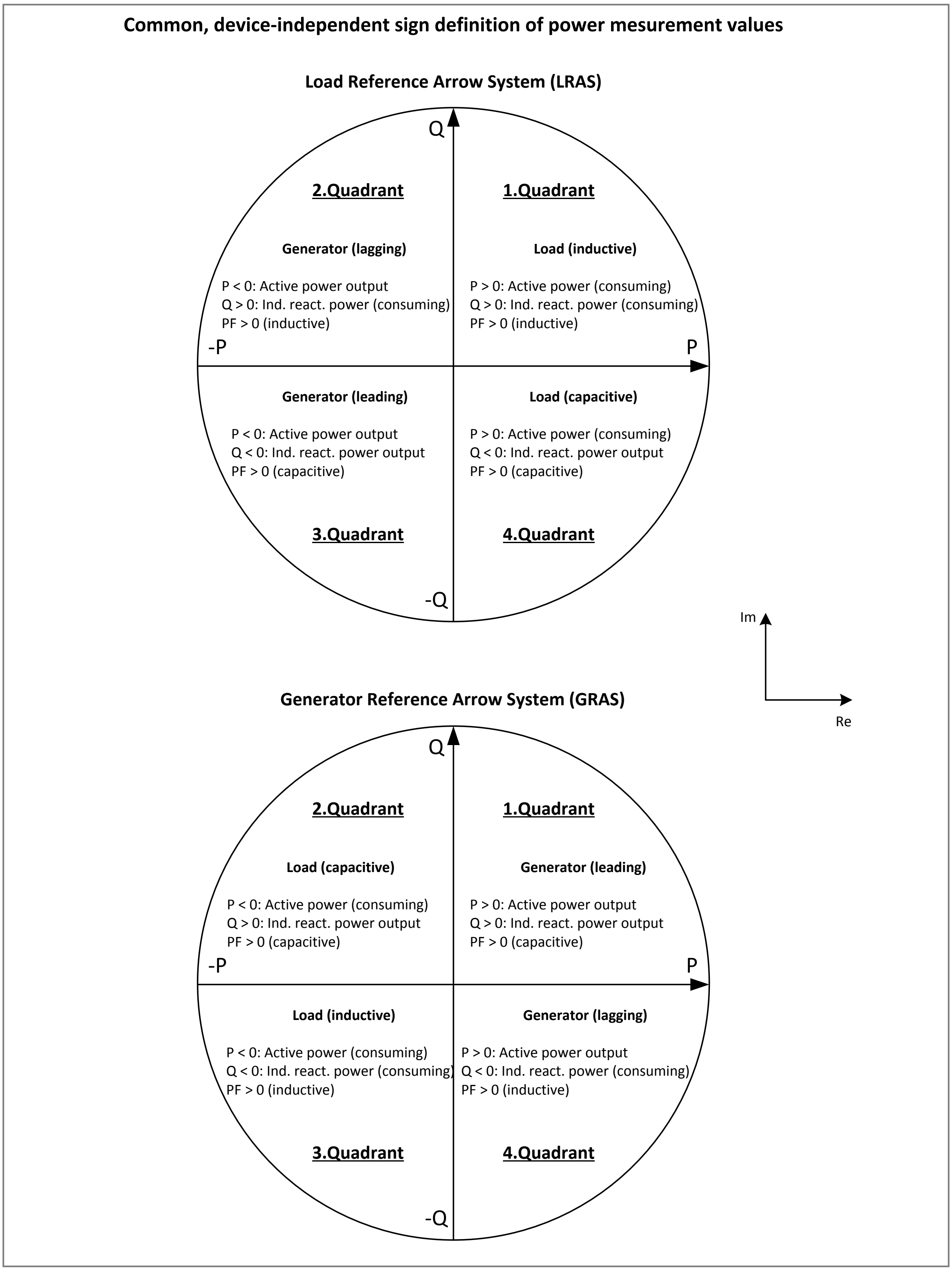


Figure 5 Common sign definition of power measurement values

Device-depending sign definition of active power P, reactive power Q and power factor PF

To differentiate the different AC loads without any further indicator and to control the reactive power by the power factor in P16x devices the power factor shows the sign of the reactive power.

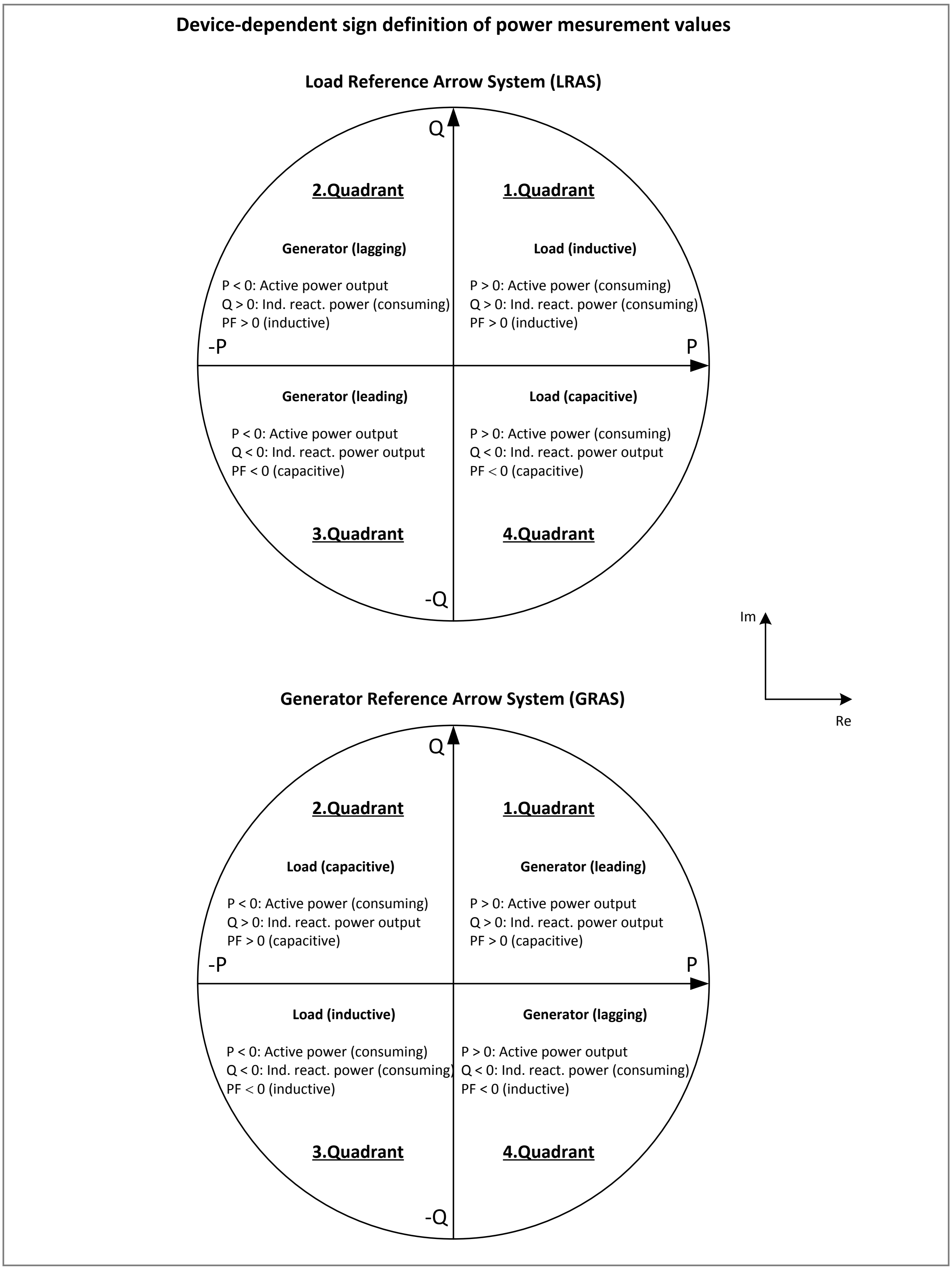


Figure 6 Device-depending sign definition of power measurement values

Sign definition of active power P and reactive power Q

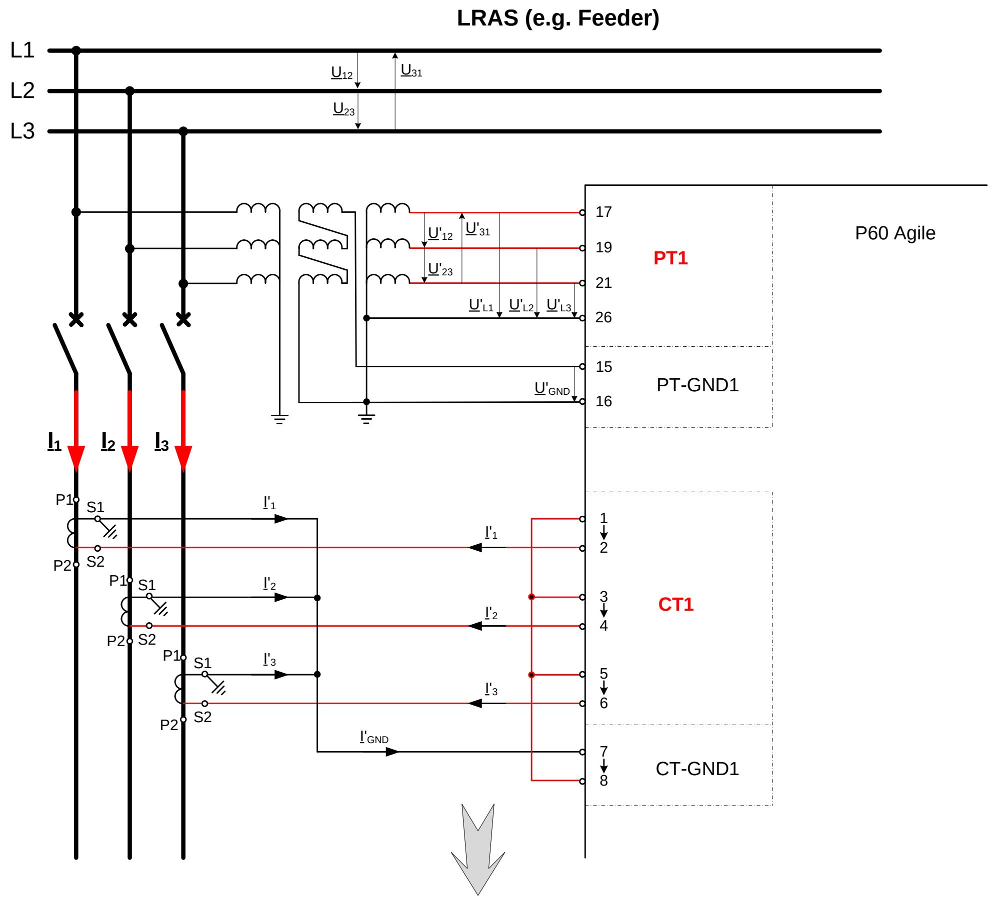
The positive or negative sign indication of the measurement quantities P and Q depends on

- 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]
- the setting of parameter:
    - *Definition* [P9411] to define *power direction* of POWER CT1
- the direction of the primary load flow (while operating normally) in the feeder which is considered for power measurement.

Note 1: CT2 is not available in P16x Agile models so power calculations will be based on CT1.

Note 2: The above is only valid for a three-phase system with a clockwise field of rotation.

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



Parameter settings:

P60 Config Tool ⇒ SYSTEM\Measuring\Power:

POWER CT1:
„PT reference“ [P9410] = „**PT1**“
„Direction“ [P9411] = „**0°**“

P60 Config Tool ⇒ SYSTEM\Nominals\Current transformers (CT):

CT1:
„Direction L1 (Measuring)“ [P662] = „**0°**“
„Direction L2 (Measuring)“ [P663] = „**0°**“
„Direction L3 (Measuring)“ [P664] = „**0°**“
„Direction L1 (Protection)“ [P665] = „**0°**“
„Direction L2 (Protection)“ [P666] = „**0°**“
„Direction L3 (Protection)“ [P667] = „**0°**“

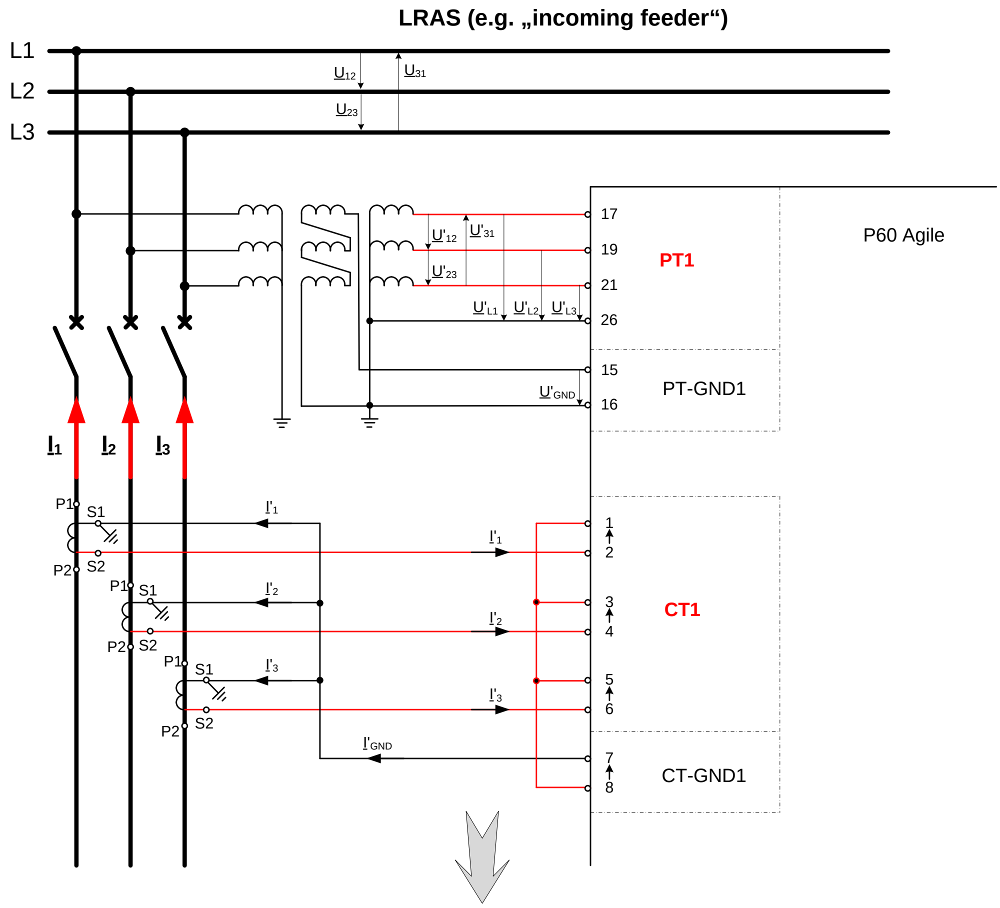
Sign indication of measuring values P, Q and PF:

Device menu ⇒ Main Manu\Operating\Meters\Power:

Active power P: „**P > 0**"
Reactive power Q and Power factor PF: „**Q > 0**" and „**LF > 0**" if the current lags the voltage (inductive load)
or
„**Q < 0**" and „**LF < 0**" if the currentleads the voltage (capacitive load)

Figure 7 Example: Power measurement of “outgoing feeder’ (LRAS) – Connection diagram and sign definition of measuring quantities P and Q

Note: Earthing of the secondary side of the phase current transformers must take place at that side where the secondary side of the CTs are interconnected.



<u>Parameter settings:</u>

P60 Config Tool ⇒ SYSTEM\Measuring\Power:

POWER CT1:
„PT reference“ [P9410] = „**PT1**“
„Direction“ [P9411] = „**0°**“

P60 Config Tool ⇒ SYSTEM\Nominals\Current transformers (CT):

CT1:
„Direction L1 (Measuring)“ [P662] = „**0°**“
„Direction L2 (Measuring)“ [P663] = „**0°**“
„Direction L3 (Measuring)“ [P664] = „**0°**“
„Direction L1 (Protection)“ [P665] = „**0°**“
„Direction L2 (Protection)“ [P666] = „**0°**“
„Direction L3 (Protection)“ [P667] = „**0°**“

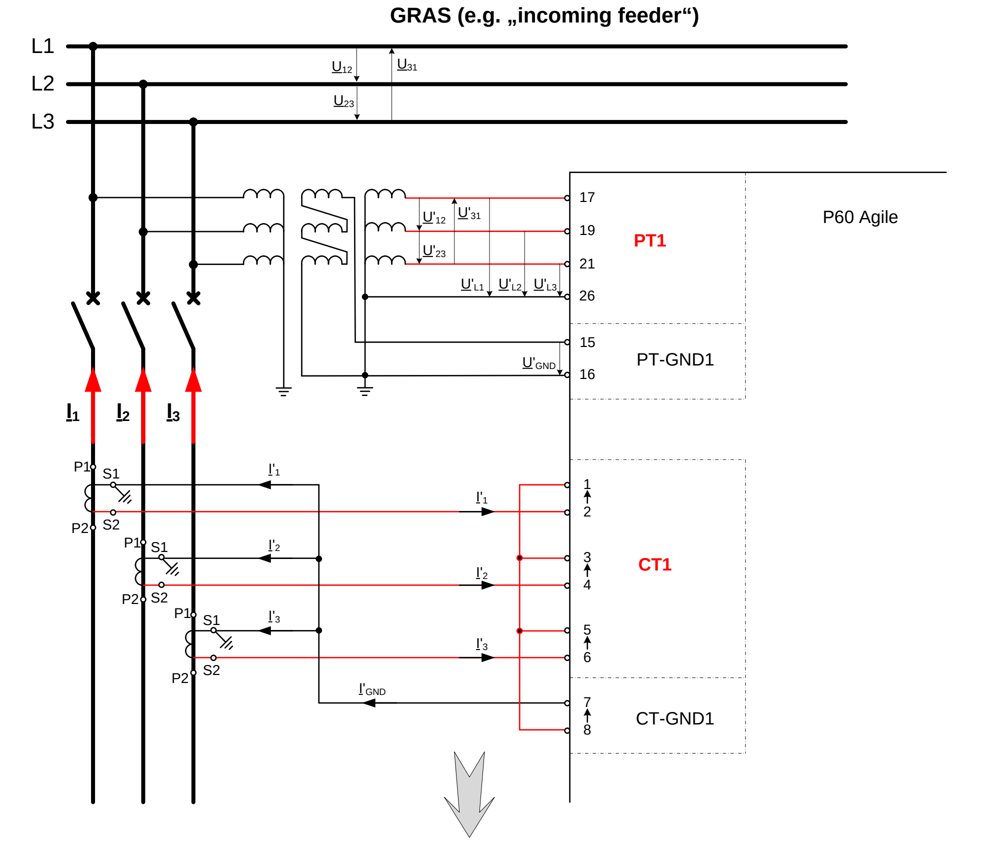
<u>Sign indication of measuring values P, Q and PF:</u>

Device menu ⇒ Main Manu\Operating\Meters\Power:

Active power P: „**P < 0**"
Reactive power Q and Power factor PF: „**Q < 0**" and „**LF < 0**" if the current lags the voltage (generator, leading)
<u>or</u>
„**Q > 0**" and „**LF > 0**" if the currentleads the voltage (generator, lagging)

Figure 8 Example: Power measurement of “incoming feeder’ (LRAS) – Connection diagram and sign definition of measuring quantities P and Q

Note: Any change in <u>one</u> of the conditions for sign definition of the measured power values will lead to a change in the sign for measured values of P and Q.



Parameter settings:

P60 Config Tool ⇒ SYSTEM\Measuring\Power:

POWER CT1:
„PT reference" [P9410] = „PT1"
„Direction" [P9411] = „180°"

P60 Config Tool ⇒ SYSTEM\Nominals\Current transformers (CT):

CT1:
„Direction L1 (Measuring)" [P662] = „0°"
„Direction L2 (Measuring)" [P663] = „0°"
„Direction L3 (Measuring)" [P664] = „0°"
„Direction L1 (Protection)" [P665] = „0°"
„Direction L2 (Protection)" [P666] = „0°"
„Direction L3 (Protection)" [P667] = „0°"

Sign indication of measuring values P, Q and PF:

Device menu ⇒ Main Menu\Operating\Meters\Power:

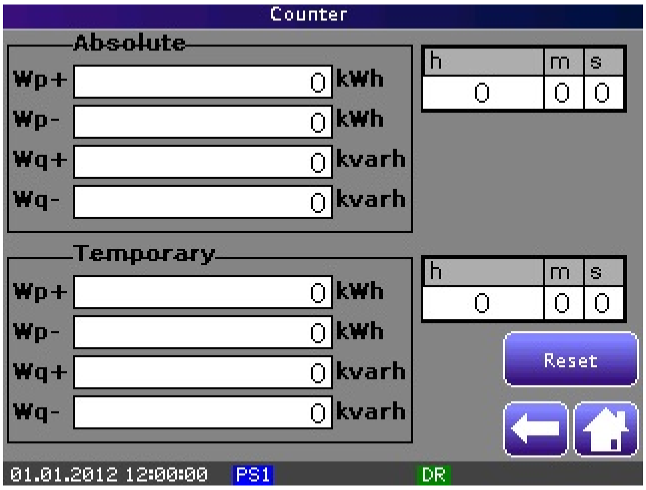
Active power P: „P > 0"
Reactive power Q and Power factor PF: „Q > 0" and „LF > 0" if the current lags the voltage (generator, leading)
or
„Q < 0" and „LF < 0" if the current leads the voltage (generator, lagging)

Figure 9 Example: Power measurement of "incoming feeder' (GRAS) – Connection diagram and sign definition of measuring quantities P and Q

Meters\Counter

The Counter page provides energy counting values and counting values of operating hours:

Operating measurements – Counter



Energy counting

For each measuring sample the values of different power quantities are 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

The ‘Reset’ touch-screen button only refers to temporary counting values (energy values and operating hours). After reset of temporary counting values counting starts from start value “0”.

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.

Meters\Ground

The Meters\Ground page shows all measured or calculated residual voltage and current values.

Operating measurements – Ground

Referencing of displayed ground measurement values U_G and I_G:
According to different manners of building the measurement quantities of the zero sequence system the following generated measuring values are available:

- $U_{G,PT1}$: residual voltage calculated from the phase voltages of PT1
- $U_{G,PT2}$: residual voltage calculated from the phase voltages of PT2
- $U_{G,PT3}$: residual voltage calculated from the phase voltages of PT3
- $U_{G,PT\text{-}GND1}$: residual voltage directly measured via PT-GND1
- $I_{G,CT1}$: ground current calculated from phase currents of CT1 ($3 \times I_{0,CT1} = I_{G,CT1}$)
- $I_{G,CT\text{-}GND1}$: ground current directly measured via CT-GND1

Meters\U/I Complex

The U/I Complex page shows voltage and/or current measuring values (signals) which can be displayed in tabulated form or values via vector diagram.

Selection of display representation

Selection

Up to 6 selectable voltage and current measurement quantities can be displayed via the vector diagram. The measurement quantities (Signal button) have to be assigned to the vector (Channel button) using the touchscreen. One additional reference channel (Ref. signal option) is used to define the reference vector (0°) for the alignment of all other vectors within the diagram.

Note:	*The measurement quantity (signal) which is assigned to the Ref. signal channel is not displayed in the vector diagram.*

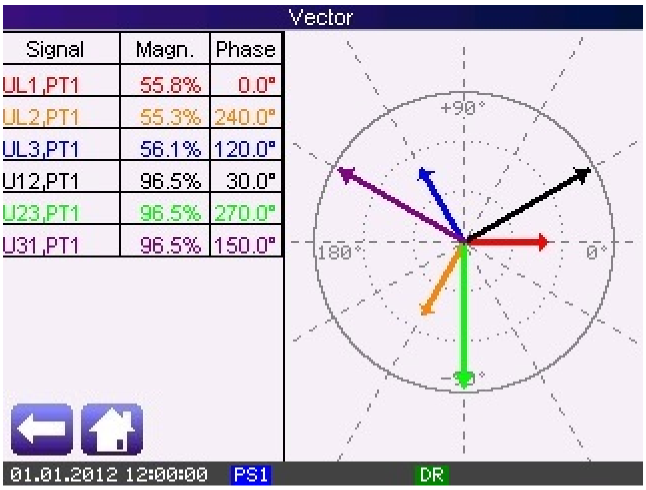
The magnitudes of measuring quantities can be displayed using the Unit ref. button, either as absolute value (units: [V], [A]), or as relative value ([%]).

Operating measurements – Selection of meas. displayed quantities as vectors

Vector diagram

The colour serves as the corresponding factor between vector and measuring quantity (signal) listed on the left side of the diagram.

Operating measurements – selected U/I values via vector diagram



Tabulated form

Each available voltage and current measurement quantity (signal) is displayed according to its magnitude and phase angle

Operating measurements – U/I values in tabulated form

Signal	Magnitude	Phase
UL1,PT1	10.00 kV	30.0°
UL2,PT1	10.00 kV	150.0°
UL3,PT1	10.00 kV	270.0°
UL1,PT2	20.00 kV	0.0°
UL2,PT2	20.00 kV	120.0°
UL3,PT2	20.00 kV	240.0°
IL1,CT1	100.0 A	90.0°
IL2,CT1	110.0 A	210.0°
IL3,CT1	90.70 A	330.0°
UG,PT-GND1	10.0 kV	300.0°
U1,PT3	15.70 kV	35.0°

Selection and representation (tabulated form) of measuring quantity

The indicated absolute unit of the measuring value depends on the type of the selected measuring quantity.

Note: *The reference quantity of the measuring value's relative unit depends on the physical measuring quantity (see table below).*

Depending on the P60 Agile device variant the following measuring quantities are available:

U/I values in tabulated form – measuring quantities

Name of meas. quantity	Description	Absolute unit	Relative unit	Reference quantity of the relative unit
U12,PT1	Phase-to-phase voltage U12, PT1	V	%	Voltage (L-L) [P603]
U23,PT1	Phase-to-phase voltage U23, PT1	V	%	Voltage (L-L) [P603]
U31,PT1	Phase-to-phase voltage U31, PT1	V	%	Voltage (L-L) [P603]
UL1,PT1	Phase voltage UL1, PT1	V	%	Voltage (L-L) [P603]
UL2,PT1	Phase voltage UL2, PT1	V	%	Voltage (L-L) [P603]
UL3,PT1	Phase voltage UL3, PT1	V	%	Voltage (L-L) [P603]
UG; PT1	Residual voltage UG, PT1	V	%	Voltage (L-L) [P603] / √3
Uo,PT1	Zero sequence voltage Uo, PT1	V	%	Voltage (L-L) [P603] / √3
U1,PT1	Positive sequence voltage U1, PT1	V	%	Voltage (L-L) [P603] / √3
U2,PT1	Negative sequence voltage U2, PT1	V	%	Voltage (L-L) [P603] / √3
U12,PT2	Phase-to-phase voltage U12, PT2	V	%	Voltage (L-L) [P603]
U23 PT2	Phase-to-phase voltage U23, PT2	V	%	Voltage (L-L) [P603]
U31,PT2	Phase-to-phase voltage U31, PT2	V	%	Voltage (L-L) [P603]
UL1,PT2	Phase voltage UL1, PT2	V	%	Voltage (L-L) [P603]
UL2,PT2	Phase voltage UL2, PT2	V	%	Voltage (L-L) [P603]

Name of meas. quantity	Description	Absolute unit	Relative unit	Reference quantity of the relative unit
UL3,PT2	Phase voltage UL3, PT2	V	%	Voltage (L-L) [P603]
UG,PT2	Residual voltage UG, PT2	V	%	Voltage (L-L) [P603] / √3
Uo,PT2	Zero sequence voltage Uo, PT2	V	%	Voltage (L-L) [P603] / √3
U1,PT2	Positive sequence voltage U1, PT2	V	%	Voltage (L-L) [P603] / √3
U2,PT2	Negative sequence voltage U2, PT2	V	%	Voltage (L-L) [P603] / √3
U12,PT3	Phase-to-phase voltage U12, PT3	V	%	Voltage (L-L) [P603]
U23,PT3	Phase-to-phase voltage U23, PT3	V	%	Voltage (L-L) [P603]
U31,PT3	Phase-to-phase voltage U31, PT3	V	%	Voltage (L-L) [P603]
UL1,PT3	Phase voltage UL1, PT3	V	%	Voltage (L-L) [P603]
UL2,PT3	Phase voltage UL2, PT3	V	%	Voltage (L-L) [P603]
UL3,PT3	Phase voltage UL3, PT3	V	%	Voltage (L-L) [P603]
UG,PT3	Residual voltage UG, PT3	V	%	Voltage (L-L) [P603] / √3
Uo,PT3	Zero sequence voltage Uo, PT3	V	%	Voltage (L-L) [P603] / √3
U1,PT3	Positive sequence voltage U1, PT3	V	%	Voltage (L-L) [P603] / √3
U2,PT3	Negative sequence voltage U2, PT3	V	%	Voltage (L-L) [P603] / √3
UG,PT-GND1	Residual voltage UG, PT-GND1	V	%	Residual voltage [P606]
IL1,CT1	Phase current IL1, CT1	A	%	Current [P604]
IL2,CT1	Phase current IL2, CT1	A	%	Current [P604]
IL3,CT1	Phase current IL3, CT1	A	%	Current [P604]
IG,CT1	Ground current IG, CT1	A	%	Current [P604]
Io,CT1	Zero sequence current Io, CT1	A	%	Current [P604] / √3
I1,CT1	Positive sequence current I1, CT1	A	%	Current [P604] / √3
I2,CT1	Negative sequence current I2, CT1	A	%	Current [P604] / √3
IG,CT-GND1	Ground current IG, CT-GND1	A	%	Ground current [P607]
IdG	Ground differential current IdG	A	%	Ground current [P607]

Meters\Harmonics

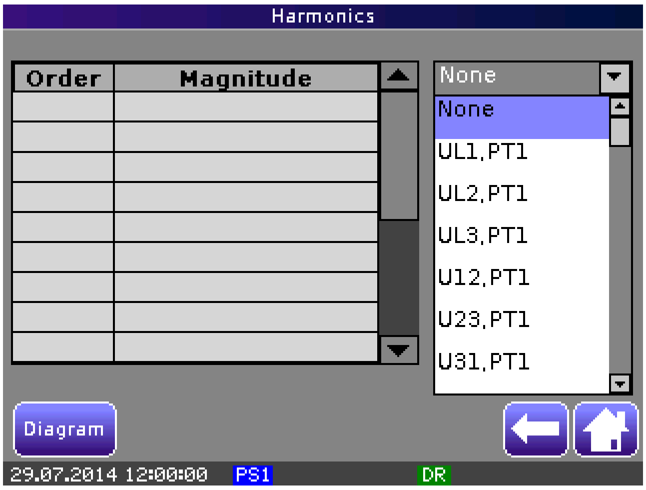
This submenu shows the harmonic content (fundamental oscillation and harmonics) of a selected measuring value which is represented in tabulated form and as bar chart.

Harmonics are additional, *sinusoidal oscillations with frequencies fx* which are multiple integers of the measuring quantity's fundamental frequency f1 (= nominal frequency fn). The fundamental oscillation and the harmonics are represented on the display according to their ordinal number n (multiple integer of the fundamental frequency n = fx/f1) and the magnitude of the measuring value:

Fundamental oscillation: ordinal number “1“, and

Harmonics: ordinal number “2“ to “17“.

The magnitude of the fundamental oscillation is shown as an absolute value; the magnitude of the harmonics as percentage referring to the absolute value of the measuring signal's fundamental.



Harmonics – selection and table of measuring quantity

Selection and representation (tabulated form) of measuring quantity
The measuring quantity which is represented on the display is selected by selection hotkey of the touchscreen. The indicated unit of the measuring value's fundamental oscillation depends on the type of the selected measuring quantity. Depending on the P16x device variant the following measuring quantities are available:

Harmonics – selection of measuring quantity

Name of meas. quantity	Description	Unit of Fundamental	Unit of Harmonics
U12,PT1	Phase-to-phase voltage U12, PT1	V	%
U23,PT1	Phase-to-phase voltage U23, PT1	V	%
U31,PT1	Phase-to-phase voltage U31, PT1	V	%
UL1,PT1	Phase voltage UL1, PT1	V	%
UL2,PT1	Phase voltage UL2, PT1	V	%
UL3,PT1	Phase voltage UL3, PT1	V	%
Uo,PT1	Zero sequence voltage Uo, PT1	V	%
U1,PT1	Positive sequence voltage U1, PT1	V	%
U2,PT1	Negative sequence voltage U2, PT1	V	%
U12,PT2	Phase-to-phase voltage U12, PT2	V	%
U23 PT2	Phase-to-phase voltage U23, PT2	V	%
U31,PT2	Phase-to-phase voltage U31, PT2	V	%
UL1,PT2	Phase voltage UL1, PT2	V	%
UL2,PT2	Phase voltage UL2, PT2	V	%
UL3,PT2	Phase voltage UL3, PT2	V	%
Uo,PT2	Zero sequence voltage Uo, PT2	V	%
U1,PT2	Positive sequence voltage U1, PT2	V	%
U2,PT2	Negative sequence voltage U2, PT2	V	%
U12,PT3	Phase-to-phase voltage U12, PT3	V	%
U23,PT3	Phase-to-phase voltage U23, PT3	V	%
U31,PT3	Phase-to-phase voltage U31, PT3	V	%
UL1,PT3	Phase voltage UL1, PT3	V	%
UL2,PT3	Phase voltage UL2, PT3	V	%

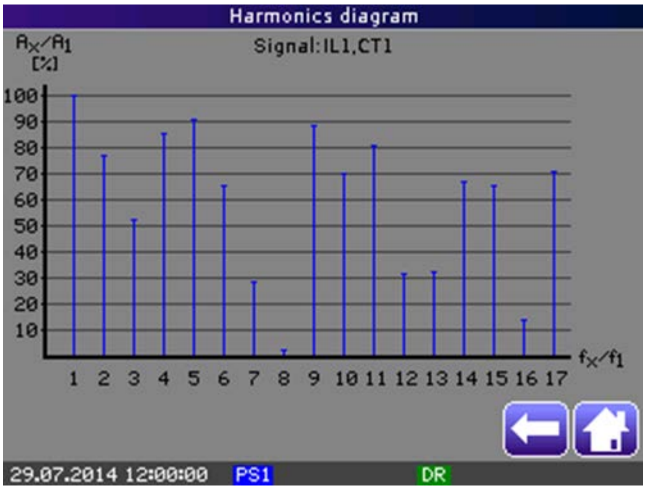
Name of meas. quantity	Description	Unit of Fundamental	Unit of Harmonics
UL3,PT3	Phase voltage UL3, PT3	V	%
Uo,PT3	Zero sequence voltage Uo, PT3	V	%
U1,PT3	Positive sequence voltage U1, PT3	V	%
U2,PT3	Negative sequence voltage U2, PT3	V	%
UG,PT-GND1	Residual voltage UG, PT-GND1	V	%
IL1,CT1	Phase current IL1, CT1	A	%
IL2,CT1	Phase current IL2, CT1	A	%
IL3,CT1	Phase current IL3, CT1	A	%
Io,CT1	Zero sequence current Io, CT1	A	%
I1,CT1	Positive sequence current I1, CT1	A	%
I2,CT1	Negative sequence current I2, CT1	A	%

Graphical representation

Operating “Diagram” hotkey opens menu page “Harmonics diagram” which shows a bar chart with the percentage distribution of the total of all different harmonics.

The amount of the fundamental oscillation A_1 and the amount of the harmonics A_x are represented as percentage according to their ordinal number $n = f_x/f_1$ referring to the measuring quantity’s fundamental oscillation.

Harmonics – bar chart



2.4.1.2 Synchronizer

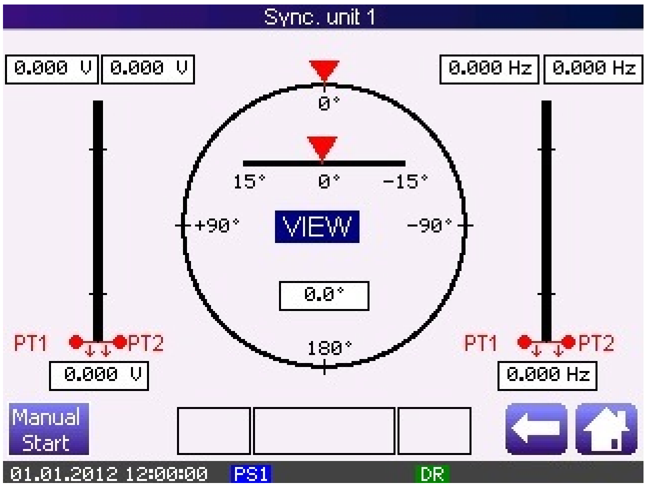
While synchronizing process all relevant measurement values of each synchronizing unit (Sync. unit 1, Sync. unit 2 or Sync. unit 3) are displayed via the Synchronizer menu page.

Operating – Selection of synchronizer unit

Depending on parameter setting of the synchronizing units, it is possible to perform a manual start of the synchronizing functions using the **Manual Start** hotkey. The current synchronization can be cancelled by using **Manual Stop** hotkey.

Note:	*Hotkey "Manual Start" only appears at the synchronizing page if function "Start synchronizer manually" is assigned to one of the four user levels and the assigned user level is activated!*

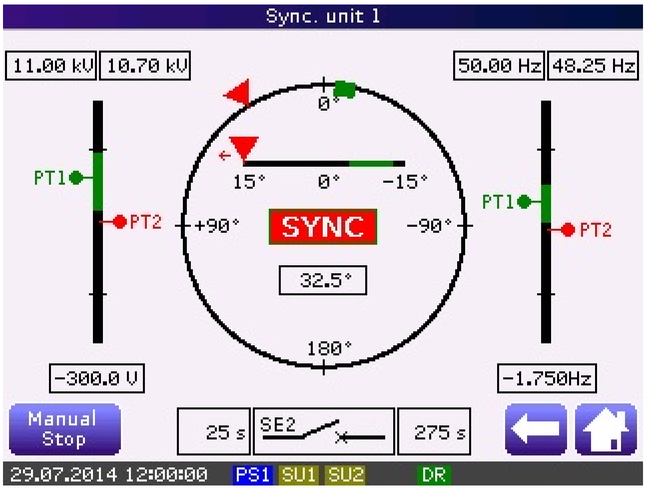
Synchronizer – Manual start of Sync. unit 1



Note:	*When synchronisation is conducted between two voltage systems of different voltage levels (e.g. high-voltage side and low-voltage side of a transformer), displayed voltage values at the synchronisation page refer to that voltage reference system which is assigned to parameter "Voltage reference" [P2307], [P2347] or [P2387].*

As soon as a synchronizing unit is activated, status information of the selected synchronizing unit will be shown.

Synchronizer – Current state of Sync. unit 1



2.4.1.3 Status (SD Card, Debug)

SD Card

This menu page provides information about the type of SD card which is used for data recording.

Note:	*The maximum size of the SD card is 2MB.*

Debug

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

Status – Debug

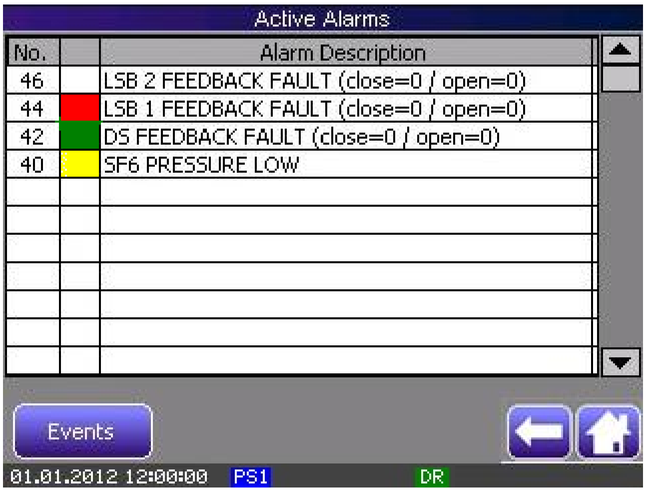
> *Note: For IEC 61850 communication MAC address is displayed at page 405.*

2.4.2 Alarms

The user can find information on active alarm messages as well as all active events on the front panel HMI display.

2.4.2.1 Active alarms

When an alarm occurs this page will open automatically. Depending on the configuration of the alarm channels, the alarm number (which also serves as event number), the active alarm colour (OFF, red, green or yellow), and the alarm description (editable text; max. 40 characters) are displayed. Up to 449 alarms can be managed.



Active alarms appear in order of occurrence. If the P60 Agile saves more than 11 alarm messages, the list can be scrolled up and down via:

- touch-screen or

- if parameterized –assigned buttons on the front panel of the device (see chapter 3.3.6 ‘Graphic’ (Referencing and selection of displayed measurement values)**Button Configuration**).

> *Note:* *For configuration of the alarms please refer to chapter 3.5.2 ‘Alarm channels’ (configuration via P60 Configurator Tool only).*

If an alarm occurs the Alarm LED on the front plate and the active alarm colour in the Active alarms menu page will blink fast until acknowledged or until the alarm is no longer active.

The Alarm LED and the active alarm colour in the Active alarms menu page blinks at a slower interval if the alarm is no longer active but not yet acknowledged.

An audible signal may also be activated.

The following table describes LED and audible signal control (beeper) according to the alarm status.

Alarm status

Alarm status	Alarm LED/ active alarm colour	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 must be acknowledged twice. Once to switch the beeper OFF and a second time to register the alarm.

Click on the Events key to open the Active Events submenu.

Reset of alarms via touch screen

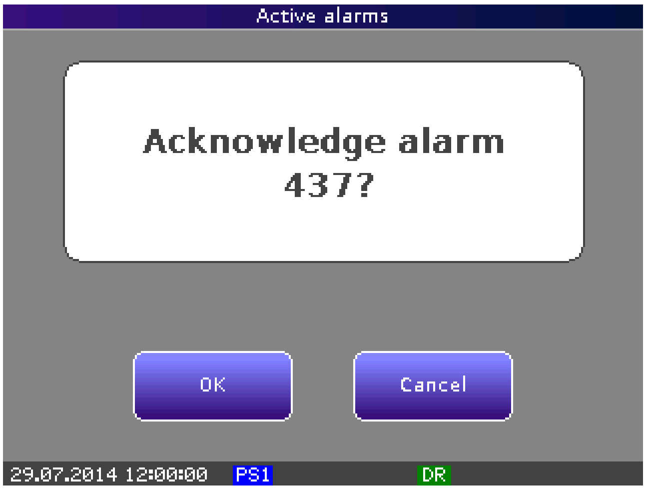
The alarms which are indicated at menu page “Active alarms” (alarm page) can be reset (acknowledged) commonly or individually via touch screen of P60 Agile.

> *Note:* *Alarms are only resettable if parameter setting is “Condition = LATCHED” and the alarms are not active anymore!*

To reset the indicated alarms commonly the button which is assigned function “ACK” has to be operated.

For individual reset the alarm has to be selected by clicking at the referring line in the display. Subsequently, the following menu page is shown which gives the opportunity to conduct ot cancel procedure of resetting the selected alarm:

Reset of the selected alarm

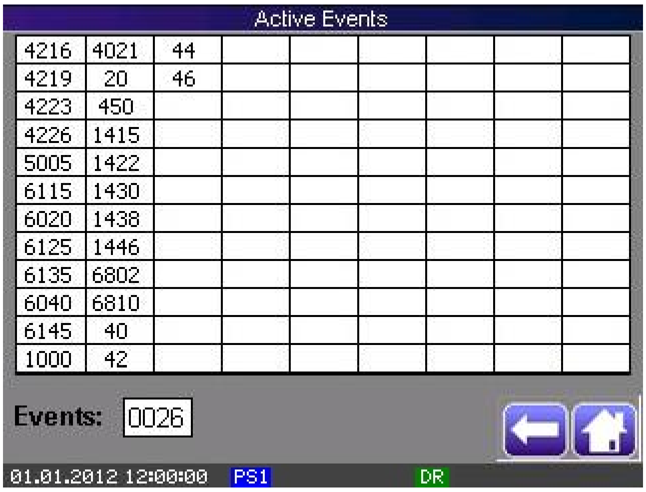


Operating execution button “OK” will reset the alarm and erase its indication at menu page “Active alarms” and the alarm page will be displayed again.

Operating execution button “Cancel” will abort reset procedure and the alarm page will be displayed again.

2.4.2.2 Active events

This page displays all active events by their respective event numbers as well as the total number of active events. Event registration occurs chronologically with the first column top down.



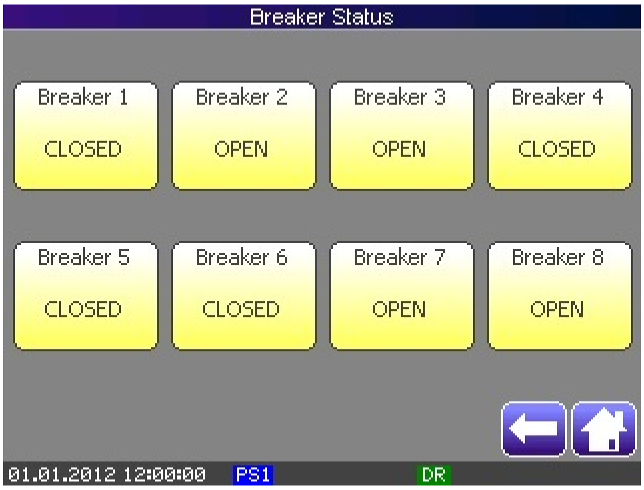
4216	4021	44						
4219	20	46						
4223	450							
4226	1415							
5005	1422							
6115	1430							
6020	1438							
6125	1446							
6135	6802							
6040	6810							
6145	40							
1000	42							

Pressing the Event history hotkey will bring up the list of all stored events.

2.4.3 Breaker

The Breaker selection page gives an overview of the current status of switching elements (circuit breakers, disconnectors and grounding switches) used in the application.

Current breaker status



2.4.4 Parameters

Device configuration and parameter settings can be performed by following methods:

- by *P60 Agile configuration software*, or
- by using the *touchscreen of the device*.

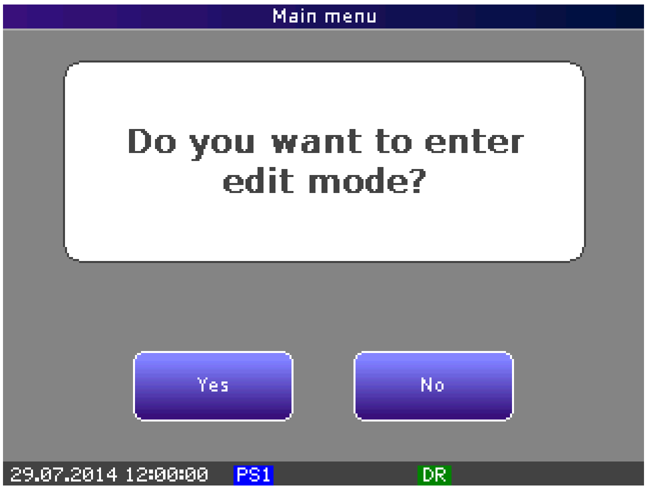
Device configuration via P60 Configurator
Refer to the P60 Agile Configurator manual for details.

Device configuration via touchscreen

CAUTION:	*Parameter setting via touchscreen (LCD) is a special function. Blocking of this function is possible via assignment of function “Blocking of parameter changes via LCD” to one or more of the different user levels!*

Among others the main menu also shows submenu “Parameters”. After clicking to this submenu the following pop-up window gives opportunity to enter the parameter mode:

Entering the parameter mode



Operating execution button “Yes” will open menu “Parameters”:

Parametermode – menu “Parameters”

The parameters of the different submenus can be set via touchscreen.

For example: *Menu “SYSTEM\Nominals\Voltage transformers”;* setting of parameter “Assignment” [P642]

By clicking to the parameter the following window opens in which selection of the required selection option can be done:

Parameter selection options

Operating the „OK“ execution button will open the following window:

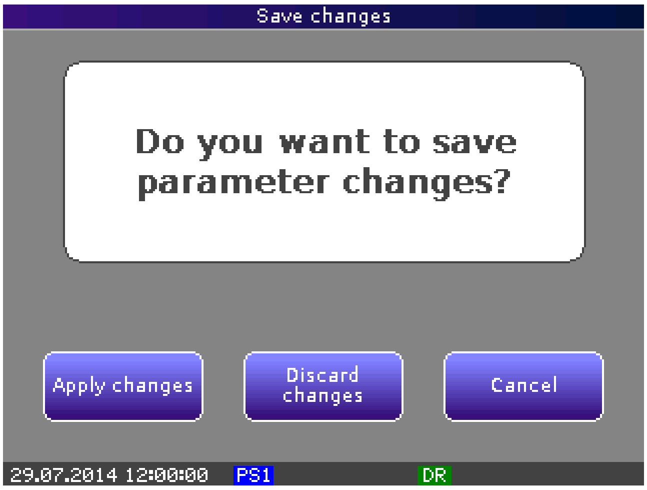
Highlighting the modified parameter setting

Any modification of parameter setting will be highlighted by "*" symbol in column "P/E". Operating "Back" arrow button provides further changing of any other parameter setting of other submenus.

After finishing parameter setting clicking to the "Home page" button requires user's decision about the following parameter saving selection options:

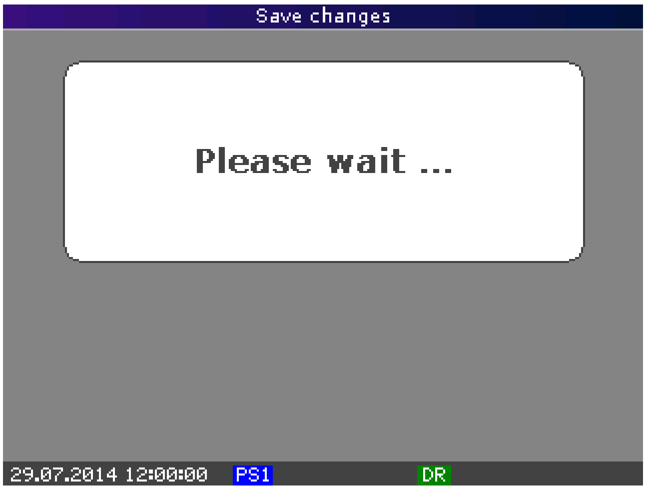
- Apply changes
- Discard changes or
- Cancel

Parameter saving selection options



- "Cancel" is for returning back to menu **Parameters**.
- "Discard changes" will ignore any modification of parameter settings and shows the adjusted **Home page**.
- "Apply changes" will lead to system reboot of the device to save all the changes of parameter settings:

Saving changes of parameter settings by system reboot



The Parameters selection page displays all device settings:

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

Parameter settings of P60 Agile

2.4.4.1 SETUP

The SETUP menu shows how the P60 Agile variant has been adapted to the application. For this, two sub-menus are provided:

- User levels sub-menu (configured user access levels) and
- Measuring Inputs sub-menu (enable /disable menu for the current measurement inputs: CT1 and CT-GND1, and voltage measurement inputs: PT1, PT2, PT3, PT-GND1)

SETUP - Adaption of device variant to the application

User levels

The user levels submenu provides parameters to individually configure the different user levels. Parameters refer to:

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

Measuring inputs

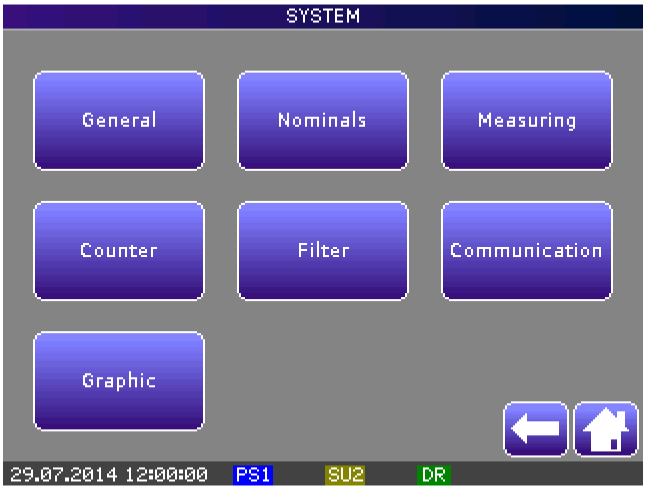
The Measuring inputs submenu provides parameters to enable/disable current and voltage measurement inputs according to the application.

Note:	*Disabled measurement inputs will not provide any measurement quantities.*

2.4.4.2 SYSTEM

The SYSTEM submenu provides all the system parameters of P60 Agile. Further information on this can be found in the System Settings chapter.

System parameters



2.4.4.3 RECORDER

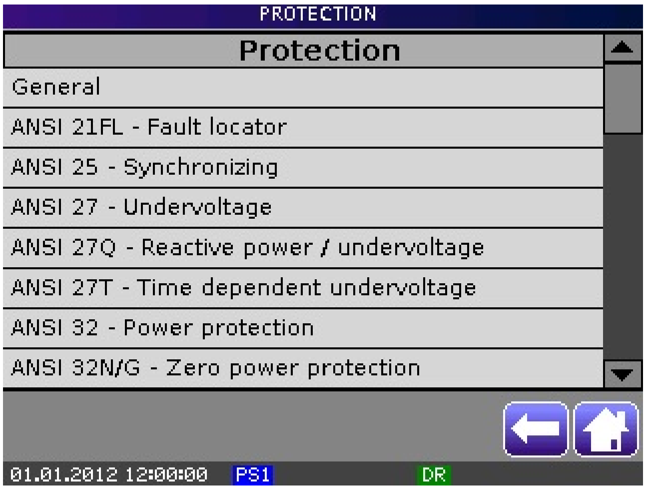
The RECORDER submenu provides all of the parameters about configuration of *recording functions* such as *Fault recorder* and *Disturbance recorder*. Further information on this can be found in the Recorder (File information and manual trigger) chapter.

Parameters of recording functions

2.4.4.4 PROTECTION

The PROTECTION submenu provides all the protection parameters of P60 Agile. Further information on this can be found in the Protection Functions chapter.

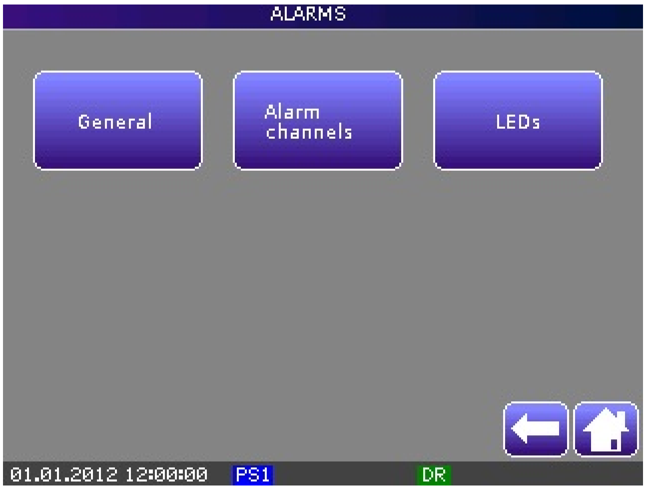
Protection parameters



2.4.4.5 ALARMS

The ALARMS submenu provides all of the parameters relating to alarms and LED configuration of P60 Agile. Further information on this can be found in the System Settings chapter.

Alarm parameters



2.4.4.6 I/O

The I/O submenu provides all the parameters about binary inputs and outputs of P60 Agile. Further information on this can be found in the System Settings chapter.

Parameters of binary inputs and outputs

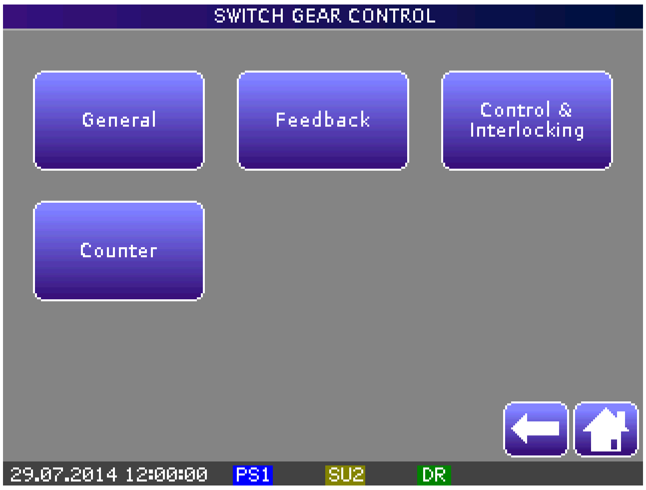
2.4.4.7 LVM

The LVM submenu provides all of the parameters about configuration of LVM – Limit Value Monitoring function. Further information on this can be found in the LVM – Limit Value Monitoring chapter.

2.4.4.8 SWITCHGEAR CONTROL

The SWITCHGEAR CONTROL submenu provides all the parameters relating to configuration of switching elements. Further information on this can be found in the 'System Settings' chapter.

Configuration menu for switching elements



2.4.5 Recorder (File information and Manual trigger)

The P60 Agile device variants provide the following recording functions:

- Event recorder
- Fault recorder and
- Disturbance recorder

Recording functions

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 through the P60 Agile display or through the PC/Notebook by using the P60 Agile Configurator software. See menu bar Tools\Event recorder, then click Read Data, then Start.

Clicking File and Save in the P60 Agile Event recorder window will generate an event recording file (xxx.ser) including the recorded data. This file can be saved through the PC/notebook. This file can only be read using the P60 Agile Configurator.

- It is possible to read the recorded data of the fault recorder either through the P60 Agile display or through the PC/Notebook by using the P60 Agile Configurator software. See menu bar Tools\Fault recorder, then click Read Data, then Start.

  Clicking File, then Save in the P60 Agile Fault recorder window will generate a fault recording file (xxx.sfr) including the recorded data. This file can be saved via PC/notebook. This file can only be read using the P60 Agile Configurator.

- It is not possible to read the recorded data of the disturbance recorder via the P60 Agile display.

  When disturbance recorder data recording is triggered, either manually or by trigger event, a recording file (xxx.sdr) is generated on the removable SD Card. This file can be saved by either reading the file directly from the SD card or by using the P60 Agile Configurator software.

Note:	*Saved recording file xxx.sdr cannot be read using P60 Agile Configurator software. However, the file can be converted to Comtrade format. The Comtrade file can then be opened using appropriate software.*

2.4.5.1 Event recorder

The event history saves up to 10000 events using the first-in-first-out (FIFO) principle. Each event provides information such as:

- the consecutive number
- the event number
- the event text
- 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

> *Note:* *In the displayed event list active events are highlighted light green, and inactive events are represented with white background colour.*
> *The latest event is always assigned to number "0".*

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

To refresh the displayed event list automatically, an Auto Refresh button is available on the screen, with the settings:

- ON: will activate automatic refresh.
- 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 stopped (Auto Refresh: OFF).*

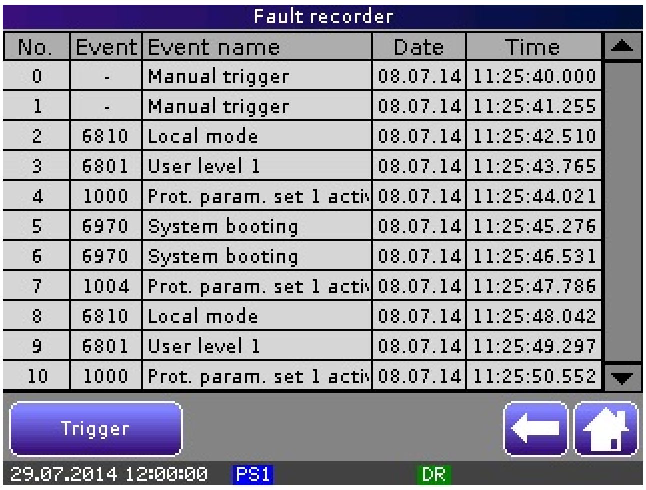
2.4.5.2 Fault recorder

The fault recorder saves up to 1000 recordings using the first-in-first-out (FIFO) principle. 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.

At the time of activating the fault recorder records:

- all relevant file information (record number, trigger-event number, event text, date and time stamp) and
- all available measuring values of current, voltage and frequency (depending on the P60 Agile device variant) for one record at the time of activating the trigger-event.

Fault recorder – File information



No.	Event	Event name	Date	Time
0	-	Manual trigger	08.07.14	11:25:40.000
1	-	Manual trigger	08.07.14	11:25:41.255
2	6810	Local mode	08.07.14	11:25:42.510
3	6801	User level 1	08.07.14	11:25:43.765
4	1000	Prot. param. set 1 acti	08.07.14	11:25:44.021
5	6970	System booting	08.07.14	11:25:45.276
6	6970	System booting	08.07.14	11:25:46.531
7	1004	Prot. param. set 1 acti	08.07.14	11:25:47.786
8	6810	Local mode	08.07.14	11:25:48.042
9	6801	User level 1	08.07.14	11:25:49.297
10	1000	Prot. param. set 1 acti	08.07.14	11:25:50.552

In addition to any trigger event (assigned event to parameter P[8061] or any trip-event), fault recording can also be started manually through the **Trigger** hotkey. In this case, there is no registered event-number in the fault recorder, but the **Manual trigger** event-text will be indicated.

Fault recorder – Manual trigger

No.	Event	Text	Date	Time
0	9998	Manual trigger	01.02.13	12:12:11.876
1	9998	Manual trigger	09.09.09	12:21:11.860
2	9998	Manual trigger	09.09.09	12:21:05.345

At the time of activating the fault recorder records:

- all relevant file information (record number, trigger-event number, event text, date and time stamp) and
- all available measuring values of current, voltage and frequency (depending on the P60 Agile device variant) for one record, at the time of activating the trigger-event:

Fault recorder – Snapshot of measuring values

Main menu\Recorder\Fault Recorder

Fault Recorder Level2		
Label	**Value**	**Unit**
Event no.		-
Event name		
Date		
Time		
Pickup source		
Fault phase		
Prot. step no.		
Prot. set no.		
UL1 (PT1)	0.00	V
UL2 (PT1)	0.00	V
UL3 (PT1)	0.00	V
U12 (PT1)	0.00	V
U23 (PT1)	0.00	V
U31 (PT1)	0.00	V
UL1 (PT2)	0.00	V
UL2 (PT2)	0.00	V
UL3 (PT2)	0.00	V
U12 (PT2)	0.00	V
U23 (PT2)	0.00	V
U31 (PT2)	0.00	V
UL1 (PT3)	0.00	V
UL2 (PT3)	0.00	V
UL3 (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
IL1 (CT1)	0.00	A
IL2 (CT1)	0.00	A
IL3 (CT1)	0.00	A
IL1 (CT2)*	0.00	A
IL2 (CT2)*	0.00	A
IL3 (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

Note: *The recorded data of each fault recording is saved as an individual fault recording file (“xxx.sfr”) on the SD card. A read-out of the recording file data is only possible using the P60 Configurator.*

The recorded data of a fault recording can be shown on the device display by double-clicking the selected file entry on the following menu page:
*Main Menu\Recorder**Fault Recorder**.*

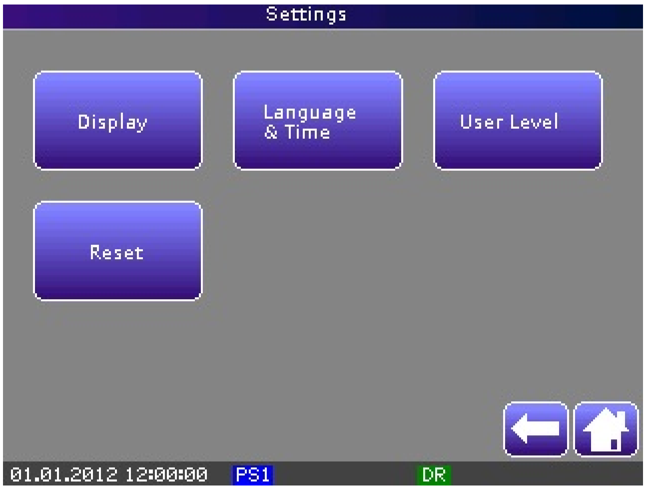
** CT2 option not supported in P16x devices.*

2.4.5.3 Disturbance Recorder

Manual trigger

2.4.6 Settings

This page allows changes to device settings of colour and brightness of the display, menu language and time, displayed single line diagram, entering different user levels (in preparation). All available counters and memories can be reset through the Resets submenu.



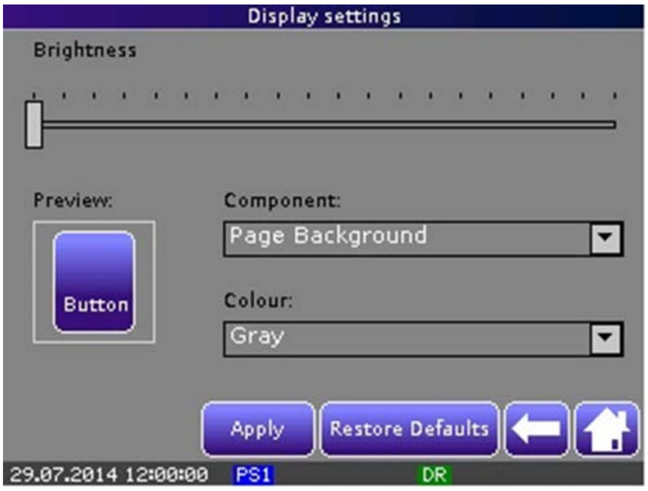
2.4.6.1 Display

The colour layout and brightness of the menu page components can be changed with the following settings on this page:

- Background colour of menu pages (Page Background)
- Background colour of Hotkey lower half (Button Bottom)
- Background colour of Hotkey upper half (Button Top)
- Text colour of Hotkeys (Button Text)

Settings of brightness only refer to the whole menu page. For changing brightness, please use the touch-screen slider control. Colours can be adapted separately by red, green and blue settings. The array **Preview** shows the adjusted colour scheme. To save the settings, press button **Apply**. For resetting the colour scheme to factory settings, press button **Restore Defaults**.

Display settings



2.4.6.2 Language & Time

Menu language, date and time can be set under Change Language & Time.

Change Language & Time

2.4.6.3 User level (Change-over via touchscreen)

Changing to different user levels via touchscreen is possible under Change User Level.

Change User Level

To change User Level, a 4 digit password should be entered using the number keypad on the touchscreen. Pressing the OK hotkey will automatically open the required user level.

When user level 2, 3 or 4 is activated, a symbol of a key and the number of the active user levels is shown in the date row.

Example: Indication of active user level “2”

The Reset User Level hotkey allows the user to exit from an advanced access level and resets the device to Level 1 access.

Note:	*There is no symbol for active user level.*

2.4.6.4 Reset

The Reset page enables the reset (data erase) of

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

After pressing one of the available hotkeys, a confirmation prompt will be displayed.

For example, the event recorder.

Reset of event recorder

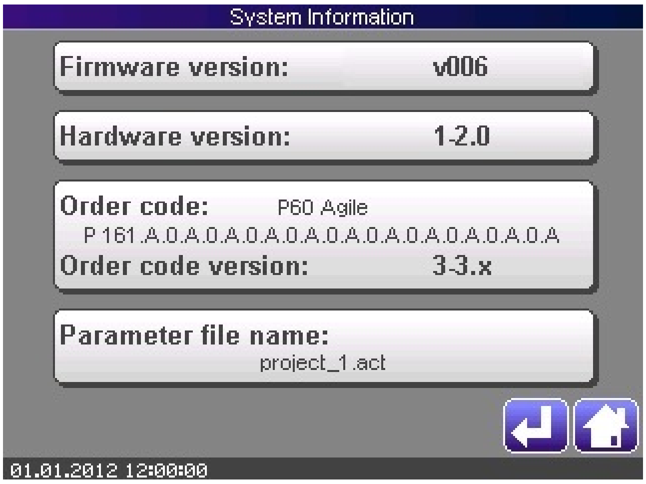
Pressing the **OK** button will carry out the reset. The Cancel button returns the user to the previous menu page.

2.4.7 Info

The System Information page gives information about:

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

System Information



SYSTEM SETTINGS

CHAPTER 3

1 CHAPTER OVERVIEW

This chapter consists of the following sections:

2 SYSTEM SETTINGS

2.1 All events

2.1.1 Introduction event system

The event system of the P60 Agile allows the user to implement individual applications, as 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 conditions of this event are met (e.g. threshold 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 both a source and a sink. For example, all binary outputs are sinks and activated by a source event. But each binary output generates source events on 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 setting (e.g. 01 = 1425) of the binary output Shunt Trip 1 and, as a consequence, protection trip signal opens the breaker.

2.1.2 Event list

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

Note: Event numbers (e.g. [E1234]) relating to parameter sets (SET1 – SET4) exist only once for all four parameter sets.

P60 Agile event list

Event No.	Name	Description	Event system	Event recorder
	Static event			
E0000	OFF-Event	Event is always inactive (untrue)	☑	-
E9999	ON-Event	Event is always active (true)	☑	-
	Alarm events 0001 – 0499			
E001 – E449	Alarm	Alarm channel 1 – 449	☑	☑
E450 – E499	Groups	Alarm groups 450 – 499	☑	☑
SET1 – SET4	Protection events E1000 – E3999			
E1000	Prot. param. set 1 active	Protection parameter set 1 active	☑	☑
E1001	Prot. param. set 2 active	Protection parameter set 2 active	☑	☑

Event No.	Name	Description	Event system	Event recorder
E1002	Prot. param. set 3 active	Protection parameter set 3 active	☑	☑
E1003	Prot. param. set 4 active	Protection parameter set 4 active	☑	☑
E1004	Prot. param. set 1 activated manually		☑	☑
E1005	Prot. param. set 2 activated manually		☑	☑
E1006	Prot. param. set 3 activated manually		☑	☑
E1007	Prot. param. set 4 activated manually		☑	☑
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		☑	☑
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		☑	☑

Event No.	Name	Description	Event system	Event recorder
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		☑	☑
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		☑	☑

Event No.	Name	Description	Event system	Event recorder
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		☑	☑
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		☑	☑

Event No.	Name	Description	Event system	Event recorder
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		☑	☑
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		☑	☑

Event No.	Name	Description	Event system	Event recorder
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		☑	☑
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		☑	☑
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		☑	☑

Event No.	Name	Description	Event system	Event recorder
E1399	ANSI59N/G-4 pickup		☑	☑
E1400	ANSI59N/G-4 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		☑	☑
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		☑	☑
E1470	ANSI95i-CT1 module active		☑	☑
E1471	ANSI95i-CT1 blocked module		☑	☑
E1472	ANSI95i-CT1 blocked module by Imax		☑	☑
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		☑	☑

Event No.	Name	Description	Event system	Event recorder
E1478	ANSI95i-CT1 L3 blocked by 5H		☑	☑
E1479	ANSI95i-CT1 2H supervision blocked		☑	☑
E1480	ANSI95i-CT1 5H supervision blocked		☑	☑
E1515	ANSI95i-GND1 module active		☑	☑
E1516	ANSI95i-GND1 blocked module		☑	☑
E1517	ANSI95i-GND1 blocked module by Imax		☑	☑
E1518	ANSI95i-GND1 blocked by 2H		☑	☑
E1519	ANSI95i-GND1 blocked by 5H		☑	☑
E1520	ANSI95i-GND1 2H supervision blocked		☑	☑
E1521	ANSI95i-GND1 5H supervision blocked		☑	☑
E1570	ANSI78 module active		☑	☑
E1571	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		☑	☑
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		☑	☑

Event No.	Name	Description	Event system	Event recorder
E1626	ANSI 81R-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		☑	☑
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		☑	☑

Event No.	Name	Description	Event system	Event recorder
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		☑	☑
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		☑	☑

Event No.	Name	Description	Event system	Event recorder
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		☑	☑
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		☑	☑
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	ANSI 25-1 SC: PT2 > Max. voltage		☑	☑
E1872	ANSI 25-1 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 < Min. df		☑	☑
E1880	ANSI25-1 SC: df > Max. df		☑	☑
E1881	ANSI25-1 SC: df in range		☑	☑
E1882	ANSI25-1 SC: dPHI < Min. dPHI		☑	☑
E1883	ANSI25-1 SC: dPHI > Max. dPHI		☑	☑
E1884	ANSI25-1 SC: dPHI in range		☑	☑
E1885	ANSI25-1 SC: Synchronous pre-event		☑	☑
E1886	ANSI25-1 SC: Synchronous		☑	☑
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		☑	☑

Event No.	Name	Description	Event system	Event recorder
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		☑	☑
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		☑	☑

Event No.	Name	Description	Event system	Event recorder
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		☑	☑
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		☑	☑

Event No.	Name	Description	Event system	Event recorder
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		☑	☑
E2020	ANSI25A-1 Frequency higher event		☑	☑
E2021	ANSI25A-1 Frequency lower event		☑	☑
E2022	ANSI25A-1 Voltage higher event		☑	☑
E2023	ANSI25A-1 Voltage lower event		☑	☑
E2025	ANSI25A-2 Frequency higher event		☑	☑
E2026	ANSI25A-2 Frequency lower event		☑	☑
E2027	ANSI25A-2 Voltage higher event		☑	☑
E2028	ANSI25A-2 Voltage lower event		☑	☑
E2030	ANSI25A-3 Frequency higher event		☑	☑
E2031	ANSI25A-3 Frequency lower event		☑	☑
E2032	ANSI25A-3 Voltage higher event		☑	☑
E2033	ANSI25A-3 Voltage lower event		☑	☑
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		☑	☑

Event No.	Name	Description	Event system	Event recorder
E2063	ANSI67G-4 blocked step		☑	☑
E2064	ANSI67G-4 pickup		☑	☑
E2065	ANSI67G-4 trip		☑	☑
E2066	ANSI67G-4 low voltage		☑	☑
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		☑	☑
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		☑	☑

Event No.	Name	Description	Event system	Event recorder
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		☑	☑
E2335	SOTF active		☑	☑
E2336	SOTF blocked		☑	☑
E2338	SOTF-1 active		☑	☑
E2339	SOTF-1 blocked		☑	☑
E2340	SOTF-1 trigger		☑	☑
E2341	SOTF-1 pickup		☑	☑
E2342	SOTF-1 trip		☑	☑
E2344	SOTF-2 active		☑	☑
E2345	SOTF-2 blocked		☑	☑
E2346	SOTF-2 trigger		☑	☑
E2347	SOTF.2 pickup		☑	☑
E2348	SOTF-2 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		☑	☑
E2180	YG active		☑	☑
E2181	YG blocked		☑	☑
E2185	YG-1 active		☑	☑
E2186	YG-1 blocked		☑	☑
E2187	YG-1 pickup		☑	☑
E2188	YG-1 trip		☑	☑

Event No.	Name	Description	Event system	Event recorder
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		☑	☑
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		☑	☑
E2231	ANSI50BF-3 pickup		☑	☑
E2232	ANSI50BF-3 trip		☑	☑
E2235	ANSI74TC active		☑	☑
E2236	ANSI74TC blocked		☑	☑
E2237	ANSI74TC pickup		☑	☑
E2238	ANSI74TC trip		☑	☑
E2240	ANSI51/46VR module active		☑	☑
E2241	ANSI51/46VR blocked module		☑	☑
E2242	ANSI51/46VR prot.blocking		☑	☑
E2245	ANSI46 module active		☑	☑
E2246	ANSI46 blocked module		☑	☑

Event No.	Name	Description	Event system	Event recorder
E2248	ANSI46-1 step active		☑	☑
E2249	ANSI46-1 blocked step		☑	☑
E2250	ANSI46-1 pickup		☑	☑
E2251	ANSI46-1 trip		☑	☑
E2256	ANSI46-2 step active		☑	☑
E2257	ANSI46-2 blocked step		☑	☑
E2258	ANSI46-2 pickup		☑	☑
E2259	ANSI46-2 trip		☑	☑
E2264	ANSI46-3 step active		☑	☑
E2265	ANSI46-3 blocked step		☑	☑
E2266	ANSI46-3 pickup		☑	☑
E2267	ANSI46-3 trip		☑	☑
E2272	ANSI46-4 step active		☑	☑
E2273	ANSI46-4 blocked step		☑	☑
E2274	ANSI46-4 pickup		☑	☑
E2275	ANSI46-4 trip		☑	☑
E2280	ANSI32N/G module active		☑	☑
E2281	ANSI32N/G blocked module		☑	☑
E2282	ANSI32N/G-1 step active		☑	☑
E2283	ANSI32N/G-1 blocked step		☑	☑
E2284	ANSI32N/G-1 pickup		☑	☑
E2285	ANSI32N/G-1 trip		☑	☑
E2290	ANSI32N/G-2 step active		☑	☑
E2291	ANSI32N/G-2 blocked step		☑	☑
E2292	ANSI32N/G-2 pickup		☑	☑
E2293	ANSI32N/G-2 trip		☑	☑
E2298	ANSI32N/G-3 step active		☑	☑
E2299	ANSI32N/G-3 blocked step		☑	☑
E2300	ANSI32N/G-3 pickup		☑	☑
E2301	ANSI32N/G-3 trip		☑	☑
E2306	ANSI32N/G-4 step active		☑	☑
E2307	ANSI32N/G-4 blocked step		☑	☑
E2308	ANSI32N/G-4 pickup		☑	☑
E2309	ANSI32N/G-4 trip		☑	☑
E2314	ANSI32N/G-5 step active		☑	☑
E2315	ANSI32N/G-5 blocked step		☑	☑
E2316	ANSI32N/G-5 pickup		☑	☑
E2317	ANSI32N/G-5 trip		☑	☑
E2322	ANSI32N/G-6 step active		☑	☑
E2323	ANSI32N/G-6 blocked step		☑	☑
E2324	ANSI32N/G-6 pickup		☑	☑
E2325	ANSI32N/G-6 trip		☑	☑
E2330	CLD active		☑	☑

Event No.	Name	Description	Event system	Event recorder
E2331	CLD blocked		☑	☑
E2332	CLD pickup		☑	☑
E2333	CLD cold load		☑	☑
E2350	ANSI49 module active		☑	☑
E2351	ANSI49 module blocked		☑	☑
E2352	ANSI49-1 step active		☑	☑
E2353	ANSI49-1 step blocked		☑	☑
E2354	ANSI49-1 warning		☑	☑
E2355	ANSI49-1 trip		☑	☑
E2356	ANSI49-2 step active		☑	☑
E2357	ANSI49-2 step blocked		☑	☑
E2358	ANSI49-2 warning		☑	☑
E2359	ANSI49-2 trip		☑	☑
E2360	ANSI49-3 step active		☑	☑
E2361	ANSI49-3 step blocked		☑	☑
E2362	ANSI49-3 warning		☑	☑
E2363	ANSI49-3 trip		☑	☑
E2364	ANSI49-4 step active		☑	☑
E2365	ANSI49-4 step blocked		☑	☑
E2366	ANSI49-4 warning		☑	☑
E2367	ANSI49-4 trip		☑	☑
E2368	ANSI86 module active		☑	☑
E2370	ANSI64REF active		☑	☑
E2371	ANSI64REF blocked		☑	☑
E2372	ANSI64REF-1 active		☑	☑
E2374	ANSI64REF-1 blocked		☑	☑
E2375	ANSI64REF-1 pickup		☑	☑
E2376	ANSI64REF-1 trip		☑	☑
E2379	ANSI64REF-2 active		☑	☑
E2380	ANSI64REF-2 blocked		☑	☑
E2381	ANSI64REF-2 pickup		☑	☑
E2382	ANSI64REF-2 trip		☑	☑
E2385	ANSI21FL active		☑	☑
E2386	ANSI21FL blocked		☑	☑
E2387	ANSI21FL busy		☑	☑
E2457	ANSI37 module active		☑	☑
E2458	ANSI37 module blocked		☑	☑
E2459	ANSI37-1 step active		☑	☑
E2460	ANSI37-1 step blocked		☑	☑
E2461	ANSI37-1 pickup		☑	☑
E2462	ANSI37-1 trip		☑	☑
E2463	ANSI37-2 step active		☑	☑
E2464	ANSI37-2 step blocked		☑	☑

Event No.	Name	Description	Event system	Event recorder
E2465	ANSI37-2 pickup		☑	☑
E2466	ANSI37-2 trip		☑	☑
E2467	ANSI37-3 step active		☑	☑
E2468	ANSI37-3 step blocked		☑	☑
E2469	ANSI37-3 pickup		☑	☑
E2470	ANSI37-3 trip		☑	☑
	Binary input events E4010 – E4228			
E4010	Binary input “Fct. 10” input event	Binary input event input event	☑	☑
E4011	Binary input “Fct. 11” input event	Binary input event input event	☑	☑
E4012	Binary input “Fct. 12” input event	Binary input event input event	☑	☑
E4013	Binary input “Fct. 13” input event	Binary input event input event	☑	☑
E4014	Binary input “Fct. 14” input event	Binary input event input event	☑	☑
E4015	Binary input “Fct. 15” input event	Binary input event input event	☑	☑
E4016	Binary input “Fct. 16” input event	Binary input event input event	☑	☑
E4017	Binary input “Fct. 17” input event	Binary input event input event	☑	☑
E4018	Binary input “Fct. 18” input event	Binary input event input event	☑	☑
E4019	Binary input “Fct. 19” input event	Binary input event input event	☑	☑
E4020	Binary input “Fct. 20” input event	Binary input event input event	☑	☑
E4021	Binary input “Fct. 21” input event	Binary input event input event	☑	☑
E4022	Binary input “Fct. 22” input event	Binary input event input event	☑	☑
E4023	Binary input “Fct. 23” input event	Binary input event input event	☑	☑
E4024	Binary input “Fct. 24” input event	Binary input event input event	☑	☑
E4025	Binary input “Fct. 25” input event	Binary input event input event	☑	☑
E4026	Binary input “Fct. 26” input event	Binary input event input event	☑	☑
E4027	Binary input “Fct. 27” input event	Binary input event input event	☑	☑
E4028	Binary input “Fct. 28” input event	Binary input event input event	☑	☑
E4110	Binary input “Fct. 10” predelay event	Binary input event predelay event	☑	☑
E4111	Binary input “Fct. 11” predelay event	Binary input event predelay event	☑	☑
E4112	Binary input “Fct. 12” predelay event	Binary input event predelay event	☑	☑
E4113	Binary input “Fct. 13” predelay event	Binary input event predelay event	☑	☑
E4114	Binary input “Fct. 14” predelay event	Binary input event predelay event	☑	☑
E4115	Binary input “Fct. 15” predelay event	Binary input event predelay event	☑	☑
E4116	Binary input “Fct. 16” predelay event	Binary input event predelay event	☑	☑
E4117	Binary input “Fct. 17” predelay event	Binary input event predelay event	☑	☑
E4118	Binary input “Fct. 18” predelay event	Binary input event predelay event	☑	☑
E4119	Binary input “Fct. 19” predelay event	Binary input event predelay event	☑	☑
E4120	Binary input “Fct. 20” predelay event	Binary input event predelay event	☑	☑
E4121	Binary input “Fct. 21” predelay event	Binary input event predelay event	☑	☑
E4122	Binary input “Fct. 22” predelay event	Binary input event predelay event	☑	☑
E4123	Binary input “Fct. 23” predelay event	Binary input event predelay event	☑	☑
E4124	Binary input “Fct. 24” predelay event	Binary input event predelay event	☑	☑
E4125	Binary input “Fct. 25” predelay event	Binary input event predelay event	☑	☑
E4126	Binary input “Fct. 26” predelay event	Binary input event predelay event	☑	☑

Event No.	Name	Description	Event system	Event recorder
E4127	Binary input “Fct. 27” predelay event	Binary input event predelay event	☑	☑
E4128	Binary input “Fct. 28” predelay event	Binary input event predelay event	☑	☑
E4210	Binary input “Fct. 10” inverted event	Binary input event inverted event	☑	☑
E4211	Binary input “Fct. 11” inverted event	Binary input event inverted event	☑	☑
E4212	Binary input “Fct. 12” inverted event	Binary input event inverted event	☑	☑
E4213	Binary input “Fct. 13” inverted event	Binary input event inverted event	☑	☑
E4214	Binary input “Fct. 14” inverted event	Binary input event inverted event	☑	☑
E4215	Binary input “Fct. 15” inverted event	Binary input event inverted event	☑	☑
E4216	Binary input “Fct. 16” inverted event	Binary input event inverted event	☑	☑
E4217	Binary input “Fct. 17” inverted event	Binary input event inverted event	☑	☑
E4218	Binary input “Fct. 18” inverted event	Binary input event inverted event	☑	☑
E4219	Binary input “Fct. 19” inverted event	Binary input event inverted event	☑	☑
E4220	Binary input “Fct. 20” inverted event	Binary input event inverted event	☑	☑
E4221	Binary input “Fct. 21” inverted event	Binary input event inverted event	☑	☑
E4222	Binary input “Fct. 22” inverted event	Binary input event inverted event	☑	☑
E4223	Binary input “Fct. 23” inverted event	Binary input event inverted event	☑	☑
E4224	Binary input “Fct. 24” inverted event	Binary input event inverted event	☑	☑
E4225	Binary input “Fct. 25” inverted event	Binary input event inverted event	☑	☑
E4226	Binary input “Fct. 26” inverted event	Binary input event inverted event	☑	☑
E4227	Binary input “Fct. 27” inverted event	Binary input event inverted event	☑	☑
E4228	Binary input “Fct. 28” inverted event	Binary input event inverted event	☑	☑
	Binary output events E4500 – E4521			
E4500	Shunt Trip 1 output set	Shunt Trip 1 output event	☑	☑
E4501	Shunt Trip 2 output set	Shunt Trip 2 output event	☑	☑
E4502	Lockout relay set	Lockout relay event	☑	☑
E4503	Lockout relay predelay	Lockout relay predelay event	☑	☑
E4504	Synchron relay set	Synchron relay event	☑	☑
E4505	Synchron relay predelay	Synchron relay predelay event	☑	☑
E4506	Function output “Fct. 1” set	Function output 1event	☑	☑
E4507	Function output “Fct. 1” predelay	Function output 1 predelay event	☑	☑
E4508	Function output “Fct. 2” set	Function output 2 event	☑	☑
E4509	Function output “Fct. 2” predelay	Function output 2 predelay event	☑	☑
E4510	Function output “Fct. 3” set	Function output 3 event	☑	☑
E4511	Function output “Fct. 3” predelay	Function output 3 predelay event	☑	☑
E4512	Function output “Fct. 4” set	Function output 4 event	☑	☑
E4513	Function output “Fct. 4” predelay	Function output 4 predelay event	☑	☑
E4514	Function output “Fct. 5” set	Function output 5 event	☑	☑
E4515	Function output “Fct. 5” predelay	Function output 5 predelay event	☑	☑
E4516	Function output “Fct. 6” set	Function output 6 event	☑	☑
E4517	Function output “Fct. 6” predelay	Function output 6 predelay event	☑	☑
E4518	Function output “Fct. 7” set	Function output 7 event	☑	☑
E4519	Function output “Fct. 7” predelay	Function output 7 predelay event	☑	☑
E4520	Function output “Fct. 8” set	Function output 8 event	☑	☑

Event No.	Name	Description	Event system	Event recorder
E4521	Function output “Fct. 8” predelay	Function output 8 predelay event	☑	☑
	Event system			
E5950	Event history stop	Event recording stop is active	☑	☑
	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)	☑	☑

Event No.	Name	Description	Event system	Event recorder
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)	☑	☑
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)	☑	☑

Event No.	Name	Description	Event system	Event recorder
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)	☑	☑
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)	☑	☑

Event No.	Name	Description	Event system	Event recorder
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 – E6414	Event of assigned function is active as long as button is pressed		
E6400	0		☑	☑
E6401	1		☑	☑
E6402	Stop		☑	☑
E6403	Start		☑	☑
E6404	Page Up		☑	☑
E6405	Page Down		☑	☑
E6406	Key	Brings up menu page “User levels”	☑	☑
E6407	Alarm Ack	Acknowledgement of alarms	☑	☑
E6408	Alarm page	Brings up menu page “Alarms”	☑	☑
E6409	Auto/Manual		☑	☑
E6414	Emergency OFF 1 / Emergency OFF 2		☑	☑
	ComU GGIO4 events 6500 – 6515			
E6500 - E6515	GGIO4 events	Events for GGIO4	☑	☑
	ComU general events 6530 – 6593			
E6530 - E6593	ComU general events	ComU general purpose events	☑	☑
	Modbus events 6600 - 6631			
E6600 - E6631	Modbus events	Could be set via Modbus	☑	☑
	Operation mode events 6810 - 6811			
E6810	Local mode		☑	☑
E6811	Remote mode		☑	☑
	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	☑	☑

Event No.	Name	Description	Event system	Event recorder
	System events			
E6970	System booting	Event turns to active when system starts (booting phase) and automatically turns to inactive when system start has finished (booting has finished).	☑	☑
E6971	WD reset CU	Watchdog for reset of control unit (CU)	☑	☑
E6972	WD reset MU	Watchdog for reset of measuring unit (MU)	☑	☑
E6973	WD reset GU	Watchdog for reset of graphic unit (GU)	☑	☑
E6974	WD reset ComU	Watchdog for reset of communication unit (ComU)	☑	☑
	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		☑	☑
	Limit value monitoring LVM E8100 - E8299			
E8100	LVM-1 pickup	Limit value monitoring LVM step 1 pickup	☑	☑
E8101	LVM-1 trip	Limit value monitoring LVM step 1 trip	☑	☑
to	…	…		
E8298	LVM-100 pickup	Limit value monitoring LVM step 100 pickup	☑	☑
E8299	LVM-100 trip	Limit value monitoring LVM step 100 trip	☑	☑
	System supervision events E9000 - E9048			
E9000		Common alarm of system supervision	☑	☑
E9001		Common alarm system total error	☑	☑
E9002		CU CPU communication failure	☑	☑
E9003		MU CPU communication failure	☑	☑
E9004		GU CPU communication failure	☑	☑
E9005		ComU CPU communication failure	☑	☑
E9006		CU Bad CPU communication	☑	☑
E9007		Firmware constellation invalid	☑	☑
E9008		Unknown parameter file	☑	☑
E9009		Unknown hardware	☑	☑
E9010		CU DRAM error	☑	☑
E9011		CU Serial Flash error	☑	☑

Event No.	Name	Description	Event system	Event recorder
E9012		CU Binary Inputs ADC SPI error	☑	☑
E9013		CU Binary Outputs DAC MAX4820 error	☑	☑
E9014		CU Serial Port 1 Framing error	☑	☑
E9015		CU Analogue Inputs ADC AD7914 error	☑	☑
E9016		CU Profibus error	☑	☑
E9017		CU SD card error	☑	☑
E9018		CU Binary Inputs ADC I²C error	☑	☑
E9020		CU Parameter file error	☑	☑
E9021		MU Parameter file error	☑	☑
E9022		GU Parameter file error	☑	☑
E9023		ComU Parameter file error	☑	☑
E9030		Event system feedback loop detected	☑	☑
E9040		MU kWh counter crc error	☑	☑
E9041		MU EEPROM error	☑	☑
E9042		MU Calibration file crc error	☑	☑
E9043		MU Overload	☑	☑
E9044		MU ADC0 error	☑	☑
E9045		MU ADC1 error	☑	☑
E9046		MU Battery low alarm	☑	☑
E9047		MU Calibration error	☑	☑
E9048		MU Battery defect	☑	☑
	GOOSE events E9200 - E9998			
E9200 - E9998	GOOSE events	Events for GOOSE (IEC 61850)		
	Static event			
E9999	ON-Event	Event is always active (true)	☑	-

2.2 SETUP (Basic device settings)

2.2.1 User levels

SETUP Menu – Configurable User levels

Main Menu\Parameters\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	300	300	s	0 … 65000

Active by event		0	0	0	event	0 ... 9999
Block by event		0	0	0	event	0 ... 9999
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 parameter upload (read)	☐	☐	☐	☐	-	☐/☑
Block parameter download (write)	☐	☐	☐	☐	-	☐/☑
Block parameter view via LCD	☐	☐	☐	☐	-	☐/☑
Block parameter change via LCD	☐	☐	☐	☐	-	☐/☑

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 activated.

Parameter description:

Activation

P Priority
Priority setting of the user level against activation of other user levels; when two or more user levels are activated simultaneously, the user level is with the highest priority is activated. According to the setting options of setting *Priority* [P], order of priority is as follows:

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

Note: User level 1 is only active when none of the user levels 2, 3 and 4 are activated

P Password
Enter 4-digit password to activate the relevant user level

P Activation time
Duration for activated user level: as soon as user level 2, 3 or 4 is activated, activation time set by setting *Activation time* [P] starts. As soon as the timer has run down, P60 Agile 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 setting *Active by event* [P]. Activation is only effective

when the activating event is active. As soon as the user level is active, corresponding event [E6802], [E6803] or [E6804] is 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. To block, the number related to this blocking event has to be assigned to setting *Block by event* [P]. Blocking is only effective when 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**.

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 the corresponding event Local mode [E6810] is activated.

CAUTION: Assigning Local mode to any user level only is only a declaration of the assigned user level as local mode. Corresponding functionality of that user level declared as Local mode should be programmed by assigning selected Functions (listed below) to the user level.

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; the corresponding event Remote mode [E6811] is activated.

CAUTION: Assigning Local mode to any user level only is only a declaration of the assigned user level as local mode. Corresponding functionality of that user level declared as Local mode should be programmed by assigning selected Functions (listed below) to the user level.

P Change display settings

Authorisation for setting 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 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 P60 Agile 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 P60 Agile 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 parameter upload (read)

Authorisation for blocking of reading the P60 Agile parameter file by P60 Agile Configurator; reading the parameter file via P60 Agile Configurator is only permitted if the user level which is assigned to parameter *Block parameter upload (read)* [P] is activated.

P Block parameter download (write)

Authorisation for blocking of writing the P60 Agile parameter file by the P60 Agile Configurator. Writing the parameter file using the P60 Agile CONFIGURATOR is only permitted if the user level which is assigned to parameter *Block parameter download (read)* [P] is activated.

P Block parameter 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 paraeter view via LCD* [P] is activated.

P Block param. change via LCD

Authorisation for blocking of entering the parameter setting mode via display; entering of parameter setting mode via display is blocked, if the user level which is assigned to parameter “Block param. change via LCD“ [P] is activated.

2.2.2 Measuring inputs

SETUP Menu – Enable/Disable current and voltage measurement inputs

Main Menu\Parameters\SETUP				
Measuring inputs				
P/E No.	System Description	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*	Option not supported in P16x		
P91512	CT-GND1	Enabled	-	Enabled/Disabled

Parameter description:

Voltage measurement inputs

P91500 PT1

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

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

P91501 PT2

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

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

P91502 PT3

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

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

P91503 PT-GND1

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

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

Current measurement inputs

P91510 CT1

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

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

P91511 CT2

- This option not supported in P16x devices.

P91513 CT-GND1

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

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

Note: If an input is disabled it should not be used as a source for any of the protection functions as no measurements will be available.

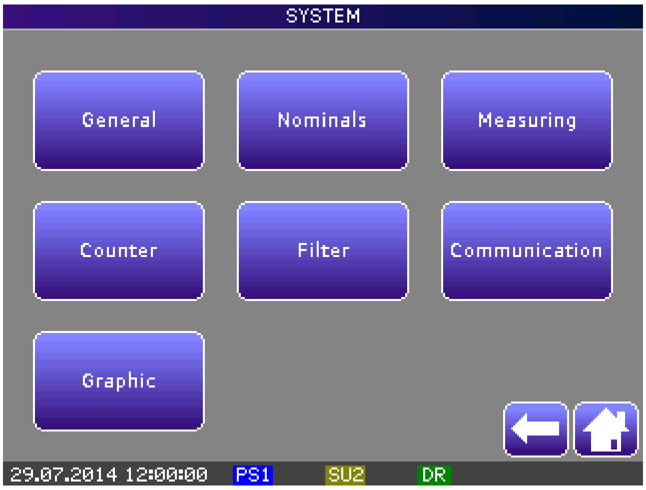
2.3 SYSTEM (System parameters)

System parameters adapt the P60 Agile OBS to the specific application such as voltage and current transformers (PTs and CTs), communication systems etc. The parameters are arranged in the following submenus:

- **General** (time zone and daylight saving time)
- **Nominals** (Rated values of the application)
- **Measuring** (Coordination of measuring inputs)
- **Counter** (Counting functions)
- **Filter** (Filter for measurement display)

- **Communication** (Standard communication) and
- **Graphic** (Referencing and selection of displayed measurement values; button, display and bargraph configuration)

System parameters



2.3.1 General

The parameters of “General” submenu refer to parameters settings for time zone and daylight saving time.

Time setting submenu

				Main Menu\ Parameters\SYSTEM\
General				
P/E No.	System Description	Value	Unit	(Setting range)
	Time setting			
P963	Daylight saving time	OFF	-	OFF/ON
P964	Local time zone	0	-	0 … 12

Parameter description:

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] (up to ±12 hours offset to „Coordinated Universal Time (UTC)“ or „Greenwich Mean Time (GMT)“).

2.3.2 Nominals (rated data of the application)

Parameters of the Nominals menu 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)

System parameters – Nominals

2.3.2.1 Reference Values (Reference Values for protection settings)

System parameters – Reference Values

Main Menu\Parameters\SYSTEM\Nominals				
Reference Values				
P/E No.	System Description	Value	Unit	(Setting range)
	Primary W1			
P600	Connection type	Y	-	none/Y/D
P602	Star point grounding	isolated	-	isolated/compensated/earthed
P603	Voltage (L-L)	20000	V	0 ... 999999
P604	Current	100	A	0 ... 999999,9
P605	Power	3464	kW	0 ... 9999999
P606	Ground voltage	20000	V	0 ... 999999
P607	Ground current	100	A	0 ... 99999,999
	Secondary W2			
P610	Connection type	Option not relevant for P16x		
P611	Phase shift			
P612	Star point grounding			
P613	Voltage (L-L)			
P614	Current			
P615	Power			
P616	Ground voltage			
P617	Ground current			
	Tertiary W3			

Main Menu\Parameters\SYSTEM\Nominals				
Reference Values				
P620	Connection type	Option not relevant for P16x		
P621	Phase shift			
P622	Star point grounding			
P623	Voltage (L-L)			
P624	Current			
P625	Power			
P626	Ground voltage			
P627	Ground current			
	Frequency			
P630	Nominal frequency	50	Hz	50/60

Parameter description:

Primary side W1 (or transformer primary side W1)

P600 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 transformer present in the application
- Y: the winding strands of transformer primary side W1 will be wired in star Y connection (star point does exist)
- D: the winding strands of transformer primary side W1 will be wired in delta Δ connection (star point does not exist)

Note: The references to transformer may be ignored; these have been retained only due to the platform functionality reserved for future.

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 ground (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 grounded).
- 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 grounded).

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)

Winding W2 not relevant for the P16x.

Tertiary side W3 (or transformer tertiary side W3)

Winding W3 not relevant for the P16x.

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.

> *Note:* *The parameters P603 to P607 and P630 must be set, and are used by the P60 Agile as the nominal values for protection function thresholds.*

2.3.2.2 Potential transformers (Rated data of PTs)

System parameters – Potential Transformers

Main Menu\ Parameters\SYSTEM\Nominals				
Potential Transformers				
P/E No.	System Description	Value	Unit	(Setting range)
	PT1			
P640	PT1 primary side	0	V	0 … 999999
P641	PT1 secondary side	0	V	0 … 999999
P642	PT1 assignment	W1	-	W1/W2*/W3*
	PT2			

P643	PT2 primary side	0	V	0 … 999999
P644	PT2 secondary side	0	V	0 … 999999
P645	PT2 assignment	W1	-	W1/W2/W3
	PT3			
P646	PT3 primary side	0	V	0 … 999999
P647	PT3 secondary side	0	V	0 … 999999
P648	PT3 assignment	W1	-	W1/W2*/W3*
	PT-GND1			
P649	PT-GND1 primary side	0	V	0 … 999999
P650	PT-GND1 secondary side	0	V	0 … 999999
P651	PT-GND1 assignment	W1	-	W1/W2*/W3*

Note: Windings W2 and W3 are not relevant for the P16x.

Parameter description:

Potential transformer 1

P640 PT1 primary side

Primary side nominal voltage of potential transformer PT1

P641 PT1 secondary side

Secondary side nominal voltage of potential transformer PT1

P642 PT1 assignment

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

Potential transformer 2

P643 PT2 primary side

Primary side nominal voltage of potential transformer PT2

P644 PT2 secondary side

Secondary side nominal voltage of potential transformer PT2

P645 PT2 assignment

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

Potential transformer 3

P646 PT3 primary side

Primary side nominal voltage of potential transformer PT3

P647 PT3 secondary side

Secondary side nominal voltage of potential transformer PT3

P648 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

P649 PT-GND1 primary side

Primary side nominal neutral voltage of potential transformer PT-GND1

P650 PT-GND1 secondary side

Secondary side nominal neutral voltage of potential transformer PT-GND1

P651 PT-GND1 assignment

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

2.3.2.3 Current transformers (Rated data of CTs)

System parameters – Current Transformers

Main Menu\ Parameters\SYSTEM\Nominals				
Current Transformers				
P/E No.	System Description	Value	Unit	(Setting range)
	CT1-M/P			
P660	Primary	0	A	0 ... 65535
P661	Secondary	1	A	1A / 5A
P665	Direction L1	0°	°	0/180
P666	Direction L2	0°	°	0/180
P667	Direction L3	0°	°	0/180
P668	Assignment	W1	-	W1/W2*/W3*
	CT1-M			
P689**	Primary	0	A	0 ... 65535
P690**	Secondary	1	A	1A / 5A
P662	Direction L1	0	A	0/180
P663	Direction L2	0°	°	0/180
P664	Direction L3	0°	°	0/180
	CT2-M/P*			
P669	Primary	Option not supported in P16x		
P670	Secondary			
P671	Direction L1			
P672	Direction L2			
P673	Direction L3			
P674	Assignment			
	CT-GND1			
P681	Primary	0	A	0 ... 65535
P682	Secondary	1	A	1A / 5A
P683	Direction	0°	°	0/180
P684	Assignment	W1	-	W1/W2*/W3*

> ***Note:** *Windings W2 and W3 are not relevant for the P16x.*
>
> ***Parameter settings P689 and P690 are supported from FW v1.0-1.23.x onwards.*

Parameter description:

Three phase current transformer input CT1-M/P (connecting protection winding of the external current transformer to CT1-M/P).

P660 Primary**

Primary side nominal current of the external current transformer connected to CT1-M/P.

P661 Secondary**

Secondary side nominal current of the external current transformer connected to CT1-M/P.

P665 Direction L1

Setting the measuring direction for the phase current I_{L1} at the measurement inputs CT1-M/P. With correct connection of the secondary side of the current transformer, setting 0° means for the P60 Agile 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 the need to modify wiring.

P666 Direction L2

Setting the measuring direction for the phase current I_{L2} at the measurement inputs CT1-M/P. With correct connection of the secondary side of the current transformer, setting 0° means for the P60 Agile 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 the need to modify wiring.

P667 Direction L3

Setting the measuring direction for the phase current I_{L3} at the measurement inputs CT1-M/P. With correct connection of the secondary side of the current transformer, setting 0° means for the P60 Agile 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 the need to modify wiring.

P668 Assignment

Assignment of phase current measurement input CT1-M/P and optional CT1-M (when P60 Agile is equipped with additional terminals for connecting measurement winding of external current transformer) to the voltage level (CT location: transformer winding side W1, W2* or W3*).

The P60 Agile has optional measurement CT inputs for connecting the measurement core of the external CT.

Three phase current measurement input CT1-M (connecting measurement windings of external current transformer to CT1-M)

CAUTION: **When separate CT (measurement core) and CT (protection core) with different primary side nominal values are connected to P60 Agile, the *ratio of the CT primary side nominal values*: *"Primary"* [P660] / *"Primary"* [P689] must not exceed ratio 5:1!**
If so, connection of such CTs is not applicable!

Examples*:** ***"Primary [P660] = 500" / "Primary [P689] = 100" **= 5:1 => allowed!**
"Primary [P660] = 600" / "Primary [P689] = 100" **= 6:1 => not allowed!**

P689 Primary

Primary side nominal current of the external current transformer connected to CT1-M

P690 Secondary

Secondary side nominal current of the external current transformer connected to CT1-M

P662 Direction L1

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 external current transformer, setting "0°" means for the P60 Agile 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

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 external current transformer, setting "0°" means for the P60 Agile 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

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 external current transformer, setting "0°" means for the P60 Agile 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.

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

This option is not supported in P16x devices.

Ground current transformer CT-GND1

P681 Primary

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

P682 Secondary

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

P683 Direction

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 external current transformer, setting 0°

means for the P60 Agile a reference angle of 0° for determination of phase position of the current I_G. 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 the need to modify wiring.

P684 Assignment

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

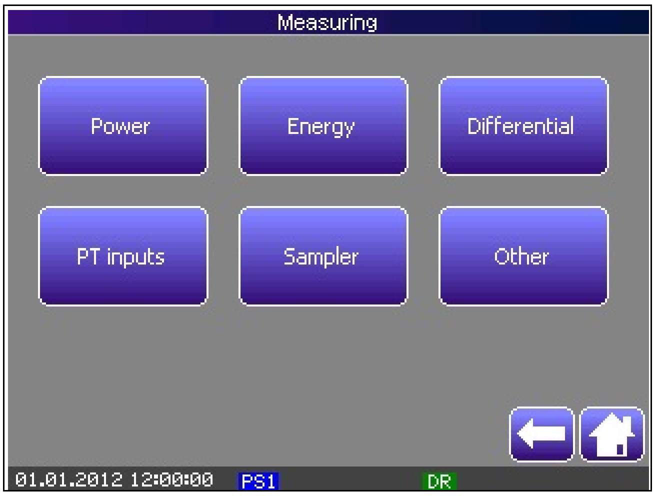
**Note: Windings W2 and W3 are not relevant for the P16x.*

2.3.3 Measuring (coordination of measuring channels)

Parameters of the Measuring menu are for coordinating the measuring channels to the application. These include:

- Coordination of voltage and current measuring inputs for power measurement (Power)
- Assignment of power measuring for energy counters (Energy)
- Setting options for zero current compensation (star point grounding) and assignment of the current measuring inputs for determination of the ground current for function ANSI 64REF-Restricted ground fault protection (Differential
- Setting options to adjust measuring ranges of voltage measurement inputs (PT inputs)
- Setting options to enable/disable DC voltage measurement via PT1, PT2 and/or PT3 (DC voltage)- ***Function presently not supported in P16x.***
- Coordination of sample function for frequency measurement (Sampler), and
- Setting of DC-filter for current measuring (Other)

System parameters – Measuring



2.3.3.1 Power

System parameters – Measuring\Power

Main Menu\ Parameters\SYSTEM\Measuring				
Power				
P/E No.	System Description	Value	Unit	(Setting range)
	POWER CT1			
P9410	PT reference	PT1	-	PT1/PT2/PT3
P9411	Direction	0°	°	0/180
	POWER CT2*			
P9413	PT reference	Option not supported in P16x		
P9414	Direction			
	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

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

POWER CT1

Note: *All protective functions whose protective criteria depends on current and voltage measurement values as well (e.g. ANSI 32, 67 etc.), refer to the setting of Power CT1.*

P9410 PT reference

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

According to the P60 Agile 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.), would optionally refer to the setting of parameter “PT reference“ [P9410]*

P9411 Direction

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

- **0°**: When 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) When 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°:*** When 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 negative signs (*P < 0*, *Q < 0*) When 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

This option is not supported in P16x devices.

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.

According to the P60 Agile device variant, the following options are available:

- PT-GND1: calculation of I_G by CT1, measuring of U_G by PT-GND1
- PT1: calculation of I_G by CT1, calculation of U_G by PT1
- PT2: calculation of I_G by CT1, calculation of U_G by PT2
- PT3: calculation of I_G by CT1, calculation of U_G 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] 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°:** When the 1-phase or 3-phase voltage measurement input (PT-GND1, PT1, PT2 or PT3), assigned by parameter *PT reference* [9419], 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 ($P_0 > 0$, $Q_0 > 0$) When ground current I_G lags the residual voltage U_G. In case of the same connection and setting preconditions the ground current I_G leads the residual voltage U_G, *active ground power* P_0 will show positive sign ($P_0 > 0$) and *reactive ground power* will show negative sign ($Q_0 < 0$).

- **180°:** When the 1-phase or 3-phase voltage measurement input (PT-GND1, PT1, PT2 or PT3), assigned by parameter *PT reference* [9419], 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 ($P_0 < 0$, $Q_0 < 0$) When ground current I_G lags the residual voltage U_G. In case of the same connection and setting preconditions the ground current leads the residual voltage U_G, *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

This option is not supported in P16x devices

GND POWER CT-GND1

P9428 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.

According to the P60 Agile device variant, the following options are available:

- PT-GND1: measuring of I_G by CT-GND1, measuring of U_G by PT-GND1
- PT1: measuring of I_G by CT-GND1, calculation of U_G by PT1
- PT2: measuring of I_G by CT-GND1, calculation of U_G by PT2
- PT3: measuring of I_G by CT-GND1, calculation of U_G 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] 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°: When the 1-phase or 3-phase voltage measurement input (PT-GND1, PT1, PT2 or PT3), assigned by parameter *PT reference* [9428], 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 X1.1:13 to terminal X1.1:14 **and**

  parameter *Direction* [P683] is set to 0°,

  then *active ground power P_0* and *reactive ground power Q_0* will show *positive* signs (*$P_0 > 0$*, *$Q_0 > 0$*) When ground current I_G lags the residual voltage U_G. In case of the same connection and setting preconditions the ground current I_G leads the residual voltage U_G, *active ground power P_0* will show positive sign *($P_0 > 0$)* and *reactive ground power* will show negative sign *($Q_0 < 0$).*

- 180°: When the 1-phase or 3-phase voltage measurement input (PT-GND1, PT1, PT2 or PT3), assigned by parameter *PT reference* [9428], 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 X1.1:13 to terminal X1.1:14 **and**

  parameter *Direction* [P0683] is set to 0°,

  then *active ground power P_0* and *reactive ground power Q_0* will show *negative* signs (*$P_0 < 0$*, *$Q_0 < 0$*) When ground current I_G lags the residual voltage U_G. In case of the same connection and setting preconditions the ground current leads the residual voltage U_G, *active ground power P_0* will show negative sign *($P_0 < 0$)* and *reactive ground power Q_0* will show positive sign *($Q_0 > 0$).*

2.3.3.2 Energy

System parameters – Measuring\Energy

Main Menu\ Parameters\SYSTEM\Measuring				
Energy				
P/E No.	System Description	Value	Unit	(Setting range)
P9434	kWh counter reference	Power CT1	-	Power CT1/ Power CT2*
P9450	Min. start current	0	%	0 … 65535,5
P9451	Blocking	0	event	0 … 9999

Parameter description:

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*: this option is not supported in P16x devices

P9450 Min. start current

Minimum limit of the measuring current to activate energy counting; energy counting is blocked as long as the measured current in all three phases remain below this minimum setting.

> **NOTE:** *The minimum limit of measuring current to activate energy counting is to be set as a percentage of the nominal value of the process quantity "phase current". The nominal value of the process quantity is to be set by parameter: Current [P604]*
>
> *The parameter Current [P604] is located in submenu: SYSTEM\Nominals**Reference values***

P9451 Blocking

Energy counting function can be completely blocked by any active event. For blocking, the number related to this blocking event has to be assigned to parameter [P9451]. Blocking is only effective as long as the blocking event is active. If the blocking event becomes inactive, blocking is abandoned and energy counting is to be continued with the counting value which was saved at the point of time of blocking.

If blocking of the energy counting function is not required, set this parameter to "0".

2.3.3.3 Differential

System parameters – Measuring\Differential

Main Menu\ Parameters\SYSTEM\Measuring				
Differential				
P/E No.	System Description	Value	Unit	(Setting range)
	Zero compensation			
P9436	W1 zero compensation	Option is not supported in P16x		
P9437	W2 zero compensation			
	Ground differential			
P9439	CT-GNDx source	CT-GND1	-	CT-GND1
P9440	CTx source	CT1	-	CT1/CT2*
P9441	Diff-current reference	W1	-	W1/W2**/W3**

Parameter description:

Zero compensation

P9436 W1 zero compensation

This option is not applicable to P16x devices

P9437 W2 zero compensation

This option is not applicable to P16x devices.

Ground differential

The following parameters refer to the protective function *Restricted earth fault – ANSI 64REF*

P9439 CT-GNDxsource

Assignment of the current measurement input which measures the ground current directly for protective function *Restricted earth fault – ANSI 64REF.* At present, the characteristic quantity (ground current) of *restricted earth fault* protection is to be measured vie ground current measurement input CT-GND1:

- CT-GND1: measured ground current $\underline{I}_{GND}$ by CT-GND1

P9440 CTxsource

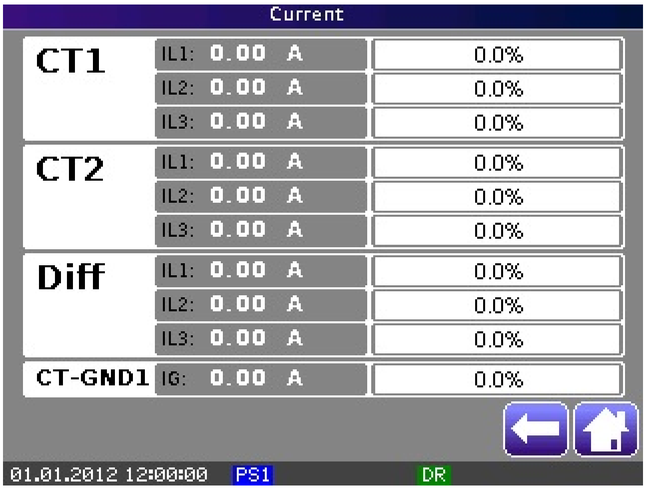
Assignment of the current measurement input which calculates the ground current for protective function *Restricted earth fault – ANSI 64REF.* Depending on the P60 Agile device variant, that measurement input which calculates the ground current from the 3-phase current measurement input of protective function *Restricted earth fault – ANSI 64REF*, can be assigned to a certain current measurement input (CT1 or CT2). Parameter [P9440] determines the current measurement input which will provide measurement values as characteristic quantity (ground current) to the *restricted earth fault* protection:

- CT1: calculated ground current: $\underline{I}_G = 3 \times \underline{I}_0 = \underline{I}_1+\underline{I}_2+\underline{I}_3$ from the phase currents, which are to be measured by CT1
- CT2*: This option is not supported in P16x devices

P9441 Diff-current reference

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

Meters "Current" – Differential currents "DIFF"



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

- W1: the primary winding W1

Note: Windings W2 and W3 are not relevant for the P16x.

2.3.3.4 PT inputs

System parameters – Measuring\PT inputs

Main Menu\ Parameters\SYSTEM\Measuring				
PT inputs				
P/E No.	System Description	Value	Unit	(Setting range)
	PT input mode			
P9400	PT1 mode	0 ... 1100V	V	0 ... 200V/0 ... 1100V
P9401	PT2 mode	0 ... 1100V	V	0 ... 200V/0 ... 1100V
P9402	PT3/PT-GND1 mode	0 ... 1100V	V	0 ... 200V/0 ... 1100V

Parameter description:

PT input mode

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

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

- Lower range: 0 to 200V AC
- Upper range: 0 to 1100V AC

Depending on the set values (parameters [P9400] to [P9402] of the voltage measuring inputs, the different voltage measuring inputs of P60 Agile 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:

- 0 – 200V: measuring input PT1 applies lower measuring range
  (e.g. for nominal voltages Un = 100V, 110V)
- 0 – 1100V: measuring input PT1 applies upper measuring range
  (e.g. for nominal voltages Un = 400V)

> *Note: The measuring range chosen should always be twice as much as the nominal voltage: Un ≤ 2 x $U_{Meas.\ range}$*

P9401 PT2 mode :

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

- 0 – 200V: measuring input PT2 applies lower measuring range
  (e.g. for nominal voltages Un = 100V, 110V)
- 0 – 1100V: measuring input PT2 applies upper measuring range
  (e.g. for nominal voltages Un = 400V)

> *Note: The measuring range chosen should always be twice as much as the nominal voltage: Un ≤ 2 x $U_{Meas.\ range}$*

P9402 PT3/PT-GND1 mode :

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

- 0 – 200V: measuring inputs PT-GND1 and PT3 apply lower measuring range (e.g. for nominal voltages Un = 100V, 110V)
- 0 – 1100V: measuring inputs PT-GND1 and PT3 apply upper measuring range (e.g. for nominal voltages Un = 400V)

> *Note: The measuring range chosen should always be twice as much as the nominal voltage: Un ≤ 2 x $U_{Meas.\ range}$*

2.3.3.5 Sampler

System parameters – Measuring\Sampler

Main Menu\ Parameters\SYSTEM\Measuring				
Sampler				
P/E No.	System Description	Value	Unit	(Setting range)
	Sampler			
P9455	Min frequency	10	Hz	0,10 ... 200
P9456	Max. frequency	80	Hz	0,10 ... 200
P9457	Frequency source	Auto	-	Auto/PT1/PT2/PT3/Fn

Sampler

The Sampler sub-menu provides parameters of the module for sampling current and voltage measurement values.

The sample rate for U/I measurement is 36 samples per cycle. In case that the frequency of the measured voltage quantities will differ from the set value of parameter *Nominal frequency* [P630], the time between two samples (sample time) has to be modified to the meet the rate of 36 samples per cycle.

Parameters [P9455] and [P9456] determine the range of the measured frequency which is valid for effectiveness of sample time adaption.

P9455 Min. frequency

Minimum frequency limit for adaption of the time between two samples; in the case that the frequency of the measured voltage quantity falls below the set value of parameter *Min. frequency* [P9455], then, calculation of the sample time reflects the set value of parameter *Nominal frequency* [P630].

P9456 Max. frequency

Maximum frequency limit for adaption of the time between two samples; in the case that the frequency of the measured voltage quantity exceeds the set value of parameter *Min. frequency* [P9455], then, calculation of the sample time reflects the set value of parameter *Nominal frequency* [P630].

P9457 Frequency source

Selection of the source for frequency measuring for calculation of the sample time, where:

- PT1: calculation of the sample time reflects the measured frequency value of PT1. If there is no frequency measurement at PT1 (fPT1 = 0), then calculation of the sample time reflects the set value of parameter *Nominal frequency* [P630].

- PT2: calculation of the sample time reflects the measured frequency value of PT2. If there is no frequency measurement at PT2 (fPT2 = 0), then calculation of the sample time reflects the set value of parameter *Nominal frequency* [P630].
- PT3: calculation of the sample time reflects the measured frequency value of PT3. If there is no frequency measurement at PT3 (fPT3 = 0), then calculation of the sample time reflects the set value of parameter *Nominal frequency* [P630].
- Fn: calculation of the sample time reflects the set value of parameter *Nominal frequency* [P630]
- Auto: calculation of the sample time reflects the measured frequency value of PT1. If there is no frequency measurement at PT1 (f_{PT1} = 0), then calculation of the sample time reflects the measured frequency value of PT2. If there is no frequency measurement at PT2 (f_{PT2} = 0), then calculation of the sample time reflects the measured frequency value of PT3. If there is no frequency measurement at PT3 (f_{PT3} = 0), then calculation of the sample time reflects the set value of parameter *Nominal frequency* [P630].

2.3.3.6 Floating average

System parameters – Measuring\Floating average

Main Menu\ Parameters\SYSTEM\Measuring				
Other				
P/E No.	System Description	Value	Unit	(Setting range)
P9463	Source of Uavg 10min	PT1	-	PT1/PT2/PT3

Parameter description:

P9463 Source of Uavg 10min

This parameter determines the voltage measurement input which will provide measurement values as characteristic quantity (floating voltage average) to the ANSI 59 – Overvoltage protection for those protection steps which are assigned to “10min arithmetic mean protection (ANSI 59AV)”; e.g. step 1: *“Pickup source [P1205] = Uavg 10min”*:

- “PT1“: voltage input PT1
- “PT2“: voltage input PT2
- “PT3“: voltage input PT3

2.3.3.7 Other

System parameters – Measuring\Other

Main Menu\ Parameters\SYSTEM\Measuring				
Other				
P/E No.	System Description	Value	Unit	(Setting range)
P9435	DC regulator	1	LSB	1 ... 2048

Parameter description:

P9435 DC regulator

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

To eliminate the DC portion parameter *DC regulator* [P9435] can be used. The DC regulator modifies the TRMS signal afflicted with DC portion with an adjustable rapidity. 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 = 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 = 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 done once a cycle.

2.3.4 Counter (counting functions)

System parameters – counting functions

Main Menu\ Parameters\SYSTEM\Counter				
Counter				
P/E No.	System Description	Value	Unit	(Setting range)
P700	Working hours counter	0	h	0 ... 999999
P701	Working hours counter act	0	event	0 ... 9999
	Energy counter			
P710	Wp+	0	kWh	0 ... 4294967295
P711	Wp-	0	kWh	0 ... 4294967295
P712	Wq+	0	kvarh	0 ... 4294967295
P713	Wq-	0	kvarh	0 ... 4294967295
E710	Wp+ overflow	-	-	-
E711	Wp- overflow	-	-	-
E712	Wq+ overflow	-	-	-
E713	Wq- overflow	-	-	-
E714	Wp+ overflow (temporary)	-	-	-
E715	Wp- overflow (temporary)	-	-	-
E716	Wq+ overflow (temporary)	-	-	-
E717	Wq- overflow (temporary)	-	-	-

	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

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 (download of parameter file “xxx.cpt”; e.g. after exchange), the working hours counter continues operating using the set counting value as new start value.

> *Note:* *The working hours counter will start if the measured frequency value (via voltage measurement at PTx) exceeds 30Hz or in case the device variant does not provide frequency measurement – the event assigned to parameter ‘Working hours counter act’ [P701] is active.*

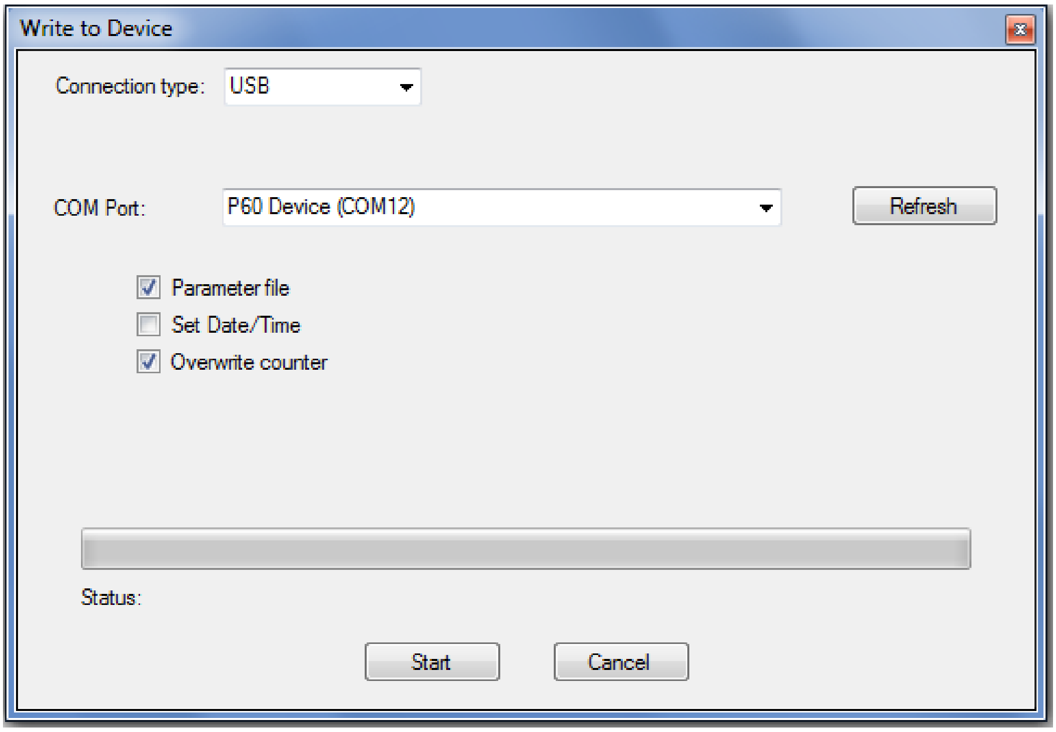
P701 Working hours counter act

The working hours counter can be activated by any active event. To activate the counter, the number related to this activation event has to be assigned to parameter [P701]. Counting is only effective for as long as the activating event is active. If the activating event becomes inactive, counting is abandoned.

If activation of working hours counter via activating event is not required, set this parameter to “**0**”.

> *Note:* *When sending the parameter file to the device the set values of parameters [P700] and [P710] to [P713] will only be saved if you tick the box “Overwrite counters” in the P60 configurator software.*

P60 Configurator – counting functions



Energy counters (absolute counting values)

P710 Wp+

Set value for the absolute counting values the positive, active energy counter; precisely at the time when the set value of parameter *Wp+* [P710] is saved (download of parameter file “xxx.cpt”; e.g. after exchange of the device), 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 (download of parameter file “xxx.cpt”; e.g. after exchange of the device), 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 (download of parameter file “xxx.cpt”; e.g. after exchange of the device), 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-* [P713] is saved (download of parameter file “xxx.cpt”; e.g. after exchange of the device), the negative, reactive energy counter continues operating using the set counting value as new start value.

Event description:

Absolute counting values

E710 Wp+ overflow

When the absolute, positive, active energy counter exceeds its maximum absolute counting value ($2^{32} - 1 = 4294967295$), event *Wp+ overflow* [E710] is activated, and counting will continue using “0” as new start value. Active event [E710] is deactivated automatically 1s after its activation.

E711 Wp- overflow

When the absolute, negative, active energy counter exceeds its maximum absolute counting value (2^{32} – 1 = 4294967295),, event *Wp- overflow* [E711] is activated, and counting will continue using “0” as new start value. Active event [E711] is deactivated automatically 1s after its activation.

E712 Wq+ overflow

When the absolute, positive, reactive energy counter exceeds its maximum absolute counting value (2^{32} – 1 = 4294967295), event *Wq+ overflow* [E712] is activated, and counting will continue using “0” as new start value. Active event [E712] is deactivated automatically 1s after its activation.

E713 Wq- overflow

When the absolute, negative, reactive energy counter exceeds its maximum absolute counting value (2^{32} – 1 = 4294967295), event *Wq- overflow* [E713] is activated, and counting will continue using “0” as new start value. Active event [E713] is deactivated automatically 1s after its activation.

Temporary counting values

E714 Wp+ overflow (temporary)

When the temporary, positive, active energy counter exceeds its maximum absolute counting value, event *Wp+ overflow (temporary)* [E714] is activated, and counting will continue using “0” as new start value. Active event [E714] is deactivated automatically 1s after its activation.

E715 Wp- overflow (temporary)

When the temporary, negative, active energy counter exceeds its maximum absolute counting value, event *Wp- overflow (temporary)* [E715] is activated, and counting will continue using “0” as new start value. Active event [E715] is deactivated automatically 1s after its activation.

E716 Wq+ overflow (temporary)

When the temporary, positive, reactive energy counter exceeds its maximum absolute *counting value*, event *Wq+ overflow (temporary)* [E716] is activated, and counting will continue using “0” as new start value. Active event [E716] is deactivated automatically 1s after its activation.

E717 Wq- overflow (temporary)

When the temporary, negative, reactive energy counter exceeds its *maximum absolute counting value*, event *Wq- overflow (temporary)* [E717] is activated, and counting will continue using “0” as new start value. Active event [E717] is deactivated automatically 1s after its activation.

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 counting values of all the AR-counters can be reset by any active event. To 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 reset to the start counting values set by parameters: [P720] to [P721]. Blocking of all the counters is only effective as long as the blocking event is active. If the reset event becomes inactive, counting is effective again.

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

2.3.5 Filter (filter functions for measurement, display and event recording)

System parameters – Filter functions

				Main Menu\ Parameters\SYSTEM\Filter
		Filter		
P/E No.	System Description	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
	Frequency			
P806	Max. rate of change	2.0	Hz/per cycle	0,100 … 6553,5
	Filter event recording			
P880	Filter event recording from	0	event	0 ... 9999
P881	-to	0	event	0 ... 9999
P882	Filter event recording from	0	event	0 ... 9999
P883	-to	0	event	0 ... 9999
P884	Filter event recording from	0	event	0 ... 9999
P885	-to	0	event	0 ... 9999
P886	Filter event recording from	0	event	0 ... 9999
P887	-to	0	event	0 ... 9999
P888	Filter event recording from	0	event	0 ... 9999
P889	-to	0	event	0 ... 9999
P890	Filter event recording from	0	event	0 ... 9999
P891	-to	0	event	0 ... 9999
P892	Filter event recording from	0	event	0 ... 9999
P893	-to	0	event	0 ... 9999

P894	Filter event recording from	0	event	0 ... 9999
P895	-to	0	event	0 ... 9999
P896	Filter event recording from	0	event	0 ... 9999
P897	-to	0	event	0 ... 9999
P898	Filter event recording from	0	event	0 ... 9999
P899	-to	0	event	0 ... 9999

Parameter description:

Dead Band

Dead band parameters [P800] to [P802] are applicable for device display and transmission via communication protocols of measurement values only.

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] should be set as a percentage of the nominal value of the characteristic quantity (phase current). The nominal value of the characteristic quantity should be set by parameter Current [P604], for primary side W1.

The parameters *Current* [P0604] is 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] should 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 set by parameter Voltage (L-L) [P603], for primary side W1.

*The parameters Voltage (L-L) [P603] is 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] should 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 set by parameter Power [P605] for primary side W1.

*The parameter Power [P605] is in submenu: SYSTEM \Nominals **Reference values**.*

Frequency

P806 Max. rate of change

Filter function for frequency measurement to distinguish between an increasing frequency and a frequency jump caused by disturbance influence.

> *Note:* *This feature can be used for applications in which no high frequency jumps are expected. However, a recognized high frequency jump might be due to an electromagnetic influence (EMC). The filter function can then be used to suppress this frequency peak and to avoid any unwanted tripping of the CB via active frequency protective functions.*

At the end of each measuring cycle a new frequency measurement value f_t is determined. Subsequently, this value is to be compared with the previously measured frequency value f_{t-1}. The frequency difference is then calculated: $\Delta f = f_t - f_{t-1}$, which gives information about the extent of the frequency jump:

- Δf > [P806]:

  If the frequency difference Δf exceeds the set value of parameter Max rate of change [P806] three times in succession the following measured frequency value is being ignored and the previously measured value remains valid for the measuring unit of P60 Agile.

- Δf < [P806]:

  If the frequency difference Δf is below the set value of parameter Max rate of change [P806], the new measured frequency value is valid for the measuring unit of P60 Agile.

Filter event recording

P880 Filter event recording from

Blocking of event recording for selected event(s); For blocking the event recording of a selected event or a range of selectable events, the number of the (first) selected event has to be assigned to parameter [P880]. Together with parameter *- to* [P881] a selected range of consecutive events can be determined which are not to be recorded by the event recorder.

If blocking of event recording for selected event(s) is not required, set this parameter to “**0**”.

P881 - to

Blocking of event recording for selected events; together with parameter *Filter event recording from* [P880] a range of consecutive events can be determined which are not to be recorded by the event recorder. For blocking the event recording of a selectable range of consecutive events, the number of the last selected event must be assigned to parameter [P881].

If blocking of event recording for a selected range of consecutive events is not required, set this parameter to “**0**”.

P883 Filter event recording from

(see description of parameters [P880])

P899 - to

(see description of parameters [P881])

2.3.6 Communication (configuration of interfaces)

Each P60 Agile provides a standard RS422/485 interface using the Modbus RTU data protocol. For additional communication options, please refer to the valid order code. As well as the standard communication, the following parameter descriptions also take into account all available communication options.

2.3.6.1 Serial Port 1

Communication – Standard interface - Serial port 1

Main Menu\ Parameters\SYSTEM\Communication				
Port settings				
P/E No.	System Description	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
P904	Format	8,None,1		8,None,1/8,None,2/8,Even,1/8,Even,2/ 8,Odd,1/8,Odd,2

Parameter description:

P900 Port

Standard interface of P60 Agile; the physical interface provides the following setting options:

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

P901 Address

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

P902 Baud rate

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 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).

P904 Format

Format definition (byte frame) of date telegram for protocoll type MODBUS RTU; the byte frame of the data telegram of P16x can be adapted to the interface configuration of the applied

Modbus Master system. The byte frame is determined as follows: Start bit = 1 (fix), No. of data bits, parity, No. of Stop bits.

- 8, None, 1: 1 start bit, 8 data bits, no parity, 1 stop bit
- 8, None, 2: 1 start bit, 8 data bits, no parity, 2 stop bits
- 8, Even, 1: 1 start bit, 8 data bits, even parity, 1 stop bit
- 8, Even, 2: 1 start bit, 8 data bits, even parity, 2 stop bits
- 8, Odd, 1: 1 start bit, 8 data bits, odd parity, 1 stop bit
- 8, Odd, 2: 1 start bit, 8 data bits, odd parity, 2 stop bits

2.3.6.2 Serial Port 2

Communication – Optional interface - Serial port 2

Main Menu\ Parameters\SYSTEM\Communication\				
Serial port 2				
P/E No.	System Description	Value	Unit	(Setting range)
	Serial port 2			
P905	Port	OFF	-	OFF/ON
P906	Address	1	-	0 … 255
P907	Baudrate	57600	Bd	9600/19200/38400/57600
P908	Protocol	IEC 870-5-103	-	IEC 870-5-103
P909	Format	8,None,1		8, None, 1/8, None, 2/8, Even, 1/8, Even, 2/8, Odd, 1/8, Odd, 2
P915	The fiber optic lighting in the idle state	Light off	-	Light off/Light on
P916	Wait before response	0	ms	0 … 2000ms

Parameter description:

P905 Port

Standard interface of P60 Agile; the physical IEC 60870-5-103 interface provides following setting options:

- OFF: disabled or
- ON: enabled.

P906 Address

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

P907 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 baud rate is the same for both the sender and the receiver.*

P908 Protocol

Options for data protocol of standard interface; the data protocol of the interface *Serial port 2* is only:

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

P909 The fiber optic lighting in the idle state

Selection of the optic lighting logic in idle state; the following setting options are available:

- Light off: idle state: transmission LED is off
- Light on: idle state: transmission LED is on

P915 Format

Format definition (byte frame) of date telegram for protocoll type IEC 60870-5-103; the byte frame of the data telegram of P16x can be adapted to the interface configuration of the applied Modbus Master system. The byte frame is determined as follows: Start bit = 1 (fix); No. of data bits, parity, No. of Stop bits.

- 8, None, 1: 1 start bit, 8 data bits, no parity, 1 stop bit
- 8, None, 2: 1 start bit, 8 data bits, no parity, 2 stop bits
- 8, Even, 1: 1 start bit, 8 data bits, even parity, 1 stop bit
- 8, Even, 2: 1 start bit, 8 data bits, even parity, 2 stop bits
- 8, Odd, 1: 1 start bit, 8 data bits, odd parity arität, 1 stop bit
- 8, Odd, 2: 1 start bit, 8 data bits, odd parity, 2 stop bits

P916 Wait before response

Waiting period until the P16x device is sending a response to a master IEC 60870-5-103 protocol request; applying the waiting period can be useful in case of using some slower media converter like RS232/RS485, between control station and P16x device.

2.3.6.3 Ethernet

Communication – Optional interface - Ethernet

Main Menu\ Parameters\SYSTEM\Communication\				
Ethernet				
P/E No.	System Description	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

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 P60 Agile 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

2.3.6.4 Network topology (IEC 61850)

Communication – IEC 61850 network topology

Main Menu\ Parameters\SYSTEM\Communication				
Network Topology				
P/E No.	System Description	Value	Unit	(Setting range)
	Network topology			
P978	Network topology	OFF	-	Ring/Double Star/Ring with HSR/ Double Start with PRP

Parameter description:

P978 Network topology

If the P60 Agile device variant is equipped with IEC 61850 redundancy communication ports (see order code), the following options are available:

Ring:

Ring topology- Ethernet communication port 1 and port 2 are active; device can send and receive Ethernet frames via both ports using protocol type *Rapid Spanning Tree Protocol (RSTP)*

RSTP is used to quickly reconnect a network in case of the network fault. The fault recovery time depends on the number of devices in the ring, and on the time taken by the devices to determine the root bridge and compute the port roles. The port roles are: discarding, learning and forwarding. See the IEEE 802.1D - 2004 standard for additional information.

According the standard 802.1D - 2004, the recommended set values of the most important parameters such as *Bridge Hello Time*, *Bridge Max Age*, *Bridge Forward Delay*, and *Bridge Priority* are shown in the following table:

RSTP Bridge parameters

SLNo.	Parameter	Default setting [s]
1	Bridge Max Age	20
2	Bridge Hello Time	2
3	Bridge Forward Delay	15
4	Bridge Priority	32768

Double Star:

Star topology with one additional (stand by) port. Ethernet communication via port 1 and port 2 are active however, the device can only receive and send Ethernet frames via first connected port. If connection is broken down (Link down), the device will try to establish connection via the next connected port (Link up). It can be the same port or the second port. If connection breaks down (Link down) again the device will try to establish connection via next connected (Link up) port.

Ring with HSR:

Ring topology - Ethernet communication port A and port B are active; device can send and receive Ethernet frames via both ports using protocol type IEC 62439-3 *High-availability Seamless Redundancy (HSR) protocol*.

Double Star with PRP:

Star topology; the device receives and sends Ethernet frames via both ports (port A and port B) at the same time. This is redundancy using the double Star topology with IEC 62439-3 *Parallel Redundancy Protocol (PRP)* protocol.

> *Note: The above options are not valid for P60 Agile device variants equipped with IEC 61850 single communication port.*

2.3.6.5 SNTP

Communication – Optional interface - SNTP

Main Menu\ Parameters\SYSTEM\Communication				
SNTP				
P/E No.	System Description	Value	Unit	(Setting range)
	SNTP			
P962	SNTP (Time synchronisation)	OFF	-	OFF/ON
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

Parameter description:

P962 SNTP (Time synchronisation)

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

- OFF: Time synchronization is deactivated
- ON: Time synchronization is activated

> ***CAUTION:*** *The P16x system time will consider the synchronising source time, "local time zone" [P964] setting as well as the "Daylight saving time" [P963] setting. When 'Daylight saving time' is enabled the basic time in P60 is the "Winter time".*

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 to connect to an Internet time server. The P60 Agile operates as a client periodically sending requests to the time server (512 sec polling interval).

The P60 Agile accepts also SNTP broadcast messages via Local Broadcast or Multicast from a local time server (SCADA system).

If parameters [P965] to [P968] are all set to zero, The P60 Agile will not send any requests.

2.3.6.6 IEC 61850

Communication – Optional interface - IEC 61850

Main Menu\ Parameters\SYSTEM\Communication				
IEC 61850				
P/E No.	System Description	Value	Unit	(Setting range)
	IEC 61850			
P969	IEC 61850	OFF		OFF/ON
P970	IEDName Index (Dxxx)	1		0 ... 255
P975	Command for IEC 61850 data formatting	0	-	0 ... 9999

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, event [E0328] is activated.

Note:	*For more information about IEC61850 communication, please refer to separate document **P60 Agile – IEC 61850 communication protocol User manual***

P970 IEDName Index (Dxxx)

Index referring to the name of the applied intelligent electronic device P60 Agile.

Note:	*The index of one device may exist only once within the network*

P975 Command for IEC 61850 data formatting

Password to authorize formatting of the IEC 61850 memory area at the communication board for IEC 61850 communication. When executing the command, all data sets, reports and controls (created by IED Manager or some Clients) for IEC 61850 communication will be deleted.

To gain access to execute the command, a 4-digit password must be assigned to parameter [P975]. Instructions for this are as follows:

1. Go to: Main Menu\Operating\Status**Debug**
2. Scroll up to page no. 424 using the ***+1*** button
3. Press **Send Cmd**,
4. enter the 4-digit password
5. Press **Send**.

> *Note:* *It is recommended to format the memory area for IEC 61850 communication before uploading any new data model – CID file (data model depends on firmware version of IEC 61850 communication). Please use User level access to avoid intentional or accidental deletion.*

2.3.6.7 IEC 60870-5-103

Communication – IEC 60870-5-103 report telegrams

Main Menu\ Parameters\SYSTEM\Communication				
IEC 60870-5-103				
P/E No.	System Description	Value	Unit	(Setting range)
	IEC 60870-5-103			
P976	Report telegrams with function type 240	OFF	-	OFF/ON
P977	Report telegrams with function type 148	OFF	-	OFF/ON

Parameter description:

P976 Report telegrams with function type 240

This parameter enables disables transmission of data points (measurement values) in accordance with function type 240, where:

- OFF: disables or
- ON: enables the data transmission.

P977 Report telegrams with function type 148

This parameter enables disables transmission of those data points (measurement values) in accordance with function type 148, where:

- OFF: disables or
- ON: enables the data transmission.

> *Note:* *For more information about IEC60870-5-103 communication please refer to the P60 Agile Relay Menu Database document.*

2.3.6.8 FTP

Communication – File transfer protocol (FTP)

Main Menu\ Parameters\SYSTEM\Communication\				
FTP				
P/E No.	System Description	Value	Unit	(Setting range)
P980	FTP	OFF	-	OFF/ON
P981	User name	Admin	-	0 … 255
P986	Password	Admin	-	0 … 9999
P991	Port	21		0 … 65535

Parameter description:

P980 FTP

This parameter activates/deactivates the TCP connection to the File transfer protocol (FTP) server, where:

- OFF: disables or
- ON: enables the TCP connection.

P981 User name

This parameter is for setting the username which will be used for login in on the FTP server.

P986 Password

This parameter is for setting the password which will be used for login in on the FTP server.

P991 Port

Number of the TCP port which is used for FTP connection; standard port number is 21.

2.3.6.9 RSTP

Communication – Rapid Spanning Tree Protocol (RSTP)

Main Menu\ Parameters\SYSTEM\Communication\				
RSTP				
P/E No.	System Description	Value	Unit	(Setting range)
P980	Priority	32768	-	0 ... 61440
P981	Hello Time	2	-	1 ... 10
P986	Max Age	20	-	6 ... 40
P991	Forward Delay	15		4 ... 30

Parameter description:

P980 Priority

This parameter is for setting the default value for Rapid Spanning Tree Protocol (RSTP) bridge priority.

P981 Hello Time

This parameter is for setting the default value for Rapid Spanning Tree Protocol (RSTP) bridge hello time.

P986 Max Age

This parameter is for setting the default value for Rapid Spanning Tree Protocol (RSTP) message maximum age.

P991 Forward Delay

This parameter is for setting the default value for Rapid Spanning Tree Protocol (RSTP) bridge forward delay.

2.3.7 Graphic (referencing and selection of displayed measurement values)

System parameters – Referencing and selection of displayed measurement values

				Main Menu\Parameter\System\Graphic
		Graphic		
P/E No.	System Description	Value	Unit	(Setting range)
	Measuring			
P60001	Ground power reference (display)	GND_Power_CT-GND1	-	GND_Power_CT1/ GND_Power_CT2*/ GND_Power_CT-GND1
	Button configuration			
P60010	Button 1 function	Page Up	-	Page Up
P60011	Button 2 function	Key	-	Key
P60012	Button 3 function	1	-	1
P60013	Button 4 function	Page Down	-	Page Down
P60014	Button 5 function	ACK	-	Alarm Ack
P60015	Button 6 function	0	-	0
	Menu configuration			
P60020	Meters -> Voltage/Frequency	ON	-	ON/OFF
P60021	Meters -> Current	ON	-	ON/OFF
P60022	Meters -> Power	ON	-	ON/OFF
P60023	Meters -> Counter	ON	-	ON/OFF
P60024	Meters -> Harmonics	ON	-	ON/OFF
P60025	Meters -> Ground	ON	-	ON/OFF
P60026	Meters -> Analog inputs**	ON	-	ON/OFF
P60027	Meters -> U/I Complex	ON	-	ON/OFF
P60029	Meters -> DC voltage**	ON	-	ON/OFF
P60031	Home Screen	Main Menu	-	Main Menu/User page 1/ User page 2/ User page 3/ User page 4
	Display configuration			
P60041	Show Phase Voltage	ON	-	ON/OFF
P60050	Time to shut off LCD	300	s	10 … 3600
P60051	Inactivity timer	120	s	30 … 3600
	Bargraph Parameter			
P60057	Current Bargraph upper threshold Green	100	%	0 ... 150
P60058	Current Bargraph lower threshold Red	120	%	0 ... 200

** option presently not available/supported in P16x devices.

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:

- *$U_{G,}$PT1*: residual voltage calculated from the phase voltages of PT1
- *$U_{G,}$PT2*: residual voltage calculated from the phase voltages of PT2
- *$U_{G,}$PT3*: residual voltage calculated from the phase voltages of PT3
- *$U_{G,}$PT-GND1*: residual voltage directly measured via PT-GND1
- *$I_{G,}$CT1*: ground current calculated from phase currents of CT1 (3 x $I_{0,CT1}$ = $I_{G,CT1}$)
- *$I_{G,}$CT2*: This option is not supported in P16x devices
- *$I_{G,}$CT-GND1*: ground current directly measured via CT-GND1

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_G, 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 the measuring input which is assigned to Parameter *PT reference* [P9422].

GND_Power_CT2*: This option is not supported in P16x devices

GND_Power_CT-GND1: Direct measurement of ground current by CT-GND1 **and** acquisition of the residual voltage by the 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 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\Measuring**Power**: PT reference [P9419] and PT reference [P9428].*

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; the following setting to be selected:

- Page Up: Menu navigation: Function key 1 will scroll up the displayed menu page. Function key 1 will activate event [E6404] for at least 2s.

P60011 Button 2 function

Functional configuration of function key 2; the following setting to be selected:

- Key: Menu navigation: Function key 2 will bring up the menu page User level. Operating function key 1 will activate event [E6406] for at least 2s.

P60012 Button 3 function

Functional configuration of function key 3; the following setting to be selected:

- 1: switchgear control: Function key 3 will switch on the previously selected switching element. Function key 3 will activate event [E6401] for at least 2 s.

P60013 Button 4 function

Functional configuration of function key 4; the following setting to be selected:

- Page Down: Menu navigation: Function key will scroll down the displayed menu page. Function key 4 will activate event [E6405] for at least 2s.

P60014 Button 5 function

Functional configuration of function key 5; the following setting to be selected:

- Alarm Ack: Menu navigation: Function key 5 will reset all the active alarms and menu page Active Alarms will be displayed. Function key 5 will activate event [E6407] for at least 2 s.

P60015 Button 6 function

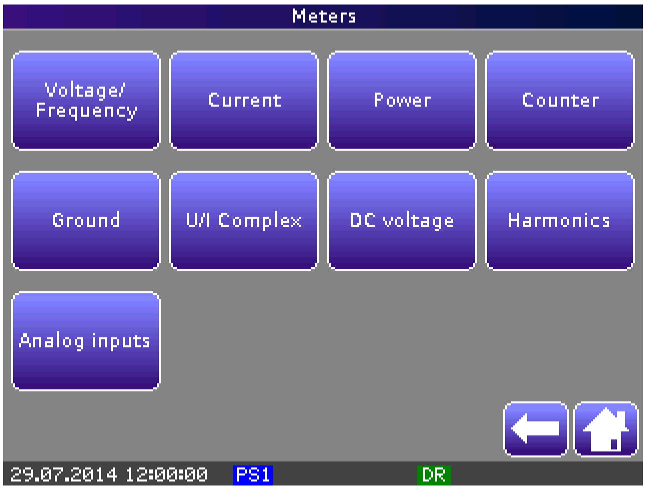
Functional configuration of function key 6; the following setting to be selected:

- 0: switchgear control: Function key 6 will switch off the previously selected switching element. Function key 6 will activate event [E6400] for at least 2 s.

Menu Configuration

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

Configuration of selection page Meters



P60020 Meters -> Voltage/Frequency

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

OFF: the selection key Voltage/Frequency and Meters page Voltage/Frequency will be hidden,

ON: the selection key Voltage/Frequency and Meters page Voltage/Frequency will be displayed.

P60021 Meters -> Current

Display of Meters page Current; to display or to hide this page please choose from 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 from 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 from 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.

P60024 Meters -> Harmonics

Display of Meters page Ground; to display or to hide this page please choose from 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.

P60025 Meters -> Ground

Display of Meters page Ground; to display or to hide this page please choose from 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 -> Analog inputs (Feature not available in P16x)**

P60027 Meters -> U/I Complex

Display of measuring values at “Meters” page “U/I Complex”; to display or to hide the selected measuring value(s) please choose from the following setting options:

OFF: U/I Complex values will be hidden, or

ON: U/I Complex values will be displayed at “Meters” page “U/I Complex”.

P60029 Meters -> DC voltage (Feature not available in P16x)**

P60031 Home Screen

Definition of the displayed start page; when operating hotkey „Home“ or after automatic, time-depending switchover to the home screen (see parameter “Inactivity timer” [P60051]) the following menu page can be configured as “Home screen”:

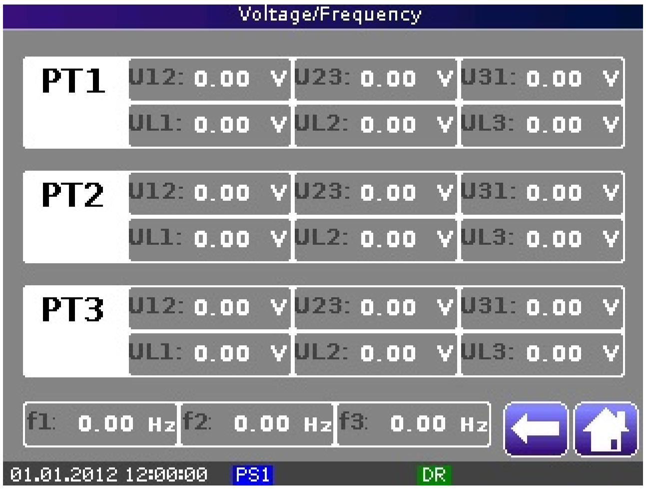
- Main Menu
- User page 1
- User page 2
- User page 3
- User page 4

Display configuration

P60041 Show Phase Voltage

Display of phase voltages UL1, UL2 and UL3 at Meters page Voltage/Frequency can be enabled or disabled.

Meters\Voltage – Display of phase voltages UL1, UL2, UL3



Display of Meters page Voltage; to display or to hide phase measuring values of the voltages, please choose from 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 P60 Agile 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 LCD to shut off; if no button was pressed or the screen was not touched for the duration set by parameter *Time to shut off LCD* [P60050], the LCD will automatically shut off. After pressing any button or touching the screen, the LCD will operate immediately.

Note:	*The minimum setting time is 10s.*

P60051 Inactivity timer

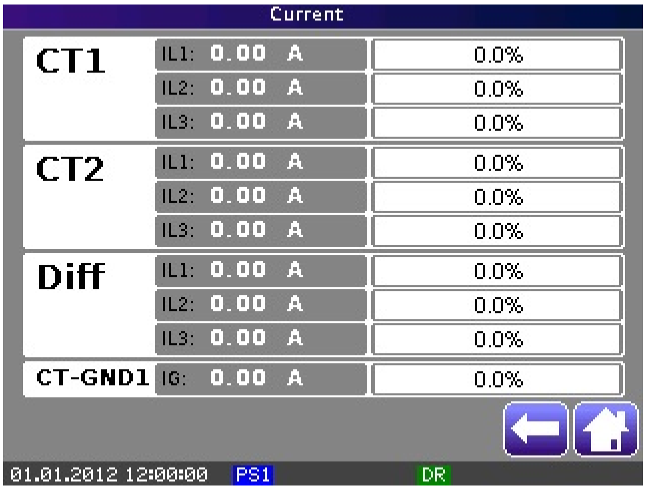
Delay time of the relay display for automatic switch-over to the home screen; if no button was pressed or the screen was not touched for the duration set by parameter “Inactivity timer“ [P60051], the display will automatically show that menu page which is assigned to parameter “Home screen” [P60031].

Note:	*The minimum setting time is 30s.*

Bargraph configuration

Besides percentage currents, the colours of the bargraphs displayed on the Meters page Current represents the application’s current load. Depending on the actual level of currents and the set limits for colour changes (see parameters [P60057] and [P60058]), the bargraphs show green, orange or red.

Meters\Current – Display of current load by bargraphs



Different colours 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 colours 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] and* Ground current *[P607], for primary side W1*
>
> *The referring parameters* Current *[P604] and* Ground current *[P607] are in submenu: SYSTEM\Nominals**Reference values**.*

P60057 Current Bargraph upper threshold Green

Upper Limit for bargraph (phase currents and differential currents) to display colour green; if the set value of parameter *Current Bargraph upper threshold Green* [P60057] is exceeded, bargraph colour will change from green to orange.

Colour 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 colour red; if the set value of parameter *Current Bargraph upper threshold Green* [P60057] is exceeded, bargraph colour will change from orange to red.

Colour 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], colour changes only between green and red.*

PROTECTION FUNCTIONS

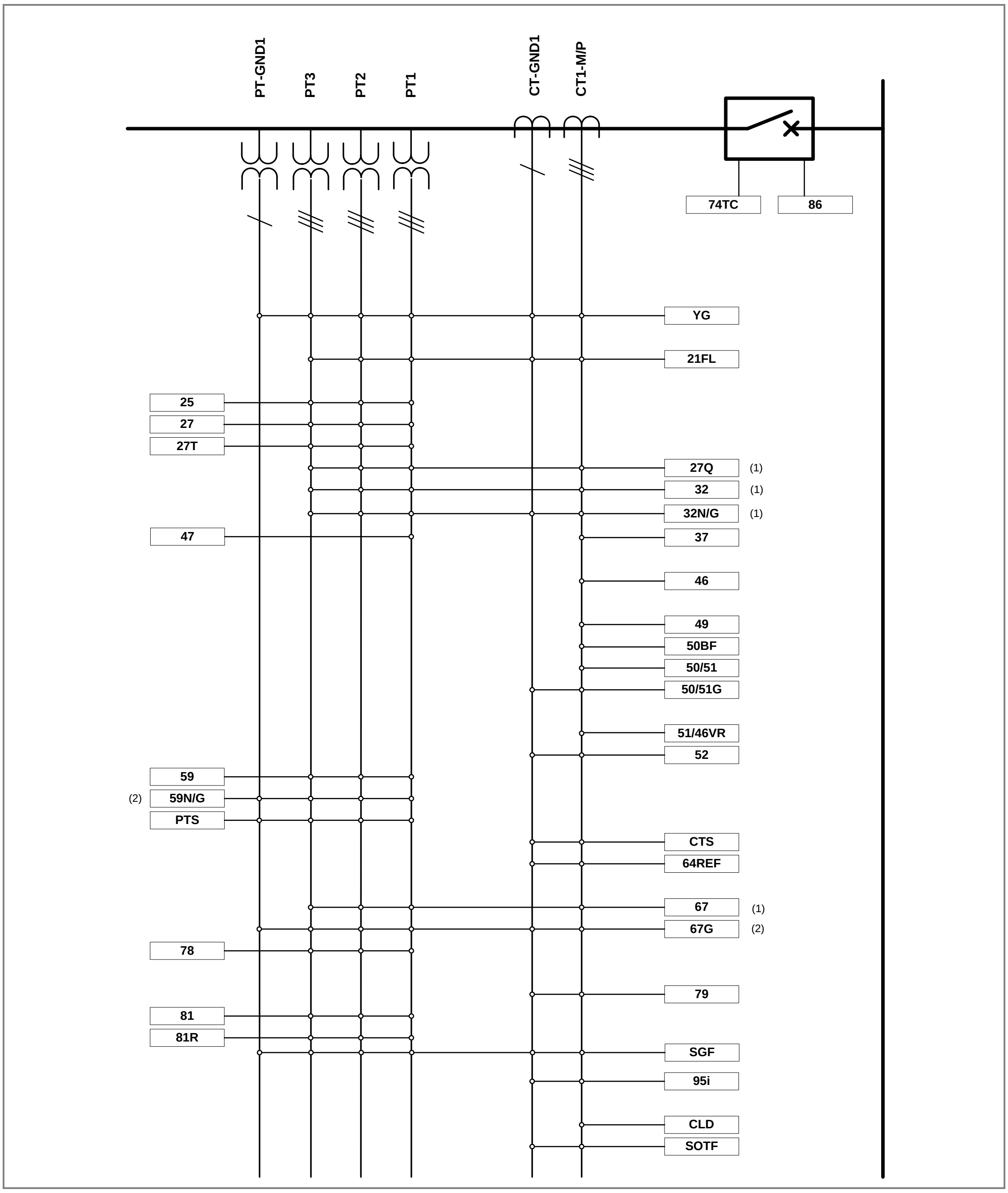
CHAPTER 4

1 CHAPTER OVERVIEW

This chapter consists of the following sections:

2 PROTECTION

Refer to the following figure for allocation of protection functions and measured values in the P16x range. The functions are detailed in the following sections. The availability of functions are dependant on the hardware variant ordered.



(1) depending on power measurement at common changeover

(2) measured or calculated

Figure 1 P60 Agile - Process variables of protection functions

2.1.1 General (Parameter set changeover)

The P60 Agile offers four identical protection parameter sets which each represent the complete protective functionality with regards to settings options. 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.

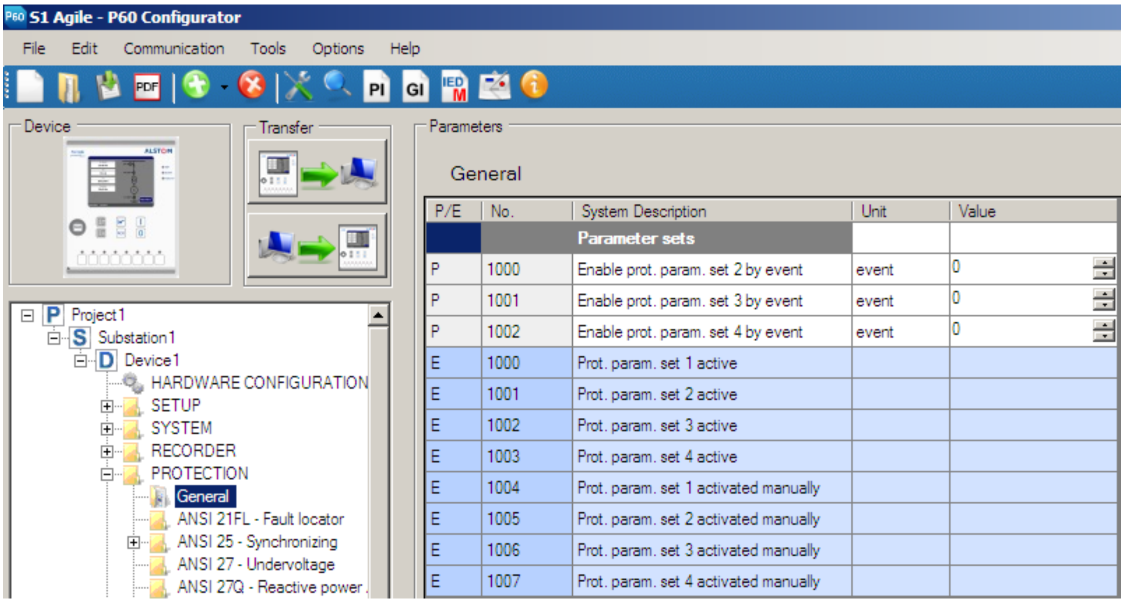
Note:	*Parameter numbers (e.g. [P2345]) relating to parameter sets (SET1 – SET4) exist only once for all four parameter sets.*

General Protection Parameters

In general, only one protection parameter set 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 assigned.

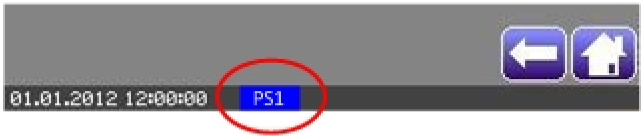
Note:	*The duration for parameter set changeover is about 15 ms. Within this time window none of the protective functions are active. Parameter set changeover is carried out at run-time. This means no system reboot is required.*

General protection parameters – Protection parameter set changeover



CAUTION:	**The currently active parameter set is displayed in the lower status line of the device display:**

Status line: indication of currently active parameter set



The corresponding event [E1000], [E1001], [E1002] or [E1003] is also activated. The event status can be checked via the following submenu: Main Manu\Alarms\operate button

Events**ActiveEvents**.
The event table will show either active event [E1000], [E1001], [E1002] or [E1003].

The following is determined on behalf of priority for the active protection parameter set in order to guarantee that in the case of simultaneously active events – assigned to parameters [P1000] to [P1002] – only one protection parameter set is active.

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

Protection: General parameters [P] and events[E]

Main Menu\ Parameters\PROTECTION\				
General				
P/E No.	System Description	Value	Unit	(Setting range)
Parameter Sets				
P1000	Enable prot. param. set 2 by event	0	event	0 … 9999
P1001	Enable prot. param. set 3 by event	0	event	0 … 9999
P1002	Enable prot. param. set 4 by event	0	event	0 … 9999
E1000	Prot. param. set 1 active	-	-	-
E1001	Prot. param. set 2 active	-	-	-
E1002	Prot. param. set 3 active	-	-	-
E1003	Prot. param. set 4 active	-	-	-
E1004	Prot. param. set 1 activated manually	-	-	-
E1005	Prot. param. set 2 activated manually	-	-	-
E1006	Prot. param. set 3 activated manually	-	-	-
E1007	Prot. param. set 4 activated manually	-	-	-

Parameter description:

P1000 Enable protection parameter set 2

Protection parameter set 2 can be activated by any event. For activation the number of the activating event has to be allocated to parameter [P1000]. Activation is only active for the time the allocated event is active. As soon as activation is active event *Prot. param. set 2 active* [E1001] is activated, and event *Prot. param. set 1 active* [E1000] becomes inactive. If the activation event becomes inactive, activation of parameter set 2 is abandoned and parameter set 1 is effective again. Event [E1001] is then deactivated automatically and event [E1000] becomes to active again.

If changeover to parameter set 2 is not required, set parameter [P1000] to “**0**”.

Protection parameter set 1 is given the lowest priority.

Protection parameter set 2 is given the second 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 only active for the time the allocated event is active. As soon as activation is active event *Prot. param. set 3 active* [E1002] is activated, and event *Prot. param. set 1 active* [E1000] becomes inactive. If the activation event becomes inactive, activation of parameter set 3 is abandoned and parameter set 1 is effective again. Event [E1002] is then deactivated automatically and event [E1000] becomes active again

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

Protection parameter set 3 is given the third 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 activation is active, event *Prot. param. set 4 active* [E1003] is activated, and event *Prot. param. set 1 active* [E1000] becomes inactive. If the activation event becomes inactive, activation of parameter set 2 is abandoned and parameter set 1 is effective again. Event [E1003] is then deactivated automatically and event [E1000] 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.

Event description:

Parameter set changeover via P60 Configurator Tool.

E1004 Prot. parameter set 1 activated manually

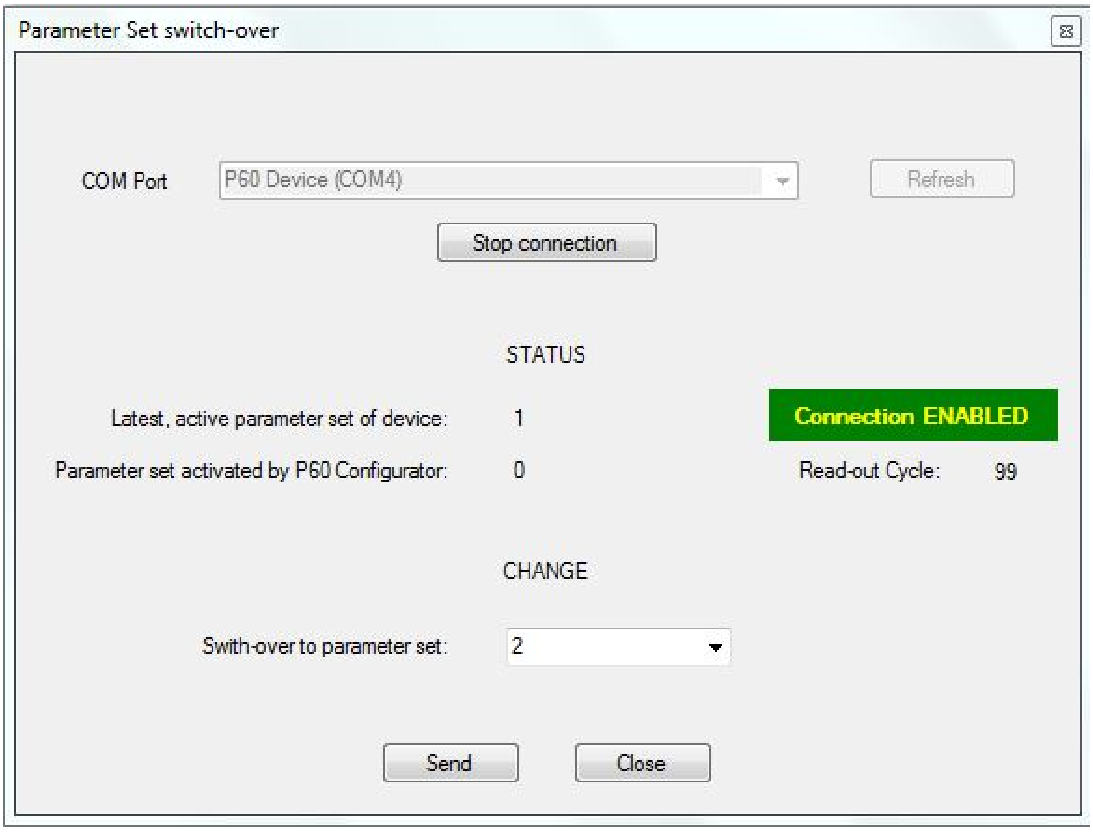
to

E1007 Prot. parameter set 4 activated manually

Changeover from one prot. parameter set to another can be done using the P60 Configurator Tool as follows:

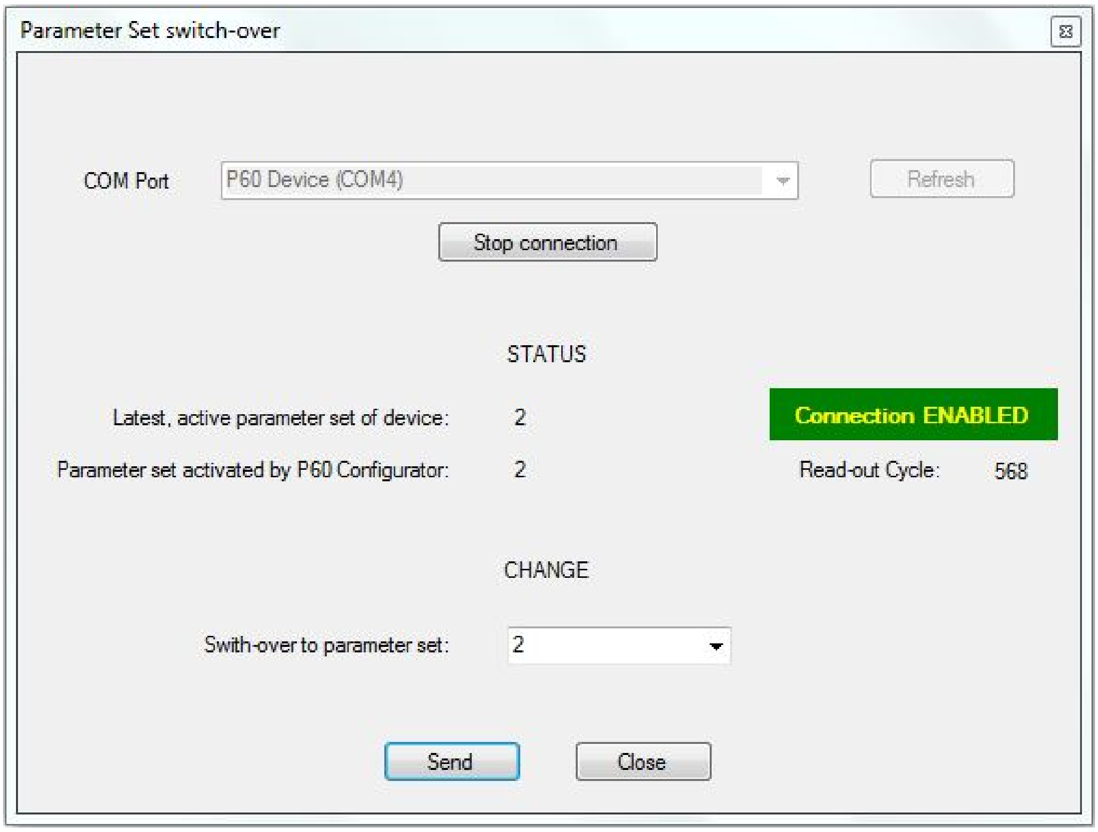
1. Set up a connection between P60 device and your PC/Notebook
2. Launch the P60 Configurator Tool
3. Open the Tools**Change parameter set** sub-menu
4. If the device and PC/notebook are connected correctly, the message "Monitoring ENABLED" will appear
5. Choose the prot. parameter set you wish to activate by clicking "Change parameter set"
6. Click the **Send** button

Example: Activation of prot. parameter set 2 using the P60 Configurator Tool – sending command



1. After sending the command, the selected parameter set x (example: parameter set 2) becomes active, which will be indicated by the following window:

Example: Activation of prot. parameter set 2 using the P60 Agile Configurator Tool – actual status

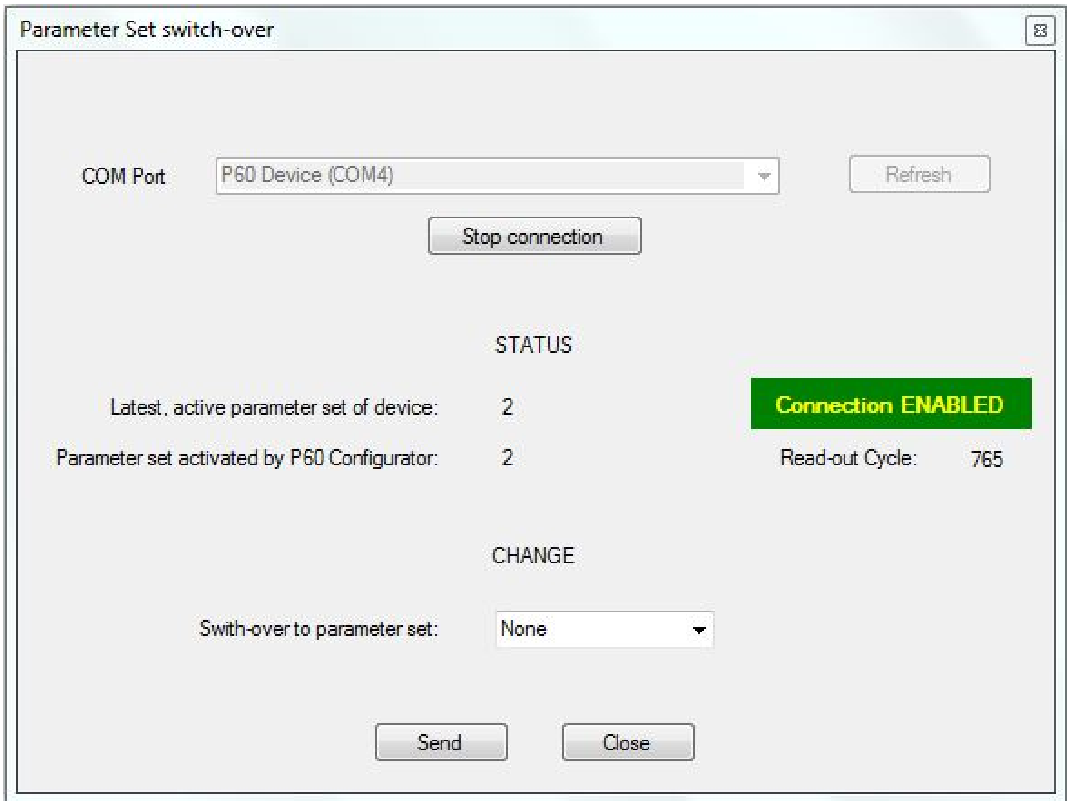


As soon as the command send is sent, the corresponding event *Prot. param. set x activated manually* [E100x] is activated.

CAUTION: Once a parameter set is activated using the P60 configurator it is not possible to change the active parameter set using any activation event assigned to parameters [P1000], [P1001] or [P1002]!

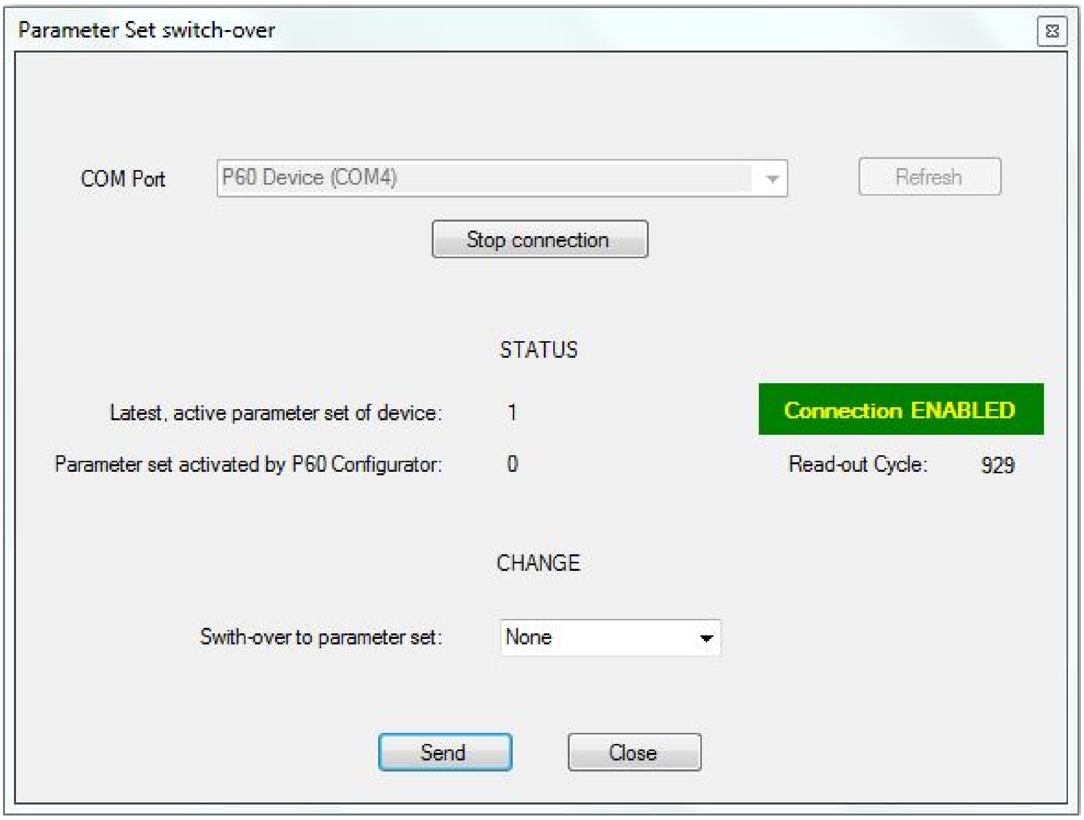
To change the active parameter set go “Change Parameter SET” in the P60 configurator tool, select “none” and send it to the device.

Recovery of parameter switch possibility via activation events – "Send = None"



After executing the command "Send" the following window appears:

Parameter switch possibility via activation events is recovered



2.1.2 ANSI 21FL – Fault locator

The Fault Locator calculates the distance to the fault location after an overcurrent protection trip. The calculation is initiated each time that the circuit breaker is switched off using any of the protective functions:

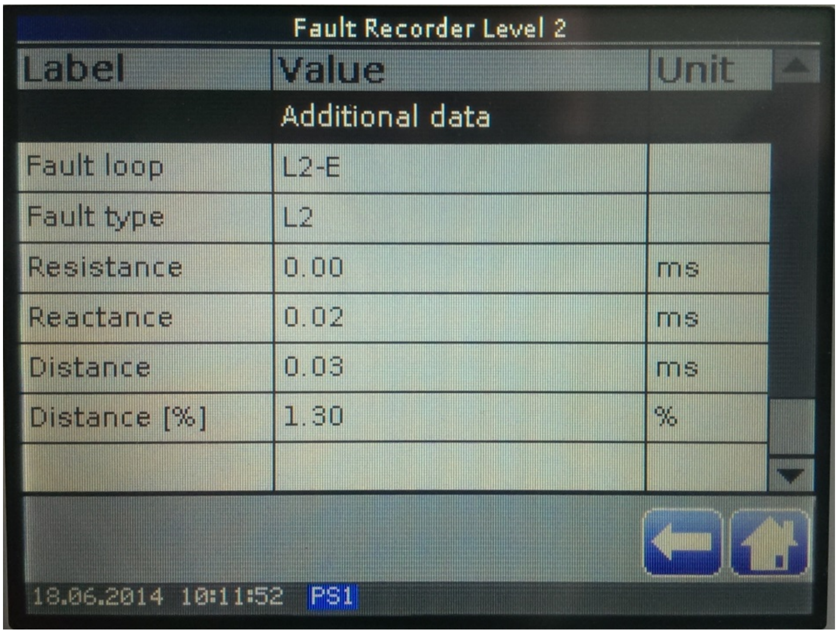
- ANSI 50/51,
- ANSI 50G/51G,
- ANSI 67 and
- ANSI 67G.

Each protection step provides a separate parameter “Start fault locator” [Pxxxx] to start calculation of fault distance.

Immediately prior to the protection trip all relevant current and voltage values are saved. At the moment of protection trip, calculation of the fault location starts and event *ANSI21FL busy* [E2387] is activated. When calculation is finished, event [E2387] is deactivated. Subsequently to the evaluation of the measuring values the following fault values will be represented by fault recorder:

- **Fault loop**: indication of the faulty phase-to phase or phase-to-earth loop
- **Fault type**: indication of faulty phase
- **Resistance**: calculated, absolute value of cable/line resistance referring to fault distance
- **Reactance**: calculated, absolute value of cable/line reactance referring to fault distance
- **Distance**: calculated, absolute value of fault distance
- **Distance [%]**: calculated, relative value of fault distance referring to the total length of the protected cable/line

ANSI 21FL – Representation of fault values at device display



> *Note:* *Additionally to the tripping overcurrent protective function, function ANSI 21FL will generate a fault recording which is accessible via P60 Agile display or via P60 configurator tool. The fault recording file “xxx.sfr” can be read-out and saved using P60 configurator tool.*

ANSI 21FL: Parameters [P] and events [E]

Main Menu\ Parameters\PROTECTION\				
ANSI 21FL				
SET 1	SET 2	SET 3	SET 4	
P/E No.	System Description	Value	Unit	(Setting range)
P3465	Function	OFF	-	OFF/PowerCT1/PowerCT2*
P3466	Blocking	0	event	0 … 9999
P3467	Length unit	km	-	km/miles
P3468	Cable length	100	Km/miles	0 … 1000,000
P3469	Reactance per km/miles	0	Ω per km/miles	0 … 40000,00000
P3470	kE-amplitude	0	-	0 … 40000,00000
P3471	kE-angle	0	deg	0 … 180,0
E2385	ANSI21FL active	-	-	-
E2386	ANSI21FL blocked	-	-	-
E2387	ANSI21FL busy	-	-	-

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 a consequence only one group of parameters. SET PARAMETERS are therefore equal to STEP parameters. The protection parameters of SET 1 represented below are described in detail in the following examples.*

Protection parameters of parameter SET 1 – ANSI 21FL

P3465 Function

This parameter activates/deactivates the fault locator function where the setting:

OFF: deactivates the fault locator function or

ON: activates the fault locator function.

When fault locator function ANSI 21FL is enabled by parameter [P3465], then event *ANSI21FL active* [E2385] is activated.

P3466 Blocking

The fault locator function can be completely blocked by any active event. For blocking the number related to this blocking event it must be assigned to parameter [P3466]. Blocking is only effective so long as the blocking event is active. As soon as blocking is active, event *ANSI21FL blocked* [E2386] is activated. If the blocking event becomes inactive blocking is abandoned and the fault locator function is effective again. Event [E2386] is deactivated automatically.

If blocking of the fault locator function is not required, set this parameter to **0**.

P3467 Length unit

Selection of applied unit for cable/line length; where the setting:

km: indicates the cable/line length unit in kilometres or

miles: indicates the cable/line length unit in miles

P3468 Cable length

Total length of the protected cable/line;

P3470 Reactance per km/mile

This parameter is to set the value of the characteristic quantity specific inductive resistance per unit length X' = X/l.

It is:

X' = L' 2 π f

<u>with</u>: specific inductance L' and frequency f

and:

L' = L/l.

<u>with</u>: inductance L [H] and unit length l [km or miles]

=> characteristic quantity "Reactance per km/miles": X' = X/l. [Ω per km] or [Ω per miles] for a defined conductor length of a single cable lead or line. The characteristic quantity is indicated of e.g. 1 km/mile (see data sheet of the applied conductor).

Impedance correction of phase-to-ground loop

As a single-phase earth fault causes impedance measurement of the complete phase-to-ground fault loop $\underline{Z}_{F,meas.}$, but the set value of parameter *Reactance per km/mile* [P3469] only considers the cable/line impedance $Z_{cable/line}$, the ground impedance $\underline{Z}_E$ on precise determination of the fault distance has to be taken into account. For this complex correction factor $\underline{k}$E for ground fault impedance adaption can be set by two parameters [P3471] and [P3472]:

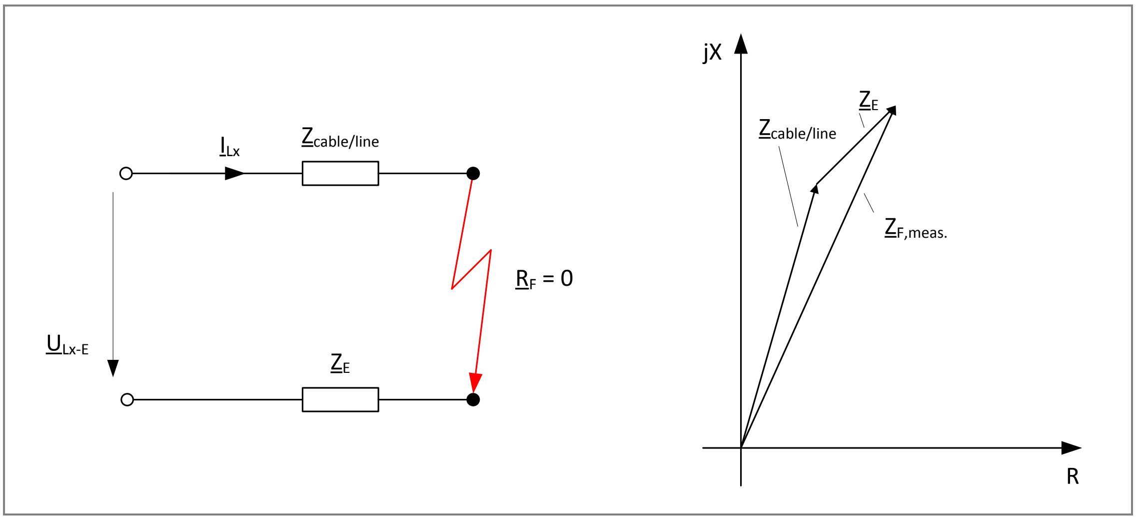


Figure 2 ANSI 21FL – Correction of earth fault impedance

=> $\underline{Z}_{F,meas} = \underline{Z}_{cable/line} + \underline{Z}_E$

With measuring values of I_{Lx} and $U_{Lx\text{-}E}$ it is:

$\underline{U}_{Lx\text{-}E}$ I $\underline{I}_{Lx\text{-}}$ $= \underline{Z}_{F,meas}$

$= \underline{Z}_{cable/line} + \underline{Z}_E$

It is: $\underline{Z}_E = \underline{Z}_{cable/line} * \underline{k}_E$

=> $\underline{Z}_{F,meas} = \underline{Z}_{cable/line} + \underline{Z}_{cable/line} * \underline{k}_E$

$= \underline{Z}_{cable/line} * (1 + \underline{k}_E)$

=> $\underline{Z}_{cable/line} = \underline{Z}_{F,meas} / (1 + \underline{k}_E) = R_{cable/line} + jX_{cable/line}$

=> Distance to fault location $= X_{cable/line}$ / **X`** $_{\mathbf{cable/line}}$

$= X_{cable/line}$ / **Reactance per km/mile [P3469]**

Setting of the complex correction factor kE

It is: $\underline{k}E = |kE|*e^{j\varphi_{kE}} = (Z_0\text{'}_{,cable/line} – Z_1\text{'}_{,cable/line}) / 3*Z_1\text{'}_{, cable/line}$

with:

|kE|: absolute value of the correction factor = Parameter *kE-amplitude* [P3470]

φ_{kE}: angle of the complex correction factor = Parameter *kE-angle* [P3471]

$Z_0\text{'}_{,cable/line}$: specific zero sequence impedance of the cable/line (see data sheet of cable/line)

$Z_1\text{'}_{,cable/line}$: specific positive sequence impedance of the cable/line (see data sheet of cable/line)

P3471 kE-amplitude

Amplitude correction factor for impedance of phase-to-ground loop; the setting of the *absolute value kE-amplitude* [P3471] of the complex correction factor kE is as follows:

kE-amplitude [P3470] = |kE|

$= \sqrt{[(X_0\text{'}_{,cable/line} – X_1\text{'}_{,cable/line})^2 + (R_0\text{'}_{,cable/line} – R_1\text{'}_{,cable/line})^2]} / [3 * \sqrt{(R_1\text{'}^2_{,cable/line} + X_1\text{'}^2_{,cable/line})}]$

with:

$R_0\text{'}_{,cable/line}$: specific zero sequence resistance of the cable/line (see data sheet of cable/line)

$R_1\text{'}_{,cable/line}$: specific positive sequence resistance of the cable/line (see data sheet of cable/line)

$X_0\text{'}_{,cable/line}$: specific zero sequence resistance of the cable/line (see data sheet of cable/line)

$X_1\text{'}_{,cable/line}$: specific positive sequence resistance of the cable/line (see data sheet of cable/line)

P3472 kE-angle

Angle correction factor for impedance of phase-to-ground loop; the setting of the angle *kE-angle* [P3472] of the complex correction factor kE is as follows:

kE-angle [P3471] = φ_{kE}

$= \arctan [(X_0\text{'}_{,cable/line} – X_1\text{'}_{,cable/line})/(R_0\text{'}_{,cable/line} – R_1\text{'}_{,cable/line})] – \arctan [X_1\text{'}_{,cable/line} / R_1\text{'}_{,cable/line}]$

2.1.3 ANSI 25 – Synchronizing

The P60 Agile provides up to three 3-phase voltage measurement inputs PT1, PT2 and PT3. For synchronisation of two three phase systems each, the Synchronizing ANSI 25 function 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

ANSI 25 – Synchronizing units 1 to 3

Each synchronizing unit provides the following sub-functions depending on the synchronisation of two three phase power systems.

- **Sync unit x**
  - Synchrocheck (synchronizing check: U, f, dU, df, dPHI) and
  - Voltage check (U, f)

Voltage measurement for synchronizing

All criteria for “Synchrocheck” and “Voltage check” function is based on measuring the phase-to-phase voltages of the two 3-phase power systems to be synchronized. Depending on selected option of parameter “Check mode” [P23x4] either all three phase-to-phase voltages U12PTx, U23PTx, U31PTx, or only one phase-to-phase voltage U12PTx can be defined as characteristic quantity to be monitored (with: x = 1, 2 or 3). Parameter setting depends on the type of peripheral voltage measurement:

- 3-phase voltage measurement via three 1-pole isolated voltage transformers, or
- 2-phase voltage measurement via one 2-pole isolated voltage transformer.

Note:	*When using a 2-pole isolated voltage transformer for measuring phase-to-phase voltage U12, the secondary side of the voltage transformer must be connected to terminals designated as “UL1” and “UL2” of the P163 voltage measurement inputs PT1, PT2 or PT3.*

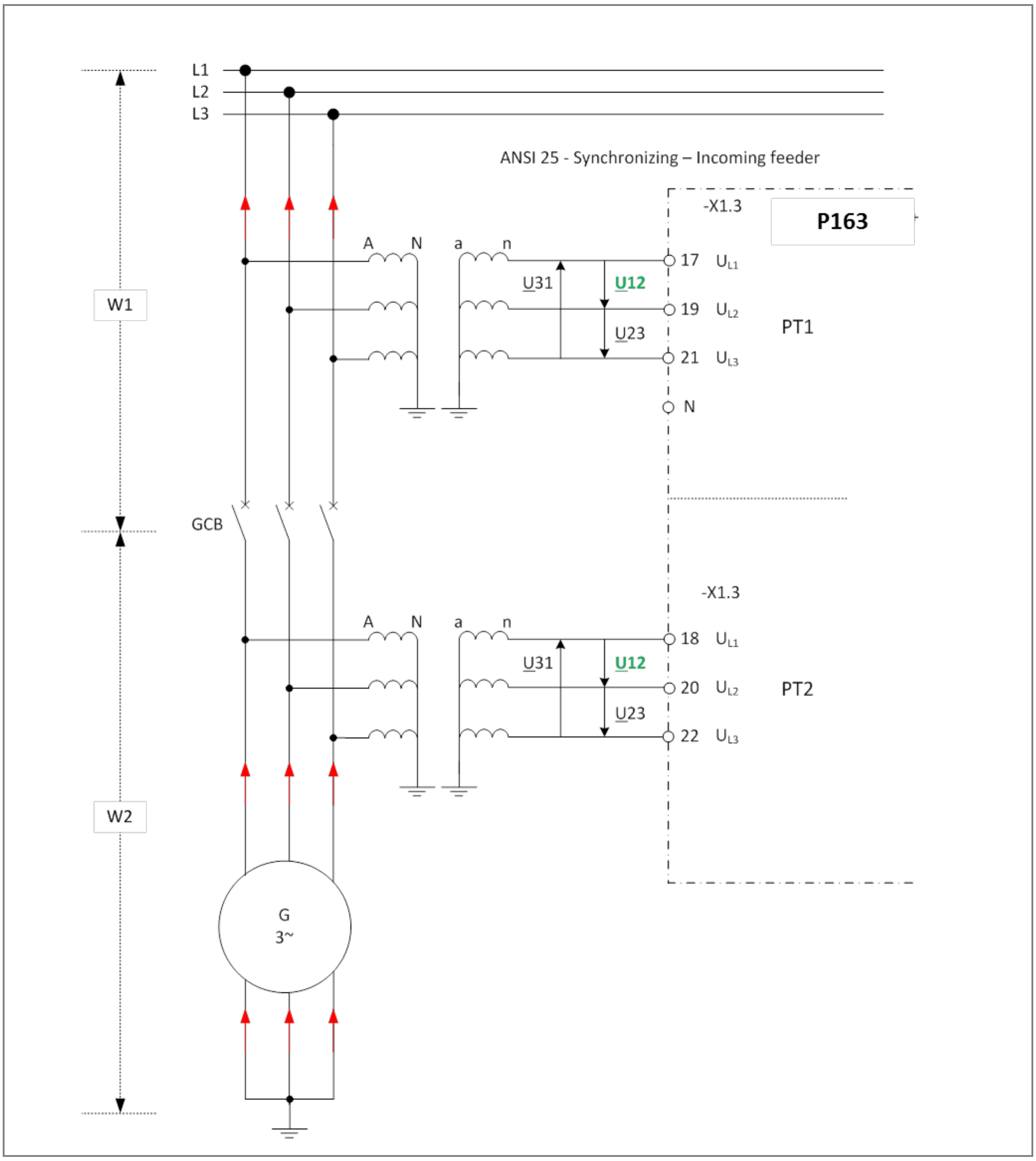


Figure 3 ANSI 25 – Three phase voltage measurement via three 1-pole voltage transformers

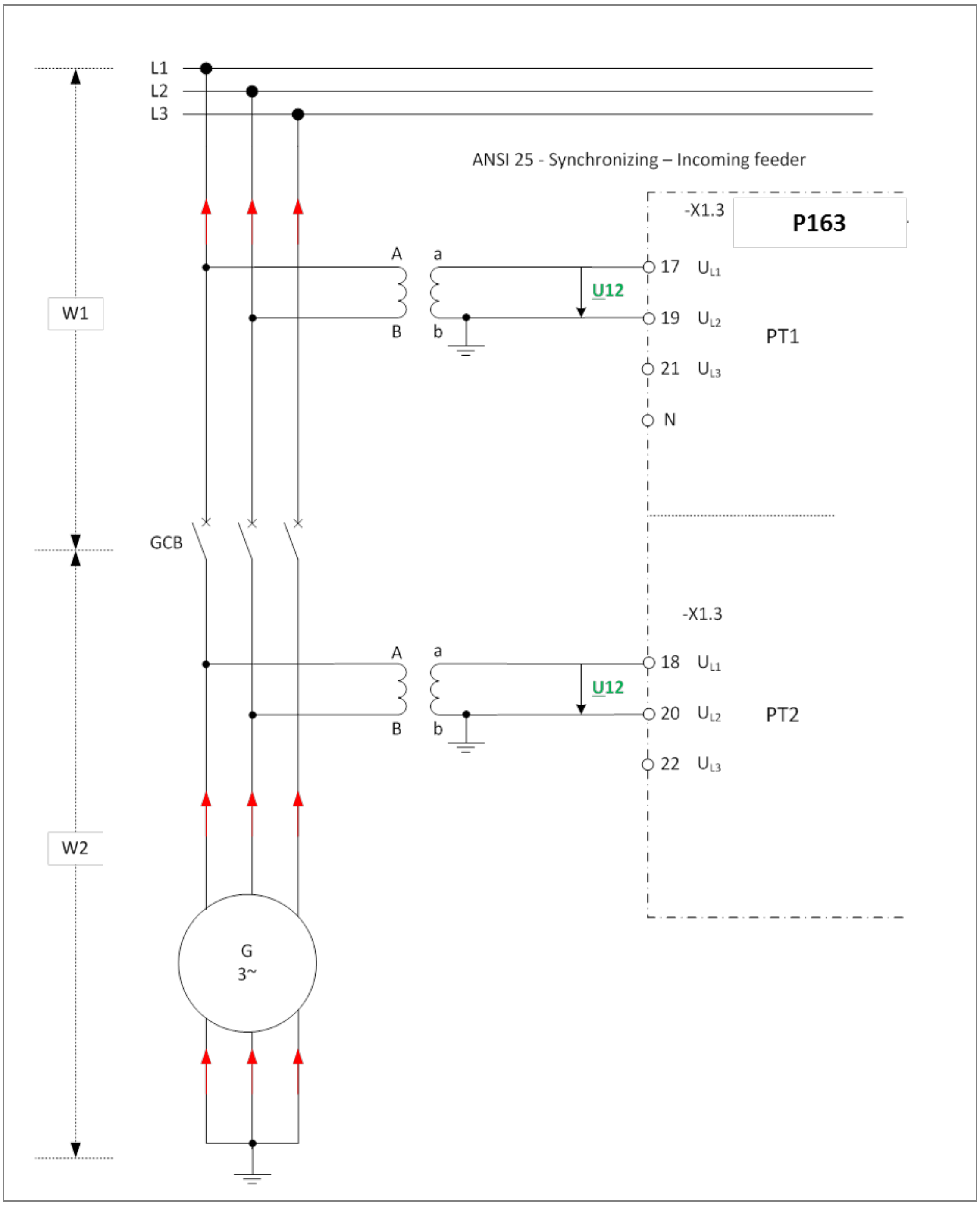
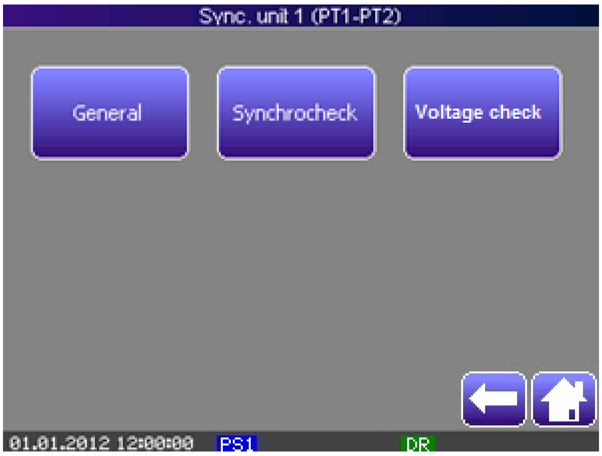


Figure 4 ANSI 25 Two phase voltage measurement via one 2-pole isolated voltage transformers

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

- Submenu General: parameters, valid for of all sub-functions, of one synchronising unit
- Submenu Synchrocheck: parameters of synchronizing check and,
- Submenu voltage check: parameters to determine the voltage and frequency operating range

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



- **Synchronizing unit 1 (Sync. unit 1)**

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

Main Menu\ Parameters\PROTECTION\ANSI25\Sync. unit 1 (PT1-PT2)

General

SET 1	SET 2	SET 3	SET 4	

P/E No.	System Description	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 (manual)	60	s	0 … 999999,999
P2309	Rotating field supervision	ON	-	OFF/ON
P2310	Switching element	none	-	None/SE1/SE2/SE3/SE4/SE5/SE6 /SE7/SE8
P2311	Show synchronizer page automatic	OFF	-	OFF/ON
P2312	PT1 label	PT1	-	(editable text parameter)
P2313	PT2 label	PT2	-	(editable text parameter)
P2314	Check mode	3-phase	-	3-phase/2-phase
E1855	ANSI25-1 Active	-	-	-
E1856	ANSI25-1 Blocked	-	-	-
E1857	ANSI25-1 Negative phase seq. PT1	-	-	-
E1858	ANSI25-1 Negative phase seq. PT2	-	-	-

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

Main Menu\ Parameters\PROTECTION\ANSI25\Sync. unit 1 (PT1-PT2)

Synchrocheck

SET 1	SET 2	SET 3	SET 4	

P/E No.	System Description	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			

ANSI 25 – Sync. unit 1 (PT1-PT2): Voltage check parameters [P] and events [E]

Main Menu\ Parameters\PROTECTION\ANSI25\Sync. unit 1 (PT1-PT2)

Voltage check

SET 1	SET 2	SET 3	SET 4	

P/E No.	System Description	Value	Unit	(Setting range)
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

- **Synchronizing unit 2 (Sync. unit 2)**

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

Main Menu\ Parameters\PROTECTION\ANSI25\Sync. unit 2 (PT1-PT3)

General

SET 1	SET 2	SET 3	SET 4

P/E No.	System Description	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 (manual)	60	s	0 … 999999,999
P2349	Rotating field supervision	ON	-	OFF/ON
P2350	Switching element	none	-	None/SE1/SE2/SE3/SE4/SE5/SE6 /SE7/SE8
P2351	Show synchronizer page automatic	OFF	-	OFF/ON
P2352	PT1 label	PT1	-	(editable text parameter)
P2353	PT2 label	PT2	-	(editable text parameter)
P2354	Check mode	3-phase	-	3-phase/2-phase
E1910	ANSI25-2 Active	-	-	-
E1911	ANSI25-2 Blocked	-	-	-
E1912	ANSI25-2 Negative phase seq. PT1	-	-	-
E1913	ANSI25-2 Negative phase seq. PT3	-	-	-

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

Main Menu\Parameter\Protection\ANSI25\Sync. unit 2 (PT1-PT3)				
Synchrocheck				
SET 1	SET 2	SET 3	SET 4	
P/E No.	System Description	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			

ANSI 25 – Sync. unit 2 (PT1-PT3): Voltage Check-Parameters [P] and Events [E]

Main Menu\Parameter\Protection\ANSI25\Sync. unit 2 (PT1-PT3)

Voltage Check

SET 1	SET 2	SET 3	SET 4

P/E No.	System Description	Value	Unit	(Setting range)
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			

• Synchronizing unit 3 (Sync. unit 3)

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

Main Menu\ Parameters\PROTECTION\ANSI25\Sync. unit 3 (PT2-PT3)				
General				
SET 1	SET 2	SET 3	SET 4	
P/E No.	System Description	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 (manual)	60	s	0 … 999999,999
P2389	Rotating field supervision	ON	-	OFF/ON
P2390	Switching element	none	-	None/SE1/SE2/SE3/SE4/SE5/SE6 /SE7/SE8
P2391	Show synchronizer page automatic	OFF	-	OFF/ON
P2392	PT1lable	PT1	-	(editable text parameter)
P2393	PT2 label	PT2	-	(editable text parameter)
P2394	Check mode	3-phase	-	3-phase/2-phase
E1965	ANSI25-3 Active	-	-	-
E1966	ANSI25-3 Blocked	-	-	-
E1967	ANSI25-3 Negative phase seq. PT2	-	-	-
E1968	ANSI25-3 Negative phase seq. PT3	-	-	-

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

Main Menu\ Parameters\PROTECTION\ANSI25\Sync. unit 3 (PT2-PT3)				
Synchrocheck				
SET 1	SET 2	SET 3	SET 4	
P/E No.	System Description	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			

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

Main Menu\ Parameters\PROTECTION\ANSI25\Sync. unit 3 (PT2-PT3)				
Voltage check				
SET 1	SET 2	SET 3	SET 4	
P/E No.	System Description	Value	Unit	(Setting range)
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

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). Parameter descriptions of the SET PARAMETERS and the parameters of the first synchronizing unit (Sync. unit 1) represented below are described below in detail as examples.*

CAUTION: P60 Agile device variants which were built according to ordering option G59 or G59 and ANSI87 do not provide frequency measurement via voltage measurement input PT3

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. Therefore, the general parameters apply to all of the following sub-functions of the synchronizing units:

- Synchrocheck (synchronizing check: U, f, dU, df, dPHI) and
- Voltage check (U, f)

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 as long as the assigned event is active. As soon as activation is active, event *ANSI25-1 Active* [E1855] is activated. If the assigned event becomes inactive, synchronizing unit 1 is deactivated. Event [E1855] is then 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 as long as the blocking event is active. As soon as blocking is active, event *ANSI25-1 Blocked* [E1856] is activated. If the blocking event becomes inactive, blocking is abandoned and synchronizing unit 1 is effective again. Event [E1856] is then deactivated automatically.

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

P2307 Voltage reference

Three phase voltage of the reference (for example, mains busbar) to which the other three phase system needs to be synchronised (for example, generator); the reference system can be assigned either to the voltage measurement input:

PT1 or

PT2.

When synchronisation is conducted between two voltage systems of different voltage levels (e.g. high-voltage side and low-voltage side of a transformer), the settings of the reference quantities of the relating winding sides (W1 and W2 or W2 and W3 or W1 and W3) have to be considered! Corresponding parameters are located in the submenu:
SYSTEM \Nominals**Reference values**:

Vector shift group:

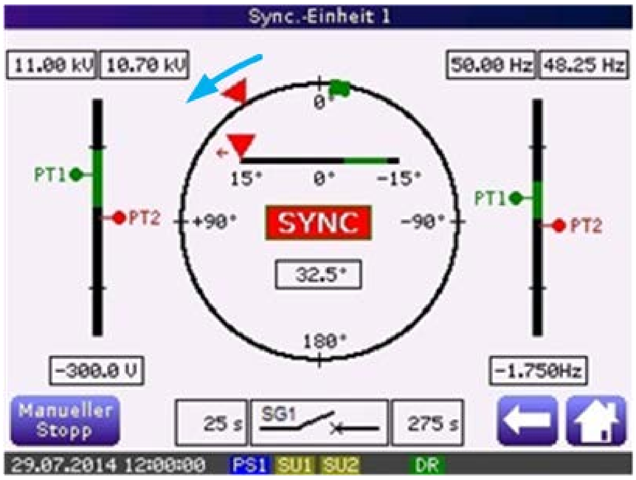
- Connection type [P600], [P610] or [P620] and
- Phase shift [P611] or [P621], and

Transformer ratio:

- “Voltage (L-L)” [P603], [P613] or [P623] and

NOTE:	*When frequency of the three phase power system which is to be synchronized is lower than frequency of the reference system, then angle indicator (red triangle) in the graphical synchronizer page rotates anti-clockwise.* *When frequency of the three phase power system which is to be synchronized is higher than frequency of the reference system, then angle indicator (red triangle) in the graphical synchronizer page rotates clockwise.*

Rotation direction of angle indicator (red triangle)



P2308 Max. operating time (manual)

Maximum time delay until the automatic deactivation of a manually initiated synchronisation via synchronizing unit 1 (Sync. unit 1); as soon as synchronizing unit 1 is activated manually, the timer Max. operating time starts. When synchronisation has not stopped manually before Max. operation time has run down, synchronizing unit 1 is automatically deactivated.

> *Note: Parameter Max. operation time (manual)[P2308] is valid only for a manually initiated synchronisation via synchronizing unit 1 which can apply the following sub-functions:*
>
> *-Synchrocheck (synchronizing check: U, f, dU, df, dPHI) and/or*
> *-Voltage check (U, f) and/or*
> *-Controller (see “ANSI 25A – Automatic synchronization (controller)).*
>
> *To provide the possibility of a manually initiated synchronisation, 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) where:

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 primary side W1*
>
> *The parameter Voltage (L-L) [P603] is located in submenu: SYSTEM\Nominals**Reference values**.*

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

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

> **CAUTION: Function “Rotating field supervision” is <u>not</u> applicable in case that phase-to-phase voltage <u>U</u>12 is measured at PT1 and PT2 by a 2-pole isolated voltage transformer each!**

P2310 Switching element

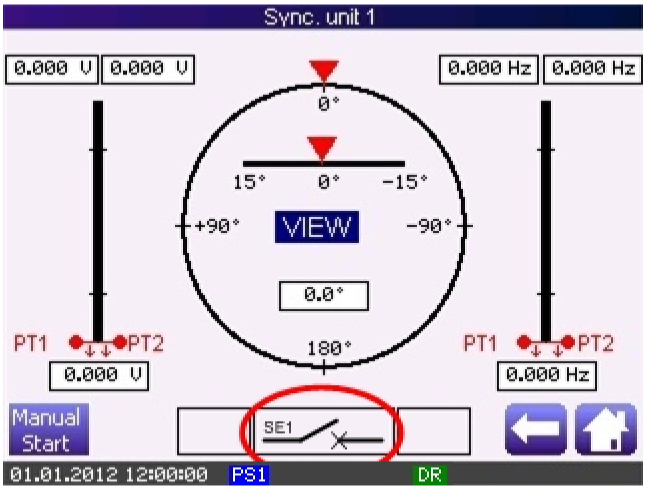
Assignment of the switching element to the graphical synchronizer page; depending on the P60 Agile device variant, one of the available switching elements can be depicted on the synchronizer page of synchronizing unit 1. Available options are as follows:

- none: none of the switching elements is assigned; no symbol to be depicted
- SE1: symbol of assigned switching element 1 (SE1) is to be depicted

- SE2: symbol of assigned switching element 1 (SE2) is to be depicted
- SE3: symbol of assigned switching element 1 (SE3) is to be depicted
- SE4: symbol of assigned switching element 1 (SE4) is to be depicted
- SE5: symbol of assigned switching element 1 (SE5) is to be depicted
- SE6: symbol of assigned switching element 1 (SE6) is to be depicted
- SE7: symbol of assigned switching element 1 (SE7) is to be depicted
- SE8: symbol of assigned switching element 1 (SE8) is to be depicted

The symbol always shows the current state of the assigned switching element SE x.

Assignment of the switching element to the graphical synchronizer page



Note:	*Usually, it is that switching element to be assigned to the synchronizer page which is expected to perform the closing command of the synchronizing unit 1.*

P2311 Show synchronizer page automatic

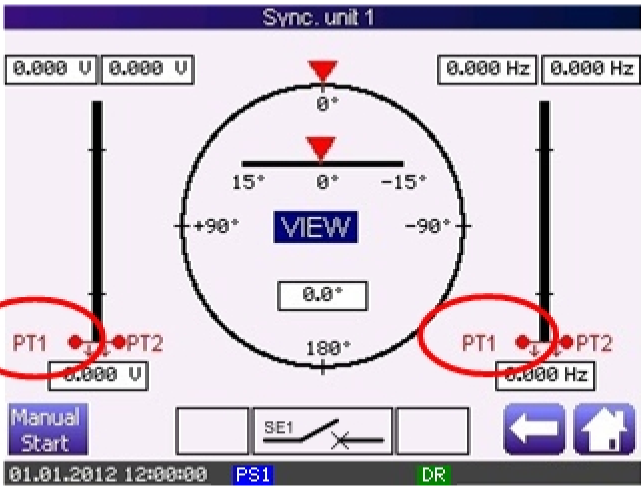
Automatic pop-up of the synchronizer page; as soon as synchronizing unit 1 is activated by the event which is assigned to parameter *Activate by event* [P2305], the synchronizing page of sync. unit 1 can be configured to pop-up immediately when synchronizing process starts and/or to close automatically when synchronizing process has finished. Selection option includes:

- OFF : disables automatic pop-up of synchronizer page or
- Open automatically : enables automatic opening of synchronizer page, or
- Close automatically : enables automatic closing of synchronizer page, or
- Open/close automatically : enables automatic opening and closing of synchronizer page.

P2312 PT1 label

Text editor for voltage and frequency labels of PT1 at synchronizer page; designation of U and f indicators of voltage measurement input PT1 can be changed by the user (max. four characters)

Synchronizer page: Sync. unit 1 – labels of voltage and frequency indicators



P2313 PT2 label

Text editor for voltage and frequency indicators of PT2 at synchronizer page; description is analogue to description of parameter [P2312].

P2314 Check mode

The check mode determines the characteristic quantity for the parameterizable operating ranges of functions "Synchrocheck" and "Voltage check"; where setting:

- 3-phase: defines all three phase-to-phase voltages $U12_{PTx}$, $U23_{PTx}$ and $U31_{PTx}$,

  or

- 2-phase: defines only one phase-to-phase voltage $U12_{PTx}$

as measuring quantities/quantity to be monitored.

Synchronizing check (U, f, dU, df, dPHI) – Synchrocheck

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 checked to verify whether

- the amount of the phase-to phase voltages $\underline{U}12$, 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 will start according to the synchronizing criteria:

- Amount difference dU of the phase-to phase voltages $\underline{U}12_{PT1}$ and $\underline{U}12_{PT2}$
- Frequency difference df of the phase-to phase voltages $\underline{U}12_{PT1}$ and $\underline{U}12_{PT2}$ and
- Phase angle difference dPHI of the phase-to phase voltages $\underline{U}12_{PT1}$ and $\underline{U}12_{PT2}$

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

CAUTION: P60 device variants built according to ordering option G59 or G59 and ANSI87 do not provide frequency measurement via voltage measurement input PT3.

P2315 Function

This parameter enables/disables the effectiveness of synchronizing unit 1 (Sync. unit 1) for synchronizing check (Synchrocheck: U,f,dU,df, dPHI) where:

- 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 Synchrocheck (U,f,dU,df, dPHI) of synchronizing unit 1 (Sync. unit 1) can be blocked by any active event. For blocking, the number related to this blocking event must 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 activated. If the blocking event becomes inactive, blocking is abandoned and synchronizing check is effective again. Event [E1865] is then 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 (Synchrocheck: U,f,dU,df, dPHI).

Depending on set value of parameter “Check mode” [P2314] either

- all three phase-to-phase voltages $U12_{PTx}$, $U23_{PTx}$ and $U31_{PTx}$, or
- only one phase-to-phase voltage $U12_{PTx}$

are/is being compared with the operating range set via parameters “Max. voltage” [2317] and “Min. voltage” [P2318].

“Check mode = 3-phase”

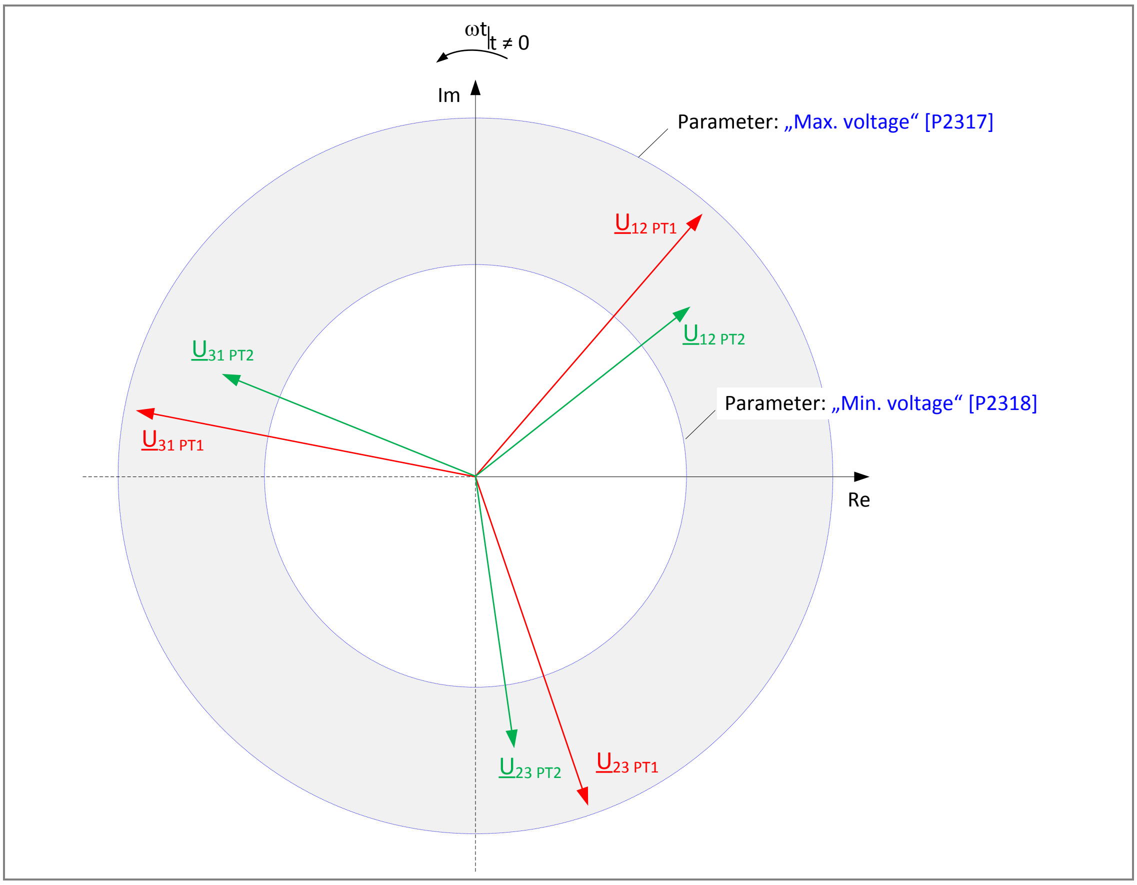


Figure 5 Synchrocheck – operating range: phase-segregated, 3 phase voltage check (amount)

"Check mode = 2-phase"

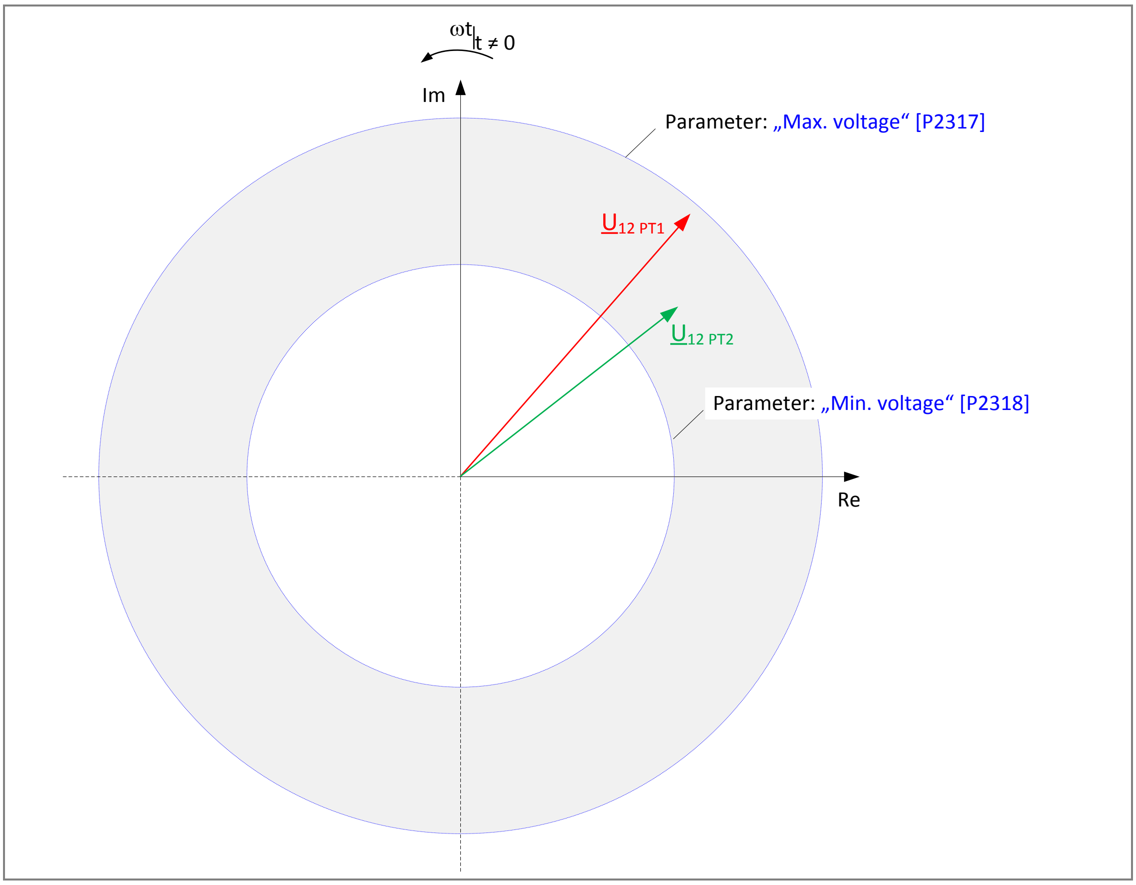


Figure 6 Synchrocheck – operating range: phase-segregated, 2 phase voltage check (amount)

Once the relevant 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 activated, and the synchronizing check procedure (dU, df, dPHI) will be conducted.

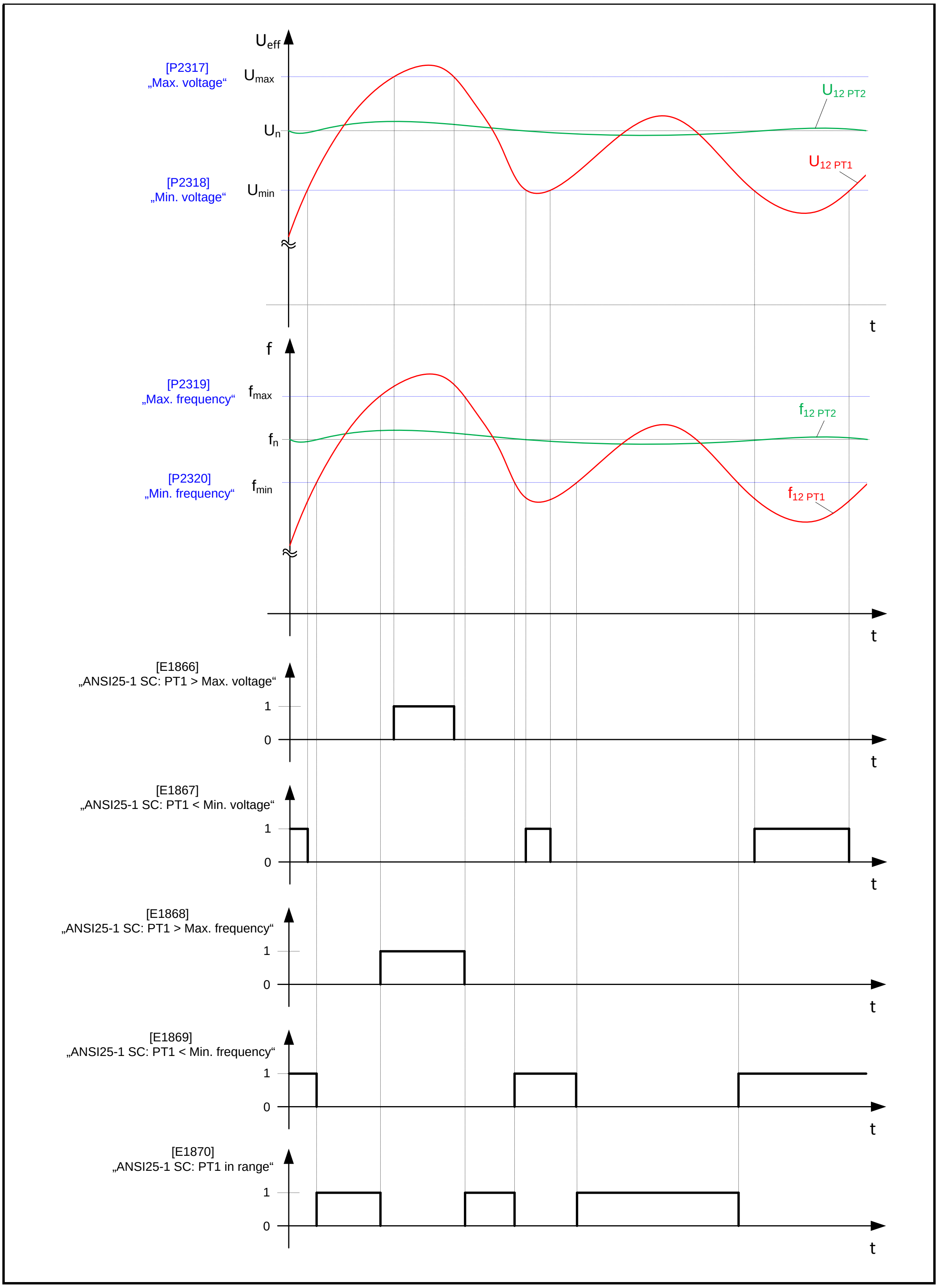


Figure 7 Function Synchrocheck – operating range PT1: parameters [P] and events [E]

Note: Verification of compliance with the set operating range for phase-to-phase voltages and frequency of PT2 is conducted in a similar manner to PT1.

P2317 Max. voltage

Maximum voltage limit (voltage magnitude) of the operating range of the phase-to-phase voltages U12 to be synchronised; for a successful synchronizing check (Synchrocheck: U, f, dU, df, dPHI), voltages must not exceed the maximum voltage limit.

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

When the measured phase-to-phase voltages U12 of PT1 and/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 activated.

P2318 Min. voltage

Minimum voltage limit (voltage magnitude) of the operating range of the phase-to-phase voltages U12, U23 and U31 to be synchronised; for a successful synchronizing check (Synchrocheck: U, f, dU, df, dPHI), voltages must not fall below the minimum voltage limit.

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

When 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 PT2is activated.

P2319 Max. frequency

Maximum frequency limit of the operating range of the phase-to-phase voltages $U12_{PT1}$ and $U12_{PT2}$; for a successful synchronizing check (Sync check: U, f, dU, df, dPHI), frequencies must not exceed the maximum frequency limit.

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

When 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 activated.

P2320 Min. frequency

Minimum frequency limit of the operating range of the phase-to-phase voltages $U12_{PT1}$ and $U12_{PT2}$; for a successful synchronizing check (Synchrocheck: U, f, dU, df, dPHI), frequencies must not fall below the minimum frequency limit.

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

When 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 activated.

Continuation of synchronizing check according to the synchronizing criteria dU, df and dPHI.

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

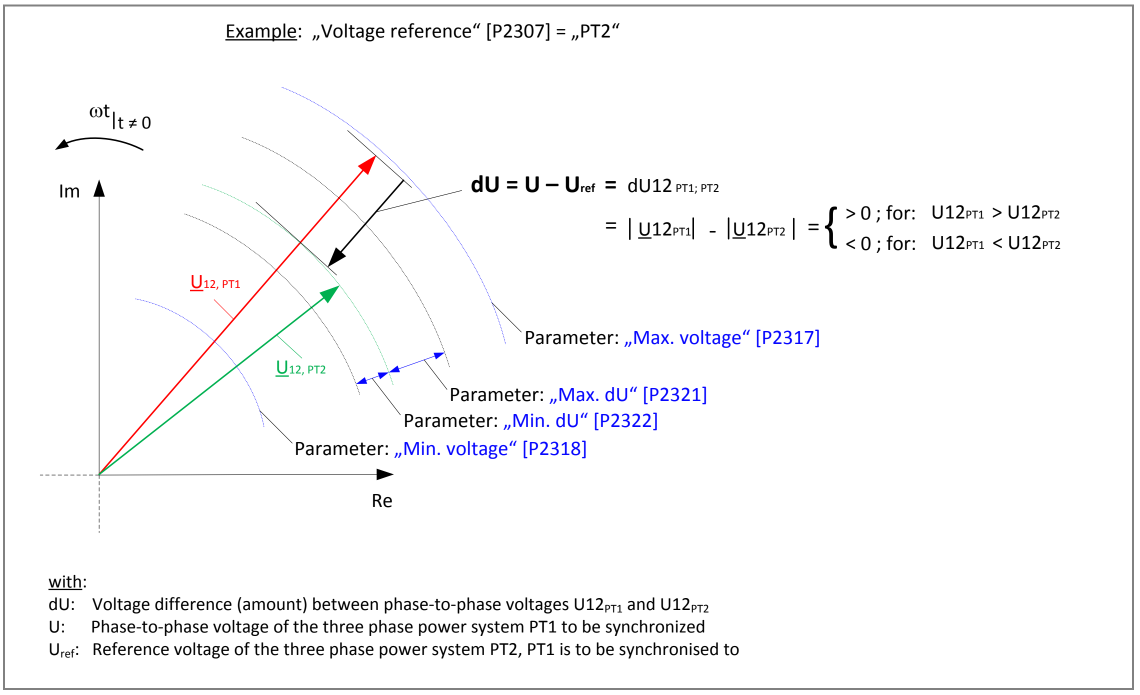


Figure 8 Function Synchrocheck – verification of compliance with voltage difference dU

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

P2321 Max. dU

Maximum limit of the voltage difference dU (difference between phase-to-phase voltages $\underline{U}12_{PT1}$ and $\underline{U}12_{PT2}$) of a level in excess of the reference voltage U_{ref}; for a successful synchronizing check (Synchrocheck: U, f, dU, df, dPHI), voltages must not exceed the maximum limit of the voltage difference dU.

When the measured voltage difference dU exceeds the maximum limit of the voltage difference dU set by parameter *Max.dU* [P2321], the event *ANSI25-1 SC: dU > Max. dU* [E1876] is activated.

P2322 Min. dU

Minimum limit of the voltage difference dU (difference between phase-to-phase voltages $\underline{U}12_{PT1}$ and $\underline{U}12_{PT2}$) of a level below the reference voltage U_{ref}; for a successful synchronizing check (Synchrocheck: U, f, dU, df, dPHI), voltages must not fall below the minimum limit of the voltage difference dU.

When the measured voltage difference dU falls below the minimum limit of the voltage difference dU set by parameter *Min.dU* [P2322], the event *ANSI25-1 SC: dU < Min. dU* [E1877] is activated.

The following figure represents the verification of compliance with the set voltage difference dU and the set frequency difference df.

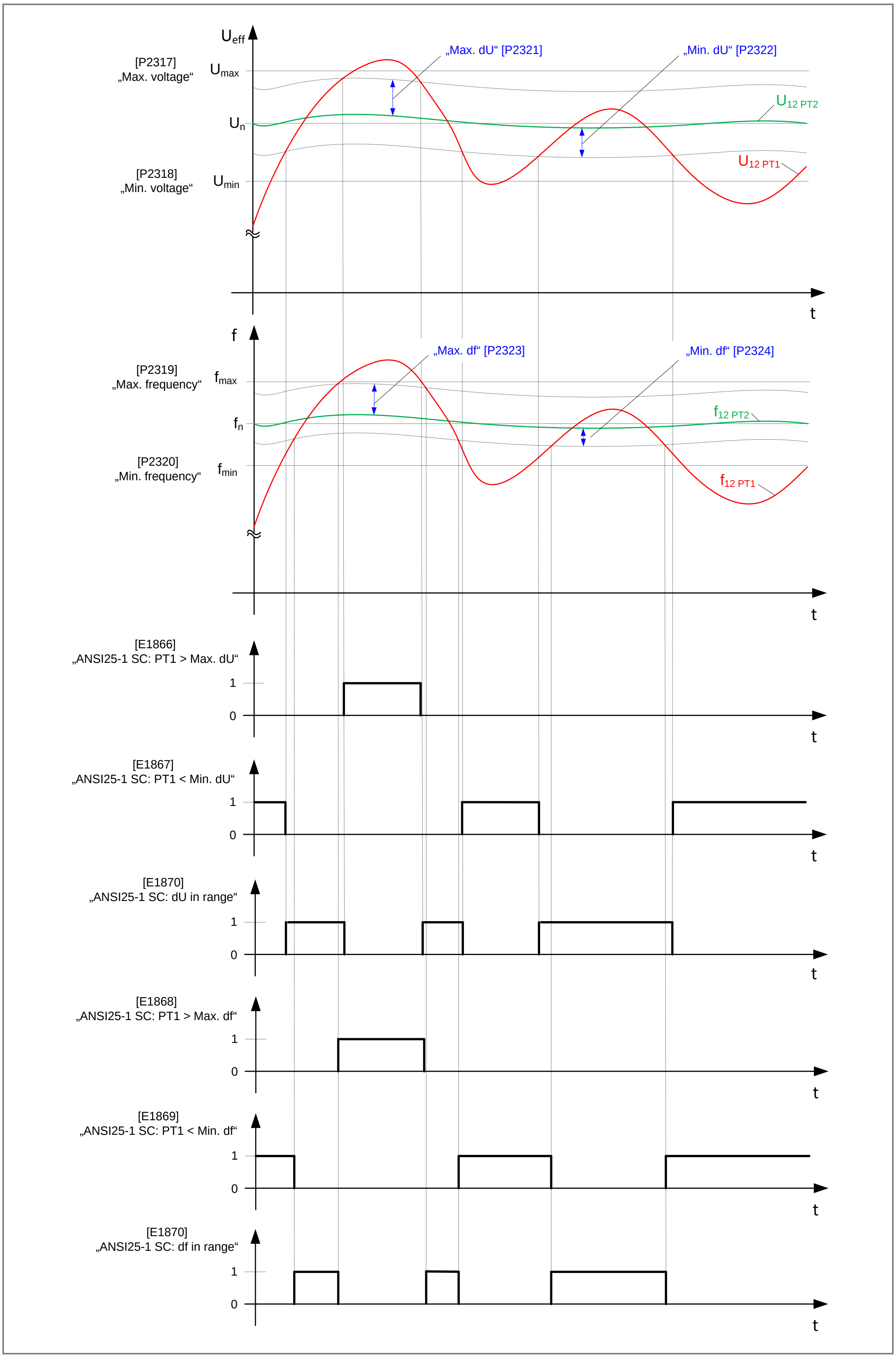


Figure 9 Function Synchrocheck – verification of compliance with dU and df

> *Note:* *As soon as the frequency difference df lies within the tolerance range set by parameters Max. df [P2323] and Min df [P2324], event ANSI25-1 SC: df in range [E1881] is activated.*

P2323 Max. df

Maximum limit of the frequency difference df (difference between frequencies of phase-to-phase voltages U12PT1 and U12PT2); for a successful synchronizing check (Synchrocheck: U, f, dU, df, dPHI), the frequency difference must not exceed the maximum limit of the frequency difference df.

When the measured frequency difference df exceeds the maximum limit of the frequency difference df set by parameter *Max.df* [P2323], the event *ANSI25-1 SC: df > Max. df* [E1879] is activated.

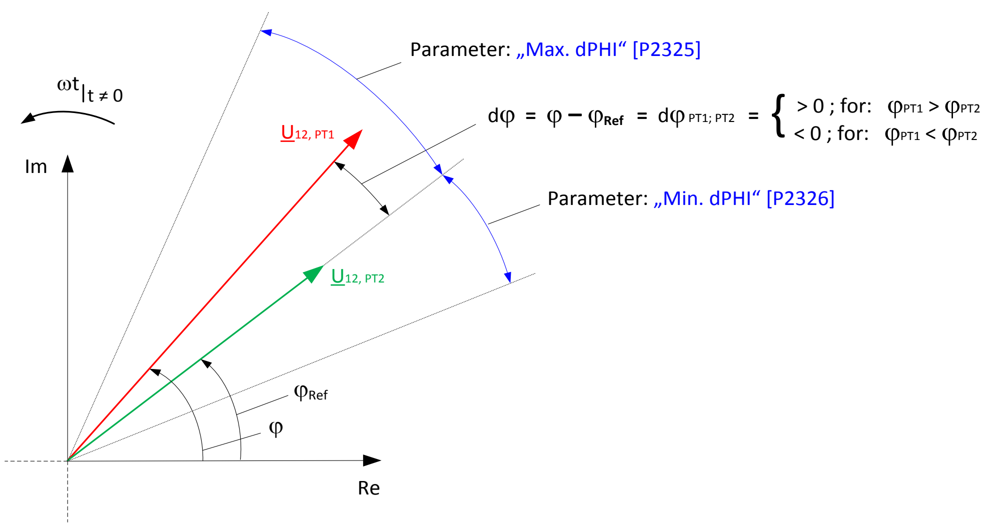
P2324 Min. df

Minimum limit of the frequency difference df (difference between frequencies of phase-to-phase voltages U12PT1 and U12PT2); for a successful synchronizing check (Synchrocheck: U, f, dU, df, dPHI), the frequency difference must not fall below the minimum limit of the frequency difference df.

When the measured frequency difference Δf falls below the maximum limit of the frequency difference df set by parameter Min.df [P2324], the event *ANSI25-1 SC: df < Min. df* [E1880] is activated.

The following figure represents the verification of compliance with the set phase angle difference dPHI.

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



with:

$U_{12,PT1}$:	Measured phase-to-phase voltage U12 of the three phase power system PT1 to be synchronized
$U_{12,PT2}$:	Measured phase-to-phase voltage U12 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 $U12_{PT1}$ and $U12_{PT2}$
φ:	Phase angle of the phase-to-phase voltage $U12_{PT1}$ of the three phase power system PT1 to be synchronized
φ_{Ref}:	Phase angle of the phase-to-phase voltage $U12_{PT2}$ of the three phase power system PT2 (reference system), PT1 is to be synchronized to

Figure 10 Function Synchrocheck – verification of compliance with Phase angle difference dPHI.

> *Note:* *As soon as the phase angle difference dPHI lies within the tolerance range set by parameters Max. dPHI [P2325] and Min dPHI [P2326], event ANSI25-1 SC: dPHI in range [E1884] is activated.*

P2325 Max. dPHI

Maximum limit of the phase angle difference dPHI (difference between phase angles of phase-to-phase voltages $\underline{U}12_{PT1}$ and $\underline{U}12_{PT2}$); for a successful synchronizing check (Synchrocheck: U,f,dU,df, dPHI), the phase angle difference must not exceed the maximum limit of the phase angle difference dPHI

When the measured phase angle difference dPHI exceeds the maximum limit of the phase angle difference df set by parameter *Max. dPHI* [P2325], the event *ANSI25-1 SC: dPHI > Max. dPHI* [E1882] is activated.

P2326 Min dPHI

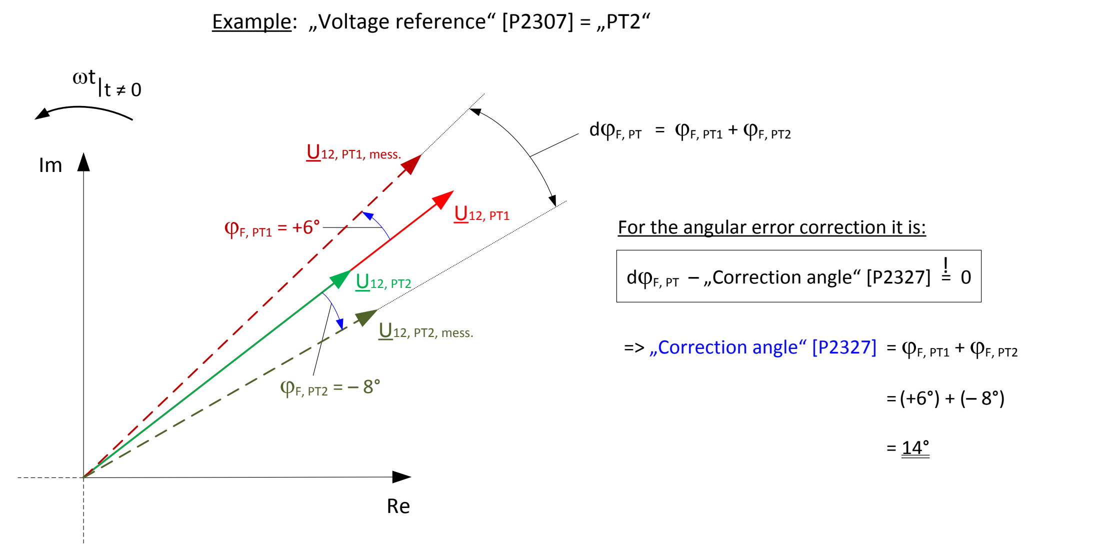
Minimum limit of the phase angle difference $\Delta\varphi$ (difference between phase angles of phase-to-phase voltages $\underline{U}12_{PT1}$ and $\underline{U}12_{PT2}$); for a successful synchronizing check (Synchrocheck: U, f, dU, df, dPHI), the phase angle difference must not fall below the minimum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

When the measured phase angle difference $\Delta\varphi$ falls below the maximum limit of the phase angle difference Δf set by parameter *Min. dPHI* [P2326], the event *ANSI25-1 SC: dPHI < Min. dPHI* [E1883] is 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 dPHI of the phase-to-phase voltages $\underline{U}12_{PT1}$ and $\underline{U}12_{PT2}$ is taken to be zero



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 11 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 U12PT1 und U12PT2.*

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 should 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 activated, and the *Delay time* [P2328] is started.

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

Consideration of operating times of additionally applied, external components

Based on synchronizing check functionality (Synchrocheck), P60 Agile calculates the actual time taken for contacts to close its binary output Synchron ON. Due to the operating times of additional, external components such as auxiliary relay, circuit breaker etc., the actual electrical connection (at primary contacts of the CB) of the two three phase power systems PT1 and PT2 is delayed.

There is therefore a possibly that the synchronizing criteria are no longer fulfilled. As a consequence, such circumstances would lead to an asynchronous 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 configured, 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

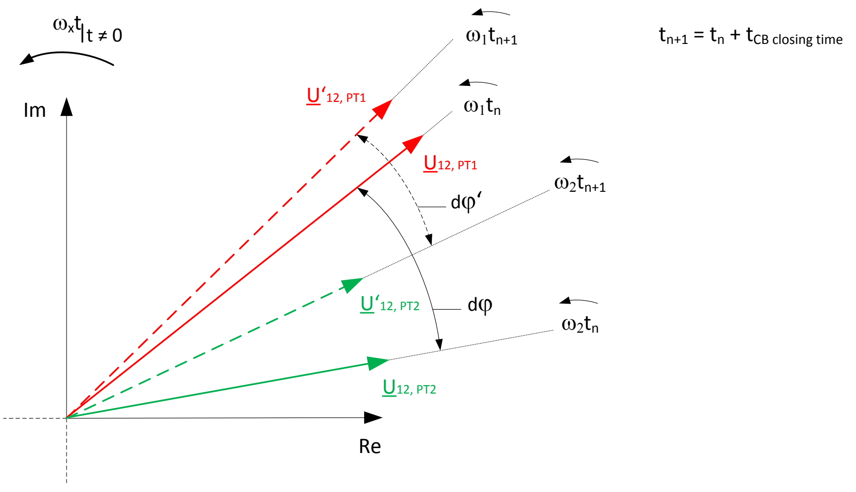
P2329 CB closing delay

Time of bringing forward the activation of the synchronous-event *ANSI25-1 SC: Synchronous pre-event [E1885],* and the start of *Delay time [P2328] f*or 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 dPHI* 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 dPHI is calculated for the time $t_{n+1} = t_n + t_{CB\ closing\ time}$, and compared with the tolerance range set by parameters *Max. dPHI* [P2325] and *Min. dPHI* [2326].

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



with:

U12, PT1:	Phase-to-phase voltage U12 of the three phase power system PT1 to be synchronized PT1, at the time t_n
U‘12, PT1:	Phase-to-phase voltage U12 of the three phase power system PT1 to be synchronized PT1, at the time t_{n+1}
U12, PT2:	Phase-to-phase voltage U12 of the three phase power system PT2, PT1 is to be synchronized to, at the time t_n
U‘12, PT2:	Phase-to-phase voltage U12 of the three phase power system PT2, PT1 is to be synchronized to, at the time t_{n+1}
dφ:	Phase angle difference, at the time t_n
dφ‘:	Phase angle difference, at the time t_{n+1}
ω_1:	Angular frequency ($\omega_1 = 2\ \pi\ f_{PT1}$) of phase-to-phase voltage U12 of the three phase power system PT1
ω_2:	Angular frequency ($\omega_2 = 2\ \pi\ f_{PT2}$) of phase-to-phase voltage U12 of the three phase power system PT2, PT1 is to be synchronized to

Figure 12 Function Synchrocheck – consideration of operating times: phasor diagram

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

- synchronous-event ANSI25-1 SC: Synchronous pre-event [E1885] is activated **and**
- if parameterised , the *Delay time [P2328]* for on-delayed of the synchronous-event *ANSI 25-1 SC: Synchronous* [E1886] is started.

Voltage.check (U, f)

Independent of function Synchrocheck (U,f,dU,df, dPHI) 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:

None of the three phase-to-phase voltages of the three phase power system should exceed the defined voltage limit set by parameter *No voltage limit [P2341].*

Definition live three phase power system:

- Phase-to-phase voltage $\underline{U}12$ of a three phase power system they must meet the defined voltage range set by parameters *Max.voltage* [P2337] and *Min. voltage* [P2338] **and**
- The frequency of the phase-to-phase voltage $\underline{U}12$ of a three phase power system they must meet the defined frequency range set by parameters *Max. frequency* [P2339] and *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 $\underline{U}12_{PT1}$ and $\underline{U}12_{PT2}$ **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] **≠** 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 depending on 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 for as long as the blocking event is active. As soon as blocking is active, event *ANSI25-1 VC: Blocked* [E1890] is activated. If the blocking event becomes inactive, blocking is abandoned and synchronizing check is effective again. Event [E1890] is then 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 live and dead power systems => Voltage check (U, f):

Depending on set value of parameter “Check mode” [P2314] either

- all three phase-to-phase voltages $U12_{PTx}$, $U23_{PTx}$ and $U31_{PTx}$, or
- only one phase-to-phase voltage $U12_{PTx}$

are/is being compared with the operating range set via parameters “Max. voltage” [2317] and “Min. voltage” [P2318].

“Check mode [P2314] = 3-phase

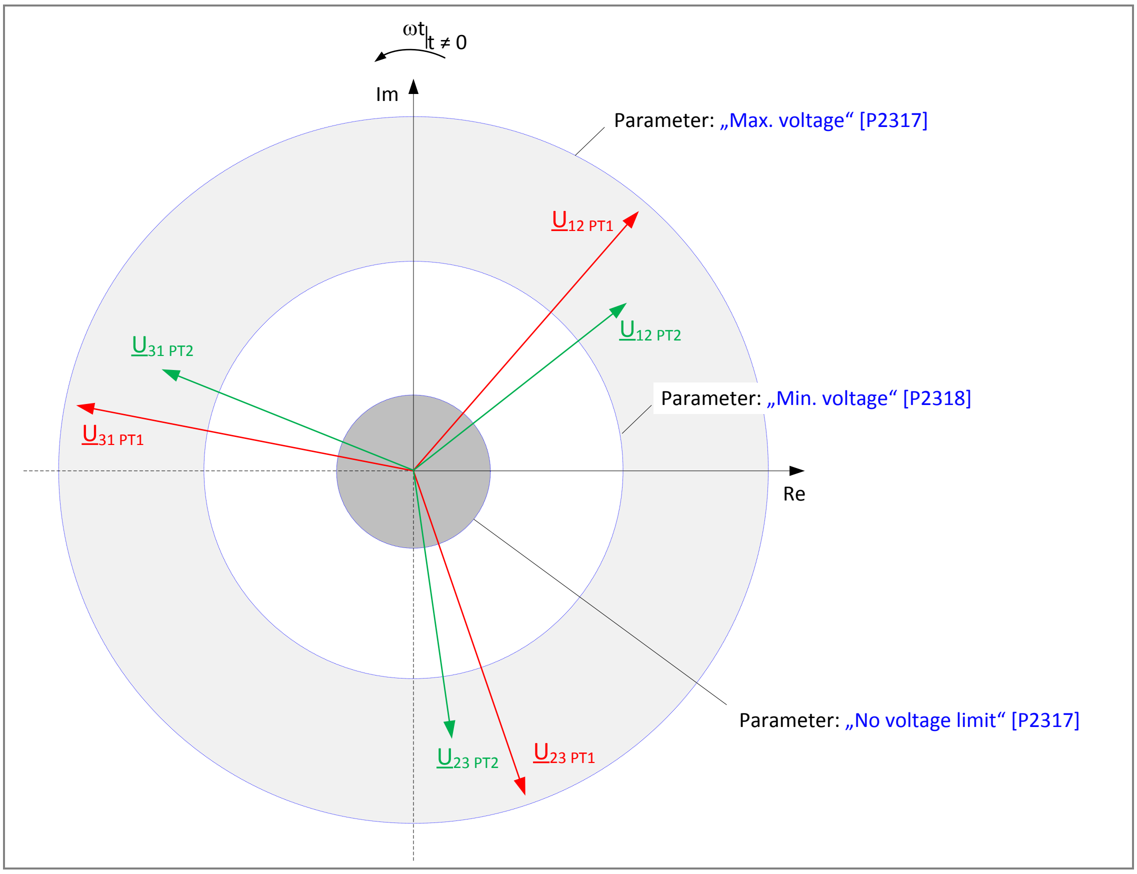


Figure 13 Voltage check – operating ranges: phase-segregated, 3 phase voltage check (amount)

"Check mode [P2314] = 2-phase

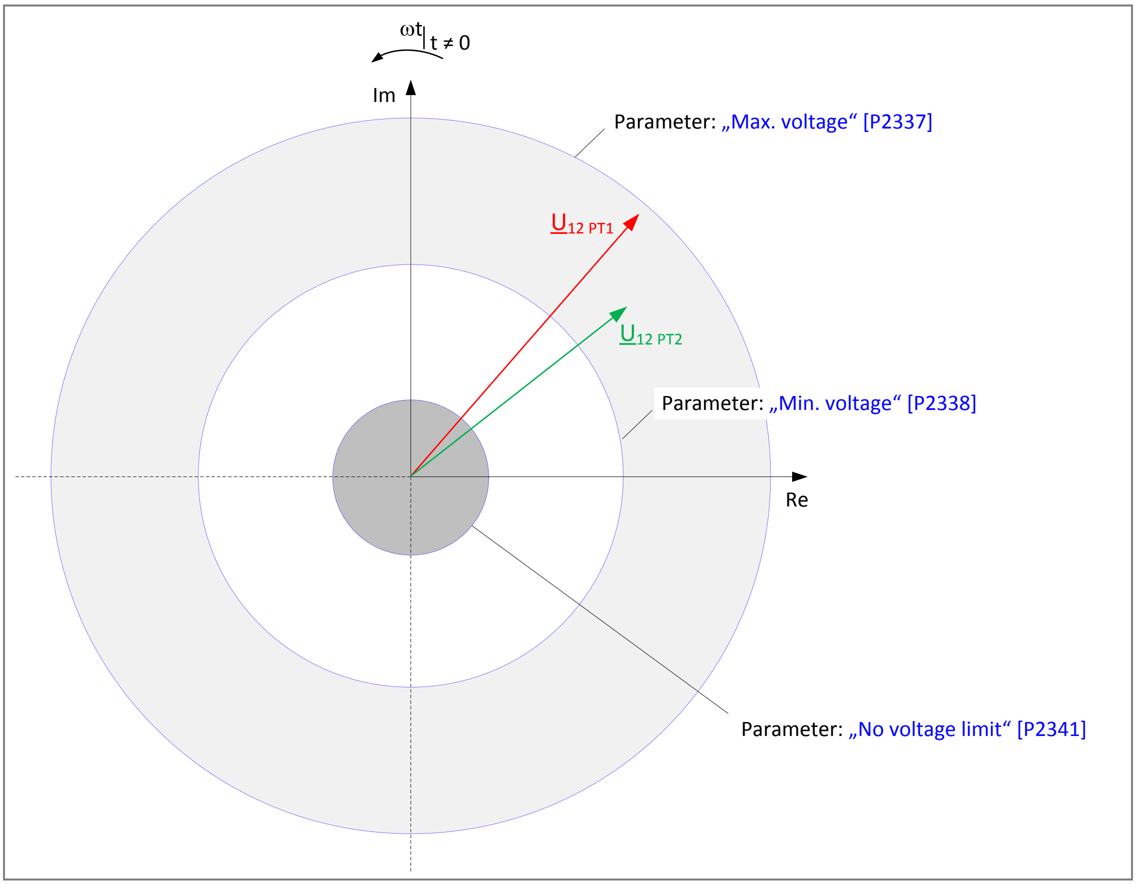


Figure 14 Voltage check – operating ranges: phase-segregated, 2 phase voltage check (amount)

As soon as the amount and the frequency of the phase-to-phase voltages U12 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 activated.

P2337 Max. voltage

Maximum voltage limit (voltage amount) of the operating range of the phase-to-phase voltages $\underline{U}12_{PT1}$ and $\underline{U}12_{PT2}$ to be synchronised; 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.

When one of the measured phase-to-phase voltages U12 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 activated.

P2338 Min. voltage

Minimum voltage limit (voltage amount) of the operating range of the phase-to-phase voltages $\underline{U}12_{PT1}$ and $\underline{U}12_{PT2}$ to be synchronised; 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.

When one of the measured phase-to-phase voltages $\underline{U}12$ 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 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.

When 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 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.

When 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 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.

When the measured phase-to-phase voltages $\underline{U}12$ of a power system (PT1 and/or PT2) 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 activated.

When the measured phase-to-phase voltages U12 of a power system (PT1 and/or PT2) 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 activated.

> *Note:* *The minimum voltage limit [P2341] of measuring voltage should be set as a percentage of the nominal value of the characteristic quantity (phase-to-phase voltage). The nominal value of the characteristic quantity should be set by parameter:*
> *Voltage (L-L) [P603], for winding side W1*
>
> *The referring parameters Voltage (L-L) [P603] is 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 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]

Synchronous event ANSI25-1 VC: Synchronous pre-event [E1905] activated and the Delay time [P2342] for on-delayed activating of synchronous event Synchron-Event ANSI 25-1 VC: Synchronous [E1906] is then started.

2.1.4 ANSI 25A-Automatic synchronizing (Controller)

Automatic synchronisation “Controller” of synchronizing units “Sync. unit 1 (PT1-PT2)”, “Sync. unit 2 (PT1-PT3)” and “Sync. unit 3 (PT2-PT3)” 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 P60 Agile device.

According to the synchronizing criteria

- Frequency
- Phase angle and
- Voltage

Function “ANSI 25A –Automatic synchronisation (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.

CAUTION: The P60 Agile device variants were built according to ordering option G59:

- do not provide frequency measurement via voltage measurement input PT3.
- do provide phase-segregated frequency measurement (zero crossings of phase voltages) only at voltage measurement input PT2.
- do provide frequency measurement at PT1 based on crossings of phase-to-neutral voltages UL1 and UL2.

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

Main Menu\ Parameters\PROTECTION\ANSI25A-Automatic synchronizing\Sync. unit 1 (PT1-PT2)				
Controller				
SET 1	SET 2	SET 3	SET 4	
P/E No.	System Description	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	-	-	-

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

Main Menu\ Parameters\PROTECTION\ANSI25A-Automatic synchronizing\Sync. unit 2 (PT1-PT3)

Controller

SET 1	SET 2	SET 3	SET 4	

P/E No.	System Description	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	-	-	-

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

Main Menu\ Parameters\PROTECTION\ANSI25A-Automatic synchronizing\Sync. unit 3 (PT2-PT3)

Controller

SET 1	SET 2	SET 3	SET 4	

P/E No.	System Description	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	-	-	-

Parameter description:

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

> ***NOTE:*** *Each of the four parameter sets always provide the same group of protection parameters for all three synchronizing units ("Sync. unit 1" to "Sync. unit 3"). Parameter descriptions of the SET PARAMETERS and the parameters of the first synchronizing unit ("Sync. unit 1") are described below in detail.*

P2425 Function

This parameter enables/disables the effectiveness of synchronizing unit 1 (Sync. unit 1) for automatic synchronisation (Controller: frequency control, phase angle control and voltage control) where:

- OFF: disables or
- ON: enables the effectiveness of synchronizing unit 1 for automatic synchronisation.

Automatic synchronisation is only initiated when:

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

Automatic blocking of "ANSI 25 – Synchronizing" control functions

With regard to the actual voltage and frequency levels of the voltage systems connected to PT1 and PT2, two cases have to be differentiated which lead to automatic blocking of the generator's voltage control, frequency control and phase angle control.

Assumption: PT1 = Generator; PT2 = Busbar

With the above assumption, function "voltage check" (see function "ANSI 25 – Synchronizing") has to be activated according to parameter setting: "Function [P2335] = PT1 and NOT PT2".

Case(1): Generator (PT1) voltage and frequency is <u>in</u> the defined "Voltage check" operating range of function "ANSI 25 – Synchronizing, see parameters: "Max. voltage" [P2337], "Min. voltage" [P2338], "Max. frequency" [P2339] and "Min. frequency" [P2340];

Busbar (PT2) is dead; means busbar voltage is below the set value of parameter "No voltage limit" [P2341].

- "ANSI25-1 VC: PT1 in range [E1895] = active" **and**
- "ANSI25-1 VC: PT2 < No voltage limit" [E1904] = active"

Under these circumstances automatic blocking of the control functions avoids permanent generator control actions to synchronize with the dead busbar.

Case(2): Generator (PT1) voltage and frequency is <u>in or out</u> of the defined "Voltage check" operating range of function "ANSI 25 – Synchronizing";

Busbar (PT2) voltage and frequency is <u>out</u> of the defined "Synchrocheck" operating range of function "ANSI 25 – Synchronizing", see parameters: "Max. voltage" [P2317], "Min. voltage" [P2318], "Max. frequency" [P2319] and "Min. frequency" [P2320], however, voltage level exceeds the set value of parameter "No voltage limit" [P2341].

- "ANSI25-1 SC: PT2 in range [E1875] = inactive" **and**
- "ANSI25-1 VC: PT2 > No voltage limit [E1903] = active"

Under these circumstances automatic blocking of the control functions avoids any generator control actions to synchronize with the reference voltage system (busbar) which is not dead but out of its defined “Synchrocheck” operating range.

Event-controlled blocking of control functions

P2426 Blocking

Automatic synchronisation (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 as long as the blocking event is active. If the blocking event becomes inactive, blocking is abandoned and automatic synchronisation is effective again.

If blocking of automatic synchronisation 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 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 equalised by function Frequency control of P60 Agile.

The Frequency control function of P60 Agile 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 (=> *Frequency increase*) and
- *Frequency lower event* [E2021]: signal to external speed governor to decrease RPM (=> *Frequency decrease*)

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

- two different binary outputs of the P60 Agile (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}.

> *Note: In view of the following statements the momentary control deviation (frequency difference ∆fU12 PT1; PT2) is given as a percentage ∆f[%] of the nominal frequency fn 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 Δf[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:
   - $f_{PT1} < f_{PT2}$
     The frequency of power system PT1 is smaller than the frequency of power stem 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:
Δf[Hz] > 0 => frequency increase

- $f_{PT1} > f_{PT2}$
  The frequency of power system PT1 is higher than the frequency of power stem 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:
  Δf[Hz] < 0 => frequency decrease

2. Determination of the control speed:
   The speed of generator frequency control is proportional to the level of control deviation Δf[%]. Pulse times are calculated according to the amount of the control deviation Δf[%],. 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 recalculated immediately after the break time has run down. The break time starts cyclically for a duration set by parameter Frequency controller interval time [P2427].

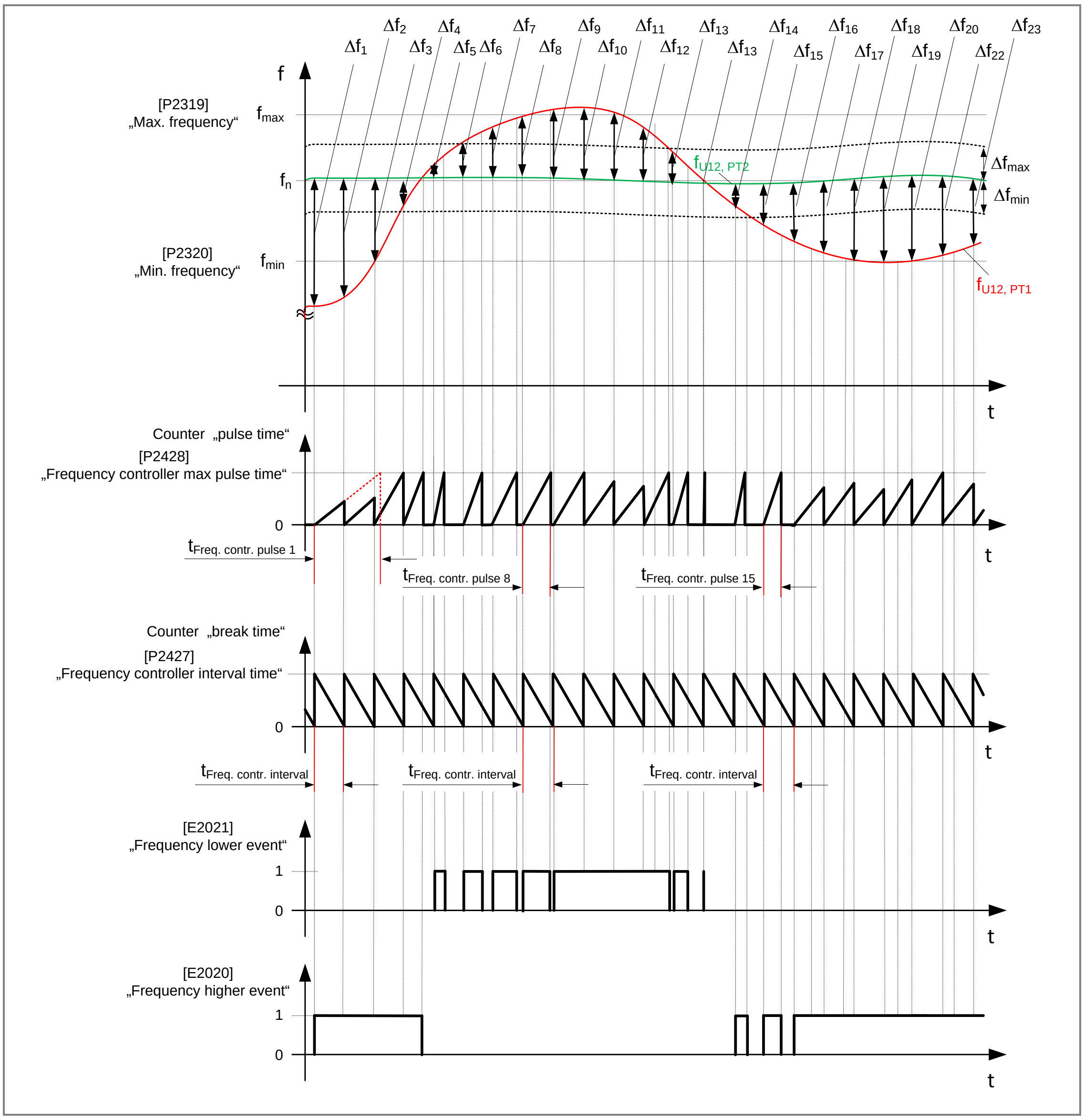


Figure 15 Function Controller – frequency control

> *Note:* *When frequency of power system PT1 (generator) lies within the tolerance range set by ∆fmax and ∆fmin (parameters Max. df [P2323] and Min df [P2324]), Frequency control is blocked in order to avoid any overshoot of the control variable fU12,PT1.*

P2427 Frequency controller interval time

Defined break time $t_{Freq.\ contr.\ interval}$ between the times of calculating the pulse times $t_{Freq.\ contr.\ pulse\ x}$; 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 $t_{Freq.\ contr.\ pulse\ x}$; while synchronizing, the fundamental value meets a defined pulse time which is needed to equalise 100% of frequency deviation referring to the nominal frequency f_n (see parameter *Nominal frequency [P630]*).

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

$t_{Freq.\ contr.\ pulse\ x}[s] / T_{[P2428]}[s] = \Delta f[Hz] / \Delta f_n[Hz]$

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

The formula for the calculated pulse time[s] is therefore as follows:

$\Rightarrow t_{Freq.\ contr.\ pulse\ x}[s] = T_{[P2428]}[s] \times \Delta f[\%] / 100\%$

= Frequency controller max pulse time [P2428] x $\Delta f[\%]$ / 100%

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

Determination of the control direction:

$\Delta f[Hz] > 0$

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

$\Delta f[Hz] < 0$

If the frequency difference *Δf is negative* ($f_{PT1} > f_{PT2}$), the frequency boost event *Frequency lower event* [E2021] is 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* [P0630], will result in the calculated pulse time of: $t_{Volt.contr.\ pulse\ x}[s] = 100\ s$.

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

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* [P0630], will result in the calculated pulse time of: $t_{Volt.contr.\ pulse\ x}[s] = 1\ s$.

Note: An activated control-event will only become inactive if the subsequent, calculated pulse time is below the set value of the set break time (parameter Frequency controller interval 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 $\Delta f_{phase\ contr.max}$, **and**
- the measured phase angle difference $\Delta\varphi$ is higher than the maximum allowable phase angle difference $\Delta\varphi_{max}$ or $\Delta\varphi_{min}$.

As soon as Phase angle control is activated, Frequency control is blocked. The regulation of the phase angle is done by the control of the motor RPM governor which is used to change the generator frequency. Function Phase angle control also operates the control-events *Frequency higher event* [E2020] and *Frequency lower event* [E2021].

The following figure shows an example of the interactions between frequency control and phase angle control and the implications for the control-events.

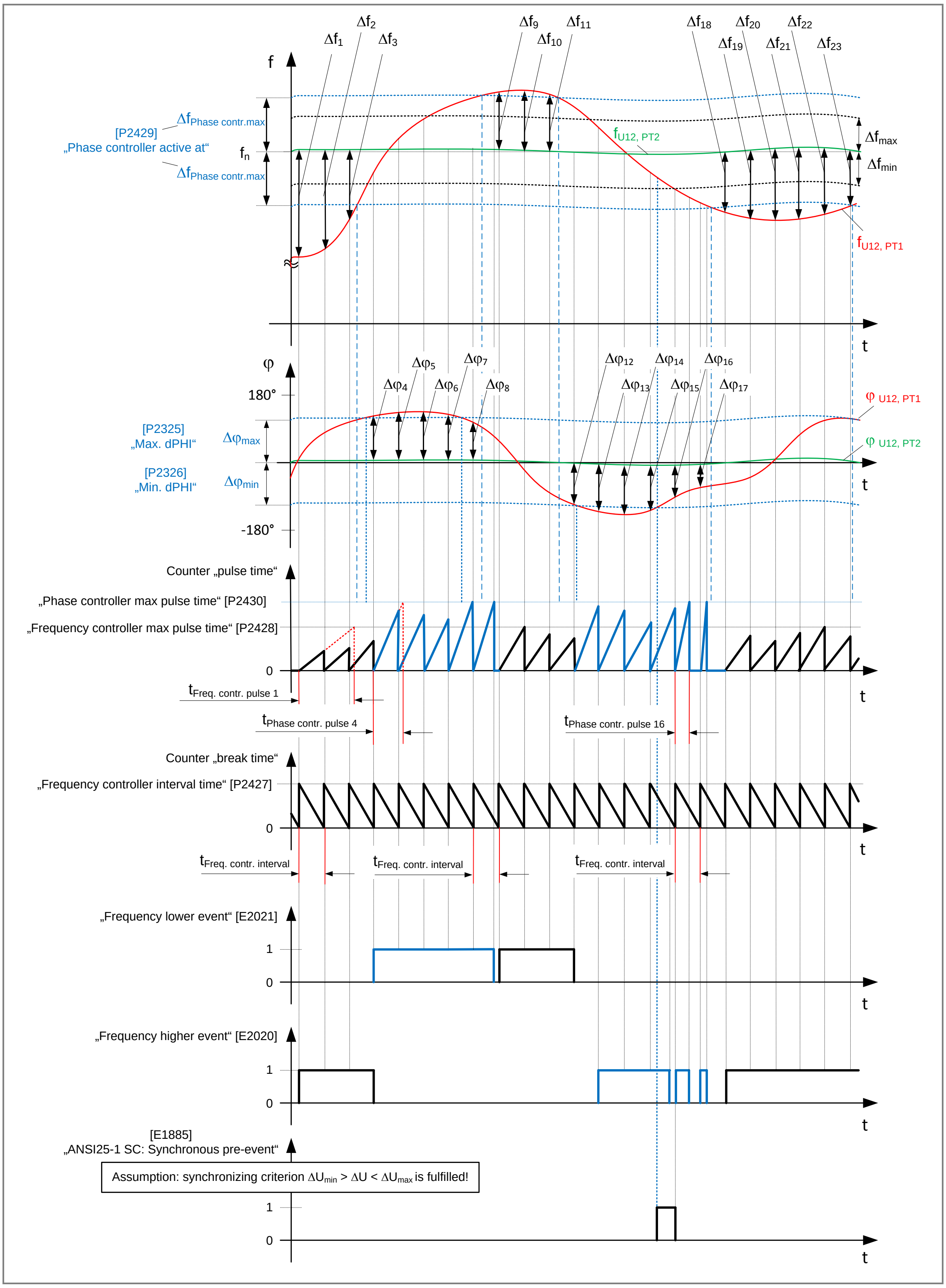


Figure 16 Function Controller – phase angle control

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 therefore 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. dPH [P2325] or Min. dPH [P2326]. So, it is granted that phase angle control should begin, if synchronizing criterion $\Delta f_{U12,\ PT1;\ U12,\ PT2} < \Delta f_{max}$ respectively $\Delta f_{U12,\ PT1;\ U12,\ PT2} < \Delta f_{min}$ is fulfilled.*

When the phase angle control is activated, the frequency control is deactivated. The corresponding control-event:

- *Frequency higher event* [E2020]: signal to external speed governor to increase RPM (=> *Frequency increase*) or
- *Frequency lower event* [E2021]: signal to external speed governor to decrease RPM (=> *Frequency decrease*)

is activated due to the cyclically calculated pulse times $t_{\text{Phase contr. pulse x}}$ which depends on the set value of parameter *Phase controller max pulse time* [P2430].

As soon as the measured phase angle difference $\Delta\varphi$ lies within the tolerance range ($\Delta\varphi_{max}$; $\Delta\varphi_{min}$) set by parameters *Max. dPHI* [P2325] and *Min. dPHI* [P2326], synchronizing criterion $\Delta\varphi_{min} > \Delta\varphi_{U12\ PT1;\ U12\ PT2} < \Delta\varphi_{max}$ is fulfilled.

There are the following cases to differentiate:

1. <u>For settings: $\Delta f_{\text{phase contr.max}}$ [P2429] > Δf_{min} [P2324] and $\Delta f_{\text{phase contr.max}}$ [P2429] > Δf_{max} [P2323] it is</u>:

a. In case that at the time: $t = t[\Delta\varphi_{min} > \Delta\varphi_{U12\ PT1;\ U12\ PT2} < \Delta\varphi_{max}]$ synchronizing conditions:

   - synchronous frequencies: $\Delta f_{min} > \Delta f_{U12\ PT1;\ U12\ PT2} < \Delta f_{max}$ and
   - synchronous voltages: $\Delta U_{min} > \Delta U12_{PT1;\ PT2} < \Delta U_{max}$
     are fulfilled, synchronous-event *ANSI25-1 SC: Synchronous pre-event* [E1885] is activated, and – if parameterised – *Delay time* [P2328] for on-delayed activation of synchronous-event *ANSI25-1 SC: Synchronous* [E1886] begins.

b. In case that at the time: $t = t[\Delta\varphi_{min} > \Delta\varphi_{U12\ PT1;\ U12\ PT2} < \Delta\varphi_{max}]$ only synchronizing condition:

   - synchronous voltages: $\Delta U_{min} > \Delta U12_{PT1;\ PT2} < \Delta U_{max}$
     is fulfilled, activation of synchronous-event *ANSI25-1 SC: Synchronous pre-event* [E1885] and – if parameterised – the start of *Delay time* [P2328] for on-delayed activation of synchronous event *ANSI25-1 SC: Synchronous* [E1886], is blocked.

c. When at the time: $t = t[\Delta\varphi_{min} > \Delta\varphi_{U12\ PT1;\ U12\ PT2} < \Delta\varphi_{max}]$ 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 parameterised – the start of *Delay time* [P2328] for on-delayed activation of synchronous event *ANSI25-1 SC: Synchronous* [E1886], is blocked. Synchronizing procedure is to be continued by function Voltage control and/or Frequency control.

d. When 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: $\Delta U_{min} > \Delta U12_{PT1;\ PT2} < \Delta U_{max}$

  are not fulfilled, activation of synchronous event *ANSI25-1 SC: Synchronous pre-event* [E1885] and – if parameterised – the start of *Delay time* [P2328] for on-delayed activation of synchronous event *ANSI25-1 SC: Synchronous* [E1886], is blocked. Synchronizing procedure will continued by function Voltage control; synchronizing condition synchronous frequencies is not considered any more.

2. For setting: $\Delta f_{phase\ contr.max}$ [P2429] ≤ Δf_{max} [P2323] it is:

a. When at the time: $t = t[\Delta\varphi_{min} > \Delta\varphi_{U12\ PT1;\ U12\ PT2} < \Delta\varphi_{max}]$ synchronizing condition:

- synchronous voltages: $\Delta U_{min} > \Delta U12_{PT1;\ PT2} < \Delta U_{max}$

  is fulfilled, synchronous event *ANSI25-1 SC: Synchronous pre-event* [E1885] is activated, and – if parameterised – *Delay time* [P2328] for on-delayed activation of synchronous event *ANSI25-1 SC: Synchronous* [E1886] will be started.

b. When at the time: $t = t[\Delta\varphi_{min} > \Delta\varphi_{U12\ PT1;\ U12\ PT2} < \Delta\varphi_{max}]$ synchronizing condition:

- synchronous voltages: $\Delta U_{min} > \Delta U12_{PT1;\ PT2} < \Delta U_{max}$

  is not fulfilled, activation of synchronous event *ANSI25-1 SC: Synchronous pre-event* [E1885] and – if parameterised – the start of *Delay time* [P2328] for on-delayed activation of synchronous event *ANSI25-1 SC: Synchronous* [E1886], is blocked. 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 deactivated. The synchronizing procedure will 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 meets a defined pulse time which is needed to equalise a maximum allowable phase angle deviation of 180°.

Phase angle deviations less than 180° are considered by individually calculated pulse times depending on the amount of the phase angle difference Δφ. 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 Δφ[°] to the maximum phase angle difference of 180°.

$t_{Phase\ contr.\ pulse\ x}[s] / T_{[P1018]}[s] = \Delta\varphi[°] / 180°$

The formula for the calculated pulse time[s] is as follows:

=> $t_{Phase\ contr.\ pulse\ x}[s] = T_{[P1018]}[s] \times \Delta\varphi[°] / 180°$

= Phase controller max pulse time [P2430] x Δφ[°] / 180°

Example: Parameter *Phase controller max pulse time* [P2430] = *0.5 s* (typical set value)

Determination of the control direction:

$\Delta\varphi[°] > 0$

If the phase angle difference *Δφ is positive* ($\varphi_{U12\ PT1} < \varphi_{U12\ PT2}$), the frequency boost event *Voltage higher event* [E2022] is activated for the duration of the calculated pulse time (RPM increase).

$\Delta\varphi[°] < 0$

If the phase angle difference *Δφ is negative* ($\varphi_{U12\ PT1} > \varphi_{U12\ PT2}$), the frequency boost event *Voltage lower event* [E2021] is activated for the duration of the calculated pulse time (RPM decrease).

Determination of the control speed:

Δφ[°] = 180°

A phase angle difference *Δφ* of *180°* between the generator system (PT1) and the busbar system (PT2) will result in the calculated pulse time of:

$t_{Volt.contr.\ pulse\ x}[s] = 0.25$ s.

$\Delta\varphi[°] = 36°$

A phase angle difference *Δφ* of *36°* between the generator system (PT1) and the busbar system (PT2) will result in the calculated pulse time of:

$t_{Volt.contr.\ pulse\ x}[s] = 0.05$ s.

Note:	*An activated control event will only become inactive if the subsequent, calculated pulse time is below the set value of the set break time (parameter Frequency controller interval 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 activated independently of functions Frequency control and Phase angle control. Function voltage control affects the three phase system that is connected to PT1 (e.g. generator).

The Voltage control function of P60 Agile is designed as a three step control including the output states: voltage increase and voltage decrease. For this, the two following 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 P60 Agile (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}.

Note:	*In view of the following statements the momentary control deviation (voltage difference ΔU12 PT1; PT2) is given as a percentage ΔU[%] of the nominal voltage Un set by parameter Voltage (L-L) [P0603].*

The procedure of voltage control is as follows:

1. Determination of the control direction: and control deviation ΔU[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:
      ΔU[V] > 0 => 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 $\Delta f_{U12\ PT1;\ PT2} = f_{U12,\ PT2} - f_{U12,\ PT1}$, it follows a negative sign for the calculated voltage difference:
      ΔU[V] < 0 => voltage decrease.

2. Determination of the control speed:
   The speed of generator voltage control is proportional of the level of control deviation ΔU[%]. Depending on the amount of the control deviation ΔU[%], so-called pulse times are 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 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].

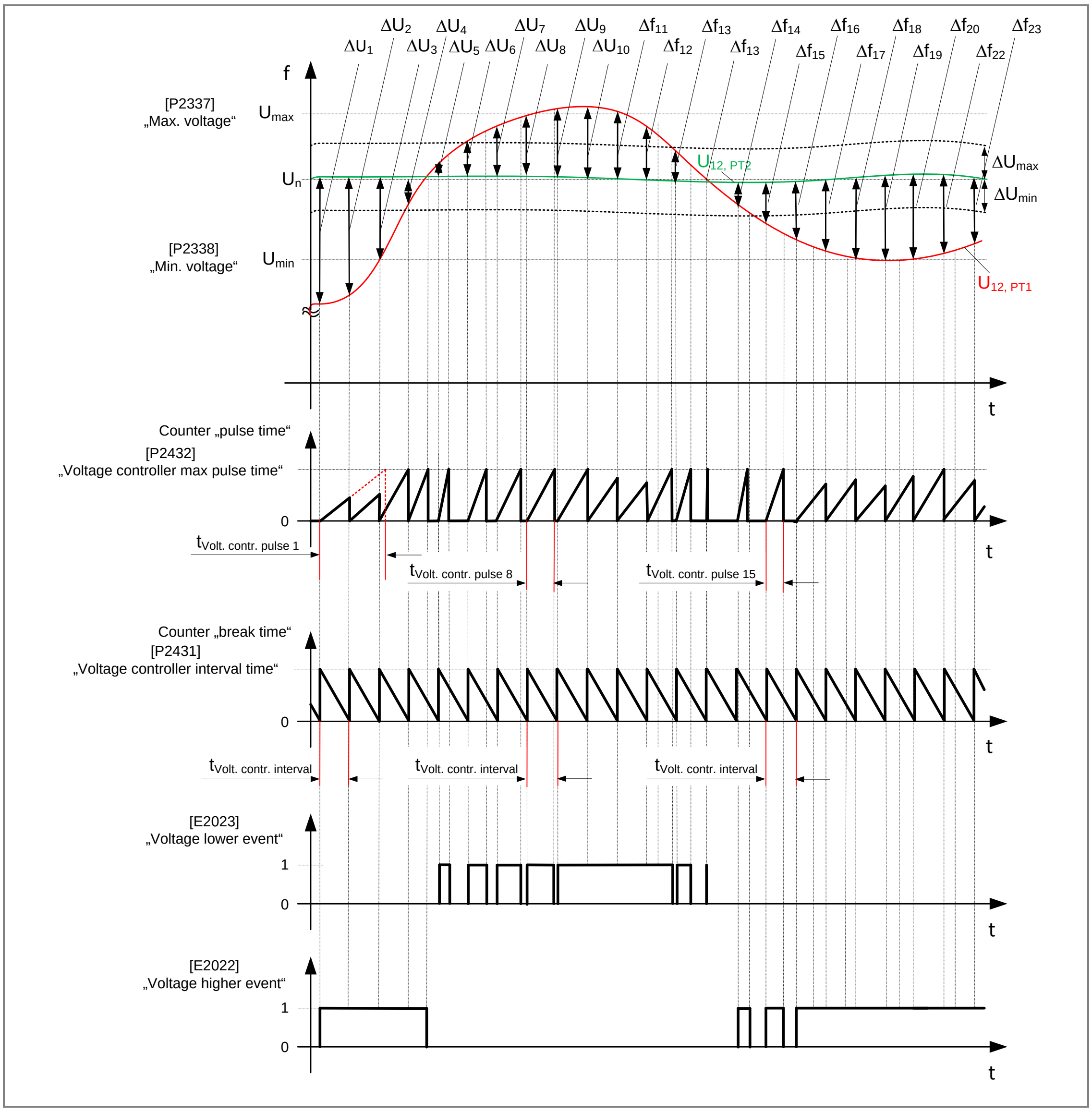


Figure 17 Function controller – voltage control

P2431 Voltage controller interval time

Defined break time $t_{Volt.\ contr.\ interval}$ between the times of calculating the pulse times $t_{Volt.contr.\ pulse\ x}$; the break time 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 $t_{Freq.\ contr.\ pulse\ x}$; while synchronizing, the fundamental value correspond with a defined pulse time which is needed to equalise 100% of voltage deviation referring to the nominal voltage U_n.

Voltage deviations less than 100% of nominal voltage U_n are considered by individually calculated pulse times depending on the amount of the voltage difference ΔU. The ration of the pulse time $t_{Volt.contr.\ pulse\ x}$ to be calculated to the fundamental value $T_{[P2432]}$ is equated with the ration of the measured voltage difference ΔU[%] to the maximum voltage difference (ΔU_n[%] = 100% Un).

$$t_{Volt.contr.\ pulse\ x}[s] \,/\, T_{[P2432]}[s] = \Delta U[V] \,/\, \Delta U_n[V]$$

= $\Delta U[\%] / 100\%$

The formula for the calculated pulse time[s] is therefore as follows:

=> $t_{Volt.contr.\ pulse\ x}[s] = T_{[P2432]}[s] \times \Delta U[\%] / 100\%$

= Voltage controller max pulse time [P2432] x $\Delta U[\%]$ / 100%

<u>**Example:** Parameter Voltage controller pulse time [P2432] = 10 s (typical set value)</u>

Determination of the control direction:

$\Delta U[V] > 0$

If the voltage difference ΔU is positive ($U_{PT1} < U_{PT2}$), the voltage boost event Voltage higher event [E2022] is activated for the duration of the calculated pulse time.

$\Delta U[V] < 0$

If the voltage difference ΔU is negative ($U_{PT1} > U_{PT2}$), the voltage boost event Voltage lower event [E2023] is 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* [P0641], will result in the calculated pulse time of: $t_{Volt.contr.\ pulse\ x}[s] = 10$ 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* [P0641], will result in the calculated pulse time of: $t_{Volt.contr.\ pulse\ x}[s] = 0.1$ s.

Note:	*An activated control event will only become 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.*

2.1.5 ANSI 27 – Undervoltage Protection

ANSI 27 – Protection parameters [P] and events [E] of SET 1

Main Menu\ Parameters\PROTECTION\

ANSI 27

SET 1	SET 2	SET 3	SET 4

P/E No.	System Description	Value	Unit	(Setting range)
SET PARAMETERS				
P1050	Undervoltage protection	OFF	-	ON/OFF
P1051	Blocking protection module	0	event	0 … 9999
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	%	1 … 200,0
P1061	Delay time	0.5	s	0 … 999999,999
P1062	Reset limit	97	%	1 … 200,0
P1063	Reset delay time trip	0	s	0 … 999999,999
P1064	Reset delay time pick-up	0	s	0 … 999999,999
P1065	Activate start condition	0	event	0 … 9999
P1066	Voltage reference	L-L	-	L-L/L-N
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
…	…	…	…	…

Parameter description:

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

> *Note:* *Each of the four parameter sets will always provide the same group of protection parameters. The parameter descriptions of the SET PARAMETERS and the parameters of STEP 1 represented below are described in detail in the following 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. The SET PARAMETERS apply to all the 12 protection STEP of one parameter SET.

P1050 Undervoltage protection

This parameter enables/disables undervoltage protection where:

OFF: disables or

ON: enables the protective function.

> *Note:* *When no voltage measurement is possible, caused by locating the PTs below the circuit breaker, and which is open, 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 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 activated. If the blocking event becomes inactive, blocking is abandoned and protective function is effective again. Event [E1050] is then deactivated automatically.

If blocking of the undervoltage protection is not required, set this parameter to **0**.

Protection parameters of STEP 1

The following STEP parameters of the undervoltage protection exist only once in each of the 12 independent protection STEPS. The STEP PARAMETERS apply only to one of the 12 protection STEPS of one parameter SET.

P1056 Pick-up source

Depending on the P60 Agile 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 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 activated. If the blocking event becomes inactive, blocking is abandoned and protective function is effective again. Event [E1055] is then 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 should be set as a percentage of the nominal value of the characteristic quantity (phase-to-phase voltage). The nominal value of the characteristic quantity should be set by parameter: Voltage (L-L) [P603], for primary side W1*
>
> *The referring parameter Voltage (L-L) [P603] is 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 will 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 [P1066]. 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.*
>
> *The parameter Voltage (L-L) [P603] is located in submenu: SYSTEM\Nominals**Reference values**.*
>
> *When the calculation of the pick-up value refers to the phase-to-neutral voltage, parameter Voltage reference [P1066] should be set to L-N, so that factor √3 is not necessary to be considered for calculation.*

P1066 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.

P1061 Delay time

Trip delay time; this 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 runs down, trip event [E1059] will be activated. This event can be used for alarm or output control purposes.

When 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 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.

P1064 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 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 should 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 [P1066]. 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*
>
> *The parameter Voltage (L-L) [P603] is located in submenu:*
> *SYSTEM \Nominals **Reference values**.*
>
> *When the calculation of the pick-up value refers to the phase-to-neutral voltage, parameter Voltage reference [P1066] should be set to L-N, so that factor √3 is not necessary to be considered for calculation.*

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 deactivated. When 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.

Generator start phase

During generator start phase undervoltage protection can be blocked if the voltage and/or frequency values falls below the set values of parameters *Min start voltage* [P1058] and/or *Min start frequency* [P1059]. For this, the corresponding event to the external generator start phase signal is to be assigned to parameter *Activate start condition* [P1065].

> *Note:* *Parameters Min start voltage [P1058] and Min start frequency [P1059] are only effective in case that the activation event which is assigned to parameter Activate start condition [P1065] is activated.*

P1065 Activate start condition

Blocking criteria ([P1058] and P1059] of first step of undervoltage protection can be activated by any active event. For activation, the number related to this activation event has to be assigned to parameter [P1065]. Activation is only effective, however, as long as the activation event is active. If the activation event becomes inactive, activation is abandoned and blocking criteria (see [P1058] and P1059] are ineffective again.

If activation of the blocking criteria (parameters [P1058] and/or [P1059]) during generator start phase is not required, set parameter *Activate start condition* [P1065] to “**0**”.

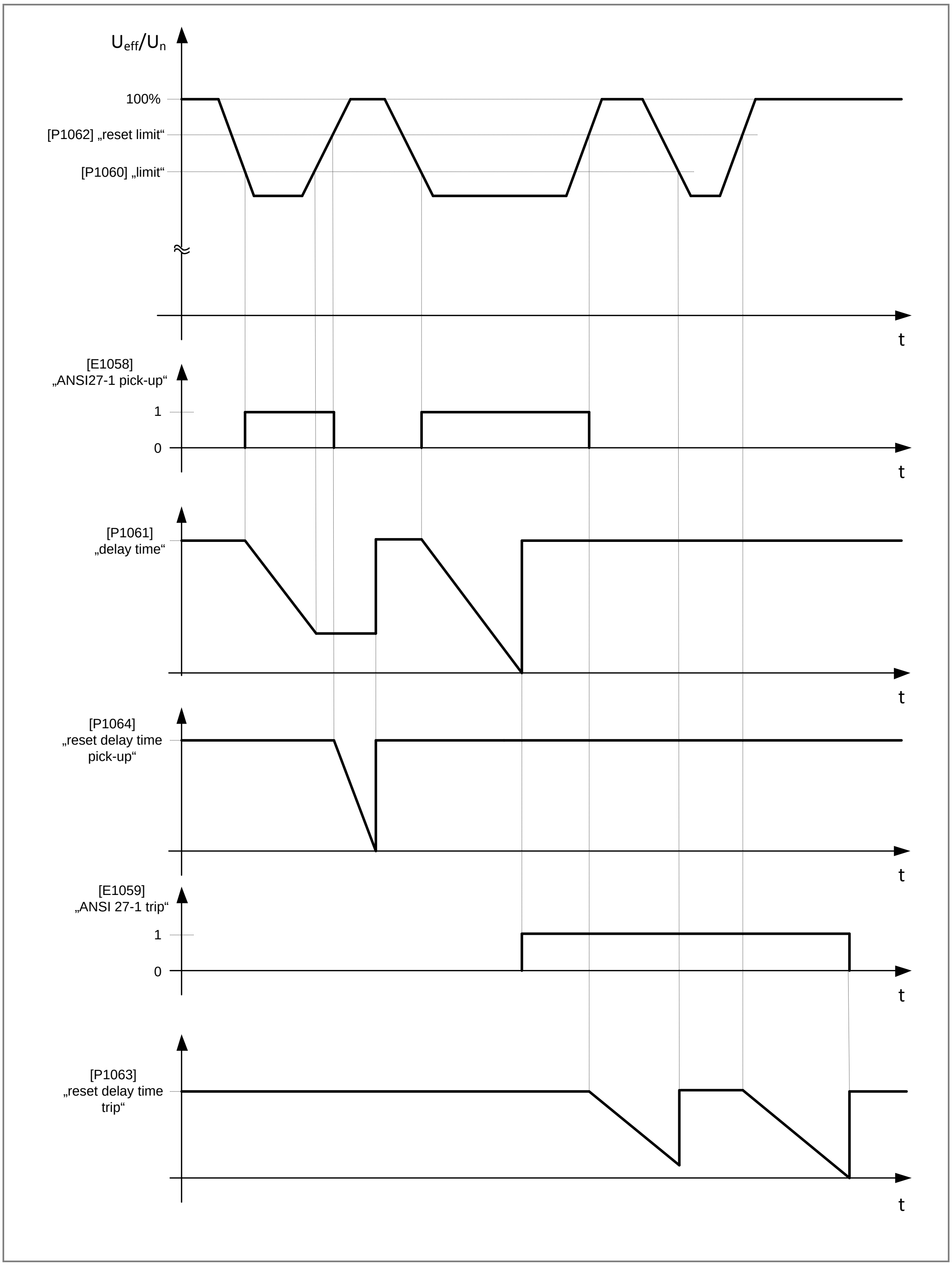


Figure 18 Undervoltage – tripping and reset characteristic

2.1.6 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 an inductive, reactive power flow in the direction towards the generating unit are detected at the network connection point simultaneously, then 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.

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.

This U<& Q> protection is an upstream system protection. This U<& Q> protection function is implemented in the P60 Agile devices as an autonomous protection element according to the above mentioned BDEW (German) regulations.

ANSI 27Q – Protection parameters [P] and events [E] of SET 1

Main Menu\ Parameters\PROTECTION\				
ANSI 27Q				
SET 1	SET 2	SET 3	SET 4	
P/E No.	System Description	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				
P1616	Function	OFF	-	ON/OFF
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	-	-	-

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

Note: *Each of the four parameter sets provides only one protection STEP and consequently, only one group of parameters. SET PARAMETERS are therefore equal to STEP parameters. The protection parameters of SET 1 represented below are described in detail in the following examples.*

Protection parameters of parameter of SET 1 – ANSI 27Q

P1580 QU- protection

This parameter enables/disables undervoltage-/reactive power protection where:

OFF: disables or

ON: enables the protective function.

Note: *When 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 events 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 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 activated. If the blocking event becomes inactive, blocking is abandoned and protective function is effective again. Event [E1406] is then 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 P60 Agile 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).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: This option is not supported in P16x devices

> *Note:* *The assignment of the voltage measurement input (PT1, PT2 or PT3) to the current measurement input CT1 is to be done by the following parameters (referring to the setting options of parameter [P1582]), in the submenu SYSTEM\Measuring\Power:*
> *-PT reference [P9410], for Power_CT1*
>
> *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*

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 operates from the 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.

- LRAS: 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)

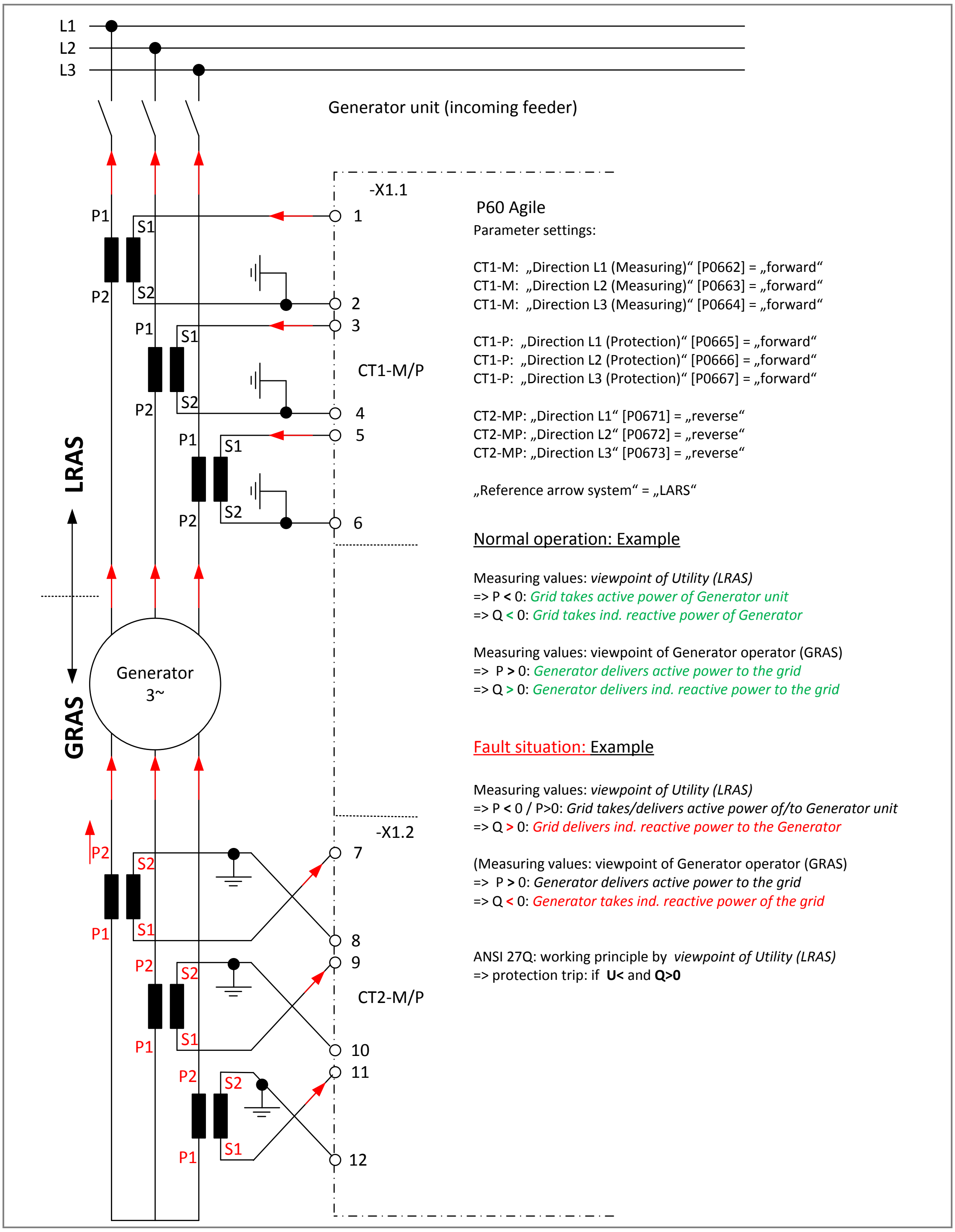


Figure 19 ANSI 27Q – Connection example and definition of load flow direction

Parameters for mains decoupling (PICK-UP)

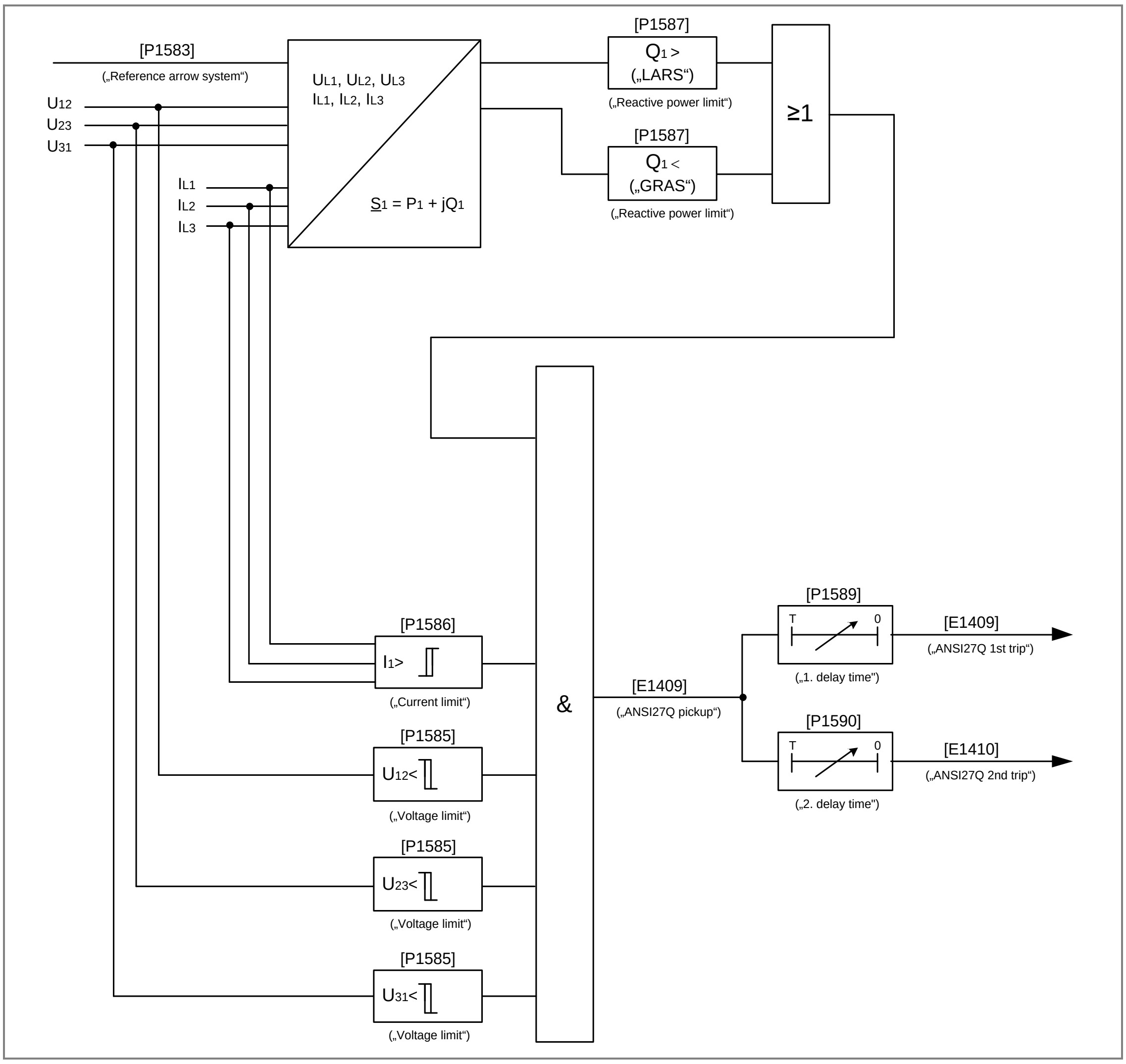


Figure 20 ANSI 27Q – Working principle of Undervoltage-/Reactive power protection

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 activated, and the counters of 1st delay time and 2nd delay time are started. As soon as one of the above mentioned conditions becomes false, pick-up event *ANSI27Q pickup* [E1408] will be deactivated.

> *Note:* *The voltage limit should be set as a percentage of the nominal value of the characteristic quantity (phase-to-phase voltage). The nominal value of the characteristic quantity should be set by parameter: Voltage (L-L) [P0603], for primary side W1*
>
> *The referring parameters Voltage (L-L) [P603] is 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]

pick-up event *ANSI27Q pickup* [E1408] is then activated, and the counters of *1st delay time* and *2nd delay time* are started. As soon as one of the above mentioned conditions becomes false, pick-up event *ANSI27Q pickup* [E1408] will be deactivated.

> *Note:* *The current limit should be set as a percentage of the nominal value of the characteristic quantity (phase current). The nominal value of the characteristic quantity should be set by parameter: Current [P0604], for primary side W1*
>
> *The parameter Current [P604] is 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 activated, and the counters of *1st delay time* and *2nd delay time* are started. As soon as one of the above mentioned conditions becomes false, pick-up event *ANSI27Q pickup* [E1408] will be deactivated.

> *Note:* *The reactive power limit should 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 should be set by parameter: Power [P605], for primary side W1*

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

The parameter *Power* [P605] is located in submenu: SYSTEM\Nominals**Reference values**.

The parameter *Assignment* [P668] is located in submenu: SYSTEM\Nominals**Current transformer**.

P1589 1. delay time

First trip delay time; 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; 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, the delay time for resetting the trip event *ANSI27 1st trip* [E1409]. As soon as the pick-up event *ANSI27Q pickup* [E1408] is 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 deactivated.

When 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, the delay time for resetting the trip event *ANSI27 2nd trip* [E1410]. As soon as the pick-up event *ANSI27Q pickup* [E1408] is 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 deactivated.

When 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)

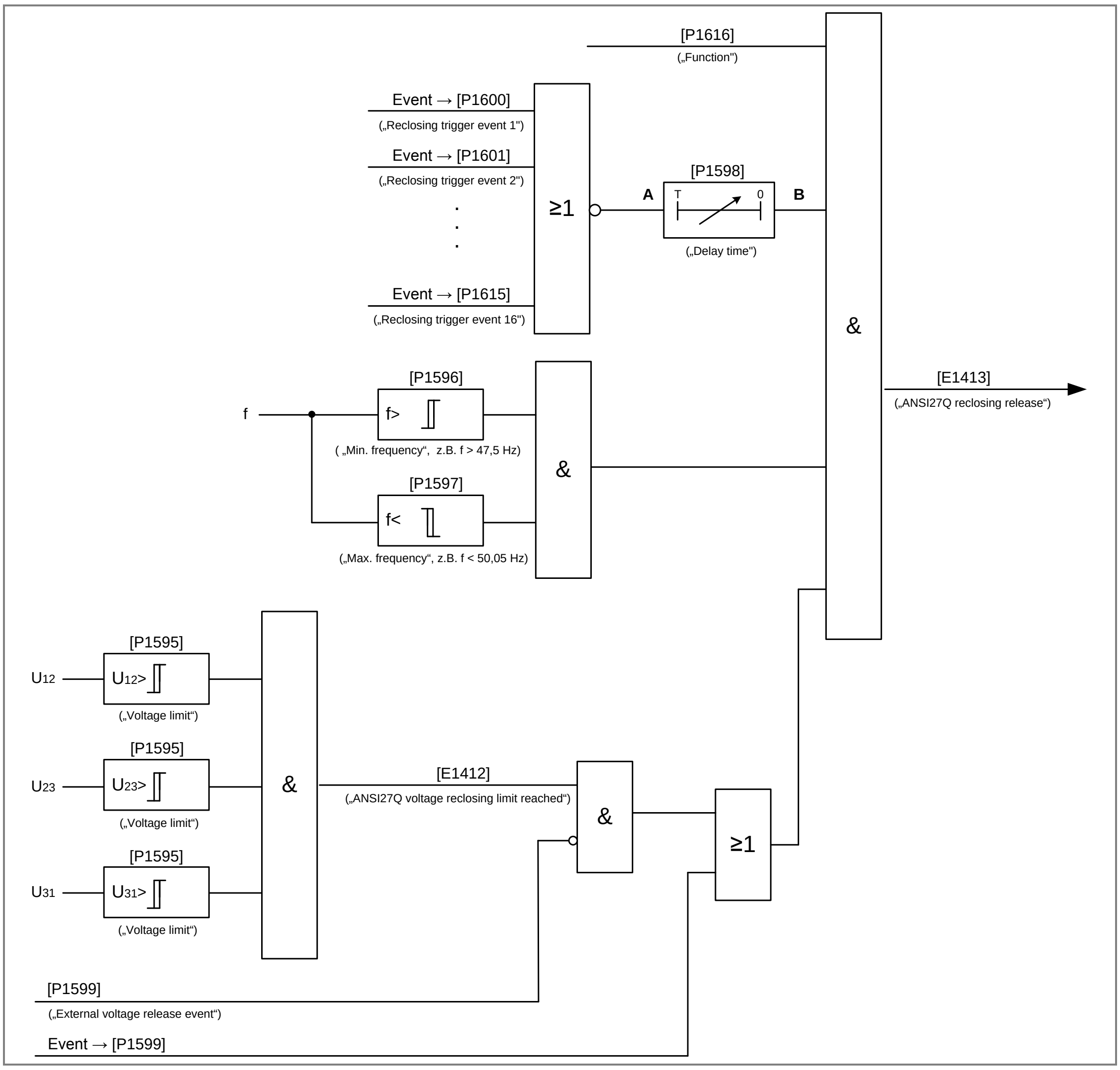


Figure 21 ANSI 27Q – Working principle of reclosing block diagram

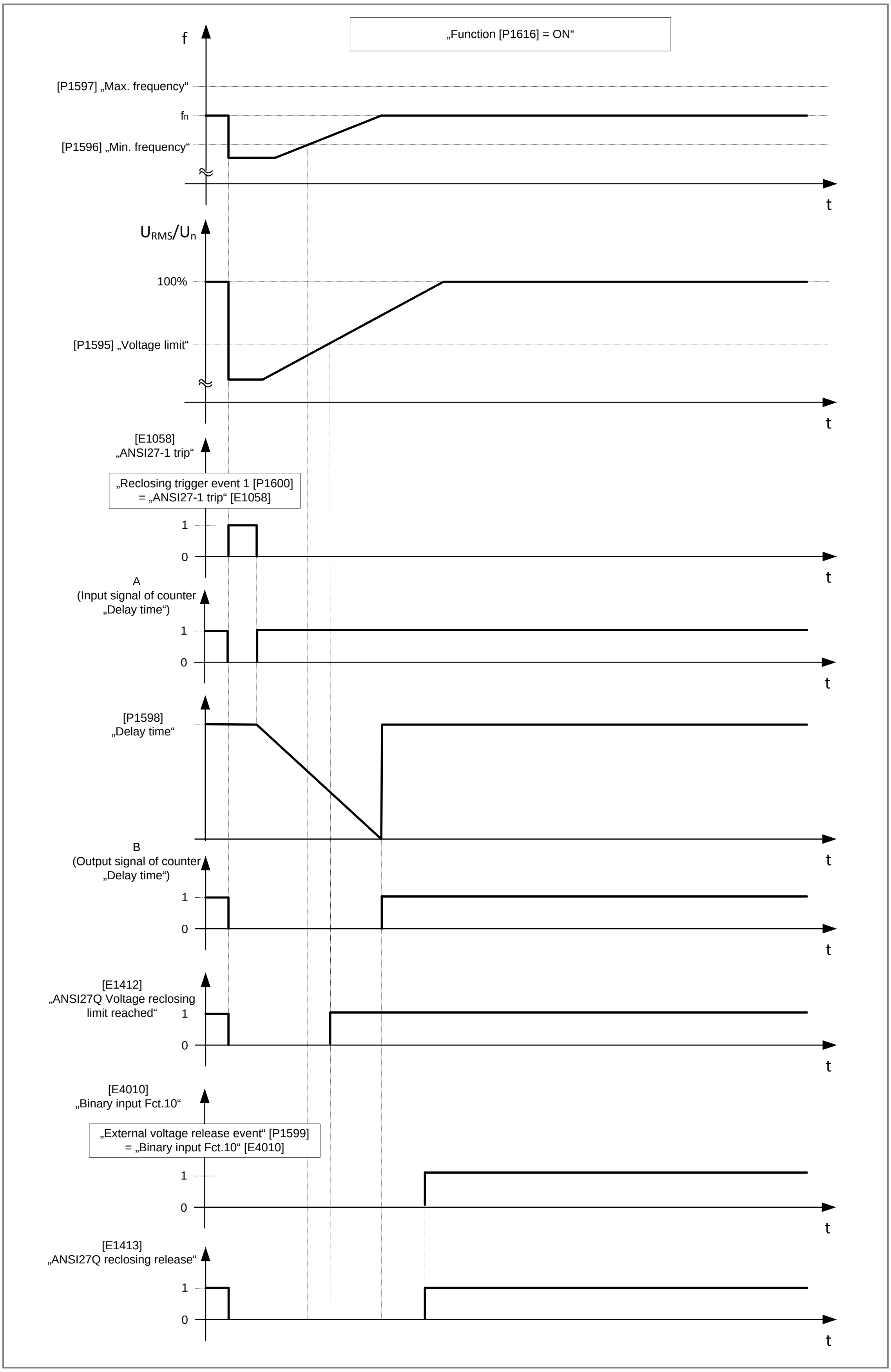


Figure 22 ANSI 27Q –Working principle of reclosing: function/time diagram

P1616 Function

This parameter enables/disables reclosing function of “ANSI 27Q – Undervoltage-/Reactive power protection” where:

- OFF: disables the reclosing function or
- ON: enables the reclosing function.

Note:	*Disabling of reclosing function can be used for testing purposes of the protection function.*

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 P60 Agile is located at the network connection point. No external enable signal is necessary, since it is generated by the internal voltage monitoring function of P60 Agile. Criterion voltage supervision via parameter Voltage limit [P1595] for reclosing release is only valid for parameter setting: External voltage release event [P1599] = 0.*
Note:	*The minimum limit of measuring voltage should be set as a percentage of the nominal value of the characteristic quantity (phase-to-phase voltage). The nominal value of the characteristic quantity should be set by parameter: Voltage (L-L) [P603], for primary side*
	*The referring parameters Voltage (L-L) [P603] is located in submenu: SYSTEM\Nominals**Reference values**.*

P1596 Min. frequency

Minimum frequency value; it is needed to generate the reclosing release signal. Parameter [P1596] should be set as an absolute value.

P1597 Max. frequency

Maximum frequency value; it allows the generation of the reclosing release signal. Parameter [P1597] should 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 trip events assigned to parameters [P1600] to [P1615] are deactivated, then the time counter of the reclosing delay time (delay time) is 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 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 P60 Agile uses an external enable signal for reclosing purposes, then the event number (e.g. of a binary input; When the signal is connected to a binary input) it will have to be assigned to parameter *External voltage release event* [E1599].
Criterion External voltage release event for reclosing release is only valid for parameter setting: External voltage release event [P1599] ≠ 0.

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 deactivated.

> *Note: P60 Agile can 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]

2.1.7 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, power plants being operated in parallel to operator's medium-voltage grids must meet certain requirements of grid support.

As far as protection devices are concerned power plants should in case of voltage drop, contribute to grid support and therefore not be disconnected from the grid. Conventional under voltage protection can therefore not necessarily be used.

The time-dependent undervoltage relay ANSI 27T as used in the P60 Agile fully meets the abovementioned requirement. The trigger characteristic can be freely defined by parameterising 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, there are two situations:

- 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 reach the set value, the characteristic curve will not be reset and the subsequent voltage drop triggers a protection depending on the characteristic curve.

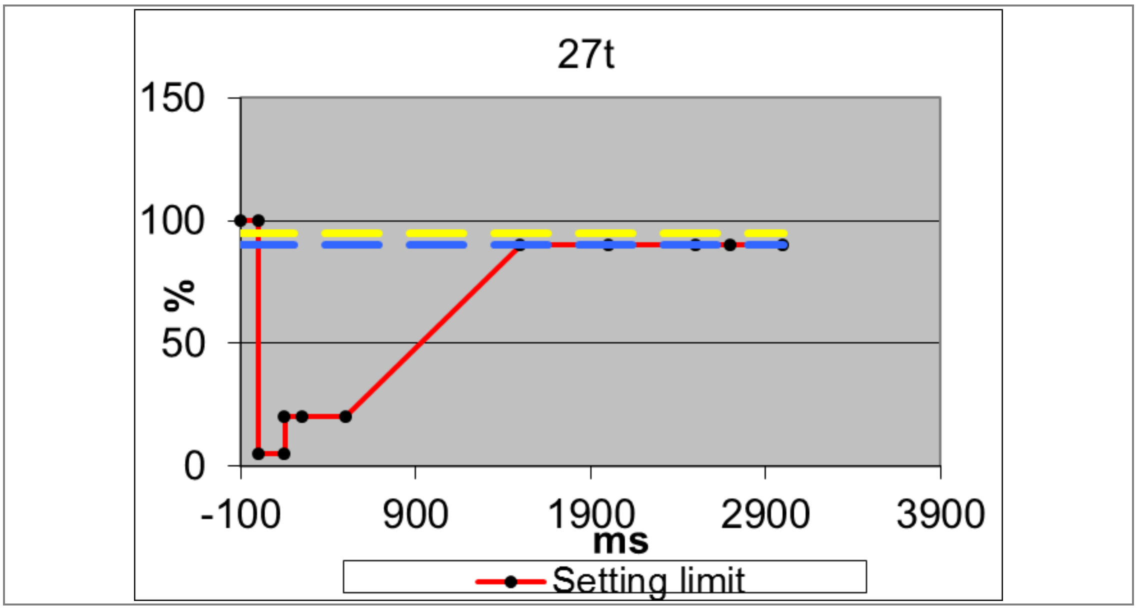


Figure 23 ANSI 27T – Configurable trip curve

ANSI 27T – Protection parameters [P] and events [E] of SET 1

Main Menu\ Parameters\PROTECTION\				
ANSI 27T				
SET 1	SET 2	SET 3	SET 4	
P/E No.	System Description	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	-	-	-
		-	-	-

Parameter description:

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

> *Note:* *Each of the four parameter sets provides only one protection STEP and only one group of parameters. SET PARAMETERS are equal to STEP parameters. The protection parameters of SET 1 represented below are described in detail in the following examples.*

Protection parameters of parameter of SET 1 – ANSI 27T

P1475 Time dep. Undervoltage protection

This parameter enables/disables time-dependent undervoltage protection where:

OFF: disables or

ON: enables the protective function.

> *Note:* *When 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 a blocking event has to be assigned to parameter [P1476].*

When time-dependent undervoltage protection ANSI 27T is enabled by parameter [P1475], then event *ANSI27T module active* [E1350] is 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 as long as the blocking event is active. As soon as blocking is active, event *ANSI27T module active* [E1351] is activated. If the blocking event becomes inactive, blocking is abandoned and protective function is effective again. Event [E1351] is then 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 P60 Agile 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] (recognised 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 started, and the pick-up event counter (voltage drops counter) is incremented.

> *Note: The pick-up value for voltage drop should be set as a percentage of the nominal value of the characteristic quantity (phase-to-phase voltage). The nominal value of the characteristic quantity should be set by parameter: Voltage (L-L) [P0603], for primary side W1*
>
> *The parameter Voltage (L-L) [P603] is 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 activated, so too does either:

- event ANSI27T trip by voltage drop count [E1356] or
- event ANSI27T trip by voltage underrun [E1357].

The Time slot for voltage drops count is also reset. When 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 should be set as a percentage of the nominal value of the characteristic quantity (phase-to-phase voltage). The nominal value of the characteristic quantity should be set by parameter: Voltage (L-L) [P603], for primary side W1*
>
> *The parameter Voltage (L-L) [P603] is 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 deactivated. So too is a possible active trip-event *ANSI27T trip* [E1355].

According to 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 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

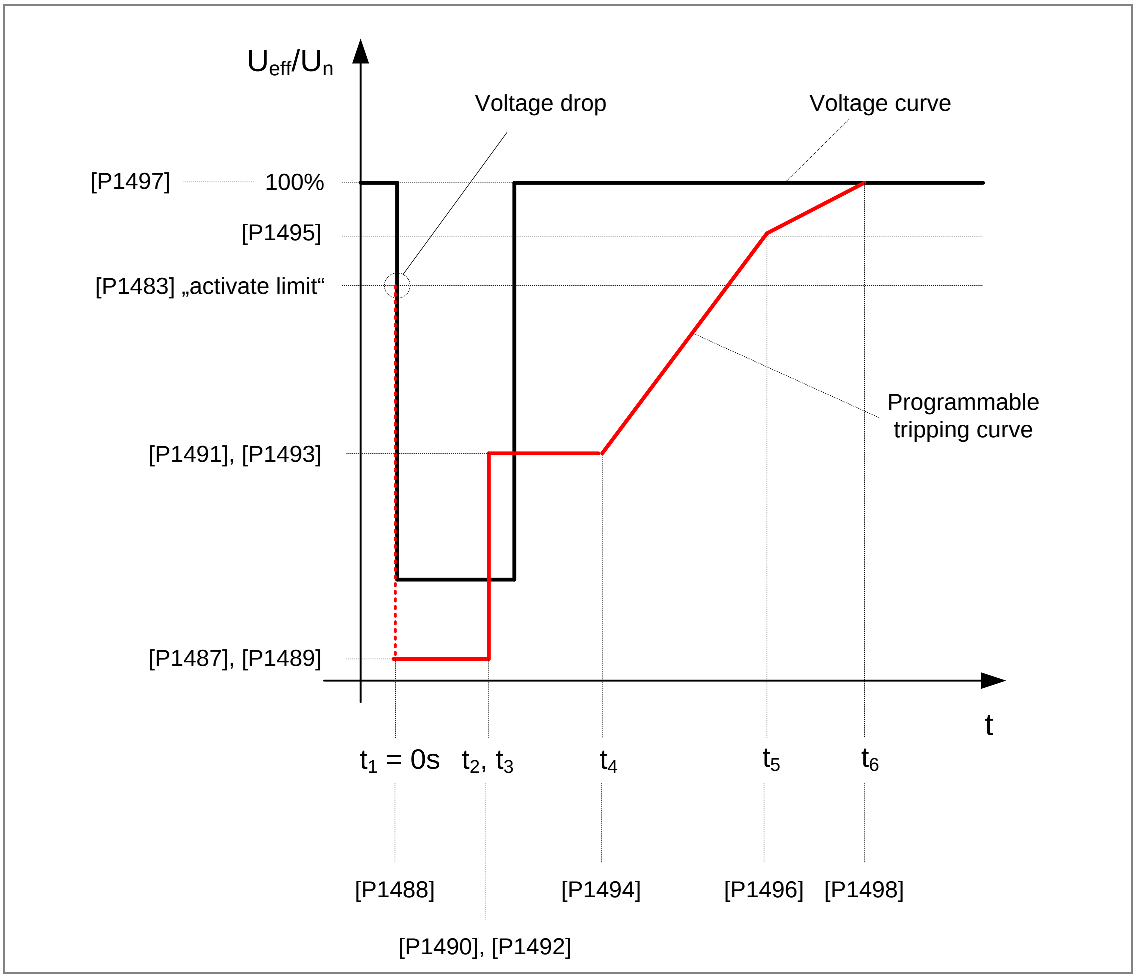


Figure 24 ANSI 27T – programmable tripping curve

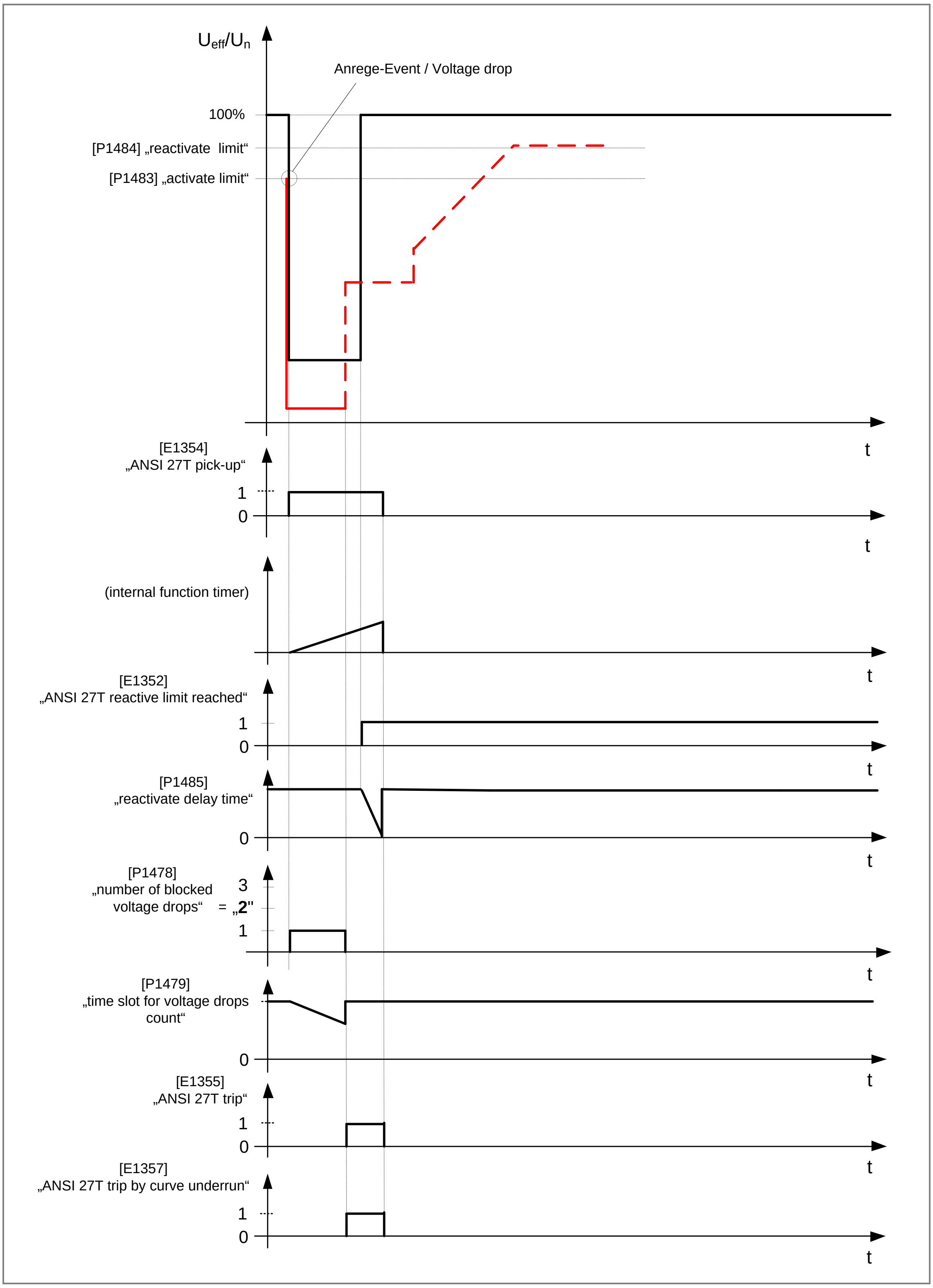


Figure 25 Time-dependent protection trip

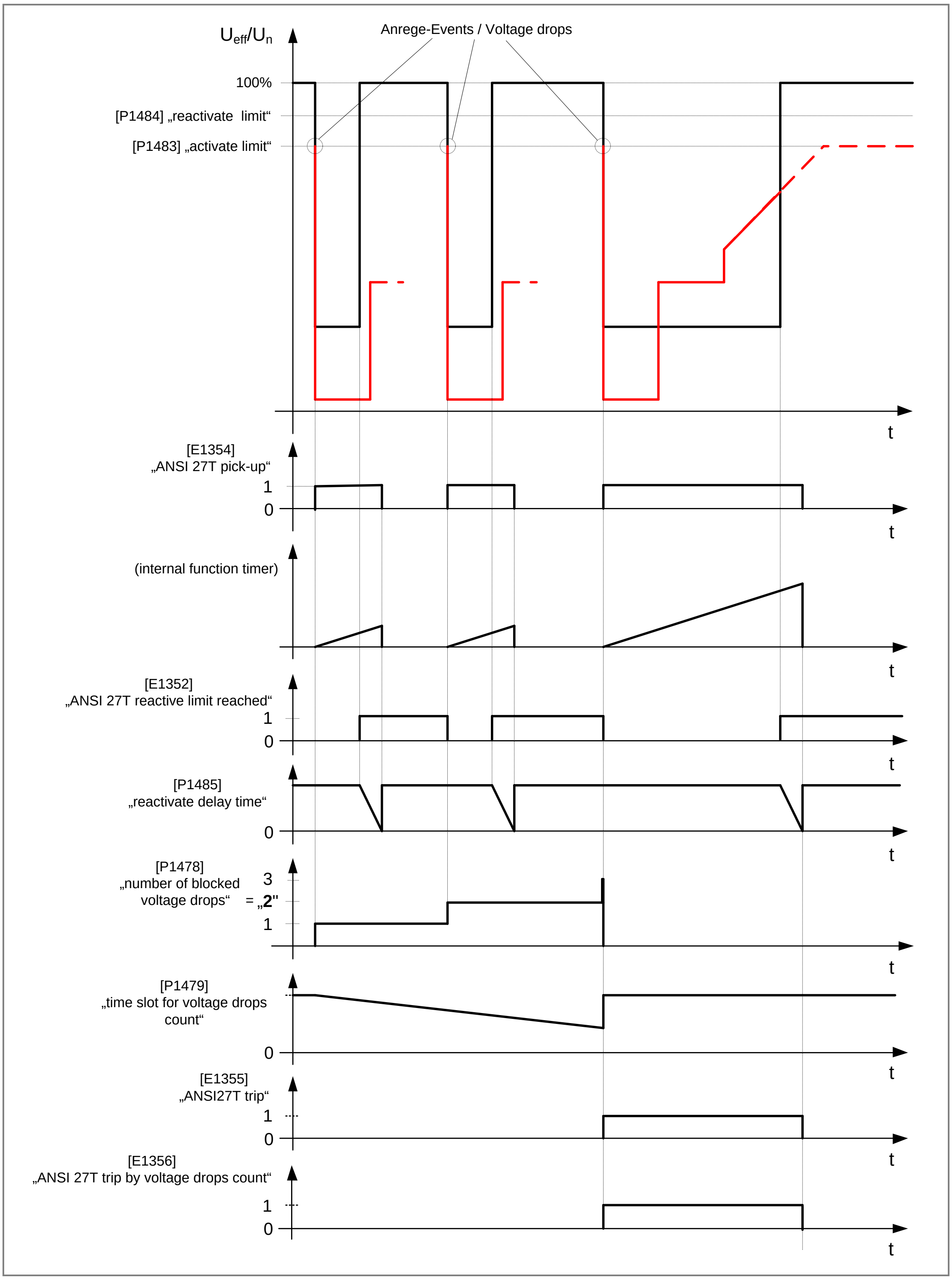


Figure 26 Time-dependent protection trip

2.1.8 ANSI 32 – Directional Power Protection

ANSI 32 – Protection parameters [P] and events [E] of SET 1

Main Menu\ Parameters\PROTECTION\				
		ANSI 32		
SET 1	SET 2	SET 3	SET 4	
P/E No.	System Description	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*
…	…	…	…	…

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. The parameter descriptions of the SET PARAMETERS and the parameters of STEP 1 represented below are described in detail in the following 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. The SET PARAMETERS therefore apply to all of the 6 protection STEPS of one parameter SET.

P2240 Power protection

This parameter enables/disables directional power protection where:

- 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 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 as long as the blocking event is active. As soon as blocking is active, event *ANSI32 blocked module* [E1806] is activated. If the blocking event becomes inactive, blocking is abandoned and protective function is effective again. Event [E1806] is then 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. The STEP PARAMETERS apply only to one of the 6 protection STEPS of one parameter SET.

P2245 Pick-up source

Depending on the P60 Agile 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: This option is not supported in P16x devices

Note: The assignment of the voltage measurement input (PT1, PT2 or PT3) to the current measurement input CT1 is to be done by the parameter (referring to the setting options of parameter [P1582]), in the submenu SYSTEM\Measuring\Power:
PT reference [P9410], for Power_CT1.

To measure power direction correctly, the needed energy flow direction is to be defined by parameter: Direction [P9411], for Power_CT1.

For setting Power_CT1, event ANSI32-1 step active [E1807] is 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 as long as the blocking event is active. As soon as blocking is active, event *ANSI32-1 blocked step* [E1808] is activated. If the blocking event becomes inactive, blocking is abandoned and protective function is effective again. Event [E1808] is then 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 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 figure represents the different setting options for the applied characteristic quantity as protective criterion.

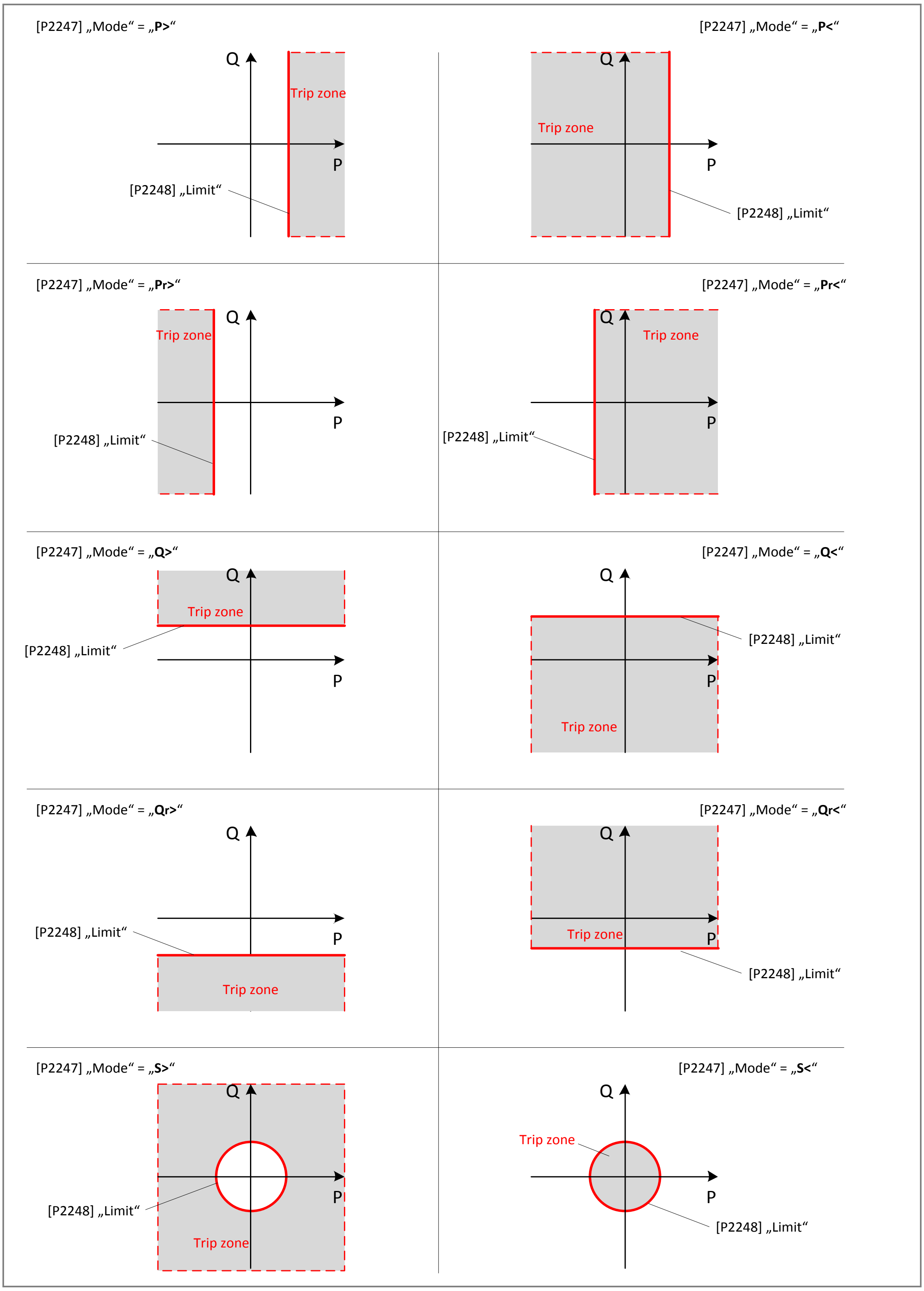


Figure 27 Directional power protection – Selection of protective criterion

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.

When 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 saved.

> *Note:* *The pick-up value should be set as a percentage of the nominal value of the measurement quantity Power (according to user's input either as active power, reactive power or apparent power). The nominal value of the characteristic quantity should be set by parameter: Power [P605], for primary side W1*
>
> *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*
>
> *The parameter Power [P605] is located in submenu: SYSTEM \Nominals **Reference values**. The parameter Assignment [P668] is 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.

When 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 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.

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 should be set as a percentage of the nominal value of the measurement quantity Power (according to user's input either as active power, reactive power or apparent power). The nominal value of the characteristic quantity should be set by parameter: Power [P605], for primary side W1.*
>
> *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.*
>
> *The parameter Power [P605] is located in submenu: SYSTEM \Nominals **Reference values**. The parameter Assignment [P668] is located in submenu: SYSTEM \Nominals \\ **Current transformer**.*

P2251 Reset delay time trip

Trip reset delay time; it is the delay time for resetting the trip event *ANSI32-1 trip* [E1810].

If the trip reset delay time (Reset delay time trip) has run down, trip event *ANSI32-1 trip* [E1809] is deactivated. When 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 *ANSI32-1 trip* [E1810] remains active.

P2252 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 reset.

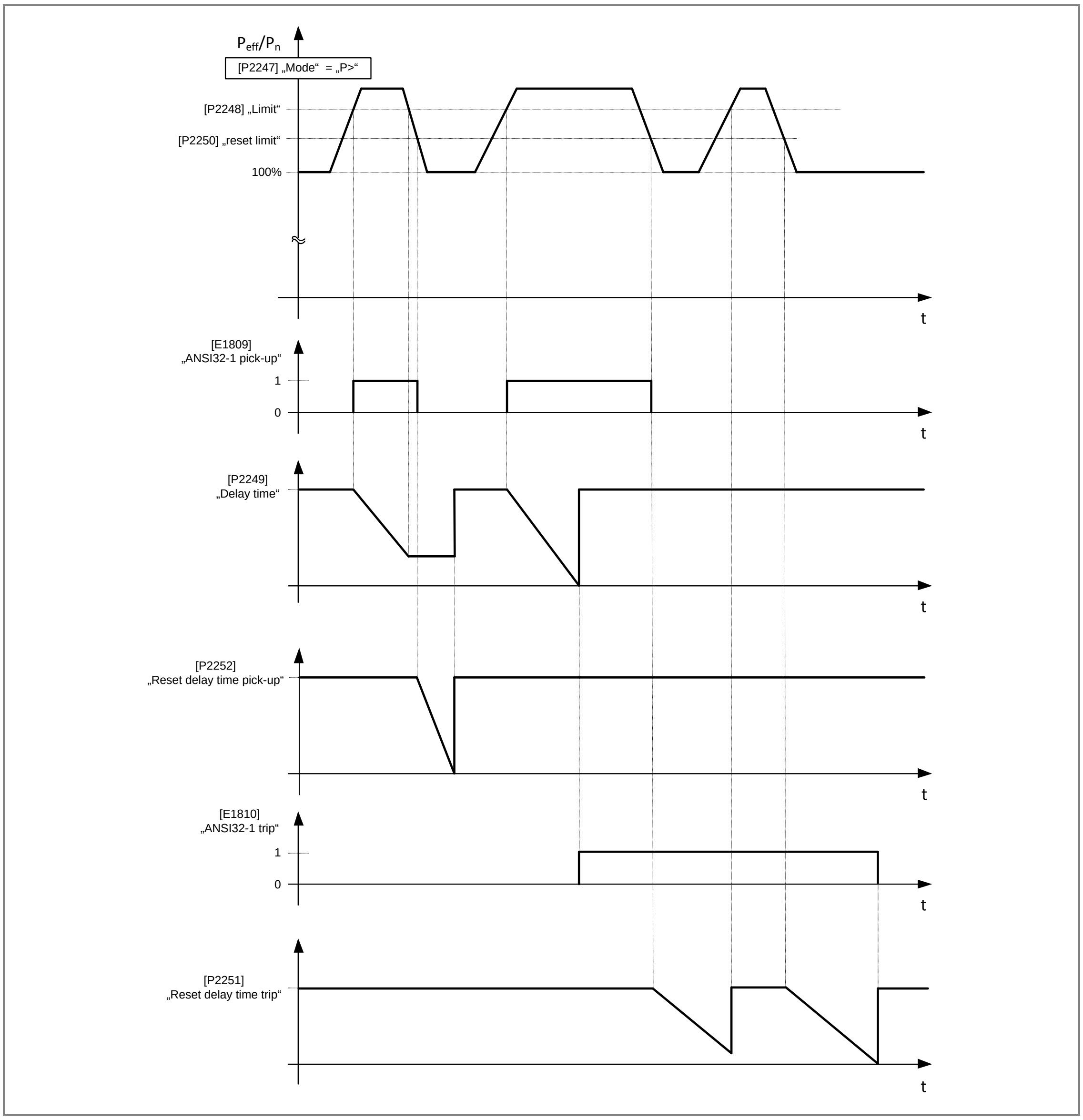


Figure 28 Directional power protection – tripping and reset characteristic: over-run of P>

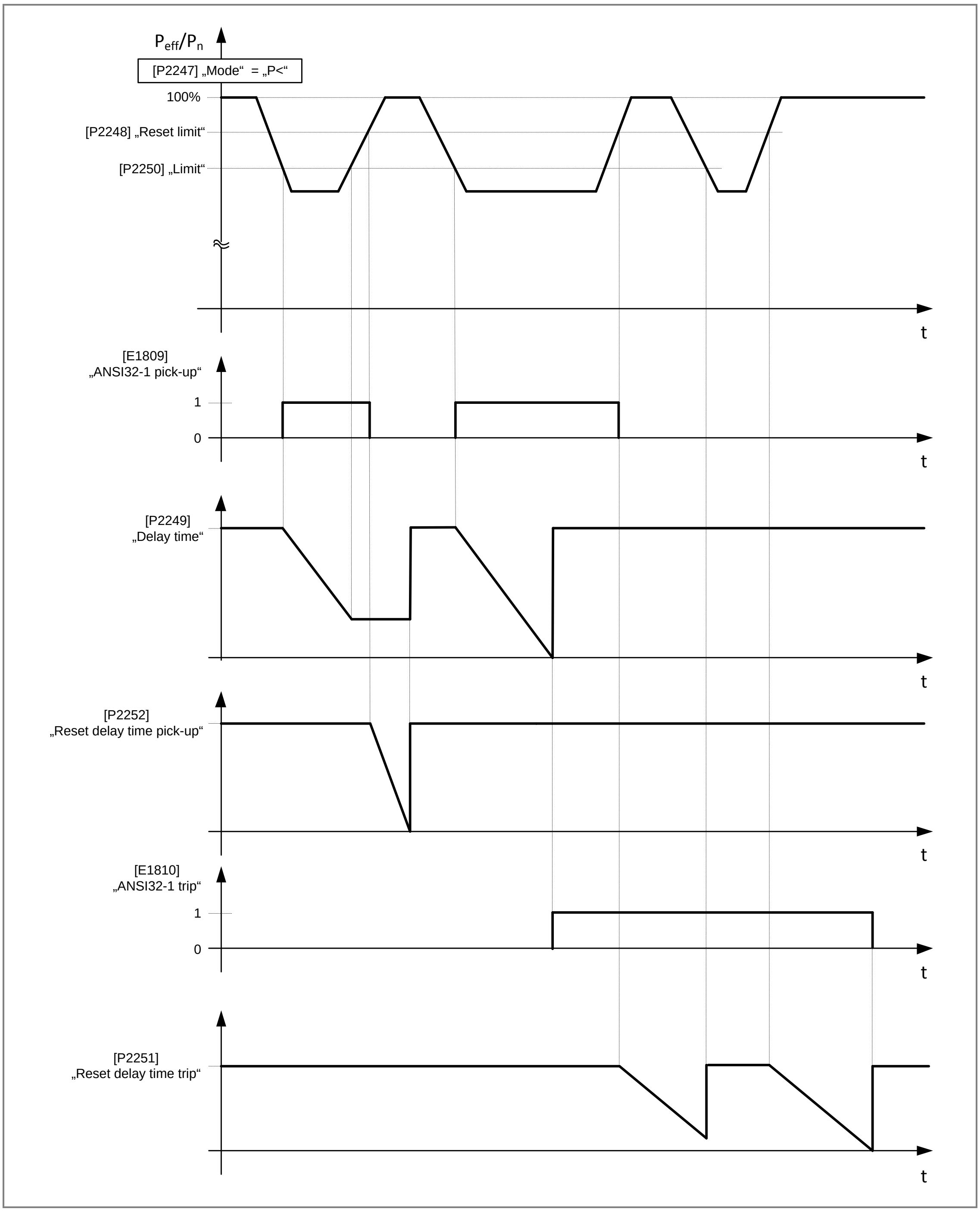


Figure 29 Directional power protection – tripping and reset characteristic: under-run of “P<”

2.1.9 ANSI 32N/G – Zero Power Protection

ANSI 32N/G – Protection parameters [P] and events [E] of SET 1

Main Menu\Parameter\Protection\

ANSI 32N/G

SET 1 | SET 2 | SET 3 | SET 4

P/E No.	System Description	Value	Unit	(Setting range)
SET PARAMETERS				
P2970	Zero power protection	ON	-	ON/OFF
P2971	Blocking protection module	0	event	0 … 9999
E2280	ANSI32N/G module active	-	-	-
E2281	ANSI32N/G blocked module	-	-	-
STEP 1				
P2975	Pickup source	GND_Power_CT1	-	none/GND_Power_CT1/ GND_Power_CT2*/GND_Power_CT-GND1
P2976	Blocking protection step	0	event	0 … 9999
P2977	Mode	$Q_0r>$	-	$S_0</S_0>/P_0</P_0>/Q_0</Q_0>/P_0r</P_0r>/Q_0r</Q_0r>$
P2978	Limit	30	%	0 … 65535,0
P2979	Delay time	0.5	s/-	0 … 999999,999
P2980	Reset limit	27	%	0 … 65535,0
P2981	Reset delay time trip	1	s/-	0 … 999999,999
P2982	Reset delay time pickup	1	s	0 … 999999,999
E2282	ANSI32N/G-1 step active	-	-	-
E2283	ANSI32N/G-1 blocked step	-	-	-
E2284	ANSI32N/G-1 pickup	-	-	-
E2285	ANSI32N/G-1 trip	-	-	-
STEP 2				
P2985	Pickup source	GND_Power_CT1	-	none/GND_Power_CT1/ GND_Power_CT2*/GND_Power_CT-GND1
…	…	…	…	…

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. The parameter descriptions of the SET PARAMETERS and the parameters of STEP 1 represented below are described in detail in the following examples.*

Protection parameters of parameter SET 1 – ANSI 32N/G

SET PARAMETERS

The following SET PARAMETERS of the overcurrent protection exist only once in each of the four parameter sets. The SET PARAMETERS apply to all of the 6 protection STEPS of one parameter SET.

P2970 Zero power protection

This parameter enables/disables zero power protection where in:

- OFF: disables or
- ON: enables the protective function.

When zero power protection ANSI 32N/G is enabled by parameter [P2970], then event *ANSI32N/G module active* [E2280] is being activated.

P2971 Blocking protection module

Zero 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 [P2971]. Blocking is only effective, however, as long as the blocking event is active. As soon as blocking is active, event *ANSI32N/G blocked module* [E2281] is activated. If the blocking event becomes inactive, blocking is abandoned and protective function is effective again. Event [E2281] is then 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. The SET PARAMETERS apply only to one of the 6 protection STEPS of one parameter SET.

P2975 Pick-up source

Depending on the P60 Agile device variant every protection step of zero power protection can be assigned to a certain current measurement input (CT1, CT2 or CT-GND1). Parameter [P2975] therefore determines the zero current measurement input and its assigned residual voltage measurement input which will provide measurement values as characteristic quantities (zero current and phase angle between zero current and residual voltage as reference voltage) for the zero power protection:

- none: no current measurement; protection step is deactivated
- GND Power_CT1: zero power measurement by CT1 **and**

  determination of zero power direction by additional measured residual voltage $\underline{U}_0$ via the assigned voltage measurement input set by parameter *PT reference* [P9419].
- GND Power_CT2: This option is not supported in P16x devices
- GND Power CT-GND1: zero power measurement by CT-GND1 **and**

  determination of zero power direction by additionally measured residual voltage $\underline{U}_0$ 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 zero 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\Measuring**\Power:***
> *PT reference [P9419], for GND Power_CT1*
> *PT reference [P9428], for GND Power_CT-GND1*

To measure zero power direction correctly, the required energy flow direction is to be defined by following parameters:

- *Direction* [P9420], for GND Power_CT1 *and*

- *Direction* [P9429], for GND Power_CT-GND1.

For settings GND Power_CT1 or GND Power_CT-GND1, event ANSI32N/G-1 step active [E2282] is activated.

Note:	*In case that residual voltage is to be calculated from voltage measuring via PT1, PT2 or PT3 it is required to connect terminal N of P16x device (X1.2:18; X1.2:26) to ground potential!* *For test purposes via voltage generator, test equipment it is required to connect terminal N of P16x device to the "neutral" potential of the voltage test equipment!*

P2976 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 [P2976]. Blocking is only effective, however, as long as the blocking event is active. As soon as blocking is active, event *ANSI32N/G-1 blocked step* [E2283] is activated. If the blocking event becomes inactive, blocking is abandoned and protective function is effective again. Event [E2283] is then deactivated automatically.

If blocking of the first step of overcurrent protection is not required, set this parameter to **0**.

P2977 Mode

Selection of operating mode according to the protective criterion (characteristic quantity) of the zero power protection; the first step of zero power protection is optionally adjustable. The set value of parameter *Limit* [P2978] refers to the characteristic quantity of the set protective criterion of parameter *Mode* [P2977]. Following setting options of the characteristic quantity are available:

- P_0<: protective function detects an alarm in case of *zero active power "limit" under-run*
- P_0>: protective function detects an alarm in case of *zero active power "limit" over-run*
- *Q_0*<:*protective* function detects an alarm in case of *zero reactive power "limit" under-run*
- *Q_0*>:*protective* function detects an alarm in case of *zero reactive power "limit" over-run*
- *S_0*<: *protective* function detects an alarm in case of *zero apparent power "limit" under-run*
- *S_0*>: *protective* function detects an alarm in case of *zero apparent power "limit" over-run*
- P_0r<:protective function detects an alarm in case of zero active power "limit" under-run
- P_0r>:protective function detects an alarm in case of zero <u>reverse</u> active power "limit" over-run
- Q_0r<:protective function detects an alarm in case of zero reactive power "limit" under-run
- Q_0r>:protective function detects an alarm in case of zero <u>reverse</u> reactive power "limit" over-run

Note: Definition of zero reverse active power: $\boldsymbol{P_0 r = -P_0}$
Definition of zero reverse reactive power: $\boldsymbol{Q_0 r = -Q_0}$

The following graphic represents the various setting options for the applied characteristic quantity as protective criterion.

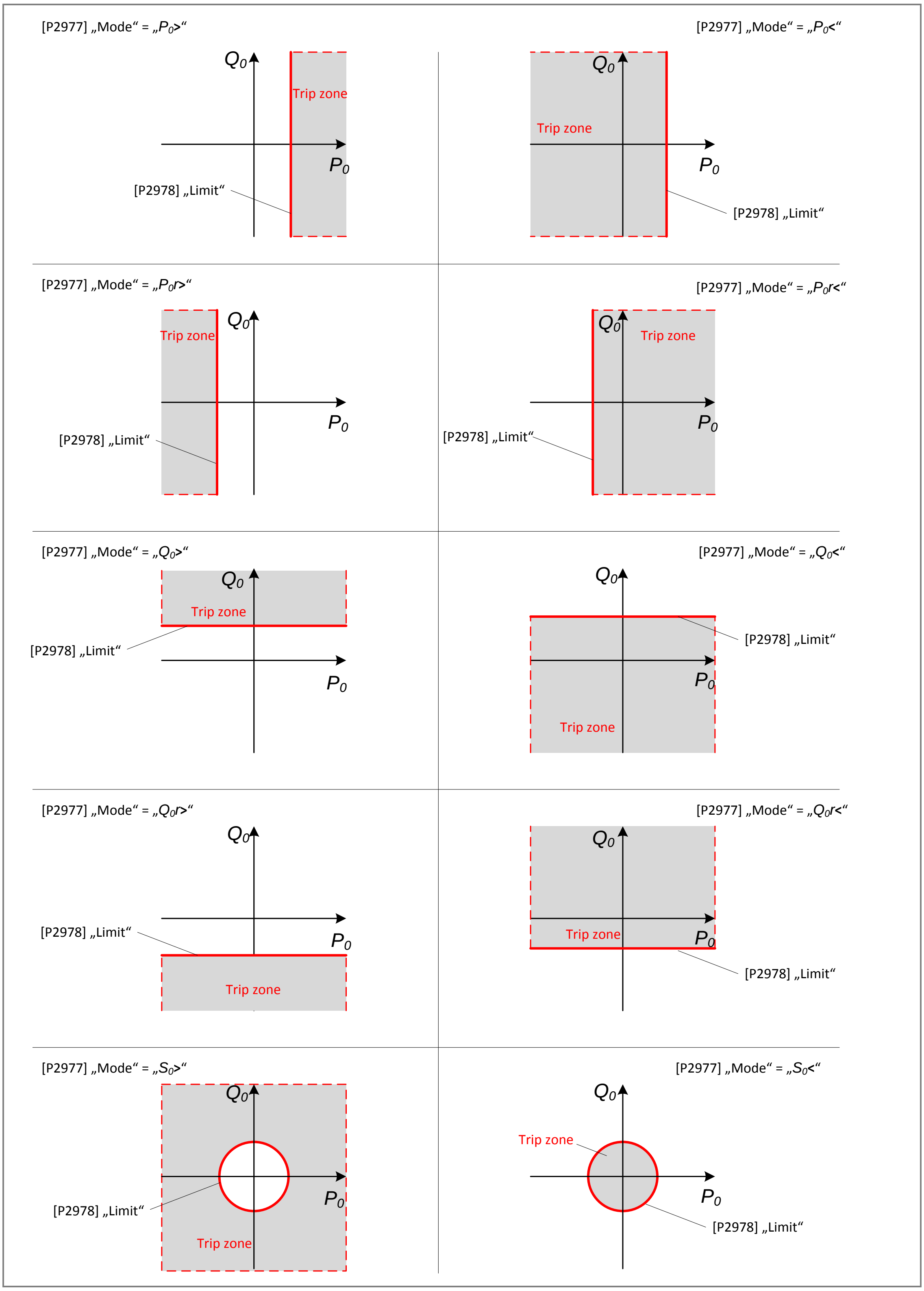


Figure 30 Zero power protection – selection of protective criterion

P2978 Limit

Pick-up value of the first zero power protection element (STEP1); at the moment that the characteristic quantity – depending on the set value of parameter *Mode* [P2977] – exceeds (or falls below) this limit, *ANSI32N/G-1 pick-up* [E2284] will become active, and Delay time of the first zero power protection element will start.

In case that the characteristic quantity falls below (or exceeds) the Limit of the first zero power protection element *before Delay time has* run down, the timer of Delay time will stop and the attained time value is saved.

> *Note: The pick-up value should be set as a percentage of the nominal value of the measurement quantity Power (according to user's input either as zero active power, zero reactive power or zero apparent power). The nominal value of the characteristic quantity is set by parameter: Power [P605], for primary side W1*
>
> *Here, it is that winding side relating to the zero power monitoring, which is assigned to the applied current measurement input by parameter:*
> *Assignment [P668], for current measurement input CT1 or*
> *Assignment [P684], for current measurement input CT-GND1.*
>
> *The referring parameters Power [P605] is located in submenu: SYSTEM\Nominals**Reference values**.*
> *The referring parameters Assignment [P668] and Assignment [P684] are located in submenu: SYSTEM\Nominals**Current transformer**.*

P2979 Delay time

Trip delay time is the delay time of the trip event *ANSI32N/G-1 trip* [E2285].

As soon as the pick-up event *ANSI32N/G-1 pickup* [E2284] is active and Delay time run down, trip event [E2285] is activated. This event can be used for alarm or output control purposes.

If the characteristic quantity – depending on the set value of parameter *Mode* [P2977] – exceeds (or falls below) the pick-up value (Limit) of the first zero 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 will be 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 [E2284] will be deactivated.

P2980 Reset limit

Reset limit of the first step of zero power protection. As soon as the trip event *ANSI32N/G-1 trip* [E2285] is active and the characteristic quantity – depending on the set value of parameter *Mode* [P2977] – 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 set as a percentage of the nominal value of the measurement quantity Power (according to user's input either as zero active power, zero reactive power or zero apparent power). The nominal value of the characteristic quantity is set by parameter: Power [P605], for primary side W1*
>
> *The winding side relating to the zero power monitoring is assigned to the applied current measurement input by parameter:*
> *Assignment [P668], for current measurement input CT1 or*
> *Assignment [P684], for current measurement input CT-GND1.*
>
> *The referring parameters Power [P605] is located in submenu: SYSTEM\Nominals**Reference values***
> *The referring parameters Assignment [P668] and Assignment [P684] are located in submenu: SYSTEM\Nominals\ **Current transformer**.*

P2981 Reset delay time trip

Trip reset delay time is the delay time for resetting the trip event *ANSI32N/G-1 trip* [E2285]. If the trip reset delay time (Reset delay time trip) has run down, trip event *ANSI32N/G-1 trip* [E2285] is deactivated. If the characteristic quantity – depending on the set value of parameter *Mode* [P2977] – falls below (or exceeds) the pick-up value (Limit) of the first zero 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 *ANSI32N/G-1 trip*[E2285] remains active.

P2982 Reset delay time pick-up

Pick-up reset delay time 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 reset.

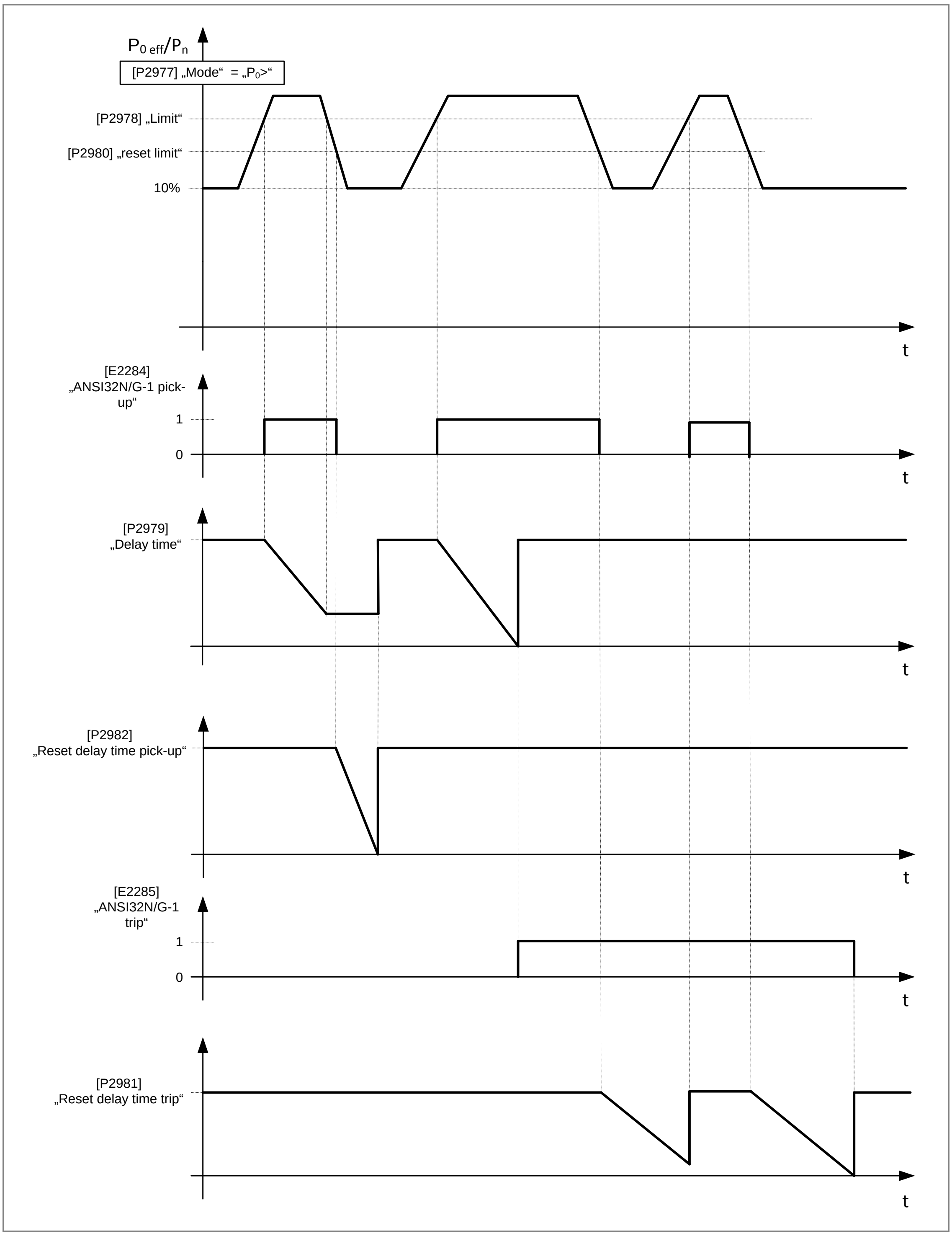


Figure 31 Zero power protection – tripping and reset characteristic: over-run of P0>

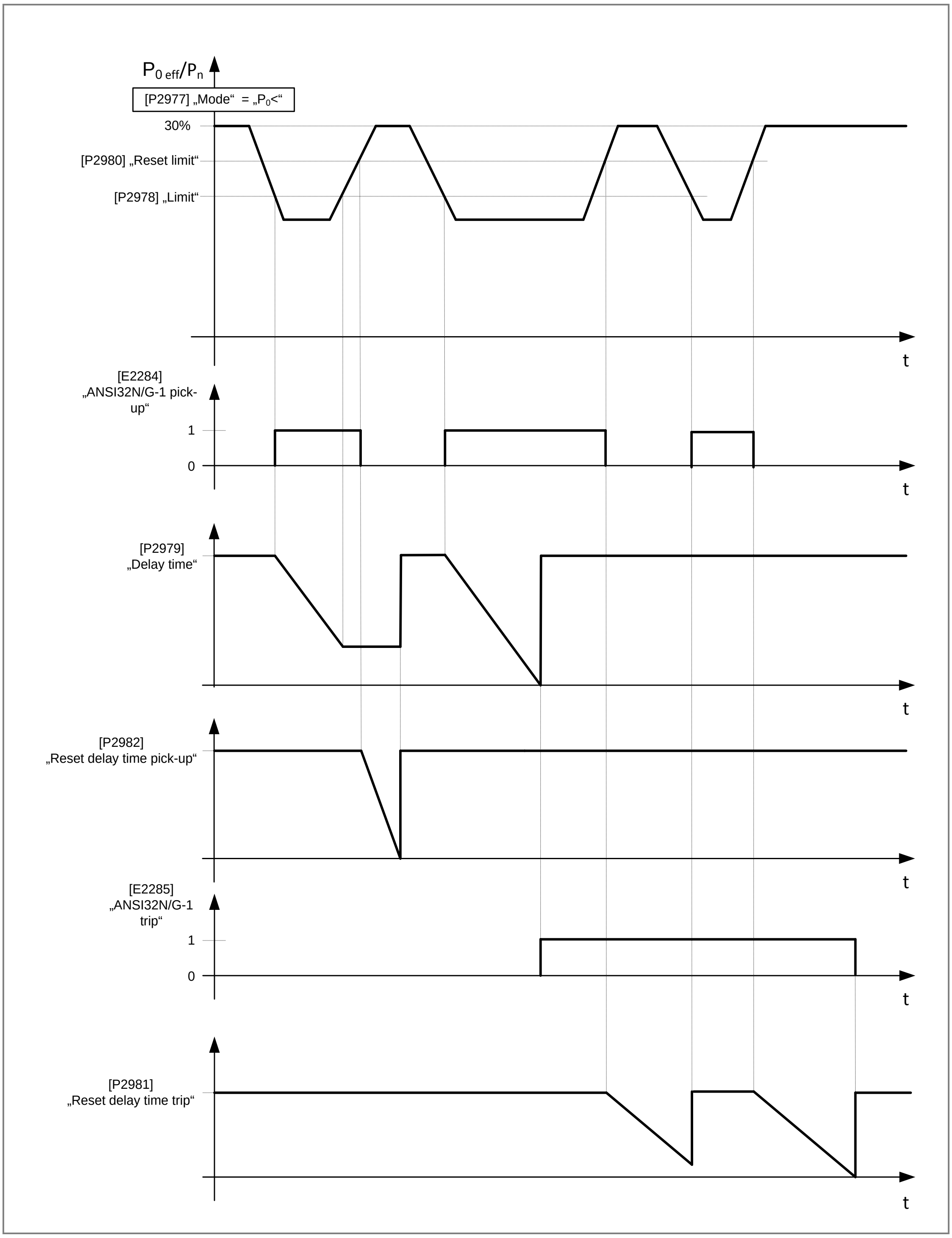


Figure 32 Zero power protection – tripping and reset characteristic: under-run of P0<

2.1.10 ANSI 37 – Undercurrent Protection

ANSI 37 – Protection parameters [P] and events [E]

Main Menu\Parameters\PROTECTION\				
ANSI 37 – Undercurrent				
SET 1	SET 2	SET 3	SET 4	
P/E No.	System Description	Value	Unit	(Setting range)
SET PARAMETERS				
P3559	Overcurrent protection	ON	-	ON/OFF
P3560	Blocking protection module	0	event	0 … 9999
E2457	ANSI37 module active	-	-	-
E2458	ANSI37 blocked module	-	-	-
STEP 1				
P3561	Pickup source	CT1	-	none/CT1/CT2
P3562	Blocking protection step	0	event	0 … 9999
P3563	Limit	300	%	0 … 1999,9
P3564	Delay time	1,0	s	0 … 999999,999
P3565	Reset limit	350	%	0 … 1999,9
P3566	Reset delay time trip	0	s	0 … 999999,999
P3567	Reset delay time pickup	0	s	0 … 999999,999
E2459	ANSI37-1 step active	-	-	-
E2460	ANSI37-1 blocked step	-	-	-
E2461	ANSI37-1 pickup	-	-	-
E2462	ANSI37-1 trip	-	-	-
STEP 2				
P3568	Pickup source	CT1	-	none/CT1/CT2
…	…	…	…	…

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.*

Standard protection parameters of parameter SET 1 – ANSI 37

SET PARAMETERS

The following SET PARAMETERS of the undercurrent 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.

P3559 Undercurrent protection

This parameter enables/disables undercurrent protection where:

- OFF: disables or
- ON: enables the protective function.

When undercurrent protection ANSI 37 is enabled by parameter [P3559], then event “ANSI37 module active” [E2457] is activated.

P3560 Blocking protection module

Undercurrent protection can be completely blocked by any active event. For blocking, the number related to this blocking event has to be assigned to parameter [P3560]. Blocking is only effective, however, as long as the blocking event is active. As soon as blocking is active, event “ANSI37 blocked module” [E2458] is activated. If the blocking event turns inactive, blocking is abandoned and protective function is effective again. Then, event [E2458] is deactivated automatically.

If blocking of the undercurrent protection is not required, set this parameter to “0”.

Standard protection parameters of STEP 1

The following STEP parameters of the undercurrent protection exist only once in each of the 3 independent protection STEPS. Thus, the STEP PARAMETERS apply only to one of the 3 protection STEPS of one parameter SET.

P3561 Pick-up source

Depending on the P16x device variant every protection step of undercurrent protection can be assigned to current measurement input (CT1). Parameter [P3561] 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 (Not applicable for P16x devices)

For setting “CT1”, event “ANSI37-1 step active“ [E2459] is activated.

P3562 Blocking protection step

The first step of undercurrent protection can be blocked by any active event. For blocking, the number related to this blocking event has to be assigned to parameter [P3562]. Blocking is only effective, however, as long as the blocking event is active. As soon as blocking is active, event “ANSI37-1 blocked step” [E2460] is activated. If the blocking event turns inactive, blocking is abandoned and protective function is effective again. Then, event [E2460] is deactivated automatically.

If blocking of the first step of undercurrent protection is not required, set this parameter to “0”.

P3563 Limit

Pick-up value of the first undercurrent protection element (STEP1); at the moment that the characteristic quantity (phase current) falls below this limit in one of the three phases, “ANSI37-1 pick-up“ [E2461] will become active, and “Delay time“ of the first undercurrent protection element will start.

In case that the characteristic quantity (phase current) exceeds “Limit” of the first undercurrent protection element in all three phases before “Delay time“ has run down, the timer of “Delay time“ 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*

*The parameters Current [P604] is located in submenu: SYSTEM\Nominals**Reference values**.*

P3564 Delay time

Trip delay time; it is the delay time (definite time “DT”) of the trip event “ANSI37-1 trip“ [E2462].

As soon as the pick-up event “ANSI37-1 pickup“ [E2461] is active and “Delay time” runs down, trip event [E2462] will be activated. This event can be used for alarm or output control purposes. When the characteristic quantity (voltage) exceeds the pick-up value (“Limit”) of the first undercurrent protection step in all three phases before the trip delay time (“Delay time”) has run down, the timer of “Delay time” will be stopped and the counter value is saved. If the characteristic quantity subsequently exceeds the “Reset limit“ in all three phases, then, the “Reset delay time pick-up” timer will start and the pick-up event [E2461] will be deactivated.

P3567 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 reset.

P3565 Reset limit

Pick-up reset limit of the first undercurrent protection element (STEP1); if the

- pick-up event “ANSI37-1 pickup“ [E2461] is active and
- the characteristic quantity (phase current) exceeds the pick-up value “Limit“ in all three phases, and
- the characteristic quantity (phase current) exceeds the pick-up reset value “Reset limit“ in all three phases,

then, pick-up event [E2461] is 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*
>
> *The parameter “Current“ [P604] is located in submenu: SYSTEM\Nominals**Reference values**.*

P3566 Reset delay time trip

Trip reset delay time; it is the delay time for resetting the trip event ANSI37-1 trip [E2462].
If the trip reset delay time (“Reset delay time trip”) has run down, trip event ANS327-1 trip [E2462] is deactivated. In case that the characteristic quantity (voltage) falls below the pick-up value (“limit”) of the first undercurrent 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 ANSI37-1 trip [E2462] remains active.

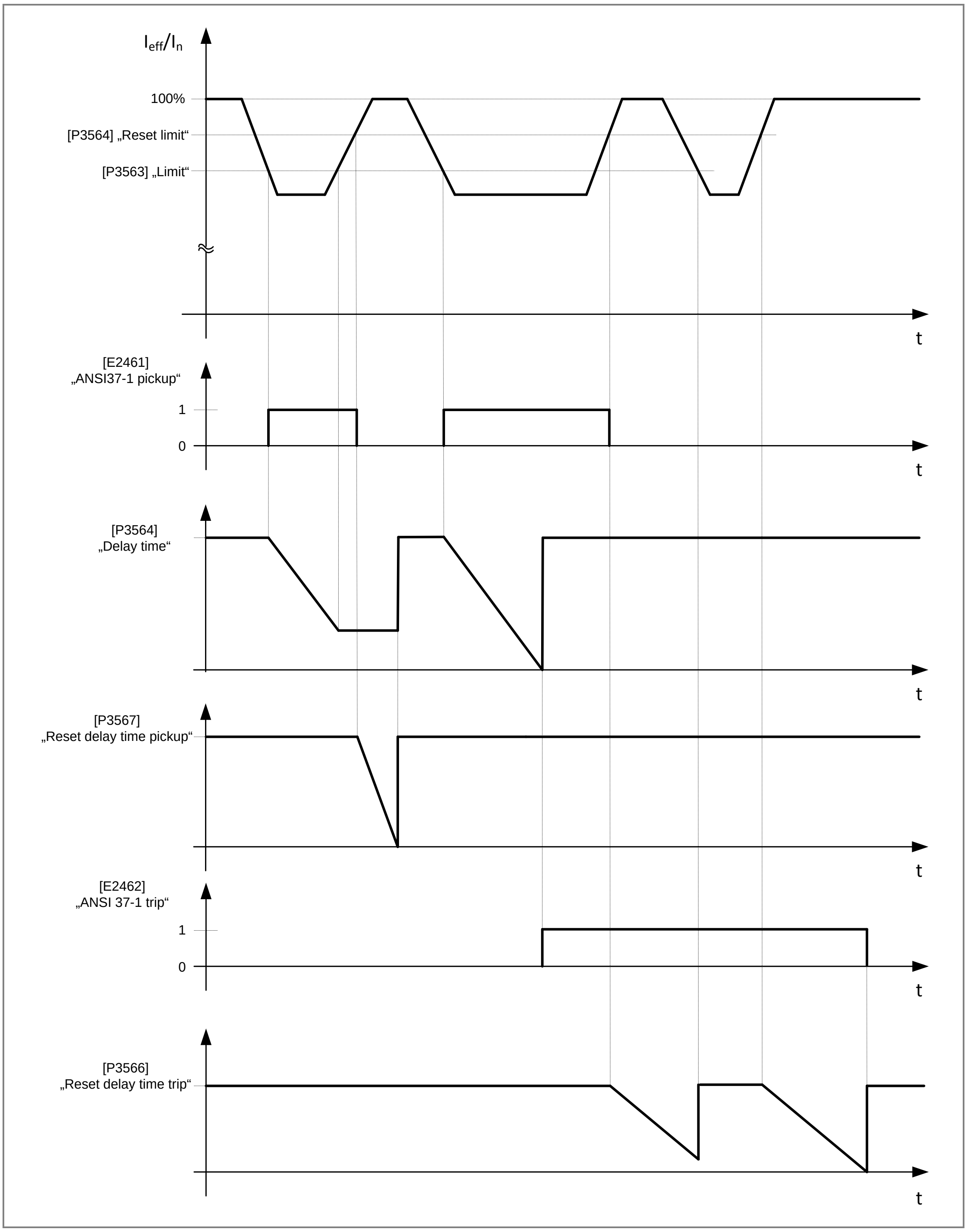


Figure 33 Undercurrent protection – trip characteristic (DT) and reset characteristic (DT)

2.1.11 ANSI 46 – Negative Phase Sequence Current Protection (NPS)

ANSI 46 – Standard (STD) protection parameters [P] and events [E] of SET 1

Main Menu\ Parameters\PROTECTION\ANSI46 – Negative phase sequence current\				
STD				
SET 1	SET 2	SET 3	SET 4	
P/E No.	System Description	Value	Unit	(Setting range)
SET PARAMETERS				
P2885	NPS current	OFF	-	ON/OFF
P2886	Blocking protection module	0	event	0 … 9999
P2887	DP1 activation	0	event	0 … 9999
P2888	DP2 activation	0	event	0 … 9999
E2245	ANSI46 module active	-	-	-
E2246	ANSI46 blocked module	-	-	-
STEP 1				
P2890	Pickup source	none	-	none/CT1/CT2*
P2891	Blocking protection step	0	event	0 … 9999
P2892	Reference	I_2/I_n	-	I_2/I_n / I_2/I_1
P2893	Pickup curve	Definite	-	Definite/ANSI NINV/ANSI VINV/ANSI EINV/ IEC NINV/IEC VINV/IEC LINV/IEC EINV/ Therm Flat/IT/I2T/I4T
P2894	Limit	20	%	0 … 65535,5
P2895	Delay time/TMS	10	s/-	0 … 999999,999
P2896	Min. delay time	0	s/-	0 … 999999,999
P2897	Reset curve	Definite	-	Definite/ANSI NINV/ANSI VINV/ANSI EINV/ IEC NINV/IEC VINV/IEC LINV/IEC EINV
P2898	Reset after TRIP immediately	OFF	-	ON/OFF
P2899	Reset limit	10	%	0 … 65535,5
P2900	Reset delay time trip/TMS	1	s/-	0 … 999999,999
P2901	Reset delay time pickup	1	s	0 … 999999,999
P2902	Harmonics stabilizer	OFF	-	OFF / 2H / 5H / 2H/5H
P2903	Voltage restrained	OFF	-	ON/OFF
P2904	Min. start current	0	%	0 … 65535,5
E2248	ANSI46-1 step active	-	-	-
E2249	ANSI46-1 blocked step	-	-	-
E2250	ANSI46-1 pickup	-	-	-
E2251	ANSI46-1 trip	-	-	-
STEP 2				
P2910	Pickup source	none	-	none/CT1/CT2*
…	…	…	…	…

ANSI 46 – Dynamic parameters (DP1) of protection parameters [P] of SET 1

Main Menu\ Parameters\PROTECTION\ANSI46 – Negative phase sequence current\

DP1

SET 1 | SET 2 | SET 3 | SET 4

P/E No.	System Description	Value	Unit	(Setting range)
STEP 1				
P3275	Limit	20	%	0 … 65535,5
P3276	Delay time/TMS	10	s/-	0 … 999999,999
P3277	Min. delay time	0	s/-	0 … 999999,999
P3278	Reset limit	10	%	0 … 65535,5
P3279	Reset delay time trip/TMS	1	s/-	0 … 999999,999
P3280	Reset delay time pickup	1	s	0 … 999999,999
STEP 2				
P3281	Limit	20	%	0 … 65535,5
…	…	…	…	…

ANSI 46 – Dynamic parameters (DP2) protection parameters [P] of SET 1

Main Menu\ Parameters\PROTECTION\ANSI46 – Negative phase sequence current\

DP2

SET 1 | SET 2 | SET 3 | SET 4

P/E No.	System Description	Value	Unit	(Setting range)
STEP 1				
P3299	Limit	20	%	0 … 65535,5
P3300	Delay time/TMS	10	s/-	0 … 999999,999
P3301	Min. delay time	0	s/-	0 … 999999,999
P3302	Reset limit	10	%	0 … 65535,5
P3303	Reset delay time trip/TMS	1	s/-	0 … 999999,999
P3304	Reset delay time pickup	1	s	0 … 999999,999
STEP 2				
P3305	Limit	20	%	0 … 65535,5
…	…	…	…	…

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. The parameter descriptions of the SET PARAMETERS and the parameters of STEP 1 represented below are described in detail in the following examples.*

STD – Standard protection parameters of parameter SET 1 – ANSI 46

STD – SET PARAMETERS

The following SET PARAMETERS of the NPS current protection exist only once in each of the four parameter sets. The SET PARAMETERS apply to all of the 4 protection STEPS of one parameter SET.

P2885 NPS current

This parameter enables/disables negative phase sequence protection where:

- OFF: disables or
- ON: enables the protective function.

When NPS current protection ANSI 46 is enabled by parameter [P2885], then event *ANSI46 module active* [E2245] is being activated.

P2886 Blocking protection module

NPS current protection can be completely blocked by any active event. For blocking, the number related to this blocking event has to be assigned to parameter [P2886]. Blocking is only effective, however, as long as the blocking event is active. As soon as blocking is active, event *ANSI46 blocked module* [E2246] is activated. If the blocking event becomes inactive, blocking is abandoned and protective function is effective again. Event [E2246] is then deactivated automatically.

If blocking of the *NPS current protection* is not required, set this parameter to **0**.

P2887 DP1 activation

Dynamic parameters 1 of function ANSI46 can be activated by any active event. For activation, the number related to this event has to be assigned to parameter [P2887]. Activation is only effective, however, as long as the assigned event is active. If the assigned event becomes inactive, *DP1* is deactivated.

If activation of *DP1* is not required, set this parameter to **0**.

P2888 DP2 activation

Dynamic parameters 2 of function ANSI46 can be activated by any active event. For activation, the number related to this event has to be assigned to parameter [P2888]. Activation is only effective, however, as long as the assigned event is active. If the assigned event becomes inactive, *DP2* is deactivated.

If activation of *DP2* is not required, set this parameter to **0**.

> *Note:* *Appropriate settings of the corresponding parameters of DP1/DP2 are to be made in the submenu: PROTECTION\Negative phase sequence current ANSI 46\DPx.*
>
> *With dynamic parameters DP1 and/or DP2 it is possible to activate a set of parameters in submenu DP1 and/or DP2.*

STD – Standard protection parameters of STEP 1

The following STEP parameters of the negative phase sequence current protection exist only once in each of the 4 independent protection STEPS. The STEP parameters therefore apply only to one of the 4 protection STEPS of one parameter SET

P2890 Pick-up source

Depending on the P60 Agile device variant every protection step of NPS current protection can be assigned to a certain current measurement input (CT1 or CT2). Parameter [P2890] determines the current measurement input which will provide measurement values as characteristic quantities (inverse component of current) to the NPS current protection:

- none: no current measurement; protection step is deactivated
- CT1: current input CT1
- CT2: This option is not supported in P16x devices

For settings CT1 event *ANSI46-1 step active* [E2248] is activated.

P2891 Blocking protection step

The first step of NPS current protection can be blocked by any active event. For blocking, the number related to this blocking event has to be assigned to parameter [P2891]. Blocking is only effective, however, as long as the blocking event is active. As soon as blocking is active, event *ANSI46-1 blocked step* [E2249] is activated. If the blocking event becomes inactive, blocking is abandoned and protective function is effective again. Event [E2249] is the deactivated automatically.

If blocking of the first step of NPS current protection is not required, set this parameter to **0**.

P2892 Reference

The reference parameter sets the characteristic quantity for the NPS current protection module; calculation of the settings of parameters Limit and Reset limit of the NPS current protection ANSI 46 can be assigned by the following setting options:

- I_2/I_n: where I_2 is negative phase sequence current component (NPS) of actual measure current value and I_n is nominal current or
- I_2/I_1: where I_2 is negative phase sequence current component (NPS) of actual measure current value and I_1 is positive phase sequence current component of actual measured current value

P2893 Pick-up curve

Tripping characteristic of the delay time; via parameter [P2893]; the tripping characteristic of the first step of NPS current protection is optionally adjustable as:

- **D**efinite **T**ime-delay NPS current protection (**DT**) or
- **I**nverse **D**efinite **M**inimum **T**ime-delay protection (**IDMT**) or
- **Thermal pickup curve** representing the *thermal characteristic* of motors: Therm Flat and IxT.

There are up to 7 different inverse time characteristics (IDMT) available, in accordance with 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)

Parameters of inverse curves (IDMT)

Curve type	Operate (trip) time			Reset time		Designation
	$t(G) = TMS\left[\frac{k}{\left(\frac{G}{G_S}\right)^{\alpha} - 1} + c\right]$			$t_r(G) = TMS\left(\frac{t_r}{1 - \left(\frac{G}{G_S}\right)^{\alpha}}\right)$		
	K [s]	*c* [s]	***α*** -	t_r [s]	***α*** -	
A	0.14	0	0.02	0014	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

where:

t(G): *theoretical operate time with 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*

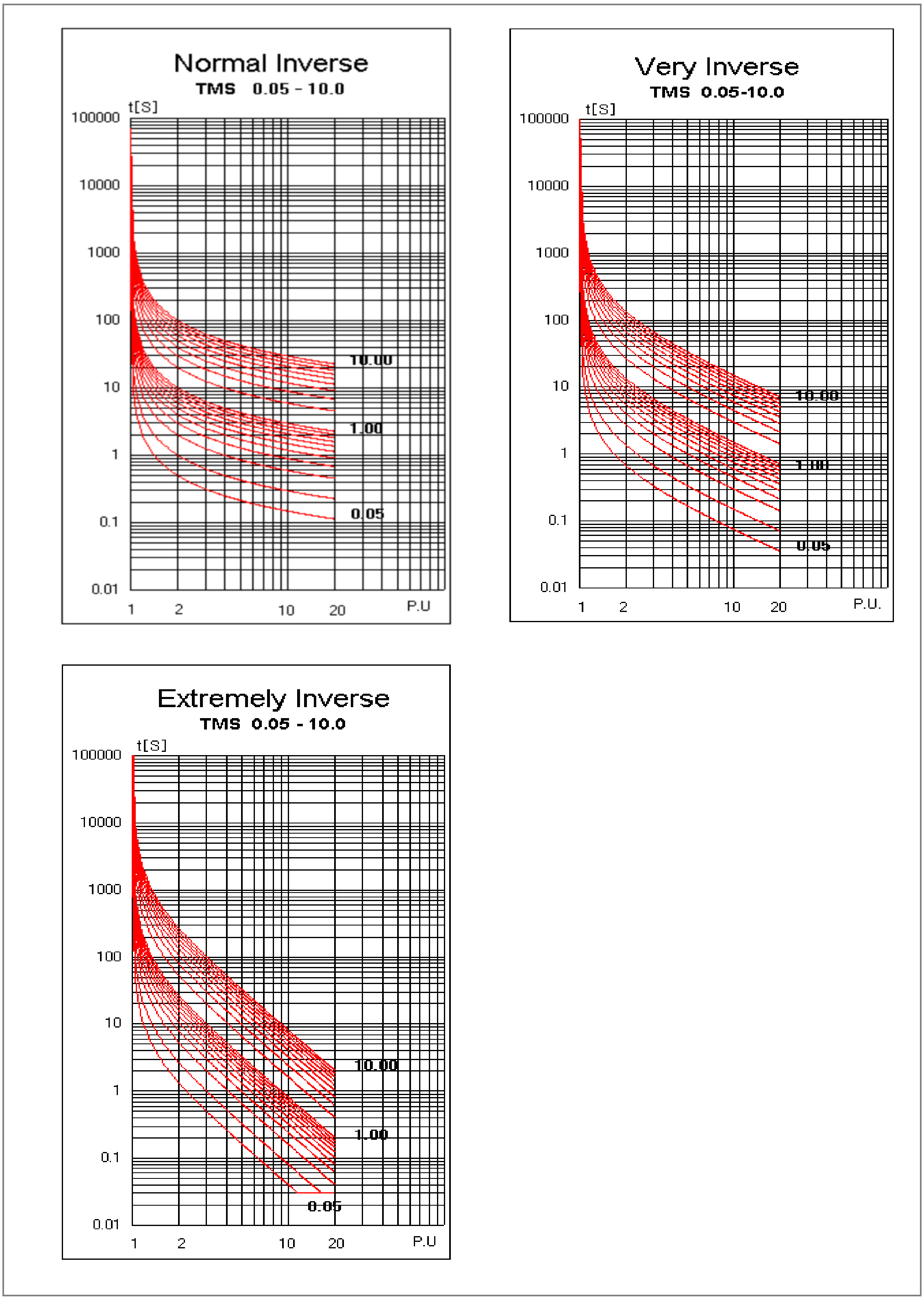


Figure 34 Inverse IEC curves – examples

For motor protection applications, following four thermal curves are available which represents different kinds of thermal characteritics:

- Therm Flat
- IT
- I2T
- I4T

Parameters of thermal curves

Operate (trip) time			Reset time		Curve type
$t(G) = TMS\left(\frac{5*k^{\beta}}{\left(\frac{G}{G_n}\right)^{\alpha}}\right)$			$t_r(G) = TMS\left\lvert\frac{5*3^{\beta}}{\left(\frac{G}{G_n}\right)^{\alpha}}\right\rvert$		
k	***β***	***α***	***β***	***α***	
1	2	0	2	0	Therm Flat
3	1	1	2	0	IT
3	2	2	2	0	I^2T
3	4	4	2	0	I^4T

whereby:

t(G): *theoretical operate time with constant value of G (seconds)*

$t_r(G)$: *time setting (reset time for G=0 and TMS = 1)*

k, α, β: *constant values which define the chosen curve shape*

TMS: *Time Multiplier Setting*

G: *measured value of the characteristic quantity*

G_n: *nominal value (start) of the characteristic quantity*

P2894 Limit

Pick-up value of the first NPS current protection element (STEP1); at the moment that the characteristic quantity (inverse component of current) exceeds this limit the *ANSI46-1 pick-up* [E2250] will become active, and Delay time/TMS of the first NPS current protection element will start.

If the characteristic quantity (inverse component of current) falls below Limit of the first NPS current 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:* *Inverse component of current is calculated via equation $\underline{I}_2 = 1/3 \times [\underline{I}_{L1} + a^2\underline{I}_{L2} + a\underline{I}_{L3}]$. If the parameter Reference [P2892] is set to I_2/I_n the pick-up value is set as percentage of the nominal values of the characteristic quantity regarding nominal current. The nominal value of the characteristic quantity should be set by parameter:*
> *Current [P604], for primary side W1*
>
> *The referring parameters Current [P604] is located in submenu:*
> *SYSTEM\Nominals**Reference values**.*

If the parameter *Reference* [P2892] is set to I_2/I_1 the pick-up value should be set as percentage. The measured value of the characteristic quantity is in percentage and will be compared directly with the limit.

P2895 Delay time/TMS

Tripping delay time of trip event *ANSI46-1 trip* [E2251]; the working principle of the delay time counter depends on the *tripping characteristic* set by parameter *Pickup curve* [P2893]. Hence follows that parameter *Delay Time/TMS* [P2895] takes on a different meaning, depending on the chosen tripping characteristic (DT or IDMT).

- **DT** tripping characteristic: Pickup curve P2893] = **Definite**
  In this case the tripping delay time is equal to a constant time value set by parameter **Delay time**/TMS [P2895].
- **IDMT** *tripping characteristic: e.g. Pickup curve [P2893] = ANSI N**INV** or e.g. Pickup curve [P2893] = **I2T***

  For this, the tripping delay *time* is not constant, but, it will be calculated cyclically, depending on the adjusted IDMT curve (or thermal curve) and the level of momentary inverse component of current increase (characteristic quantity). Therefore, setting of parameter *Delay Time /**TMS*** [P2895] means a displacement with regard to the time axis of the tripping curve (**TMS: T**ime **M**ultiplier **S**etting)

  If pick-up event *ANSI46-1 pick-up* [E2250] is active and *Delay Time/TMS* run down, trip event *ANSI46-1 trip* [E2251] will be activated. This event can be used for alarm or output control purposes.

P2896 Min. delay time

Note:	*This parameter applies only for inverse trip characteristics (IDMT curves) and thermal curves.*

Minimum trip delay time for inverse trip curves; in the case of high current faults the tripping delay time could be too small for the application. To avoid this, a minimum trip delay time can be set by parameter *Min. delay time* [P2896].

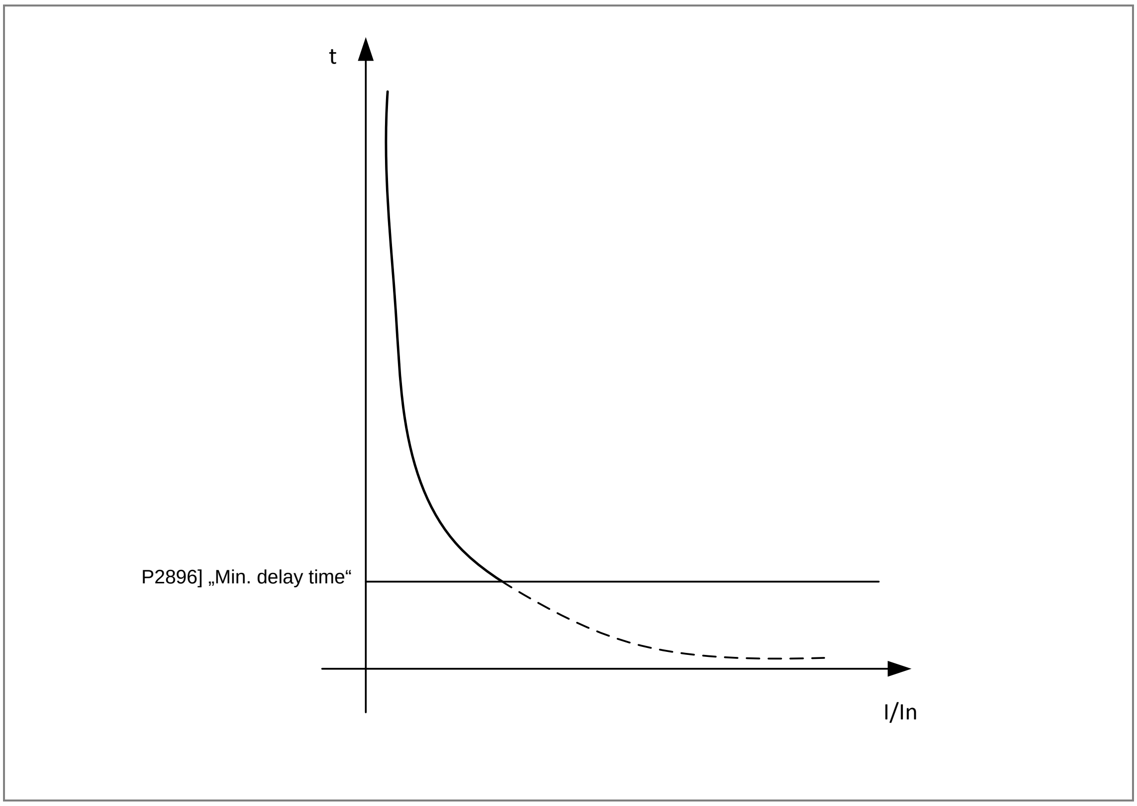


Figure 35 IDMT Trip characteristic– minimum trip delay time

P2897 Reset curve

Reset characteristic of Delay time/TMS; via parameter [P2897] the reset characteristic of the first step of NPS current protection is optionally adjustable as:

- **D**efinite **T**ime-delay NPS current protection (**DT**) or
- **I**nverse **D**efinite **M**inimum **T**ime-delay protection (**IDMT**) or
- **Thermal reset curve** for motor protection applications: Therm Flat and IxT.

There are up to 7 different inverse time characteristics available, in accordance with 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 [P2897] only provides setting option Definite (DT).*
>
> *If the tripping characteristic of Delay time/TMS is set to xxx INV (IDMT) or thermal curve, then parameter Reset curve [P2897] provides both, setting option Definite (DT) or setting option xxx INV (IDMT) or thermal curve.*

For motor protection applications there are the following four thermal reset curves available which represents different kinds of thermal characteritics:

- Therm Flat
- IT
- I2T
- I4T

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* [P2897]:

- **DT**: *the stored counter value* is to be processed according to the setting of Reset delay time pick-up
- **IDMT or thermal curves**: the stored counter value is to be processed according to the setting of Reset delay time trip/TMS

P2898 Reset after TRIP immediately

Immediate reset of trip event ANSI46-1 trip [E2251]; in the case that the reset curve is assigned an inverse characteristic (**IDMT or thermal curves**), then the Reset after TRIP immediately can be activated/deactivated by parameter [P2898] as soon as the characteristic quantity falls below the Reset Limit.

- OFF: Immediate reset of trip event ANSI46-1 trip [E2251] is deactivated
- ON: Immediate reset of trip event ANSI46-1 trip [E2251] is activated

> *Note:* *If the reset curve of the first protection element (STEP1) is assigned a definite time (DT) characteristic (parameter Reset curve [P2897] = Definite), and the trip event ANSI46-1 trip [E2251] should immediately be reset, then set parameter Reset Delay time trip/TMS [P2900] = 0.*

P2899 Reset limit

Pick-up reset limit of the first NPS current protection element (STEP1); if the

- pick-up event *ANSI46-1 pickup* [E2250] is active **and**
- the characteristic quantity (inverse component of current) falls below the pick-up value Limit **and**
- the characteristic quantity (inverse component of current) falls below the pick-up reset value Reset limit,

  then, pick-up event [E2250] is deactivated and the Reset delay time pick-up timer will start.

Inverse component of current is calculated via equation $I_2 = 1/3 \times [I_{L1} + a^2 I_{L2} + a I_{L3}]$. If the parameter Reference [P2892] is set to I_2/I_n the pick-up value is set as percentage of the nominal values of the characteristic quantity regarding with nominal current. The nominal value of the characteristic quantity should be set by parameter:

- *Current* [P604], for primary side W1

These parameters *Current* [P604] is located in submenu: SYSTEM\Nominals**Reference values**

If the parameter *Reference* [P2892] is set to I_2/I_1 the pick-up value should be set as percentage. The measured value of the characteristic quantity is in percentage and will be compared directly with the reset limit.

P2900 Reset delay time trip/TMS

Delay time to reset the trip event ANSI46-1 trip [E2251]; the operating procedure of the timer for resetting the trip event depends on the set characteristic of the *reset curve*. Parameter *Reset delay time trip/TMS* [P2900] therefore takes on a different meaning, depending on the *reset characteristic of Reset curve* (DT or IDMT) set by parameter *Reset curve* [P2897]:

- **DT** reset characteristic: *Reset curve [P2897] = Definite*
  The delay time to reset the trip event is equal to a <u>constant</u> time value, to be set by parameter *Reset **delay time**/TMS* [P2900].

- **IDMT** reset characteristic: e.g. *Reset curve [P2897] = ANSI NINV or e.g. Reset curve [P2897] =* ***I2T***

  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 (inverse component of current) it will be cyclically re-calculated. When applying any inverse curve (IDMT or thermal curve) to the reset curve, this means the setting of parameter *Reset delay time trip/**TMS*** [P2900] takes on a displacement of the inverse curve shape with regard to the time axis (**TMS:** Time Multiplier Setting).

If trip event *ANSI46-1 trip* [E2251] is activated and Reset delay time trip/TMS has run down, the trip event *ANSI46-1 trip* [E2251] will be deactivated.

Note: In dependence of the set value of parameter Reset after TRIP immediately [P2900], deactivating of trip event ANSI46-1 trip [E2251] takes on a different working principle.

P2901 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 [P2901] is only valid where *Reset curve [P2897] = 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.

P2902 Harmonics stabilizer

Blocking of protection element (STEP1) of NPS current protection by harmonics stabilizer ANSI 95i function for measuring values. According to the settings of the *harmonics stabilizer ANSI 95i* function, the pickup of the NPS current protection may be temporarily blocked upon exceeding of defined contents of the 2^{nd} and/or 5^{th} harmonic (I_{100Hz} and/or I_{250Hz}) in the phase current:

- OFF: blocking of *ANSI 46-1* by ANSI 95i is deactivated
- 2H: blocking of *ANSI 46 -1* by ANSI 95i in case of 2^{nd} harmonic
- 5H: blocking of *ANSI 46 -1* by ANSI 95i in case of 5^{th} harmonic
- 2H/5H: blocking of *ANSI 46 -1* by ANSI 95i in case of 2^{nd} or 5^{th} harmonic

> *Note: Appropriate settings of the corresponding parameters of ANSI95i are to be made in the submenu: PROTECTION**95i Harmonics stabilizer**.*

P2903 Voltage restrained

Voltage restraint modification of the pick-up value (Limit) and the reset value (Reset Limit) of the first protection element (STEP1) NPS current protection by function Voltage restrained ANSI 51/46VR; according to the settings of the Voltage restrained ANSI 51/46VR function, the NPS current protection may automatically be sensitised.

- OFF: Sensitization of ANSI 46-1 by 51/46VR is deactivated
- ON: Sensitization of ANSI 46-1 by 51/46VR is activated

> *Note: Appropriate settings of the corresponding parameters of function Voltage restrained ANSI 51/46VR are to be made in the submenu: PROTECTION\51/**46VR Voltage restrained**.*

P2904 Min. start current

Minimum limit of the measuring current to activate NPS current protection; the first protection step of NPS current protection is blocked as long as the measured current in all three phases remain below this minimum setting.

If measured currents in all three phases remain below this minimum setting the event *ANSI46-1 blocked step* [E2249] will become active.

> *Note: If the parameter Reference [P2892] is set to I_2/I_n, the min. start limit is set as percentage of the nominal values of the characteristic quantity (phase current) regarding with nominal current. The nominal value of the characteristic quantity should be set by parameter: Current [P604], for primary side W1*
>
> *The parameters Current [P604] is located in submenu: SYSTEM\Nominals**Reference values***

Dynamic protection parameters of STEP 1

Dynamic parameters can be used to adapt the protection settings of the protective function temporarily to the conditions of the electrical system. Changing of network conditions might be caused by:

- Cold load situation
- load changes
- automatic reclosing

While in normal conditions the standard parameters STD are valid. When network conditions change, dynamic parameters DP1 or DP2 can be activated by the event assigned to parameter *DP1 activation* [P2887] or *DP1 activation* [P2888]. Parameters [P3275] to [P3280] or [P3275] to [P3280] then become active and corresponding standard parameters become inactive. As soon as the activating event turns to inactive, standard parameters are activated and dynamic parameters become inactive.

The duration of change-over between standard parameters and dynamic parameters is in accordance with the protection cycle time (<2ms) of the protection device.

The following dynamic STEP parameters of the negative phase sequence current protection exist only once in each of the 4 independent protection STEPS. The dynamic STEP parameters therefore apply only to one of the 4 protection STEPS of one parameter SET.

Dynamic protection parameters – DP1

P3275 Limit
See description of parameter [P2894]

P3276 Delay time/TMS
See description of parameter [P2895]

P3277 Min. delay time
See description of parameter [P2896]

P3278 Reset limit
See description of parameter [P2899]

P3279 Reset delay time trip/TMS
See description of parameter [P2900]

P3280 Reset delay time pickup
See description of parameter [P2901]

Dynamic protection parameters – DP2

P3299 Limit
See description of parameter [P2894]

P3300 Delay time/TMS
See description of parameter [P2895]

P3301 Min. delay time
See description of parameter [P2896]

P3302 Reset limit
See description of parameter [P2899]

P3303 Reset delay time trip/TMS
See description of parameter [P2900]

P3304 Reset delay time pickup
See description of parameter [P2901]

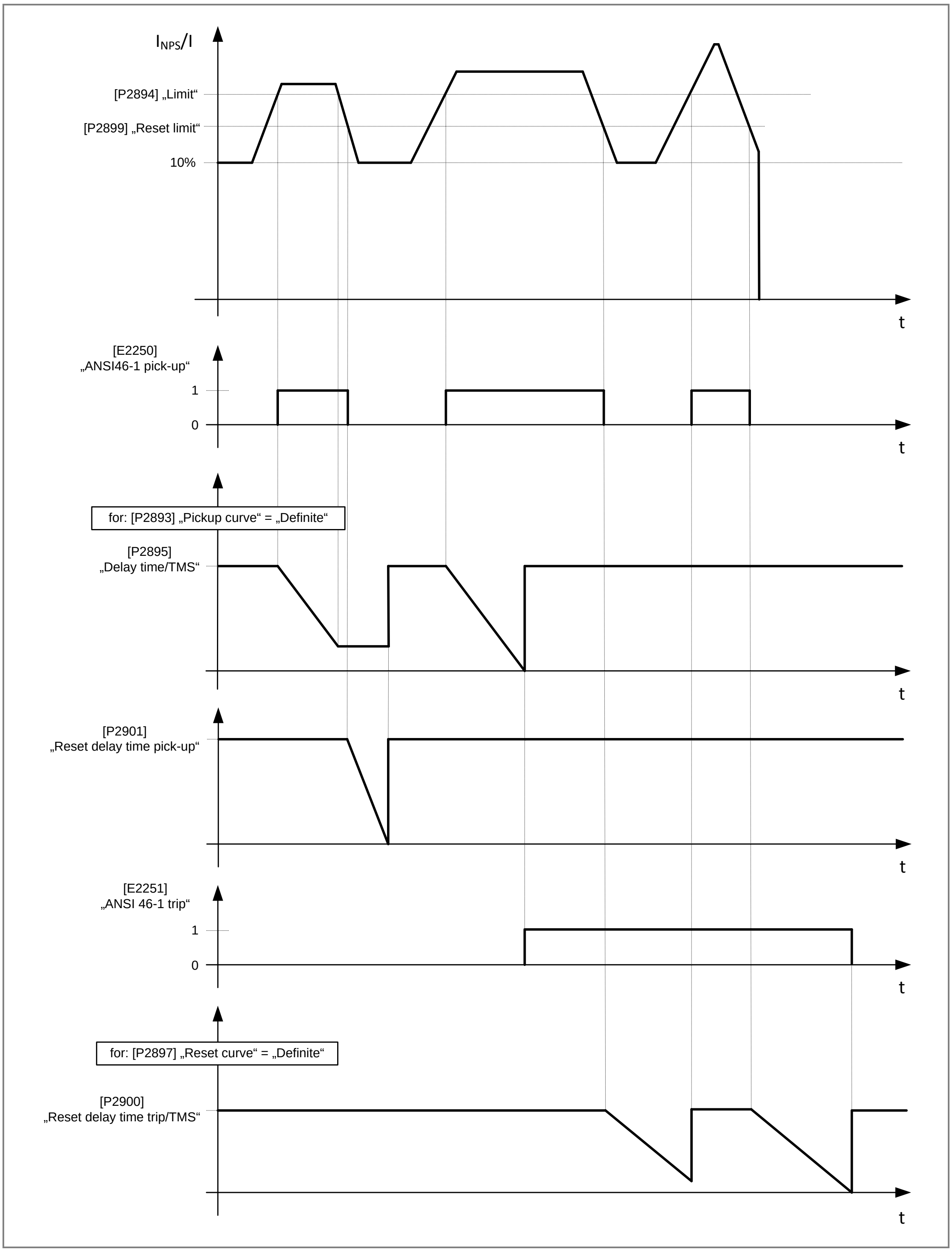


Figure 36 NPS current protection – Trip characteristic (DT) and Reset characteristic (DT)

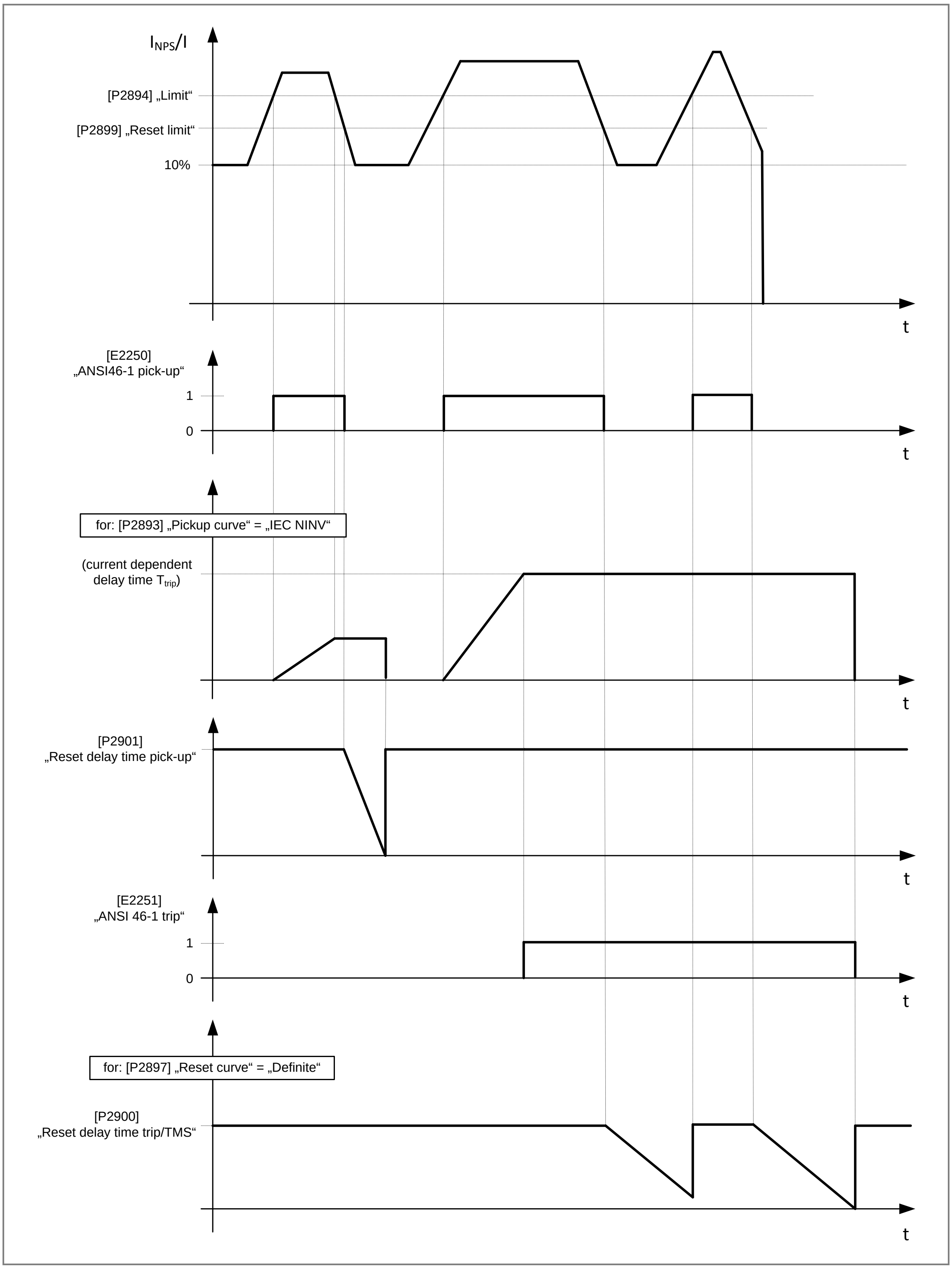


Figure 37 **NPS current protection – Trip characteristic (IDMT) and Reset characteristic (DT)**

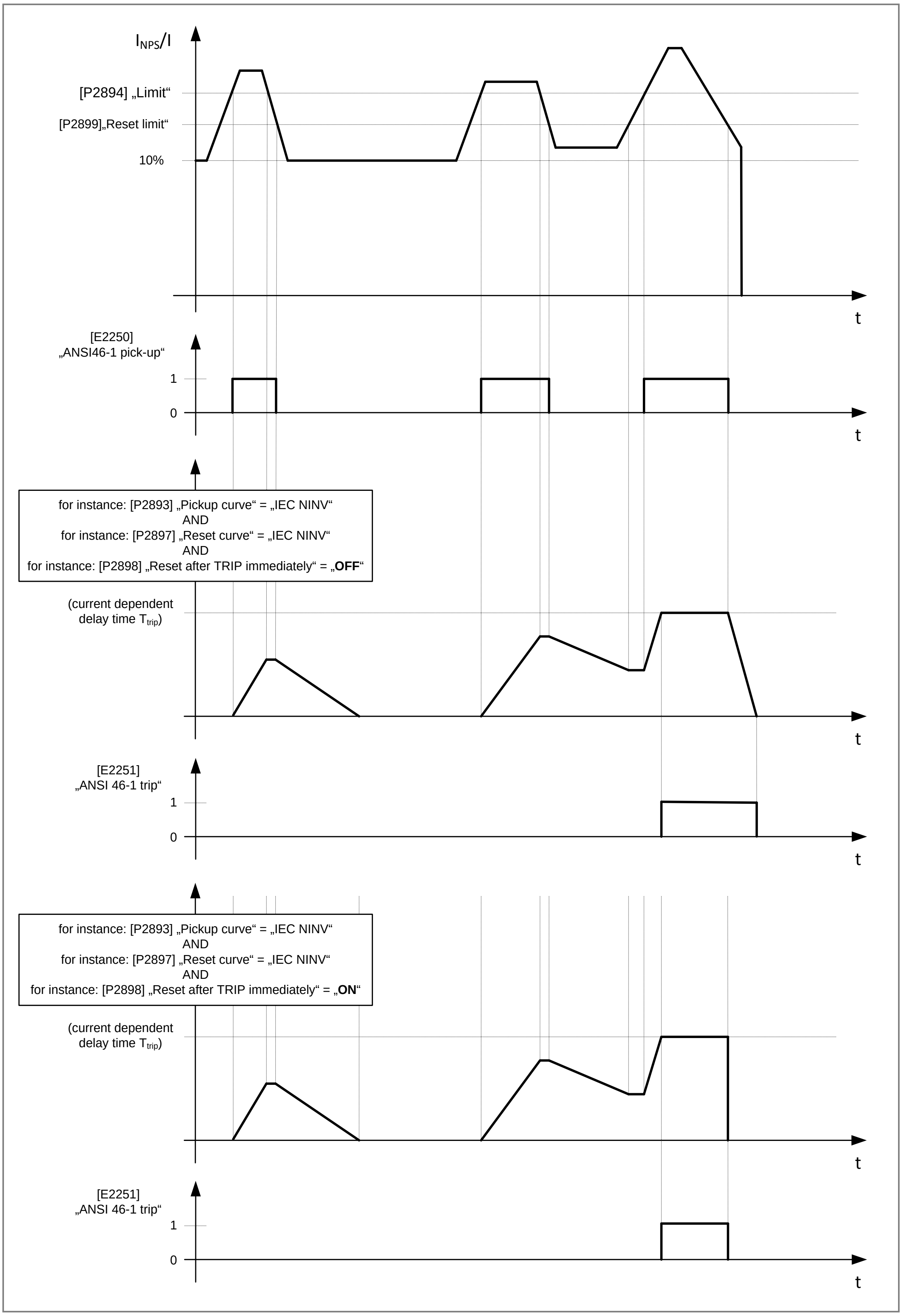


Figure 38 NPS current protection – Trip characteristic (IDMT) and Reset characteristic (IDMT)

2.1.12 ANSI 47 – Negative Phase Sequence Overvoltage Protection

ANSI 47 – Protection parameters [P] and events [E] of SET 1

				Main Menu\Parameters\PROTECTION\
ANSI 47 – Negative phase sequence voltage				
SET 1	SET 2	SET 3	SET 4	
P/E No.	System Description	Value	Unit	(Setting range)
SET PARAMETERS				
P3674	Negative phase sequence voltage	OFF	-	ON/OFF
P3675	Blocking protection module	0	event	0 … 9999
E2497	ANSI47 module active	-	-	-
E2498	ANSI47 blocked module	-	-	-
STEP 1				
P3676	Pickup source	PT1	-	none/PT1/PT2/PT3
P3677	Blocking protection step	0	event	0 … 9999
P3678	Limit	20	%	1 … 200
P3679	Delay time	1	s	0 … 999999,999
P3680	Reset limit	19	%	1 … 200
P3681	Reset delay time trip	1	s	0 … 999999,999
P3682	Reset delay time pickup	0	s	0 … 999999,999
E2499	ANSI47-1 step active	-	-	-
E2500	ANSI47-1 blocked step	-	-	-
E2501	ANSI47-1 pickup	-	-	-
E2502	ANSI47-1 trip	-	-	-
STEP 2				
P3683	Pickup source	PT1	-	none/PT1/PT2/PT3
…	…	…	…	…

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 47

SET PARAMETERS

The following SET PARAMETERS of the negative phase sequence voltage 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.

P3674 Negative phase sequence voltage

This parameter enables/disables negative phase sequence voltage protection where:

- OFF: disables or
- ON: enables the protective function.

When negative phase sequence voltage protection ANSI 47 is enabled by parameter [P3674], then event “ANSI47 module active” [E2497] is activated.

P3675 Blocking protection module

Negative phase sequence voltage protection can be completely blocked by any active event. For blocking, the number related to this blocking event has to be assigned to parameter [P3675]. Blocking is only effective, however, as long as the blocking event is active. As soon as blocking is active, event “ANSI47 blocked module” [E2498] is activated. If the blocking event turns inactive, blocking is abandoned and protective function is effective again. Then, event [E2498] is deactivated automatically.

If blocking of the negative phase sequence voltage protection is not required, set this parameter to “0”.

Protection parameters of STEP 1

The following STEP parameters of the negative phase sequence voltage protection exist only once in each of the 12 independent protection STEPS. Thus, the STEP PARAMETERS apply only to one of the 12 protection STEPS of one parameter SET.

P3676 Pick-up source

Depending on the P16x device variant every protection step of negative phase sequence voltage protection can be assigned to a certain voltage measurement input (PT1, PT2 or PT3). Parameter [P3676] determines the voltage measurement input which will provide measurement values as characteristic quantity (negative phase sequence voltage U_2 of the 3-phase voltage system) to the negative phase sequence voltage 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 *ANSI47-1 step acitve* [E2499] is activated.

P3677 Blocking protection step

The first step of negative phase sequence voltage protection can be blocked by any active event. For blocking, the number related to this blocking event has to be assigned to parameter [P3677]. Blocking is only effective, however, as long as the blocking event is active. As soon as blocking is active, event *ANSI47-1 blocked step* [E2500] is activated. If the blocking event turns inactive, blocking is abandoned and protective function is effective again. Then, event [E2500] is deactivated automatically.

If blocking of the first step of negative phase sequence voltage protection is not required, set this parameter to “**0**”.

P3678 Limit

Pick-up value of the first negative phase sequence voltage protection element. At the moment that the characteristic quantity (negative phase sequence voltage U2 of the 3-phase voltage system) exceeds this limit, pick-up event ANSI47-1 pickup [E2501] 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 process quantity "Phase-to-Ground voltage U_{L-E}" ($U_{L-E} = U_{L-L}/\sqrt{3}$). The nominal value of the phase-to-phase voltage U_{L-L} is to be set by parameter: Voltage (L-L) [P603], for primary side W1*
>
> *The parameters Voltage (L-L) [P603] is located in submenu: SYSTEM\Nominals**Reference values**.*

P3679 Delay time

Trip delay time; it is the delay time of the trip event *ANSI47-1 trip* [E2502].

As soon as the pick-up event *ANSI47-1 pickup* [E2501] is active and "Delay time" run down, trip event [E2502] will be activated. This event can be used for alarm or output control purposes.

In case that the characteristic quantity (negative phase sequence voltage U_2 of the 3-phase voltage system) falls below the pick-up value ("Limit") of the first negative phase sequence voltage 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 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 [E2501] will be deactivated.

P3682 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 reset.

P3680 Reset limit

Reset limit of the first step of negative phase sequence voltage protection. As soon as the trip event *ANSI47-1 trip* [E2502] is active and the characteristic quantity (negative phase sequence voltage U_2 of the 3-phase voltage system) 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 process quantity "Phase-to-Ground voltage U_{L-E}" ($U_{L-E} = U_{L-L}/\sqrt{3}$). The nominal value of the phase-to-phase voltage U_{L-L} is to be set by parameter: Voltage (L-L) [P603], for primary side W1*
>
> *The parameters Voltage (L-L) [P603] is located in submenu: SYSTEM\Nominals**Reference values**.*

P3681 Reset delay time trip

Trip reset delay time; it is the delay time for resetting the trip event *ANSI47-1 trip* [E2502].

If the trip reset delay time (Reset delay time trip) has run down, trip event *ANSI47-1 trip* [E1157] is deactivated. In case that the characteristic quantity (negative phase sequence voltage U_2 of the 3-phase voltage system) exceeds the pick-up value (Limit) of the first negative phase sequence voltage 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 *ANSI47-1 trip* [E2502] remains active.

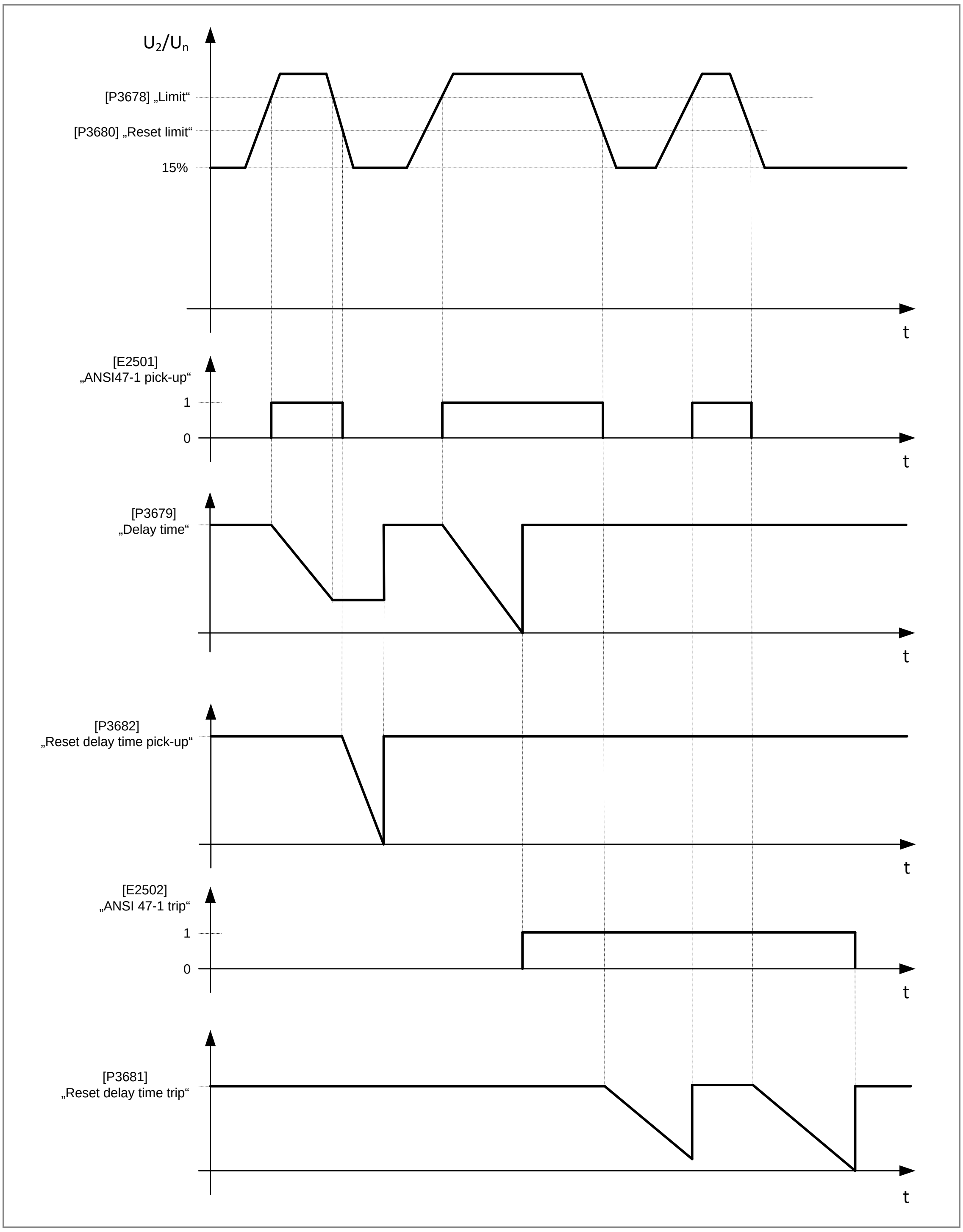


Figure 39 ANSI 47 – Tripping and reset characteristic

2.1.13 ANSI 49 – Thermal replica

ANSI 49 – Protection parameters [P] and events [E] of SET 1

Main Menu\Parameter\Protection\				
ANSI 49				
SET 1 / SET 2 / SET 3 / SET 4				
P/E No.	System Description	Value	Unit	(Setting range)
SET PARAMETERS				
P3395	Thermal replica	OFF	-	OFF/ON
P3396	Blocking protection module	0	event	0 … 9999
P3397	Reset thermal level	0	event	0 … 9999
P3398	Thermal level reset value	0	%	0 … 6553,5
P3399	Store thermal level	volatile	-	volatile/nonvolatile
P3400	Pick-up source	CT1	-	CT1/CT2*
P3401	Basic current	100.0	%	1 … 6553,5
P3402	Basic current factor k	1.00		1 … 655,35
P3403	Current heating threshold	0	%	0 … 6553,5
P3404	Heating time constant	2244	s	0 … 65535
P3405	Cooling time constant	6732	s	0 … 65535
E2350	ANSI49 module active	-	-	-
E2351	ANSI49 blocked module	-	-	-
STEP 1				
P3411	Enable protection step	OFF	-	OFF/ON
P3412	Blocking protection step	0	event	0 … 9999
P3413	Warning limit	0	%	0 … 6553,5
P3414	Delay time	0	s	0 … 6553,5
P3415	Trip limit	0	%	0 … 6553,5
P3416	Delay time	0	s	0 … 6553,5
E2352	ANSI49-1 step active	-	-	-
E2353	ANSI49-1 step blocked	-	-	-
E2354	ANSI49-1 warning	-	-	-
E2355	ANSI49-1 trip	-	-	-
STEP 2				
P3417	Thermal replica step	OFF	-	OFF/ON
…	…	…	…	…

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. The parameter descriptions of the SET PARAMETERS and the parameters of STEP 1 represented below are described in detail in the following examples.*

Protection parameters of parameter SET 1 – ANSI 49

SET PARAMETERS

The following SET PARAMETERS of the Thermal replica exist only once in each of the four parameter sets. The SET PARAMETERS therefore apply to all of the 4 protection STEPS of one parameter SET.

P3395 Thermal replica

This parameter enables/disables thermal replica where:

- OFF: disables, or
- ON: enables the protective function.

When function Thermal replica ANSI 49 is enabled by parameter [P3395], event *ANSI49 module active* [E2350] is activated.

P3396 Blocking protection module

Thermal replica can be completely blocked by any active event. For blocking, the number related to this blocking event has to be assigned to parameter [P3396]. Blocking is only effective, however, as long as the blocking event is active. As soon as blocking is active, event *ANSI49 module blocked* [E2351] and corresponding events for every step *ANSI49-x step blocked* [E23xx] are being activated. If the blocking event becomes inactive, blocking is abandoned and protective function is effective again. Then, event [E2351] and corresponding events [E23xx] for every step are being deactivated automatically.

If blocking of the thermal replica is not required, set this parameter to **0**.

P3397 Reset thermal level

The actual thermal level can be reset by any active event. For reset, the number related to this reset event has to be assigned to parameter *Reset thermal level* [P3397].

If reset of the actual thermal level is not required, set this parameter to **0**.

P3398 Thermal level reset value

The actual thermal level will be reset to this value.

P3399 Store thermal level

- volatile: current state of thermal level will not be stored after system reboot; or
- nonvolatile: current state of thermal level will be stored after system reboot.

P3400 Pickup source

Depending on the P60 Agile device variant every protection step of thermal replica can be assigned to a certain current measurement input (CT1 or CT2). Parameter [P3400] determines the current measurement input which will provide measurement values as characteristic quantities (phase current) to the thermal replica:

- CT1: current input CT1
- CT2: This option is not supported in P16x devices

P3401 Basic current

Basic current I_B to define the maximum permissible thermal operating current $I_{thermal,max.}$ (thermal limit) of the operating device to be protected (motor, transformer, cable/line); the thermal limit is obtained by multiplying the basic current I_B by the overload factor k (see parameter *Basic current factor k* [P3402]):

$I_{thermal,max.} = I_B \times k$

with:

I_B: Basic current: percentage of nominal current In of the operating device to be protected

k: Basic current factor: overload factor as multiplier for basic current

The basic current should be set as a percentage of the nominal value of the characteristic quantity (phase current). The nominal value of the characteristic quantity should be set by parameter:

- *Current* [P604], for primary side W1

The referring parameters *Current* [P604] is located in submenu: SYSTEM\Nominals**Reference values**.

P3402 Basic current factor k

Overload factor to define the maximum permissible thermal operating current $I_{thermal,max.}$ of the operating device to be protected (motor, transformer, cable/line); with basis current factor k it is possible to set the thermal limit to meet special costumer requirements as well as to prevent any measurement inaccuracies.

P3403 Current heating threshold

Current threshold to discriminate the heating situation from the cooling situation of an operating device depending on the power flow;

- **Heating:**

  The actual thermal level will be calculated according to the *Heating time constant* [P3404] if the equivalent current is greater than the set value of parameter [P3404].

  Example: A motor is driving a load.

- **Cooling:**

  The actual thermal level will be calculated according to *Cooling time constant* [P3405] if the equivalent current is less or equal than the set value of parameter [P3404].

  Example: A motor is operated in idle mode.

Note:	*The current heating threshold should be set as a percentage of the nominal value of the characteristic quantity (phase current). The nominal value of the characteristic quantity should be set by parameter: Current [P604], for primary side W1* *The referring parameters Current [P604] is located in submenu: SYSTEM\Nominals**Reference values.***

P3404 Heating time constant

Specific heating time constant of an operating device to be protected; the heating time constant of an electrical equipment is defined as response time required for the equipment to reach 63.2% of its thermal stabilization temperature when subjected to a unit step of current, with basic (or nominal or rated) load.

P3405 Cooling time constant

Specific cooling time constant of an operating device to be protected; the cooling time constant is the time which the thermal level of electrical equipment needs to reach the ambient temperature after the equipment is switched off.

The cooling of electrical equipment depends on its mechanical structure and cooling system used. The efficiency of the ventilation system varies widely in between the states of equipment operation (fan and ventilation system in operation) and equipment at rest (fan and ventilation system stopped). In this case the cooling of the equipment occurs much more slowly with the equipment stopped than the equipment in operation. If there is no datasheet of the operating device available, the cooling time constant usually should be twice or three times as much as the set value for the heating time constant.

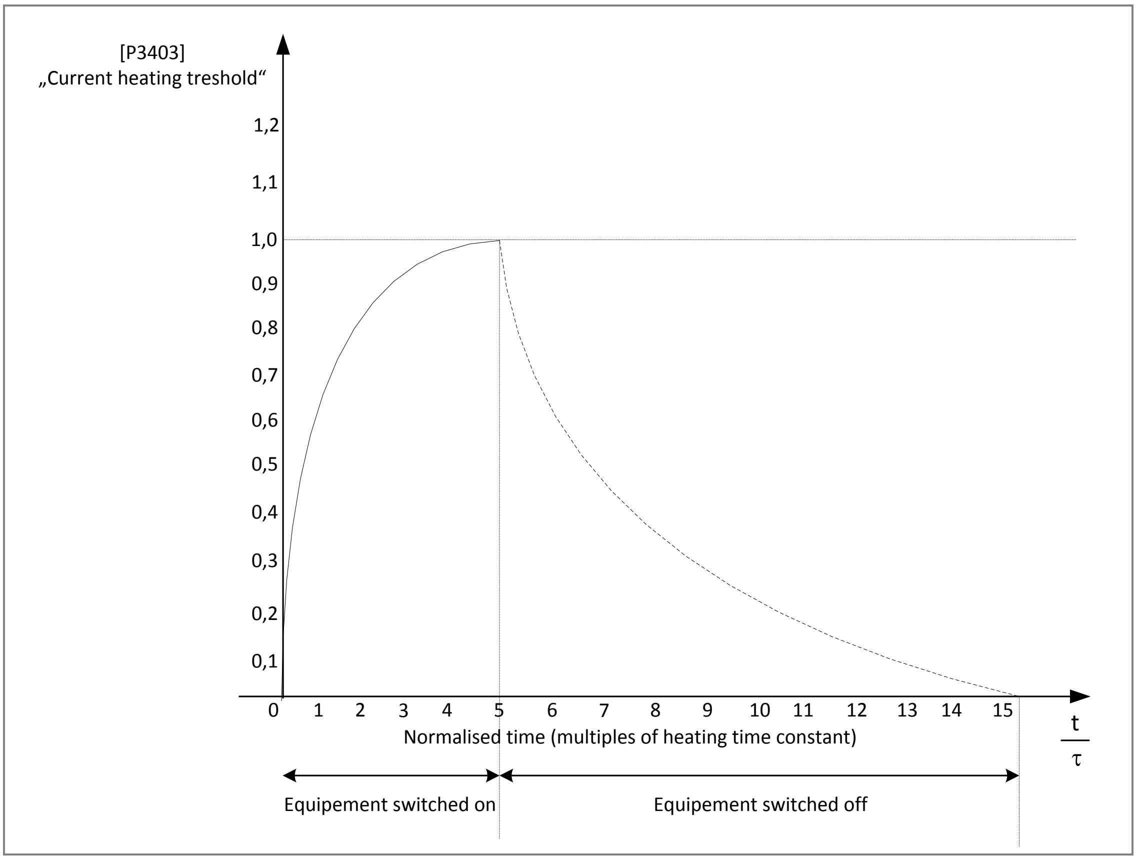


Figure 40 Equipment temperature due operation at nominal current followed by switching-off

Protection parameters of STEP 1

The following STEP parameters of the thermal replica exist only once in each of the 4 independent protection STEPS. The STEP parameters therefore apply only to one of the 4 protection STEPS of one parameter SET.

P3411 Enable protection step

This parameter enables/disables Thermal replica protection step where:

- OFF: disables or
- ON: enables the protection step.

When thermal replica protection step is enabled by parameter [P3411], then event *ANSI49-1 step active* E2352] is activated.

P3412 Blocking protection step

The first step of thermal replica can be blocked by any active event. For blocking, the number related to this blocking event has to be assigned to parameter [P3412]. Blocking is only effective, however, as long as the blocking event is active. As soon as blocking is active, event *ANSI49-1 blocked step* [E2353] is activated. If the blocking event becomes inactive, blocking is abandoned and protective function is effective again. Event [E2353] is then deactivated automatically.

If blocking of the first step of thermal replica is not required, set this parameter to **0**.

P3413 Warning limit

Pick-up value for warning of the first thermal replica element (STEP1); at the moment that the characteristic quantity exceeds the Warning limit, the Delay time, set by parameter [P3414], of the first thermal replica element will start.

In case that the characteristic quantity falls below the Warning limit of the first thermal replica element before Delay time has run down, the timer of Delay time will be stopped and the time value is saved.

P3414 Delay time

Warning delay time of event ANSI49-1 warning [E2354]. As soon as the characteristic value exceeds the Warning limit set by parameter [P3413] and *Delay time* [P3414] run down, warning event *ANSI49-1 warning* [E2354] will be activated. This event can be used for alarm or output control purposes.

P3415 Trip limit

Pick-up value for tripping of the first thermal replica element (STEP1); when the characteristic quantity exceeds the Trip limit, the Delay time, set by parameter [P3415], of the first thermal replica element will start.

If the characteristic quantity falls below the Trip limit of the first thermal replica element before Delay time has run down, the timer of Delay time will be stopped and the attained time value is saved.

P3416 Delay time

Tripping delay time of event ANSI49-1 trip [E2355]. As soon as the characteristic value exceeds Trip limit set by parameter [P3415] and *Delay time* [P3416] run down, trip event *ANSI49-1 trip* [E2355] will be activated. This event can be used for alarm or output control purposes.

ANSI 50/51 – Overcurrent Protection

ANSI 50/51 – Standard (STD) protection parameters [P] and events [E] of SET 1

Main Menu\Parameters\PROTECTION\ANSI 50/51 – Overcurrent

STD

SET 1 | SET 2 | SET 3 | SET 4

P/E No.	System Description	Value	Unit	(Setting range)
SET PARAMETERS				
P1620	Overcurrent protection	ON	-	ON/OFF
P1621	Blocking protection module	0	event	0 … 9999
P1622	DP1 activation	0	event	0 … 9999
P1623	DP2 activation	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	200	%	5 … 1999,9
P1629	Delay time/TMS	0.03	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	195	%	5 … 1999,9
P1633	Reset delay time trip/TMS	0	s/-	0 … 999999,999
P1634	Reset delay time pickup	0	s	0 … 999999,999
P1635	Harmonics stabilizer	OFF	-	OFF / 2H / 5H / 2H/5H
P1637	Voltage restrained	ON	-	ON/OFF
P1638	Start fault locator	No	-	No/Yes
P1642	Min delay time	0	s/-	0 … 999999,999
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*
…	…	…	…	…

ANSI 50/51 – Dynamic paramter (DP1) protection parameters [P] and events [E] of SET 1

Main Menu\Parameters\PROTECTION\ANSI 50/51 – Overcurrent				
DP1				
SET 1	SET 2	SET 3	SET 4	
P/E No.	System Description	Value	Unit	(Setting range)
STEP 1				
P3035	Limit	200	%	5 … 65535,5
P3036	Delay time/TMS	0.03	s/-	0 … 999999,999
P3037	Min. delay time	0	s/-	0 … 999999,999
P3038	Reset limit	195	%	5 … 65535,5
P3039	Reset delay time trip/TMS	0	s/-	0 … 999999,999
P3040	Reset delay time pickup	0	s	0 … 999999,999
STEP 2				
P3041	Limit	20	%	0 … 65535,5
…	…	…	…	…

ANSI 50/51 – Dynamic parameters (DP2) protection parameters [P] of SET 1

Main Menu\Parameters\PROTECTION\ANSI 50/51 – Overcurrent				
DP2				
SET 1	SET 2	SET 3	SET 4	
P/E No.	System Description	Value	Unit	(Setting range)
STEP 1				
P3071	Limit	200	%	5 … 65535,5
P3072	Delay time/TMS	0.03	s/-	0 … 999999,999
P3073	Min. delay time	0	s/-	0 … 999999,999
P3074	Reset limit	195	%	5 … 65535,5
P3075	Reset delay time trip/TMS	0	s/-	0 … 999999,999
P3076	Reset delay time pickup	0	s	0 … 999999,999
STEP 2				
P3077	Limit	20	%	0 … 65535,5
…	…	…	…	…

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. The parameter descriptions of the SET PARAMETERS and the parameters of STEP 1 represented below are described in detail in the following examples.*

STD – Standard protection parameters of parameter SET 1 – ANSI 50/51

STD – SET PARAMETERS

The following SET PARAMETERS of the overcurrent protection exist only once in each of the four parameter sets. The SET PARAMETERS therefore apply to all of the 6 protection STEPS of one parameter SET.

P1620 Overcurrent protection

This parameter enables/disables overcurrent protection where:

- OFF: disables or
- ON: enables the protective function.

When overcurrent protection ANSI 50/51 is enabled by parameter [P1620], then event *ANSI*50/51 *module active* [E1415] is 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 activated. If the blocking event becomes inactive, blocking is abandoned and protective function is effective again. Event [E1416] is then deactivated automatically.

If blocking of the overcurrent protection is not required, set this parameter to **0**.

P1622 DP1 activation

Dynamic parameters 1 of function ANSI50/51 can be activated by any active event. For activation, the number related to this event has to be assigned to parameter [P1622]. Activation is only effective, however, as long as the assigned event is active. If the assigned event becomes inactive, DP1 is deactivated.

If activation of DP1 is not required, set this parameter to **0**.

P1623 DP2 activation

Dynamic parameters 2 of function ANSI50/51 can be activated by any active event. For activation, the number related to this event has to be assigned to parameter [P1623]. Activation is only effective, however, as long as the assigned event is active. If the assigned event becomes inactive, *DP2* is deactivated.

If activation of DP2 is not required, set this parameter to **0**

Note: *Appropriate settings of the corresponding parameters of DP1/DP2 are to be made in the submenu: PROTECTION\Overcurrent ANSI 50/51**DPx**.*

With dynamic parameters DP1 and/or DP2 it is possible to activate a set of parameters in submenu DP1 and/or DP2.

STD – Standard protection parameters of STEP 1

The following STEP parameters of the overcurrent protection exist only once in each of the 6 independent protection STEPS. The STEP PARAMETERS therefore apply only to one of the 6 protection STEPS of one parameter SET.

P1625 Pick-up source

Depending on P60 Agile 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: This option is not supported in P16x devices

For settings CT1 or CT2, event *ANSI50/51-1 step active* [E1422] is 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 activated. If the blocking event becomes inactive, blocking is abandoned and protective function is effective again. Event [E1423] is then 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:

- **D**efinite **T**ime-delay overcurrent protection (**DT**) or
- **I**nverse **D**efinite **M**inimum **T**ime-delay protection (**IDMT**)

  There are up to 7 different inverse time characteristics (IDMT) available, in accordance with 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)

Parameters of inverse curves (IDMT)

Curve type	Operate (trip) time			Reset time		
	$t(G) = TMS\left[\dfrac{k}{\left(\dfrac{G}{G_S}\right)^{\alpha} - 1} + c\right]$			$t_r(G) = TMS\left(\dfrac{t_r}{1 - \left(\dfrac{G}{G_S}\right)^{\alpha}}\right)$		Designation
	K [s]	*c* [s]	***α*** -	*t_r* [s]	***α*** -	
A	0.14	0	0.02	0014	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

where:

t(G):	*theoretical operate time with 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*

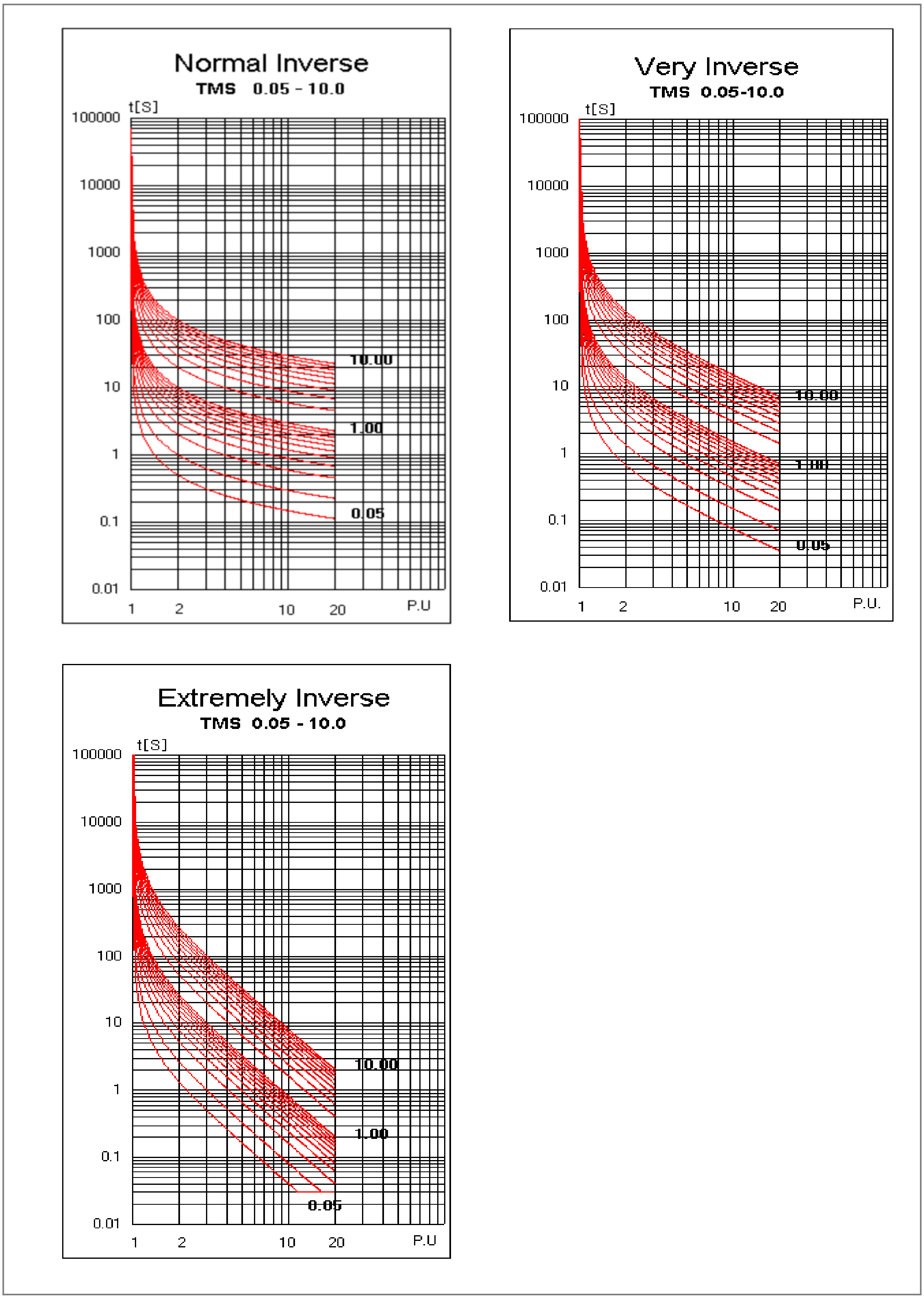


Figure 41 Inverse IEC curves – examples

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 saved.

> *Note: The pick-up value should be set as a percentage of the nominal value of the characteristic quantity (phase current). The nominal value of the characteristic quantity is set by parameter: Current [P604], for primary side W1*
>
> *The referring parameters Current [P604] is 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]. Parameter *Delay Time/TMS* [P1629] therefore 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 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: T**ime **M**ultiplier **S**etting)

  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 deactivated and the timer of the Reset delay time pick-up will start.

> *Note: The Reset Limit should be set as a percentage of the nominal value of the characteristic quantity (phase current). The nominal value of the characteristic quantity is set by parameter: Current [P604], for primary side W1*
>
> *The referring parameters Current [P604] is 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:

- **D**efinite **T**ime-delay overcurrent protection (**DT**) or
- **I**nverse **D**efinite **M**inimum **T**ime-delay protection (**IDMT**)

- There are up to 7 different inverse time characteristics available, in accordance with 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 if the tripping delay time (Delay time/TMS) has not yet run down.

CAUTION: Parameter [P1634] is only valid when of *Reset curve [P1630]* = Definite

While the Reset delay time pick-up timer is running, the counter value of the tripping delay time maintains 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*. Parameter *Reset delay time trip/TMS* [P1633] therefore 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, 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:* *Depending on 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 pickup of the overcurrent 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 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 made in the submenu: PROTECTION\95i Harmonics stabilizer.*

P1637 Voltage restrained

Voltage restrained 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 made in the submenu: PROTECTION\51/46VR Voltage restrained.*

P1638 Start fault locator

Start of function Fault locator ANSI 21FL in case of a protection trip via the first step of overcurrent protection; where:

- OFF: does not start the fault locator function or
- ON: starts the calculation of fault location by function Fault locator ANSI 21FL in case that:
  I. function “Fault locator ANSI 21FL” is enabled (parameter *Function [P3465] = ON*) **and**
  II. the trip event *ANSI50/51-1 trip* [E1425] becomes active*.*

P1642 Min. delay time

Note:	*This parameter only applies for invers trip characteristics (IDMT curves)*

Minimum trip delay time for inverse trip curves; in case of high current faults the tripping delay time could be too short for the application. To avoid this, a minimum trip delay time can be set by parameter *Min. delay time* [P1642]

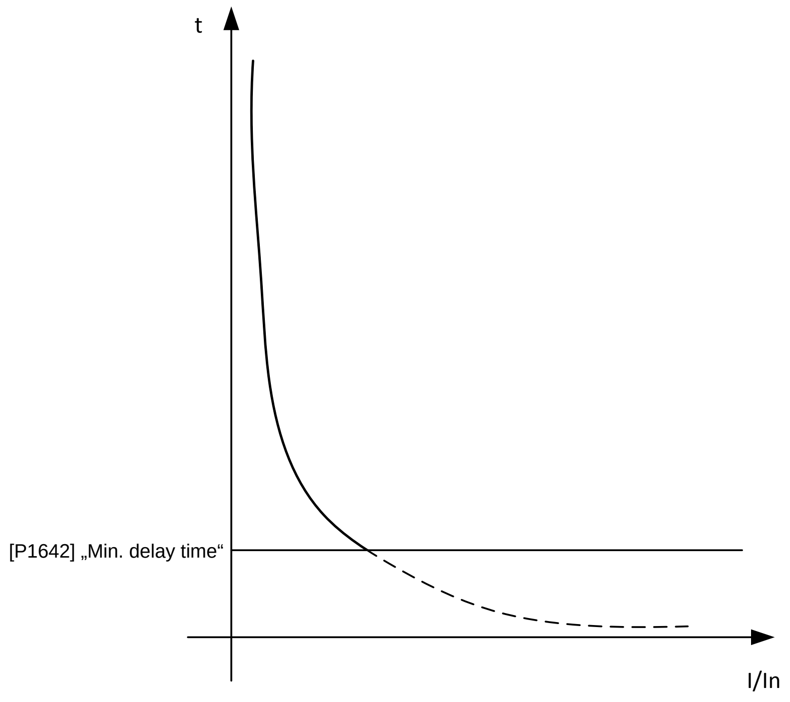


Figure 42 IDMT Trip characteristic– minimum trip delay time

Dynamic protection parameters of STEP 1

Dynamic parameters can be used to adapt the protection settings of the overcurrent protection function temporarily to the conditions of the electrical system. Changing of network conditions might be caused by:

- Cold load situation,
- load changes,

- automatic reclosing, etc.

While in normal conditions the standard parameters STD are valid. When network conditions change, dynamic parameters DP1 or DP2 can be activated by the event assigned to parameter *DP1 activation* [P1622] or *DP1 activation* [P1623]. Parameters [P3035] to [P3040] or [P3071] to [P3076] become active and corresponding standard parameters become inactive. As soon as the activating event becomes inactive, standard parameters are activated and dynamic parameters become inactive.

The duration of change-over between standard parameters and dynamic parameters is in accordance with the protection cycle time (<2ms) of the protection device.

The following dynamic STEP parameters of the overcurrent protection exist only once in each of the 6 independent protection STEPS. The dynamic STEP parameters apply only to one of the 6 protection STEPS of one parameter SET.

Dynamic protection parameters – DP1

P3035 Limit

See description of parameter [P1628]

P3036 Delay time/TMS

See description of parameter [P1629]

P3037 Min. delay time

See description of parameter [P1642]

P3038 Reset limit

See description of parameter [P1632]

P3039 Reset delay time trip/TMS

See description of parameter [P1633]

P3040 Reset delay time pickup

See description of parameter [P1634]

Dynamic protection parameters – DP2

P3071 Limit

See description of parameter [P1628]

P3072 Delay time/TMS

See description of parameter [P1629]

P3073 Min. delay time

See description of parameter [P1642]

P3074 Reset limit

See description of parameter [P1632]

P3075 Reset delay time trip/TMS

See description of parameter [P1633]

P3076 Reset delay time pickup

See description of parameter [P1634]

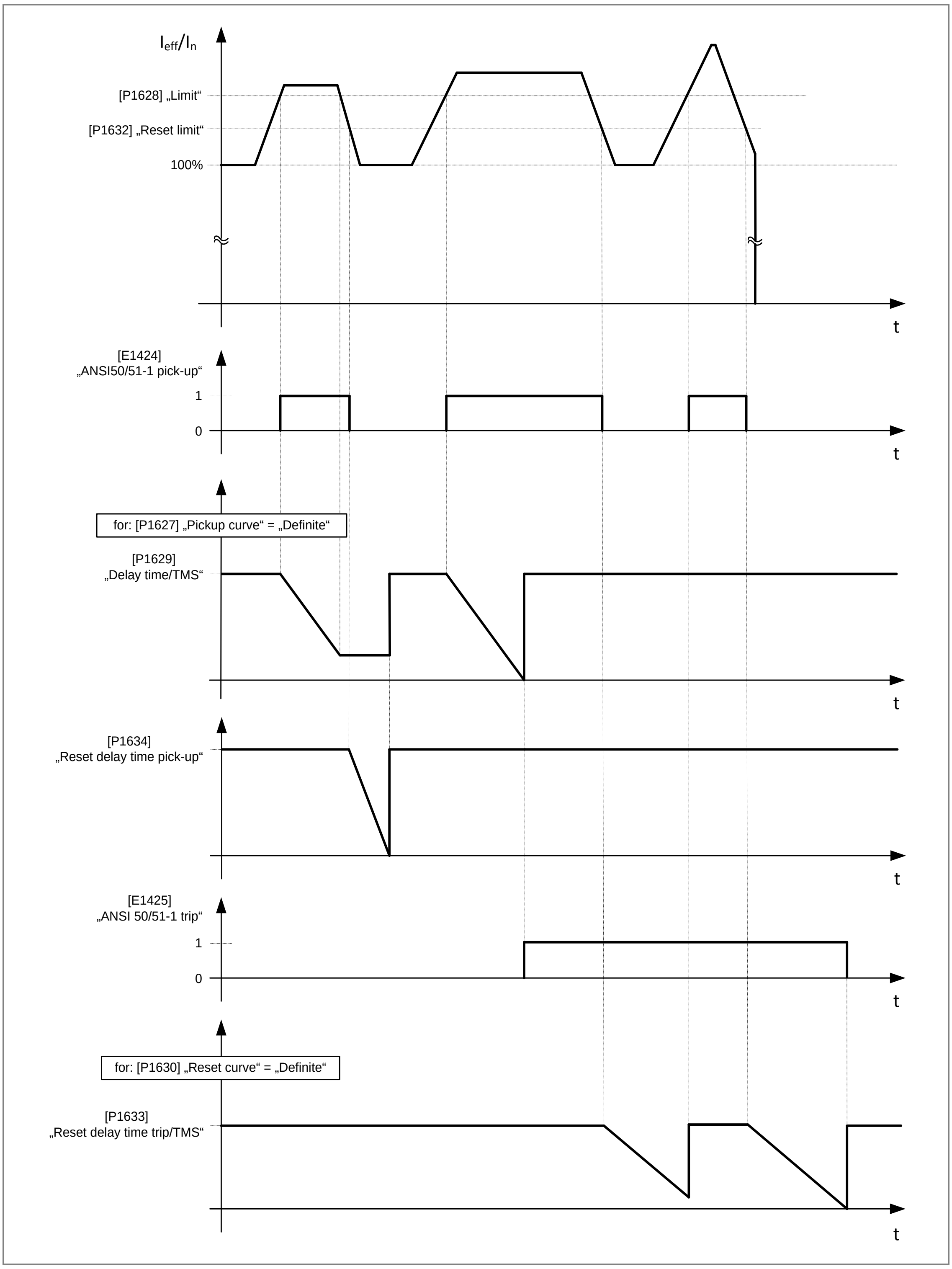


Figure 43 Overcurrent protection – Trip characteristic (DT) and Reset characteristic (DT)

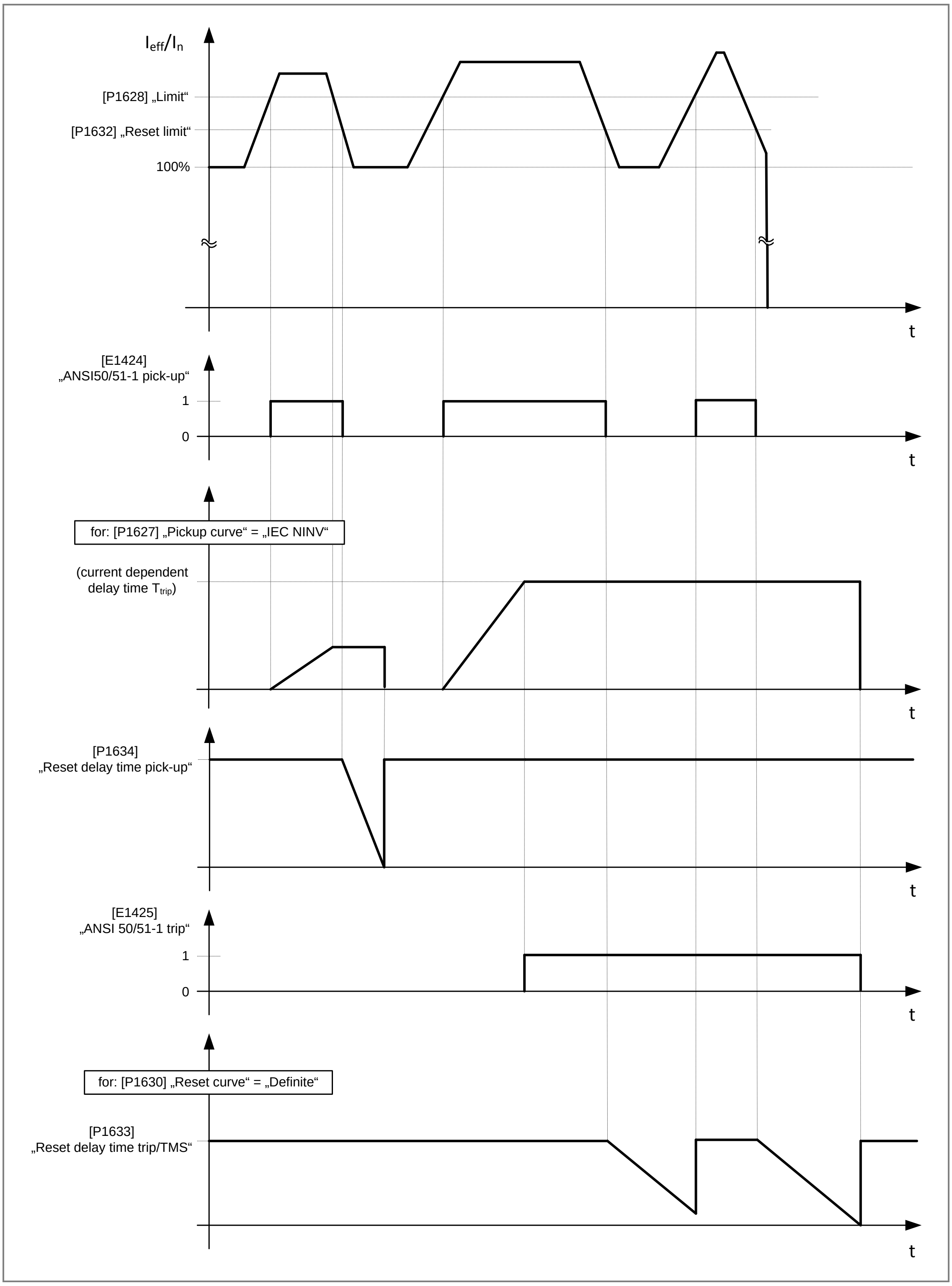


Figure 44 Overcurrent protection – Trip characteristic (IDMT) and Reset characteristic (DT)

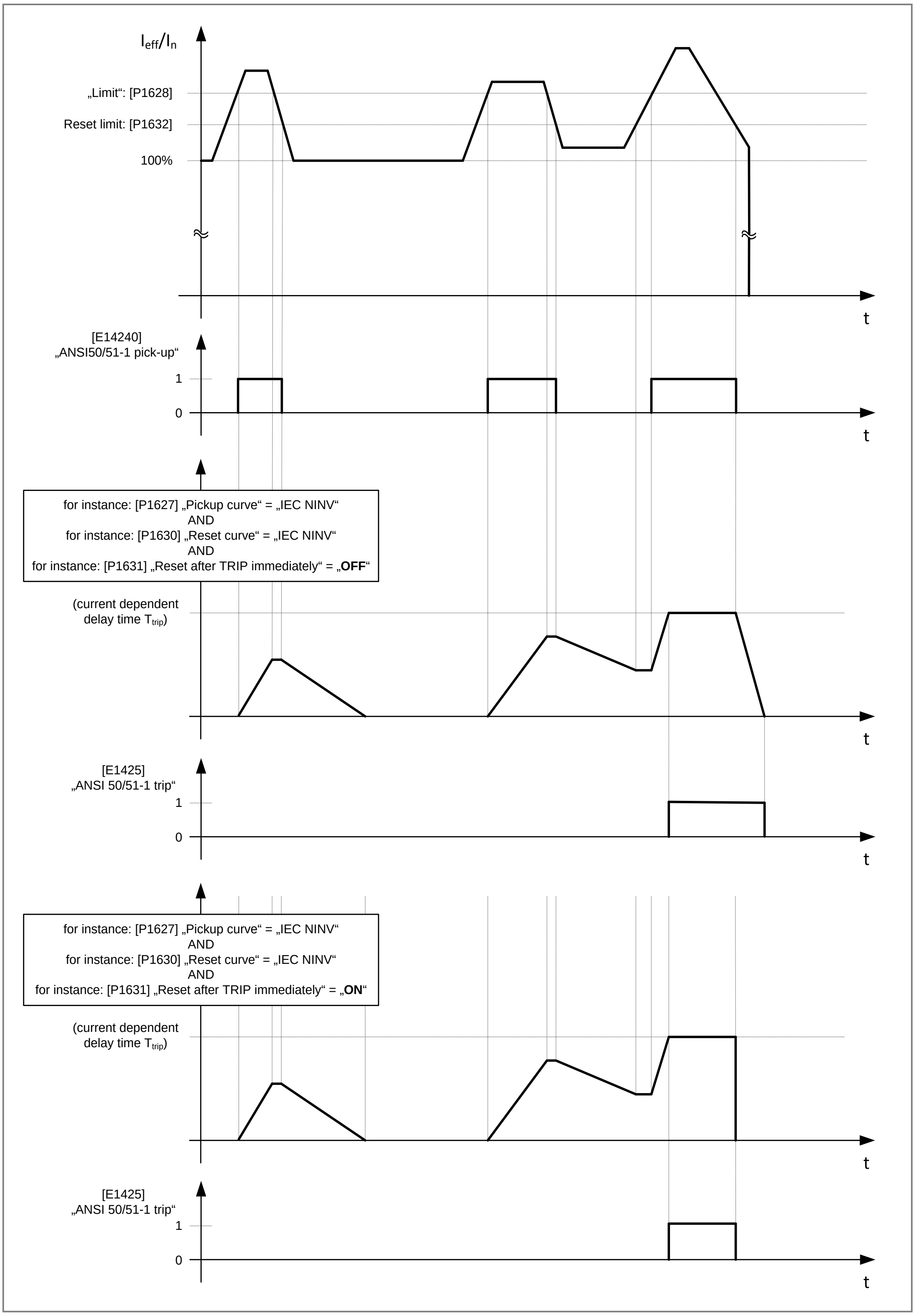


Figure 45 Overcurrent protection – Trip characteristic (IDMT) and Reset characteristic (IDMT)

2.1.14 ANSI 50BF – Breaker Failure Protection

ANSI 50BF – Protection parameters [P] and events [E] of SET 1

Main Menu\Parameters\PROTECTION\				
ANSI 50BF				
SET 1	SET 2	SET 3	SET 4	
P/E No.	System Description	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	20	%	5 … 1999,9
P2842	Delay time	0	s	0 … 999999,999
P2843	Reset limit	15	%	5 … 1999,9
P2844	Reset delay time trip	0	s	0 … 999999,999
P2845	Reset delay time pickup	0	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*
…	…	…	…	…

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. The parameter descriptions of the SET PARAMETERS and the parameters of STEP 1 represented below are described in detail in the following 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. 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 where:

- 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 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 activated. If the blocking event becomes inactive, blocking is abandoned and protective function is effective again. Event [E2216] is then 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. The SET PARAMETERS apply only to one of the 3 protection STEPS of one parameter SET.

P2838 Pick-up source

Depending on the P60 Agile 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: This option is not supported in P16x devices

For setting CT1, event *ANSI50BF-1 step active* [E2217] is 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 activated. If the blocking event becomes inactive, blocking is abandoned and protective function is effective again. Event [E2218] is then 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 activated (triggered) by any active event. To activate, the number related to this trigger event has to be assigned to parameter [P2840].

> *Note:* *Usually, those trip-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.

When 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 saved.

> *Note: The pick-up value should be set as a percentage of the nominal value of the characteristic quantity (phase current). The nominal value of the characteristic quantity should be set by parameter: Current [P604], for primary side W1*
>
> *The parameter Current [P604] is 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.

When 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 saved. If the characteristic quantity subsequently exceeds the Reset limit, the Reset delay time pick-up timer will then 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*,
- pick-up event [E2219] is then deactivated and the timer of the Reset delay time pick-up will start.

> *Note: The Reset Limit should be set as a percentage of the nominal value of the characteristic quantity (phase current). The nominal value of the characteristic quantity should be set by parameter: Current [P604], for primary side W1*
>
> *The parameter Current [P604] is 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; when 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 deactivated.

When 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.

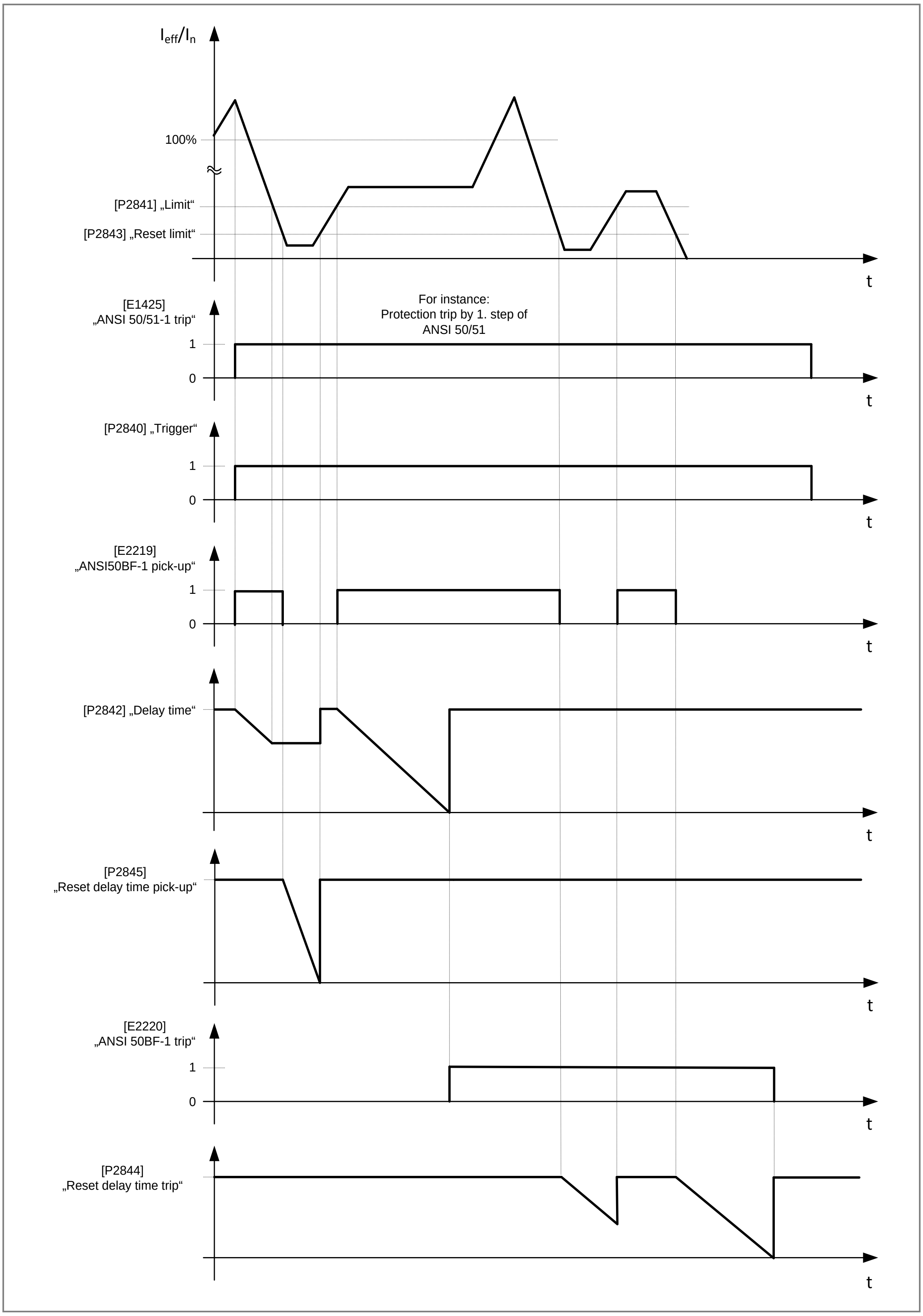


Figure 46 **ANSI 50BF – Trip and reset characteristic**

2.1.15 ANSI 50G/51G – Ground Overcurrent Protection

ANSI 50G/51G – Standard (STD) protection parameters [P] and events [E] of SET 1

Main Menu\Parameters\PROTECTION\ANSI 50G/51G – Ground overcurrent

STD

SET 1 | SET 2 | SET 3 | SET 4

P/E No.	System Description	Value	Unit	(Setting range)
SET PARAMETERS				
P2030	Ground overcurrent protection	ON	-	ON/OFF
P2031	Blocking protection module	0	event	0 … 9999
P2032	DP1 activation	0	event	0 … 9999
P2033	DP2 activation	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	50	%	5 … 1999,9
P2039	Delay time/TMS	0.03	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	45	%	5 … 1999,9
P2043	Reset delay time trip/TMS	0	s/-	0 … 999999,999
P2044	Reset delay time pickup	0	s	0 … 999999,999
P2045	Harmonics stabilizer	OFF	-	OFF / 2H / 5H / 2H/5H
P2046	Start fault locator	No	-	No/Yes
P2052	Min delay time	0	s/-	0 … 999999,999
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*
…	…	…	…	…

ANSI 50G/51G – Dynamic parameters (DP1) of protection parameters [P] of SET 1

Main Menu\Parameters\PROTECTION\ANSI 50G/51G – Ground overcurrent

DP1

SET 1 | SET 2 | SET 3 | SET 4

P/E No.	System Description	Value	Unit	(Setting range)
STEP 1				

P3107	Limit	50	%	5 … 1999,9
P3108	Delay time/TMS	0.03	s/-	0 … 999999,999
P3109	Min. delay time	0	s/-	0 … 999999,999
P3110	Reset limit	50	%	5 … 1999,9
P3111	Reset delay time trip/TMS	0	s/-	0 … 999999,999
P3112	Reset delay time pickup	0	s	0 … 999999,999
STEP 2				
P3113	Limit	20	%	0 … 65535,5
…	…	…	…	…

ANSI 50G/51G – Dynamic parameters (DP2) protection parameters [P] of SET 1

Main Menu\Parameters\PROTECTION\ANSI 50G/51G – Ground overcurrent

DP2

SET 1 | SET 2 | SET 3 | SET 4

P/E No.	System Description	Value	Unit	(Setting range)
STEP 1				
P3143	Limit	50	%	5 … 1999,9
P3144	Delay time/TMS	0.03	s/-	0 … 999999,999
P3145	Min. delay time	0	s/-	0 … 999999,999
P3146	Reset limit	50	%	5 … 1999,9
P3147	Reset delay time trip/TMS	0	s/-	0 … 999999,999
P3148	Reset delay time pickup	0	s	0 … 999999,999
STEP 2				
P3149	Limit	20	%	0 … 65535,5
…	…	…	…	…

Parameter description:

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

> *Note:* *Each of the four parameter sets provides the same group of protection parameters. The parameter descriptions of the SET PARAMETERS and the parameters of STEP 1 represented below are described in detail in the following examples.*

STD – Standard protection parameters of parameter SET 1 – ANSI 50G/51G

STD – SET PARAMETERS

The following SET PARAMETERS of the ground overcurrent protection exist only once in each of the four parameter sets. 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 where:

- OFF: disables or
- ON: enables the protective function.

When ground overcurrent protection ANSI 50G/51G is enabled by parameter [P2030], then event *ANSI*50G/51G *module active* [E1680] is 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 activated. If the blocking event becomes inactive, blocking is abandoned and protective function is effective again. Event [E1681] is then deactivated automatically.

If blocking of the ground overcurrent protection is not required, set this parameter to **0**.

P2032 DP1 activation

Dynamic parameters 1 of function ANSI50G/51G can be activated by any active event. For activation, the number related to this event has to be assigned to parameter [P2032]. Activation is only effective, however, as long as the assigned event is active. If the assigned event becomes inactive, *DP1* is deactivated.

If activation of *DP1* is not required, set this parameter to **0**.

P2033 DP2 activation

Dynamic parameters 2 of function ANSI50G/51G can be activated by any active event. For activation, the number related to this event has to be assigned to parameter [P2033]. Activation is only effective, however, as long as the assigned event is active. If the assigned event becomes inactive, *DP2* is deactivated.

If activation of *DP2* is not required, set this parameter to **0**.

Note: *Appropriate settings of the corresponding parameters of DP1/DP2 are to be made in the submenu: PROTECTION\ANSI50G/**51G-Ground current\DPx**.*

With dynamic parameters DP1 and/or DP2 it is possible to activate a set of parameters in submenu DP1 and/or DP2.

STD – Standard 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. The STEP PARAMETERS apply only to one of the 6 protection STEPS of one parameter SET.

P2035 Pick-up source

Depending on the P60 Agile 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 $\underline{I}_G$ by CT-GND1
- CT1: calculated ground current: $\underline{I}_G = 3 \times \underline{I}_0 = \underline{I}_1+\underline{I}_2+\underline{I}_3$ from the phase currents, which are to be measured by CT1
- CT2: This option is not supported in P16x devices

For setting CT1, the event *ANSI50G/51G-1 step active* [E1687] is 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 activated. If the blocking event becomes inactive, blocking is abandoned and protective function is effective again. Event [E1688] is then 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:

- **D**efinite **T**ime-delay ground overcurrent protection (**DT**) or
- **I**nverse **D**efinite **M**inimum **T**ime-delay protection (**IDMT**)

There are up to 7 different inverse time characteristics (IDMT) available, which meet 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)

Details for parameters of inverse curves (IDMT) and Inverse IEC curve examples can be found under ANSI 50/51 section.

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, *ANSI50G/51G-1 pick-up* [E1689] will become active, and Delay time/TMS of the first ground overcurrent protection element will start.

When 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 saved.

> *Note: The pick-up value should be set as a percentage of the nominal value of the characteristic quantity (ground current I_G). The nominal value of the characteristic quantity should be set by parameter: Ground current [P607], for primary side W1*
>
> *The parameter Ground current [P607] is 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]. It 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*,

pick-up event [E1689] is then deactivated and the timer of the Reset delay time pick-up will start.

Note: The Reset limit should be set as a percentage of the nominal value of the characteristic quantity (ground current I_{GND}). The nominal value of the characteristic quantity should be set by parameter: Ground current [P607], for primary side W1

*The parameter Ground current [P607] is 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:

- **D**efinite **T**ime-delay ground overcurrent protection (**DT**) or
- **I**nverse **D**efinite **M**inimum **T**ime-delay protection (**IDMT**)

There are up to 7 different *inverse time characteristics* available, which meet 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; when 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. It 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:* *According to 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]; When 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 stabiliser

Blocking of the first protection element (STEP1) of ground overcurrent protection by harmonics stabiliser ANSI 95i function for measuring values of CT1; according to the settings of the harmonics stabiliser ANSI 95i function, the ground overcurrent 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 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 made in the submenu: PROTECTION\95i Harmonics stabiliser.*

P2046 Start fault locator

Start of function Fault locator ANSI 21FL in case of a protection trip via the first step of ground overcurrent protection; where:

- OFF: does not start the fault locator function or
- ON: starts the calculation of fault location by function Fault locator ANSI 21FL in case that:
  - I. function Fault locator ANSI 21FL is enabled (parameter *Function [P3465] = ON*) **and**
  - II. the trip event *ANSI50G/51G-1 trip* [E1690] becomes active.

P2052 Min. delay time

> *Note: This parameter only applies for inverse trip characteristics (IDMT curves).*

Minimum trip delay time 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 delay time can be set by parameter *Min. delay time* [P2052]

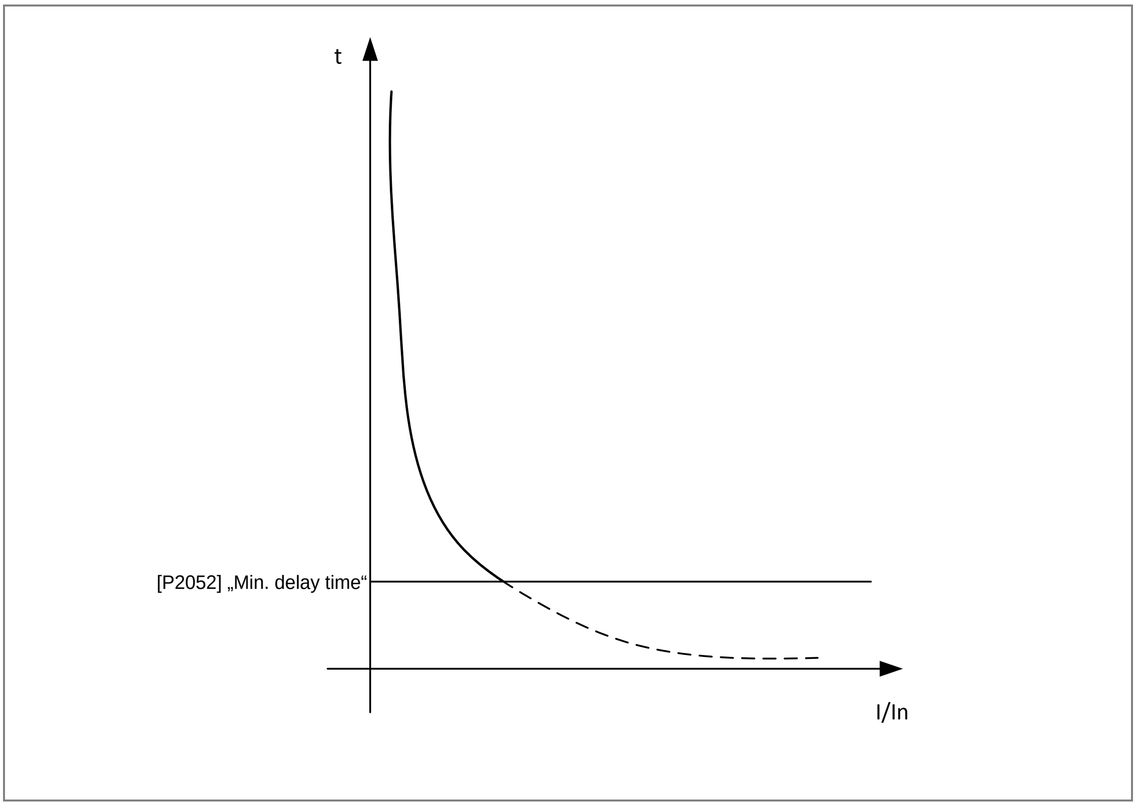


Figure 47 IDMT Trip characteristic– minimum trip delay time

Dynamic protection parameters of STEP 1

Dynamic parameters can be used to adapt the protection settings of the ground overcurrent protection function temporarily to the conditions of the electrical system. Changing of network conditions might be caused by:

- Cold load situation
- load changes
- automatic reclosing

While in normal conditions the standard parameters STD are valid. When network conditions change, dynamic parameters DP1 or DP2 can be activated by the event assigned to parameter DP1 activation [P2032] or DP1 activation [P2033].Parameters [P3107] to [P3112] or [P3143] to [P3148] become active and corresponding standard parameters become inactive. As soon as the activating event becomes inactive, standard parameters are activated and dynamic parameters become inactive.

The duration of change-over between standard parameters and dynamic parameters is in accordance with to the protection cycle time (<2ms) of the protection device.

The following dynamic STEP parameters of the ground overcurrent protection exist only once in each of the 6 independent protection STEPS. The dynamic STEP parameters apply only to one of the 6 protection STEPS of one parameter SET

Dynamic protection parameters – DP1

P3107 Limit

See description of parameter [P2038]

P3108 Delay time/TMS
See description of parameter [P2039]

P3109 Min. delay time
See description of parameter [P2052]

P3110 Reset limit
See description of parameter [P2042]

P3111 Reset delay time trip/TMS
See description of parameter [P2043]

P3112 Reset delay time pickup
See description of parameter [P2044]

Dynamic protection parameters – DP2

P3143 Limit
See description of parameter [P2038]

P3144 Delay time/TMS
See description of parameter [P2039]

P3145 Min. delay time
See description of parameter [P2052]

P3146 Reset limit
See description of parameter [P2042]

P3147 Reset delay time trip/TMS
See description of parameter [P2043]

P3148 Reset delay time pickup
See description of parameter [P2044]

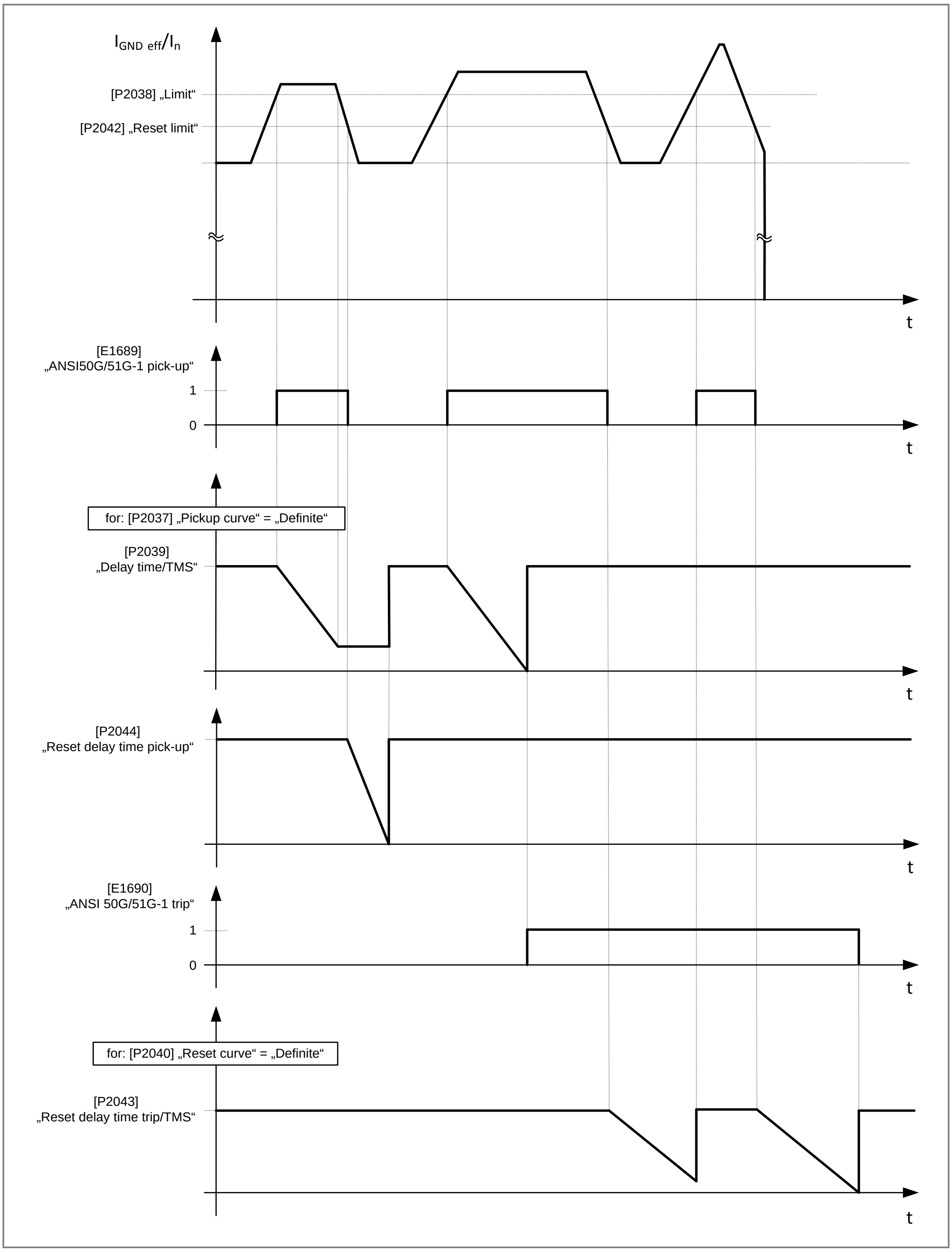


Figure 48 Ground overcurrent protection. – Trip characteristic (DT) and Reset characteristic (DT)

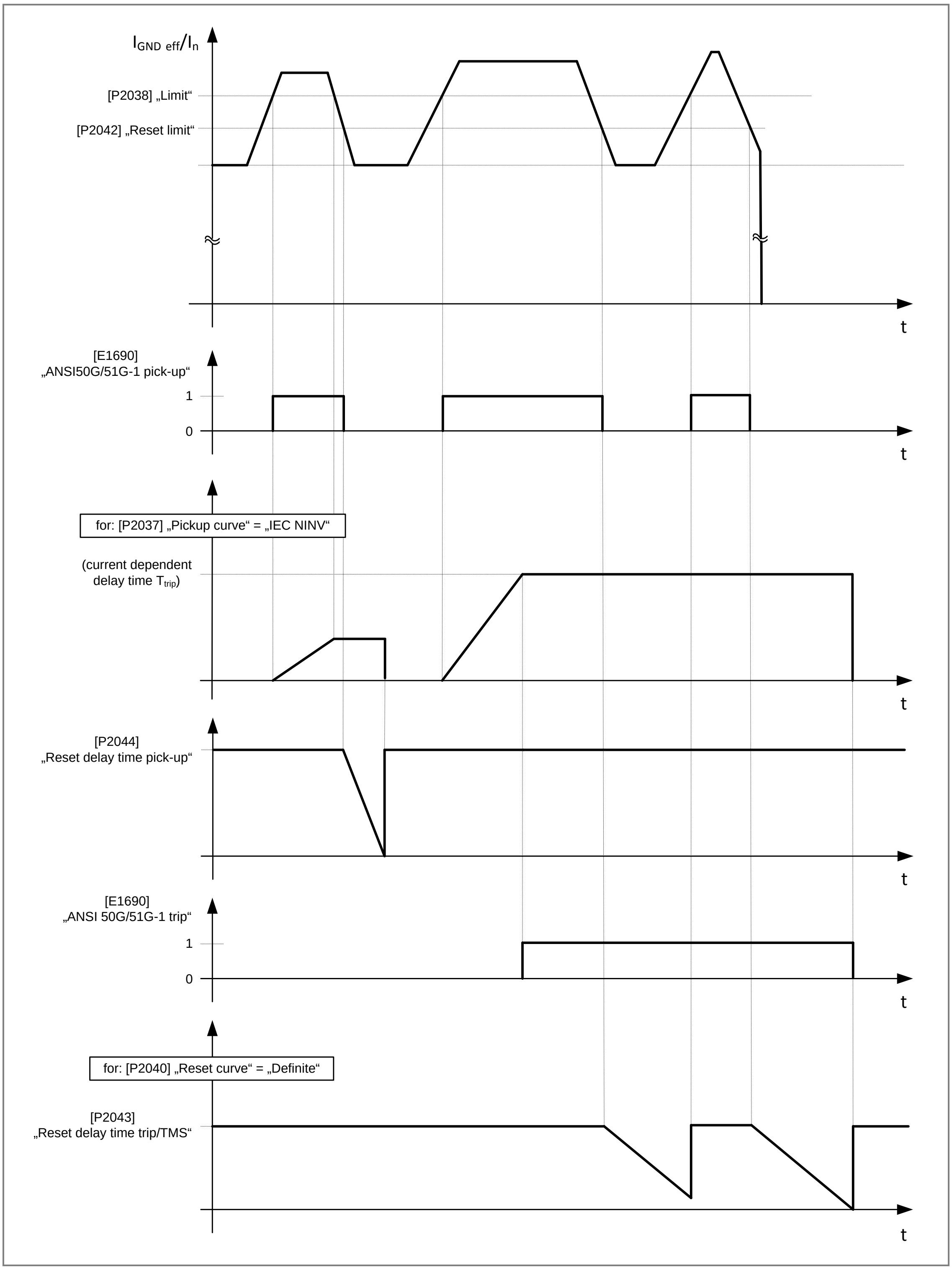


Figure 49 **Ground overcurrent protection – Trip characteristic (IDMT) and Reset characteristic (DT)**

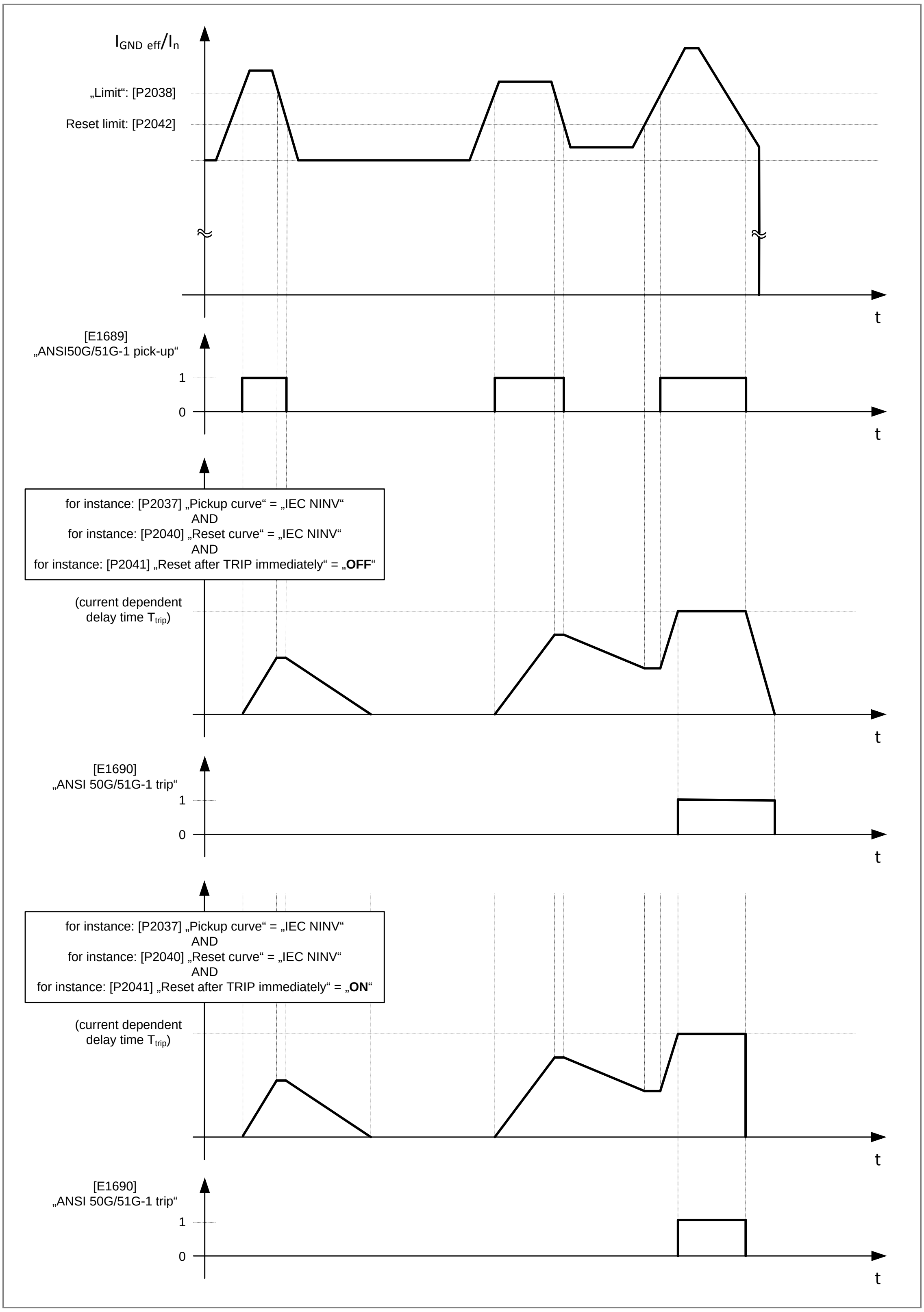


Figure 50 **Ground overcurrent protection – Trip characteristic (IDMT) and Reset characteristic (IDMT)**

2.1.16 ANSI 51/46 VR – Voltage restraint

ANSI 51/46 VR – Protection parameters [P] and events [E] of SET 1

Main Menu\Parameters\PROTECTION\				
ANSI 51/46VR				
SET 1	SET 2	SET 3	SET 4	
P/E No.	System Description	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	95	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	-	-	-

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

Note: Each of the four parameter sets provides only one protection STEP and, as a consequence, only one group of parameters. SET PARAMETERS of SET 1 represented below are described in detail in the following examples.

Protection parameters of parameter of SET 1 – ANSI 51/46 VR

P2875 Function

This parameter enables/disables voltage restraint overcurrent protection where:

- 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 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 activated. If the blocking event becomes inactive, blocking is abandoned and protective function is effective again. Event [E2241] is then 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

- Overcurrent protection ANSI 50/51 and/or
- Negative phase sequence current protection (NPS) ANSI46
  can be assigned by the following setting options of parameter *Voltage reference* [P2877] 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 for activated protection steps of ANSI 50/51 and/or ANSI46.

Each protective element of overcurrent protection overcurrent protection ANSI 50/51 and negative phase sequence current protection (NPS) ANSI46 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/Un. The curve for calculating the multiplier should be set by the following four parameters.

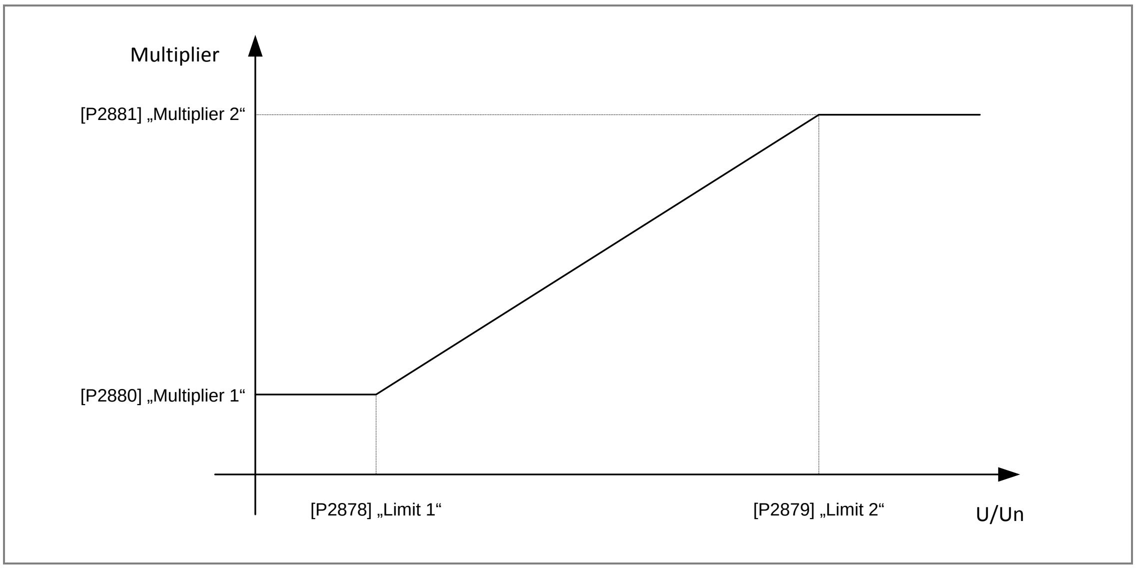


Figure 51 ANSI 51/46VR – Voltage-dependent curve for calculation of the multiplier

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 value of parameter [P2878] determines the beginning of the voltage-stabilised curve.

P2879 Multiplier 1

Start value of the multiplier to define the voltage stabilising curve; together with parameter *Limit 1* [P2878] the set value of parameter [P2879] determines the beginning of the voltage-stabilised 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 value of parameter [P2880] determines the end of the voltage-stabilised curve, and as a consequence, the maximum adaption of the pick-up value Limit and the Reset limit.

P2881 Multiplier 2

Maximum value of the voltage ratio U/Un to define the voltage stabilising curve; together with parameter Limit 2 [P2880] the set value of parameter [P2881] determines the end of the voltage-stabilised curve, and as a consequence, the maximum adaptation of the pick-up value Limit and the Reset limit.

P2882 Blocking protection

Blocking of a voltage restrained overcurrent protection step; where:

- 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.

2.1.17 ANSI 52 – Pole discordance protection

ANSI 52 – Parameter set 1: Protection parameters [P] and Events [E]

Main Menu\Parameters\PROTECTION\				
ANSI 52 – Pole discordance protection				
SET 1	SET 2	SET 3	SET 4	
P/E No.	Description	Vaule	Unit	(Setting range)
SET PARAMETERs				
P3718	Pole discordance protection	OFF	-	ON/OFF
P3719	Blocking protection module	0	event	0 ... 9999
E2523	ANSI52 module active	-	-	-
E2524	ANSI52 blocked module	-	-	-
STEP 1				
P3720	Function	OFF	-	OFF/Auxiliary contacts/ CT1/CT2
P3721	Blocking protection step	0	event	0 ... 9999
P3722	Open L1	0	event	0 ... 9999
P3723	Open L2	0	event	0 ... 9999
P3724	Open L3	0	event	0 ... 9999
P3725	Closed L1	0	event	0 ... 9999
P3726	Closed L2	0	event	0 ... 9999
P3727	Closed L3	0	event	0 ... 9999
P3728	Current limit	10	%	0 ... 100
P3729	Delay time	1	s	0 ... 999999,999
P3730	External pole discordance detection	0	event	0 ... 9999
E2525	ANSI52-1 active	-	-	-
E2526	ANSI52-1 blocked	-	-	-
E2527	ANSI52-1 pickup	-	-	-

E2528	ANSI52-1 trip	-	-	-
STEP 2				
P3731	Function	OFF	-	OFF/Auxiliary contacts/ current criterion
…	…	…	…	…

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 52

SET PARAMETERS

The following SET PARAMETERS of the pole discordance 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.

P3718 Pole discordance protection

This parameter enables/disables pole discordance protection where:

- OFF: disables or
- ON: enables the protective function.

When pole discordance protection ANSI 52 is enabled by parameter [P3718], then event "ANSI52 module active" [E2523] is activated.

P3719 Blocking protection module

Pole discordance protection can be completely blocked by any active event. For blocking, the number related to this blocking event has to be assigned to parameter [P3719]. Blocking is only effective, however, as long as the blocking event is active. As soon as blocking is active, event *"ANSI52 blocked module"* [E2524] is activated. If the blocking event turns inactive, blocking is abandoned and protective function is effective again. Then, event [E2524] is deactivated automatically.

If blocking of the pole discordance protection is not required, set this parameter to "**0**".

Protection parameters of STEP 1

The following STEP parameters of the pole discordance protection exist only once in each of the 3 independent protection STEPS. Thus, the STEP PARAMETERS apply only to one of the 3 protection STEPS of one parameter SET.

P3720 Function

This parameter enables/disables the first step of *pole discordance protection*, activation of the protection step takes place by selecting the protection criterion (characteristic quantity) for detection of the individual pole positions of the switching element' primary contacts) where selection option:

- OFF: disables the protective function, or
- Auxiliary contacts: enables the protective function => protective criterion

  detection of switching element's pole position via evaluation of switching element's *auxiliary contacts*, or

- CT1: enables the protective function => protective criterion: detection of switching element's pole position via phase-seggregated *current check of phase currents* measured by *CT1*, **or**
- CT2: Option not applicable for P16x

When *pole discordance protection* is enabled by parameter [P3720], then event *"ANSI52-1 active"* [E2525] is activated.

P3721 Blocking protection step

The first step of *pole discordance* protection can be blocked by any active event. For blocking, the number related to this blocking event has to be assigned to parameter [P3721]. Blocking is only effective, however, as long as the blocking event is active. As soon as blocking is active, event *"ANSI52-1 blocked step"* [E2526] is activated. If the blocking event turns inactive, blocking is abandoned and protective function is effective again. Then, event [E2526] is deactivated automatically.

If blocking of the first step of *pole discordance* protection is not required, set this parameter to "**0**".

Detection criterion "Auxiliary contacts" and pickup logic

The pole positions of the switching device can be transmitted via auxiliary contacts to the P16x via binary inputs. For evaluation of the pole positions the referring events have to be assigned to the following parameters [P3722] to [P3727].

CAUTION: Parameters [P3722] to [P3727] are only valid for the first step of pole discordance protection when parameter setting is as follows: *"Function [P3720 = Auxiliary contacts"*!
To gain a proper functionality when using auxiliary contacts as detection criterion, the primary cntacts have to be fully syncronized with the auxiliary contacts of the monitored switching element. This means, primary contacts and the auxiliary contacts have to switch simultaneously!

The pickup logic according to detection criterion *auxiliary contacts* is as follows:

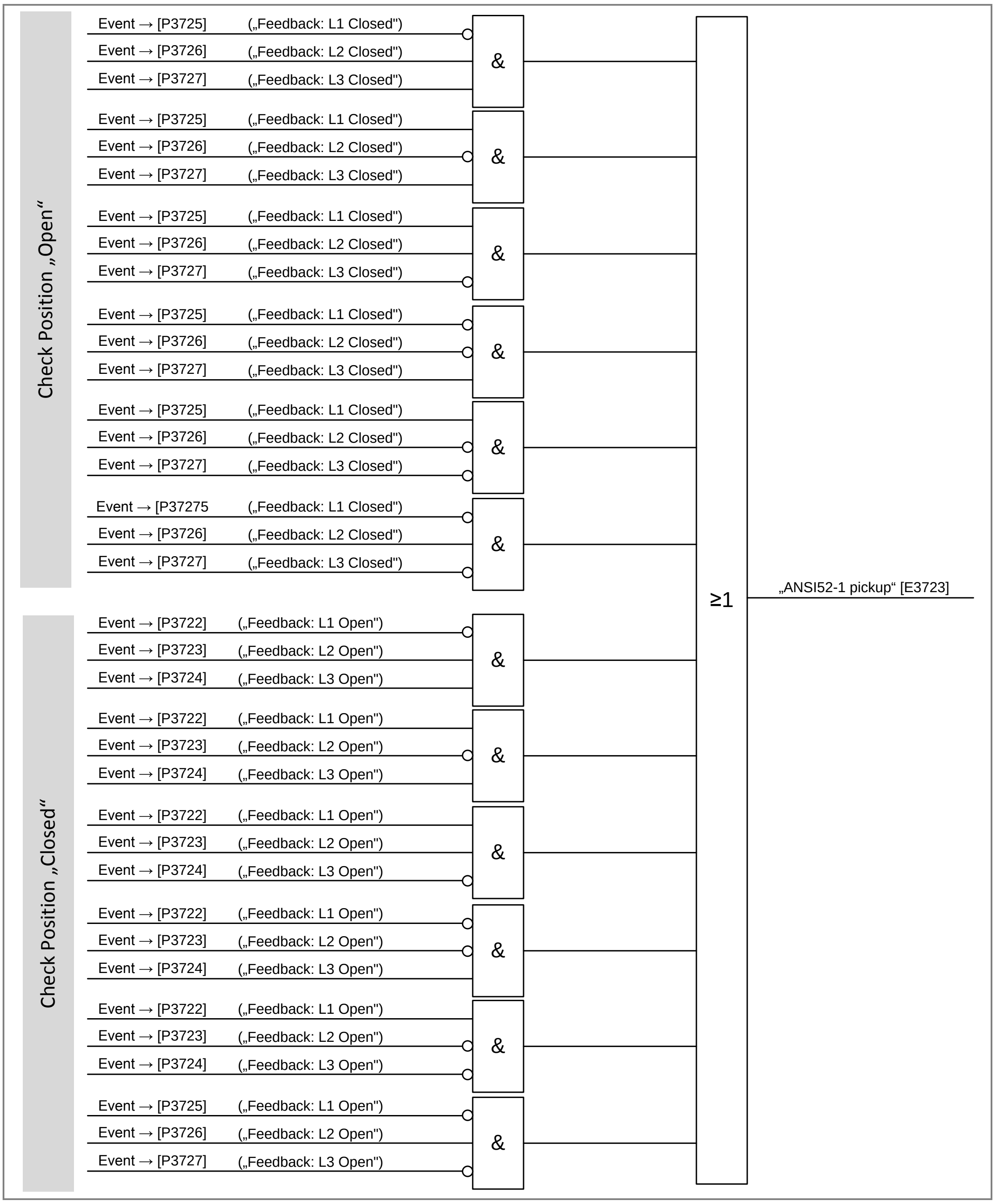


Figure 52 ANSI 52 – Detection criterion: Auxiliary contacts

Check position “Open“

If one or two of the pole position feedbacks (phase L1, L2, and/or L3) of the monitored switching element indicate position “Closed”, then pickup-event “ANSI52-1 pickup” [P2527] is activated and the and the trip delay time (“Delay time”) of the first pole discordance protection element will start.

When all three pole position feedbacks (phase L1, L2, and/or L3) indicate position “Open” before the trip delay time (“Delay time”) has run down, the timer of “Delay time” will be stopped and reset to zero, and the pick-up event [E2527] will be deactivated.

Check position “Closed“

If one or two of the pole position feedbacks of the monitored switching element indicate position “Open”, then pickup-event *“ANSI52-1 pickup”* [P2527] is activated and the and the trip delay time (“Delay time”) of the first pole discordance protection element will start.

When all three pole position feedbacks indicate position “Closed” before the trip delay time (“Delay time”) has run down, the timer of “Delay time” will be stopped and reset to zero, and the pick-up event [E2527] will be deactivated.

P3722 Open L1

Detection criterion for monitoring switching element’s pole position “Open” of phase L1

P3723 Open L2

(analog to description of parameter [P3722], relating to phase L2)

P3724 Open L3

(analog to description of parameter [P3722], relating to phase L3)

P3725 Closed L1

Detection criterion for monitoring switching element’s pole position “Closed” of phase L1

P3726 Closed L2

(analog to description of parameter [P3725], relating to phase L2)

P3727 Closed L3

(analog to description of parameter [P3725], relating to phase L3)

Detection criterion current check and pickup logic

As an alternative to the detection criterion auxiliary contacts, the pole positions can also be monitored by applying the current check.

CAUTION:	**Parameter [P3722] are only valid for the first step of pole discordance protection when parameter setting is as follows: *“Function [P3720 = CT1“*** **Current check is only applicable if the monitored switching element is energized.**

The pickup logic according to detection criterion *current criterion* is as follows:

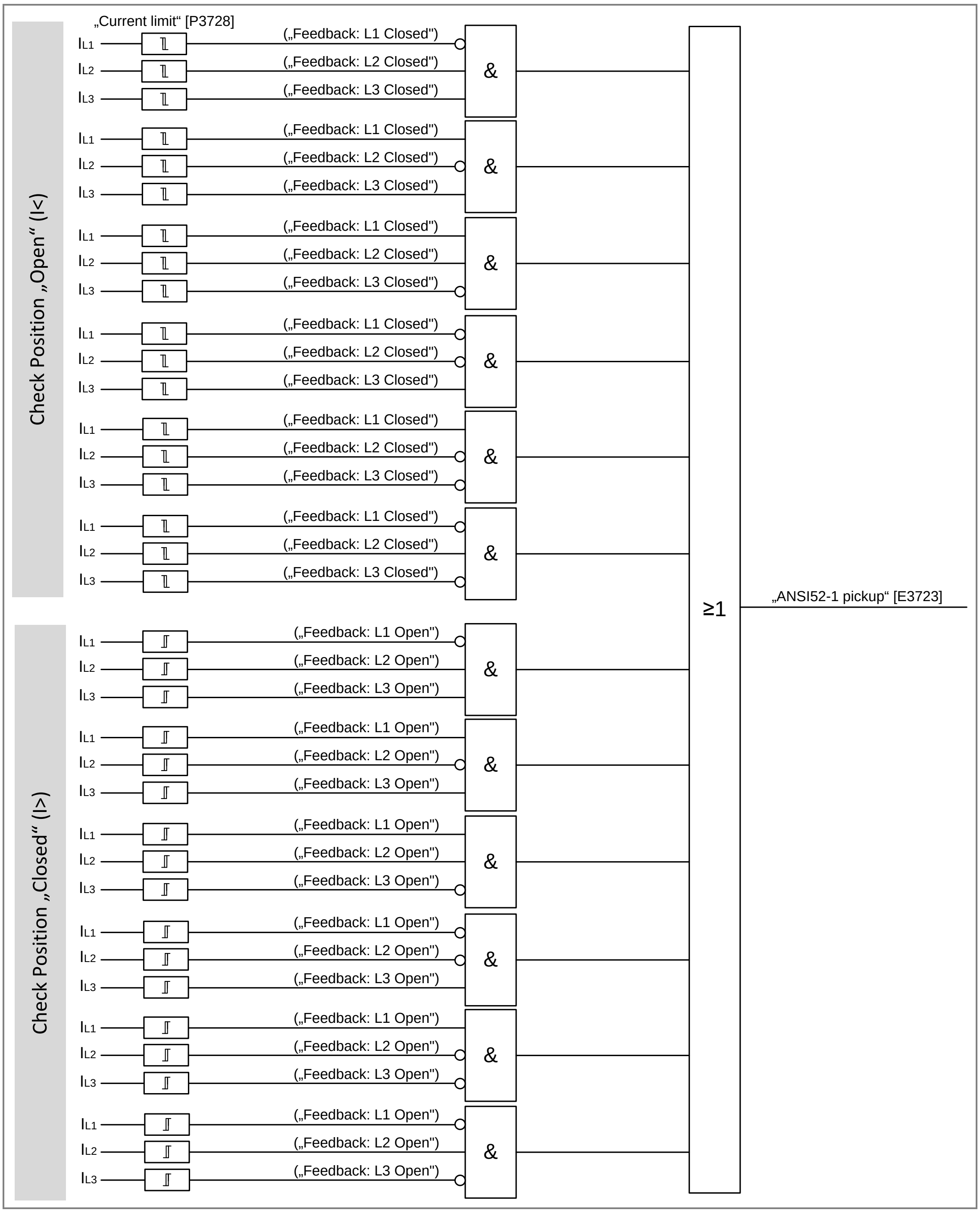


Figure 53 ANSI 52 – Detection criterion: Current check

P3728 Current limit

Pickup value for the first step of pole discordance protection according to the detection criterion "**Current criterion**";

Check position "Open"

At the moment that the process quantity (phase current) exceeds this limit in one or two phases it can be concluded that one or more pole contacts are closed. Then pickup-event "ANSI52-1 pickup” [P2527] is activated and the trip delay time (“Delay time”) of the first pole discordance protection element will start.

In case that the process quantity (phase current) falls below the “Current limit” in all three phases before “Delay time“ has run down, the timer of “Delay time” will be stopped and reset to zero, and the pick-up event [E2527] will be deactivated.

Check position “Closed“

At the moment that the process quantity (phase current) falls below this limit in one or two phases it can be concluded that one or more pole contacts are open. Then pickup-event “ANSI52-1 pickup” [P2527] is activated and the and the trip delay time (“Delay time”) of the first pole discordance protection element will start.

In case that the process quantity (phase current) exceeds the “Current limit” in all three phases before “Delay time“ has run down, the timer of “Delay time” will be stopped and reset to zero, and the pick-up event [E2527] will be deactivated.

P2529 Delay time

Trip delay time; it is the delay time of the trip event *“ANSI52-1 trip“* [E2528].

As soon as the pick-up event *“ANSI52-1 pickup“* [E2527] is active and “Delay time” run down, trip event [E2528] will be activated. This event can be used for alarm or output control purposes.

P3730 External pole discordance detection

When external pole discordance equipment (external pickup) is used to detect any mismatch of the pole contacts, then the event number of the relating signal (e.g. binary input) which is transmitted to the P16x has to be assigned to parameter [P3730].

> *Note: Detection criterion „External pole discordance“ is only valid when parameter setting is as follows: „External pole discordance detection ≠ 0“ !*

2.1.18 ANSI 59 – Overvoltage Protection

ANSI 59 – Protection parameters [P] and events [E] of SET 1

				Main Menu\Parameters\PROTECTION\
ANSI 59				
SET 1	SET 2	SET 3	SET 4	
P/E No.	System Description	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/ Uavg 10min
P1206	Blocking protection step	0	event	0 … 9999
P1207	Limit	110	%	1 … 200
P1208	Delay time	0.5	s	0 … 999999,999
P1209	Reset limit	105	%	1 … 200

P1210	Reset delay time trip	0	s	0 … 999999,999
P1211	Reset delay time pickup	0	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
…	…	…	…	…

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. The parameter descriptions of the SET PARAMETERS and the parameters of STEP 1 represented below are described in detail in the following examples.*

Protection parameters of SET 1 – ANSI 59

SET PARAMETERS

The following SET PARAMETERS of the overvoltage protection exist only once in each of the four parameter sets. The SET PARAMETERS apply to all of the 12 protection STEPS of one parameter SET.

P1200 Overvoltage protection

This parameter enables/disables overvoltage protection where:

- 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 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 activated. If the blocking event becomes inactive, blocking is abandoned and protective function is effective again. Event [E1151] is then 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. The SET PARAMETERS apply only to one of the 12 protection STEPS of one parameter SET.

P1205 Pick-up source

Depending on the P60 Agile 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
- Uavg 10min: voltage input (see parameter setting,*"Source of Uavg10min"* [P9463] in submenu: SYSTEM\Measuring**Floating average)**

For settings PT1, PT2 or PT3, event *ANSI59-1 step active* [E1154] is 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 activated. If the blocking event becomes inactive, blocking is abandoned and protective function is effective again. event [E1155] is then 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. When 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 should 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 [P1212]. 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*
>
> *When the calculation of the pick-up value refers to the phase-to-neutral voltage, parameter Voltage reference [P1202] should be set to L-N, so that factor √3 is not necessary to be considered for calculation.*
>
> *The referring parameters Voltage (L-L) [P603] is located in submenu: SYSTEM\Nominals**Reference values**.*

P1212 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.

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.

When 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 saved. If the characteristic quantity subsequently falls below the Reset limit, the Reset delay time pick-up timer will then 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 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 should 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 [P1212]. 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

When the calculation of the pick-up value refers to the phase-to-neutral voltage, parameter Voltage reference [P1212] should be set to L-N, so that factor √3 is not necessary to be considered for calculation.

The referring parameters Voltage (L-L) [P603] is 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 deactivated. When 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.

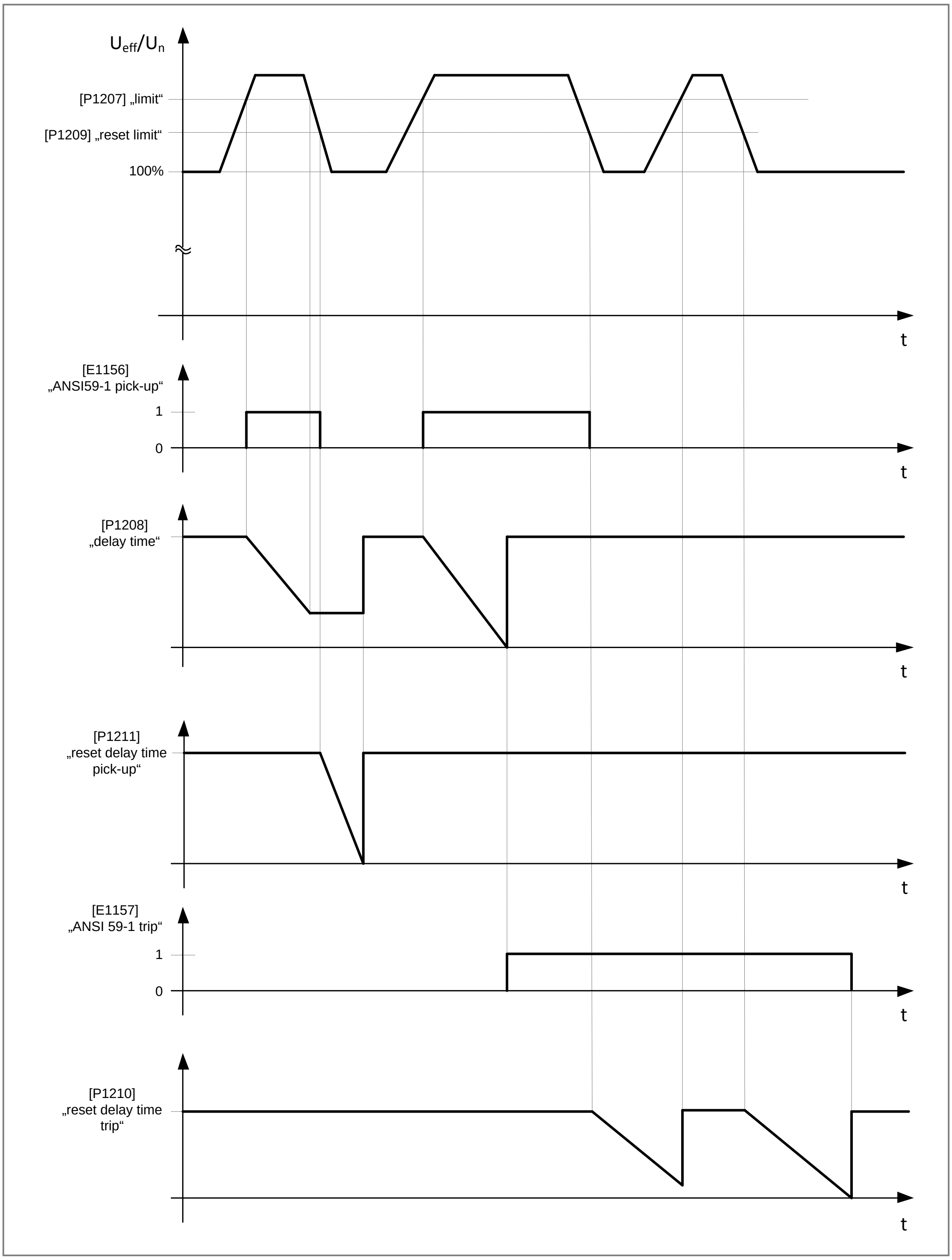


Figure 54 **Overvoltage – Tripping and reset characteristic**

2.1.19 ANSI 59N/G – Neutral Voltage Displacement (NVD)

ANSI 59N/G – Protection parameters [P] and events [E] of SET 1

Main Menu\Parameters\PROTECTION\				
ANSI 59N/G				
SET 1	SET 2	SET 3	SET 4	
P/E No.	System Description	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	0	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
…	…	…	…	…

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. The parameter descriptions of the SET PARAMETERS and the parameters of STEP 1 represented below are described in detail in the following 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. 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 where:

- 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 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 activated. If the blocking event becomes inactive, blocking is abandoned and protective function is effective again. Event [E1371] is then 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. The STEP PARAMETERS apply only to one of the 4 protection STEPS of one parameter SET.

P1540 Pick-up source

Depending on the P60 Agile 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 activated.

> *Note:* *In case that residual voltage is to be calculated by voltage measuring via PT1, PT2 or PT3 it is required to connect terminal N of P16x device (X1.2:18; X1.2:26) to ground potential!*
>
> *For test purposes via voltage generator test equipment it is required to connect terminal N of P16x device to the neutral potential of the voltage test equipment.*

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 activated. If the blocking event becomes inactive, blocking is abandoned and protective function is effective again. Event [E1374] is then 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 should be set as a percentage of the nominal value of the characteristic quantity (residual voltage UG). The nominal value of the characteristic quantity should be set by parameter: Ground voltage [P606], for primary side W1*
>
> *The parameter Ground voltage [P606] is 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.

When 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 saved. If the characteristic quantity subsequently falls below the Reset limit, the Reset delay time pick-up timer then 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 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 should be set as a percentage of the nominal value of the characteristic quantity (residual voltage U_G). The nominal value of the characteristic quantity should be set by parameter: Ground voltage [P606], for primary side W1*
>
> *The parameter Ground voltage [P606] is 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 deactivated. When 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.

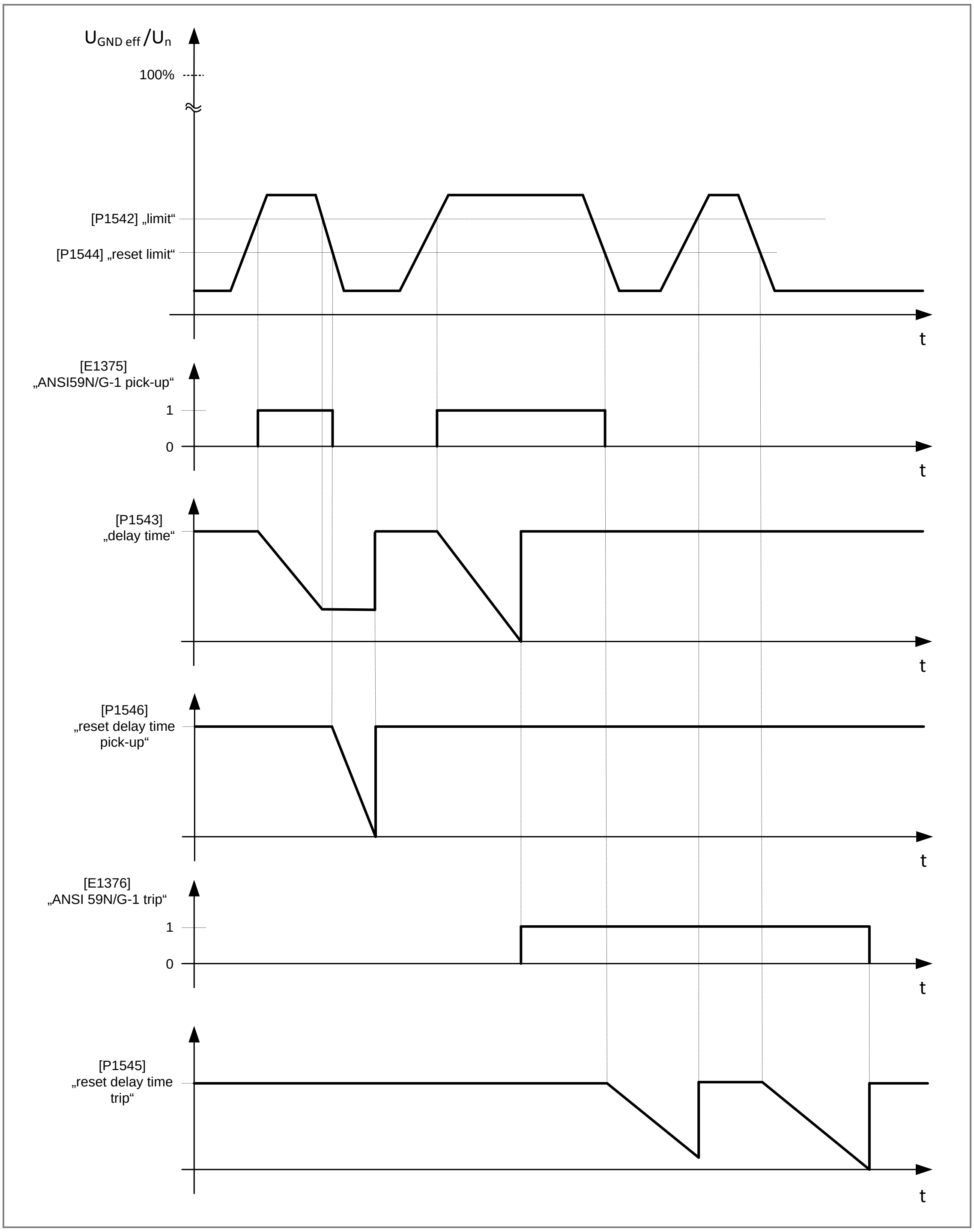


Figure 55 Neutral Voltage Displacement (NVD) – Tripping and reset characteristic

2.1.20 ANSI 64REF – Restricted Earth Fault Protection

Functioning of the differential protection is based on a balance of ground current $\underline{I}_G$ measured at the transformer star point (CT-GNDx) and the summation $\underline{I}_\Sigma = 3 \times \underline{I}_0 = [\underline{I}_{L1} + \underline{I}_{L2} + \underline{I}_{L3}]$ calculated from measured phase current input (CTx).

$\underline{I}_{d,G} = \underline{I}_G + \underline{I}_\Sigma$

The resulting variable of this current comparison is the differential ground current $\underline{\mathbf{I}}_{\mathbf{d,G}}$ as protection criterion for easy differentiating operating or ground fault event.

- For the operating event ideally applies: $\Sigma\, \underline{I} = 0$ (Kirchhoff's law)
- In the event of fault, a differential ground current occurs: $\Sigma\, \underline{I} \neq 0 = \underline{\mathbf{I}}_{\mathbf{d,G}}$

This protection principle is advantageous because of the high degree of selectivity, as the CTs unambiguously define the protection range on both ends of the equipment to protect. Consequently, fault finding can be affected in fast mode.

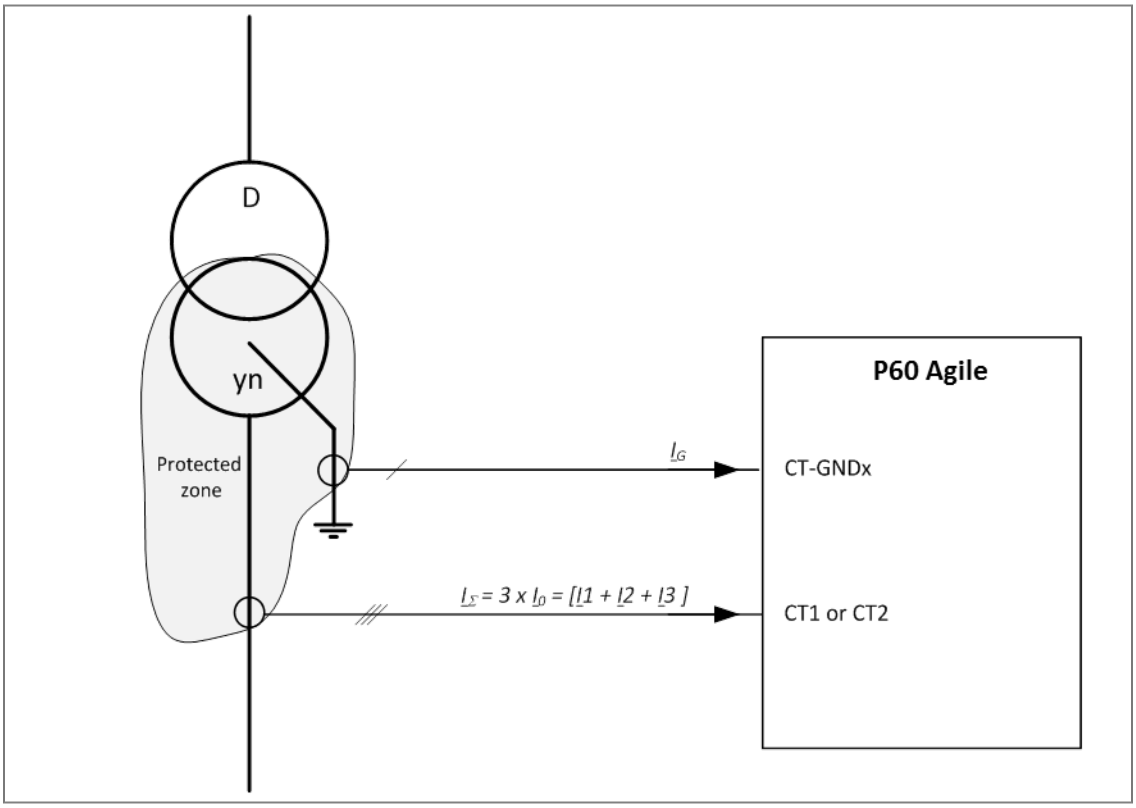


Figure 56 ANSI 64REF – Protective zone

To assign the measuring input channels to measure $\underline{I}_G$ and $\underline{I}_\Sigma$ see parameters:

- CT-GNDx source [P9439] and
- CTx source [P9440]

In the sub-menu: SYSTEM\Measuring**Differential**

ANSI 64REF – Protection parameters [P] and events [E] of SET 1

Main Menu\Parameters\PROTECTION\				
ANSI 64REF				
SET 1	SET 2	SET 3	SET 4	
P/E No.	System Description	Value	Unit	(Setting range)
SET PARAMETERS				
P3440	Restricted earth fault	OFF	-	ON/OFF
P3441	Blocking	0	event	0 … 9999
P3442	Hysteresis	0.0	%	0 … 1999,9
E2370	ANSI64REF active	-	-	-
E2371	ANSI64REF blocked	-	-	-
STEP 1				
P3447	Function	ON	-	ON/OFF
P3448	Blocking	0	event	0 … 9999
P3449	Is0 setting	300.0	%	0 … 1999,9
P3450	Is1 setting	600.0	%	0 … 1999,9
P3451	Is2 setting	900.0	%	0 … 1999,9
P3452	Id0 setting	20.0	%	0 … 1999,9
P3453	Id1 setting	41.0	%	0 … 1999,9
P3454	Id2 setting	191.0	%	0 … 1999,9
P3455	Delay time	0.03	s	0 ... 65,535
P3456	Harmonics stabilizer CT-GNDx	OFF	-	OFF / 2H / 5H / 2H/5H
P3457	Harmonics stabilizer CTx	OFF	-	OFF / 2H / 5H / 2H/5H
E2373	ANSI 64REF-1 active	-	-	-
E2374	ANSI 64REF-1 blocked	-	-	-
E2375	ANSI 64REF-1 pickup	-	-	-
E2376	ANSI 64REF-1 trip	-	-	-
STEP 2				
P3460	Function	OFF	-	ON/OFF
P3461	Blocking	0	event	0 … 9999
P3462	Id>>	300.0	%	0 … 1999,9
P3463	Delay time	0.03	s	0 ... 65,535
E2379	ANSI 64REF-2 active	-	-	-
E2380	ANSI 64REF-2 blocked	-	-	-
E2381	ANSI 64REF-2 pickup	-	-	-
E2382	ANSI 64REF-2 trip	-	-	-

Parameter description:

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

Protection parameters of parameter SET 1 – ANSI 64REF

SET PARAMETERS

The following SET PARAMETERS of the restricted earth fault protection (ground fault differential protection) exist only once in each of the four parameter sets. The SET PARAMETERS apply to protection STEP 1 and protection STEP 2 of one parameter SET.

P3440 Restricted earth fault

This parameter activates/deactivates the restricted earth fault protection where the setting:

- OFF: deactivates the protection function or
- ON: activates the protection function.

When restricted earth fault protection ANSI 64REF is enabled by parameter [P3440], then event *ANSI64REF active* [E2370] is activated.

P3441 Blocking

Restricted earth fault 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 [P3341]. Blocking is only effective, however, as long as the blocking event is active. As soon as blocking is active, event *ANSI64REF blocked* [E2371] is activated. If the blocking event becomes inactive, blocking is abandoned and protective function is effective again. Event [E2371] is then deactivated automatically.

If blocking of the restricted earth fault protection is not required, set this parameter to **0**.

P3442 Hysteresis

This parameter [P3442] determines the reset limit for the pick-up event *ANSI64REF-1 pickup* [E2375] of the stabilized restricted earth fault protection element (STEP1) or *ANSI64REF-2 pickup* [E2381] for the unstabilized high-set restricted earth fault protection element (STEP 2). At the moment the characteristic value (differential ground current) falls below the reset limit, the activated pick-up event [E2375] or [E2381] will be deactivated.

Note:	*Stabilized restricted earth fault protection element (STEP 1):* *(reset limit) = configured trip curve – Hysteresis [P3442]* *High-set restricted earth fault protection element (STEP 2):* *(reset limit) = Id>> [P3462] – Hysteresis [P3442]*

Protection parameters – Stabilized restricted earth fault protection element (STEP 1)

P3447 Function

This parameter activates/deactivates the stabilized restricted earth fault protection element (STEP 1) where the setting:

- OFF: deactivates the stabilized restricted earth fault protection element or
- ON: activates the stabilized restricted earth fault protection element.

When stabilized restricted earth fault protection element is enabled by parameter [P3447], then event *ANSI64REF-1 active* [E2373] is activated.

P3448 Blocking

Stabilized restricted earth fault 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 [P3448]. Blocking is only effective, however, as long as the blocking event is active. As soon as blocking is active, event *ANSI64REF-1 blocked* [E2374] is activated. If the blocking event becomes inactive, blocking is abandoned and protective element is effective again. Event [E2374] is then deactivated automatically.

If blocking of the stabilized restricted earth fault protection element (STEP 1) is not required, set this parameter to **0**.

Configuration of the tripping curve

The tripping characteristic of the P60 Agile stabilized restricted earth fault protection element (STEP 1) 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 (see parameters *Is0* [P3449]; *Id0* [P3452])
- Range 2: stabilized tripping characteristic with 1st gradient factor (see parameters *Is1* [P3450]; *Id1* [P3453])
- Range 3: stabilized tripping characteristic with 2nd gradient factor (see parameters *Is2* [P3451]; *Id2* [P3454])

Calculation of stabilization current:

$I_{stab} = |I_G| + |I_1| + |I_2| + |I_3|$

$= I_G + I_1 + I_2 + I_3$

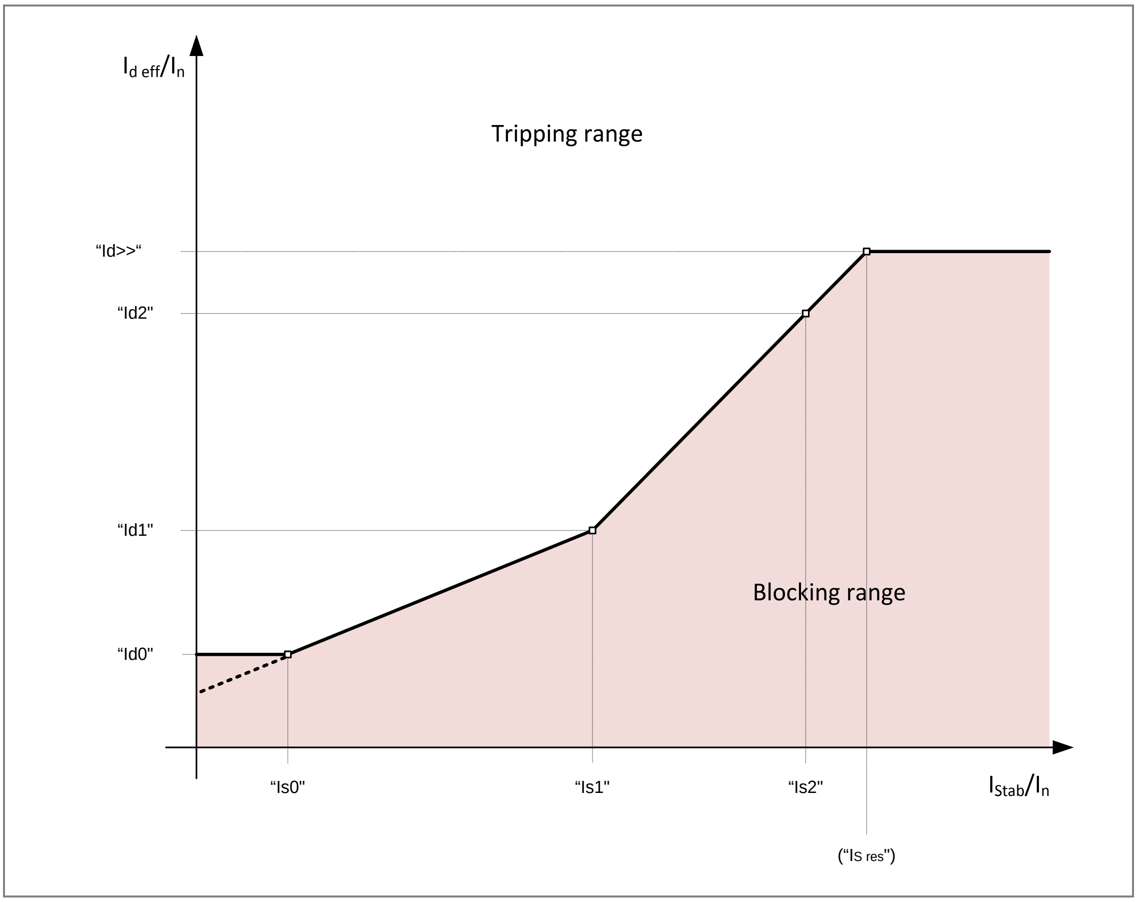


Figure 57 P60 Agile – ANSI 64REF-1 tripping characteristic

Note: Parameters [P3449] to [P3454] are to be set as a percentage of the nominal value of the characteristic quantity (ground current). The nominal value of the characteristic quantity should be set by parameter: Ground Current [P607], for primary side W1

*The referring parameters Ground Current [P607] and Ground Current [P627] are located in submenu: SYSTEM\Nominals**Reference values**.*

P3449 Is0

In combination with parameter Id0 [P3452] parameter [P3449] defines the first straight line segment (as well as the starting point of the second straight line segment) of the tripping curve of the stabilized restricted earth fault protection. The first straight line segment is valid for a value range of the stabilisation current between I_{stab} *= 0* and I_{stab} *= Is0*, in which the tripping characteristic corresponds to the constant pick-up value of the characteristic quantity (differential ground current I_d) *Id0.*

P3450 Is1

In combination with parameter *Id1* [P3453] parameter [P3450] defines the second straight line segment (as well as the starting point of the third straight line segment) of the tripping curve of the stabilized restricted earth fault. The second straight line segment is valid for a value range of the stabilisation current between I_{stab} = *Is0* and
I_{stab} = *Is1*.

P3451 Is2

In combination with parameter *Id2* [P3454] parameter [P3451] defines the second point to determine the slope of the third straight line segment of the tripping curve of the stabilized restricted earth fault. An ending point of the third straight line segment can be set by using parameter Id>> [P3462] 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* and I_{stab} = $I_{S\ res}$.

P3452 Id0

First, constant tripping value of the differential ground current I_d for definition of the tripping characteristic curve; exceeds the characteristic quantity (differential ground current I_d), the set value of parameter [P3452] – for stabilization ground currents in the range between I_{stab} *= 0* and I_{stab} = *Is0* – the pick-up event *ANSI64REF-1 pick-up* [E2375] will be activated.

If there is no active blocking of the Harmonics stabilizer ANI95i and Delay time (Parameter *Delay time* [P3455]) run down then trip event *ANSI64REF-1 trip* [E2376] is also activated. This event can be used for alarm or output control purposes.

P3453 Id1

In combination with parameter *Is1* [P3450] parameter [P3453] defines the second straight line segment (as well as the starting point of the third straight line segment) of the tripping curve of the stabilized restricted earth fault. If the characteristic quantity (differential ground current I_d) exceeds the range of values set with the parameters [P3450] and [P3453] – for stabilization ground currents in the range between I_{stab} = *Is0* and I_{stab} = *Is1* – the pick-up event *ANSI64REF-1 pick-up* [E2375] will be activated.

If there is no active blocking of the Harmonics stabilizer ANI95i and Delay time (Parameter *Delay time* [P3455]) run down then trip event *ANSI64REF-1 trip* [E2376] is also activated. This event can be used for alarm or output control purposes.

P3454 Id2

In combination with parameter *Is2* [P3451] parameter [P3454] defines the second point to determine the slope of the third straight line segment of the stabilized restricted earth fault protection tripping curve. If the characteristic variable (differential ground current I_d) exceeds the range of values set with the parameters [P3451] and [P3454] – for stabilization ground currents in the range between I_{stab} = *Is1* and I_{stab} = *Is res* – the pick-up event *ANSI64REF-1 pick-up* [E2375] will be activated.

If there is no active blocking of the Harmonics stabilizer ANI95i and Delay time (Parameter *Delay time* [P3455]) run down then trip event *ANSI64REF-1 trip* [E2376] is also activated. This event can be used for alarm or output control purposes.

P3455 Delay time

Trip delay time is the delay time of the trip event *ANSI64REF-1 trip* [E2376].

As soon as the pick-up event *ANSI64REF-1 pick-up* [E2375] is active and Delay time run down and there is no active blocking of the Harmonics stabilizer ANI95i ,then, trip event [E2376] will be activated. This event can be used for alarm or output control purposes.

P3456 Harmonics stabilizer CT-GNDx

Blocking of stabilized restricted earth fault protection element (STEP 1) by harmonics stabilizer ANSI 95i function for measuring values of CT-GND1; according to the settings of the harmonics stabilizer ANSI 95i function, the pickup of the stabilized restricted earth fault protection element (STEP 1) may be temporarily blocked upon exceeding of defined contents of the 2nd and/or 5th harmonic (I_{100Hz} and/or I_{250Hz}) in the ground current:

- OFF: blocking of ANSI 64REF-1 by ANSI 95i is deactivated
- 2H: blocking of ANSI 64REF-1 by ANSI 95i in case of 2nd harmonic
- 5H: blocking of ANSI 64REF-1 by ANSI 95i in case of 5th harmonic
- 2H/5H: blocking of ANSI 64REF-1 by ANSI 95i in case of 2nd or 5th harmonic

Note:	*Appropriate settings of the corresponding parameters of ANSI95i are to be made in the submenu: PROTECTION\95i Harmonics stabilizer.*

P3457 Harmonics stabilizer CTx

Blocking of stabilized restricted earth fault protection element (STEP 1) by harmonics stabilizer ANSI 95i function for measuring values of CT1 or CT2; (see description of parameter [P3456]).

Protection parameter – High-set restricted earth fault protection element (STEP 2)

P3460 Function

This parameter activates/deactivates the high-set restricted earth fault protection element (STEP 2) where the setting:

- OFF: deactivates the high-set restricted earth fault protection element or
- ON: activates the high-set restricted earth fault protection element.

When high-set restricted earth fault protection element is enabled by parameter [P3460], then event *ANSI64REF-2 active* [E2379] is activated.

P3461 Blocking

High-set restricted earth fault 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 [P3461]. Blocking is only effective, however, as long as the blocking event is active. As soon as blocking is active, event *ANSI64REF-2 blocked* [E2371] is activated. If the blocking event becomes inactive, blocking is abandoned and protective element is effective again. Event [E2371] is then deactivated automatically.

If blocking of the high-set restricted earth fault protection element (STEP 2) is not required, set this parameter to **0**.

P3462 Id>>

This parameter defines the *pick-up value* for the characteristic quantity (differential ground current I_d) of the high-set restricted earth fault protection element (STEP 2), disregarding the height of the stabilization current I_{stab}.

If the characteristic quantity exceeds the value set for parameter [P3462], the trip event *ANSI64REF-2 trip* [E2382] will be activated regardless of the stabilized tripping characteristic. This event can be used for alarm or output control purposes.

> *Note: The pick-up value should be set as a percentage of the nominal value of the characteristic quantity (ground current). The nominal value of the characteristic quantity should be set by parameter: Ground Current [P607], for primary side W1*
>
> *The parameter Ground Current [P607] is located in submenu: SYSTEM\Nominals**Reference values**.*

P3463 Delay time

Trip delay time; it is the delay time of the trip event *ANSI64REF-2 trip* [E2382].

As soon as the pick-up event *ANSI64REF-2 pick-up*[E2381] is active and Delay time run down, trip event [E2382] will be activated. This event can be used for alarm or output control purposes.

2.1.21 ANSI 67 – Directional Overcurrent Protection

ANSI 67 – Standard (STD) protection parameters [P] and events [E] of SET 1

Main Menu\Parameters\PROTECTION\ANSI 67 – Directional overcurrent\

STD

SET 1 | SET 2 | SET 3 | SET 4

P/E No.	System Description	Value	Unit	(Setting range)
SET PARAMETERS				
P2155	Directional overcurrent protection	ON	-	ON/OFF
P2156	Blocking protection module	0	event	0 … 9999
P2157	DP1 activation	0	event	0 … 9999
P2158	DP2 activation	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	200	%	5 … 1999,9
P2164	Delay time/TMS	0.03	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	150	%	5 … 1999,9
P2168	Reset delay time trip/TMS	0	s/-	0 … 999999,999
P2169	Reset delay time pickup	0	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
P2176	Start fault locator	No	-	No/Yes
P2179	Min. delay time	0	s	0 … 999999,999

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 L1	-	-	-
E1752	ANSI67-1 low voltage L2	-	-	-
E1753	ANSI67-1 low voltage L3	-	-	-
STEP 2				
P2180	Pickup source	CT1	-	none/CT1/CT2*
…	…	…	…	…

ANSI 67 – Dynamic parameters (DP1) of protection parameters [P] of SET 1

Main Menu\Parameters\PROTECTION\ANSI 67 – Directional overcurrent

DP1

SET 1 | SET 2 | SET 3 | SET 4

P/E No.	System Description	Value	Unit	(Setting range)
STEP 1				
P3179	Limit	200	%	5 … 1999,9
P3180	Delay time/TMS	0.03	s/-	0 … 999999,999
P3181	Min. delay time	0	s/-	0 … 999999,999
P3182	Reset limit	150	%	5 … 1999,9
P3183	Reset delay time trip/TMS	0	s/-	0 … 999999,999
P3184	Reset delay time pickup	0	s	0 … 999999,999
STEP 2				
P3185	Limit	20	%	0 … 65535,5
…	…	…	…	…

ANSI 67 – Dynamic parameters (DP2) protection parameters [P] of SET 1

Main Menu\Parameters\PROTECTION\ANSI 67 – Directional overcurrent				
DP2				
SET 1	SET 2	SET 3	SET 4	
P/E No.	System Description	Value	Unit	(Setting range)
STEP 1				
P3203	Limit	200	%	5 … 1999,9
P3204	Delay time/TMS	0.03	s/-	0 … 999999,999
P3205	Min. delay time	0	s/-	0 … 999999,999
P3206	Reset limit	150	%	5 … 1999,9
P3207	Reset delay time trip/TMS	0	s/-	0 … 999999,999
P3208	Reset delay time pickup	0	s	0 … 999999,999
STEP 2				
P3209	Limit	20	%	0 … 65535,5
…	…	…	…	…

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. The parameter descriptions of the SET PARAMETERS and the parameters of STEP 1 represented below are described in detail in the following examples.*

STD – Standard protection parameters of parameter SET 1 – ANSI 67

STD - SET PARAMETERS

The following SET PARAMETERS of the overcurrent protection exist only once in each of the four parameter sets. 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 where:

- OFF: disables or
- ON: enables the protective function.

When directional overcurrent protection ANSI 67 is enabled by parameter [P2155], then event *ANSI*67 *module active* [E1735] is 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 activated. If the blocking event becomes inactive, blocking is abandoned and protective function is effective again. Event [E1736] is then deactivated automatically.

If blocking of the directional overcurrent protection is not required, set this parameter to 0.

P2157 DP1 activation

Dynamic parameters 1 of function ANSI 67 can be activated by any active event. For activation, the number related to this event has to be assigned to parameter [P2157]. Activation is only effective, however, as long as the assigned event is active. If the assigned event becomes inactive, DP1 is deactivated.

If activation of DP1 is not required, set this parameter to 0.

P2158 DP2 activation

Dynamic parameters 2 of function ANSI 67 can be activated by any active event. For activation, the number related to this event has to be assigned to parameter [P2158]. Activation is only effective, however, as long as the assigned event is active. If the assigned event becomes inactive, *DP2* is being deactivated.

If activation of *DP2* is not required, set this parameter to **0**.

Note: Appropriate settings of the corresponding parameters of DP1/DP2 are to be made in the submenu: PROTECTION\Directional overcurrent ANSI 67 \DPx activation.

With dynamic parameters DP1 and/or DP2 it is possible to activate a set of parameters in submenu DP1 and/or DP2.

STD – Standard 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. The STEP PARAMETERS apply only to one of the 4 protection STEPS of one parameter SET.

P2160 Pick-up source

Depending on the P60 Agile device variant each protection step of directional overcurrent protection can be assigned to a certain current measurement input (CT1 or CT2 – if available). 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: This option is not supported in P16x devices

*Note: The assignment of the voltage measurement input (PT1, PT2 or PT3) to the current measurement input CT1 is to be done by the following parameters (referring to the setting options of parameter [P2160]), in the submenu SYSTEM \Measuring**Power**:*
PT reference [P9410], for Power_CT1

To measure current direction correctly, the needed energy flow direction is to be defined by following parameter: Direction [P9411], for Power_CT1

For Power_CT1 setting, event ANSI67-1 step active [E1741] is 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 activated. If the blocking event becomes inactive, blocking is abandoned and protective function is effective again. Event [E1742] is then 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:

- **D**efinite **T**ime-delay overcurrent protection (**DT**) or
- **I**nverse **D**efinite **M**inimum **T**ime-delay protection (**IDMT**)

There are up to 7 different inverse time characteristics (IDMT) available, which meet 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)

Details for parameters of inverse curves (IDMT) and Inverse IEC curve examples can be found under ANSI 50/51 section.

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 ILx and reference voltage UILx ref (with: x = 1, 2, 3) is located within the trip angle range, events ANSI67-1 pick-up [E1746] and phase segregated pickup event(s) – depending on the fault loop – ANSI67-1 pickup L1 [E1743] and/or ANSI67-1 pickup L2 [E1744] and/or ANSI67-1 pickup L3 [E1745] will become active, and Delay time/TMS of the first directional overcurrent protection element will start.

When 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 saved.

The pick-up value should be set as a percentage of the nominal value of the characteristic quantity (phase current). The nominal value of the characteristic quantity should be set by parameter:

- *Current* [P604], for primary side W1

The parameter *Current* [P604] is located in submenu: SYSTEM \Nominals **Reference values**.

Note:	*Depending on the fault loop the phase-segregated pickup event(s) ANSI67-1 pickup L1 [E1743] and/or ANSI67-1 pickup L2 [E1744] and/or ANSI67-1 pickup L3 [E1745] and common pickup event ANSI67-1 pickup [E1746] will be activated/deactivated simultaneously.*

Fault loops and corresponding pickup events

Active pickup event	Fault loop						
	L1-E	L2-E	L3-E	L1-L2	L1-L3	L2-L3	L1-L2-L3
ANSI67-1 pickup L1 [E1743]	active	inactive	inactive	active	active	inactive	active
ANSI67-1 pickup L2 [E1744]	inactive	active	inactive	active	inactive	active	active
ANSI67-1 pickup L3 [E1745]	inactive	inactive	active	inactive	active	active	active
ANSI67-1 pickup [E1746]	active	active	active	active	active	active	active

P2164 Delay time/TMS

Tripping delay time of trip event *ANSI67-1 trip* [E1750] and phase-seggregated trip event(s) – depending on the fault loop – *ANSI67-1 trip L1* [E1747] and/or *ANSI67-1 trip L2* [E1748] and/or *ANSI67-1 trip L3* [E1749]; the working principle of the delay time counter depends on the *tripping characteristic* set by parameter *Pickup curve* [P2162]. Parameter *Delay Time/TMS* [P2164] therefore 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:** **T**ime **M**ultiplier **S**etting)

If pick-up event *ANSI67-1 pick-up* [E1746] and *phase-segregated pickup event(s)* are active and Delay Time/TMS run down, trip event *ANSI67-1 trip* [E1750] and *phase-segregated trip event(s)* will be activated. These events can be used for alarm or output control purposes.

Note: Depending on the fault loop the phase-segregated trip event(s) ANSI67-1 trip L1 [E1747] and/or ANSI67-1 trip L2 [E1748] and/or ANSI67-1 trip L3 [E1749] and common trip event ANSI67-1 trip [E1750] will be activated/deactivated simultaneously.

ANSI 67 – Fault loops and corresponding trip events

Active trip event	Fault loop						
	L1-E	L2-E	L3-E	L1-L2	L1-L3	L2-L3	L1-L2-L3
ANSI67-1 trip L1” [E1747]	active	inactive	inactive	active	active	inactive	active
ANSI67-1 trip L2” [E1748]	inactive	active	inactive	active	inactive	active	active
ANSI67-1 trip L3” [E1749]	inactive	inactive	active	inactive	active	active	active
ANSI67-1 trip” [E1750]	active	active	active	active	active	active	active

P2167 Reset limit

Pick-up reset limit of the first directional overcurrent protection element (STEP1); if the

- pick-up event ANSI67-1 pickup [E1746] and phase-segregated pickup event(s) are 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] *and phase-seggregated pickup event(s) are* deactivated and the timer of the Reset delay time pick-up will start.

> *Note: The reset limit should be set as a percentage of the nominal value of the characteristic quantity (phase current). The nominal value of the characteristic quantity should be set by parameter: Current [P604], for primary side W1*
>
> *The parameters Current [P604] is 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:

- **D**efinite **T**ime-delay overcurrent protection (**DT**) or
- **I**nverse **D**efinite **M**inimum **T**ime-delay protection (**IDMT**)

There are up to 7 different *inverse time characteristics* available, which meet 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; When 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 remains 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] and *phase-segregated trip event(s)*; the operating procedure of the timer for resetting the trip event depends on the set characteristic of the reset curve. Parameter *Reset delay time trip/TMS* [P2168] therefore 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] and *phase-segregated trip event(s)* are activated and Reset delay time trip/TMS has run down, the trip event *ANSI67-1 trip* [E1750] and *phase-seggregated trip event(s)* are will be deactivated.

> *Note: According to the set value of parameter Reset after TRIP immediately [P2168], deactivating of trip event ANSI67-1 trip [E1750] and phase-segregated trip event(s) take on a different working principle.*

P2166 Reset after TRIP immediately

Immediate reset of trip event ANSI67-1 trip [E1750] and *phase-segregated trip event(s)*; when 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] and *phase-segregated trip event(s*) is deactivated
- ON: Immediate reset of trip *event ANSI67-1 trip* [E1750] and *phase-segregated trip event(s)* 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] and phase-segregated trip event(s) 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 $\underline{I}_x$ and reference voltage $\underline{U}_{ILx}$ *(with: x = 1, 2, 3)* is **0°**; the tripping range is constructed by +/-90° along the absolute angle)
- *Backward:* The protection step trips only in backward direction (the absolute angle difference between phase current $\underline{I}_x$ and

reference voltage $\underline{U}_{ILx}$ *(with: x = 1, 2, 3)* is **180°**; the tripping range is constructed by +/-90° 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].

Reference voltages for options *Forward, Backward* and *Angle:*

- Phase current I_{L1}: reference voltage: $U_{IL1\ ref} = \underline{U}_{23} = \underline{U}_{2E} - \underline{U}_{3E}$
- Phase current I_{L2}: reference voltage: $U_{IL2\ ref} = \underline{U}_{31} = \underline{U}_{3E} - \underline{U}_{1E}$
- Phase current I_{L3}: reference voltage: $U_{IL3\ ref} = \underline{U}_{12} = \underline{U}_{1E} - \underline{U}_{2E}$

Note:	*In case of reference voltage loss phase-segregated operating of directional overcurrent protection ANSI 67G operates according to selected option of parameter Voltage low mode [P2176].*

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* $\underline{U}_{IL1}$):

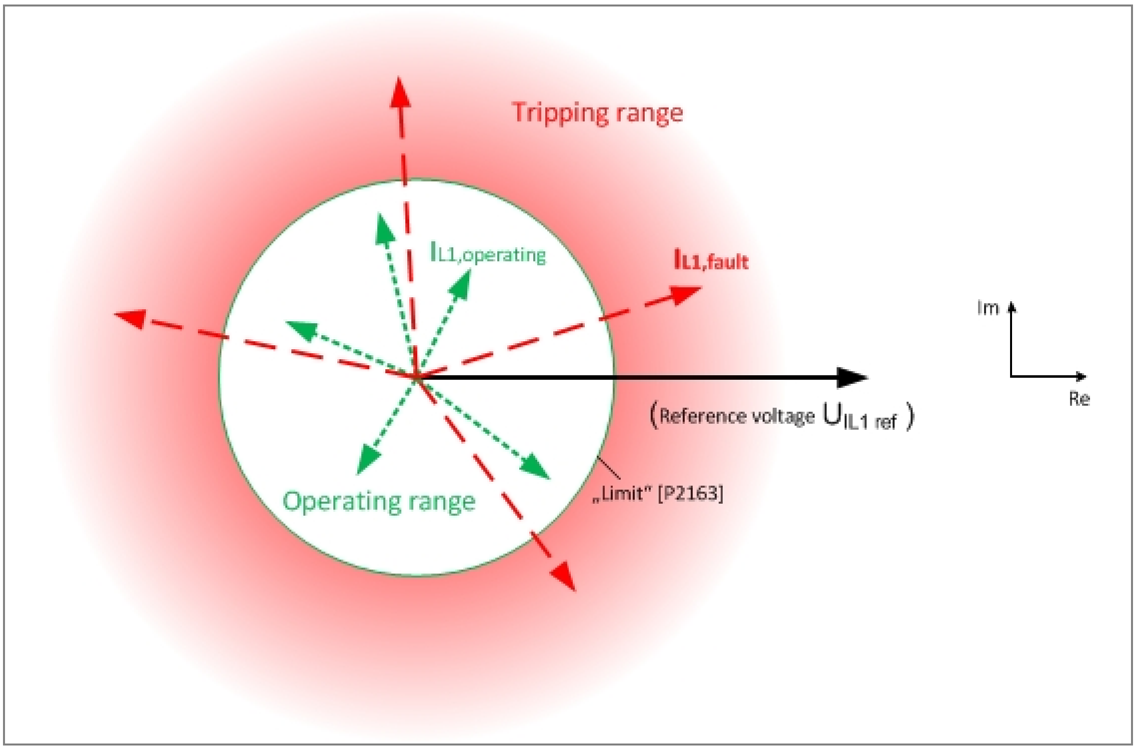


Figure 58 ANSI 67: Selection of direction mode – Non-directional

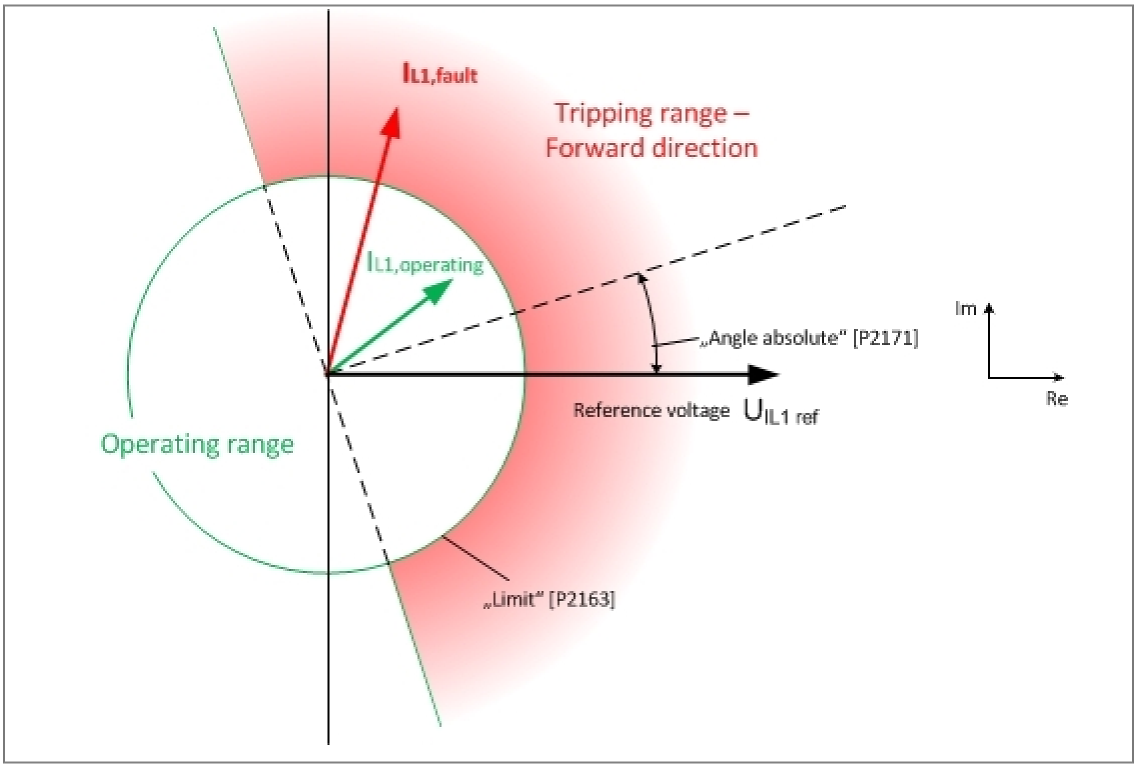


Figure 59 ANSI 67: Selection of direction mode – Forward

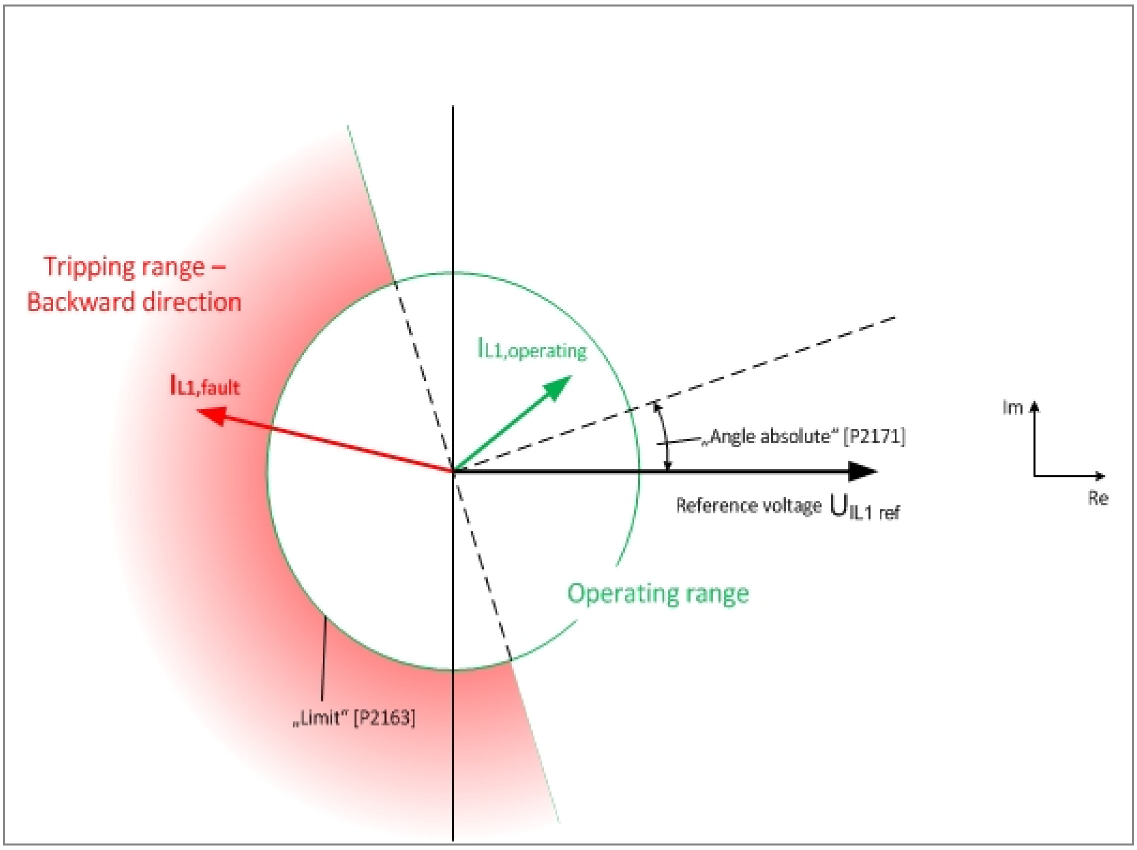


Figure 60 ANSI 67: Selection of direction mode – Backward

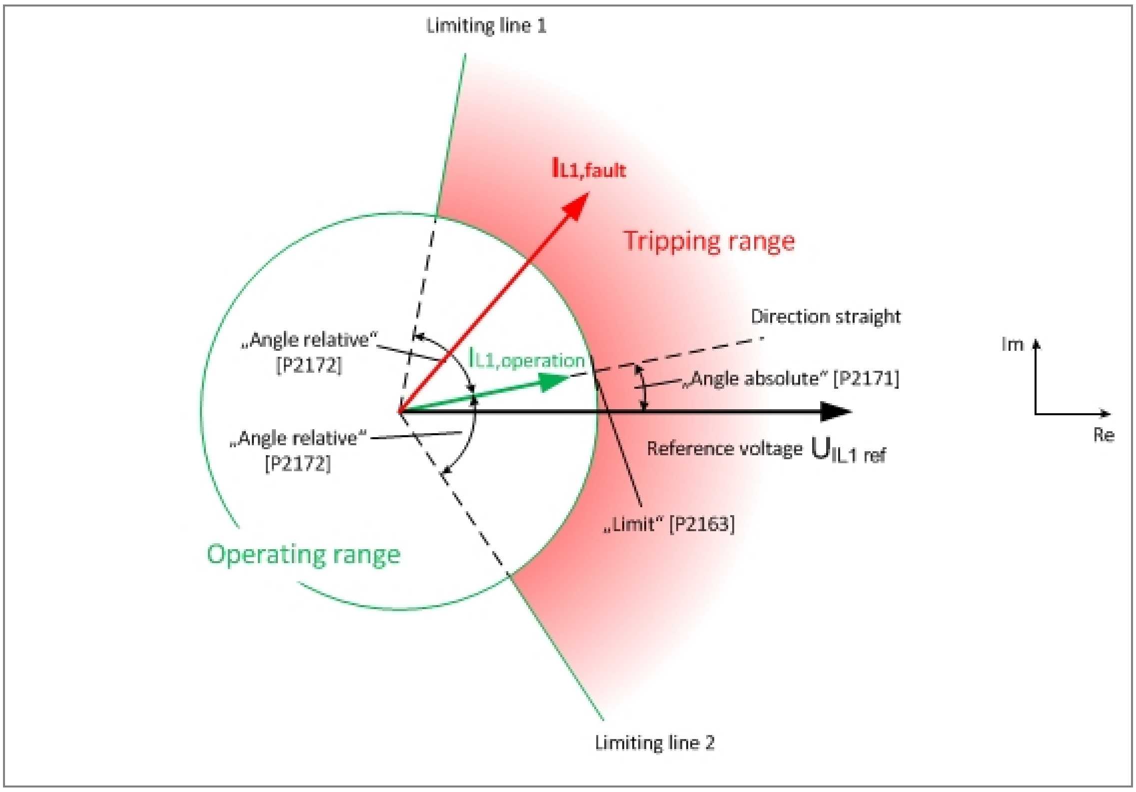


Figure 61 ANSI 67: Selection of direction mode – Angle

P2171 Angle absolute

Absolute angle difference between phase current I_{Lx} and reference voltage $U_{ILx\ ref}$ 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 stabiliser

Blocking of protection element (STEP1) of directional overcurrent protection by harmonics stabiliser ANSI 95i function for measuring values of CT1; according to the settings of the harmonics stabiliser ANSI 95i function, the pickup of the directional overcurrent 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 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 made in the submenu: PROTECTION\95i Harmonics stabiliser.*

P2174 Voltage low limit

Minimum limit of the measuring voltage to activate directional overcurrent protection; as soon as at least one measured reference voltage $U_{ILx\ ref}$ falls below this minimum setting, the operating mode of the first protection step of *directional overcurrent protection* meets 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 should be set as a percentage of the nominal value of the characteristic quantity (phase-to-phase voltage). The nominal value of the characteristic quantity should be set by parameter: Voltage (L-L) [P603], for primary side W1*
>
> *The referring parameters Voltage (L-L) [P603] is 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, corresponding event(s) *ANSI67-1 Voltage low mode L1* [E1751] and/or *ANSI67-1 Voltage low mode L2* [E1752] and/or *ANSI67-1 Voltage low mode L3* [E1753will be activated, and 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

P2076 Start fault locator

Start of function Fault locator ANSI 21FL in case of a protection trip via the first step of directional overcurrent protection; where:

- OFF: does not start the fault locator function or
- ON: starts the calculation of fault location by function Fault locator ANSI 21FL in case that:
  - I. function Fault locator ANSI 21FL is enabled (parameter *Function* [P3465] = ON) **and**
  - II. the trip event *ANSI67-1 trip* [E1750] and *phase-segregated trip event(s)* become active.

P2179 Min. delay time

> *Note: This parameter only applies for inverse trip characteristics (IDMT curves).*

Minimum trip delay time for inverse trip curves; in case of high current faults the tripping delay time could be too small for the application. To avoid this, a minimum trip delay time can be set by parameter *Min. delay time* [P2179].

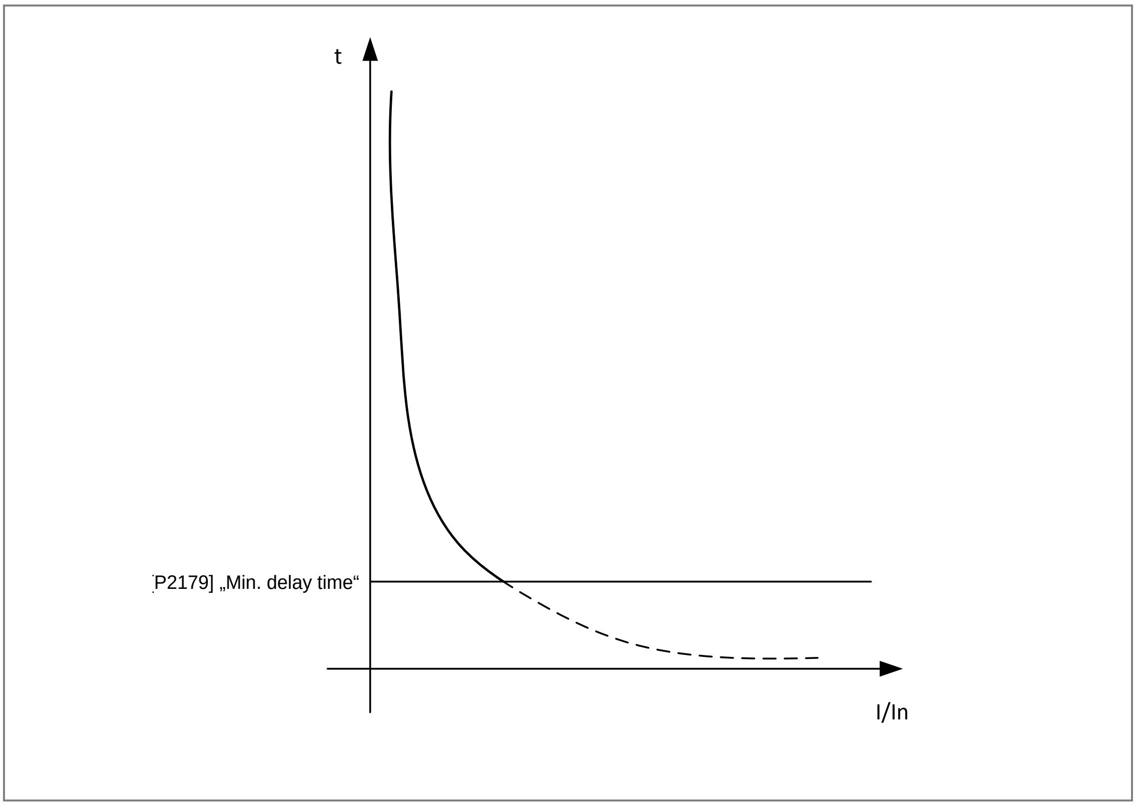


Figure 62 IDMT Trip characteristic– minimum trip delay time

Dynamic protection parameters of STEP 1

Dynamic parameters can be used to adapt the protection settings of the directional overcurrent protection function temporarily to the conditions of the electrical system. Changing of network conditions might be caused by:

- Cold load situation
- load changes
- automatic reclosing

While in normal conditions the standard parameters STD are valid. When network conditions change, dynamic parameters DP1 or DP2 can be activated by the event assigned to parameter *DP1 activation* [P2157] or *DP1 activation* [P2158]. Parameters [P3179] to [P3184] or [P3203] to [P3208] become active and corresponding standard parameters become turns to inactive. As soon as the activating event becomes inactive, standard parameters are activated and dynamic parameters become inactive.

The duration of change-over between standard parameters and dynamic parameters is in accordance with the protection cycle time (<2ms) of the protection device.

The following dynamic STEP parameters of the directional overcurrent protection exist only once in each of the 4 independent protection STEPS. The dynamic STEP parameters apply only to one of the 4 protection STEPS of one parameter SET

Dynamic protection parameters – DP1

P3179 Limit

See description of parameter [P2163]

P3180 Delay time/TMS

See description of parameter [P2164]

P3181 Min. delay time

See description of parameter [P2179]

P3182 Reset limit

See description of parameter [P2167]

P3183 Reset delay time trip/TMS

See description of parameter [P2168]

P3184 Reset delay time pickup

See description of parameter [P2169]

Dynamic protection parameters – DP2

P3203 Limit

See description of parameter [P2163]

P3204 Delay time/TMS

See description of parameter [P2164]

P3205 Min. delay time

See description of parameter [P2179]

P3206 Reset limit

See description of parameter [P2167]

P3207 Reset delay time trip/TMS

See description of parameter [P2168]

P3208 Reset delay time pickup

See description of parameter [P2169]

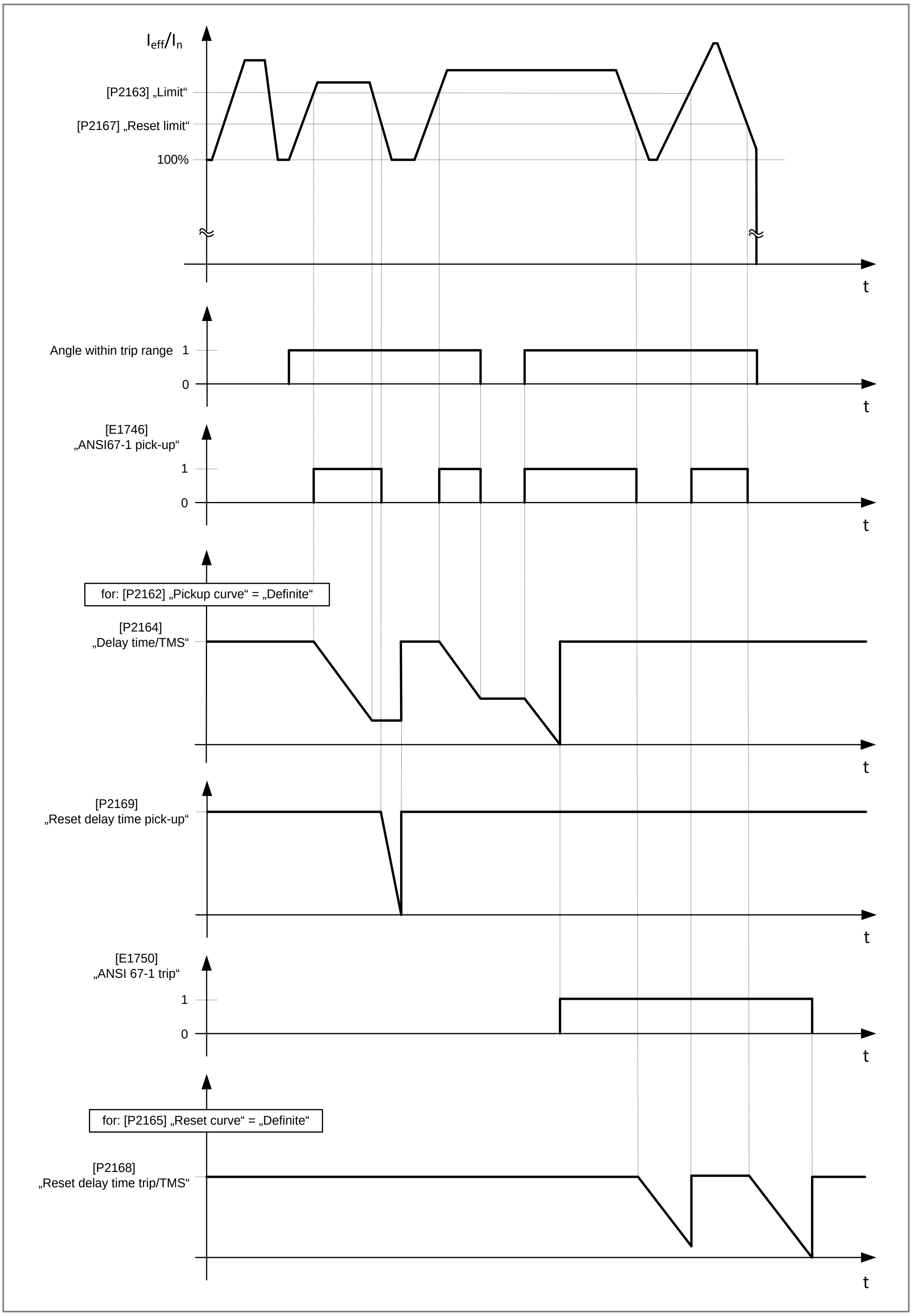


Figure 63 Directional overcurrent protection – Trip characteristic (DT) and Reset characteristic (DT)

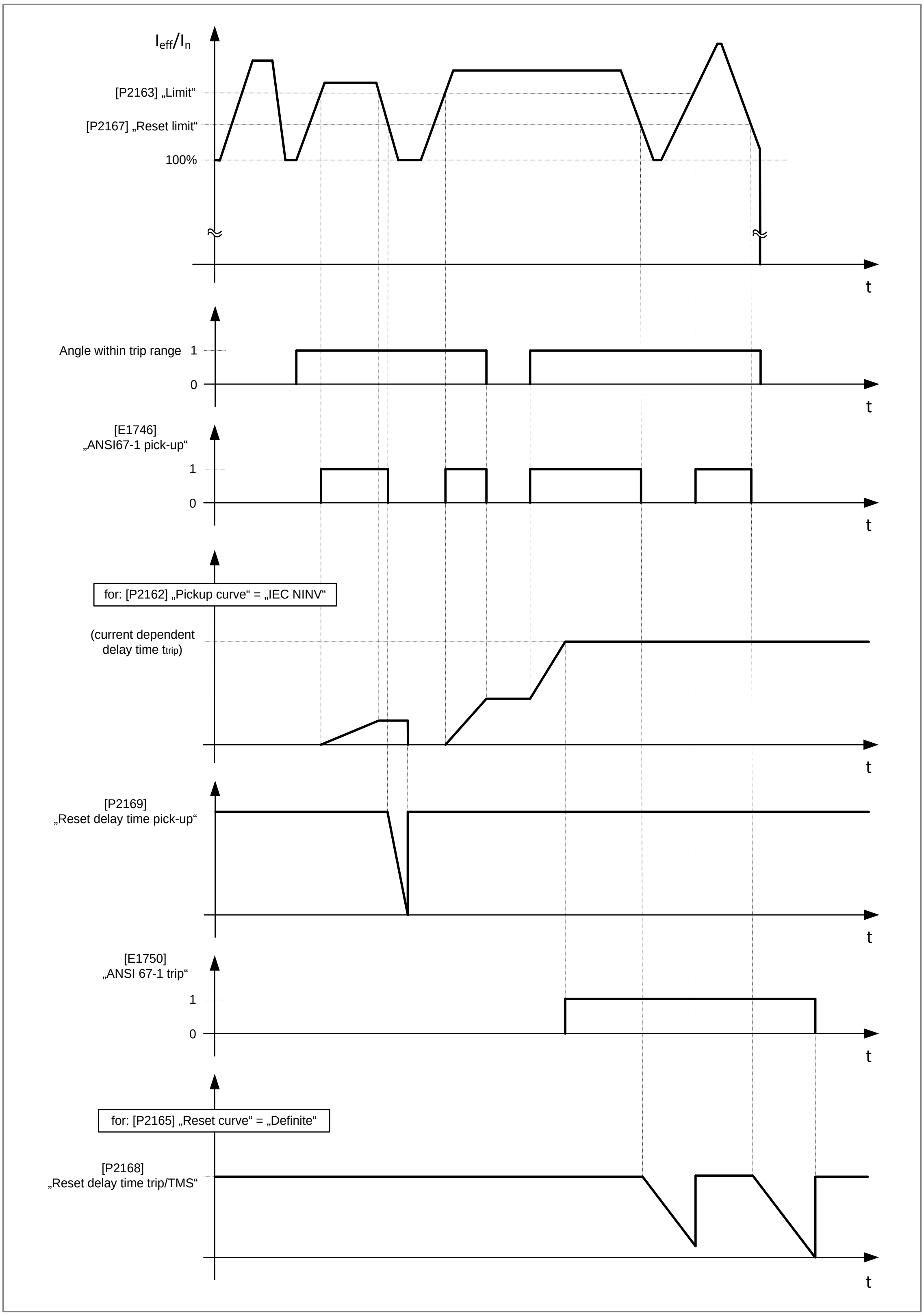


Figure 64 Directional overcurrent protection – Trip characteristic (IDMT) and Reset characteristic (DT)

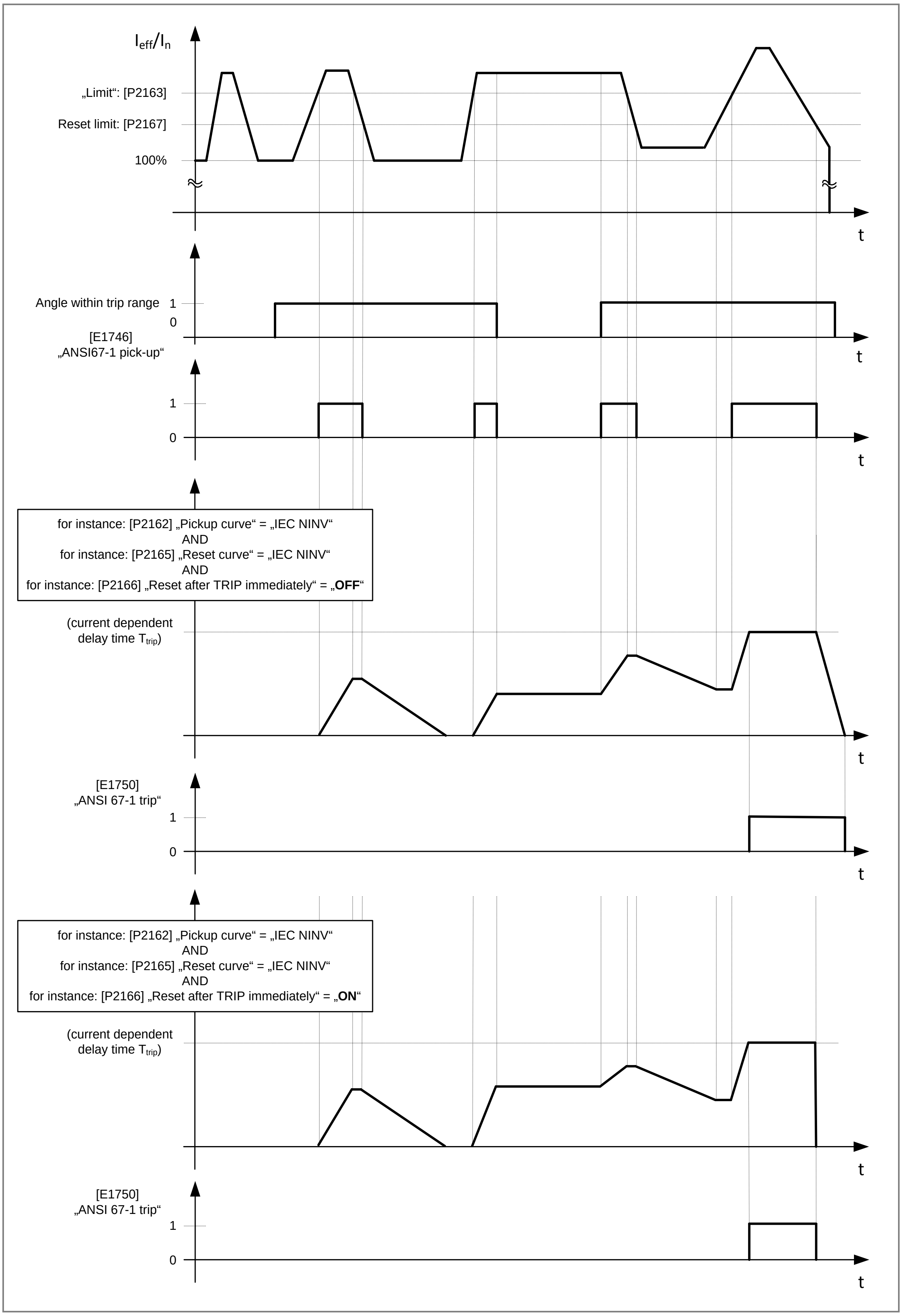


Figure 65 Directional overcurrent protection – Trip characteristic (IDMT) and Reset characteristic (IDMT)

2.1.22 ANSI 67G – Directional Ground Overcurrent Protection

ANSI 67G – Standard (STD) protection parameters [P] and events [E] of SET 1

Main Menu\Parameters\PROTECTION\ANSI 67G – Directional ground current\

STD

SET 1 | SET 2 | SET 3 | SET 4

P/E No.	System Description	Value	Unit	(Setting range)
SET PARAMETERS				
P2455	Direct. ground overcurrent	OFF	-	ON/OFF
P2456	Blocking prot. module	0	event	0 … 9999
P2457	DP1 activation	0	event	0 … 9999
P2458	DP2 activation	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	50	%	5 … 1999,9
P2464	Delay time/TMS	0.03	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	45	%	5 … 1999,9
P2468	Reset delay time trip/TMS	0	s/-	0 … 999999,999
P2469	Reset delay time pickup	0	s	0 … 999999,999
P2470	Direction mode	Non-directional	-	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
P2476	Start fault locator	No	-	No/Yes
P2479	Min. delay time	0	s	0 … 999999,999
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
…	…	…	…	…

ANSI 67G – Dynamic parameters (DP1) of protection parameters [P] of SET 1

Main Menu\Parameters\PROTECTION\ANSI 67G – Directional ground current\				
DP1				
SET 1	SET 2	SET 3	SET 4	
P/E No.	System Description	Value	Unit	(Setting range)
STEP 1				
P3227	Limit	50	%	5 … 1999,9
P3228	Delay time/TMS	0.03	s/-	0 … 999999,999
P3229	Min. delay time	0	s/-	0 … 999999,999
P3230	Reset limit	45	%	5 … 65535,5
P3231	Reset delay time trip/TMS	0	s/-	0 … 999999,999
P3232	Reset delay time pickup	0	s	0 … 999999,999
STEP 2				
P3233	Limit	20	%	0 … 65535,5
…	…	…	…	…

ANSI 67G – Dynamic parameters (DP2) protection parameters [P] of SET 1

Main Menu\Parameters\PROTECTION\ANSI59-95i\ ANSI 67				
DP2				
SET 1	SET 2	SET 3	SET 4	
P/E No.	System Description	Value	Unit	(Setting range)
STEP 1				
P3251	Limit	50	%	5 … 1999,9
P3252	Delay time/TMS	0.03	s/-	0 … 999999,999
P3253	Min. delay time	0	s/-	0 … 999999,999
P3254	Reset limit	45	%	5 … 65535,5
P3255	Reset delay time trip/TMS	0	s/-	0 … 999999,999
P3256	Reset delay time pickup	0	s	0 … 999999,999
STEP 2				
P3257	Limit	20	%	0 … 65535,5
…	…	…	…	…

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. The parameter descriptions of the SET PARAMETERS and the parameters of STEP 1 represented below are described in detail in the following examples.*

STD – Standard protection parameters of parameter SET 1 – ANSI 67G

STD - SET PARAMETERS

The following SET PARAMETERS of the ground overcurrent protection exist only once in each of the four parameter sets. 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 where:

- OFF: disables or
- ON: enables the protective function.

When directional ground overcurrent protection ANSI 67G is enabled by parameter [P2455], then event *ANSI*67G *module active* [E2035] is 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 activated. If the blocking event becomes inactive, blocking is abandoned and protective function is effective again. Event [E2036] is then deactivated automatically.

If blocking of the directional ground overcurrent protection is not required, set this parameter to **0**.

P2457 DP1 activation

Dynamic parameters 1 of function ANSI 67G can be activated by any active event. For activation, the number related to this event has to be assigned to parameter [P2157]. Activation is only effective, however, as long as the assigned event is active. If the assigned event becomes inactive, *DP1* is deactivated.

If activation of *DP1* is not required, set this parameter to **0**.

P2458 DP2 activation

Dynamic parameters 2 of function ANSI 67G can be activated by any active event. For activation, the number related to this event has to be assigned to parameter [P2158]. Activation is only effective, however, as long as the assigned event is active. If the assigned event becomes inactive, *DP2* is deactivated.

If activation of *DP2* is not required, set this parameter to **0**.

Note: *Appropriate settings of the corresponding parameters of DP1/DP2 are to be made in the submenu: PROTECTION\Directional ground overcurrent ANSI 67G \DPx.*

With dynamic parameters DP1 and/or DP2 it is possible to activate a set of parameters in submenu DP1 and/or DP2.

STD – Standard 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. The STEP PARAMETERS apply only to one of the 4 protection STEPS of one parameter SET.

P2460 Pick-up source

Depending on the P60 Agile device variant each protection step of directional ground overcurrent protection can be assigned to a certain current measurement input (CT1, CT2 or

CT-GND1). 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 $\underline{I}_G$ via calculation of total current $\underline{I}_0$ *($\underline{I}_G = 3 \times \underline{I}_0 = 3 \times [\underline{I}_1 + \underline{I}_2 + \underline{I}_3]$)* **and** determination of ground current direction by additionally measured residual voltage UG via the assigned voltage measurement input set by parameter PT reference [P9419].
- GND Power_CT2: This option is not supported in P16x devices
- GND Power CT-GND1: ground current measurement by CT-GND1 and determination of ground current direction by additionally measured residual voltage UG via the assigned voltage measurement input set by parameter PT reference [P9428].

The assignment of the voltage measurement input (PT1, PT2, PT3 or PT-GND1) to the ground current measurement input CT1 or CT-GND1 is to be done by the following parameters (referring to the setting options of parameter [P2460]), in the submenu SYSTEM\Measuring\Power:

- *PT reference* [P9419], for GND Power_CT1 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* [P9429], for GND Power_CT-GND1.

For settings GND Power_CT1 or GND Power_CT-GND1 event *ANSI67G-1 step active* [E2038] is activated.

Note:	*In case that residual voltage is to be calculated by voltage measuring via PT1, PT2 or PT3 it is required to connect terminal "N" of P16x device (X1.2:26) to ground potential.* *For test purposes via voltage generator test equipment it is required to connect terminal "N" of P16x device to the "neutral" potential of the voltage test equipment!* *In the case of residual voltage being derived from voltage measuring PT1, PT2 or PT3, it is required to consider 180° phase shift compared to directly measured residual voltage via PT-GND1. For directly measured residual voltage via PT-GND1 this is not required.*

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 activated. If the blocking event becomes inactive, blocking is abandoned and protective function is effective again. Event [E2039] is then 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:

- **D**efinite **T**ime-delay overcurrent protection (**DT**) or
- **I**nverse **D**efinite **M**inimum **T**ime-delay protection (**IDMT**)

There are up to 7 different inverse time characteristics (IDMT) available, which meet 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)

Details for parameters of inverse curves (IDMT) and Inverse IEC curve examples can be found under ANSI 50/51 section.

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.

When 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/TM has run down, the timer of Delay time/TMS will be stopped and the attained time value is saved.

> *Note: The pick-up value should be set as a percentage of the nominal value of the characteristic quantity (ground current). The nominal value of the characteristic quantity should be set by parameter: Ground current [P607], for primary side W1*
>
> *The parameter Ground current [P607] is 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]. Parameter *Delay Time/TMS* [P2464] therefore 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: T**ime **M**ultiplier **S**etting)

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, pick-up event *ANSI67G-1 pick-up* [E2040] is then deactivated and the timer of the Reset delay time pick-up will start.

> *Note: The reset limit should be set as a percentage of the nominal value of the characteristic quantity (ground current). The nominal value of the characteristic quantity should be set by parameter: Ground current [P607], for primary side W1*
>
> *The parameter Ground current [P607] is 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:

- **D**efinite **T**ime-delay overcurrent protection (**DT**) or
- **I**nverse **D**efinite **M**inimum **T**ime-delay protection (**IDMT**)

There are up to 7 different *inverse time characteristics* available, which meet 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)

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; when the tripping delay time (Delay time/TMS) has not yet run down.

CAUTION: Parameter [P2469] is only valid when *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. Parameter *Reset delay time trip/TMS* [P2468] therefore 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:** Time Multiplier Setting).

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: *According to the set value of parameter Reset after TRIP immediately [P2468], 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]; When 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 $\underline{I}_G$ and residual voltage $\underline{U}_G$ as its voltage reference):

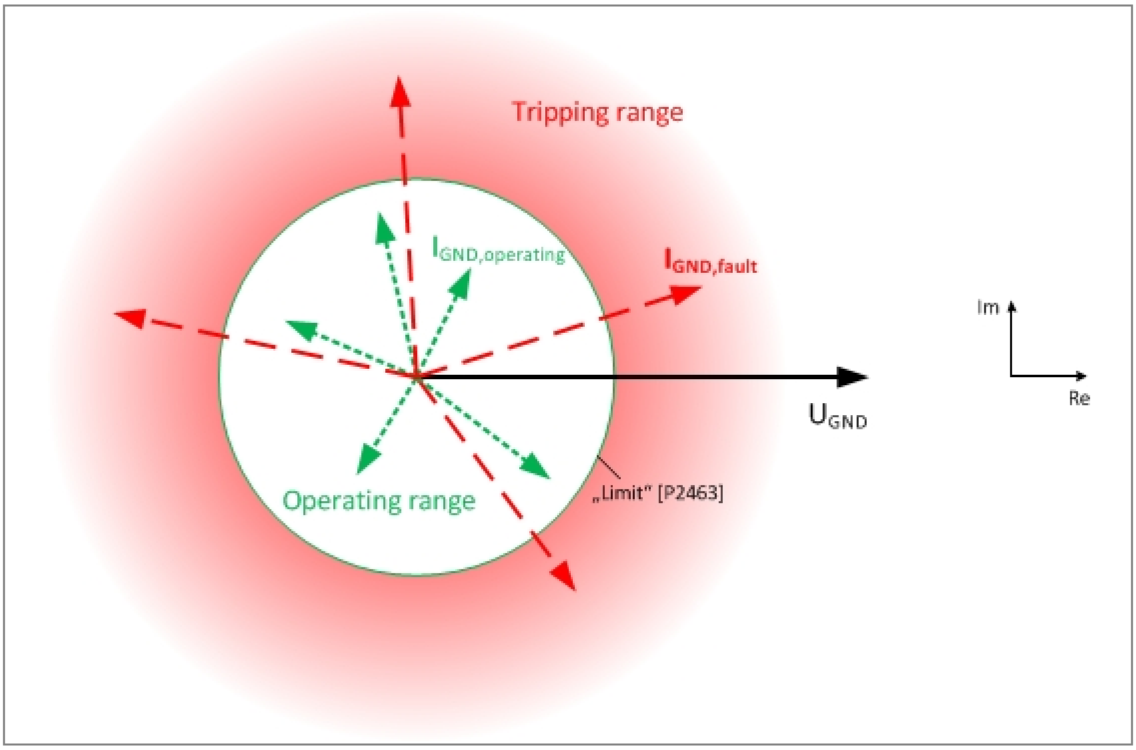


Figure 66 ANSI 67G: Selection of direction mode – Non-directional

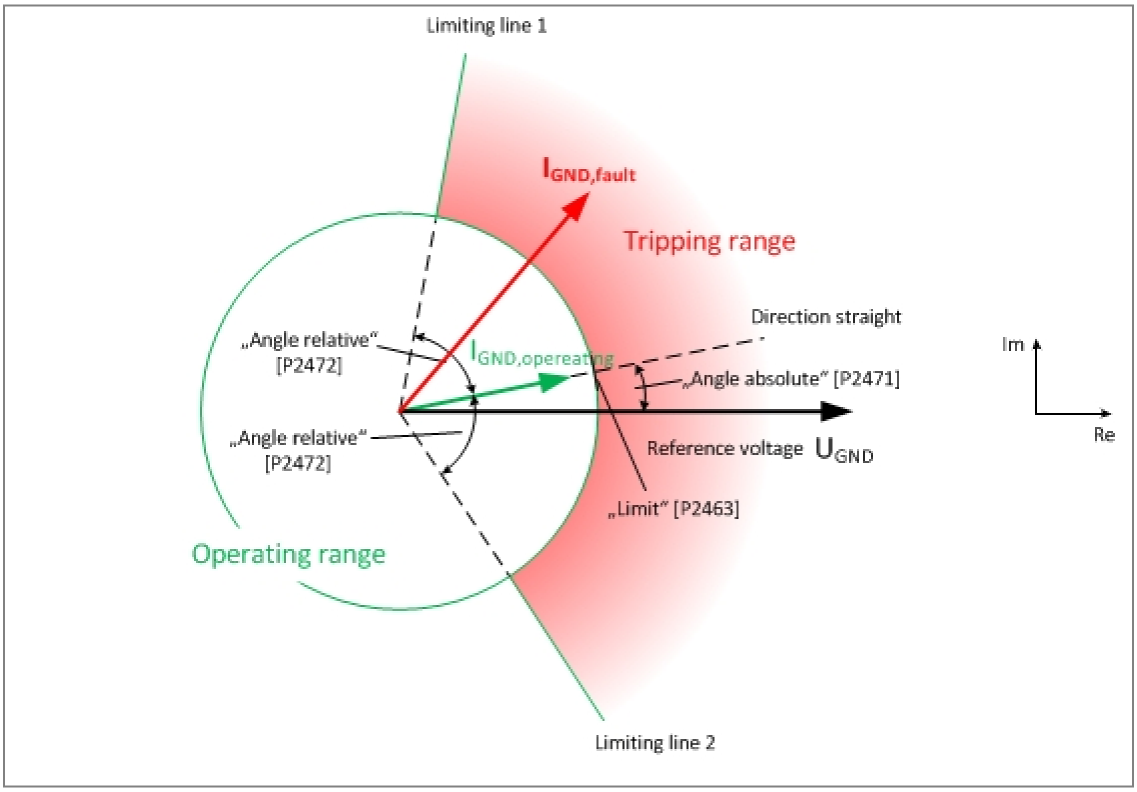


Figure 67 ANSI 67G:Selection of direction mode – Angle

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 stabiliser

Blocking of protection element (STEP1) of directional ground overcurrent protection by harmonics stabiliser ANSI 95i function for measuring values of ground current; according to the settings of the harmonics stabiliser ANSI 95i function, the pickup of the directional ground overcurrent 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 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 made in the submenu: PROTECTION**95i Harmonics stabiliser**.*

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 meets 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 should be set as a percentage of the nominal value of the characteristic quantity (residual voltage). The nominal value of the characteristic quantity should be set by parameter: Ground voltage [P606], for primary side W1*
>
> *The parameter Ground voltage [P606] is 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].

P2476 Start fault locator

Start of function Fault locator ANSI 21FL in case of a protection trip via the first step of directional ground overcurrent protection; where:

- OFF: does not start the fault locator function or
- ON: starts the calculation of fault location by function Fault locator ANSI 21FL

  in case that:

  I. function Fault locator ANSI 21FL is enabled (parameter *Function* [P3465] = ON) **and**
  II. the trip event *ANSI67G-1 trip* [E2041] becomes active.

P2479 Min. delay time

> *Note: This parameter only applies for inverse trip characteristics (IDMT curves)*

Minimum trip delay time 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 delay time can be set by parameter *Min. delay time* [P2479]

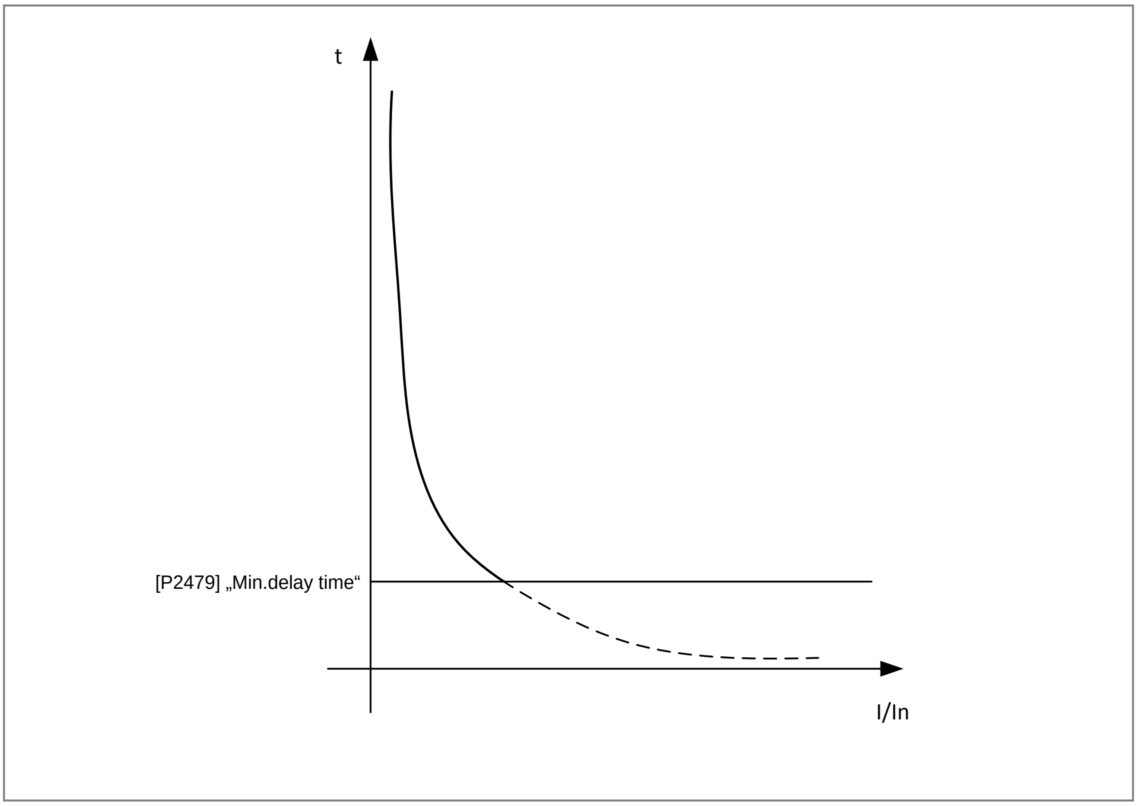


Figure 68 IDMT Trip characteristic– minimum trip delay time

Dynamic protection parameters of STEP 1

Dynamic parameters can be used to adapt the protection settings of the directional ground overcurrent protection function temporarily to the conditions of the electrical system. Changing of network conditions might be caused by:

- Cold load situation
- load changes
- automatic reclosing, etc.

While in normal conditions the standard parameters STD are valid. When network conditions change, dynamic parameters DP1 or DP2 can be activated by the event assigned to parameter *DP1 activation* [P2457] or *DP1 activation* [P2458]. Parameters [P3227] to [P3232] or [P3251] to [P3256] become active and corresponding standard parameters become inactive. As soon as the activating event becomes inactive, standard parameters are being activated and dynamic parameters become inactive.

The duration of change-over between standard parameters and dynamic parameters is in accordance with the protection cycle time (<2ms) of the protection device.

The following dynamic STEP parameters of the directional overcurrent protection exist only once in each of the 4 independent protection STEPS. The dynamic STEP parameters apply only to one of the 4 protection STEPS of one parameter SET

Dynamic protection parameters – DP1

P3227 Limit

See description of parameter [P2463]

P3228 Delay time/TMS
See description of parameter [P2464]

P3229 Min. delay time
See description of parameter [P2479]

P3230 Reset limit
See description of parameter [P2467]

P3231 Reset delay time trip/TMS
See description of parameter [P2468]

P3232 Reset delay time pickup
See description of parameter [P2469]

Dynamic protection parameters – DP2

P3251 Limit
See description of parameter [P2463]

P3252 Delay time/TMS
See description of parameter [P2464]

P3253 Min. delay time
See description of parameter [P2479]

P3254 Reset limit
See description of parameter [P2467]

P3255 Reset delay time trip/TMS
See description of parameter [P2468]

P3256 Reset delay time pickup
See description of parameter [P2469]

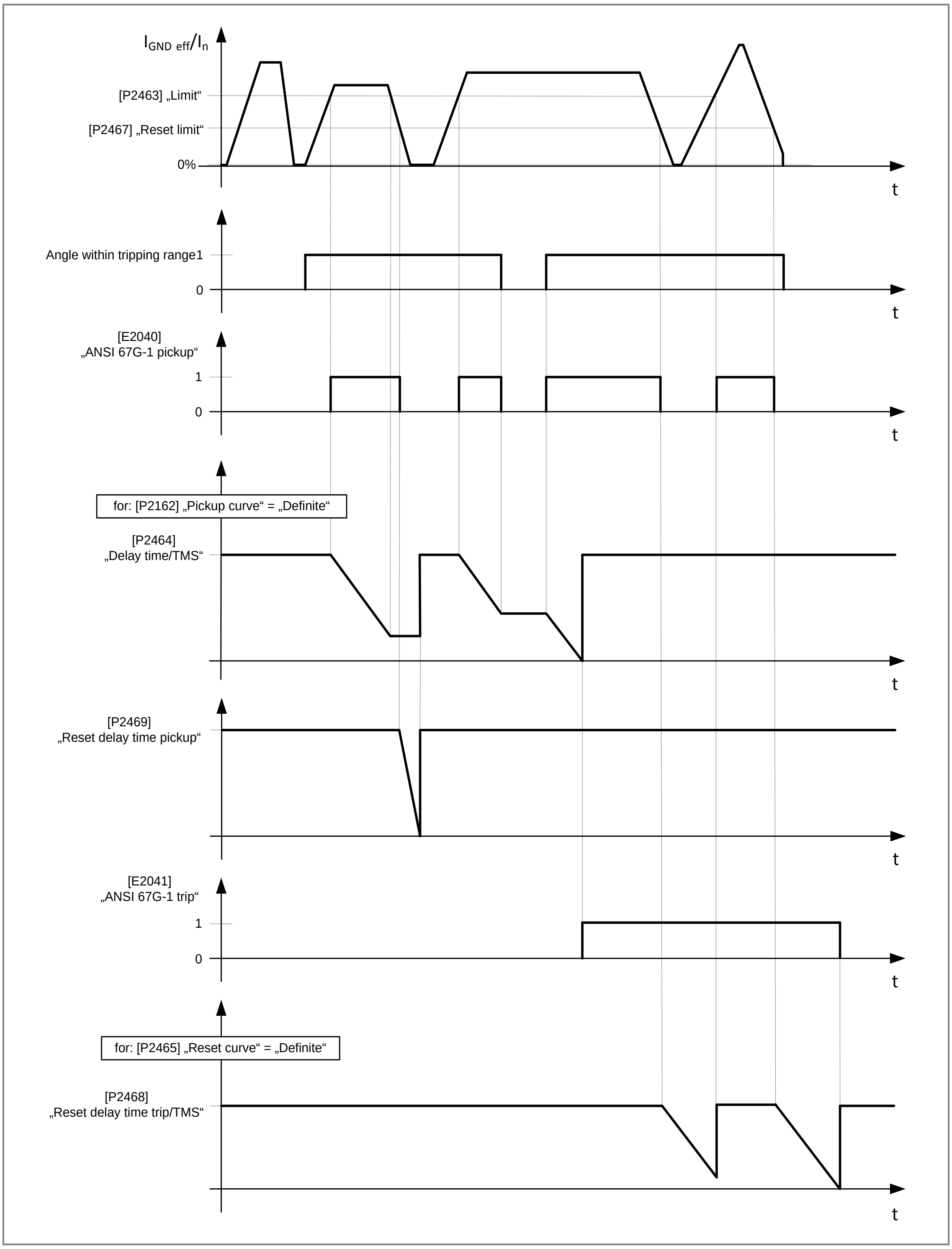


Figure 69 Directional ground overcurrent protection – Trip characteristic (DT) and Reset characteristic (DT)

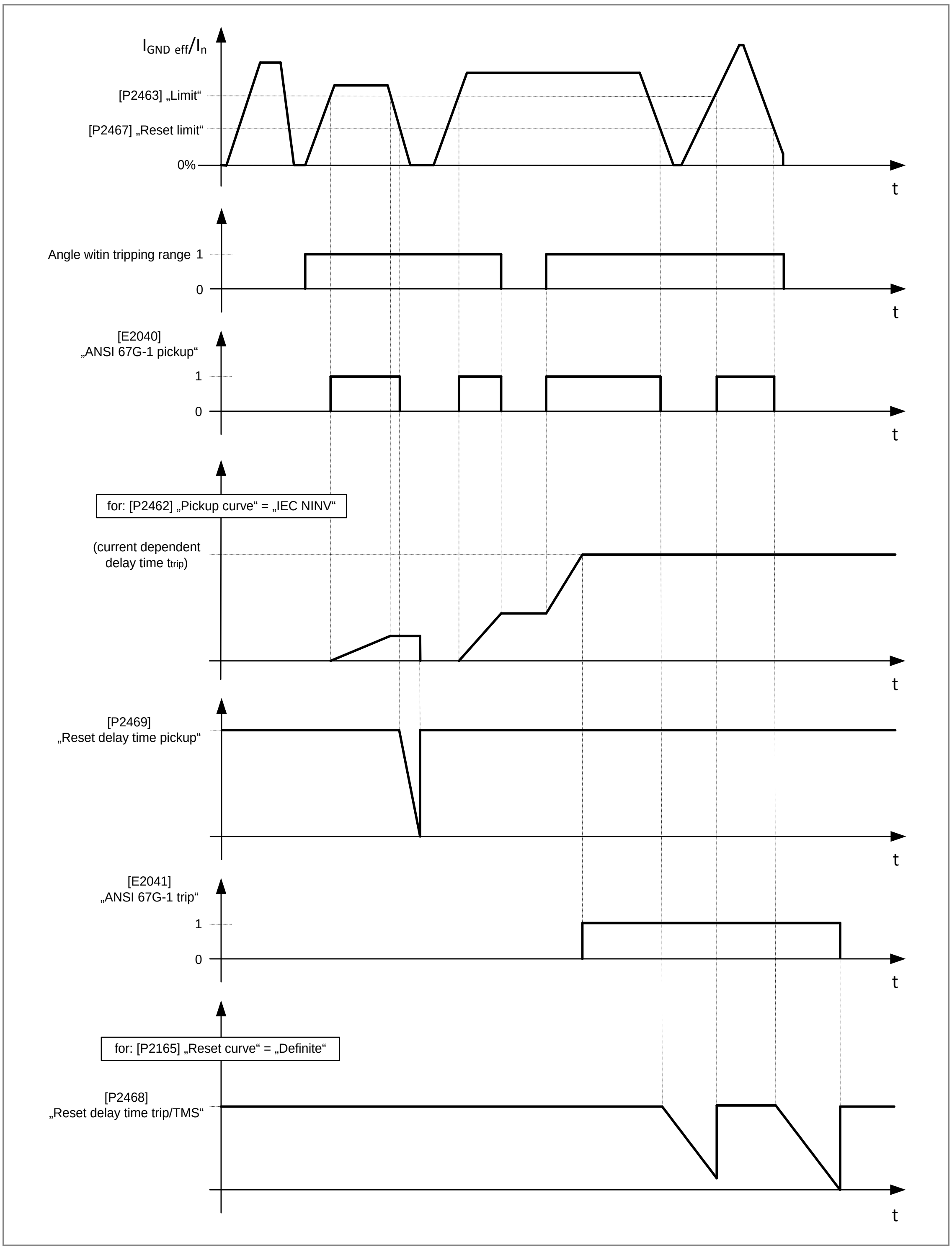


Figure 70 **Directional ground overcurrent protection – Trip characteristic (IDMT) and Reset characteristic (DT)**

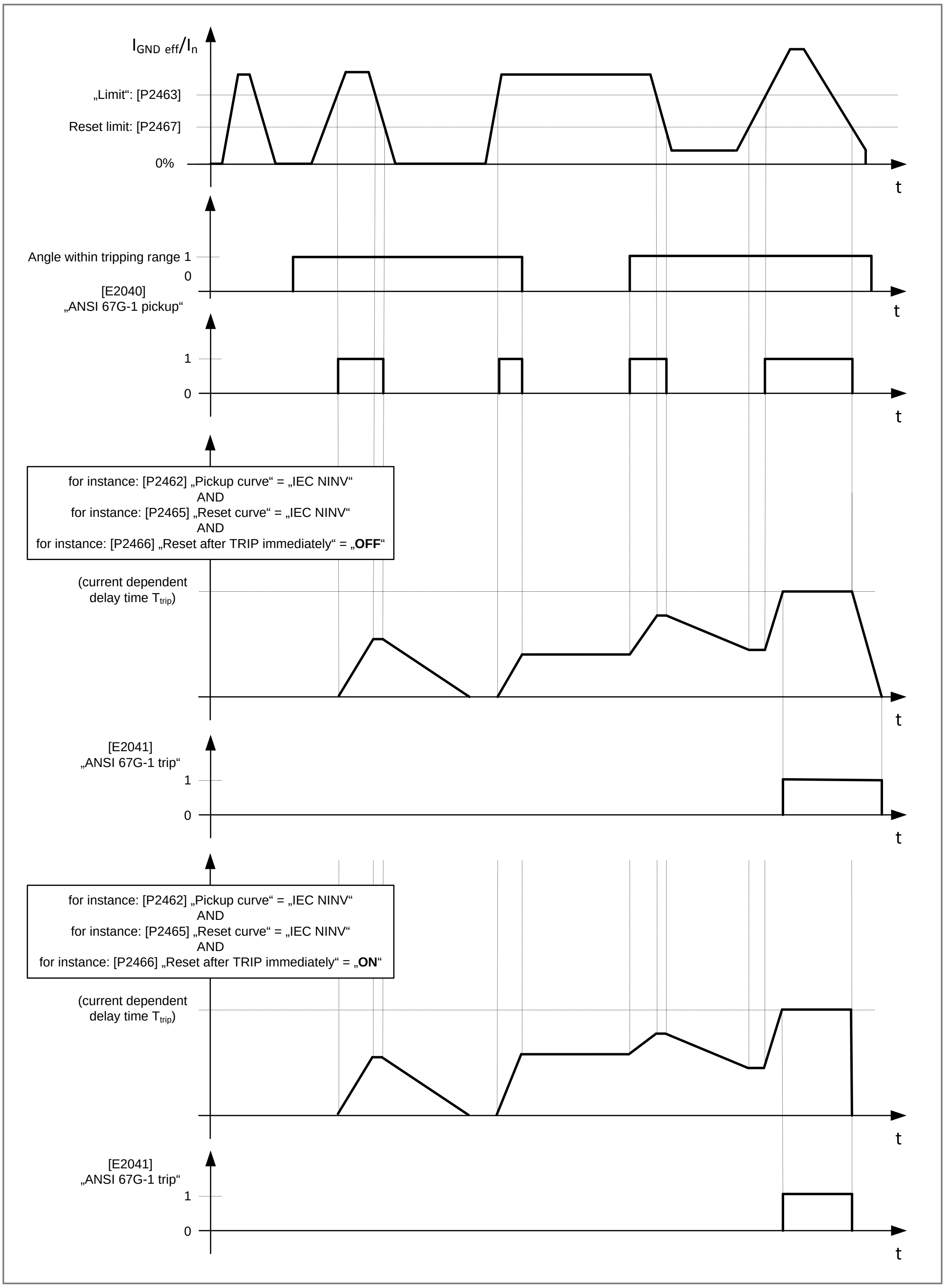


Figure 71 **Directional ground overcurrent protection – Trip characteristic (IDMT) and Reset characteristic (IDMT)**

2.1.23 ANSI 74TC – Trip Circuit Supervision

ANSI 74TC – Protection parameters [P] and events [E] of SET 1

				Main Menu\Parameters\PROTECTION\
ANSI 74TC				
SET 1	SET 2	SET 3	SET 4	
P/E No.	System Description	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	Delay time	5	s	0 … 6553,5
E2235	ANSI74TC active	-	-	-
E2236	ANSI74TC blocked	-	-	-
E2237	ANSI74TC pickup	-	-	-
E2238	ANSI74TC trip	-	-	-

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

> **Note:** *Each of the four parameter sets provides only one protection STEP and, as a consequence, only one group of parameters. SET PARAMETERS are therefore equal to STEP parameters. The protection parameters of SET 1 below are described in detail in the following examples.*

Protection parameters of parameter of SET 1 – ANSI 74TC

SET PARAMETERS

P2865 Function

This parameter enables/disables trip circuit supervision function where:

- OFF: disables or
- ON: enables the protective function.

When trip circuit supervision ANSI74TC is enabled by parameter [P2865], then event *ANSI74TC active* [E2235] is 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 for as long as the blocking event is active. As soon as blocking is active, event *ANSI74TC blocked* [E2236] is activated. If the blocking event becomes inactive, blocking is abandoned and trip circuit supervision function is effective again. Event [E2236] is then automatically deactivated.

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 relay 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 indicate the status of an interrupted trip circuit.

> *Note: Function ANSI 74TC is only for trip circuit supervision of one breaker*

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 diagram as an example:

> **CAUTION: For correct operating of function ANSI74TC the polarity of the connected binary inputs must be as per following connection diagrams.**
> **For connection example below, binary inputs Fct. 26 and Fct. 27 have to be used for function ANSI 74TC.**

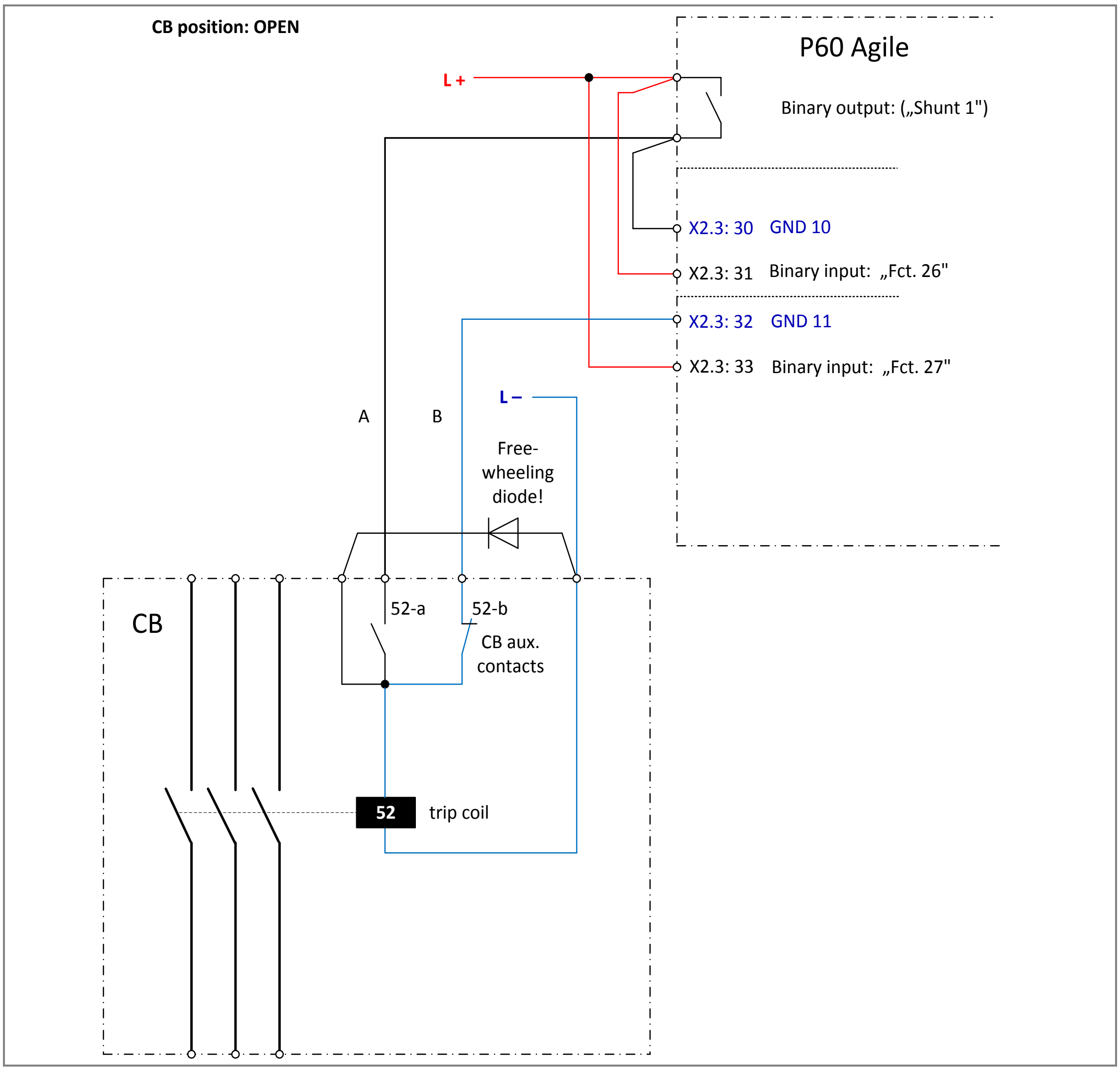


Figure 72 Trip circuit supervision – example of a connected trip circuit: CB open

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.

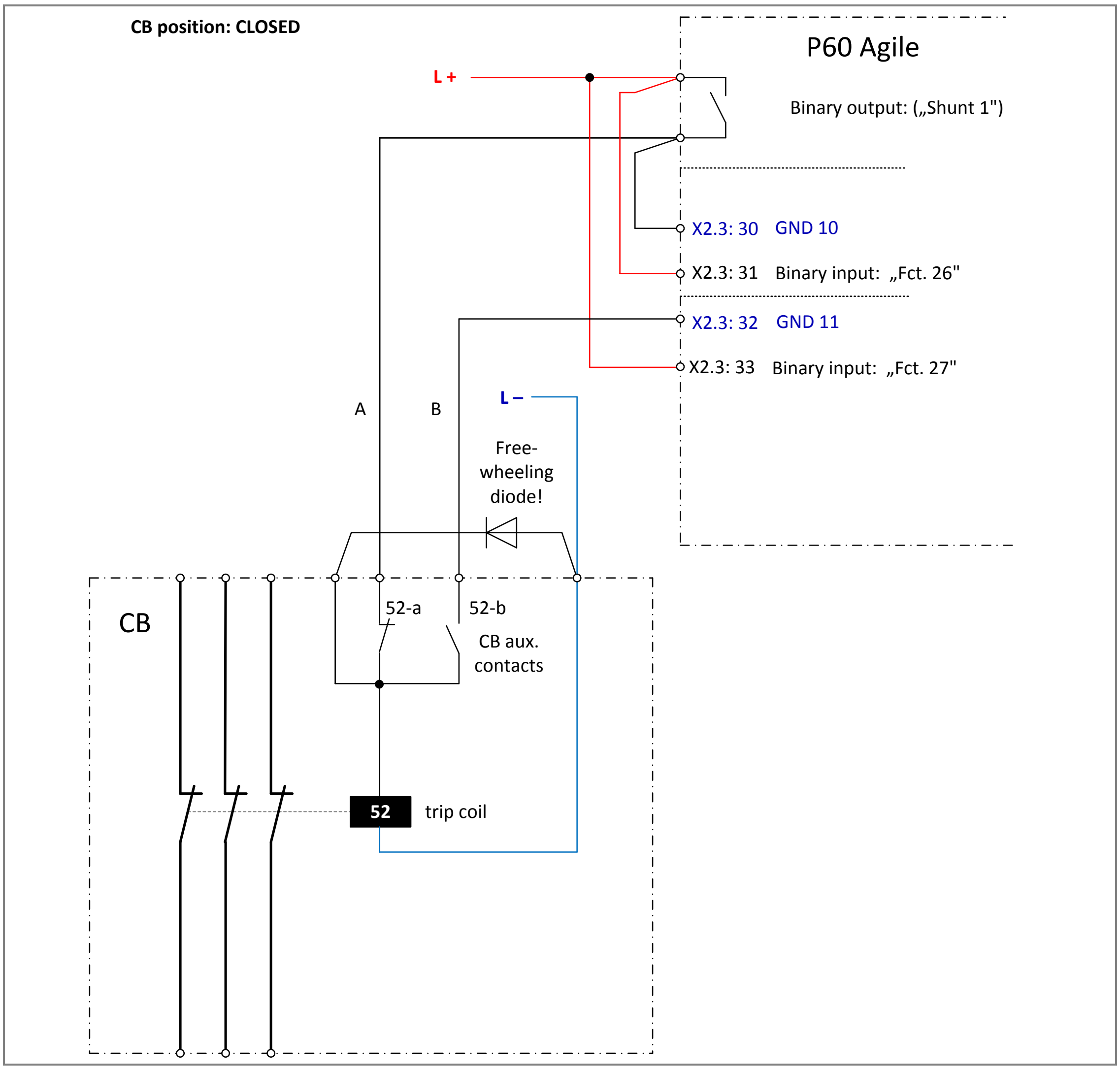


Figure 73 **Trip circuit supervision – example of a connected trip circuit: CB closed**

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 the P60 Agile against high cut-off voltage of the inductive components (eg. Auxiliary relays, CB trip coil etc.) connected to the binary inputs and or binary outputs of P60 Agile, the inductive components must be equipped with a free-wheeling diode (DC voltage) or varistors (AC voltage).

P2867 Mode

Supervision mode of the evaluation logic referring to the binary inputs; where 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 activated and the *Delay time* [P2870] is 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 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 assigned to this parameter.

P2870 Delay time

Trip delay time; 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 activated and Delay time is started.

As soon as the pick-up event *ANSI 74TC pickup* [E2237] is active and Delay time has run down, trip event [E2238] will be activated. This event can be used for alarm or output control purposes. Following the protection trip, and once faulty conditions are no longer existent, pick-up event [E2237] and trip event [E2238] are deactivated automatically.

2.1.24 ANSI 78 – Vector Surge Protection

ANSI 78 – Protection parameters [P] and events [E] of SET 1

Main Menu\Parameters\PROTECTION\

ANSI 78

SET 1 | SET 2 | SET 3 | SET 4

P/E No.	System Description	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
P1869	Pickup mode	OR	-	OR/AND
P1870	Limit	6	deg	0 … 25
P1871	K1	1	-	0 … 999,9
P1872	Direction	none	-	none/positive/negative
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
…	…	…	…	…

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. The parameter descriptions of the STEP PARAMETERS and the parameters of STEP 1 represented below are described in detail in the following 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. Therefore, 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 where:

- 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, vector surge protection must then be blocked by a suitable event. For this, the related number of such blocking events has to be assigned to parameter [P1861].*

When vector surge protection ANSI78 is enabled by parameter [P1860], then event *ANSI78 module active* [E1570] is 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]. However, blocking is only effective as long as the blocking event is active. As soon as blocking is active, event *ANSI78 blocked module* [E1571] is activated. If the blocking event becomes inactive, blocking is abandoned and protective function is effective again. Then, event [E1571] is 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. Therefore the STEP PARAMETERS only apply to one of the 3 protection STEPS of one parameter SET.

P1865 Pickup source

Depending on the P60 Agile 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 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]. However, blocking is only effective as long as the blocking event is active. As soon as blocking is active, event *ANSI78-1 blocked step* [E1577] is activated. If the blocking event becomes inactive, blocking is abandoned and protective function is effective again. Then, event [E1577] is 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 should be set as a percentage of the nominal value of the characteristic quantity (phase-to-phase voltage). The nominal value of the characteristic quantity should be set by parameter: Voltage (L-L) [P603], for primary side W1*
>
> *The referring parameters Voltage (L-L) [P603] is 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 deactivated, and event *ANSI78-1 blocked step by min. start voltage* [E1578] is deactivated.

Application: Min. start voltage delay time is used to detect a stable voltage restoration.

P1869 Pickup mode

Selection of pickup condition for vector surge protection; the following selection options are available:

- **OR**: In case that at least in one phase the maximum permissible voltage angle difference

  $\Delta\Theta_{max}$ (parameter “Limit“ [P1870] and “K1“ [P1871]) is exceeded and no blocking is

  active, then pickup event “ANSI78-1 pick-up“ [E1579] is being activated.

CAUTION: OR option not applicable for standard P60 device variants.

- **AND**: In case that in all three phases the maximum permissible voltage angle difference $\Delta\Theta_{max}$

  (parameter “Limit“ [P1870] and “K1“ [P1871]) is exceeded and no blocking is active,

  then pickup event “ANSI78-1 pick-up“ [E1579] is being activated.

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 $\Delta\Theta_{max}$ **=** *Limit* [P1870] **x** *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 characteristic 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 activated. Depending on activation/deactivation of the Current increase monitoring trip event *ANSI78-1 trip* [E1580] should 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 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: 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 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 activated; trip event ANSI78-1 trip [E1580] is not 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 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 reset.

P1872 Direction

Operating direction of vector surge protection; the working principle in view of the vector surge direction ($\Delta\Theta > 0$ => positive vector surge; $\Delta\Theta < 0$ => negative vector surge) can be chosen by the following setting options of parameter *"Direction"* [P1872]:

- "**none**": supervision for the max. permissible voltage angle difference $\Delta\Theta max$ independent of a positive or negative vector surge
- "**positive**": supervision for a positive voltage angle difference $\Delta\Theta$
- "**negative**": supervision for a negative voltage angle difference $\Delta\Theta$

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. The current increase monitoring function 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. When the phase current difference exceeds the set value *Current increase* [P1875] after the *Current increase time* [P1876] has run down, trip event *ANSI78-1 trip* [E1580] is then activated.

> *Note* *The minimum limit for detecting an inclining/declining phase current should be set as a percentage of the nominal value of the characteristic quantity (phase current). The nominal value of the characteristic quantity should be set by parameter:*
> *Current [P604], for primary side W1*
>
> *The referring parameters Current [P604] is 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 P60 Agile 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: This option is not supported in P16x devices

2.1.25 ANSI 79 – Automatic Reclose (AR)

ANSI 79 – Parameter set 1: Protection parameters [P] and Events [E]

Main Menu\Parameters\PROTECTION\

ANSI 79

SET 1 | SET 2 | SET 3 | SET 4

P/E No.	System Description	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	-	-	-
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	-	-	-

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 a consequence, only one group of parameters. SET PARAMETERS are therefore equal to STEP parameters. The protection parameters of SET 1 represented below are described in detail in the following 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) where:

- OFF: disables or
- ON: enables the protective function.

When Automatic Reclose (AR) ANSI 79 is enabled by parameter [P2675] event *ANSI79 Ready* [E2160] is then 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 for as long as the blocking event is active. As soon as blocking is active, event *ANSI79 Blocked* [E2161] is activated. If the blocking event becomes inactive, blocking is abandoned and protective function is effective again. Event [E2161] is then deactivated automatically.

If blocking of function Automatic Reclose (AR) is not required, set this parameter to **0**.

P2676 Lock

An AR-cycle of Automatic Reclose (AR) function which is already running can be interrupted (locked) by any active event. To do 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 activated. When the locking event becomes inactive, then the AR-cycle will still be interrupted.

If locking of an AR-cycle of function Automatic Reclose (AR) is not required, set this parameter to **0**.

P2677 Unlock

An AR-cycle of Automatic Reclose (AR) function which is already active but interrupted 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 continued, and event *ANSI79 Locked* [E2161] is deactivated.

CAUTION: If the locking of an AR-Cycle is expected in the application, please ensure that a corresponding unlocking event is 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 started and events *ANSI79 Cycle* [E2163] and *ANSI79 Fail* [2175] are 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; when the activation event becomes active, the first pause time set by parameter *1. Pause time* [P2680] is started and event *1. Pause time* [E2689] is activated.

P2681 2. Pause time

(Description similar to 1.pause time)

P2682 3. Pause time

(Description similar to 1.pause time)

P2683 4. Pause time

(Description similar to 1.pause time)

P2684 5. Pause time

(Description similar to 1.pause time)

P2685 6. Pause time

(Description similar to 1.pause time)

P2686 7. Pause time

(Description similar to 1.pause time)

P2687 8. Pause time

(Description similar to 1.pause time)

Parameters of an AR-cycle e.g. for ground 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]. Once this is active, the AR-cycle is started and event *ANSI79 Cycle* [E2163] is 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; when the activation event begins, the first pause time set by parameter *1. Pause time* [P2690] is started and event *ANSI 79 1. Pause time* [E2164] is activated.

P2690 2. Pause time

(Description similar to 1.pause time)

P2691 3. Pause time

(Description similar to 1.pause time)

P2692 4. Pause time

(Description similar to 1.pause time)

P2693 5. Pause time

(Description similar to 1.pause time)

P2694 6. Pause time

(Description similar to 1.pause time)

P2695 7. Pause time

(Description similar to 1.pause time)

P2696 8. Pause time

(Description similar to 1.pause time)

Parameters for auto-reclosing (RECLOSING)

P2697 Breaker close command time

Impulse duration for the reclosing command to the CB; when an active pause time has run down, closing-event *ANSI79 Breaker close command* [E2172] is activated. This event can be used for alarm or output control purposes.

Simultaneously,

- the counter of the impulse duration set by parameter *Breaker close success time* [P2697] **and**
- the counter of the reclosing success supervision set by parameter *Breaker success time* [P2698] are being started **and**
- event *Breaker close success time* [E2173] is 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.

The following cases have to be taken into account:

Automatic reclosing attempt was successful

The CB is closed. Event *ANSI79 Success* [E2174] and *ANSI79 Off-time* [E2176] are activated. Simultaneously, the counter of the AR-blocking-time set by parameter *Off- time* [P2699] is activated.

Automatic reclosing attempt was unsuccessful

The CB is open again (by further protection trip) and – if parameterised – the second pause time set by parameter *2. Pause time* [P2681] is 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 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 deactivated and event *ANSI79 Ready* is 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].

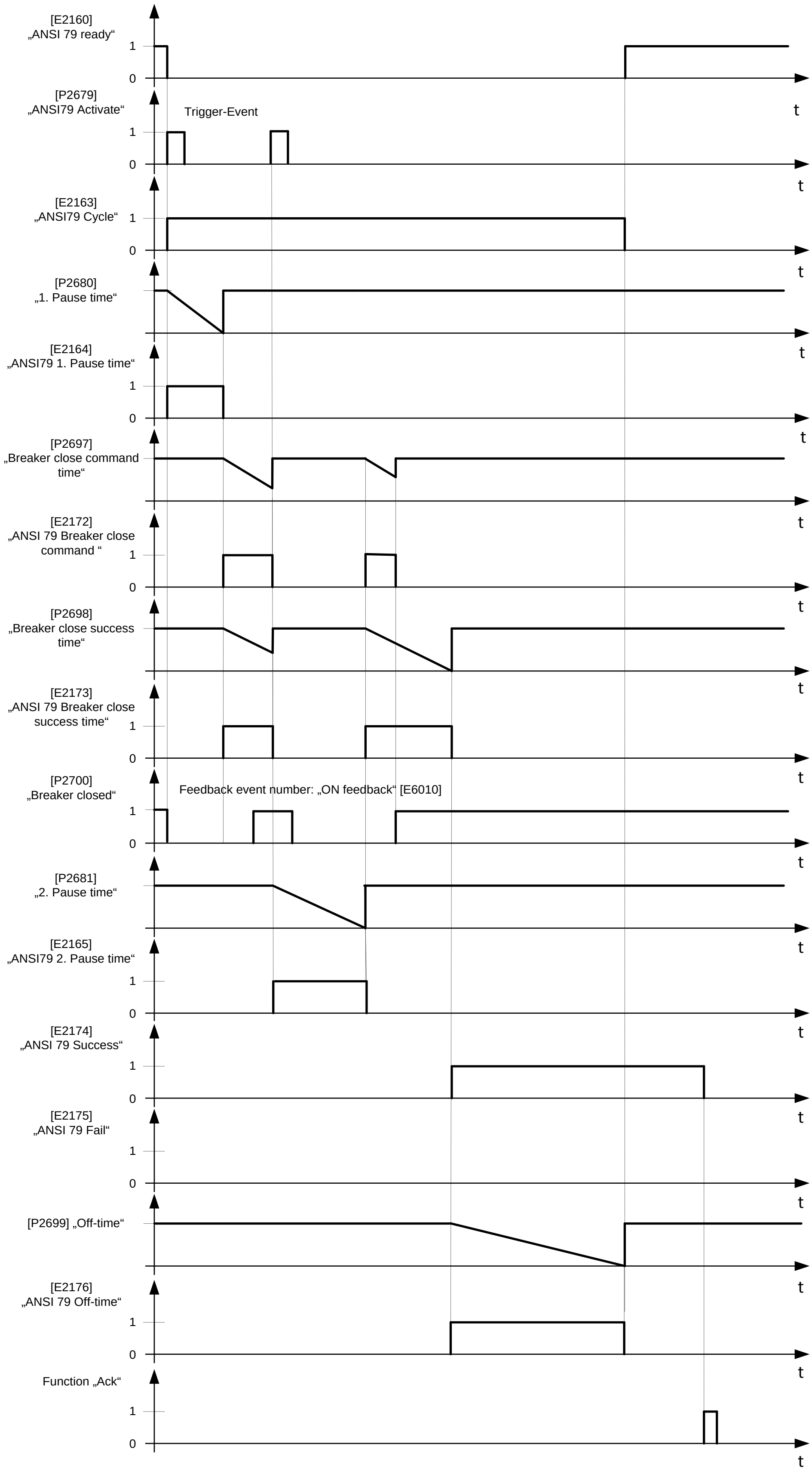


Figure 74 **Automatic reclosing (AR) – functional scheme**

2.1.26 ANSI 81 – Frequency Protection

ANSI 81 – Protection parameters [P] and events [E] of SET 1

Main Menu\Parameters\PROTECTION\				
ANSI 81				
SET 1	SET 2	SET 3	SET 4	
P/E No.	System Description	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
…	…	…	…	…

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. The parameter descriptions of the STEP PARAMETERS and the parameters of STEP 1 represented below are described in detail in the following 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. The SET PARAMETERS apply to all of the 12 protection STEPS of one parameter SET.

P1325 Frequency protection
This parameter enables/disables frequency protection where:

- OFF: disables or

- ON: enables the protective function.

> **Note:** *When 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 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 activated. If the blocking event becomes inactive, blocking is abandoned and protective function is effective again. Event [E1251] is then 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. The STEP 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 P60 Agile 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 activated.

> **CAUTION: P60 Agile device variants which were built according to ordering option G59 or G59 and ANSI87 do not provide frequency measurement via voltage measurement input PT3**

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 activated. If the blocking event becomes inactive, blocking is abandoned and protective function is effective again. Event [E1255] is then 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 should 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 set by parameter: Voltage (L-L) [P603], for primary side W1*
>
> *The parameter Voltage (L-L) [P603] is 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.

When 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 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 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 deactivated. When 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.

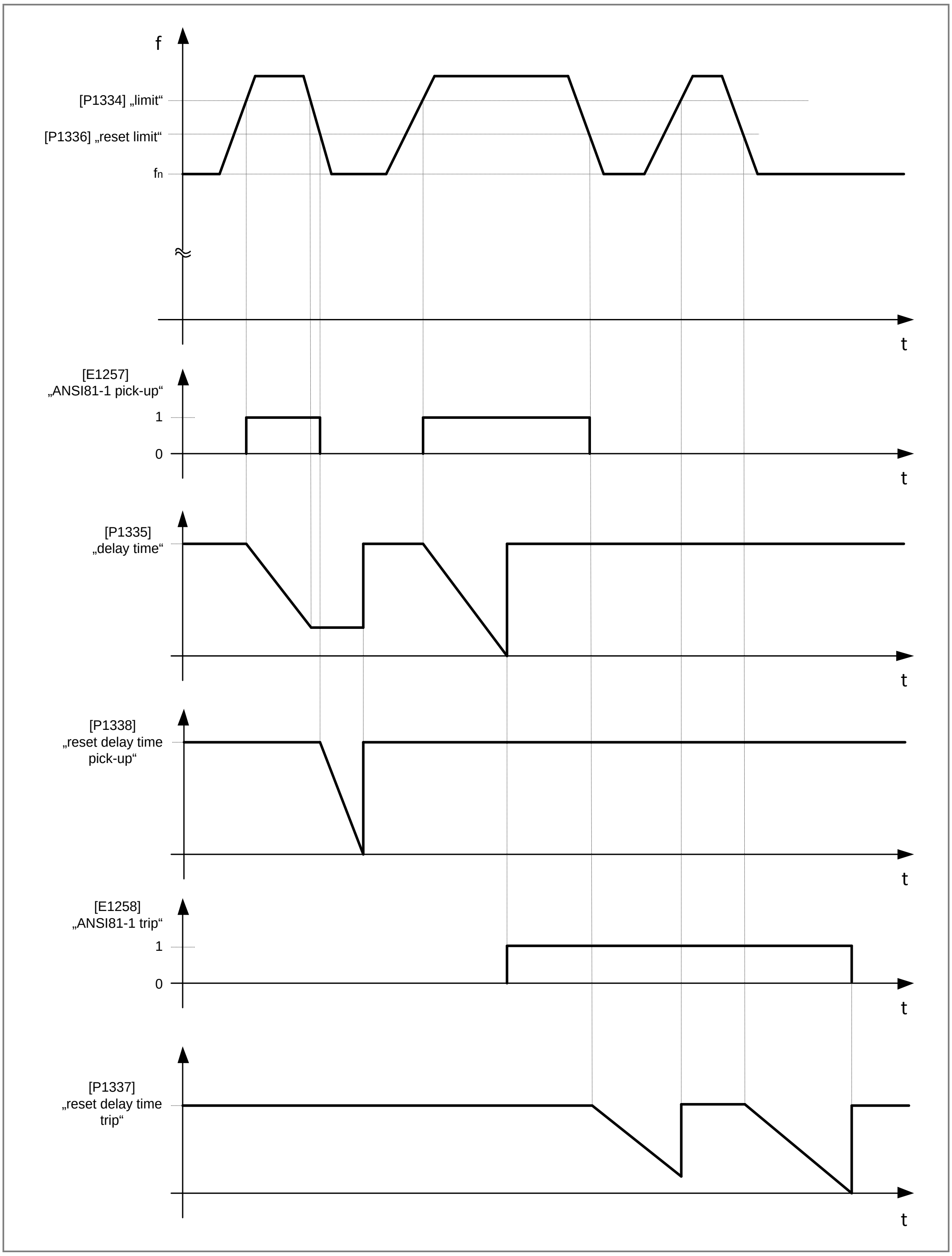


Figure 75 Overfrequency – tripping and reset characteristic

Protection parameter set 1

First protection element – Under frequency

P1331 Pick-up source

Depending on the P60 Agile 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 activated.

CAUTION: P60 Agile device variants which were built according to ordering option G59 or G59 and ANSI87 do not provide frequency measurement via voltage measurement input PT3

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 activated. If the blocking event becomes inactive, blocking is abandoned and protective function is effective again. Event [E1255] is then 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 should be set as a percentage of the nominal value of the characteristic quantity (phase-to-phase voltage). The nominal value of the characteristic quantity should be set by parameter:
Voltage (L-L) [P603], for primary side W1

*The parameter Voltage (L-L) [P603] is 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.

When 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 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 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 deactivated. When 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.

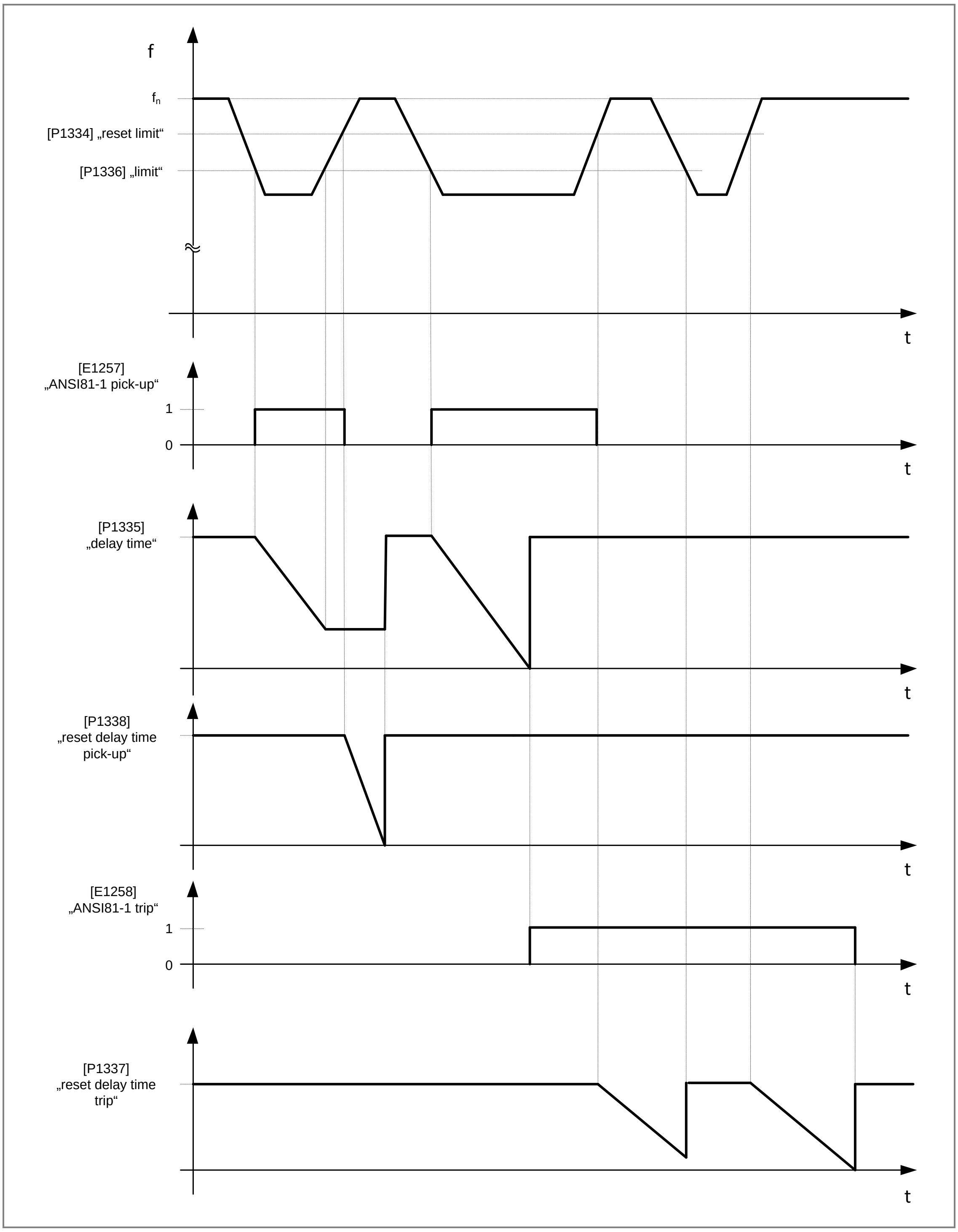


Figure 76 Underfrequency – tripping and reset characteristic

2.1.27 ANSI 81R – Rate of Change of Frequency (RoCoF)

ANSI 81R – Protection parameters [P] and events [E] of SET 1

Main Menu\Parameters\PROTECTION\

ANSI 81R – df/dt (ROCOF)

SET 1 | SET 2 | SET 3 | SET 4

P/E No.	System Description	Value	Unit	(Setting range)
SET PARAMETERS				
P3582	Rate of Change of Frequency (RoCoF)	OFF	-	ON/OFF
P3583	Blocking protection module	0	event	0 … 9999
E2471	ANSI81R module active	-	-	-
E2472	ANSI81R blocked module	-	-	-
STEP1				
P3584	Pickup source	PT1	-	none/PT1/PT2/PT3
P3585	Blocking protection step	0	event	0 … 9999
P3586	Min. start voltage	15	%	15 … 200,0
P3587	Min.start voltage delay time	1	s	0 … 999999,999
P3588	Mode	df/dt	-	df/dt / f> & df/dt / f< & df/dt / f > & DF/DT/ f< & DF/DT
P3589	Direction	none	-	none/positive/negative
P3590	f< limit	80,00	Hz	0 … 80,00
P3591	f> limit	0	Hz	0 … 80,00
P3592	df/dt limit	1	Hz/s	0 … 20
P3593	Hysteresis	1	Hz/s	0 … 20
P3594	K2	1	-	0 … 99,9
P3595	Delay time	1	s	0 … 999999,999
P3596	DF	1	Hz	0 … 20,00
P3597	DT	1	s	0 … 999999,999
P3598	Pickup mode	OR	-	OR/AND
E2473	ANSI81R-1 step active	-	-	-
E2474	ANSI81R-1 blocked step	-	-	-
E2475	ANSI81R-1 pickup	-	-	-
E2476	ANSI81R-1 trip	-	-	-
STEP2				
P3599	Pickup source	PT2	-	none/PT1/PT2/PT3
…	…	…	…	…

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. The parameter descriptions of the SET PARAMETERS and the parameters of STEP 1 represented below are described in detail in the following examples.*

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. The SET PARAMETERS apply to all of the 3 protection STEPS of one parameter SET.

Protection parameters of parameter SET 1 – ANSI 81R

The following STEP parameters of the rate of change of frequency (RoCoF) protection exist only once in each of the 3 independent protection STEPS. The STEP PARAMETERS apply only to one of the 6 protection STEPS of one parameter SET.

P3582 ROCOF

This parameter enables/disables rate of change of frequency (RoCoF) protection where:

- OFF: disables or
- ON: enables the protective function.

> ***Note:*** *When 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 [P3583].*

When rate of change of frequency (RoCoF) protection ANSI81R is enabled by parameter [P3582], then event *ANSI81R module active* [E2471] is activated.

P3583 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 [P3583]. Blocking is only effective, however, as long as the blocking event is active. As soon as blocking is active, event *ANSI81R blocked module* [E2472] is activated. If the blocking event becomes inactive, blocking is abandoned and protective function is effective again. Event [E2472] is then 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 6 independent protection STEPS. The SET PARAMETERS apply only to one of the 6 protection STEPS of one parameter SET.

P3584 Pickup source

Depending on the P60 Agile 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 [P3584] determines the voltage measurement input which will provide measurement values as characteristic quantities (see parameterizable protection criteria) 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* [E2473] is activated.

CAUTION: P60 Agile device variants which were built according to ordering option G59

-do not provide frequency measurement via voltage measurement input PT3

-do provide phase segregated frequency measurement (Zero crossings of phase voltages) only at voltage measurement PT2

-do provide frequency measurement at PT1 based on crossings of phase-neutral voltages UL1 and UL2

P3585 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 [P3585]. Blocking is only effective, however, as long as the blocking event is active. As soon as blocking is active, event *ANSI81R-1 blocked step* [E2474] is activated. If the blocking event becomes inactive, blocking is abandoned and protective function is effective again. Event [E2474] is then deactivated automatically.

If blocking of the first step of vector surge protection is not required, set this parameter to **0**.

P3586 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* [E2474] is activated.

Note: The minimum limit of the measuring voltage to activate rate of change of frequency (RoCoF) protection should be set as a percentage of the nominal value of the characteristic quantity (phase-to-phase voltage). The nominal value of the characteristic quantity should be set by parameter: Voltage (L-L) [P603], for primary side W1

*The parameter Voltage (L-L) [P603] is located in submenu: SYSTEM \Nominals **Reference values***.*

P3587 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. stat voltage* [P3586] is exceeded after a preceded voltage restoration, the counter *Min. start voltage delay time* [P3587] starts. Once the time has elapsed the counter is set to zero, the blocking of rate of change of frequency (RoCoF) protection is deactivated, and event *ANSI81R-1 blocked step by MSV* [E2474] is deactivated.

Application: Min. start voltage delay time is used to detect a stable voltage restoration.

P3588 Mode

Selection of operating mode according to the protective criterion (characteristic quantity) of the rate of change of frequency (RoCoF) protection; the first step of the rate of change of frequency (RoCoF) protection is optionally adjustable. Following setting options for the characteristic quantity are available:

- df/dt: Supervision of the *frequency gradient df/dt* depending on:

  -the set value of parameter *df/dt limit* [P3592], **and**

-the *supervision direction* of the rate of change of frequency (positive or negative sign of the frequency gradient slope) set by parameter *Direction* [P3589].

If:

-the *measured frequency gradient* exceeds the *max. permissible frequency gradient* df/dt_{max} set by parameter *df/dt limit* [P3592], **and**

-the *sign* of the measured frequency gradient *slope* is equal to the *set value* of parameter *Direction* [P3589], **and**

-no blocking event (parameter *Blocking protection module* [P3583]) is active, **and**

-no blocking event (parameter *Blocking protection step* [P3585]) is active, **and**

-no blocking by insufficient voltage (parameter *Min. start voltage* [P3586]) is active,

then pick-up event *ANSI81R-1 pick-up* [E2475] is activated, and the counter of the trip delay time (see parameter *Delay time* [P3595) is started. As soon as trip delay time run down, trip event *ANSI81R-1 trip* [E2476] will be activated. This event can be used for alarm or output control purposes.

In case that the characteristic quantity (df/dt) falls below the pick-up value ("df/dt limit" – "Hysteresis"), or the measured slope direction differs from the set supervision direction before the trip delay time has run down, the timer of trip delay time will be stopped and reset to zero, and the pick-up event [E2475] will be deactivated.

- f>&df/dt: Supervision of the *frequency gradient df/dt* depending on:

-the set value of parameter *df/dt limit* [P3592], **and**

-the *supervision direction* of the rate of change of frequency (positive or negative sign of the frequency gradient slope) set by parameter *Direction* [P3589], **and**

-the *max. permissible frequency limit* set by parameter *f> limit* [P3591].

If:

-the *measured frequency* exceeds the *max. permissible frequency limit* set by parameter *f> limit* [P3591], **and**

-the *measured frequency gradient* exceeds the *max. permissible frequency gradient* df/dt_{max} set by parameter *df/dt limit* [P3592], **and**

-the *sign* of the measured frequency gradient *slope* is equal to the *set value* of parameter *Direction* [P3589], **and**

-no blocking event (parameter *Blocking protection module* [P3583]) is active, **and**

-no blocking event (parameter *Blocking protection step* [P3585]) is active, **and**

-no blocking by insufficient voltage (parameter *Min. start voltage* [P3586]) is active,

then pick-up event *ANSI81R-1 pick-up* [E2475] is activated, and the counter of the trip delay time (see parameter *Delay time* [P3595) is started. As soon as trip delay time run down, trip event *ANSI81R-1 trip* [E2476] will be activated. This event can be used for alarm or output control purposes.

In case that the measured frequency gradient df/dt falls below the pick-value (“df/dt limit” – “Hysteresis”), **or** the measured slope direction differs from the set supervision direction, **or** the measured frequency falls below the max. permissible frequency limit before the trip delay time has run down, the timer of trip delay time will be stopped and reset to zero, and the pick-up event [E2475] will be deactivated.

- f<&df/dt: Supervision of the *frequency gradient df/dt* depending on:

  -the set value of parameter *df/dt limit* [P3592], **and**

  -the *supervision direction* of the rate of change of frequency (positive or negative sign of the frequency gradient slope) set by parameter *Direction* [P3589], **and**

  -the *min. permissible frequency limit* set by parameter *f< limit* [P3590].

  If:

  -the *measured frequency* falls below the *min. permissible frequency limit* set by parameter *f< limit* [P3590], **and**

  -the *measured frequency gradient* exceeds the *max. permissible frequency gradient* df/dt_{max} set by parameter *df/dt limit* [P3592], **and**

  -the *sign* of the measured frequency gradient *slope* is equal to the *set value* of parameter *Direction* [P3589], **and**

  -no blocking event (parameter *Blocking protection module* [P3583]) is active, **and**

  -no blocking event (parameter *Blocking protection step* [P3585]) is active, **and**

  -no blocking by insufficient voltage (parameter *Min. start voltage* [P3586]) is active,

  then pick-up event *ANSI81R-1 pick-up* [E2475] is activated, and the counter of the trip delay time (see parameter *Delay time* [P3595) is started. As soon as trip delay time run down, trip event *ANSI81R-1 trip* [E2476] will be activated. This event can be used for alarm or output control purposes.

  In case that the measured *frequency gradient df/dt falls below* the *pick-up value (df/dt limit),* **or** the *measured slope direction* differs from the *set supervision direction*, **or** the *measured frequency* exceeds the *min. permissible frequency limit* before the trip delay time has run down, the timer of trip delay time will be stopped and reset to zero, and the pick-up event [E2475] will be deactivated.

- “f>&DF/DT: Supervision of frequency change (time-depending frequency change) depending on:

  -the max. permissible frequency limit set by parameter f> limit [P3591], **and**

  -the max. permissible frequency change set by parameter DF [P3596], **and**

-the supervision time set by parameter DT [P3597], **and**

If:

-no blocking event (parameter Blocking protection module [P3583]) is active, **and**

-no blocking event (parameter Blocking protection step [P3585]) is active, **and**

-no blocking by insufficient voltage (parameter Min. start voltage [P3586]) is active, **and**

as soon as the measured frequency exceeds the max. permissible frequency limit set by parameter f> limit [P3591],

then the pick-up event *ANSI81R-1 pick-up* [E2475] is activated, and the counter of the supervision time “DT” is started.

While the supervision time “DT” is active, the frequency difference is calculated form each actual measured frequency value and the frequency value set by parameter f> limit [P3591]. When the amount of the frequency difference |DF| exceeds the set value of parameter DF [P3596], trip event *ANSI81R-1 trip* [E2476] will be activated. This event can be used for alarm or output control purposes.

In case that the measured frequency falls below the max. permissible frequency limit before the supervision time DT has run down, the timer of trip delay time will be stopped and reset to zero, and the pick-up event [E2475] will be deactivated.

- f<&DF/DT: Supervision of frequency change (time-depending frequency change) depending on:

-the min. permissible frequency limit set by parameter “f< limit” [P3590], **and**

-the max. permissible frequency change set by parameter “DF” [P3596], **and**

-the supervision time set by parameter “DT” [P3597], **and**

If:

-no blocking event (parameter “Blocking protection module“ [P3583]) is active, **and**

-no blocking event (parameter “Blocking protection step“ [P3585]) is active, **and**

-no blocking by insufficient voltage (parameter “Min. start voltage“ [P3586]) is active, **and**

as soon as the measured frequency exceeds the min. permissible frequency limit set by parameter “f< limit” [P3590],

then the pick-up event *ANSI81R-1 pick-up* [E2475] is activated, and the counter of the supervision time “DT” is started.

While the supervision time DT is active, the frequency difference is calculated form each actual measured frequency value and the frequency value set by parameter f< limit [P3590]. When the amount of the frequency difference |DF| exceeds the set value of parameter DF [P3596], trip event *ANSI81R-1 trip* [E2476] will be activated. This event can be used for alarm or output control purposes.

In case that the measured frequency exceeds the min. permissible frequency limit before the supervision time DT has run down, the timer of trip delay time will be stopped and reset to zero, and the *pick-up event* [E2475] will be deactivated.

P3589 Direction

Operating direction of rate of change of frequency (RoCoF) protection; the working principle in view of the frequency slope direction (df/dt >0 => positive slope; df/dt < 0 => negative slope) can be chosen by the following setting options of parameter *Direction* [P3589]:

- none: supervision of the of change of frequency independent of a positive or negative slope of df/dt.
- positive: supervision for a positive slope of the rate of change of frequency
- negative: supervision for a negative slope of the rate of change of frequency

P3590 f< limit

Frequency limit for activating rate of change of frequency (RoCoF) protection function; the protective function set to active by parameter *Rate of Change of Frequency (RoCoF)* [P3582] = *ON* will become active only will become active only in case that the measured frequency value falls below the set value of parameter *f< limit* [P3590].

P3591 f> limit

Frequency limit for activating rate of change of frequency (RoCoF) protection function; the protective function set to active by parameter *Rate of Change of Frequency (RoCoF) [P3582]* = *ON* will become active only in case that the measured frequency value exceeds the set value of parameter *f> limit* [P3591].

P3592 df/dt limit

Pick-up value of frequency gradient df/dt; this parameter is only valid for following settings of parameter [P3593] :

- df/dt
- f> & df/dt
- f< & df/dt

P3593 Hysteresis

This parameter [P3593] determines the reset limit for the pick-up *event ANSI81R-1 pickup* [E2475] 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 *ANSI81R-1 pickup* [E2475] will be deactivated:

(reset limit) = *K2* [P3594] **x** *df/dt limit* [P1920] **–** *Hysteresis* [P3593]

P3594 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 [P3594] by the setting of parameter *df/dt limit* [P3592] gives the maximum permissible *rate of change of frequency* df/dt_{max} as the limit for *rate of change of frequency (RoCoF) protection*.

Max. permissible rate of change of frequency df/dt_{max} **=** *df/dt limit* [P3592] **x** K2 [P3594]

Typical rates are:

- K2 = 1.0 Correction factor for low impedance grid, and
- K2 = 1.6 Correction factor for high impedance grid.

P3595 Delay time

Trip delay time is the delay time of the trip event *ANSI81R-1 trip* [E2476].

As soon as the pick-up event *ANSI81R-1 pickup* [E2475] is active and Delay time run down, trip event [E2476] will be activated.

P3596 DF

This parameter defines the limit of the max. permissible frequency difference within the supervision time set by parameter DT [3597] for the protection criterion DF/DT

P3597 DT

This parameter defines the duration of supervision time of the max. permissible frequency difference set by parameter DF [3596] for the protection criterion DF/DT

P3598 Pickup mode

Selection of pickup condition for rate of change of frequency (RoCoF) protection; when no blocking is active the pickup event ANSI81R-1 pick-up [E2475] is activated according to the following selection options:

- OR: Pickup event is activated, if at least in one phase the the selected protective criterion (see parameter Mode [P3588]) is fulfilled, or
- AND: Pickup event is activated, if at least in all three phases the the selected protective criterion (see parameter Mode [P3588]) is fulfilled.

NOTE: This parameter is only valid for device variants built according to ordering option for G59

2.1.28 ANSI 86 – Lockout relay

ANSI 86 – Protection parameters [P] and events [E]

Main Menu\Parameter\Protection\					
ANSI 86					
SET 1	SET 2	SET 3	SET 4		
P/E No.	System Description		Value	Unit	(Setting range)
SET PARAMETERS					
P3435	Function		none	-	OFF/RS-FF volatile/RS-FF non-volatile/SR-FF volatile/SR-FF non volatile
P3436	Reset		0	event	0 … 9999
E2368	ANSI86 module active		-	-	-

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. The parameter descriptions of the SET PARAMETERS represented below are described in detail in the following examples.*

P3435 Function

This parameter enables/disables *ANSI 86 – Lockout relay* function where:

- OFF: disables the *ANSI 86 – Lockout relay* function or
- RS-FF volatile: enables the *ANSI 86 – Lockout relay* function, control of input element for resetting (R) follows the RS-FlipFlop logic scheme; current state of *lockout relay output event (editable)* [E4502] is not saved after system reboot*;* or
- RS-FF nonvolatile: enables the *ANSI 86 – Lockout relay* function, control of input element for resetting (R) follows the RS-FlipFlop logic scheme; current state *lockout relay output event (editable)* is saved after system reboot*.*
- SR-FF volatile: enables function “ANSI 86 – Lockout relay”, domination of input element for setting (“S“) accords to the SR-FlipFlop logic scheme; current state of lockout relay output event (editable) [E4502] is not being saved after system reboot;

  or
- SR-FF nonvolatile: enables function ANSI 86 – Lockout relay, domination of input element for setting (“S“) accords to the SR-FlipFlop logic scheme; current state of lockout relay output event (editable) [E4502] is being saved after system reboot.

When Lockout relay ANSI 86 is enabled by parameter [P3435], then event *ANSI86 module active* [E2368] is activated.

> *Note:* *The ANSI 86 function only affects the reset behaviour of the active output event (editable) [E4502] of the binary output Lockout relay.*

When Lockout relay ANSI 86 is disabled by parameter [P3435], the reset of the output event (editable) [E4502] only operates according to the states of its assigned logical input elements and the parameter settings of the binary output Lockout relay.

P3436 Reset

Assignment of any available event to reset Lockout relay function; function can be reset by any active event. For reset, the number related to this reset event has to be assigned to parameter *Reset* [P3436].

If resetting of lockout relay is not required, set this parameter to **0**.

Example 1: Function = RS-FF volatile; reset of lockout relay via binary input FCT. 17 ([E4017])

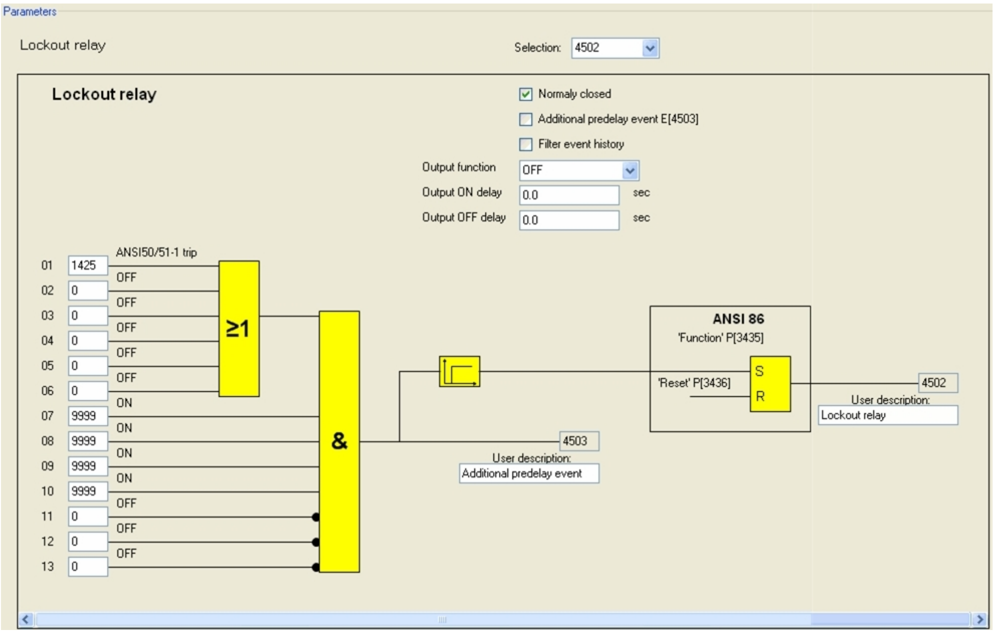
ANSI 86 – Parameter: Function = RS-FF-volatile

Parameters

ANSI 86 - Lockout relay

P/E	No.	System Description	Unit	SET 1	SET 2
P	3435	Function		RS-FF volatile	OFF
P	3436	Reset	event	4017	0
E	2368	ANSI86 module active			

Binary output – Lockout relay parameters



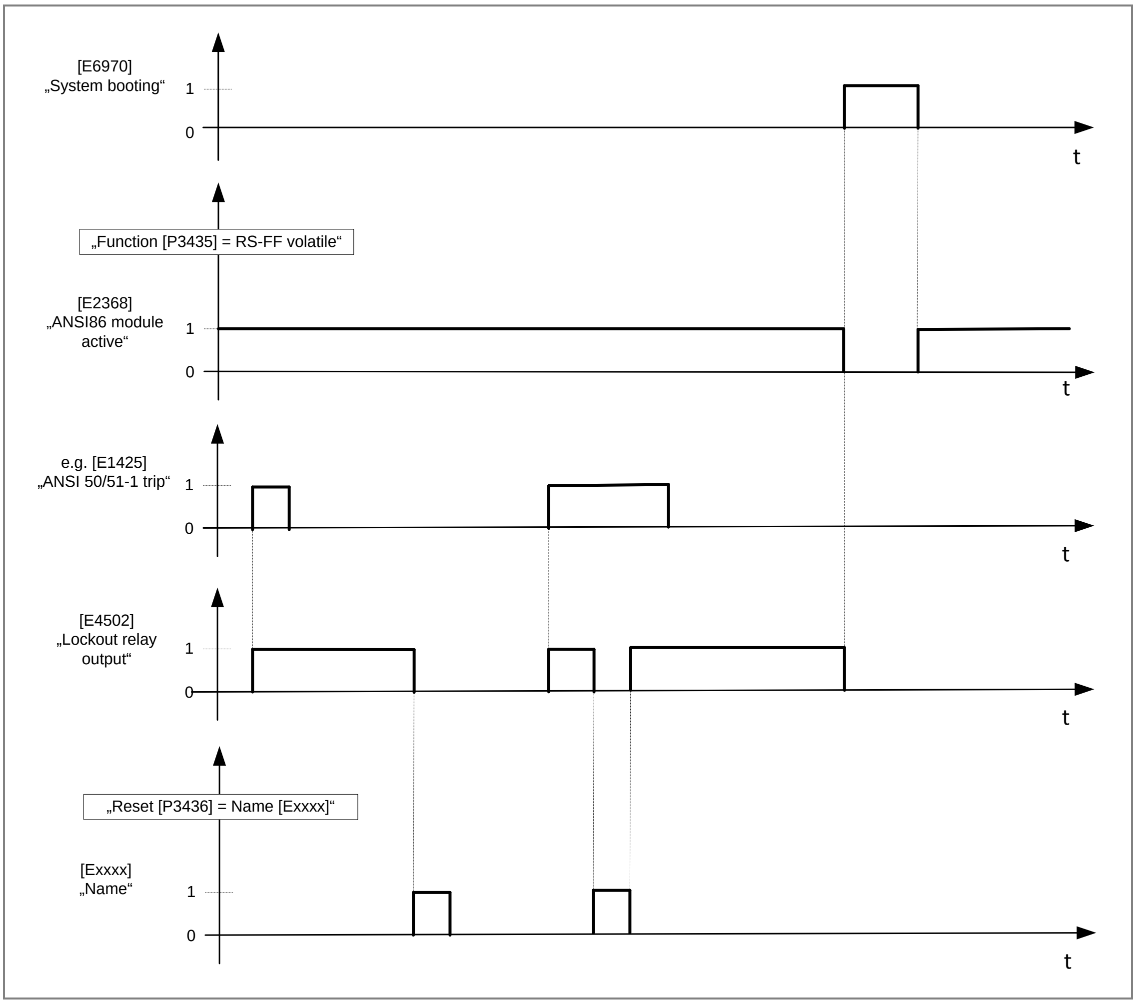


Figure 77 ANSI 86 – lockout and reset characteristic of lockout relay: RS-FF-volatile

Example 2: Function = RS-FF non-volatile; reset of lockout relay via binary input FCT. 17 (E4017])

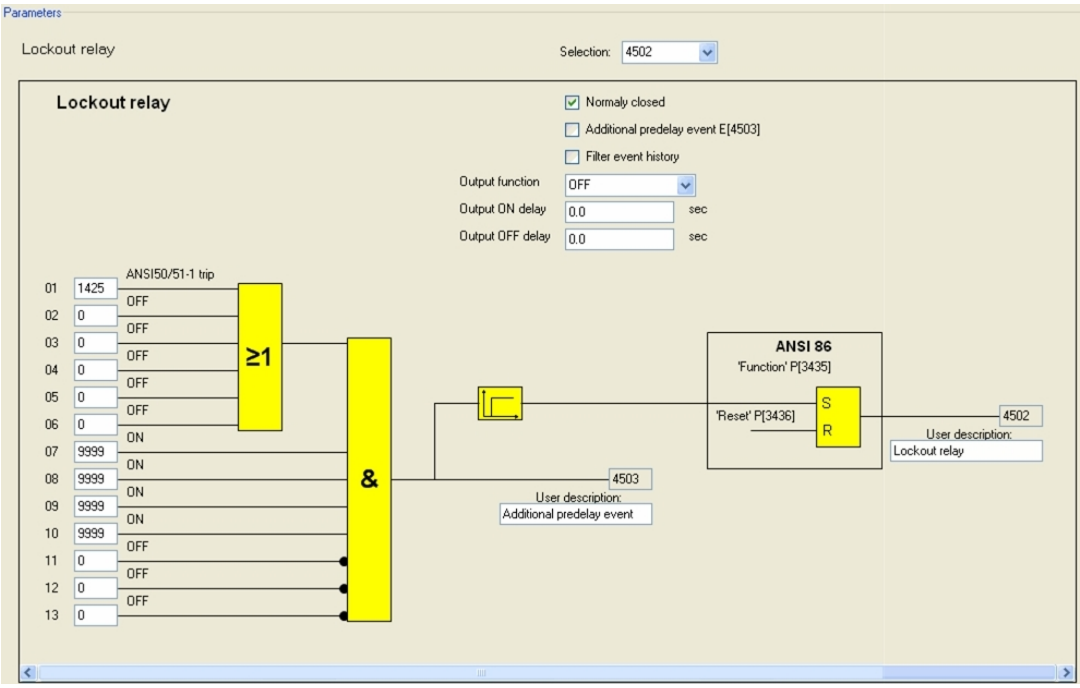
ANSI 86 – Parameter: Function = RS-FF-non-volatile

Parameters

ANSI 86 - Lockout relay

P/E	No.	System Description	Unit	SET 1	SET 2
P	3435	Function		RS-FF nonvolatile	OFF
P	3436	Reset	event	4017	0
E	2368	ANSI86 module active			

Binary output – Lockout relay parameters



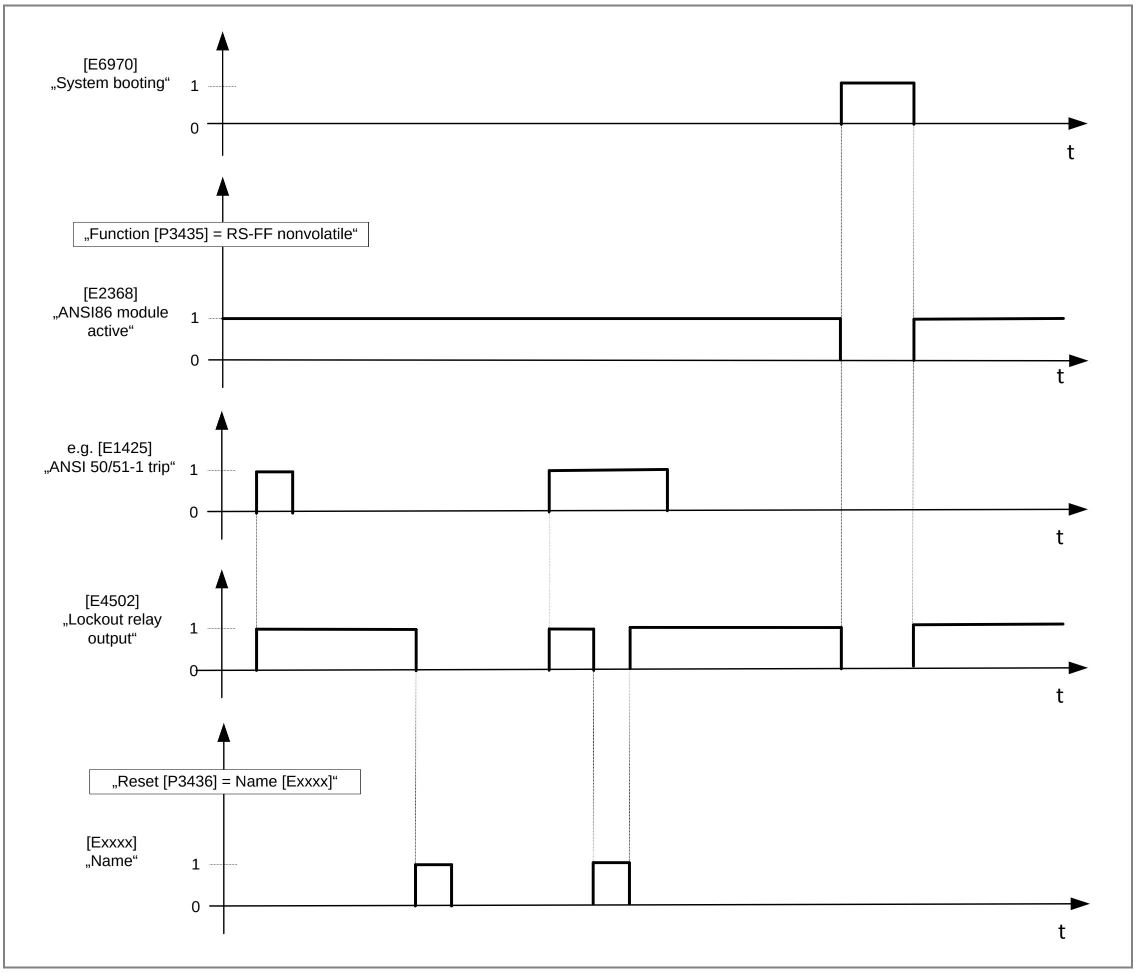


Figure 78 ANSI 86 – lockout and reset characteristic of lockout relay: RS-FF-non-volatile

2.1.29 ANSI 95i – Harmonics stabiliser

According to the P60 Agile device variant, function Harmonics stabiliser ANSI 95i is individually available for the following current measurement inputs:

- ANSI 95i-CT1: Harmonics stabiliser for current measurement input CT1
- ANSI 95i-CT2: This option is not supported in P16x devices

ANSI 95i – Protection parameters [P] and events [E] of SET 1

Main Menu\Parameters\PROTECTION\				
ANSI 95i				
SET 1	SET 2	SET 3	SET 4	
No.	System Description	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	750	%	5 … 6553,5
P1748	Mode	1-phase	-	1-phase/3-phase
P1749	2H Limit	10	%	1 … 6553,5
P1750	5H Limit	10	%	1 … 6553,5
P1751	2H max. blocking time	1	s	0 … 999999,999
P1752	5H max. blocking time	1	s	0 … 999999,999
E1470	ANSI95I-CT1 module active	-	-	-
E1471	ANSI95I-CT1 blocked module	-	-	-
E1472	ANSI95I-CT1 blocked by Imax	-	-	-
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			
P1761	Blocking protection module			
P1762	Module blocking current			
P1763	Mode			
P1764	2H Limit			
P1765	5H Limit			
P1766	2H max. blocking time			
P1767	5H max. blocking time			
E1485	ANSI95i-CT2 module active			
E1486	ANSI95i-CT2 blocked module	**Option not supported in P16x**		
E1487	ANSI95i-CT2 blocked by Imax			
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	750	%	5 … 6553,5
P1794	2H Limit	10	%	1 … 6553,5
P1795	5H Limit	10	%	1 … 6553,5

P1796	2H max. blocking time	1	s	0 … 999999,999
P1797	5H max. blocking time	1	s	0 … 999999,999
E1515	ANSI95i-GND1 module active	-	-	-
E1516	ANSI95i-GND1 blocked module	-	-	-
E1517	ANSI95i-GND1 blocked by Imax	-	-	-
E1518	ANSI95i-GND1 blocked by 2H	-	-	-
E1519	ANSI95i-GND1 blocked by 5H	-	-	-
E1520	ANSI95i-GND1 2H supervision blocked	-	-	-
E1521	ANSI95i-GND1 5H supervision blocked	-	-	-

Parameter description:

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

> *Note: For functions CT1-Harmonics stabiliser, CT2-Harmonics stabiliser and GND1-Harmonics stabiliser, each of the four parameter SETS always provides only one protection STEP and, as a consequence, only one group of protection parameters. SET PARAMETERS are equal to STEP parameters. The protection parameters of function CT1-Harmonics stabiliser of SET 1 are described in detail below.*

Protection parameters of parameter SET 1 – (ANSI 95i\CT1-Harmonics stabiliser)

P1745 Harmonics stabiliser

This parameter enables/disables function CT1-Harmonics stabiliser where:

- OFF: disables or
- ON: enables the function.

When function CT1-Harmonics stabiliser is enabled by parameter [P1745], then event *ANSI95I-CT1 module active* [E1470] is activated.

P1746 Blocking module

Function CT1-Harmonics stabiliser 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 activated. If the blocking event becomes inactive, blocking is abandoned and function CT1-Harmonics stabiliser is effective again. Event [E1471] is then deactivated automatically.

If blocking of function CT1-Harmonics stabiliser is not required, set this parameter to **0**.

P1747 Module blocking current

Maximum phase current limit for harmonics stabilisation (high-current faults); When in at least one phase the phase current exceeds the set value of parameter [P1746], function CT1-Harmonics stabiliser is blocked, and event *ANSI95I-CT1 blocked by Imax* [E1472] is activated. When the current value falls below the set value, blocking of harmonics stabilisation and event [E1472] is deactivated.

> *Note: The maximum phase current limit for harmonics stabilisation should be set as a percentage of the nominal value of the characteristic quantity (phase current). The nominal value of the characteristic quantity should be set by parameter: Current [P604], for primary side W1*
>
> *The parameter Current [P604] is located in submenu: SYSTEM \Nominals **Reference values**.*

P1748 Mode

Configuration of the harmonic blocking mode:

- **1-phase:** When only in one phase the limit of parameter(s) *2H Limit* [P1749] or/and *5H Limit* [P1750] is (are) exceeded, then protection pickup of those protective functions with activated Harmonic stabilisation is blocked only in the affected phase.
- **3-phase:** In case that at least in one phase the limit of parameter(s) *2H Limit* [P1749] or/and *5H Limit* [P1750] is (are) exceeded, then protection pickup of those protective functions with activated Harmonic stabilisation is blocked in all three phases.

P1749 2H Limit

Pick-up value of 2nd 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 – according to the selected setting option of parameter *Mode* [P1748] – the following corresponding blocking event(s) is (are) activated:

- ANSI95i-CT1 L1 blocked by 2H [E1473] and/or
- ANSI95i-CT1 L2 blocked by 2H [E1474] and/or
- ANSI95i-CT1 L3 blocked by 2H [E1475]

P1750 5H Limit

Pick-up value of 5th 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, 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.

When 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 are deactivated, and event *ANSI 95i CT1-2H supervision blocked* [E1479] is activated. When the amount of the measured 2nd harmonic falls below the set value of parameter *2H Limit* [P1749] in all three phases, event [E1479] is then 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.

When 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 are deactivated, and event *ANSI 95i CT1-5H supervision blocked* [E1480] is activated. When the amount of the measured 5th harmonic falls below the set value of parameter 5*H Limit* [P1750] in all three phases, event [E1480] is then deactivated.

2.1.30 CLD – Cold Load Detection

ANSI 95i – Protection parameters [P] and events [E] of SET 1

Main Menu\Parameter\Protection\				
CLD				
SET 1	SET 2	SET 3	SET 4	
P/E No.	**System Description**	**Value**	**Unit**	**(Setting range)**
SET PARAMETERS				
P3325	CLD function	OFF	-	OFF/I</Event/I< OR Event/ I< AND Event
P3326	Blocking	0	event	0 … 9999
P3327	CT reference	CT1	-	CT1/CT2*
P3328	Trigger limit	10.0	-	0 … 6553,5
P3329	Delay time	3600.000	s	0 … 999999,999
P3330	Reset delay time	3600.000	s	0 … 999999,999
P3331	Trigger event	0	event	0 … 9999
P3332	Fast reset	OFF	-	OFF/ON
P3333	Fast reset limit	100.0	%	0 … 6553,5
P3334	Fast reset delay time	600.000	s	0 … 999999,999
P3335	Fast reset blocking	0	event	0 … 9999
E2330	CLD active	-	-	-
E2331	CLD blocked	-	-	-
E2332	CLD pickup	-	-	-
E2333	CLD cold load	-	-	-

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 represented below are described in detail in the following examples.*

Protection parameters – CLD

SET PARAMETERS

The following SET PARAMETERS of the CLD function exist only once.

P3325 CLD function

This parameter enables/disables CLD function where:

OFF: disables CLD function or

I<: enables CLD function using criterion *I*< for working principle, when the characteristic quantity (phase current) falls below the set value of parameter T*rigger limit* [P3328] in all three phases, event *CLD pickup* [E2332] is activated or

Event: enables CLD function using *criterion Event* for working principle when the trigger event which is assigned to parameter *Trigger event* [P3331] is activated, event *CLD pickup* [E2332] is activated or

I< OR Event: enables CLD function using criterion I< OR Event for working principle, at the moment that the characteristic quantity (phase current) falls below the set value of parameter Trigger limit [P3328] in all three phases or the trigger event which is assigned to parameter Trigger event [P3331] is activated, event CLD pickup [E2332] is activated, or

I< AND Event: enables CLD function using criterion *I< AND Event* for working principle, when the characteristic quantity (phase current) falls below the set value of parameter *Trigger limit* [P3328] in all three phases **and** the trigger event which is assigned to parameter *Trigger event* [P3331] is activated, event *CLD pickup* [E2332] is activated.

P3326 Blocking

CLD function can be completely blocked by any active event. For blocking, the number related to this blocking event has to be assigned to parameter [P3326]. Blocking is only effective, however, as long as the blocking event is active. As soon as blocking is active, event *CLD blocked* [E2331] is being activated. If the blocking event becomes inactive, blocking is abandoned and protective function is effective again. Event [E2331] is then deactivated automatically.

If blocking of the CLD is not required, set this parameter to **0**.

P3327 CT reference

Depending on the P60 Agile device variant CLD function can be assigned to a certain current measurement input (CT1 or CT2). Parameter [P3327] determines the current measurement input which will provide measurement values as characteristic quantity (phase current) to CLD function:

- CT1: current input CT1
- CT2: This option is not supported in P16x devices

P3328 Trigger limit

Pick-up value of criterion *I*< for detecting a cold load situation; at the moment that the characteristic quantity (phase current) falls below the Trigger limit in all three phases, criterion *I*< is fulfilled.

APPLICATION Note: In case that the measured phase current is below the set value of parameter *Trigger limit* [P3328], it may be concluded that the circuit breaker is off.

Parameter *Trigger limit* [P3328] is only valid for the following setting options:

- *I*< and
- *I< OR Event* and
- *I< AND Event*

of parameter *CLD function* [P3325].

Depending on the selected setting option, and in case that

- criterion *I*< is fulfilled **or**
- criteria *I*< **or** *Event* are fulfilled **or**
- criteria *I*< **and** *Event* are fulfilled,

pickup event *CLD pickup* [E2332] is being activated and the *Delay time* [P3329] for activating event *CLD cold load* [E2333] starts.

P3331 Trigger event

Trigger event of criterion Event for detecting a cold load situation; criterion Event can be fulfilled by any active event. For this, the number related to this trigger event has to be assigned to parameter [P3331].

APPLICATION Note: It is recommended to assign the feedback event number of the circuit breaker (e.g. *OFF-feedback* [E6011] of breaker no. 1) to parameter *Trigger event* [P3331] to indicate cold load situation while the circuit breaker is off.

Parameter *Trigger event* [P3331] is only valid for setting options:

- Event and
- I< OR Event and
- I< AND Event

of parameter *CLD function* [P3325].

Depending on the selected setting option, and in case that:

- criterion *Event* is fulfilled **or**
- criteria *I<* **or** *Event* are fulfilled **or**
- criteria *I<* **and** *Event* are fulfilled

pickup event *CLD pickup* [E2332] is being activated and the *Delay time* [P3329] for activating event *CLD cold load* [E2333] starts.

P3329 Delay time

Delay time for activating event *CLD cold load* [E2333]; as soon as event *CLD pickup* [E2332] is active and Delay *time* run down, event *CLD cold load* [E2333] will be activated. This event can be used for either for blocking the current protection functions or to activate the dynamic parameters for current protection functions.

P3330 Reset delay time

Trip reset delay time for resetting event *CLD cold load* [E2333]; when Reset delay time has run down, event *CLD cold load* [E2333] is deactivated. This Reset delay time determines the duration for blocking the current protection functions or *activation* of the dynamic parameters referring to current protection functions.

Fast reset CLD

If the load inrush current decreases faster, function Fast reset CLD can be configured as another reset alternative.

P3332 Fast reset

This parameter enables/disables CLD fast reset function where:

- OFF: disables or
- ON: enables CLD fast reset function.

P3333 Fast reset limit

Pick-up value of fast reset CLD function; when

- Function Fast reset is activated **and**
- Fast reset blocking is deactivated **and**
- event *CLD Pickup* [E2332] is deactivated **and**
- the characteristic quantity (phase current) falls below the Fast reset limit in all three phases,

then, Fast reset delay time is started.

P3334 Fast reset delay time

Fast reset delay time; it is the delay time for resetting event *CLD cold load* [E2333].

When Fast reset delay time runs down, event *CLD cold load* [E2333] is deactivated.

P3335 Fast reset blocking

Fast reset CLD function can be completely blocked by any active event. For blocking, the number related to this blocking event has to be assigned to parameter [P3335]. Blocking is only effective, however, as long as the blocking event is active. If the blocking event becomes inactive, blocking is abandoned and fast reset function is effective again.

If blocking of the fast reset CLD function is not required, set this parameter to **0**

2.1.31 CTS – Current Transformer Supervision

CTS for CT1 – Parameter set 1: Protection parameters [P] & Events [E

Main Menu\Parameters\PROTECTION\ CTS – Current transformer supervision				
CT1				
SET 1	SET 2	SET 3	SET 4	
No.	System Description	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	-	-	-

CTS for CT2* – Parameter set 1: Protection parameters [P] & Events [E]

Main Menu\Parameter\Protection\ CTS – Current transformer supervision				
CT2*				
SET 1	SET 2	SET 3	SET 4	
No.	System Description	Value	Unit	(Setting range)
Symmetry check				
P2645	Function			
P2646	Blocking			
P2647	Min. start current	***Option not applicable to P16x**		
P2648	Symmetry quotient			
P2649	Delay time			

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	
P2654	Blocking	
P2655	Diff current limit	***Option not applicable to P16x**
P2656	Delay time	
P2657	Correction factor	
E2145	CTS-2 diff check active	
E2146	CTS-2 diff check blocked	
E2147	CTS-2 diff fault	
E2148	CTS-2 diff fault delayed	

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. The parameter descriptions of parameter SET 1 represented below are described in detail in the following examples.*

Protection parameters of parameter SET 1 – Current Transformer Supervision at CT1

Symmetry check (Supervision of current symmetry)

The Symmetry check function 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 where:

- 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 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 activated. If the blocking event becomes inactive, blocking is abandoned and protective function is effective again. Event [E2131] is then 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 current values of all three 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.

> *Note: The minimum limit of measured process quantity phase current should be set as a percentage of the nominal value of the process quantity. The nominal value of the process quantity should be set by parameter: Current [P604], for primary side W1*
>
> *The parameter Current [P604] is 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:

- Symmetry check function 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 [P2631]

the pick-up event *CTS-1 symmetry fault* [E2132] is activated and Delay time is 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 deactivated automatically.

When 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 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 activated and Delay time is started again.

Diff check (Supervision of total current difference)

The Diff check function calculates the total current difference $\Delta \underline{I}_\Sigma$ between the measured ground current (CT-GND1) and the total current $3I_0$ calculated via the measured phase currents of CT1 ($3\underline{I}_0 = \underline{I}_{L1} + \underline{I}_{L2} + \underline{I}_{L2}$). When all the current paths of CT1 and CT-GND1 are in proper conditions and any CT tolerances are neglected, it is:

$$\Delta \underline{I}_\Sigma = \underline{I}_{G1} - 3\underline{I}_0 = 0$$

In the event that quotient $\Delta \underline{I}_\Sigma$ falls below the set minimum permitted value $\Delta \underline{I}_{\Sigma\ max.perm..}$, 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; where:

- 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 activated.

P2639 Blocking

The Diff check function 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 activated. If the blocking event becomes inactive, blocking is abandoned and protective function is effective again. Event [E2136] is then deactivated automatically.

If blocking of Diff check function is not required, set this parameter to **0**.

P2640 Diff current limit

Pick-up value $\Delta\underline{I}_{\Sigma,max.perm.}$ of the supervision function Diff check; at the moment that the characteristic quantity (total current difference $\Delta\underline{I}_{\Sigma} = \underline{I}_{G1} - 3\underline{I}_0$) 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 $\Delta\underline{I}_{\Sigma}$ exceeds the pick-up value, pick-up event *CTS-1 diff fault* [E2137] is activated and Delay time is 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 $\Delta\underline{I}_{\Sigma} = \underline{I}_{G1} - 3\underline{I}_0$ 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 activated and Delay time is 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 deactivated automatically.

When the characteristic quantity (total current difference $\Delta\underline{I}_{\Sigma} = \underline{I}_{G1} - 3\underline{I}_0$) 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 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 activated and Delay time is started again.

Consideration of current-depending CT-tolerances

P2642 Correction factor

Dynamic correction factor to adopt pick-up value $\Delta I_{\Sigma,max.perm.}$; 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 $\Delta I_{\Sigma,max.perm.}$ can be automatically increased according to the increasing total current difference ΔI_{Σ}

$$\Delta I_{\Sigma}(I_{L\,max}) = \Delta I_{\Sigma,max.perm,dyn.} * I_{L\,max} + \Delta I_{\Sigma,max.perm.}$$

= Correction factor [P2642] * $I_{L\,max}$ + Diff current limit [P2640]

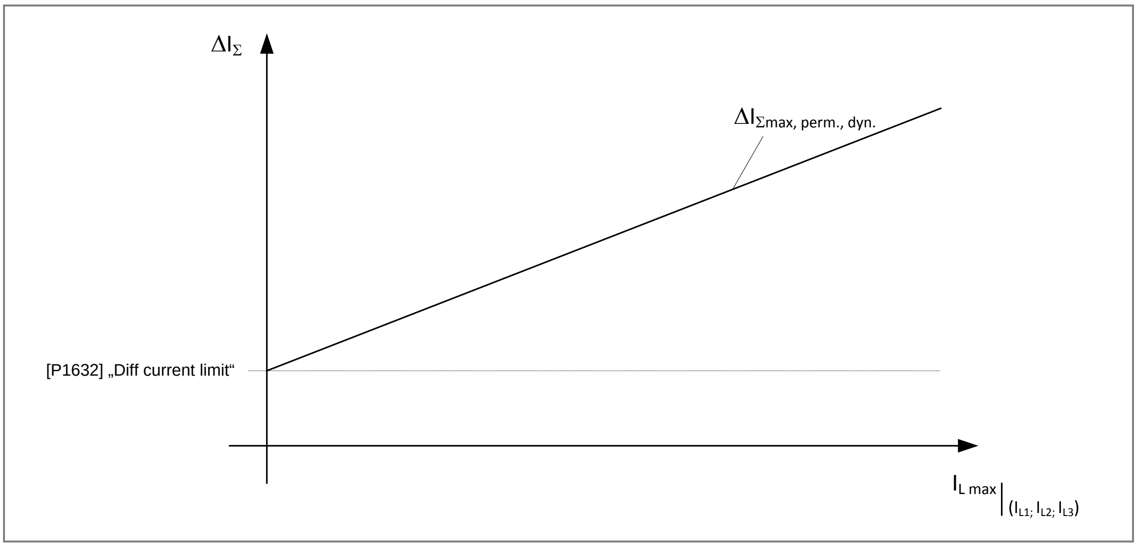


Figure 79 Diff check – Correction of current-dependent CT-tolerances

If correction of pick-up value $\Delta I_{\Sigma,max.perm.}$ is not required, set this parameter to **0**.

> ***Note:*** *When Holmgreen connection is used for current measurement and/or all three CTs fail in a fully balanced 3-phase system, then function “CTS – Current Transformer Supervision” has to be deactivated.*

2.1.32 PTS – Potential Transformer Supervision

PTS for PT1 – Parameter set 1: Protection parameters [P] and Events [E]

Main Menu\Parameters\PROTECTION\ PTS – Potential transformer supervision				
PT1				
SET 1	SET 2	SET 3	SET 4	
No.	System Description	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 failure	-	-	-
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	-	-	-

PTS for PT2 – Parameter set 1: Protection parameters [P] and Events [E]

Main Menu\Parameters\PROTECTION\ PTS – Potential transformer supervision				
PT2				
SET 1	SET 2	SET 3	SET 4	
No.	System Description	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 failure	-	-	-
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	-	-	-

PTS for PT3 – Parameter set 1: Protection parameters [P] and Events [E]

Main Menu\Parameters\PROTECTION\ PTS – Potential transformer supervision

PT3

SET 1 | SET 2 | SET 3 | SET 4

No.	System Description	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	-	-	-

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. The parameter descriptions of parameter SET 1 represented below are described in detail in the following examples.*

Protection parameters of parameter SET 1 – Potential Transformer Supervision at PT1

Symmetry check (Supervision of voltage symmetry)

The Symmetry check function cyclically calculates the quotient between measured minimum and maximum phase-to-phase voltages of PT1:

$U_Q = U_{L\text{-}L,min}/U_{L\text{-}L,max}$

In the event that quotient U_Q falls below the set minimum permitted value $U_{Q\ min.perm.}$, 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 where:

- OFF: disables or
- ON: enables the supervision function.

> *Note:* *When 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 activated.

P2541 Blocking

The Symmetry check function 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 activated. If the blocking event becomes inactive, blocking is abandoned and protective function is effective again. Event [E2071] is then 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 $U_Q = U_{L\text{-}L,min}/U_{L\text{-}L,max}$) – remain below this minimum setting.

> *Note:* *The minimum limit of measured process quantity phase-to-phase voltage should be set as a percentage of the nominal value of the process quantity. The nominal value of the process quantity should be set by parameter: Voltage (L-L) [P603], for primary side W1*
>
> *The parameter Voltage (L-L) [P603] is located in submenu: SYSTEM \Nominals **Reference values**.*

Check for voltage asymmetry 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 $U_{L\text{-}L,min}/U_{L\text{-}L,max}$) 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 $U_{L\text{-}L,min}/U_{L\text{-}L,max}$ falls below the set value of parameter [P2543] (voltage asymmetry check) **and**
- blocking of function Symmetry check is not activated by the blocking event of parameter [P2541]

the pick-up event *PTS-1 symmetry fault* [E2072] is activated and Delay time is 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. Following a protection trip, and, as soon as faulty conditions will no longer be existent, pick-up event [E2072] and trip event [E2073] are deactivated automatically.

When the characteristic quantity (quotient of the minimum and maximum phase-to-phase voltage $U_{L\text{-}L,min}/U_{L\text{-}L,max}$) 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 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 activated and Delay time is started again.

Fuse failure check

For supervision of a potential transformer fuse failure (tripping of miniature circuit breaker MCB), the Fuse failure check function 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 PT fuse 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 activated for the following parameter settings: Function / Source [P2547] = CT1* *Parameter [P2556] of function Fuse failure check will not then 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 conducted by:

- check of phase current symmetry by the characteristic quantities: calculated total current $3I_0$ and negative phase sequence current I2 of symmetrical components,
- current check for a minimum load and
- check of voltage symmetry depending on the star point treatment (isolated, compensated or solidly grounded star point)

A 1-phase and 2-phase fault is detected if there is a measured minimum load and an impermissible voltage unsymmetry, but no impermissible current symmetry.

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 conducted by:

- check of voltage loss at voltage measurement input PT1 by the characteristic quantity phase voltage:$U_{Lx\text{-}E}$ (with: x = 1,2,3) and
- current check for high-current faults such as short-circuits.

A 3-phase fault is detected in the 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, where:

- 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: This option is not supported in P16x devices
- 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 activated.

P2548 Blocking

The Fuse failure check function 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 activated. If the blocking event becomes inactive, blocking is abandoned and protective function is effective again. Event [E2077] is then 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 I2* 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; 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 U2 of symmetrical components exceed the set value of parameter *Symmetric voltage limit* [P2551], the third criterion for detecting 1-phase or 2-phase tripping of MCBs is fulfilled.

CAUTION: Parameter *Asymmetric voltage limit* [P2551] only applies to applications providing solidly grounded star points; for this, the following parameter setting applies:

- for primary side W1: *Star point grounding [P602]* = grounded

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 primary side W1: Star point grounding [P602] = 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* $U_{Lx\text{-}E}$ (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 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 IILx – ILx*I 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 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 activated for parameter setting: Function / Source [P2547] = PT-GND1.*
>
> *Parameters [P2549] to [P2555] of function Fuse failure check will not then apply.*

Function Voltage difference calculates the residual voltage difference $\Delta \underline{U}_{\Sigma}$ between the measured ground voltage (PT-GND1) and the residual current $3U_0$ calculated via the measured phase currents of PT1 ($3\underline{U}_0 = \underline{U}_{L1\text{-}E} + \underline{U}_{L2\text{-}E} + \underline{U}_{L2\text{-}E}$). When all the voltage circuits of PT1 and PT-GND1 are in proper conditions and any PT tolerances are neglected, it is:

$\Delta \underline{U}_{\Sigma} = \underline{U}_{G1} - 3\underline{U}_0 = 0$

In the event that quotient ΔU_{Σ} falls below the set minimum permitted value $\Delta \underline{U}_{\Sigma,max.perm.}$, it may be concluded that there is a fault

- in the ground voltage circuit of PT-GND1 or
- in one or two of the phase voltage circuits of PT1 (1-pole or 2 pole fuse fail).

CAUTION: A 3-pole fuse failure cannot be detected by the Voltage difference function.

P2556 Diff voltage limit

Pick-up value $\Delta \underline{U}_{\Sigma,max.perm.}$ of the supervision function Voltage difference; at the moment that the characteristic quantity (total residual voltage difference $\Delta \underline{U}_{\Sigma} = \underline{U}_{G1} - 3\underline{U}_0$) 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 $\Delta \underline{U}_{\Sigma}$ exceeds the pick-up value, pick-up event *PTS-1 fuse failure* [E2079] is activated and Delay time is 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 activated and Delay time is 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 are no longer existent, pick-up event [E2079] and trip event [E2080] are 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 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 activated and delay time is 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 where:

- OFF: disables or
- CT1: enables sub-function General check and current check of CT1 or
- CT2: This option is not supported in P16x devices

When supervision function General check is enabled by parameter [P2561], then event *PTS-1 general check active* [E2084] is 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 activated. If the blocking event becomes inactive, blocking is abandoned and protective function is effective again. Event [E2085] is then 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 $U_{Lx\text{-}E}$; 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 a consequence, there is no active voltage to be measured via PT1.

Note:	*When 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 a 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 <u>not</u> 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 becomes inactive, CB position is interpreted as OPEN and – depending on the PT location – no voltage is measured at PT1. When measured phase voltages fall below the set limit of parameter *Voltage limit* [P2564], it may not indicate 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 activated and Delay time is 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 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 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 activated and Delay time is started again.

2.1.33 SOTF – Switch On To Fault

SOTF – Protection parameters [P] and events [E] of SET 1

				Main Menu\Parameters\PROTECTION\
	SOTF – Switch on to fault			
SET 1	SET 2	SET 3	SET 4	
P/E No.	System Description	Value	Unit	(Setting range)
SET PARAMETERS				
P3340	SOTF function	OFF	-	OFF/ON
P3341	Blocking protection module	0	event	0 … 9999
E2335	SOTF active	-	-	-
E2336	SOTF blocked	-	-	-
STEP 1				
P3345	Function	OFF	-	OFF/I</Event/I< OR Event/ I< AND Event
P3346	Blocking protection step	0	event	0 … 9999
P3347	CT reference	CT1	-	CT1/CT2*
P3348	Trigger limit	10	%	5 … 6553,5
P3349	Trigger pulse	OFF	-	OFF/ON
P3350	Trigger pulse time	2,000	s	0 … 999999,999
P3351	Delay time	0,03	s	0 … 999999,999
P3352	Reset delay time	0,000	s	0 … 999999,999
P3353	Trigger event	0	-	0 … 9999
P3354	Pickup event 1	0	-	0 … 9999
P3355	Pickup event 2	0	-	0 … 9999
P3356	Pickup event 3	0	-	0 … 9999
P3357	Pickup event 4	0	-	0 … 9999
P3358	Pickup event 5	0	-	0 … 9999
P3359	Pickup event 6	0	-	0 … 9999
P3360	Pickup event 7	0	-	0 … 9999
P3361	Pickup event 8	0	-	0 … 9999
P3362	Pickup event 9	0	-	0 … 9999
P3363	Pickup event 10	0	-	0 … 9999
P3364	Pickup event 11	0	-	0 … 9999
P3365	Pickup event 12	0	-	0 … 9999
P3366	Pickup event 13	0	-	0 … 9999
P3367	Pickup event 14	0	-	0 … 9999
P3368	Pickup event 15	0	-	0 … 9999
P3369	Pickup event 16	0	-	0 … 9999
E2338	SOTF-1 active	-	-	-
E2339	SOTF-1 blocked	-	-	-
E2340	SOTF-1 trigger	-	-	-
E2341	SOTF-1 pickup	-	-	-
E2342	SOTF-1 trip	-	-	-
STEP 2				
P3370	Function	OFF	-	OFF/I</Event/I< OR Event/ I< AND Event
…	…	…	…	…

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 detail in the following examples.*

Protection parameters of parameter SET 1 – SOTF

SET PARAMETERS

The following SET PARAMETERS of the SOTF function exist only once in each of the four parameter sets. The SET PARAMETERS apply to all of the 2 protection STEPS of one parameter SET.

P3340 SOTF function

This parameter enables/disables SOTF function where:

- OFF: disables or
- ON: enables the SOTF function.

When SOTF function is enabled by parameter [P3340], then event *SOTF active* [E2335] is activated.

P3341 Blocking protection module

SOTF function can be completely blocked by any active event. For blocking, the number related to this blocking event has to be assigned to parameter [P3341]. Blocking is only effective, however, as long as the blocking event is active. As soon as blocking is active, event *SOTF blocked* [E2336] and corresponding step events *SOTF-1 blocked* [E2339] and *SOTF-2 blocked* [E2345] are being activated. If the blocking event becomes inactive, blocking is abandoned and protective function is effective again. Event [E2336] and corresponding step events [E2339] and [E2345] are then deactivated automatically.

If blocking of the SOTF function is not required, set this parameter to **0**.

Protection parameters of STEP 1

The following STEP parameters of the SOTF function exist only once in each of the 2 independent protection STEPS. The STEP parameters apply only to one of the 2 protection STEPS of one parameter SET.

P3345 Function

This parameter enables/disables the first protection step of the SOTF function where:

OFF: disables the first protection step of SOTF function **or**

I<: enables the first protection step of SOTF function using criterion *I<* for working principle, when the characteristic quantity (phase current) falls below the set value of parameter *Trigger limit* [P3348] in all three phases, event *SOTF-1 trigger* [E2340] is activated **or**

Event: enables the first protection step of SOTF function using criterion *Event* for working principle, when the trigger event which is assigned to parameter *Trigger event* [P3353] is activated, event *SOTF-1 trigger* [E2340] is activated **or**

I< OR Event: enables the first protection step of SOTF function using criterion I< OR Event for working principle, when the characteristic quantity (phase current) falls below the set value of parameter Trigger limit [P3348] in all three phases or the trigger event which is assigned to parameter Trigger event [P3353] is activated, event SOTF-1 trigger [E2340] is activated, or

I< AND Event: enables the first protection step of SOTF function using criterion *I< AND* Event for working principle, when the characteristic quantity (phase current) falls below the set value of parameter *Trigger limit* [P3348] in all three phases **and** the trigger event which is assigned to parameter *Trigger event* [P3353] is activated, event *SOTF-1 trigger* [E2340] is activated.

P3346 Blocking protection step

The first step of SOFT function can be blocked by any active event. For blocking, the number related to this blocking event has to be assigned to parameter [P3346]. Blocking is only effective, however, as long as the blocking event is active. As soon as blocking is active, event *SOTF-1 blocked* [E2339] is activated. If the blocking event becomes inactive, blocking is abandoned and protective function is effective again. Event [E2339] is then deactivated automatically.

If blocking of the first step of the SOTF function is not required, set this parameter to **0**.

P3347 CT reference

Depending on the P60 Agile device variant the first protection step of the SOTF function can be assigned to a certain current measurement input (CT1 or CT2). Parameter [P3347] determines the current measurement input which will provide measurement values as characteristic quantity (phase current) to the SOTF function:

- CT1: current input CT1
- CT2: This option is not supported in P16x devices

P3348 Trigger limit

Pick-up value of criterion *I<* for triggering event *SOTF-1 trigger* [E2340] of the first protection step *(STEP 1*) of the SOFT function; When the characteristic quantity (phase current) falls below the Trigger limit in all three phases, criterion *I<* is fulfilled.

APPLICATION Note: In case that the measured phase current is below the set value of parameter *Trigger limit* [P3348], it may be concluded that the circuit breaker is off.

Parameter *Trigger limit* [P3348] is only valid for the following setting options*:*

- *I<* and
- *I< OR Event* and
- *I< AND Event*

of parameter *Function*[P3345].

Depending on the selected setting option, and in case that

- criterion *I<* is fulfilled **or**
- criteria *I<* **or** *Event* are fulfilled **or**
- criteria *I<* **and** *Event* are fulfilled,

pickup event *SOTF-1 trigger* [E2340] is activated depending on selected setting option of parameter *Trigger pulse* [P3349].

P3353 Trigger event

Trigger event of criterion *Event* for triggering event *SOTF-1 trigger* [E2340] of the first protection step (STEP 1) of the SOFT function; criterion Event can be fulfilled by any active event. For this, the number related to this trigger event has to be assigned to parameter [P3353].

APPLICATION Note: It is recommended to assign the feedback event number of the circuit breaker (e.g. OFF-feedback [E6011] of breaker no. 1) to parameter *Trigger event* [P3353] to indicate CB off position.

Parameter *Trigger event* [P3353] is only valid for setting options:

- Event and
- I< OR Event and
- I< AND Event

of parameter *Function* [P3345].

Depending on the selected setting option, and in case that:

- criterion *Event* is fulfilled **or**
- criteria *I<* **or** *Event* are fulfilled **or**
- criteria *I<* **and** *Event* are fulfilled,

pickup event *SOTF-1 trigger* [E2340] is activated depending on selected setting option of parameter *Trigger pulse* [P3349].

P3349 Trigger pulse

This parameter enables/disables SOTF trigger pulse of first protection step (STEP 1) of SOFT function where:

OFF: disabled trigger pulse; event *SOTF-1 trigger* [E2340] is activated as long as the criterion/criteria of the selected working principle of parameter *SOTF function* [P3345] is/are fulfilled, or

ON: enabled trigger pulse; event *SOTF-1 trigger* [E2340] is activated according to a defined *pulse duration* set by parameter *Trigger pulse time*[P3350]

P3350 Trigger pulse time

Pulse duration of trigger event SOTF-1 trigger [E2340] of the first protection step (STEP 1) of SOTF function; where

- the selected criterion/criteria to detect a SOTF situation (see parameter *Function* [P3345]) is fulfilled, **and**
- parameter *Trigger pulse [P3349] = ON*,

then event *SOTF-1 trigger* [E2340] is being activated for the duration set by parameter Trigger pulse time of the first protection step (STEP 1) of SOTF function.

Note: Parameter Trigger pulse time [P3350] is only valid for setting option ON of parameter Trigger pulse [P3349].

P3354 Pickup event 1

Pickup event of first step SOTF-1 function; where

- event *SOTF-1 trigger* [E2340] is active **and**
- at least one of the 16 pickup events is active

then event *SOTF-1 pickup* [E2341] is activated. *SOTF-1 pickup* [E2341] event becomes *inactive* when all 16 pickup events are inactive.

P3355 Pickup event 2

to

P3369 Pickup event 16

See description of parameter [P3354]

P3351 Delay time

Delay time for activating trip event *SOTF-1 trip* [E2342]; as soon as event *SOTF-1 pickup* [E2341] is active and Delay time run down, trip event [E2342] will be activated. This event can be used for alarm or output control purposes.

P3352 Reset delay time

Trip reset limit delay time is the delay time for resetting the trip event *SOTF-1 trip* [E2342].

If the trip reset delay time (Reset delay time) has run down, trip event *SOTF-1 trip* [E2342] is deactivated.

2.1.34 YG – Neutral Admittance Ground Fault Protection

YG-Neutral Admittance Ground Fault Protection – Parameter set 1: Protection parameters [P] and Events [E]

Main Menu\Parameters\PROTECTION\				
YG				
SET 1	SET 2	SET 3	SET 4	
P/E No.	System Description	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
…	…	…	…	…

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. The parameter descriptions of the SET PARAMETERS and the parameters of STEP 1 represented below are described in detail in the following examples.*

Common settings of parameter SET 1: YG - Neutral Admittance Ground Fault Prot.

SET PARAMETERS

The following SET PARAMETERS of YG-Neutral Admittance Ground Fault Protection exist only once in each of the four parameter sets. The SET PARAMETERS apply to all of the 6 protection STEPS of one parameter SET.

P2705 Function

This parameter enables/disables YG-Neutral Admittance Ground Fault protection where:

OFF: disables or

ON: enables the protective function.

When YG-Neutral Admittance Ground Fault protection is enabled by parameter [P2705], then event *YG active* [E2180] is activated.

P2706 Blocking

YG-Neutral Admittance Ground 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] is activated. If the blocking event becomes inactive, blocking is abandoned and protective function is effective again. Event [E2181] is then deactivated automatically.

If blocking of the YG-Neutral Admittance Ground Fault protection is not required, set this parameter to **0**.

P2707 CT source

Depending on the P60 Agile device variant the YG-Neutral Admittance Ground 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 $\underline{I}_{GND}$ 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 Ground Fault protection:

CT1: Calculation of residual voltage: $\underline{I}_G = 3 \times \underline{I}_0 = \underline{I}_1+\underline{I}_2+\underline{I}_3$ by phase currents measured via measurement input CT1,

CT2: This option is not supported in P16x devices

CT-GND1: Measurement input CT-GND1 (direct measurement of $\underline{I}_G$)

P2708 PT source

Depending on the P60 Agile device variant the YG-Neutral Admittance Ground 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 $\underline{U}_G$ 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 Ground Fault protection:

PT1: Calculation of residual voltage: $\underline{U}_G = 3 \times \underline{U}_0 = \underline{U}_{L1}+\underline{U}_{L2}+\underline{U}_{L3}$ by phase voltages measured via measurement input PT1,

PT2: Calculation of residual voltage: $\underline{U}_G = 3 \times \underline{U}_0 = \underline{U}_{L1}+\underline{U}_{L2}+\underline{U}_{L3}$ by phase voltages measured via measurement input PT2,

PT3: Calculation of residual voltage: $\underline{U}_G = 3 \times \underline{U}_0 = \underline{U}_{L1}+\underline{U}_{L2}+\underline{U}_{L3}$ by phase voltages measured via measurement input PT3,

PT-GND1: Measurement input PT-GND1 (direct measurement of $\underline{U}_G$)

> *Note:* *In case that residual voltage is to be calculated by voltage measuring via PT1, PT2 or PT3 it is required to connect terminal N of P16x device (X1.2:18; X1.2:26) to ground potential!*
>
> *For test purposes via voltage generator test equipment it is required to connect terminal N of P16x device to the neutral potential of the voltage test equipment!*

P2709 Direction

Internal adaption of measured Neutral-Admittance Y_0 direction; to define the sign of the complex phasor of Y_0, the following setting options are available:

- 0°: no change of sign, and
- 180°: change of sign by 180°

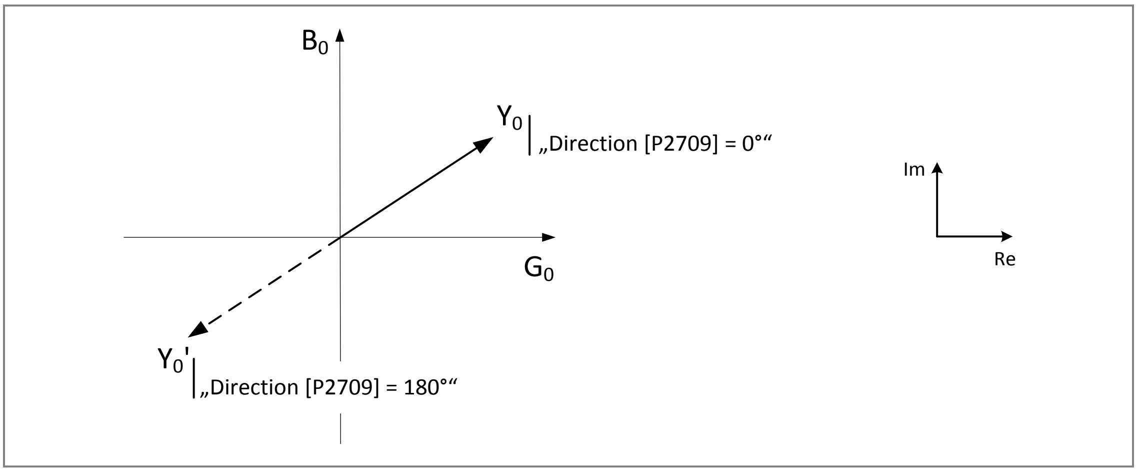


Figure 80 Internal adaption of Neutral-Admittance direction

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 negative set value will turn the complex phasor $\underline{Y}_0$ clockwise.

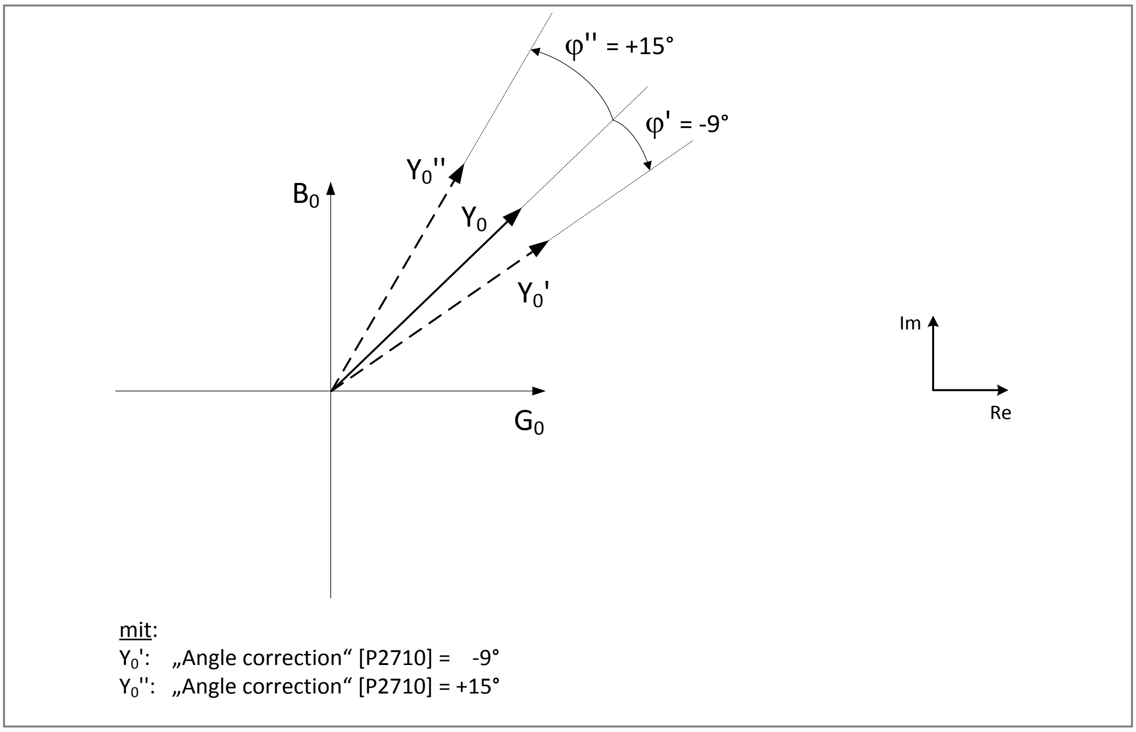


Figure 81 Correction of angular errors of PTs and CTs

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

Per stage configuration of parameter SET 1 – YG-Neutral Admittance Ground Fault

STEP PARAMETERS

The following STEP parameters of the YG-Neutral Admittance Ground Fault protection exist only once in each of the 6 independent protection STEPS. 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 Ground Fault protection; enabling the first protection step is to be done by selecting the protective criterion (characteristic quantity); where:

- 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 Ground Fault protection is enabled by parameter [P2715], then event *YG-1 active* [E2185] is activated.

P2716 Blocking

The first step of YG-Neutral Admittance Ground 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 activated. If the blocking event becomes inactive, blocking is abandoned and protective function is effective again. Event [E2186] is then deactivated automatically.

If blocking of the first step of YG-Neutral Admittance Ground 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 Ground Fault protection; the first step of YG-Neutral Admittance Ground 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 Ground Fault protection:

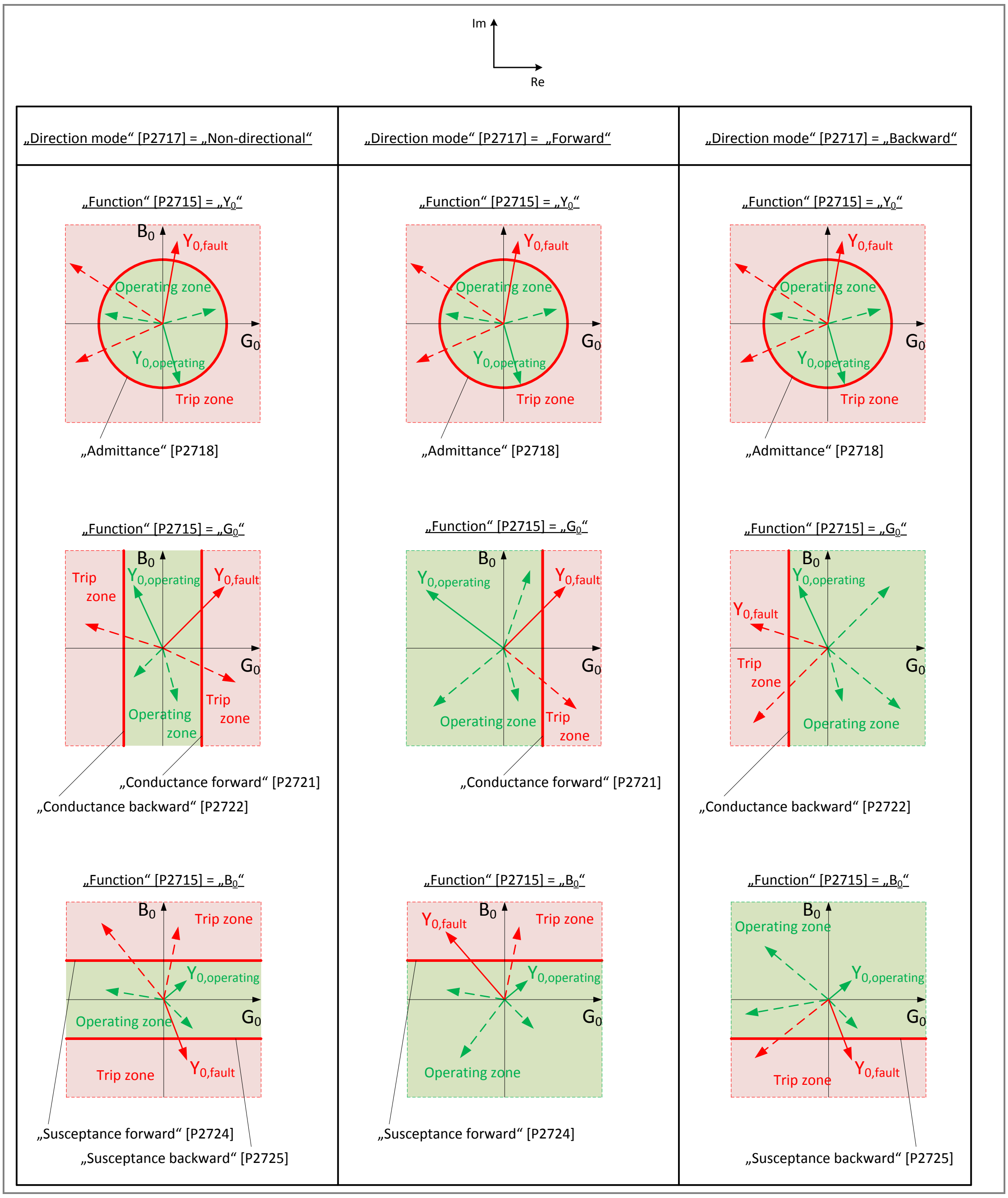


Figure 82 **Options of direction mode and protective criterion (characteristic quantity)**

Pick-up values of different protective criteria

Depending on the selected protective criterion and tripping direction of the first step of YG-Neutral Admittance Ground 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 Ground 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 Ground Fault protection element will start.

P2721 Conductance forward

Pick-up value of the first YG-Neutral Admittance Ground 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 Ground Fault protection element will start.

P2722 Conductance backward

Pick-up value of the first YG-Neutral Admittance Ground 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 Ground Fault protection element will start.

P2724 Susceptance forward

Pick-up value of the first *YG-Neutral Admittance Ground 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 Ground Fault* protection element will start.

P2725 Susceptance backward

Pick-up value of the first YG-Neutral Admittance Ground 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 Ground 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.

When the selected characteristic quantity exceeds the set pick-up value of the first YG-Neutral Admittance Ground 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 reset and pick-up event *YG-1 pickup* [E2187] is deactivated.

If the characteristic quantity subsequently exceeds the pick-up value, then 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 deactivated. When the selected characteristic quantity exceeds the set pick-up value of the first YG-Neutral Admittance Ground Fault protection element before the timer of Reset delay time has run down, the timer of Reset delay time will be reset. 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 Ground Fault protection; depending on the selected measuring method set by parameter *PT source* [P2708], the first protection step of YG-Neutral Admittance Ground 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 should be set as a percentage of the nominal value of the process quantity. The nominal value of the process quantity should be set by parameter: Ground voltage [P606], for primary side W1.*
>
> *The parameter Ground voltage [P606] is 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 Ground Fault protection; depending on the selected measuring method set by parameter *CT source* [P2707], the first protection step of YG-Neutral Admittance Ground 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 should be set as a percentage of the nominal value of the process quantity. The nominal value of the process quantity should be set by parameter: Ground current [P607] for primary side W1*
>
> *The parameter Ground current [P607] is located in submenu: SYSTEM \Nominals **Reference values**.*

MONITORING & CONTROL

CHAPTER 5

1 CHAPTER OVERVIEW

This chapter consists of the following sections:

2 ALARM PARAMETERS

2.1 General

Interrupt of event logging

Main Menu\Parameters\ALARMS\				
General				
P/E No.	System Description	Value	Unit	(Setting range)
P5950	Stop event history	0	event	0 … 9999
P5951	Remote ACK	0	event	0 … 9999
P5952	Beeper inhibit time	20	s	0,0 … 6553,5

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 it has to be assigned to parameter [P5950]. Interrupt is only effective if the stop event is active. If the stop event becomes inactive interrupting is abandoned and event logging is effective again.

If blocking of event logging is not required set this parameter to **0**.

P5951 Remote ACK

Remote acknowledgement of alarms can be activated by any active event. To activate the number related to this stop event it has to be assigned to parameter [P5951]. If there is any active alarm and the assigned event turns active, the active alarm behaves according to the selected setting option of parameter *Condition* [P] in the Alarms submenu.

If remote acknowledgement is not required set this parameter to **0**.

P5952 Beeper inhibit time

Blocking time until reactivation of the beeper by subsequent active alarm is allowed when

- an active alarm activates the beeper **and**
- the active alarm is reset by operating the ACK function (via ALARM button on front panel or via the Remote ACK function),

then the Inhibit Time beeper starts for the duration of the set value of the parameter Inhibit Time beeper [P9521]. While the timer is running another active alarm cannot reactivate the beeper. Once the Inhibit Time beeper has run down, the next active alarm will activate the beeper.

2.1.1 Alarm channels

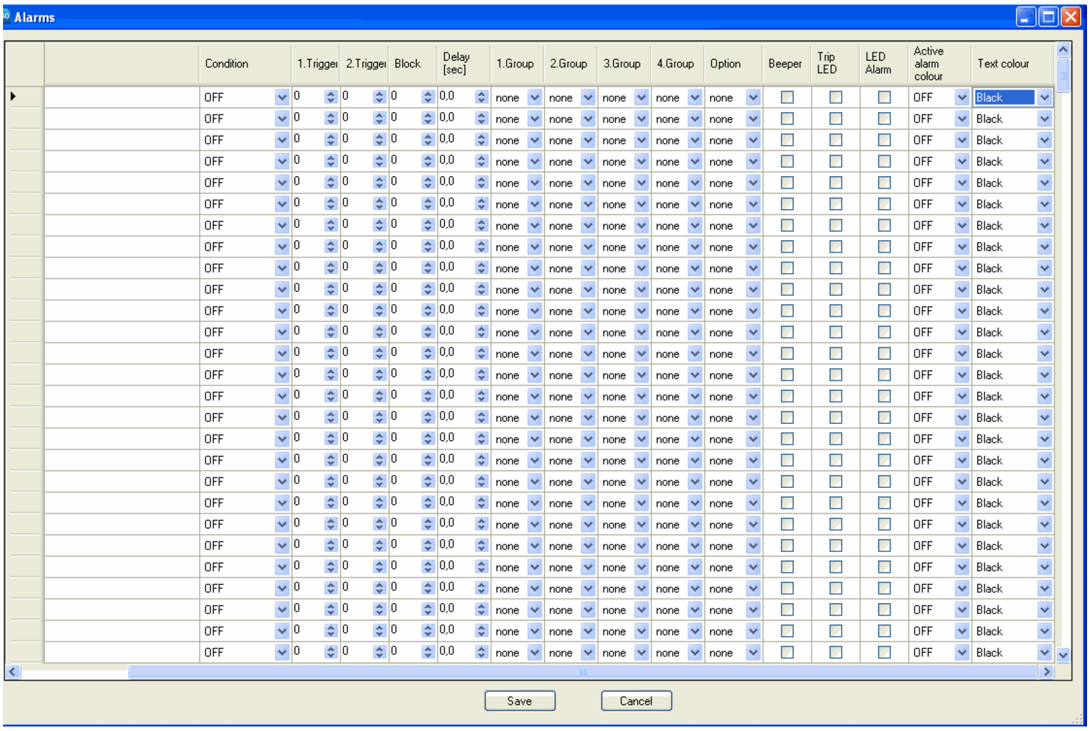
Alarm message control is available by 449 different and programmable alarm channels with output event numbers [E1] to [E449]

Alarm channels

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	☐ / ☑	☐	(tick box)
Trip LED	☐ / ☑	☐	(tick box)
LED Alarm	☐ / ☑	☐	(tick box)
LED	OFF / Red / Yellow / Green	OFF	(textring)
Text colour	Black / Red / Yellow/Green / Blink black/ Blink red / Blink yellow / Blink green	Black	(textring)

Note: Configuration of the Alarm channels can only be done using the P60 Configurator Tool.

Configuration of alarm channels using P60 Configurator Tool



Parameter description:

P Alarm text

As soon as the alarm is active the editable alarm text appears on the alarm page.

An alarm text is restricted to 40 characters.

P Condition

When the trigger event is active the alarm event as well as the display of the alarm text will become active.

The Condition parameter 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 [E1] to [E449] and the display of the alarm text remain active. After pressing the ACK key or activation of remote acknowledgement via activating event (see parameter Remote Ack [P5951]), the alarm event and the display of the alarm text will be deactivated.
- Unlatched: After clearance (trigger event = 0) the alarm event [E1] to [E449] is immediately deactivated; however, the display of the alarm text remains active. After pressing the ACK key or activation of remote acknowledgement via activating event (see parameter*Remote Ack* [P5951]), the display of the alarm text will be deactivated.
- No Ack: After clearance (trigger event = 0), both, the alarm event [E1] to [E0449] and the display of the alarm text are immediately deactivated.

Parameter Condition – settings and state changes

Parameter		Settings	tn [trigger event = 1]		tn+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

Note: *In case of temporary loss of device power supply all active alarms are to be saved failsafe (non-volatile)!*

When several alarm events set with different selection options for parameter “Condition” are assigned to the same alarm group, the alarm group event behaves in the same manner as the actual, active events. For instance, one active alarm event (“Condition = No ACK”) and another alarm event (“Condition = Latched”) are assigned to the same alarm group. Here, the alarm group event remains active until it is reset by the “ALARM” key or by assigned, active activation event of parameter “Remote ACK” [P5951].

The “ALARM” key can be used either for:

- acknowledgement of all active alarms simultaneously (call-up of Alarm page and operate “ALARM” key), or for
- individual acknowledgement of active alarms.

For individual acknowledgement the active alarm must be selected via touch screen. Subsequently, the following window offers two operating options, “OK” or “Cancel”:

Individual aknowledgement of active alarms

Operating the “OK” key will acknowledge the selected active alarm. Operating the “Cancel” key will abort the acknowledgment process. Subsequently, the alarm page will be shown on the display.

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 ([E1] to [E449]) 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. These alarm group events are 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 LED “TRIP” at the device frontpage.

P LED Alarm

Select to activate LED “ALARM” at the device frontpage.

P Active alarm colour

Select this parameter to activate the individual graphic field (located between alarm number No. and Alarm Description) at menu page “Active Alarms” when alarm is activated. The following setting options are available:

- OFF: no colorization of graphic field when alarm is activated
- Red: red colorized graphic field when alarm is activated
- Yellow: yellow colorized graphic field when alarm is activated
- Green: green colorized graphic field when alarm is activated

P Text colour

Available colours for static and flashing alarm text display:

- Black: black colorized alarm text when alarm is activated
- Red: red colorized alarm text when alarm is activated
- Yellow: yellow colorized alarm text field when alarm is activated
- Green: green colorized alarm text field when alarm is activated
- Blink black: black-flashing alarm text when alarm is activated
- Blink red: red-flashing alarm text when alarm is activated
- Blink yellow: yellow-flashing alarm text when alarm is activated
- Blink green: green-flashing alarm text field when alarm is activated

2.1.2 LEDs (Hardware)

LED configuration

Main Menu\Parameters\ALARMS\				
LEDs				
Fct. 1	Fct.2	Fct. 3	Fct. 4	
P/E No.	System Description	Value	Unit	(Setting range)
LED 1				
-	Colour	red	-	red/green/yellow
-	Status	OFF	-	Slow blink/Fast blink/Const on
-	Event number	0	event	0 … 9999
LED 2				
-	Colour	red	-	red/green/yellow
-	Status	OFF	-	Slow blink/Fast blink/Const on
-	Event number	0	event	0 … 9999
LED 3				
-	Colour	red	-	red/green/yellow
-	Status	OFF	-	Slow blink/Fast blink/Const on
-	Event number	0	event	0 … 9999
LED 4				
-	Colour	red	-	red/green/yellow
-	Status	OFF	-	Slow blink/Fast blink/Const on
-	Event number	0	event	0 … 9999
LED 4				
-	Colour	red	-	red/green/yellow
-	Status	OFF	-	Slow blink/Fast blink/Const on
-	Event number	0	event	0 … 9999
LED 6				
-	Colour	red	-	red/green/yellow
-	Status	OFF	-	Slow blink/Fast blink/Const on
-	Event number	0	event	0 … 9999
LED 7				
-	Colour	red	-	red/green/yellow
-	Status	OFF	-	Slow blink/Fast blink/Const on
-	Event number	0	event	0 … 9999
LED 8				
-	Colour	red	-	red/green/yellow
-	Status	OFF	-	Slow blink/Fast blink/Const on
-	Event number	0	event	0 … 9999

Parameter description

There are up to four activation events (see **Fct.1** to **Fct.4**) which could be assigned to activate each LED individually.

> *Note:* *Each of the eight LEDs always provides the same group of parameters. The LED parameter descriptions of the LED 1 represented below are described in detail in the following examples.*

FCT.1 – LED 1

P Colour

LED colour during activation; as soon as the event which is assigned to parameter Event number is activated, the LED is illuminated in either:

- red or
- green or
- yellow

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: 1-time per second
- Fast blink: LED is flashing quickly: 2-times per second
- Const on: LED is continuously illuminated

P Event-No.

The LED indication can be activated by any active event. For activation, the number related to this event has to be assigned to the Event number parameter Event-No. Activation is only effective as long as the assigned event is active. If the event becomes inactive, the LED turns off.

If LED activation is not required, set this parameter to 0.

2.2 I/O PARAMETERS (Binary inputs and binary outputs)

The I/O PARAMETER menu provides submenus for setting of the P60 Agile binary inputs and outputs.

2.2.1 General (settings of voltage range for binary inputs)

The binary inputs are voltage-operated and the setting ranges for connected voltages are as follows:

Parameters – Voltage range of binary inputs

				Main Menu\Parameters\I/O\
		General		
P/ENo.	System Description	Value	Unit	(Setting range)
General				
P4000	Binary inputs voltage type	DC	-	AC/DC
P4001	Binary inputs nominal voltage	110	V	24/48/60/110/220/230
EBS General				**Option not supported in P16x**
Board ID1... Board IDx				**Option not supported in P16x**

Parameter description

General

The following two parameters apply for the binary inputs of the P16x device.

P4000 Binary input voltage type

This parameter allows adapting the kind of the applied nominal voltage to the binary inputs of P16x device to:

- AC or
- DC

P4001 Binary input nominal voltage

This parameter allows the user to adapt the binary inputs to the nominal voltage used. Following nominal voltages are available for operating the binary inputs:

- 24V
- 48V
- 60V
- 110V
- 220V
- 230V

Turn-on and drop-off levels of the binary inputs operate according to the set value of the binary input nominal voltage as follows:

- Turn-on level: 80% U_{set}
- Drop-off level: 40% U_{set}

Note: The selected setting applies for all binary inputs.

2.2.2 Binary inputs

Parameters and Events – Binary inputs

Binary Inputs							
No.	Input Event	Norm. Clsd.	Pre. Event	Inv. Event	Filter Ev.	ON delay (0 … 6500 s)	OFF delay (0 … 6500 s)
10	4010	□	□ 4110	□ 4210	□	0.1	0.0
11	4011	□	□ 4111	□ 4211	□	0.1	0.0
12	4012	□	□ 4112	□ 4212	□	0.1	0.0
13	4013	□	□ 4113	□ 4213	□	0.1	0.0
14	4014	□	□ 4114	□ 4214	□	0.1	0.0
15	4015	□	□ 4115	□ 4215	□	0.1	0.0
16	4016	□	□ 4116	□ 4216	□	0.1	0.0
17	4017	□	□ 4117	□ 4217	□	0.1	0.0
18	4018	□	□ 4118	□ 4218	□	0.1	0.0

Binary Inputs							
No.	Input Event	Norm. Clsd.	Pre. Event	Inv. Event	Filter Ev.	ON delay (0 … 6500 s)	OFF delay (0 … 6500 s)
19	4019	□	□ 4119	□ 4219	□	0.1	0.0
20	4020	□	□ 4120	□ 4220	□	0.1	0.0
21	4021	□	□ 4121	□ 4221	□	0.1	0.0
22	4022	□	□ 4122	□ 4222	□	0.1	0.0
23	4023	□	□ 4123	□ 4223	□	0.1	0.0
24	4024	□	□ 4124	□ 4224	□	0.1	0.0
25	4025	□	□ 4125	□ 4225	□	0.1	0.0
26	4026	□	□ 4126	□ 4226	□	0.1	0.0
27	4027	□	□ 4127	□ 4227	□	0.1	0.0

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/inactive after the binary input has been activated/deactivated with regard to any delay time settings (parameter ON delay and/or OFF delay).

Note: Each input is assigned its own input event; see event numbers [E4010] to [E4027].

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 meets power to lock principle (normally open)
- ☑: tick the box => working principle of the binary input meets 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 /inactive 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 field 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: tick the box => the additional pre-delay event of the binary input is available

> *Note:* *Each input is assigned its own additional pre-delay event; see event numbers [E4110] to [E4127].*

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 *input event* [E41xx]. The additional inverted event is immediately activated/deactivated after the *input event* has been deactivated/activated.

To make the additional inverted event available, please tick the box in the field 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: tick the box => the additional inverted event of the binary input is available

> *Note:* *Each input is assigned its own additional inverted event; see event numbers [E4210] to [E4227].*

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 not being registered in the event history.

To activate/deactivate the filter function of a binary input, please use the tick box in the field of *Filter Ev.*:

- ☐: do not tick the box => the filter function of the binary input is not available
- ☑: tick the box => the filter function of the binary input is available

The Filter event history filter function 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.

2.2.3 Binary outputs

Depending on the device variant P60 Agile provides the following binary outputs:

Binary outputs

Binary Output	Event-No.	additional pre-delay event	P60 Agile P161 – P163
Shunt Trip 1	4500	-	☑
Shunt Trip 2	4501	-	☑
Lockout Relay	4502	4503	☑
Synchron ON	4504	4505	☑
Function 1	4506	4507	☑
Function 2	4508	4509	☑
Function 3	4510	4511	☑
Function 4	4512	4513	☑
Function 5	4514	4515	☑
Function 6	4516	4517	☑
Function 7	4518	4519	☑
Function 8	4520	4521	☑

☑: Standard

(☑): Ordering option

CAUTION: When inductive loads are switched by the contacts of the binary outputs the contacts have to be protected against destruction by contact burning! An external protective circuit has to be connected to the contacts of the affected binary output. The protective circuitry is located close to the disturbing source.

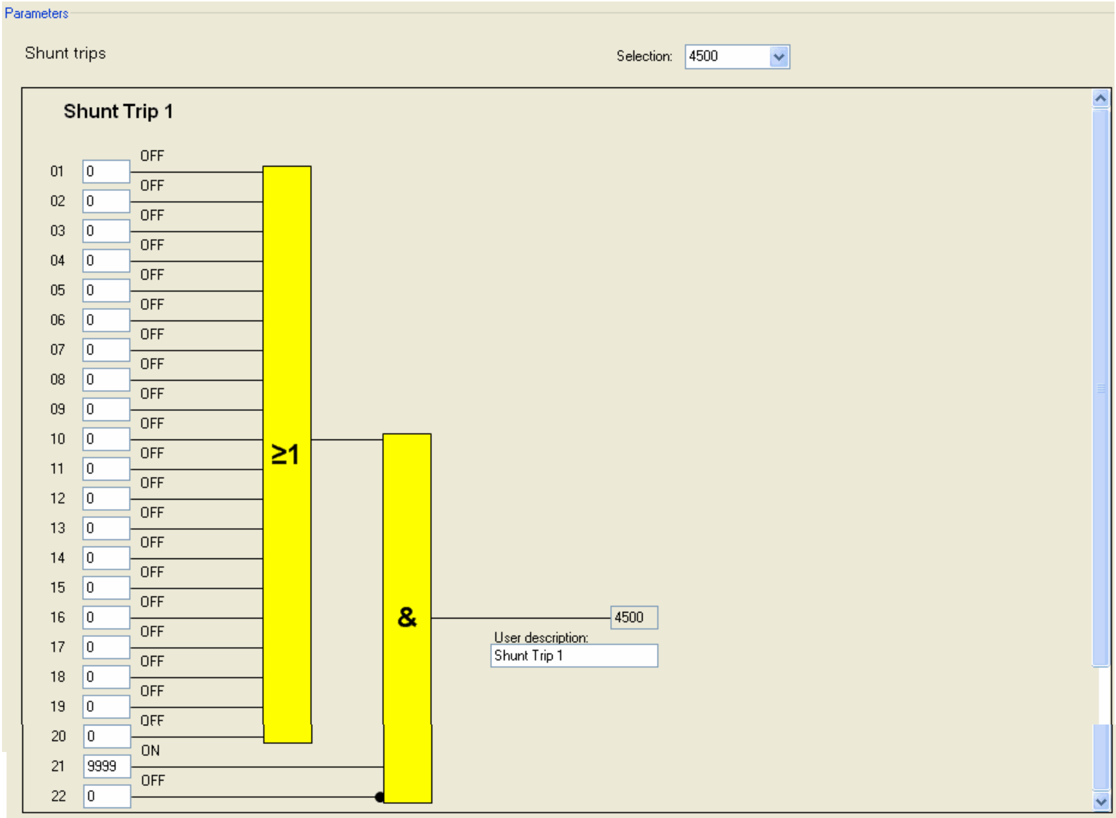
-Using *DC voltage* as switching voltage: protective circuitry with *flywheel diode*
-Using *AC voltage* as switching voltage: protective circuitry with *varistor*

2.2.3.1 Shunt Trip 1

The binary output Shunt Trip 1 provides a change-over contact. It is a normally open (NO) contact designated for tripping the connected circuit breaker.

The first relay output *"Shunt trip 1"* carries the event-number [E4500].

Shunt Trip 1



Parameter description:

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 field besides the number of the input element.

> ***NOTE***: *Setting 0 means logical 0 (positive logic: false)*
> *Setting 9999 means logical 1 (positive logic: true)*

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 meets power to lock principle (normally open)
- ☑: tick the box => working principle of the binary output meets power to unlock principle (normally closed)

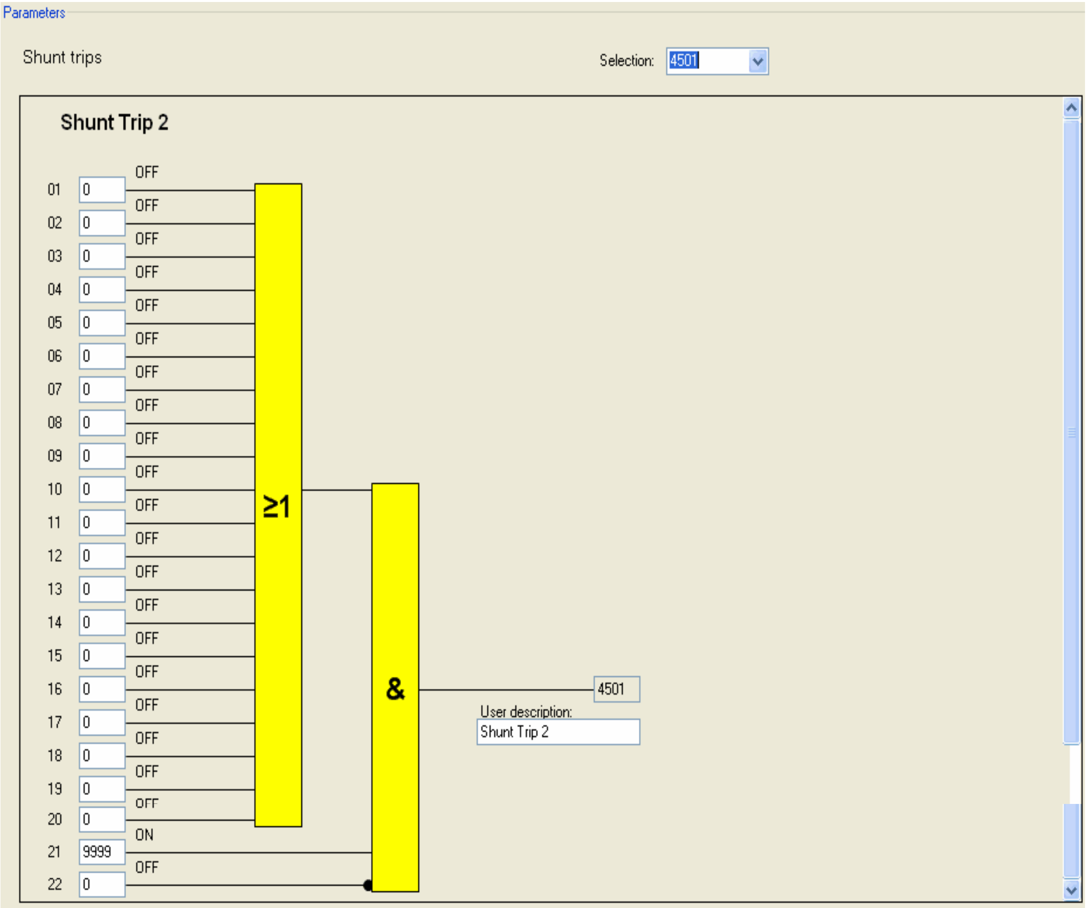
> *Note: The power to unlock principle can be activated/deactivated individually for all binary outputs.*

2.2.3.2 Shunt Trip 2

The binary output Shunt Trip 2 provides a normally open (NO) contact which is designated for tripping the connected circuit breaker.

The second relay output *"Shunt Trip 2"* carries the event-number [E4501].

Shunt Trip 2



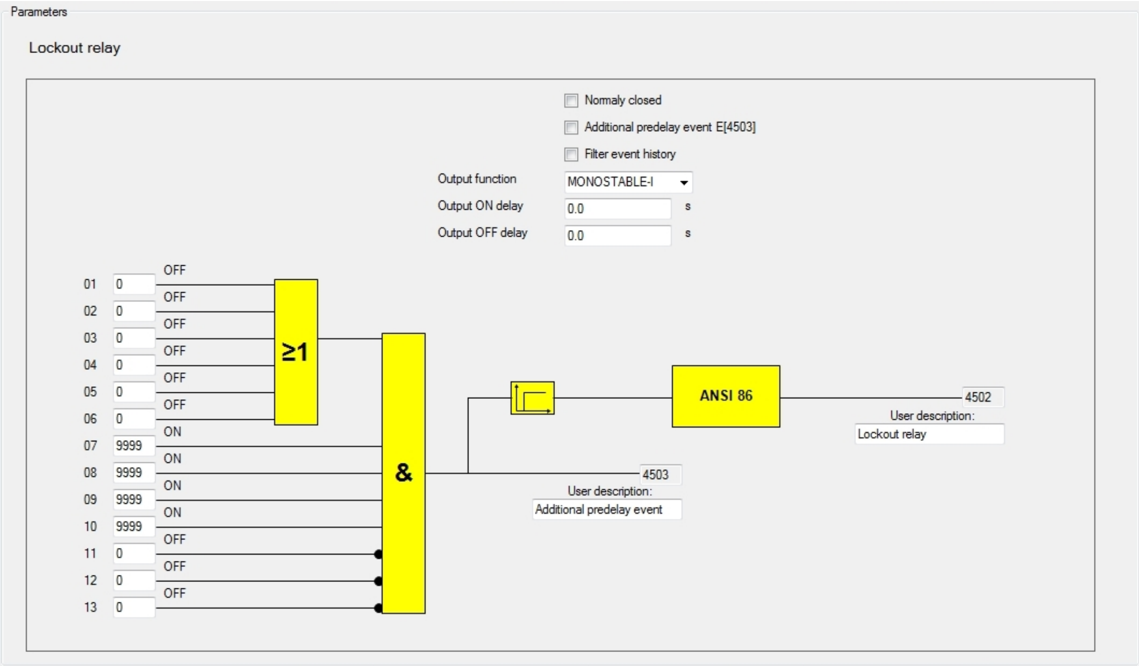
Parameter description:
Parameter description of binary output Shunt Trip 2 is equal to the binary output of the Shunt Trip 1.

2.2.3.3 Lockout relay

Lockout relay exists only once and has event number [E4502].

Note:	*If the protective function ANSI 86 – Lockout relay is not needed disable the ANSI 86 module using parameter setting: Function [P3435] = OFF.*

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 meets power to lock principle (normally open)
- ☑: tick the box => working principle of the binary output meets power to unlock principle (normally closed)

Note:	*Power to unlock principle (normally closed) is only available when selection button Output function = MONOSTABLE-I. The power to unlock principle (normally closed) can be activated/deactivated individually for all binary outputs.*

CAUTION:	**The *output event status* of the binary outputs (BOs) does not depend on the set *working principle* (see tick box parameters “Normally closed”) of the Bos. The output event status only depends on the logic of the BOs.** **The set working principle of the binary output only affects the position of the BO contact.**

Additional predelay 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 predelay event [E4503]*:

- ☐: do not tick the box => the additional pre-delay event of the binary input is not available
- ☑: 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 MONOSTABLE-I.

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 registered in the event history.

To activate/deactivate the filter function of a binary output, please use the tick box besides the Filter event history parameter:

- ☐: do not tick the box => the filter function of the binary output is not available
- ☑: tick the box => the filter function of the binary output is available

Output function

Definition of switch behaviour 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 the Output function parameter:

- Monostable-I — This function generates pulses with monostable behaviour (monostable interrupted); this means when output relay is activated/deactivated its output contact closes/opens without any time delay.
- 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 selection as well as the number of the input element.

Note:	*Setting 0 means logical 0 (positive logic: false)* *Setting 9999 means logical 1 (positive logic: true)*

2.2.3.4 Synchron ON

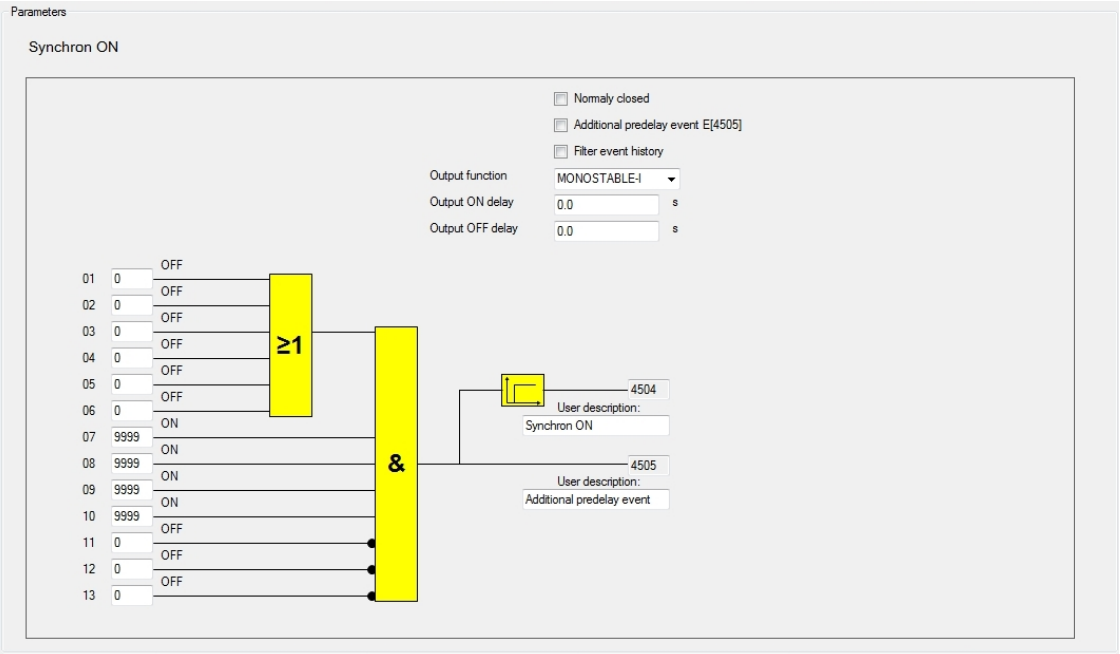
The relay of the binary output Synchron ON is equipped with two separate relay coils with individually corresponding normal open contact which are connected in series. The series connection is connected to the terminals of the binary output. The two internal relay coils of the binary output relay Synchron ON are individually controlled by different CPUs. One is controlled by the CPU of the control unit (CU), the other is controlled by the measuring unit (MU).

The binary output Synchron ON shall preferably be used for switching on the connected circuit breaker via synchronizing function ANSI 25 – Synchro check.

Synchron ON relay exists only once, and carries event number [E4504].

Note:	*Binary output Synchron ON is foreseen for function ANSI 25 – Synchronising. Alternatively, Synchron ON can be used as a binary output such as Function 1 or others.*

Synchron ON



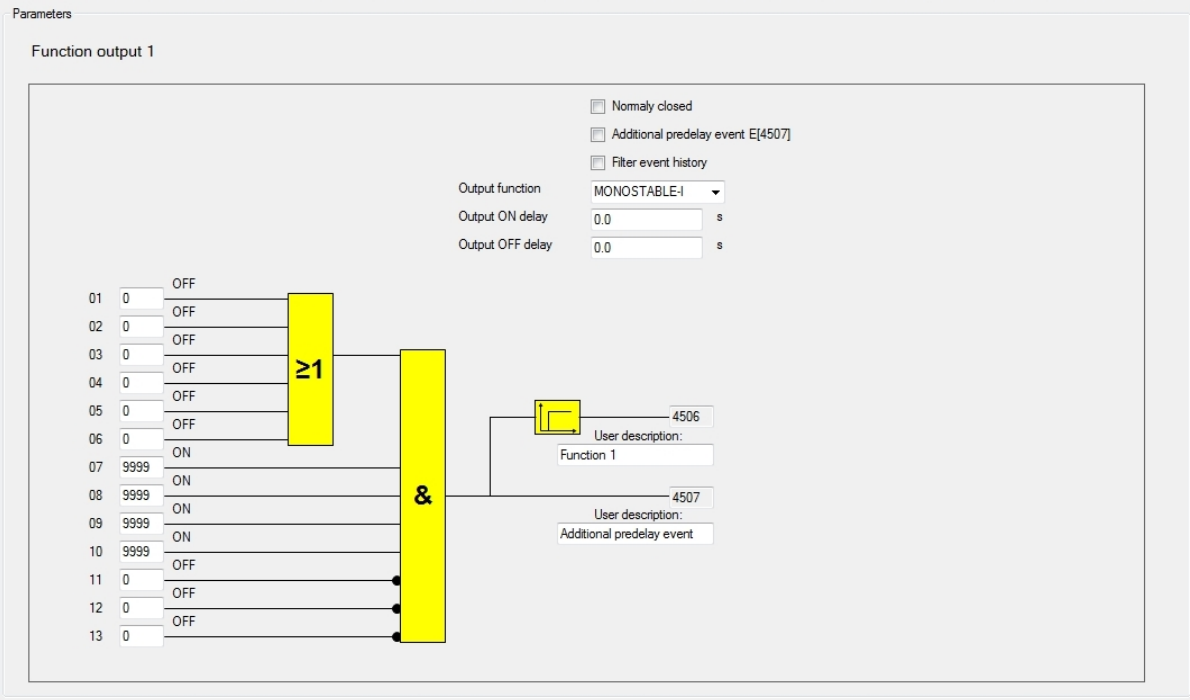
Parameter description:

Parameter description of binary output Synchron ON is identical to the binary output Lockout Relay.

2.2.3.5 Function outputs 1 to 8

According to the device variant the P60 Agile provides several relay outputs (Function 1 to Function 8). By using the Selection button each relay output can be displayed individually.

Function output 1



Parameter description:

Parameter description of binary outputs Function 1 to Function 8 is identical to the binary output Lockout Relay.

Note:	*Input 01 of "Function output 8" is assigned self-supervision event (watchdog) "Common alarm system total error" [E9001] as default setting. This event can also be assigned to another input of the same or another function output.*

2.2.4 LVM – Limit Value Monitoring

LVM-Limit Value Monitoring: Parameters [P] and Events [E]

				Main Menu\Parameters\
		LVM – Limit Value Monitoring		
P/E No.	Description	Value	Unit	(Setting range)
	LVM step 1			
P74500	Function	OFF	-	OFF/Low limit/High limit
P74501	Type	Voltage	-	Voltage /Current/ Power/Power factor/Frequency/ Analog inputs
P74502	Select	U12,PT1		(see table of meas. values)
P74503	Limit	0	%	0 … 3000,0
P74505	Delay time	0	s	0 …999999,999
P74507	Reset limit	0	%	0 … 3000,0
E8100	LVM pickup	-	-	-
E8101	LVM-trip	-	-	-
	LVM step 2			
P74509	Function	OFF	-	OFF/Low limit/High limit
…	…	…	…	…

Parameter description:

P74500 Function

This parameter disables/enables the first step of *the LVM-Limit Value Monitoring element*; enabling the first step is to be done by selecting its working principle; whereas:

- OFF: disables first monitoring step, or
- High limit: enables first monitoring step => monitoring based on the measured quantity exceeds the ‘High limit’ setting,
- Low limit: enables first monitoring step => monitoring based on the measured quantity falls below the ‘Low limit’ setting,

P74501 Type

This parameter defines the *physical type of the measuring quantity* for the first step of the LVM-Limit Value Monitoring element; The measuring range of the physical quantity accords to its type which can be selected as follows:

- Voltage
- Current
- Power
- Power factor
- Frequency
- Analog inputs

P74502 Select

This parameter defines the measuring quantity of the first setp of the LVM-Limit Value Monitoring function, whereby the measuring quantity to be provided can be selected via selection button. Depending on the P16x device variant the following measuring quantities are provided:

LVM step 1 – Selection of measuring quantity

Name of meas. quantity	Description	Setting range	Unit
	TYPE: VOLTAGE		
U12,PT1	Phase-to-phase voltage U12,PT1	0-3000.0	%
U23 PT1	Phase-to-phase voltage U23 PT1	0-3000.0	%
U31,PT1	Phase-to-phase voltage U31,PT1	0-3000.0	%
MIN,PT1	Minimum phase-to-phase average voltage, PT1	0-3000.0	%
MAX,PT1	Maximum phase-to-phase average voltage, PT1	0-3000.0	%
UL1,PT1	Phase voltage UL1,PT1	0-3000.0	%
UL2,PT1	Phase voltage UL2,PT1	0-3000.0	%
UL3,PT1	Phase voltage UL3,PT1	0-3000.0	%
ULxMIN,PT1	Minimum average phase voltage, PT1	0-3000.0	%
ULxMAX,PT1	Maximum average phase voltage, PT1	0-3000.0	%
Uo, PT1	Zero sequence voltage Uo, PT1	0-3000.0	%
U1,PT1	Positive sequence voltage U1 , PT1	0-3000.0	%
U2,PT1	Negative sequence voltage U2, PT1	0-3000.0	%
U12,PT2	Phase-to-phase voltage U12,PT2	0-3000.0	%
U23 PT2	Phase-to-phase voltage U23 PT2	0-3000.0	%
U31,PT2	Phase-to-phase voltage U31,PT2	0-3000.0	%
MIN,PT2	Minimum phase-to-phase average voltage, PT2	0-3000.0	%
MAX,PT2	Maximum phase-to-phase average voltage, PT2	0-3000.0	%
UL1,PT2	Phase voltage UL1,PT2	0-3000.0	%
UL2,PT2	Phase voltage UL2,PT2	0-3000.0	%
UL3,PT2	Phase voltage UL3,PT2	0-3000.0	%
ULxMIN,PT2	Minimum average phase voltage, PT2	0-3000.0	%
ULxMAX,PT2	Maximum average phase voltage , PT2	0-3000.0	%
Uo, PT2	Zero sequence voltage Uo , PT2	0-3000.0	%
U1,PT2	Positive sequence voltage U1, PT2	0-3000.0	%
U2,PT2	Negative sequence voltage U2, PT2	0-3000.0	%
U12,PT3	Phase-to-phase voltage U12,PT3	0-3000.0	%
U23 PT3	Phase-to-phase voltage U23 PT3	0-3000.0	%
U31,PT3	Phase-to-phase voltage U31,PT3	0-3000.0	%
MIN,PT3	Minimum phase-to-phase average voltage, PT3	0-3000.0	%
MAX,PT3	Maximum phase-to-phase average voltage, PT3	0-3000.0	%
UL1,PT3	Phase voltage UL1,PT3	0-3000.0	%
UL2,PT3	Phase voltage UL2,PT3	0-3000.0	%
UL3,PT3	Phase voltage UL3,PT3	0-3000.0	%
ULxMIN,PT3	Minimum average phase voltage, PT3	0-3000.0	%
ULxMAX,PT3	Maximum average phase voltage, PT3	0-3000.0	%

Name of meas. quantity	Description	Setting range	Unit
Uo, PT3	Zero sequence voltage Uo , PT3	0-3000.0	%
U1,PT3	Positive sequence voltage U1, PT3	0-3000.0	%
U2,PT3	Negative sequence voltage U2, PT3	0-3000.0	%
UG,PT-GND1	Residual voltage UG,PT-GND1	0-3000.0	%
	TYPE: CURRENT		
IL1,CT1	Phase current IL1,CT1	0-6000.0	%
IL2,CT1	Phase current IL2,CT1	0-6000.0	%
IL3,CT1	Phase current IL3,CT1	0-6000.0	%
MIN,CT1	Minimum average phase current, CT1	0-6000.0	%
MAX,CT1	Maximum average phase current, CT1	0-6000.0	%
Io,CT1	Zero sequence current Io, CT1	0-6000.0	%
I1,CT1	Positive sequence current I1, CT1	0-6000.0	%
I2,CT1	Negative sequence current I2, CT1	0-6000.0	%
IL1,CT2	Phase current IL1,CT2*	0-6000.0	%
IL2,CT2	Phase current IL2,CT2*	0-6000.0	%
IL3,CT2	Phase current IL3,CT2*	0-6000.0	%
MIN,CT2	Minimum average phase current, CT2*	0-6000.0	%
Max,CT2	Maximum average phase current, CT2*	0-6000.0	%
Io,CT2	Zero sequence current Io, CT2*	0-6000.0	%
I1,CT2	Positive sequence current I1, CT2*	0-6000.0	%
I2,CT2	Negative sequence current I2, CT2*	0-6000.0	%
	TYPE: POWER		
P,Power,CT1	Active power,CT1	±3000.0	%
Q,Power,CT1	Reactive power,CT1	±3000.0	%
S,Power,CT1	Apparent power,CT1	0-3000.0	%
P,Power,CT2	Active power,CT2*	±3000.0	%
Q,Power,CT2	Reactive power,CT2*	±3000.0	%
S,Power,CT2	Apparent power,CT2*	0-3000.0	%
	TYPE: POWER FACTOR		
PF,Power,CT1	Power factor, CT1	-0.99 ... +1.00	-
PF,Power,CT2	Power factor,CT2*	-0.99 ... +1.00	-
	TYPE: FREQUENCY		
f,PT1	Frequency,PT1	0-80.00	Hz
f,PT2	Frequency,PT2	0-80.00	Hz
f,PT3	Frequency,PT3	0-80.00	Hz
	TYPE: ANALOG INPUTS		
	Not supported in P16X		

P74503 Limit

Pick-up value of the *first LVM-Limit Value Monitoring element*. At the moment that the value of the monitored measuring quantity (see parameter *"Select"* [P74500]), exceeds/falls below this limit, pick-up event *"LVM-1 pickup"* [E8100] will become active, and the trip delay time ("Delay time") of the *first LVM-Limit Value Monitoring element* will start.

P74505 Delay time

Trip delay time; it is the delay time of the trip event *"LVM-1 trip"* [E8101].

As soon as the pick-up event *"LVM-1 pickup"* [E8100] is active and "Delay time" runs down, trip event [E8101] will be activated. This event can be used for alarm or output control purposes.

P74507 Reset limit

Reset limit of the *first LVM-Limit Value Monitoring element*. When the value of the monitored measuring quantity falls below/exceeds the set value of parameter *"Reset limt"* [P74507} before the *delay time* has run down, the timer of "Delay time" will be set to zero and and the pick-up event *"LVM-1 pickup"* [E8100] will be deactivated.

*Note1: *CT2 option not supported in P16x devices.*

Note2: Each of the 100 steps of limit value monitoring function provides the same parameters. Hence, the parameter descriptions of LVM step 1 represented above is applicable for remaining steps.

2.3 Virtual IO

2.3.1 IEC 61850 subscribers

IEC 61850 – Subscribers

				Main Menu\ Parameters\I/O\ Virtual I/O\
		IEC 61850 subscribers		
P/E No.	System Description	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			
P92552	Multicast MAC address: 01-0C-CD-01-	00-01	-	00-01 … 99-99
…	…	…	..	…

Parameter description:

Subscribers

P92549 Number of active Subscribers

Defines the numbers of the active source subscribers Id in the device. The maximum number is 128. For instance, if the user chooses set value 10, then the condition check will be conducted only for source Subscriber ID 1 to source Subscriber ID 10.

Source Subscriber ID 11 to source Subscriber ID 128 will not be checked.

Source subscribe ID "n"

There are 128 Subscribers available. Each Subscriber is defined individually by one group named Source subscriber ID "n", where "n" is a number from 1 to128.

Source subscribe ID 1

Note:	*Each "Source subscribe ID" always provides the same group of parameters. The parameter descriptions of Source subscribe ID 1 represented below are described in detail in the following examples.*

P92550 Multicast MAC address 01-0C-CD-01-

Define the Multicast address of the subscribers. The first part is fixed and it is in accordance with the IEC61850 standard 01-0C-CD-01. The second part of the address must be set.

P92551 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 Source subscriber ID table. This combination defines the Publisher/address of the device which sends the GOOSE message.*

Example:

As Source subscriber 1 you must set parameter **Multicast MAC address 01-0C-CD-01-**

P[92550] = **00-01** to get the elements of device B. In device B and the parameter **Application ID P[92551] = ID1** in Device B from the same Publisher 1.

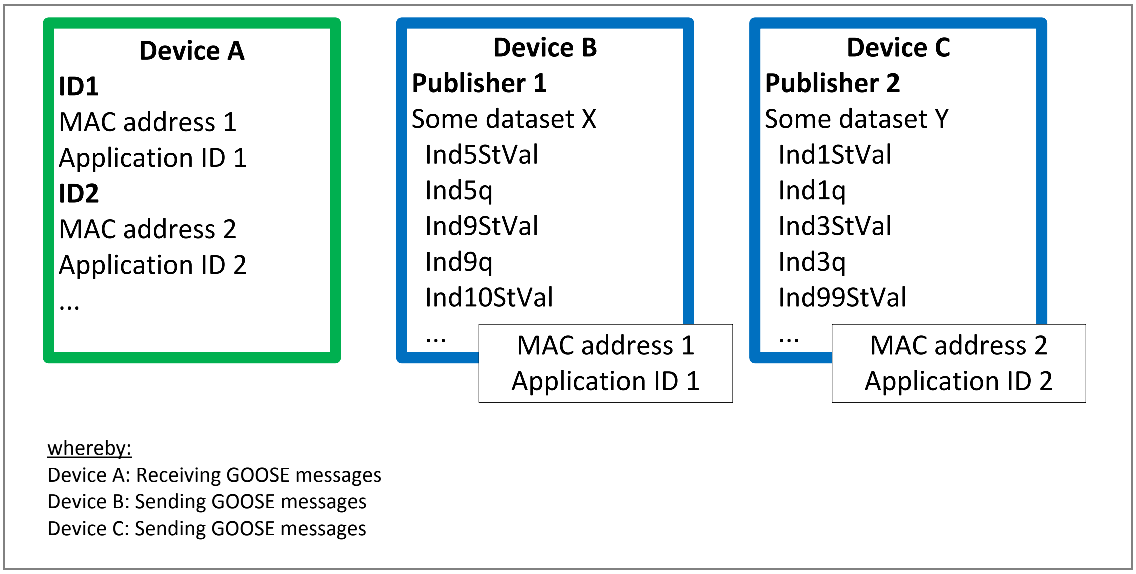


Figure 1 Example: Subscribers

2.3.2 IEC 61850 inputs mapping

IEC 61850 – Inputs mapping

				Main Menu\Parameters\I/O\ Virtual IO\
		IEC 61850 inputs mapping		
P/E No.	System Description	Value	Unit	(Setting range)
	GGIO7STInd1 - trigger setting			
P92900	Source subscriber ID	OFF	-	OFF/1 … 128
P92901	Dataset position ID – StVal	OFF	-	none/1 … 128
P92902	Dataset position ID – Q	OFF	-	none/1 … 128
E9200	GOOSE input event 1 (stVal)	-	-	-
E9330	GOOSE input event 1 (q)	-	-	-
	GGIO7STInd2 - trigger setting			
P92903	Source subscriber ID	OFF	-	OFF/1 … 128
…	…	…	..	…

Parameter description

GGIO7STInd1 - trigger setting

GOOSE inputs represents the node GGIO7 of IEC61850 data model in P60 Agile.

GGIO7STInd1- trigger setting to GGIO7STInd128- trigger setting defines the Ind1 to Ind128 in logical node GGIO7 in the P60 Agile icd file/Compact IEC61850 data model.

Each trigger setting provides the following parameters and events:

P92900 Source subscriber ID

If setting option “OFF” is selected the trigger/filter is not in use.

Active number defines what Source Subscriber ID is used for this trigger/filter. This table defines Source Subscriber ID 1 to 128 with MAC address and Application ID each.

P92901 Dataset position ID – StVal

This parameter defines the position of the dataset element StVal in the dataset of CID file (data of the source device). The dataset element represents event (trip event, binary input event, alarm, PLC …) needed to build a PLC logic, alarm, interlocking or trigger output of the device.

P92902 Dataset position ID – Q

This parameter defines the data quality and its 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 parameter will have the number StVal position +1.

Example:

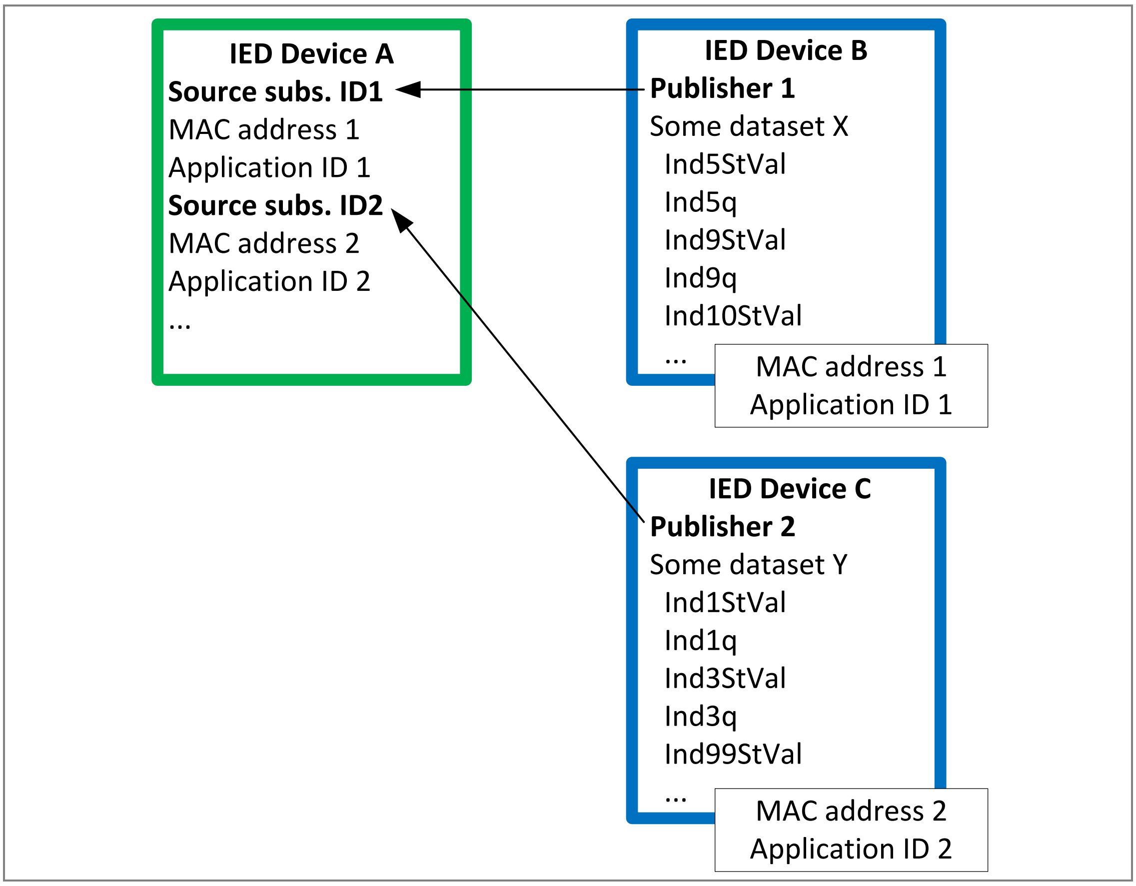


Figure 2 Example: Inputs mapping

Event description

P9200 GOOSE input event 1 (stVal)

This Event is active when the Data Parameter Dataset position Ind – StVal changes its 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 its 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 behaviour of the Event GOOSE Input Event 1 (stVal).

Example:

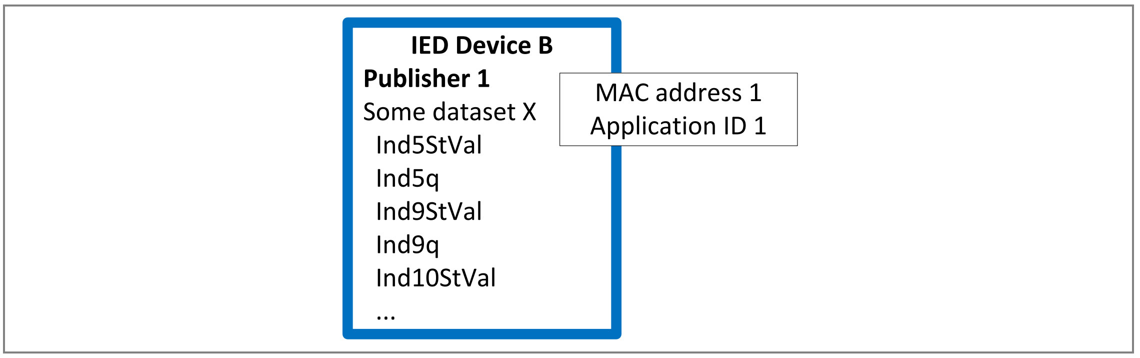


Figure 3 Position of dataset

You can see dataset X with the following elements:

- Ind5StVal,
- Ind5q,
- Ind9StVal,
- Ind9q, and
- Ind10StVal

Dataset is connected to Publisher1 (example gcbA) with defined MAC address 1

and Application ID1.

Positions of the elements are as follows:

Elements/positions of dataset X

Elements in dataset X	Position in dataset X is
Ind5StVal	1
Ind5q	2
Ind9StVal	3
Ind9q	4
Ind10StVal	5

2.3.3 IEC 61850 outputs mapping

GOOSE Output GGIO6STInd “n”- trigger setting.

The name GGIO6STInd “n” (where “n” is the number between 1 and 128) correspondents to the element in logical device System/GGIO6/ST /Ind“n” StVal (where “n” is the number between 1 and 128) in P60 Agile ICD file /Compact IEC61850 Data model.

It is possible to define 128 virtual free programmable outputs.

GGIO6STInd “number between 1 and 128”- trigger setting

GOOSE output is the logical node GGIO6

GGIO6STInd1- trigger setting to GGIO6STInd128- trigger setting defines the Ind1 to Ind 128 in logical node GGIO6 in P60 Agile IEC61850 Datamodel.

IEC 61850 – Outputs mapping

Main Menu\ Parameters\I/O\ Virtual IO\				
	IEC 61850 outputs mapping			
P/E No.	System Description	Value	Unit	(Setting range)
	GOOSE Output GGIO6STInd1 - trigger setting			
P93300	Trigger event	0	-	0 … 9999
E9800	GOOSE Output Event 1	-	-	-
	GOOSE Output GGIO6STInd2 - trigger setting			
P93301	Trigger event	0	-	0 … 9999
E9801	GOOSE Output Event 2	-	-	-
	GOOSE Output GGIO6STInd3 - trigger setting			
…	…	…	..	…

Parameter description:
GOOSE Output GGIO6STInd1 - trigger setting

P93300 Trigger event

This parameter defines that event which will activate *GOOSE output event 1* [E9800]. This can be any event in the device for example: trip event, binary input event, alarm, PLC,…

GOOSE Output GGIO6STInd2 - trigger setting

E9800 GOOSE Output Event 1

This Event is active when the Dataset position Ind - Q parameter has changed status. If the quality is good this parameter will not be active. If the quality is bad the user should use this Event to define the behaviour 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…

GOOSE Output GGIO6STInd2 - trigger setting

P93301 Trigger event

This parameter defines the event which will activate *GOOSE output event 2* [E9801]. This can be any event in the device for example: trip event, binary input event, alarm, PLC…

…

GOOSE Output GGIO6STInd128 - trigger setting

P93427 Trigger event

This parameter defines the event which will activate *GOOSE output event 128* [E9927]. This can be any event in the device for example: trip event, binary input event, alarm, PLC…

Event description:

E9800 GOOSE Output Event 1

This event is active when parameter *Trigger event* [P93300] is active. This event is the same as the element Ind1 StVal in GGIO6 in P60 Agile ICD file/Compact IEC61850 data model. The status of GGIO6/ST/Ind1/StVal element in P60 Agile IEC61850 data model corresponds to the *GOOSE output event 1* [E9800].

E9801 GOOSE Output Event 2

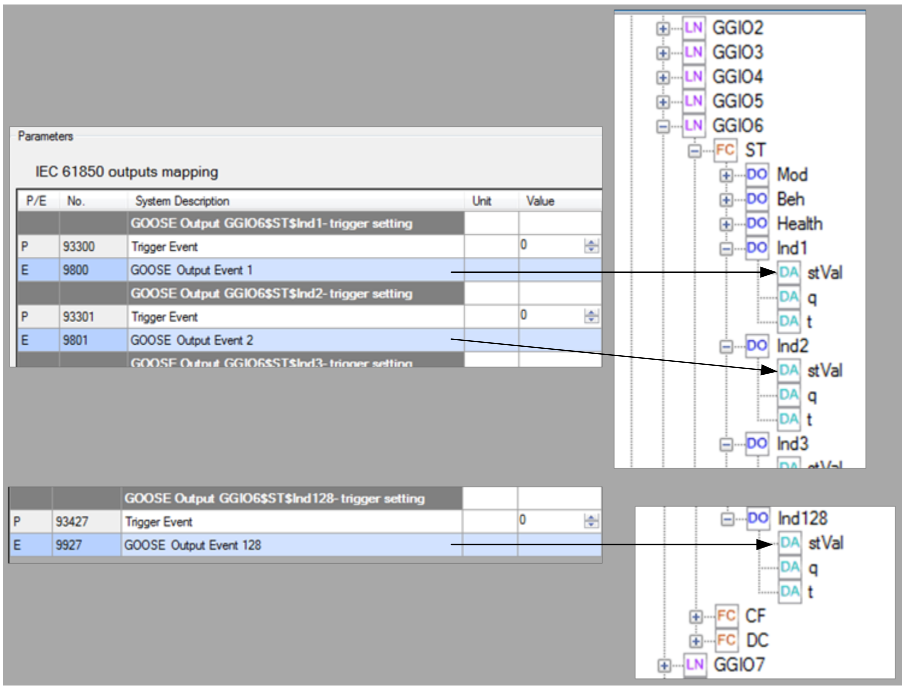
This event is active when parameter *Trigger event* [P93301] is active. This event is the same as the element Ind2 StVal in GGIO6 in P60 Agile ICD file/Compact IEC61850 data model. The status of GGIO6/ST/Ind2/StVal element in P60 Agile IEC61850 data model corresponds to the *GOOSE output event 2* [E9801].

...

E9927 GOOSE Output Event 128

This event is active when parameter *Trigger event* [P93427] is active. This event is the same as the element Ind128 StVal in GGIO6 in P60 Agile ICD file/Compact IEC61850 data model. The status of GGIO6/ST/Ind128/StVal element in P60 Agile IEC61850 data model corresponds to the status of *GOOSE output event 128* [E9927].

Outputs Mapping



2.3.4 IEC 61850 device test mode

IEC 61850 device test mode

Main Menu\ Parameters\I/O\ Virtual IO\				
IEC 61850 device test mode				
P/E No.	System Description	Value	Unit	(Setting range)
	Test mode device trigger setting			
P93431	TEST MODE Device trigger	0	-	0 … 9999
E9931	Device is in TEST mode			

Parameter description:

Test mode device trigger setting

P93431 TEST MODE Device trigger

IEC 61850 test mode can be activated by any active event. For activation, the number related to this activation event has to be assigned to parameter [P93431]. Activation is only effective, however, as long as the assigned event is active. As soon as activation of test mode is active, event “Device in TEST mode” [E9931] is being activated. If the assigned event turns inactive, test mode is being deactivated. Then, event [E9931] is being deactivated automatically.

If activation of test mode is not required, set this parameter to “0”.

Device in IEC61850 TEST mode performs the following actions:

- have all published GOOSE messages marked as Test
- refuse normal commands from Clients
- set Test flag of all relevant qualities
- set all Beh DataObjects to value 3 (test).

2.3.5 Communication events transfer table

Event status transmission via SCADA communication

Main Menu\Parameters\Virtual IO\				
Communication events transfer table				
P/E No.	System description	Value	Unit	(Setting range)
P6600	Communication out event	0	-	0 … 9999
P6601	Communication out event	0	-	0 … 9999
...	...	...	-	....
P6663	Communication out event	0	-	0 … 9999

Parameter description:
Communication events transfer table

P6600 Communication out event

The status of any event can be transmitted as datapoints via the following SCADA communication protocols:

- Modbus RTU
- IEC 60870-5-103 and
- IEC 61850

For event status transmission, the number related to this event has to be assigned to parameter [P6600].

If event status transmission is not required, set this parameter to **0**.

> *Note: A description of the communication protocols and the corresponding addressing can be found in the P60 Agile Protocol related document.*

P6601 Communication out event

to

P6663 Communication out event

See description of parameter [P6600]

2.4 SWITCHGEAR CONTROL

A switching operation of function **SWITCHGEAR 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, disconnector, load break switch, grounding 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 conducted only under fault free operation conditions of the switchgear. Any disconnection due to faulty condition is 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 fault free 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 P60 Agile to differentiate clearly the local operation mode from the remote operation mode referring to switching operations.

Moreover, switching operations in electrical power systems underlie certain authorisation, which are defined and given by the system operator.

Switching operations triggered via the protection and control system P60 Agile therefore requires 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)

To meet the requirements mentioned above the P60 Agile provides different functions ensuring the clear allocation of password-protected user level and local or remote operation for function Breaker control.

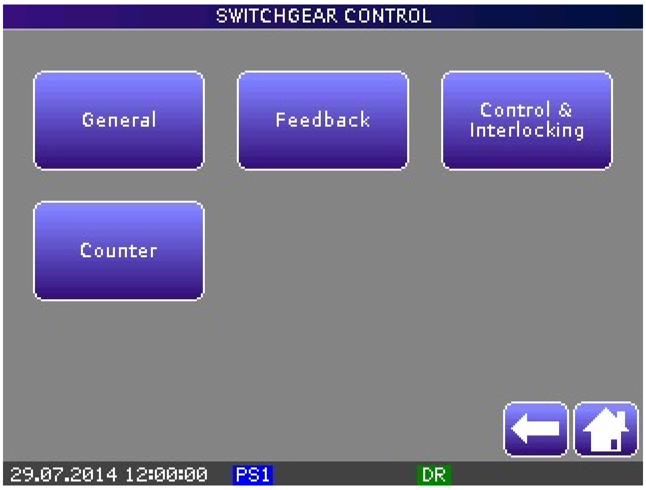
Configuration of functional keys for switching ON/OFF in case of local control

Local control can be conducted either by the configurable function keys at the front late of P60 Agile see chapter Parameter/SYSTEM/Graphic/**Button configuration**: Parameter [P60010] to [P60015]).

Configuration of SWITCHGEAR CONTROL

For Breaker control function, the following submenus are available:

SWITCHGEAR CONTROL Menu



2.4.1 General

Breaker control – General parameters [P] for blocking functions

Main Menu\Parameters\SWITCHGEAR CONTROL\				
General				
P/E No.	System Description	Value	Unit	(Setting range)
P6001	Breaker locked	0	-	0 … 9999
P6002	Block/Cancel control	0	-	0 … 9999

Parameter description:

General
The following parameters apply for all the 8 switching elements.

P6001 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 so long as the assigned event is active. If the event becomes inactive blocking of switching element selection is abandoned.

If blocking of switching element selection is not required, set this parameter to **0**.

P6002 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 so long as the assigned event is active. If the event becomes inactive, blocking/interrupt is abandoned.

If blocking of switching element selection is not required, set this parameter to **0**.

2.4.2 Feedbacks

The graphic display of the P60 Agile shows the individual single line diagram of switch panel configuration. The 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 P60 Agile. An auxiliary contact (normally open) signals ON position of the CB while the second (normally closed) signals OFF position.

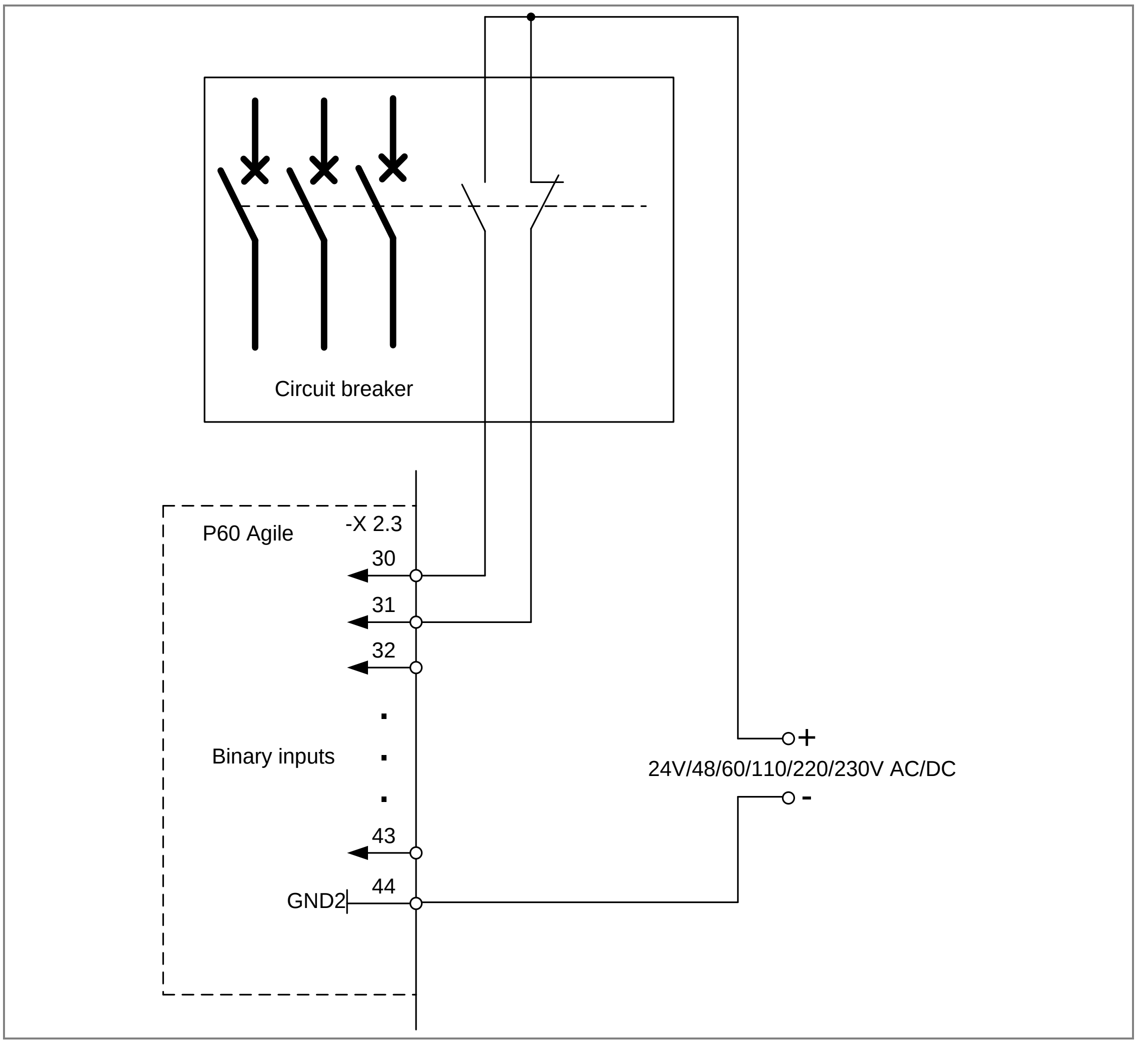


Figure 4 **Acquisition of CB positions**

Apart from the ON/OFF position, the breaker positions DIFF and FAIL may also be acquired and signalled with these two signals.

Breaker positions

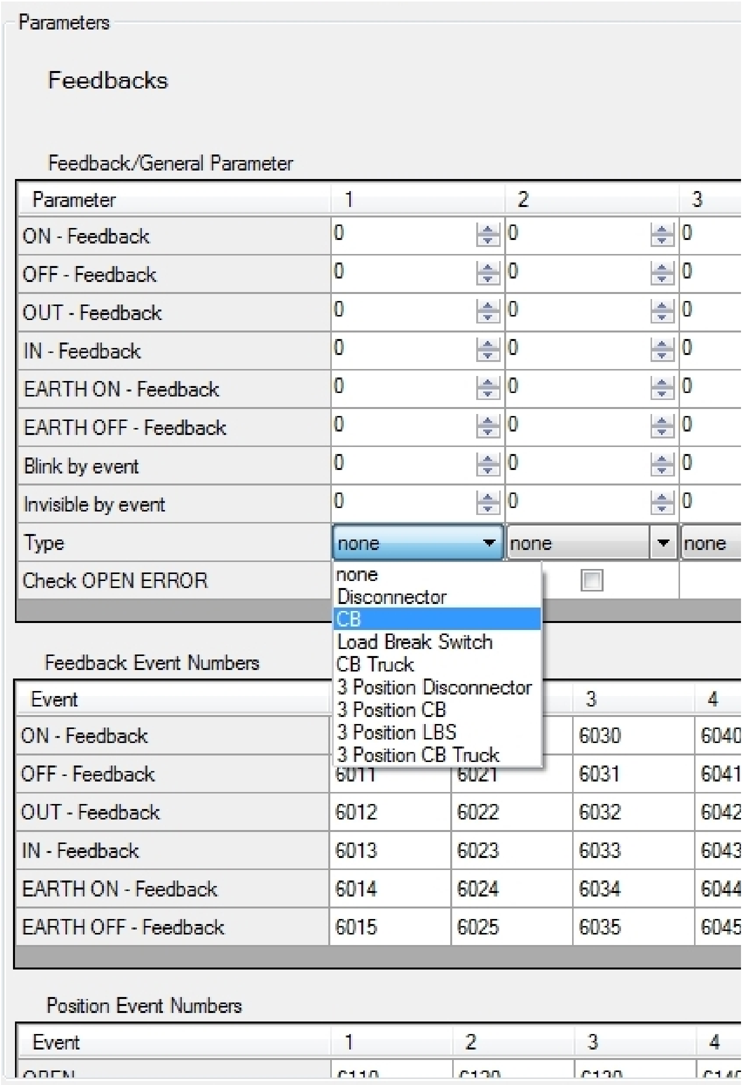
Return signal 1 (NO)	Return signal 2 (NC)	Position indication of switching element
0	1	OFF
1	0	ON
0	0	DIFF (Moving)
1	1	FAIL

The device type of switching elements (SE) is assigned via parameter Type [P] in submenu: Parameters\SWITCHGEAR CONTROL\Feedbacks.

The P60 Agile provides the following types of switching elements:

- Disconnector
- Circuit Breaker (CB)
- Load Break Switch(LBS)
- Circuit breaker truck (CB Truck)
- 3-position disconnector (3 Position Disconnector)
- 3-position circuit breaker (3 Position CB)
- 3-position load break switch (3 Position LBS)
- 3-position circuit breaker truck (3 Position CB Truck)

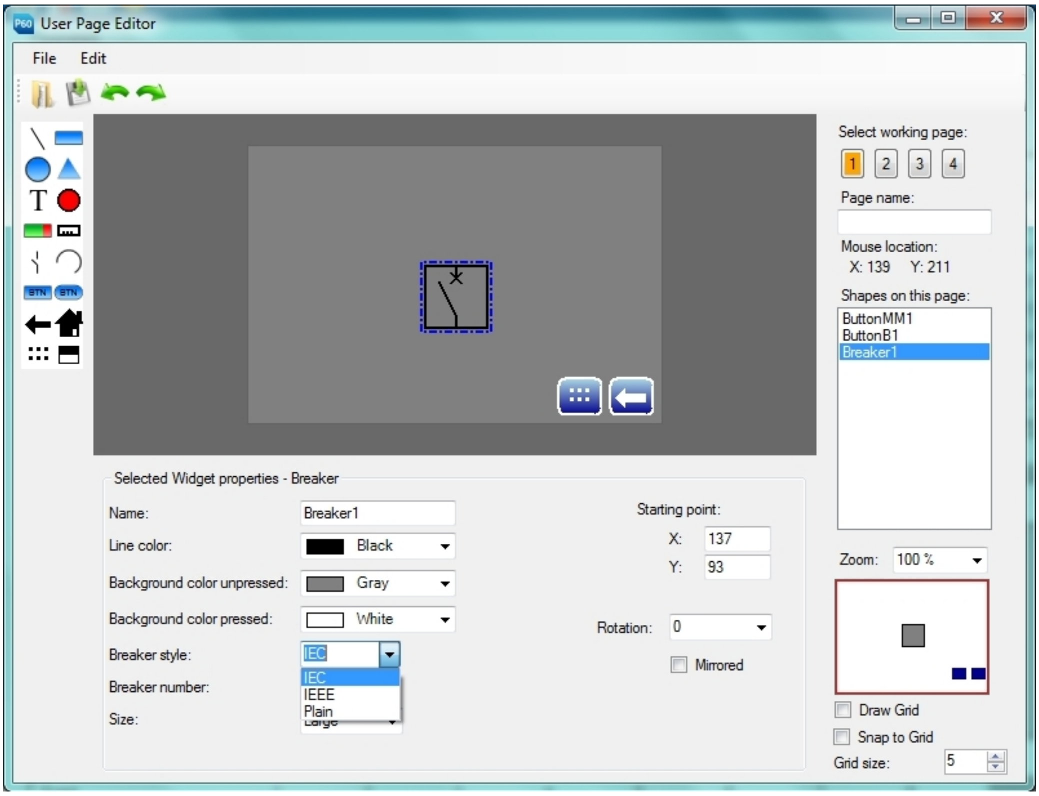
Switchgear control – Definition of SE device type



The displayed SE- symbol can be configured via parameter “Breaker style” [P] according to different standards in **User page** menu. The following setting options are available:

- IEC
- IEEE
- Neutral

Selection of switching element symbol according to different standards or neutral symbol



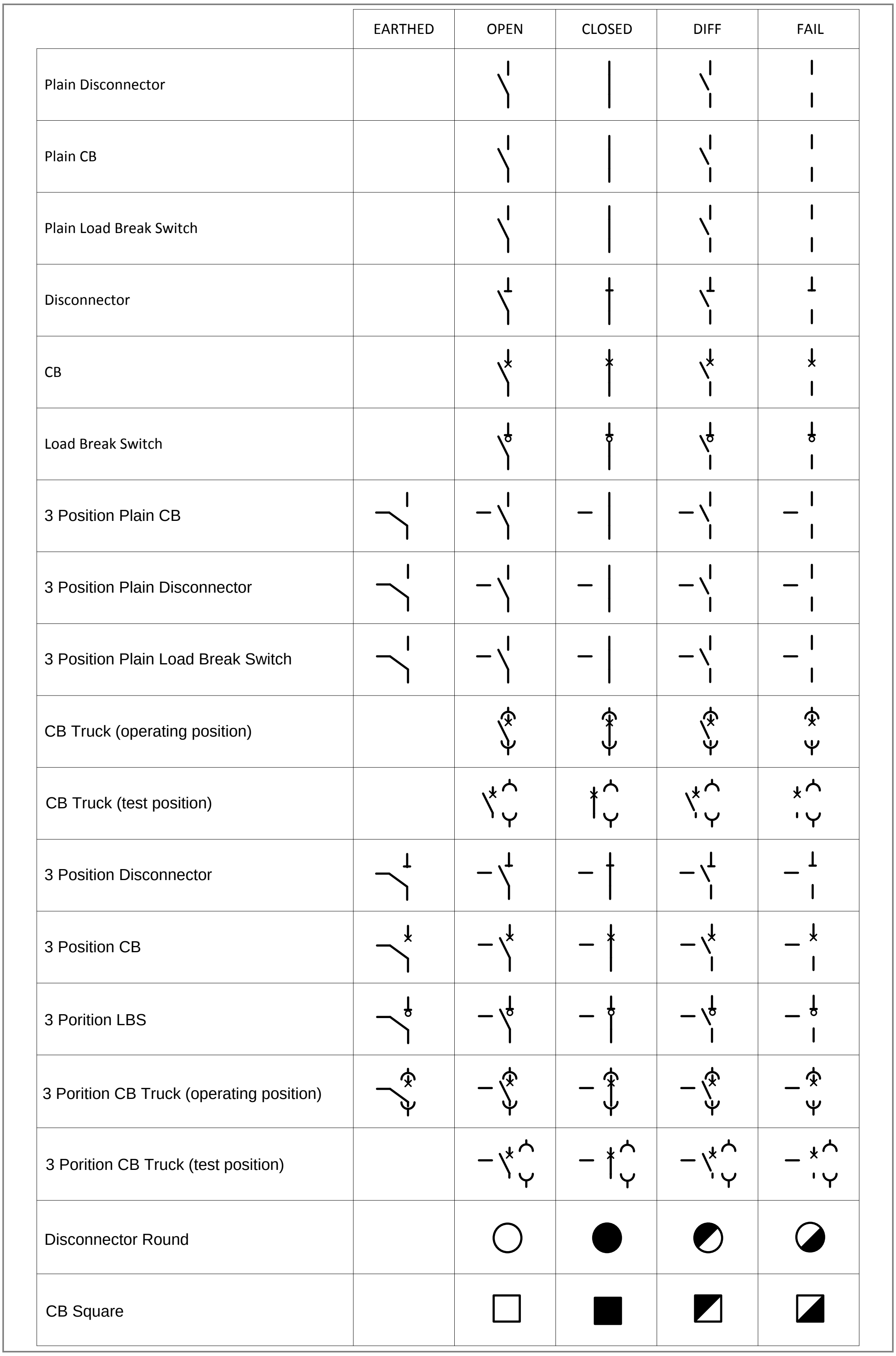


Figure 5 Active symbols of switching elements

Feedback/General Parameter – feedback signals (e.g. by binary inputs)

Main Menu\Parameters\BREAKER CONTROL\								
Feedbacks								
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

Parameter description:

Feedbacks

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 should 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 P60 Agile. 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 should 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 P60 Agile. 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 extended position of a truck; to determine the feedback signal for extended position of a 3-position-switch the event number of the applied signal should be set to parameter OUT-Feedback [P]. Usually, an auxiliary contact (NC) of the truck is to be connected to a binary input of the P60 Agile. 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 retracted position of a truck; to determine the feedback signal for retracted position of a 3-position-switch the event number of the applied signal should be set to parameter IN-Feedback [P]. Usually, an auxiliary contact (NO) of the truck is to be connected to a binary input of the P60 Agile. 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 grounding position of an earthing switch or 3-position-switch; to determine the feedback signal for grounding position of an earthing switch or 3-position-switch the event number of the applied signal should be set to parameter EARTH ON-Feedback [P]. Usually, an auxiliary contact (NO) of the earthing switch or 3-position-switch is to be connected to a binary input of the P60 Agile. 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-grounding position of an earthing switch or 3-position-switch; to determine the feedback signal for non-grounding position of an earthing switch or a 3-position-switch the event number of the applied signal should be set to parameter GROUND OFF-Feedback [P]. Usually, an auxiliary contact (NC) of the earthing switch or 3-position-switch is to be connected to a binary input of the P60 Agile. 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 so long as the assigned event is active. If the event becomes 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 so long as the assigned event is active. If the event becomes 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 the P60 Agile can be attributabled 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 use the tick box besides parameter Check OPEN ERROR:

- ☐: do not tick the box => the supervision mode is not activated
- ☑: tick the box => the supervision mode is activated

As soon as an out-of-control switch-off of a switching element is detected the event OPEN ERROR [61xx] is activated.

Event description:

Feedback Event Numbers

The following events are individually available for all 8 switching elements.

E60x0 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 [E60x0] is activated.

E60x1 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 [E60x1] is activated.

E60x2 OUT – Feedback

Feedback event for extended position of a truck; as soon as the feedback signal of extended position – set by parameter OUT-Feedback [P] – is active, the referring feedback event OUT-Feedback [E60x2] is activated.

E60x3 IN – Feedback

Feedback event for retracted position of a truck; as soon as the feedback signal of retracted position – set by parameter OUT-Feedback [P] – is active, the referring feedback event OUT-Feedback [E60x3] is activated.

E60x4 EARTH ON – Feedback

Feedback event for grounding position of an earthing switch or 3-position-switch; as soon as the feedback signal of ON position – set by parameter GROUND ON-Feedback [P] – is active, the referring feedback event GROUND ON -Feedback [E60x4] is activated.

E60x5 EARTH OFF – Feedback

Feedback event for non-grounding position of an earthing switch or 3-position-switch; as soon as the feedback signal of OFF position – set by parameter GROUND OFF-Feedback [P] – is active, the referring feedback event GROUND OFF -Feedback [E60x5] is activated.

Position Event Numbers

The following events are individually available for all 8 switching elements.

E61x0 OPEN

Position event for OFF position; the position event OPEN [E61x0] is only activated When a switching element has taken a definite position. A definite position is determined by evaluating both, feedback event ON-Feedback [E60x1] and feedback event OFF-Feedback [E]. To activate position event OPEN [E61x0],

- feedback event OFF-Feedback [E] has to be activated, **and**
- feedback event ON-Feedback [E] has to be deactivated.

E61x1 CLOSED

Position event for ON position; the position event CLOSED [E61x1] is only activated when a switching element has taken a definite position. A definite position is determined by evaluating both, feedback event ON-Feedback [E60x0] and feedback event OFF-Feedback [E60x1]. To activate position event CLOSED [E61x1],

- feedback event OFF-Feedback [E60x1] has to be deactivated, **and**

- feedback event ON-Feedback [E60x0] has to be activated.

E61x2 OUT OPEN

Position event for truck withdrawn and CB off position of operating device combination Truck/Circuit breaker (CB); the position event OUT OPEN [E61x2] is only activated When 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 [E60x2] and IN-Feedback [E60x3], and feedback events of the CB OFF-Feedback [E60x1] and ON-Feedback [E60x0]. To activate position event OUT OPEN [E61x2]

- feedback event OUT-Feedback [E60x2] of the truck has to be activated, **and**
- feedback event IN-Feedback [E60x3] of the truck has to be deactivated, **and**
- feedback event OFF-Feedback [E60x1] of the circuit breaker has to be activated, **and**
- feedback event ON-Feedback [E60x0] of the circuit breaker has to be deactivated.

E61x3 OUT CLOSED

Position event for truck withdrawn and CB on position of operating device combination Truck/Circuit breaker (CB); the position event OUT CLOSED [E61x3] is only activated when 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 [E60x2] and IN-Feedback [E60x3], and feedback events of the CB OFF-Feedback [E60x1] and ON-Feedback [E60x0]. To activate position event OUT CLOSED [E61x3]

- feedback event OUT-Feedback [E60x2] of the truck has to be activated, **and**
- feedback event IN-Feedback [E60x3] of the truck has to be deactivated, **and**
- feedback event OFF-Feedback [E60x1] of the circuit breaker has to be deactivated, **and**
- feedback event ON-Feedback [E60x0] of the circuit breaker has to be activated.

E61x4 EARTH

Position event for earthing position of a 3-position switch; the position event EARTH [E61x4] is only activated when 3-position switch has taken a definite position. A definite position is determined by evaluating its feedback events EARTH ON-Feedback [E60x4] and EARTH OFF-Feedback [E60x5] as well as ON-Feedback [E60x0] and OFF-Feedback [E60x1]. To activate position event EARTH [E61x4]

- feedback event EARTH OFF-Feedback [E60x5] has to be deactivated, **and**
- feedback event EARTH ON-Feedback [E60x4] has to be activated, **and**
- feedback event OFF-Feedback [E60x1] has to be activated, **and**
- feedback event ON-Feedback [E60x0] has to be deactivated.

E61x5 Diff (Moving)

Position event for Difference position; the position event DIFF (Moving) [E61x5] is only activated When a switching element has taken a position which is not definite. A non-definite position is determined by evaluating both, feedback event ON-Feedback [E60x0] and feedback event OFF-Feedback [E60x1]. To activate position event DIFF (Moving) [E61x5]

- feedback event OFF-Feedback [E60x1] has to be deactivated, **and**
- feedback event ON-Feedback [E60x0] has to be deactivated as well.

E61x6 FAIL

Position event for failure position; the position event FAIL [E61x6] is only activated when a switching element has taken a non-definite position. A non-definite position is determined by evaluating both, feedback event ON-Feedback [E60x0] and feedback event OFF-Feedback [E60x1]. To activate position event FAIL [E],

- feedback event OFF-Feedback [E60x1] has to be activated, and
- feedback event ON-Feedback [E60x0] 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.*

E61x7 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 P60 Agile error event OPEN ERROR [E61x7] is activated.

Note:	*The activated error event OPEN ERROR [E61x7] can be deactivated by a hotkey of the touchscreen or a function key of the front plate, if the setting option ACK is assigned to the keys.*

Reset of the activated error-event is also possible

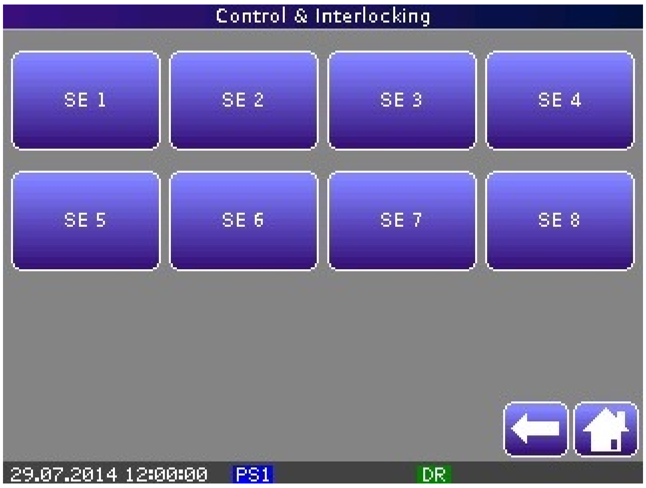
- by the communication command ACK of the different data protocols and
- by function Remote ACK [E5951]

2.4.3 Control & Interlocking

In P16x devices up to 8 switching elements (SE) can be configured individually according to control and interlocking functions:

Note: Control of 5 switching devices supported as standard.

Control & Interlocking of switching devices



Each of the switching elements (SE) can be configured individually according to its control timing as well as to its switching direction:

- “Timing”: Settings for activation duration, activation-delay and postactivation of corresponding binary output (BO)
- “Closing“: Switching direction: “OFF“ to “ON“
- “Opening“: Switching direction: “ON“ to “OFF“

- “Extending“: Draw-out of the *truck* while CB is open
- “Retracting“: Insertion of the *truck* while CB is open
- “Earthing“: Switching direction of *3-postion switch*: “OFF“ to “EARTHED“
- “Unearthing“: Switching direction of *3-postion switch*: “EARTHED“ to “OFF“

SE 1 to SE 8 – Configuration of switching operation conditions

Timing (control timing) and display representation of SE symbol
Activation duration, activation-delay and post activation of the corresponding binary output for controlling the drives of a switching element can be set by the three “control” parameters listed below. Moreover, the indication mode based on a 1-bit feedback for representing the SE symbol on the display can be activated.

Control timing and display representation of SE symbol

Control timing and display representation of SE symbol – Parameters [P]

Main Menu\Parameters\ SWITCHGEAR CONTROL\SE 1				
		Timing		
P/E	System Description	Value	Unit	(Setting range)
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
P	Show last position if control	☐	-	☐/☑

Parameter description:

Following parameters are individually available for each switching element.

P Control time (fail event)

Maximum control time (activation duration) to switch on/off the switching element; as soon as a control command is given, the assigned binary output is activated for the duration of time set by parameter *"Control time (fail event)"* [P].

If 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 activated

P -> OPEN Control fixed delay

Open control delay time (activation delay) to switch on/off the switching element; as soon as a control command is given, the activation of the assigned binary output is delayed for the duration of time set by parameter

"->OPEN Control fixed dela" [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.

If 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 activated.

P OPEN-> Control fixed delay

Extended control time (postactivation) to switch on/off the switching element; 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 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.

If 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 activated.

Display representation of SE symbol

P SE symbol 1-bit feedback

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 show the previous switch position until the switching element has reached the final position. For example, 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".

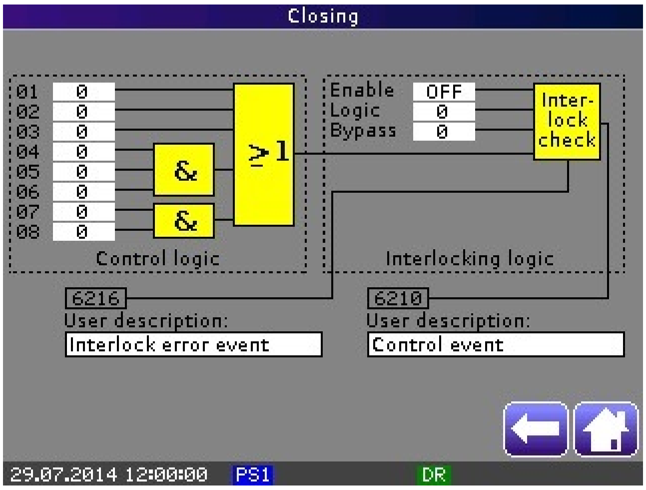
In case of a wire-break or a stuck auxiliary contact, device display shows symbol "FAIL".

Control & interlocking logic

Parameter setting can be done individually according to the switching direction of the switching element.

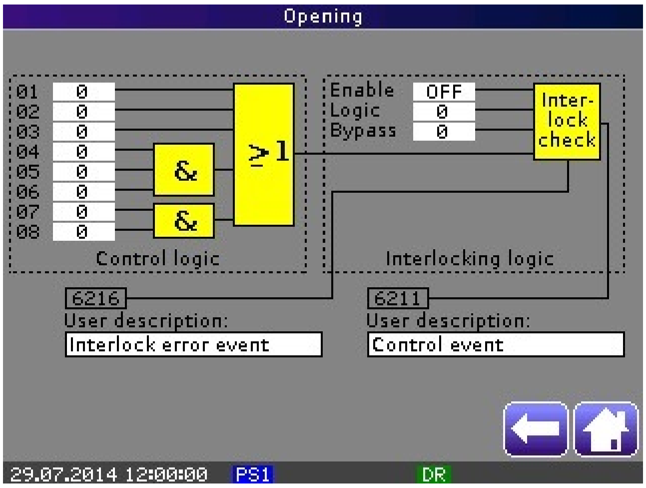
Closing direction

Configuration of SE closing direction



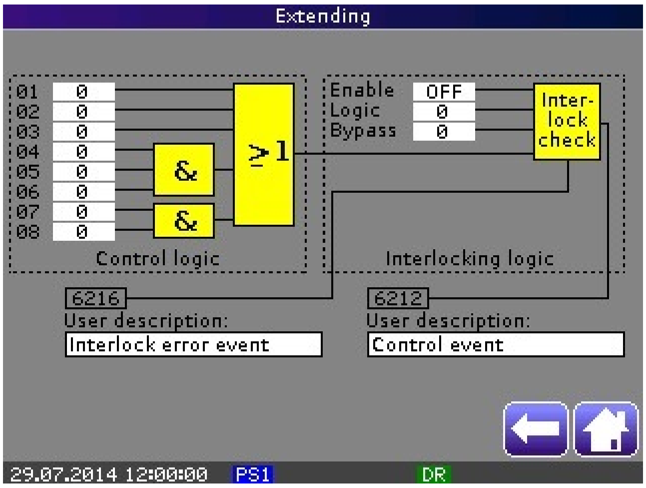
Opening direction

Configuration of SE opening direction



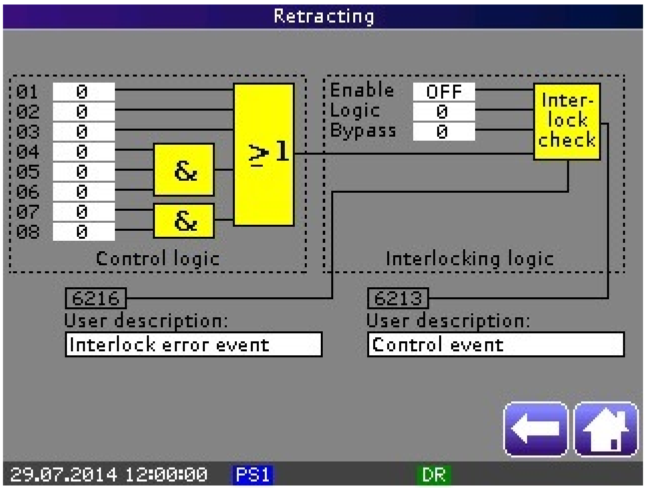
Extending direction

Configuration of SE extending direction



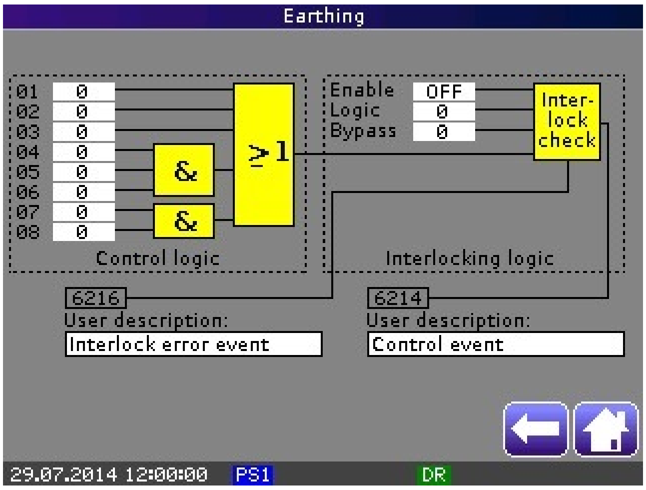
Retracting direction

Configuration of SE retracting direction



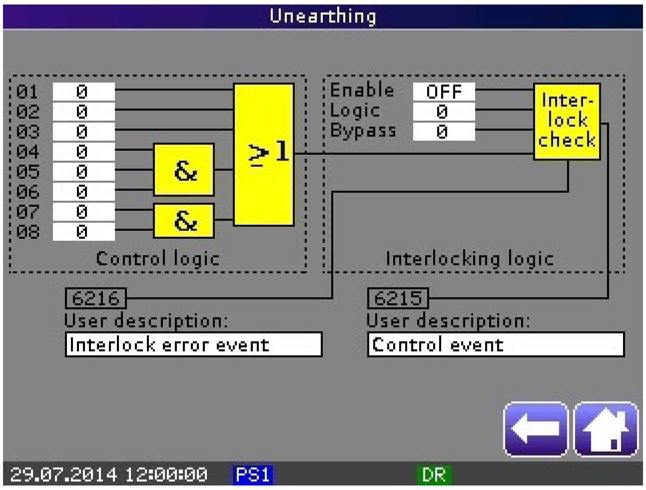
Earthing direction

Configuration of SE earthing direction



Unearthing direction

Configuration of SE unearthing direction



Control & Interlocking logics – Parameters [P]

Main Menu\Parameters\ SWITCHGEAR CONTROL\Control & Interlocking\SE1				
Closing				
P	**System Description**	**Value**	**Unit**	**(Setting range)**
	Control 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
P	User description (editable control logic event)	“Control event”	-	(1 … 16 characters)
	Interlocking logic			
P	Enable	OFF	-	OFF/ON
P	Logic	0	(event)	0 … 9999
P	Bypass	0	(event)	0 … 9999
P	User description (editable interlock logic event)	“Interlock error event”	-	(1 … 16 characters)

Control & Interlocking – Events [E]

Control & Interlock event numbers									
E	System Description	SE 1	SE 2	SE 3	SE 4	SE 5	SE 6	SE 7	SE 8
	Control logic events								
E	OPEN->CLOSED	6210	6220	6230	6240	6250	6260	6270	6280
E	CLOSED->OPEN	6211	6221	6231	6241	6251	6261	6271	6281
E	OPEN->OUT	6212	6222	6232	6242	6252	6262	6272	6282
E	OUT->OPEN	6213	6223	6233	6243	6253	6263	6273	6283
E	OPEN->EARTH	6214	6224	6234	6244	6254	6264	6274	6284
E	EARTH->OPEN	6215	6225	6235	6245	6255	6265	6275	6285
E	Control fail event	6217	6227	6237	6247	6257	6267	6277	6287
	Interlock logic events								
E	Interlock error event	6216	6226	6236	6246	6256	6266	6276	6286

Parameter description:

Control logic

P 01
to

P 08

Input elements (events) of the Control logic to activate the switching operation for the switching direction of the selected switching element (*SEx*); 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 for switching conditions of the switching element are set by programmable logic control (PLC). The output event of the logical function determines the switching conditions of the selected switching direction of the selected switching element and can be activated for module Interlocking by any active event. To activate the number related to this event it has to be assigned to parameter Logic [P]. Activation of the logical function for switching conditions is only effective so long as the assigned event is active. If the event becomes inactive the output event of the logical function is blocked.

If switching conditions for the selected switching direction of the selected switching element are not required, set this parameter to **0**.

> *Note:* *Switching conditions of a switching element are equal to the negated form (acc. to Boolean Algebra) of its Interlocking conditions.*
>
> ***Interlocking condition**: defined conditions which have to be fulfilled to prohibit closing or opening of a switching element, e.g. the CB.*
>
> ***Switching conditions**: defined conditions which have to be fulfilled to allow closing or opening of a switching element, e.g. the CB.*
>
> *You can use a logical equation (Boolean algebra) to express defined interlocking conditions. Negating a logical equation for interlocking conditions will result in switching conditions.*

P Bypass

Blocking of the configured logic for switching conditions of the switching element can be set by programmable logic control (PLC). The output event of the logical function determines the switching conditions of the selected switching direction of the selected switching element and can be blocked for module Interlocking by any active event. Blocking the number related to this blocking event has to be assigned to parameter Bypass [P]. Blocking is only effective so long as the assigned event is active. If the event becomes inactive the output event of the logical function for switching conditions is effective again.

If blocking of the configured logic for switching conditions of the selected switching direction of the selected switching element is not required set this parameter to **0**.

User description (Text editor for editable user description of events)

P6210 (Control Event)

Event (via text editor) to indicate a given control command to the corresponding binary output; 16 characters at maximum

P6216 (Interlock error event)

Event (via text editor) to indicate an interlocking infringement; 16 characters at maximum

2.4.4 Counter (counter and events of control operations)

Counter functions of control operations

Main Menu\Parameters\SWITCHGEAR CONTROL\								
Counter								
Breaker Counter								
Parameter	SE1	SE2	SE3	SE4	SE5	SE6	SE7	SE8
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								
Event	SE1	SE2	SE3	SE4	SE5	SE6	SE7	SE8
Closed->OPEN cycles max	6311	6321	6331	6341	6351	6361	6371	6381
OPEN->EARTH cycles max	6313	6323	6333	6343	6353	6363	6373	7383

Parameter description:

Breaker Counter – parameters of control operation counter

The 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 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* [E63xx] is activated.

P OPEN->EARTH cycles

Set counting start value for all the switching operations of a 3-position switch with switching direction OPEN to GROUND. This counter is incremented if switching operation was conducted for the switching direction OPEN to GROUND.

P OPEN->EARTH cycles max

Maximum set counting limit for all the switching operations of a 3-position switch with switching direction OPEN to GROUND. As soon as the counter has reached the set counting limit the event *OPEN->GROUND cycles max* [E63xx] is activated.

Event description:

Breaker Counter Events– events of control operation counter

Following events are individually available for each of 8 switching elements.

E63x1 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* [E63x1] is activated.

> *Note:* *Event [E63x1] can be used for indicating the need for revising the primary contacts of the switching element.*

E63x3 OPEN-> EARTH cycles max

As soon as the set counting limit for all the switching operation with switching direction OPEN to GROUND set by parameter OPEN->GROUND cycles max [P] has been reached, event *OPEN->GROUND cycles max* [E63x3] is activated.

> *Note:* *Event [E63x3] can be used for indicating the need for revising the primary contacts of the switching element.*

2.5 RECORDER

2.5.1 Fault recorder

Fault recorder – Parameter [P]

Main Menu\ Parameters\RECORDER\				
Fault recorder				
P/E No.	System Description	Value	Unit	(Setting range)
P8061	Trigger event	0	event	0 … 9999

Parameter description:

P8061 Trigger event

Fault recording can be activated by any active event (activation-event) assigned to parameter P[8061] or by any active trip-event. For activation via activation-event the number related to this event has to be assigned to parameter **Trigger event**. At the time the trigger-event is being activated the rising signal edge of the trigger-event starts the recording (snapshot of the measuring values).

If fault recording is not required set this parameter to **0**.

> ***Note**: In parallel to the “Trigger event” [P8061] the fault recorder is always triggered when P16x device trips the circuit breaker by any active protection function.*

2.5.2 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 inactive state.

> *Note: At the time, one of the buffers claims state ready, event DiREC Ready [E8000] is 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 using hotkey Trigger Snapshot via touchscreen (menu: Main Menu/Recorder/**Disturbance recorder**)

the state of buffer 1 changes from ready to recording (recording mode), and event *DiREC Recording* [E8001] is activated.

If a pre-trigger-time was taken into account by the set value of parameter *Pre-trigger time* [P8007], the point of time of trigger does not represent the point of time of recording. According to the set pre-trigger-time the recording duration is calculated which is for recording data before the point of time of activating the trigger-event. The date of start of recording is before the date of triggering the recorder.

The maximum recording time results from the size of the buffer memory, the sample rate, and the data volume of each sample.

Example: Size of buffer memory = 20 MB / 2

= 10 MB

= 10485760 B

Sample rate (dep. on net frequency) = 50Hz * 36 samples per period

= 1800 samples/s

Data volume of one sample (Sample width = Standard) = 92 B

=> **Max. recording time** = 10485760 B / 1800 Hz / 92 B

= **63.31s**

Maximum recording time can be reduced by parameter *Recording time* [P8006].

As long as the trigger event is activated recording is for the set recording time. In case that this time has not run down and the trigger event turns to inactive, recording duration depends upon the *recording time-after-trigger* set by parameter *Follow-up time* [P8008] or the *recording time-after-manual trigger* set by parameter *Follow-up time (manual)* [P8009].

When recording has finished the state of buffer 1 changes from recording to data (waiting mode), and event *DiREC Recording* [E8001] is deactivated. Buffer 1 therefore contains recorded data which is prepared to be stored in a non-volatile manner on the memory of SD-card.

Subsequently, the disturbance recorder function tries buffer 1 to assume state ready. The following cases have to be taken into account:

Disturbance recorder – changes of states

Actual state	Follow-up state
inactive	ready
data + Parameter: Overwrite [P8004] = ON	ready
data + Parameter: Overwrite [P8004] = OFF	data
backup	backup

If buffer 1 gains ready state the disturbance recorder is able to process another active trigger event. Otherwise the new active trigger event is ignored.

Copying of data from buffer 1 to the memory of SD card will start as soon as possible. Depending on the recording time and processor workload transmitting data could last up to several minutes. While the copy process is started buffer 1 assumes state backup and event *DiREC Backup* [E8003] is activated.

After the copy process has finished buffer 1 assumes inactive state and event [E8003] is deactivated.

Note: If the SD Card memory is full the event DiREC Full memory [E8004] is activated.
If there is no SD-card available the event DiREC No memory card [E8005] is activated.
If writing/reading the memory of the SD-card fails for any reason the event DiREC Memory error [E8006] is activated.
If a CRC error of a recorded file is indicated the event DiREC File error [E8007] is activated.

Fault recorder – Parameter [P] and Events [E]

Main Menu\ Parameters\RECORDER\				
Disturbance recorder				
P/E No.	System Description	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	-	-	-

Parameter description:

General parameters

P8000 Function

This parameter enables/disables disturbance recording function where:

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

When the disturbance recording function is enabled by parameter *Function* [P8000] the event *Di-REC Ready* [E8000] is activated.

P8001 Sample width

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

- Standard: measurement quantities according to the following table
- Development: for manufacturer's use only

Analog data of disturbance recordings for parameter setting:

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_UL1E	V	Phase-to-earth voltage (L1 and earth) measured via PT1	
PT1_UL2E	V	Phase-to-earth voltage (L2 and earth) measured via PT1	

Measuring quantity	Unit	Description	Remark
PT1_UL3E	V	Phase-to-earth voltage (L3 and earth) measured via PT1	
PT2_UL1E	V	Phase-to-earth voltage (L1 and earth) measured via PT2	
PT2_UL2E	V	Phase-to-earth voltage (L2 and earth) measured via PT2	
PT2_UL3E	V	Phase-to-earth voltage (L3 and earth) measured via PT2	
PT3_UL1E	V	Phase-to-earth voltage (L1 and earth) measured via PT3	
PT3_UL2E	V	Phase-to-earth voltage (L2 and earth) measured via PT3	
PT3_UL3E	V	Phase-to-earth voltage (L3 and earth) measured via PT3	
PT-GND1_UG	V	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 UL1 measured by PT2	G59 only
PT2_FL2N		Frequency of phase-to-neutral voltage UL2 measured by PT2	G59 only
PT2_FL3N		Frequency of phase-to-neutral voltage UL3 measured by PT2	G59 only
Parameter-Events		Events of parameters [P8028] to [P8059]	
BIO		Events of binary inputs and outputs	

***Note: Option not relavant for P16x devices.*

Sample width [P8001] = Standard

Binary data of disturbance recordings for parameter setting:
Sample width [P8001] = Standard

Event-Nr.	Function	Description
E4010	Fct. 10	Binary input Function 10
E4011	Fct. 11	Binary input Function 11
E4012	Fct. 12	Binary input Function 12
E4013	Fct. 13	Binary input Function 13
E4014	Fct. 14	Binary input Function 14
E4015	Fct. 15	Binary input Function 15
E4016	Fct. 16	Binary input Function 16
E4017	Fct. 17	Binary input Function 17
E4018	Fct. 18	Binary input Function 18
E4019	Fct. 19	Binary input Function 19
E4020	Fct. 20	Binary input Function 20
E4021	Fct. 21	Binary input Function 21
E4022	Fct. 22	Binary input Function 22
E4023	Fct. 23	Binary input Function 23
E4024	Fct. 24	Binary input Function 24
E4025	Fct. 25	Binary input Function 25
E4026	Fct. 26	Binary input Function 26
E4027	Fct. 27	Binary input Function 27
E4500	Shunt Trip 1	Binary output for protection trip
E4501	Shunt Trip 2	Binary output for protection trip

Event-Nr.	Function	Description
E4502	Lockout relay	Binary output as Lockout relay
E4504	Synchron ON	Binary output for Synchronising function
E4506	Function 1	Binary output for Function 1
E4508	Function 2	Binary output for Function 2
E4510	Function 3	Binary output for Function 3
E4512	Function 4	Binary output for Function 4
E4514	Function 5	Binary output for Function 5
E4516	Function 6	Binary output for Function 6
E4518	Function 7	Binary output for Function 7
E4520	Function 8	Binary output for Function 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 was only one buffer (Number of internal buffers = 1) and recording finished successfully the copy operation would start to transmit recorded data from the buffer to the SD card. As a consequence any active trigger event could not start a further recording.

However, 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. If all buffers provide recorded data to save to 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.

When overwriting of the next buffer starts the event *DiREC Buffer overflow* [E8002] is 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 (using the hotkey “Trigger snapshot”).

P8008 Follow-up time

Recording time-after-trigger. This parameter determines the recording duration from 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 from the point of time of deactivation of the manual trigger via touchscreen (using the hotkey "Trigger snapshot").

> *Note: The recording time-after-trigger set by parameter Follow-up time (manual) [P8009] 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**.

2.6 PLC (Programmable logic control)

Programmable logic functions

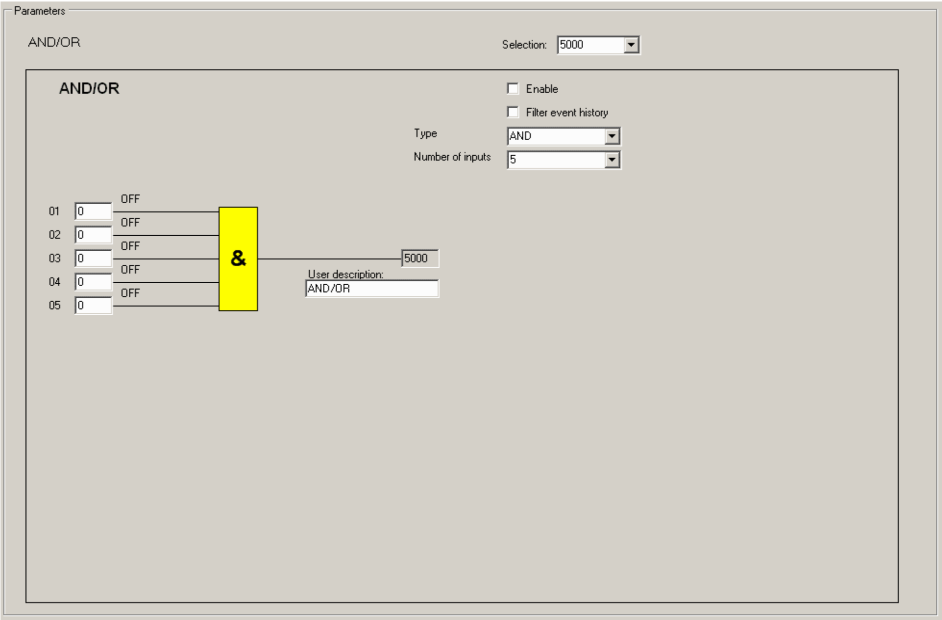
Type	Number of available logic elements	Event-No.	Number of input elements	Number of parameters
AND/OR	500	5000-5499	2-5	3
NOT (Inverter)	30	5500-5529	1	2
XOR (Exclusive OR)	20	5530-5549	2	2
Flip-Flop	20	5550-5569	2	4
Counter	20	5570-5589	4	6
Timer	80	5600-5679	1	6
Timer switch	20	5680-5699	-	6

2.6.1 Logic elements

2.6.1.1 AND/OR

By using selection button Selection the first of 500 available logic elements AND/OR can be displayed. It has the event number [E5000].

PLC – Logic element AND or OR



Parameter description:

Note:	*Each one of the 500 logic elements AND/OR always provides the same parameters. The parameter descriptions of the first logic element AND/OR represented below are described in detail in the following examples.*

P Enable

This Parameter activates/deactivates the logic element AND/OR displayed by selection button Selection.

- ☐: do not tick the box => logic element is deactivated
- ☑: 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 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
- ☑: 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 meets an AND gate
- OR: logic scheme meets 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 determined by parameter Number of inputs.

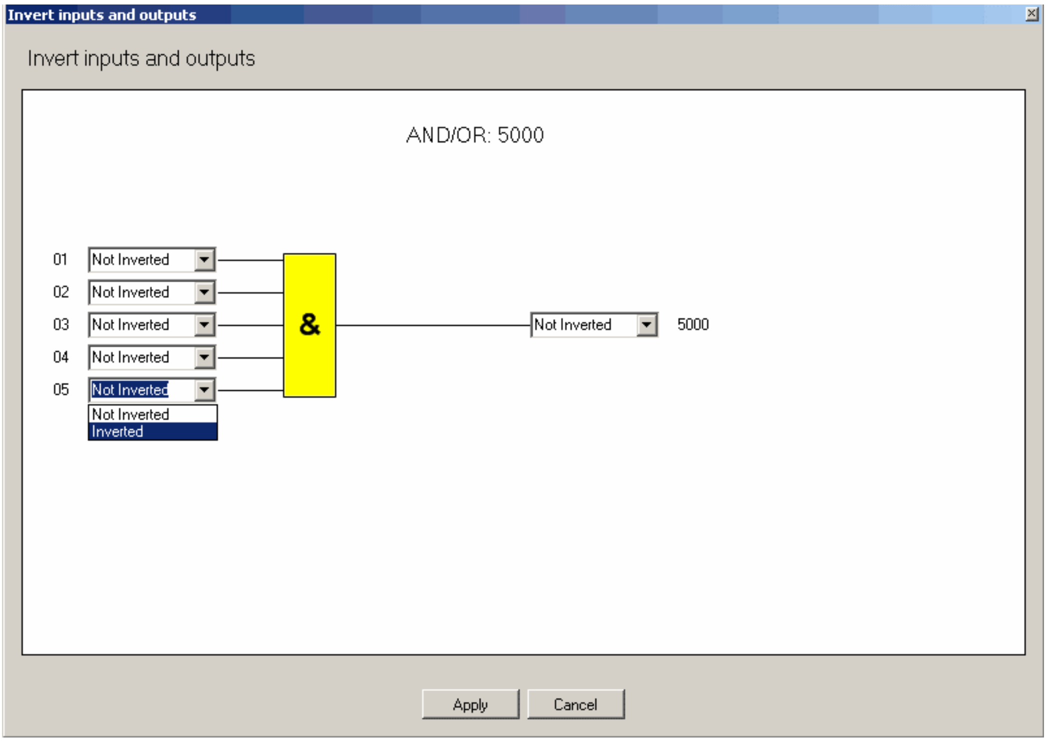
Each available event can be used as an input element. Therefore, the event number has to be registered in the selection as well as the number of the input element.

> *Note: Setting 0 means logical 0 (positive logic: false)*
> *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. Double clicking the icon of the logical element opens a new window in which the inversion can be conducted.

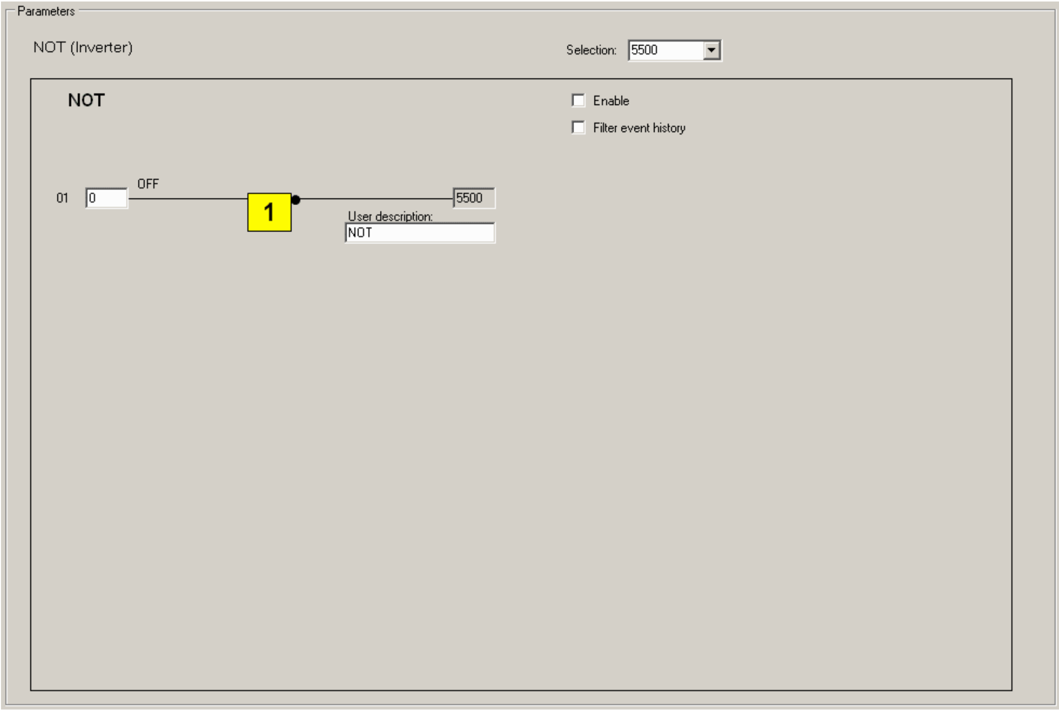
PLC – AND/OR: inversion of input elements and output event



2.6.1.2 NOT (Inverter)

By using selection button Selection the first of 30 available logic elements NOT (Inverter) can be displayed. It has the event number [E5500].

PLC – Logic element NOT (Inverter)



Parameter description:

Note:	*Each one of the 30 logic elements NOT (Inverter) always provides the same parameters. The parameter descriptions of the first logic element NOT (Inverter) represented below are described in detail in the following examples.*

P Enable

This Parameter activates/deactivates the logic element NOT (Inverter) displayed by selection button Selection.

- ☐: do not tick the box => logic element is deactivated
- ☑: 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 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
- ☑: 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)

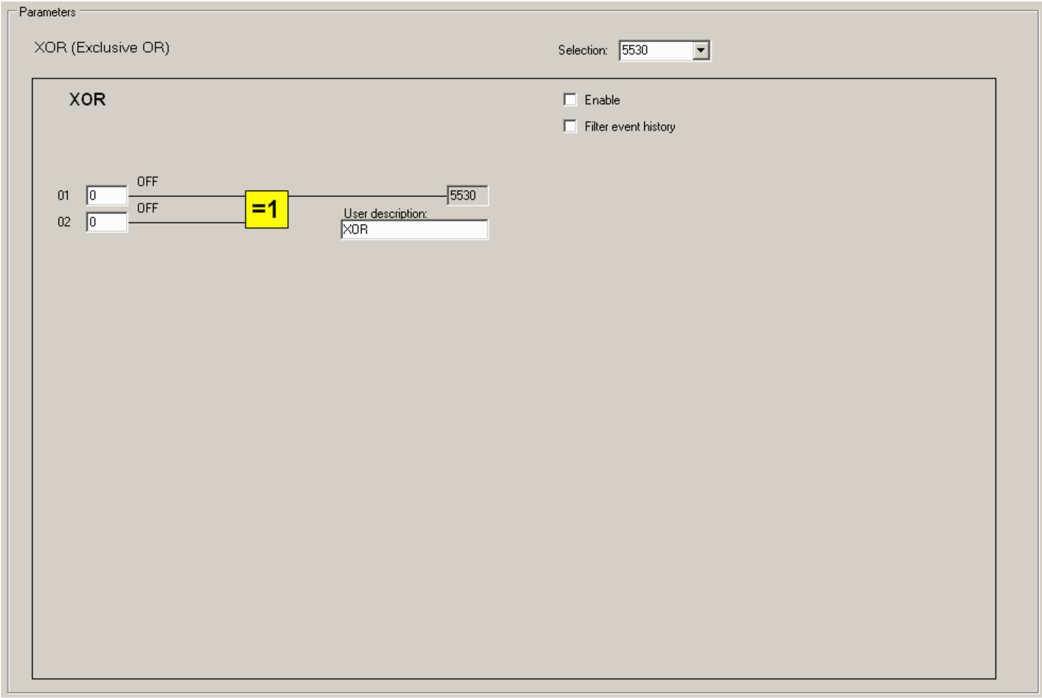
Each available event can be used as an input element. Therefore, the event number has to be registered in the field besides the number of the input element.

> ***Note:*** *Setting 0 means logical 0 (positive logic: false)*
> *Setting 9999 means logical 1 (positive logic: true)*

2.6.2 XOR (Exclusive OR)

By using the Selection button the first of 20 available logic elements XOR (Exclusive OR) can be displayed. It has the event number [E5530].

PLC – Logic element XOR (Exclusive OR)



Parameter description:

> Note: *Each one of the 20 logic elements XOR (Exclusive OR) always provides the same parameters. The parameter descriptions of the first logic element XOR (Exclusive OR) represented below are described in detail in the following examples.*

P Enable

This Parameter activates/deactivates the logic element XOR (Exclusive OR) displayed by selection button Selection.

- ☐: do not tick the box => logic element is deactivated
- ☑: 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 registered in the event history.

To activate/deactivate the filter function of a logic element use the tick box besides parameter Filter event history:

- ☐: do not tick the box => the filter function of the logic element is not available

- ☑: 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)

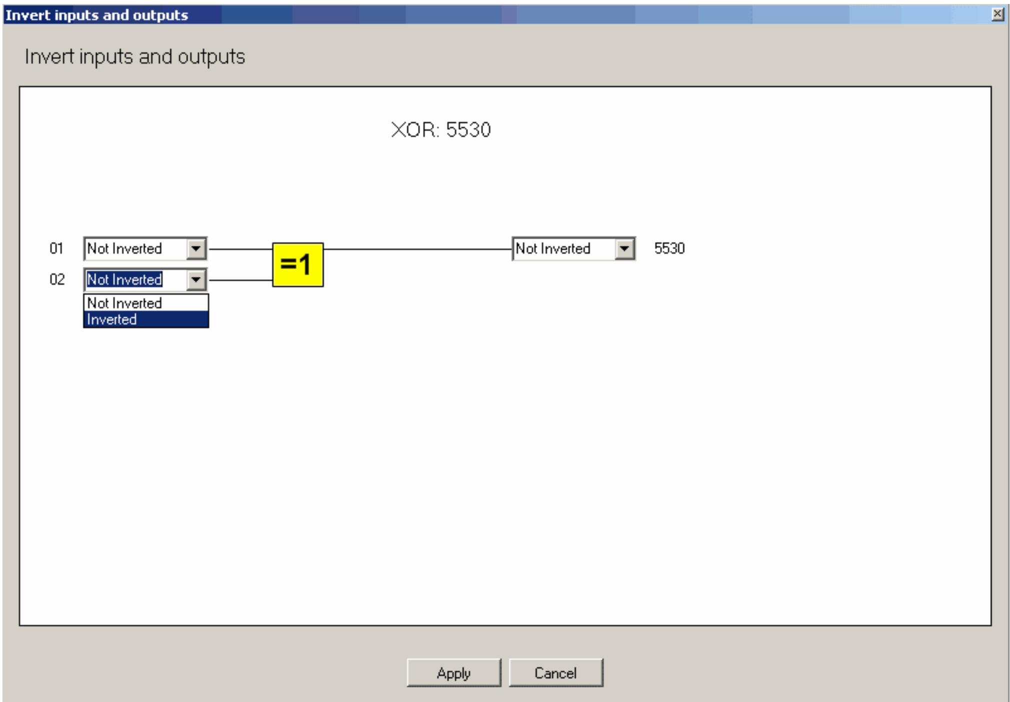
Each available event can be used as an input element. Therefore the event number has to be registered in the field besides the number of the input element.

Note:	*Setting 0 means logical 0 (positive logic: false)* *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. Double-clicking the logical element icon opens a new window in which inversion can be conducted.

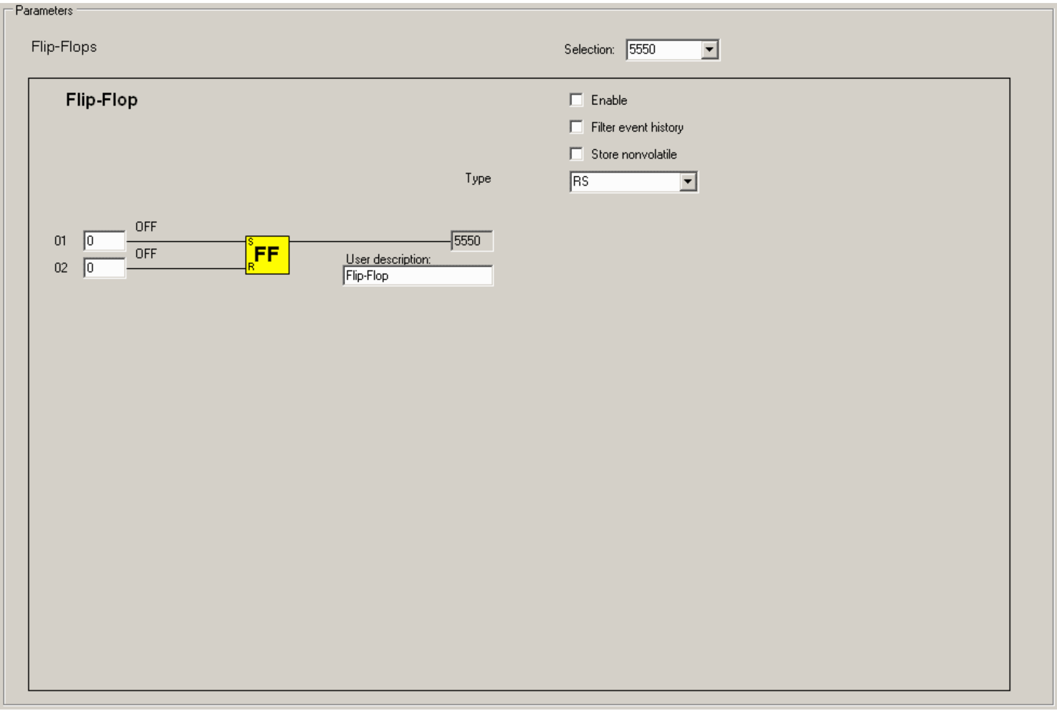
PLC –XOR(Exclusive OR): inversion of input elements and output-event



2.6.2.1 Flip-Flops

By using the Selection button the first of 20 available logic elements Flip-Flop can be displayed. It has the event number [E5550].

PLC – Logic element FlipFlop



Parameter description:

Note:	*Each one of the 20 logic elements FlipFlop always provides the same parameters. The parameter descriptions of the first logic element FlipFlop represented below are described in detail in the following examples.*

P Enable

This Parameter activates/deactivates the logic element FlipFlop displayed by selection button Selection.

- ☐: do not tick the box => logic element is deactivated
- ☑: 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 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
- ☑: 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 saved after system reboot

- ☑: tick the box => current state of *output event* [E5550] of selected logic element is 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 meets RS-FlipFlop; domination of input element for resetting (R) the flipflop or
- RS-EDGE: logic scheme meets 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 meets SR-FlipFlop; domination of input element for setting (S) the flipflop or
- T: logic scheme meets 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

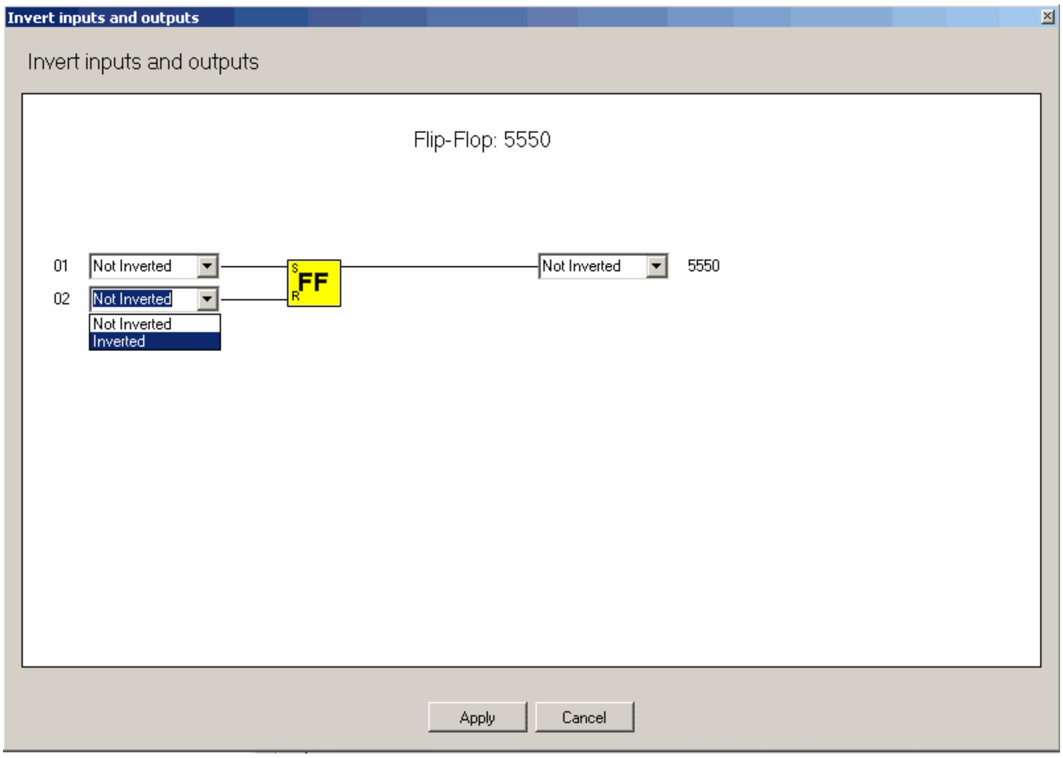
Each available event can be used as an input element. Therefore the event number has to be registered in the selection as well as the number of the input element.

Note: *Setting 0 means logical 0 (positive logic: false)*
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 window appears in which inversion can be conducted.

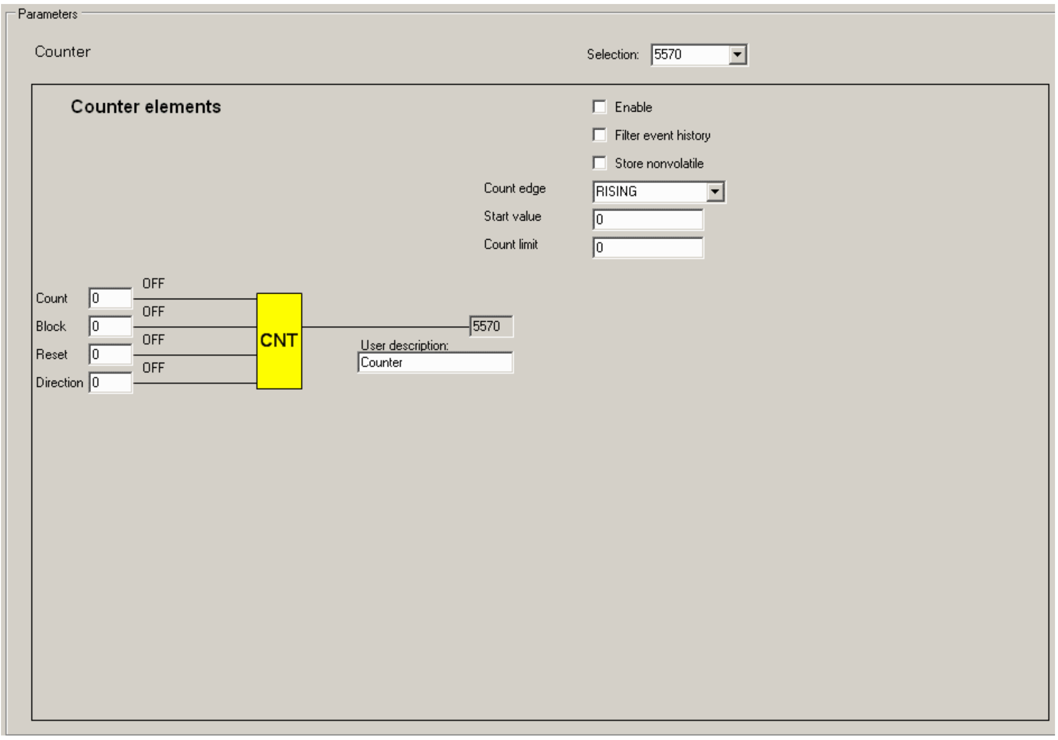
PLC – FlipFlop: inversion of input elements and output-event



2.6.2.2 Counter

By using the Selection button the first of 20 available logic elements Counter can be displayed. It has the event number [E5570].

PLC – Logic element *Counter*



Parameter description:

> *Note:* *Each one of the 20 logic elements Counter always provides the same parameters. The parameter descriptions of the first logic element Counter represented below are described in detail in the following examples.*

P Enable

This Parameter activates/deactivates the logic element Counter displayed by selection button Selection.

- ☐: do not tick the box => logic element is deactivated
- ☑: 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 registered in the event history.

To activate/deactivate the filter function of a logic element use the tick box besides parameter Filter event history:

- ☐: do not tick the box => the filter function of the logic element is not available
- ☑: 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 reset to the value given by parameter Start value
- ☑: tick the box => current counter value of selected logic element is 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 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 a rising 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] (setting range: 0 to 65000).

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 [P] (setting range: 0 to 65000), counting is 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 selection as well as the designation of the input element.

> ***Note:*** *Setting 0 means logical 0 (positive logic: false)*
> *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 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 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 so 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 becomes 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 becomes 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

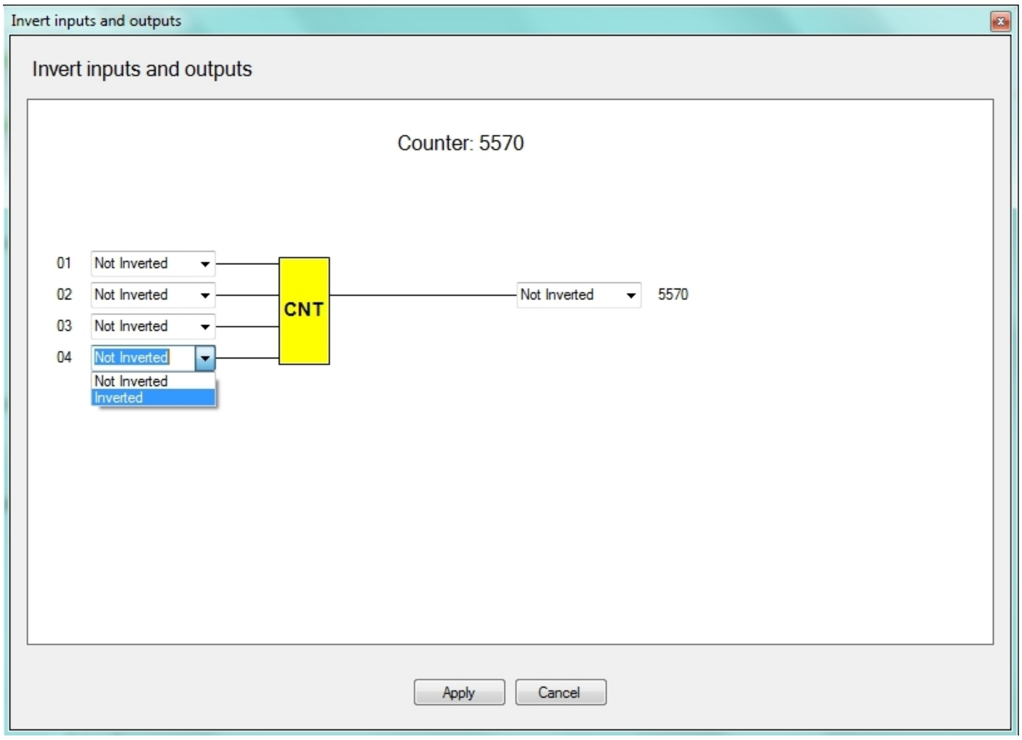
Definition of the counting behaviour according to incrementing/decrementing the counting value of the logic element Counter; depending on the setting option:

- 0: the counter is incremented or
- 1: the counter is 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. Double clicking the icon of the logical element opens a new window in which the inversion can be conducted.

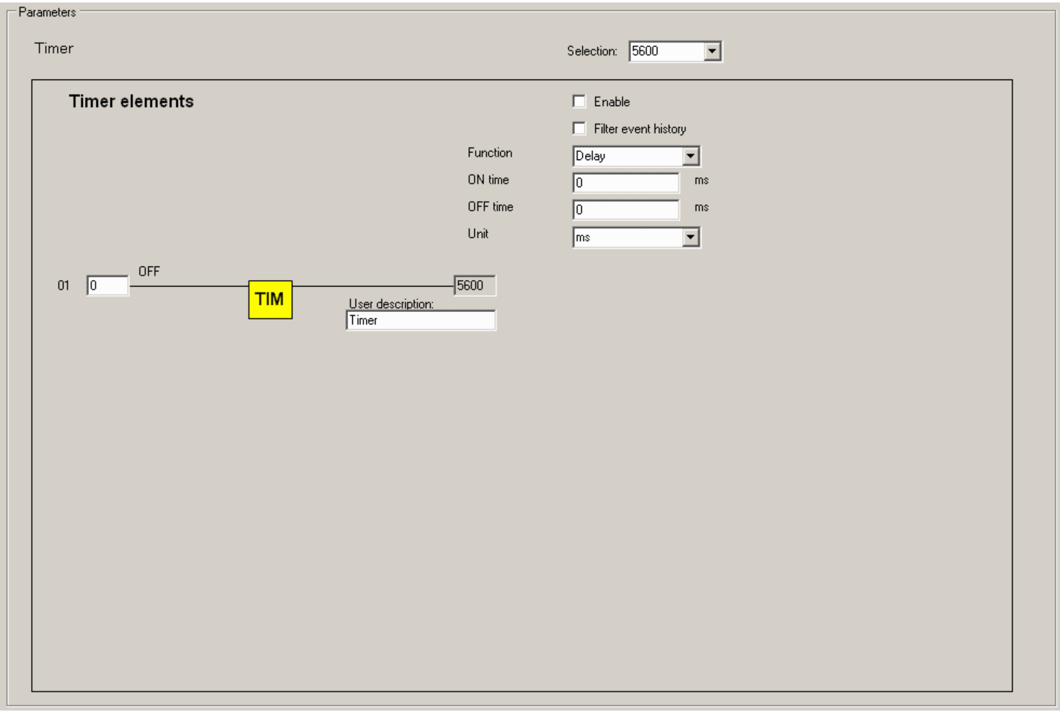
PLC – Counter: inversion of input elements and output-event



2.6.2.3 Timer

By using the Selection button the first of 80 available logic elements Timer can be displayed. It has the event number [E5600].

PLC – Logic element *Timer*



Parameter description:

> ***Note:*** *Each one of the 80 logic elements Timer always provides the same parameters. The parameter descriptions of the first logic element Timer represented below are described in detail in the following examples.*

P Enable

This Parameter activates/deactivates the logic element Timer displayed by selection button Selection.

- ☐: do not tick the box => logic element is deactivated
- ☑: 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 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
- ☑: 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]; When 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 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 deactivated.

Pulse-C: constant pulse duration (C); when the event which is assigned to the input element 01 is activated, output event [E5600] is activated for the duration of time set by parameter ON time.

Pulse-CR: constant pulse duration (C) and possibility of restart (R); when the event which is assigned to the input element “01” is activated, output event [E5600] is activated for the duration of time set by parameter ON time. When 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); When the event which is assigned to the input element “01” is activated, output event [E5600] is activated for the duration of time set by parameter ON time. When 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 deactivated.

Pulses: pulses of defined duty cycle; When the event which is assigned to the input element “01” is activated, output event [E5600] is activated for the duration of time set by parameter ON time. As soon as the on-time has run down, the output event is activated for the duration of time set by parameter OFF time.

P ON time

Settable time delay (setting range: 0 to 65000ms/s/min/h) of an on-delayed activation of the output event [E5600] of the logic element Timer

P OFF time

Settable time delay (setting range: 0 to 65000ms/s/min/h) of an off-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*

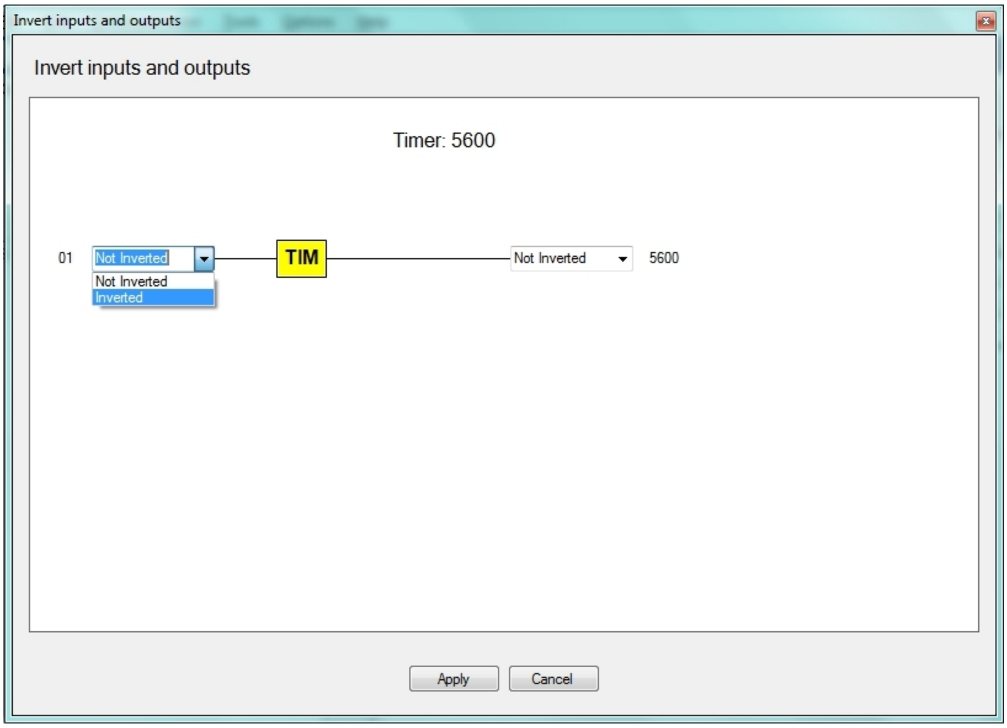
Each available event can be used as an input element. Therefore, the event number has to be registered in the field besides the number of the input element.

Note: *Setting 0 means logical 0 (positive logic: false)*
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. Double clicking the icon of the logical element opens a new window in which the inversion can be conducted.

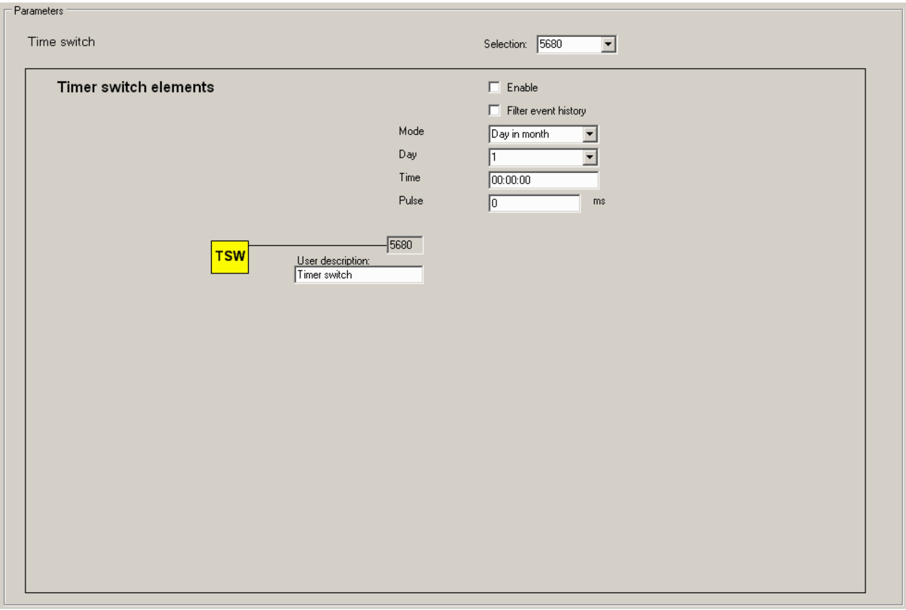
PLC – Timer: inversion of input element and output-event



2.6.2.4 Timer switch

By using selection button Selection the first of 20 available logic elements Timer switch can be displayed. It has the event number [E5680].

PLC – Logic element timer switch



Parameter description:

Note:	*Each one of the 20 logic elements Timer switch always provides the same parameters. The parameter descriptions of the first logic element Timer switch are described in detail in the following examples.*

P Enable

This Parameter activates/deactivates the logic element Timer switch displayed by selection button Selection.

- ☐: do not tick the box => logic element is deactivated
- ☑: 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 registered in the event history.

To activate/deactivate the filter function of a logic element use the tick box besides parameter Filter event history:

- ☐: do not tick the box => the filter function of the logic element is not available
- ☑: 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 duration set by parameter Pulse according to following setting options:

- Day in month: output event [E5680] is 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 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 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]. According to the setting options of parameter Modus and for a duration time set by parameter Pulse. Depending on 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 = Weekday 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 activated. According to 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 delay (setting range: 0 to 65000ms) of the output event [E5680] is activated for. According to the selected mode selected setting option of parameter Day and specific time set by parameter “Time”.

MAINTENANCE, SERVICING AND RE-TESTING

CHAPTER 6

1 CHAPTER OVERVIEW

This chapter consists of the following sections:

2 MAINTENANCE, SERVICING AND RETESTING

The devices in the P60 Agile product line were designed numerically. All functions are based on tested hardware and software.

Maintenance

All devices in the P60 Agile 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. The following components are to be considered:

- 2 x rechargeable battery, 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 battery (stand-by operation) is about 100 days. Manufacturer's warranted life time of the accumulator type is about 10 years.

Note: To avoid any loss of data, batteries should be replaced one after another.

Component	Type	Function	Failure consequences	Replacement cycle	Replacement
Accumulator	ML2430, (removable)	Storage of data in the RAM memory	Loss of data after complete discharge of the batteries: • PLC Flip-Flop status • PLC Counter status • Event history last 32 items • Status of all Alarms • Power counter of the last hour • Work hours counter of the last hour • ANSI 49 thermal level	c. every 10 years	GE
		Maintenance of counting date and time after disconnecting P60 Agile power supply	Reset of date and time to default values after complete discharge of the batteries		

Battery charging and discharging

The charging voltage level of the batteries applied in P60 Agile is 3.2V. This value is reached after 40 hours of charging the battery. When voltage drops below 2V, time and date as well as data saved in SRAM memory will be lost.

Battery voltage is monitored cyclically on the level of 2.4V, where the cycle time is 1s. When the voltage drops below this level of 2V, event ***MU Battery low alarm [E9046]*** is activated. ***Event [E9046]*** is deactivated when voltage exceeds 2V and "**ACK**" function is activated.

CAUTION: **Before commissioning the P60 Agile device it should be connected to the power supply for 40 hours to ensure the batteries are charged to full capacity.**
In addition to the first cyclic voltage monitoring, another cyclic monitoring of the battery voltage starts right after 40 hours of device operation. The cycle time is 1s and the monitored voltage level is 2.9V. When the voltage drops below 2.9V, then the event *MU Battery defect [E9048]* is activated.

In such cases batteries are faulty and must be replaced. If event *[E9048]* is still activated after battery replacement and activation of "ACK" function, then P60 Agile device must be replaced by another one.

A removal of the batteries cannot be detected!

When battery contacts are short-circuited, event *MU Battery low alarm [E9046]* is activated immediately, and event *MU Battery defect [E9048] is activated after another 40 operating hours.*

Servicing

All devices from the P60 Agile product line provide extensive self-supervision functions for signalling different internal faults. Replacement of life-limited components (see table above) may be undertaken only under ESD-conform conditions at the device manufacturer's facility.

Retesting

A repeat secondary test checks the function of the hardware including the wiring on a regular basis. Moreover, any non-documented changes of parameter settings can be detected.

Retesting intervals 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 P60 Agile devices.

SAFETY INFORMATION

CHAPTER 7

1 CHAPTER OVERVIEW

This chapter consists of the following sections:

2 SAFETY INFORMATION

The equipment must be properly installed and handled in order to maintain it in a safe condition and to keep personnel safe at all times. You must be familiar with the contents of the Safety Guide (Pxxx-SG-4LM-2) before unpacking, installing, commissioning, or servicing the equipment.

When electrical equipment is in operation, dangerous voltages are present in certain parts of the equipment. Improper use of the equipment and failure to observe warning notices will endanger personnel.

Only qualified personnel may work on or operate the equipment. Qualified personnel are individuals who:

- Are familiar with the installation, commissioning, and operation of the equipment and the system to which it is being connected.
- Are familiar with accepted safety engineering practises and are authorised to energise and de-energise equipment in the correct manner.
- Are trained in the care and use of safety apparatus in accordance with safety engineering practises.
- Are trained in emergency procedures (first aid).

Although the documentation provides instructions for installing, commissioning and operating the equipment, it cannot cover all conceivable circumstances. In the event of questions or problems, do not take any action without proper authorisation. Please contact the appropriate technical sales office and request the necessary information.

Caution: Please also take note of the following safety guidelines for the procedures listed below.

Procedure	Safety guidelines
Load parameter file	CAUTION: If a parameter file is directly loaded in the P60 Agile, the device proceeds to new start of the system (system reboot). Booting time takes around 4 s. During the booting time P60 Agile) does not provide any protective function.
Firmware-Update	CAUTION: While in booting mode P60 Agile does not provide any device functionality – in particular no protective function.

TROUBLESHOOTING

CHAPTER 8

1 CHAPTER OVERVIEW

This chapter consists of the following sections:

2 TROUBLESHOOTING

Listed below are some of the device's error messages or messages which may appear whilst using of the P60 Agile Configurator. Details of the messages are given and measures for clearance suggested.

P60 Agile watchdog event

Event no.	Error message	Meaning	Measure
9000	Watchdog event	System-internal hardware error	Hardware reset If not successful please contact manufacturer

P60 Agile Configurator error message

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

TECHNICAL SPECIFICATIONS

CHAPTER 9

1 CHAPTER OVERVIEW

This chapter consists of the following sections:

2 TECHNICAL DATA

2.1 Hardware version v1-2.x

Description	Specification	
Design	Flush-mounted housing for front panel cut-out	
Overall dimensions (W x H x D*)	210 x 250 x 95 (mm)	
Front panel cut-out (W x H)	192 x 232 (mm)	
Weight	2.5kg (approx.)	
Installation position	vertical; +/-34°	
Power supply	According to ordering options: 24V DC** or 48V DC** or 60V DC** or 110V AC***/DC**, 220V DC**, 230V AC***	
Power consumption	< 20 W	
Rechargeable battery	2 x 100mAh; removable batteries, accessible on the housing rear. *Note: In case of battery replacement, please exchange one after another.*	
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^2 Max. 6 mm^2

* D = maximum depth (including front plate, fibre optic plugs etc.)

** Ur +/-20%

*** Ur +15%/-20%

2.2 Type tests – Hardware

2.2.1 Environment

Description	Specification / Test method		Standard
Climatic environmental test	**Dry-heat test operational**		
	Temperature of exposure:	70°C	IEC 60068-2-2: 2007
	Duration:	16h	
	Cold test-operational		
	Temperature of exposure:	-25°C	IEC 60068-2-1: 2007
	Duration:	16h	
	Dry-heat test storage		
	Temperature of exposure:	70°C	IEC 60068-2-2: 2007
	Duration:	16h	
	Cold test- storage		
	Temperature of exposure:	-25°C	IEC 60068-2-1: 2007
	Duration:	16h	
	Damp-heat test		
	Temperature:	(40 ± 2)°C	IEC 60068-2-78: 2001
	Humidity:	(93 ± 3)%	
	Duration of exposure:	10 days	
	Cyclic temperature with humidity test		
	NOTE: Not tested. This test is an alternative to the damp-heat test!		IEC 60068-2-30: 2005
	Change of temperature test of IEC 60255-1: 2009		
	Lower temperature:	(-40 ± 2)°C	IEC 60068-2-14: 2009
	Upper temperature:	(70 ± 2)°C	
	Ramp rate:	(1 ± 0,2)°C/min	
	Time at lower and upper temperature:	3h	
	Duration of exposure:	5 cycles	
Mechanical tests at non-operating condition	**Vibration endurance test**		
	Orientation:	x-, y-, z-axis	IEC 60255-21-1:1988 IEC 60068-2-6:1995
	Pulse shape:	half-sine	
	Acceleration:	150m/s^2	
	Duration of the pulse:	11ms	
	Number of shocks:	18: 3 shocks in two directions of the three axis: x,y,z	
	Bump test		
	Orientation:	x-, y-, z-axis	IEC 60255-21-2:1988 IEC 60068-2-27:2009
	Pulse shape:	half-sine	
	Acceleration:	100m/s^2	
	Duration of the pulse:	16ms	
	Number of shocks:	6000: 1000 shocks in two directions of the three axis x,y,z	

<table>
<tr><th>Description</th><th colspan="3">Specification / Test method</th><th>Standard</th></tr>
<tr><td rowspan="22">Mechanical tests at operating condition</td><td colspan="4">Vibration response test</td></tr>
<tr><td>Orientation:</td><td colspan="2">x-, y-, z-axis</td><td rowspan="6">IEC 60255-21-1:1988
IEC 60068-2-6:1995</td></tr>
<tr><td>Frequency range:</td><td colspan="2">10 – 150Hz</td></tr>
<tr><td>Frequency:</td><td colspan="2">10 – 60Hz: Amplitude = 0,07mm (peak-to-peak)</td></tr>
<tr><td>Frequency:</td><td colspan="2">60 – 150Hz: Acceleration amplitude = 5m/s^2</td></tr>
<tr><td>Sweep rate:</td><td colspan="2">1 oct/min</td></tr>
<tr><td>Duration of the test:</td><td colspan="2">1 cycle per axis</td></tr>
<tr><td colspan="4">Shock response test</td></tr>
<tr><td>Orientation:</td><td colspan="2">x-, y-, z-axis</td><td rowspan="5">IEC 60255-21-2:1988
IEC 60068-2-27:2009</td></tr>
<tr><td>Pulse shape:</td><td colspan="2">half-sine</td></tr>
<tr><td>Acceleration:</td><td colspan="2">50m/s^2</td></tr>
<tr><td>Duration of the pulse:</td><td colspan="2">11ms</td></tr>
<tr><td>Number of shocks:</td><td colspan="2">18: 3 shocks in two directions of the three axis: x,y,z</td></tr>
<tr><td colspan="4">Seismic test (seismic parameters: class 2)</td></tr>
<tr><td>Orientation:</td><td colspan="2">x-, y-, z-axis</td><td>DIN EN 60255-21-3: 1993</td></tr>
<tr><td>Frequency range:</td><td colspan="2">5 – 35Hz</td><td></td></tr>
<tr><td>Z-axis frequency:</td><td colspan="2">5 – 9Hz:Amplitude = ±3,5mm (7mm, peak-to-peak)</td><td></td></tr>
<tr><td>Z-axis frequency:</td><td colspan="2">9 – 35Hz: Acceleration amplitude = 10m/s^2</td><td></td></tr>
<tr><td>x- and y-axis frequency:</td><td colspan="2">5 – 9Hz:Amplitude = ±7,5mm (15mm, peak-to-peak)</td><td></td></tr>
<tr><td>x- and y-axis frequency:</td><td colspan="2">9 – 35Hz: Acceleration amplitude = 20m/s^2</td><td></td></tr>
<tr><td>Sweep rate:</td><td colspan="2">1 oct/min</td><td></td></tr>
<tr><td>Duration of the test:</td><td colspan="2">1 cycle per axis</td><td></td></tr>
<tr><td rowspan="5">Safety related</td><td colspan="4">Insulation</td></tr>
<tr><td rowspan="2">Dielectric test voltage</td><td>Auxiliary power supply, BIs, BOs, CTs, VTs</td><td>2.8kV DC</td><td rowspan="4">EN 60255-27</td></tr>
<tr><td>ELV circuits</td><td>700V DC</td></tr>
<tr><td rowspan="2">Impulse test voltage</td><td>Auxiliary power supply, BIs, BOs, CTs, VTs</td><td>5kV; 1.2/50µs</td></tr>
<tr><td>ELV circuits</td><td>1kV; 1.2/50µs</td></tr>
</table>

2.2.2 Electromagnetic capability (EMC)

Type tests – EMC

<table>
<tr><th>Description</th><th colspan="4">Specification / Test method</th><th>Standard</th></tr>
<tr><td rowspan="21">Electromagnetic compatibility
all tests were performed acc. to EN 60255-26</td><td colspan="5">**Conducted emission**</td></tr>
<tr><td rowspan="5">Auxiliary power supply port</td><td rowspan="2">Frequency (MHz)</td><td colspan="2">Limit CLASS A (dBuV)</td><td rowspan="5">EN 60255-25:2000
EN 55022: 2010
EN 61000-6-4: 2007</td></tr>
<tr><td>Quasi-peak</td><td>Average</td></tr>
<tr><td>0.15 – 0.5</td><td>79</td><td>66</td></tr>
<tr><td>0.5 – 5.0</td><td>73</td><td>60</td></tr>
<tr><td>5.0 – 30.0</td><td>73</td><td>60</td></tr>
<tr><td colspan="5">**Radiated emission**</td></tr>
<tr><td rowspan="3">Fully operating device
<u>Note</u>: Radiated emission test above 1 GHz is not applicable since the highest internal frequency is less than 108 MHz</td><td>Frequency (MHz)</td><td colspan="2">Class A (at 3 m) (dBuV/m)</td><td rowspan="3">EN 60255-25: 2000
EN 55022: 2010
EN 61000-6-4: 2007</td></tr>
<tr><td>30 – 230</td><td colspan="2">50</td></tr>
<tr><td>230 – 1000</td><td colspan="2">57</td></tr>
<tr><td colspan="5">**Immunity to damped oscillatory wave**</td></tr>
<tr><td rowspan="3">Damped oscillatory wave</td><td rowspan="2">Aux power supply, BIs, BOs, CTs and VTs</td><td colspan="2">±2.5kV common mode</td><td rowspan="3">EN 60255-22-1</td></tr>
<tr><td colspan="2">±1kV differential mode</td></tr>
<tr><td>communication</td><td colspan="2">±2.5kV common mode</td></tr>
<tr><td rowspan="2">Slow oscillatory wave</td><td>Aux power supply, BIs, BOs, CTs and VTs, communication</td><td colspan="2">±2.5kV common mode</td><td rowspan="3">EN 61000-4-18</td></tr>
<tr><td>Aux power supply, BIs, BOs, CTs and VTs</td><td colspan="2">±1kV differential mode</td></tr>
<tr><td>Fast oscillatory wave</td><td>Aux power supply, BIs, BOs, CTs and VTs, communication</td><td colspan="2">±4kV common mode</td></tr>
<tr><td colspan="5">**Immunity to electrostatic discharge**</td></tr>
<tr><td>Discharge voltage
- on both polarities for at least 1 second
- at least 10 discharges at each point</td><td colspan="3">Contact (level x) = 15kV
Air (level 4) = 15kV</td><td>EN 60255-22-2: 2008
EN 61000-4-2: 1995 +A1: 1999 + A2: 2001
IEEE C37.90.3-2001</td></tr>
<tr><td colspan="5">**Immunity to radiated RF electromagnetic fields**</td></tr>
<tr><td>Frequency sweep</td><td colspan="3">80 – 2700MHz
80 – 1000MHz (keying test)</td><td>EN 60255-22-3: 2008
IEEE C37.90.2-2004</td></tr>
</table>

<table>
<tr><th>Description</th><th colspan="3">Specification / Test method</th><th>Standard</th></tr>
<tr><td rowspan="7"></td><td>Field strength</td><td colspan="2">10 / 20V/m
20V/m (keying test)</td><td rowspan="7">EN 61000-4-3: 2006 + A1: 2008</td></tr>
<tr><td>Modulation</td><td colspan="2">1kHz sine wave, 80%, AM modulation</td></tr>
<tr><td>Frequency step</td><td colspan="2">1% of fundamental</td></tr>
<tr><td>Dwell time /
ON / OFF period</td><td colspan="2">2s
2s / 2s</td></tr>
<tr><td>Polarity of antenna</td><td colspan="2">Horizontal and vertical</td></tr>
<tr><td>Test distance</td><td colspan="2">3m for the test level 10V/m
1.8m for the test level 20V/m</td></tr>
<tr><td>Tested spot frequencies (MHz)</td><td colspan="2">80, 160, 450, 900, 1850, 1890, 2150</td></tr>
<tr><td></td><td colspan="4">Immunity to fast transients (severity level 4)</td></tr>
<tr><td></td><td rowspan="5">Auxiliary power supply
functional earth
binary inputs
binary outputs
CTs
VTs</td><td>Repetition frequency</td><td>5kHz and 100kHz
2.5kHz</td><td rowspan="10">EN 60255-22-4: 2008
EN 60255-4-4: 2004
IEEE C37.90.1-2002</td></tr>
<tr><td></td><td>Burst duration</td><td>15ms at 2.5kHz and 5kHz, 0,75ms at 100kHz</td></tr>
<tr><td></td><td>Test duration</td><td>60s at each polarity</td></tr>
<tr><td></td><td>Common mode</td><td>4kV</td></tr>
<tr><td></td><td>Transverse mode</td><td>4kV</td></tr>
<tr><td></td><td rowspan="5">Communication
(over capacitive coupling clamp)</td><td>Repetition frequency</td><td>5kHz and 100kHz</td></tr>
<tr><td></td><td>Burst duration</td><td>15ms at 2,5kHz and 5kHz, 0,75ms at 100 kHz</td></tr>
<tr><td></td><td>Test duration</td><td>60s at each polarity</td></tr>
<tr><td></td><td>Common mode</td><td>2kV at 5kHz and 100kHz;
4kV at 2,5kHz</td></tr>
<tr><td></td><td>Transverse mode</td><td>0kV</td></tr>
<tr><td></td><td colspan="4">Immunity to surge voltages (severity level 4)</td></tr>
<tr><td></td><td rowspan="2">Auxiliary power supply
functional earth
binary inputs
binary outputs
CTs*
VTs
*Note: The operating time of instantaneous protection function elements shall be time delayed by 30ms to prevent mal-operation.</td><td>Common mode</td><td>4kV</td><td rowspan="3">EN 60255-22-5: 2002
EN 61000-4-5: 2006</td></tr>
<tr><td></td><td>Differential mode</td><td>2kV</td></tr>
<tr><td></td><td>Communication</td><td>screen</td><td>4kV</td></tr>
</table>

Description	Specification / Test method			Standard
	Immunity to conducted disturbance (severity level 3)			
	Frequency range	0.15MHz – 80MHz		EN 60255-22-6: 2001 EN 61000-4-6: 2007
	Spot frequencies	27MHz, 68MHz		
	Field strength	10 Vrms		
	Modulation	1kHz sine wave, 80%, AM modulation		
	Dwell time	2s 10s (spot frequencies)		
	Immunity to electrical disturbance (class A)			
	Binary inputs	Differential mode	150Vrms	EN 60255-22-7: 2003 EN 61000-4-16: 1998
		Common mode	300Vrms	
	Immunity to electromagnetic fields (severity level 5)			
	Field strength	100 A/m for 1 minute and 1000 A/m for 3s, 50/60Hz		EN 61000-4-8: 2010
	Immunity to pulsed electromagnetic field (severity level 5)			
	Field strength	1000 A/m		EN 61000-4-9: 1993 + A1: 2001
	Number of pulses	5 of each polarity		
	Time between pulses	10s		
	Immunity to damped oscillatory magnetic field (severity level 5)			
	Frequency	100kHz and 1MHz		EN 61000-4-10: 1998
	Field strength	100A/m (peak)		
	Repetition rate	40/s at 100kHz and 400/s at 1MHz		
	Test duration	2 s		
	Positions	X, Y, Z		
	Immunity to dips, short interruptions and AC ripple on the auxiliary voltage			
	Voltage dips (110V DC power supply)	Specification	Performance level	EN 60255-11: 2010 EN 61000-4-11: 2004 EN 61000-4-17: 1997 EN 61000-4-29: 2000
		0% (50ms)	A	
		40% (200ms)	C	
		70% (500ms)	C	
	Voltage dips (230V AC power supply)	0% (25 cycles)	A	
		40% (10/12 cycles at 50/60Hz)	C	
		70% (10/12 cycles at 50/60Hz)	C	
	Voltage interruptions (110V DC)	0% (5s)	C	

Description	Specification / Test method			Standard
	Voltage interruptions (230V AC)	0% (250/300 cycles at 50/60Hz)	C	
	Alternating component in DC voltage (DC power supply)	15% of rated value of 100/120Hz at rated 50/60Hz	A	
	Gradual shut-down / start-up (for DC power supply)	60s shut-down, 5 minutes power-off, 60s start-up	C	
	Reversal of DC power supply polarity	1 minute	A	

2.3 Type tests – software

2.3.1 Protective and monitoring functions – Accuracy

Overview of accuracies of measuring inputs concerning protection functions

ANSI 27 – Undervoltage protection

ANSI 27		
PT1, PT2, PT3: 100V*/400V*		
Operate quantity	**Set range**	**Deviation**
Magnitude (voltages U_{L-L}; U_{L-N})	at U_{set}: 10% … 60% U_n** at U_{set}: 60% … 200% U_n**	0.9% U_n** 0.5% U_{set}
Trip time: Definite time (DT)	at t_{set}: 0s … 60s	≤ 30ms or 5% of t_{set}
Reset time: Definite time (DT)	at t_{set}: 0s … 60s	≤ 40ms or 5% of t_{set}
Magnitude (minimum start voltage Umin; => U_{L-L})	See test ANSI 59 and ANSI27	See test ANSI 59 and ANSI27
Magnitude (minimum start frequency fmin)	See test ANSI 81O and ANSI 81U	See test ANSI 81O and ANSI 81U

* fn = 50 Hz
** Un = 100V, 400V

ANSI 27T – Undervoltage protection (Time dependent)

ANSI 27T		
PT1, PT2, PT3: 100V*		
Operate quantity	**Set range**	**Deviation**
Magnitude (voltages U_{L-L})	See test ANSI 27	See test ANSI 27
Trip time	Instantaneous operation	≤ 35ms
Reactive delay time: Definite time (DT)	at t_{set}: 0s … 10s	≤ 35ms

* fn = 50Hz

ANSI 50BF – Breaker failure protection

ANSI 50BF		
CT1: 1A		
Operate quantity	**Set range**	**Deviation**
Magnitude (phase currents: I_{L1}, I_{L2} I_{L3})	See test ANSI 67*	See test ANSI 67*

Trip time: Definite time (DT)	Instantaneous operation at t_{set}: 0.1s … 60s	≤ 25ms ≤ 25ms or 5% of t_{set}
Reset time: Definite time (DT)	Instantaneous operation at t_{set}: 0.3s … 30s	≤ 35ms ≤ 35ms or 5% of t_{set}

* I_n = 1A

Note: CT1 = 5A: see test ANSI 67

ANSI 50/51 –Overcurrent protection

ANSI 50/51		
CT1: 1A*		
Operate quantity	**Set range**	**Deviation**
Magnitude (phase currents: I_{L1}, I_{L2} I_{L3})	See test ANSI 67**	See ANSI 67**
Trip time: Definite time (DT)	Instantaneous operation at t_{set}: 0.1s … 60s	≤ 35ms ≤ 35ms or 5% of t_{set}
Reset time: Definite time (DT)	Instantaneous operation at t_{set}: 0.3s … 30s	≤ 35ms ≤ 35ms or 5% of t_{set}
Trip time: IDMT	IDMT curve (IEC, ANSI) at TMS: 0.05 … 10	See test ANSI 67**
Reset time: IDMT	IDMT curve (IEC, ANSI) at TMS: 0.05 … 10	See test ANSI 67**

* f_n = 50 Hz

** I_n = 1A

Note: For CT1 = 5A: see test ANSI 67

ANSI 50/51G – Ground overcurrent protection

ANSI 50/51G		
CT-GND1: 1A*		
Operate quantity	**Set range**	**Deviation**
Magnitude (ground current I_G)	See test ANSI 67G**	See test ANSI 67G**
Trip time: Definite time (DT)	Instantaneous operation at t_{set}: 0.1s … 60s	≤ 35ms ≤ 35ms or 5% of t_{set}
Reset time: Definite time (DT)	Instantaneous operation at t_{set}: 0.3s … 30s	≤ 35ms ≤ 35ms or 5% of t_{set}
Trip time: IDMT	IDMT curve (IEC, ANSI) at TMS: 0.05 … 10	See test ANSI 67G**
Reset time: IDMT	IDMT curve (IEC, ANSI) at TMS: 0.05 … 10	See test ANSI 67G**

* f_n = 50 Hz

** I_n = 1A

Note: CT-GND1 = 5A and CT-GND1 = 2 … 3000mA: see test ANSI 67G.

ANSI 59 – Overvoltage protection

ANSI 59		
PT1, PT2, PT3: 100V*/400V*		
Operate quantity	**Set range**	**Deviation**
Magnitude (voltages U_{L-L}; U_{L-N})	at U_{set}: 10% … 60% U_n** at U_{set}: 60% … 200% U_n**	0.9% U_n** 0.5% U_{set}
Trip time: Definite time (DT)	at t_{set}*: 0s … 60s	≤ 30ms or 5% of t_{set}
Reset time: Definite time (DT)	at t_{set}*: 0s … 60s	≤ 40ms or 5% of t_{set}

* fn = 50Hz

** Un = 100V, 400V

ANSI 59N/G – Neutral voltage displacement (NVD) protection

ANSI 59N/G		
PT-GND1: 100V*		
Operate quantity	**Set range**	**Deviation**
Magnitude (residual voltage U_G)	at U_{set}: 1% … 100% U_n**	0.5% U_{set}
Trip time: Definite time (DT)	at t_{set}: 0s … 60s	≤ 35ms or 5% of t_{set}
Reset time: Definite time (DT)	at t_{set}: 0s … 60s	≤ 35ms or 5% of t_{set}
PT1, PT2, PT3: 100V*		
Operate quantity	Set range	Deviation
Magnitude (voltages U_{L-N} => calculated residual voltage U_G)	at U_{set}: 1% … 70% U_n** at U_{set}: 70% … 100% U_n**	0.5% U_{set} 1% U_{set}
PT1, PT2, PT3: 400V*		
Operate quantity	Set range	Deviation
Magnitude (voltages U_{L-N} => calculated residual voltage U_G)	at U_{set}: 1% … 70% U_n*** at U_{set}: 70% … 100% U_n***	0.5% U_{set} 1% U_{set}

* f_n = 50Hz

** U_n = 100V

*** U_n = 400V

ANSI 67 – Directional overcurrent protection

ANSI 67		
CT1: 1A; PT1: 100V*/400V*		
Operate quantity	**Set range**	**Deviation**
Magnitude (phase currents: I_{L1}, I_{L2}, I_{L3})	Measuring core: at I_{set}: 1% … 200% I_n** Protection core: (at I_{set}: 12% … 75% I_n**) **** (at I_{set}: 75% … 200% I_n**) **** at I_{set}: 200% … 2000% I_n** at I_{set}: 2000% … 3000% I_n**	 0.5% I_n** (1.1% I_n**) **** (1.2% I_n**) **** 0.5% I_{set} 1% I_{set}

Angle (between phase current and reference voltage U_{ref})	Measuring core: at I_{set}: 2% … 4% I_n** at I_{set}: 4% … 6% I_n** at I_{set}: 6% … 14% I_n** at I_{set}: 14% … 20% I_n** at I_{set}: 20% … 200% I_n** Protection core: (at I_{set}: 13% … 16% I_n**) **** (at I_{set}: 16% … 22% I_n**) **** (at I_{set}: 22% … 75% I_n**) **** (at I_{set}: 75% … 200% I_n**) **** at I_{set}: 200% … 2000% I_n**	 9.2° 3.5° 2.5° 1.5° 1° (2.6°) **** (2°) **** (1.5°) **** (1°) **** 1°
Trip time (non-directional feature): Definite time (DT)	Instantaneous operation at t_{set}: 0.1s … 60s	≤ 30ms ≤ 30ms or 5% of t_{set}
Reset time (non-directional feature): Definite time (DT)	Instantaneous operation at t_{set}: 0.3s … 30s	≤ 35ms ≤ 40ms or 5% of t_{set}
Trip time (non-directional feature): IDMT	IDMT curve (IEC, ANSI) at TMS: 0.05 … 10	≤ 35ms or 5% of t_{set}
Reset time (non-directional feature): IDMT	IDMT curve (IEC, ANSI) at TMS: 0.05 … 10	≤ 40ms or 5% of t_{set}
Trip time (directional feature): Definite time (DT)	Instantaneous operation at t_{set}: 0.1s … 60s	≤ 65ms ≤ 75ms or 6.5% of t_{set}
Reset time (directional feature): Definite time (DT)	Instantaneous operation at t_{set}: 0.3s … 30s	≤ 70ms ≤ 70ms or 5% of t_{set}
Trip time (directional feature): IDMT	IDMT curve (IEC, ANSI) at TMS: 0.05 … 10	≤ 65ms or 5% of t_{set}
Reset time (directional feature): IDMT	IDMT curve (IEC, ANSI) at TMS: 0.05 … 10	≤ 70ms or 5% of t_{set}
CT1: 5A; PT1: 100V*/400V*		
Operate quantity	**Set range**	**Deviation**
Magnitude (phase currents: I_{L1}, I_{L2}, I_{L3})	Measuring core: at I_{set}: 1% … 200% I_n*** Protection core: (at I_{set}: 12% … 100% I_n***) **** (at I_{set}: 100% … 200% I_n***) **** at I_{set}: 200% … 600% I_n***	 0.5% I_n*** (1% I_n***) **** (1.1% I_n***) **** 1.1% I_{set}
Angle (between phase current and reference voltage U_{ref})	Measuring core: at I_{set}: 2% … 4% I_n*** at I_{set}: 4% … 6% I_n*** at I_{set}: 6% … 16% I_n*** at I_{set}: 16% … 200% I_n***	 8.1° 4.4° 2.5° 1.3°

	Protection core: (at I_{set}: 12% … 16% I_n***) **** (at I_{set}: 16% … 22% I_n***) **** (at I_{set}: 22% … 30% I_n***) **** (at I_{set}: 30% … 75% I_n***) **** (at I_{set}: 75% … 200% I_n***) **** at I_{set}: 200% … 500% I_n***	 (6°) **** (3.4°) **** (2.7°) **** (2.4°) **** (1.7°) **** 1.7°
Trip time (non-directional): IDMT	IDMT curve (IEC, ANSI) at TMS: 0.05 … 10	≤ 35ms or 5% of t_{set}
Reset time (non-directional): IDMT	IDMT curve (IEC, ANSI) at TMS: 0.05 … 10	≤ 35ms or 5% of t_{set}
Trip time (directional): IDMT	IDMT curve (IEC, ANSI) at TMS: 0.05 … 10	≤ 65ms or 5% of t_{set}
Reset time (directional): IDMT	IDMT curve (IEC, ANSI) at TMS: 0.05 … 10	≤ 70ms or 5% of t_{set}

*: f_n = 50Hz
**: I_n = 1A
***: I_n = 5A
****: Deviation is only valid for devices with separate terminals for CT1-M and in case that only terminals for CT1-M/P are connected to external CT

CAUTION: **When the device is equipped with separate terminals for CT1-M and only protection core of external CT is connected to CT1-M/P, then terminals for CT1-M should be connected in series to terminals of CT1-M/P. Otherwise the P60 device is being operated out of specification.**

ANSI 67G – Directional ground overcurrent protection

ANSI 67G		
CT-GND1: 1A; PT-GND1: 100V*		
Operate quantity	**Set range**	**Deviation**
Magnitude (ground current I_G)	at I_{set}: 2% … 100% In** at I_{set}: 100% … 2000% In** at I_{set}: 2000% … 3000% In**	0,5% In** 1% I_{set} 2,5% I_{set}
Angle (between ground current and residual voltage)	at I_{set}: 2% … 8% In** at I_{set}: 8% … 20% In** at I_{set}: 20% … 500% In**	6° 2,5° 1°
Trip time: Definite time (DT)	Instantaneous operation at t_{set}: 0,1s … 60s	≤ 35ms ≤ 35ms or 5% of t_{set}
Reset time: Definite time (DT)	Instantaneous operation at t_{set}: 0,3s … 30s	≤ 35ms ≤ 35ms or 5% of t_{set}
Trip time: IDMT	IDMT curve (IEC, ANSI) at TMS: 0.05 … 10	≤ 40ms or 5% of t_{set}
Reset time: IDMT	IDMT curve (IEC, ANSI) at TMS: 0.05 … 10	≤ 40ms or 5% of t_{set}
CT-GND1: 5A; PT-GND1: 100V*		
Operate quantity	**Set range**	**Deviation**
Magnitude (ground current I_G)	at I_{set}: 5% … 100% In*** at I_{set}: 100% … 600% In***	0,5% In*** 1% I_{set}
Angle (between ground current and residual voltage)	at I_{set}: 2% … 8% In*** at I_{set}: 8% … 12% In***	6° 2°

	at I_{set}: 12% … 400% In***	1°
Trip time: IDMT	IDMT curve (IEC, ANSI) at TMS: 0.05 … 10	≤ 30ms or 5% of tset
Reset time: IDMT	IDMT curve (IEC, ANSI) at TMS: 0.05 … 10	≤ 35ms or 5% of tset
CT-GND1: 2 – 3000mA (sensitive input); PT-GND1: 100V*		
Operate quantity	**Set range**	**Deviation**
Magnitude (ground current I_G)	at I_{set}: 0,2% … 10% In** at I_{set}: 10% … 100% In** at I_{set}: 100% … 250% In** at I_{set}: 250% … 285% In**	<1mA 0,6% In** 1% I_{set} 3,5% I_{set}
Angle (between ground current and residual voltage)	at I_{set}: 0,2% … 0,5% In** at I_{set}: 0,5%… 2% In** at I_{set}: 2%… 280% In**	6° 3° 1°
Trip time: Definite time (DT)	Instantaneous operation at t_{set}: 0,1s … 60s	≤ 35ms ≤ 35ms or 5% of t_{set}
Reset time: Definite time (DT)	Instantaneous operation at t_{set}: 0,3s … 30s	≤ 35ms ≤ 35ms or 5% of t_{set}
Trip time: IDMT	IDMT curve (IEC, ANSI) at TMS: 0.05 … 10	≤ 35ms or 5% of t_{set}
Reset time: IDMT	IDMT curve (IEC, ANSI) at TMS: 0.05 … 10	≤ 40ms or 5% of t_{set}

*: fn = 50Hz

**: In = 1A

***: In = 5A

ANSI 74TC – Trip circuit supervision

ANSI 74TC		
Binary inputs: Fct. 26, Fct. 27; Binary output: Shunt trip1		
Functional test	**Set mode**	**Test result**
Supervision modes	Both Closed Open	Passed Passed Passed

ANSI 81 – Frequency protection

ANSI 81O – Overfrequency		
PT1, PT2, PT3: 100V*/400V*		
Operate quantity	**Set range**	**Deviation**
Magnitude (frequency)	at f_{set}: 100,4% … 200% fn*	2mHz
Trip time: Definite time (DT)	Instantaneous operation at t_{set}: 0,05s … 60s	≤ 45ms ≤ 60ms or 5% of t_{set}
Reset time: Definite time (DT)	Instantaneous operation at t_{set}: 0,05s … 60s	≤ 45ms ≤ 70ms or 5% of t_{set}
ANSI 81U – Underfrequency		
PT1, PT2, PT3: 100V*/400V*		
Operate quantity	**Set range**	**Deviation**
Magnitude (frequency)	at f_{set} 80% … 99,6% fn*	2mHz

Trip time: Definite time (DT)	Instantaneous operation at t_{set}: 0,05s … 60s	≤ 55ms ≤ 65ms or 5% of t_{set}
Reset time: Definite time (DT)	Instantaneous operation at t_{set}: 0,05s … 60s	≤ 70ms ≤ 70ms or 5% of t_{set}

* fn = 50Hz

ANSI 81R – Rate of change of frequency (ROCOF) protection

ANSI 81R		
PT1: 100V* (standard device)		
Operate quantity	**Set range**	**Deviation**
Magnitude (df/dt)	at df_{set}: 5mHz/s … 600mHz/s at df_{set}: 600mHz/s … 10Hz/s	≤ 45mHz/s ≤ 35mHz/s
Trip time (positive and negative direction)	at t_{set}: 0s … 200ms	≤ 90ms
Min. start voltage(U_{L-L})	See test ANSI 27 and ANSI 59	See test ANSI 27 and ANSI 59
Minimum start voltage delay time	at t_{set}: 2s … 60s	40mS
f> & f< limits	See test ANSI 81O and ANSI 81U	See test ANSI 81O and ANSI 81U

* fn = 50Hz

ANSI 95i – Harmonics stabilizer

ANSI 95i			
CT1: 1A			
Operate quantity	**Test range (phase current)**	**Set range (I_H/I_{FH})**	**Deviation**
2nd (2H) harmonic (phase currents: I_{L1}, I_{L2} I_{L3})	at $I_{FH,test}$: 300% … 1000% In**	at $I_{2H,set}$: 1% … 15% I_{FH}* at $I_{2H,set}$: 15% … 50% I_{FH}*	0,5% I_{FH} * 1% I_{FH} *
5th (5H) harmonic (phase currents: I_{L1}, I_{L2} I_{L3})	at $I_{FH,test}$: 300% … 1000% In**	at $I_{5H,set}$: 1% … 15% I_{FH}* at $I_{5H,set}$: 15% … 50% I_{FH}*	0,5% I_{FH} * 1% I_{FH} *
CT-GND1: 1A			
Operate quantity	**Test range (ground current)**	**Set range (I_H/I_{FH})**	**Deviation**
2nd (2H) harmonic (ground current I_G)	at $I_{FH,test}$: 300% … 1000% In**	at $I_{2H,set}$: 1% … 50% I_{FH}*	0,5% I_{FH} *
5th (5H) harmonic (ground current I_G)	at $I_{FH,test}$: 300% … 1000% In**	at $I_{5H,set}$: 1% … 50% I_{FH}*	1% I_{FH} *
CT1: 5A			
Operate quantity	**Test range (phase current)**	**Set range (I_H/I_{FH})**	**Deviation**
2nd (2H) harmonic (phase currents: I_{L1}, I_{L2} I_{L3})	at $I_{FH,test}$:100% … 260% In***	at $I_{2H,set}$: 1% … 15% I_{FH}* at $I_{5H,set}$: 15% … 50% I_{FH}*	0,5% I_{FH} * 1% I_{FH} *
5th (5H) harmonic (phase currents: I_{L1}, I_{L2} I_{L3})	at $I_{FH,test}$: 100% … 260% In***	at $I_{2H,set}$: 1% … 15% I_{FH}* at $I_{5H,set}$: 15% … 50% I_{FH}*	1% I_{FH} * 1% I_{FH} *
CT-GND1: 5A			
Operate quantity	**Test range (ground current)**	**Set range (I_H/I_{FH})**	**Deviation**
2nd (2H) harmonic (ground current I_G)	at $I_{FH,test}$:100% … 260% In***	at $I_{2H,set}$: 1% … 15% I_{FH} * at $I_{5H,set}$: 15% … 50% I_{FH} *	0,5% I_{FH} * 1% I_{FH} *
5th (5H) harmonic (ground current I_G)	at $I_{FH,test}$: 100% … 260% In***	at $I_{2H,set}$: 1% … 15% I_{FH} * at $I_{5H,set}$: 15% … 50% I_{FH} *	1% I_{FH} * 1% I_{FH} *

CT-GND1: 2 – 3000mA (sensitive input)			
Operate quantity	**Test range (ground current)**	**Set range (I_H/I_{FH})**	**Deviation**
2nd (2H) harmonic (ground current I_G)	at $I_{FH,test}$: 50% … 200% In**	at $I_{2H,set}$: 1% … 3% I_{FH}* at $I_{2H,set}$: 3% … 15% I_{FH}* at $I_{2H,set}$: 15% … 50% I_{FH}*	3,5% I_{FH}* 2% I_{FH}* 1% I_{FH}*
5th (5H) harmonic (ground current I_G)	at $I_{FH,test}$: 50% … 100% In**	at $I_{5H,set}$: 1% … 3% I_{FH}* at $I_{5H,set}$: 3% … 15% I_{FH}* at $I_{5H,set}$: 15% … 50% I_{FH}*	7% I_{FH}* 6% I_{FH}* 1% I_{FH}*
	at $I_{FH,test}$: 100% … 200% In**	at $I_{5H,set}$: 1% … 50% I_{FH}*	1% I_{FH}*

* portion of current at "Fundamental Harmonic" (50Hz)

**In = 1A;
*** In = 5A;

CLD – Cold Load Detection

CLD – Cold Load Detection		
CT1: 1A		
Operate quantity	**Set range**	**Deviation**
Magnitude (phase currents: I_{L1}, I_{L2} I_{L3})	See test ANSI 67	See ANSI 67
Trip time: Definite time (DT)	at t_{set}: 0s … 10s	≤ 35ms or 5% of t_{set}
Reset time: Definite time (DT)	at t_{set}: 0s … 10s	≤ 25ms or 5% of t_{set}

CTS – Current Transformer Supervision

CTS		
CT1: 1A, CT-GND1: 1A		
Operate quantity	**Set range**	**Deviation**
Magnitude (phase currents: I_{L1}, I_{L2} I_{L3})	See test ANSI 67	See test ANSI 67
Magnitude (ground current I_G)	See test ANSI 67G	See test ANSI 67G
Delay time: Definite time (DT)	Symmetry check: at t_{set}: 0s … 60s Diff check: at t_{set}: 0s … 60s	≤ 35ms or 5% of t_{set} ≤ 30ms or 5% of t_{set}

PTS – Potential Transformer Supervision

PTS		
CT1: 1A; PT1, PT2, PT3: 100V*; PT-GND1: 100V*		
Operate quantity	**Set range**	**Deviation**
Magnitude (voltages U_{L-L}; U_{L-N})	See test ANSI 27, ANSI 59	See test ANSI 27, ANSI 59
Magnitude (Ground voltage U_G)	See test ANSI 59N/G	See test ANSI 59N/G
Magnitude (phase currents: I_{L1}, I_{L2} I_{L3})	See test ANSI 67	See test ANSI 67
Delay time: Definite time (DT)	Symmetry check: at t_{set}: 0s … 60s Fuse Fail check: at t_{set}: 0s … 60s General check: at t_{set}: 0s … 60s	≤ 20ms or 5% of t_{set} ≤ 20ms or 5% of t_{set} ≤ 35ms or 5% of t_{set}

* f_n=50Hz

SOTF – Switch on to fault protection

SOTF		
CT1: 1A		
Operate quantity	**Set range**	**Deviation**
Magnitude (phase currents: I_{L1}, I_{L2} I_{L3})	See test ANSI 67	See ANSI 67
Trip time: Definite time (DT)	Instantaneous operation at t_{set}: 0,1s … 60s	≤ 35ms ≤ 35ms or 5% of t_{set}
Reset time: Definite time (DT)	Instantaneous operation at t_{set}: 0,3s … 30s	≤ 75ms ≤ 60ms or 5% of t_{set}

Note: For CT1 = 5A: see test ANSI 67

YG – Neutral admittance ground fault protection

YG		
CT-GND1: 1A (test: up to 20A); PT-GND1 : 100V*		
Operate quantity	**Set range**	**Deviation**
Magnitude (neutral admittance Y_0, neutral conductance G_0, neutral susceptance B_0)	at Y_{set}; G_{set}; B_{set}: 0,2mS … 30mS at Y_{set}; G_{set}; B_{set}: 30mS … 40mS	≤ 0,4% Y_n**; G_n**; B_n** ≤ 1% Y_{set}; G_{set}; B_{set}
Trip time: Definite time (DT)	at t_{set}: 0s … 60s	≤ 35ms or 5% of t_{set}
Reset time: Definite time (DT)	at t_{set}: 0s … 60s	≤ 35ms or 5% of t_{set}
CT-GND1: 2 – 3000mA (sensitive input; test: up to 2800mA); PT-GND1 : 100V*		
Operate quantity	**Set range**	**Deviation**
Magnitude (neutral admittance Y_0, neutral conductance G_0, neutral susceptance B_0)	at Y_{set}; G_{set}; B_{set}: 0,01mS … 1mS at Y_{set}; G_{set}; B_{set}: 1mS … 20mS at Y_{set}; G_{set}; B_{set}: 20mS … 50mS at Y_{set}; G_{set}; B_{set}: 50mS … 60mS	≤ 0,04% Y_n**; G_n**; B_n** ≤ 0,5% Y_{set}; G_{set}; B_{set} ≤ 0,7% Y_{set}; G_{set}; B_{set} ≤ 2% Y_{set}; G_{set}; B_{set}
Trip time: Definite time (DT)	See test: CT-GND1: 1A; PT-GND1	See test: CT-GND1: 1A; PT-GND1
Reset time: Definite time (DT)	See test: CT-GND1: 1A; PT-GND1	See test: CT-GND1: 1A; PT-GND1
Magnitude (minimum start voltage U_G)	See test ANSI 59N/G	See test ANSI 27 and ANSI 59
Magnitude (minimum start current I_G)	See test ANSI 50/51G	See test ANSI 50/51G

*fn=50 Hz

**Y_n; G_n; B_n: nominal values accord to primary set values of CT-GND1 and PT-GND1

ANSI 32 – Directional power protection

ANSI 32		
CT1: 1A (test: up to 8A); PT1:100V***/400V***		
Operate quantity	**Set range**	**Deviation**
Magnitude (apparent power S)	at S_{set}: 1% … 200% S_n* at S_{set}: 200% … 400% S_n*	≤ 1% S_n* ≤ 0.5% S_{set}
Magnitude (active power P, reactive power Q) for 1 ≥ (cos/sin φ) ≥ 0.939	at P_{set}; Q_{set}: 1% … 100% P_n*; Q_n* at P_{set}; Q_{set}: 100% … 210% P_n*; Q_n* at P_{set}; Q_{set}: 210% … 400% P_n*; Q_n*	≤ 1% P_n*; Q_n* ≤ 2% P_n*; Q_n* ≤ 0.75% P_{set}; Q_{set}
Magnitude (active power P, reactive power Q) for 0.939 ≥ (cos/sin φ) ≥ 0.766	at P_{set}; Q_{set}: 1% … 50% P_n*; Q_n* at P_{set}; Q_{set}: 50% … 210% P_n*; Q_n* at P_{set}; Q_{set}: 210% … 400% P_n*; Q_n*	≤ 1% P_n*; Q_n* ≤ 2% P_n*; Q_n* ≤ 1% P_{set}; Q_{set}

Magnitude (active power P, reactive power Q) for 0.766 ≥ (cos/sin φ) ≥ 0.5	at P_{set}; Q_{set}: 1% … 50% P_n*; Q_n* at P_{set}; Q_{set}: 50% … 210% P_n*; Q_n* at P_{set}; Q_{set}: 210% … 400% P_n*; Q_n*	≤ 2.5% P_n*; Q_n* ≤ 9.5% P_n*; Q_n* ≤ 2.5% P_{set}; Q_{set}
Trip time: Definite time (DT)	at t_{set}: 0s … 60s	≤ 35ms or 5% of t_{set}
Reset time: Definite time (DT)	at t_{set}: 0s … 30s	≤ 35ms or 5% of t_{set}
CT1: 5A (test: up to 20A); PT1: 100V*/400V*** **		
Operate quantity	**Set range**	**Deviation**
Magnitude (apparent power S)	at S_{set}: 1% … 200% S_n** at S_{set}: 200% … 400% S_n**	≤ 0.5% S_n** ≤ 1% S_n**
Magnitude (active power P, reactive power Q) for 1 ≥ (cos/sin φ) ≥ 0.939	at P_{set}; Q_{set}: 1% … 100% P_n**; Q_n** at P_{set}; Q_{set}: 100% … 200% P_n**; Q_n**	≤ 1% P_n**; Q_n** ≤ 2% P_n**; Q_n**
Magnitude (active power P, reactive power Q) for 0.939 ≥ (cos/sin φ) ≥ 0.766	at P_{set}; Q_{set}: 1% … 50% P_n**; Q_n** at P_{set}; Q_{set}: 50% … 210% P_n**; Q_n** at P_{set}; Q_{set}: 210% … 400% P_n**; Q_n**	≤ 1% P_n**; Q_n** ≤ 2% P_n**; Q_n** ≤ 3% P_n**; Q_n**
Magnitude (active power P, reactive power Q) for 0.766 ≥ (cos/sin φ) ≥ 0.5	at P_{set}; Q_{set}: 1% … 30% P_n**; Q_n** at P_{set}; Q_{set}: 30% … 100% P_n**; Q_n** at P_{set}; Q_{set}: 100% … 200% P_n**; Q_n**	≤ 1.5% P_n**; Q_n** ≤ 4% P_n**; Q_n** ≤ 9.5% P_n**; Q_n**
Trip time: Definite time (DT)	See test CT1: 1A	See test CT1: 1A
Reset time: Definite time (DT)	See test CT1: 1A	See test CT1: 1A

* S_n, P_n, Q_n = 173 [VA, W, VAR] at 100V and S_n, P_n, Q_n = 693 [VA, W, VAR] at 400V
** S_n, P_n, Q_n = 866 [VA, W, VAR] at 100V and S_n, P_n, Q_n = 3464 [VA, W, VAR] at 400V
*** f_n = 50Hz

ANSI 32N/G – Zero power protection

ANSI 32N/G		
CT-GND1: 1A (test: up to 8A); PT-GND1: 100V* **		
Operate quantity	**Set range**	**Deviation**
Magnitude (zero apparent power S_0)	at $S_{0,set}$: 1% … 200% S_{0n}* at $S_{0,set}$: 200% … 400% S_{0n}*	≤ 1% S_{0n}* ≤ 1% $S_{0,set}$
Magnitude (zero active power P_0, zero reactive power Q_0) for 1 ≥ (cos/sin φ) ≥ 0.939	at $P_{0,set}$; $Q_{0,set}$: 1% … 100% P_{0n}*; Q_{0n}* at $P_{0,set}$; $Q_{0,set}$: 100% … 400% P_{0n}*; Q_{0n}*	≤ 2.5% P_{0n}*; Q_{0n}* ≤ 3% $P_{0,set}$; $Q_{0,set}$
Magnitude (zero active power P_0, zero reactive power Q_0) for 0.939 ≥ (cos/sin φ) ≥ 0.766	at $P_{0,set}$; $Q_{0,set}$: 1% … 100% P_{0n}*; Q_{0n}* at $P_{0,set}$; $Q_{0,set}$: 100% … 200% P_{0n}*; Q_{0n}* at $P_{0,set}$; $Q_{0,set}$: 200% … 400% P_{0n}*; Q_{0n}*	≤ 6.5% P_{0n}*; Q_{0n}* ≤ 5.5% $P_{0,set}$; $Q_{0,set}$ ≤ 6.5% $P_{0,set}$; $Q_{0,set}$
Magnitude (zero active power P_0, zero reactive power Q_0) for 0.766 ≥ (cos/sin φ) ≥ 0.5	at $P_{0,set}$; $Q_{0,set}$: 1% … 100% P_{0n}*; Q_{0n}* at $P_{0,set}$; $Q_{0,set}$: 100% … 400% P_{0n}*; Q_{0n}*	≤ 15% $P_{0,set}$; $Q_{0,set}$ ≤ 12.5% $P_{0,set}$; $Q_{0,set}$
Trip time: Definite time (DT)	at t_{set}: 0s … 60s	≤ 35ms or 5% of t_{set}
Reset time: Definite time (DT)	at t_{set}: 0s … 30s	≤ 35ms or 5% of t_{set}

CT-GND1: 5A (test: up to 20A); PT-GND1: 100V***		
Operate quantity	**Set range**	**Deviation**
Magnitude (zero apparent power S_0)	at $S_{0,set}$: 1% … 100% S_{0n}** at $S_{0,set}$: 100% … 200% S_{0n}**	≤ 0.5% S_{0n}** ≤ 0.5% $S_{0,set}$
Magnitude (zero active power P_0, zero reactive power Q_0) for 1 ≥ (cos/sin φ) ≥ 0.939	at $P_{0,set}$; $Q_{0,set}$: 1% … 30% P_{0n}**; Q_{0n}** at $P_{0,set}$; $Q_{0,set}$: 30% … 100% P_{0n}**; Q_{0n}** at $P_{0,set}$; $Q_{0,set}$: 100% … 200% P_{0n}**; Q_{0n}**	≤ 1% P_{0n}**; Q_{0n}** ≤ 3% $P_{0,set}$; $Q_{0,set}$ ≤ 2.5% $P_{0,set}$; $Q_{0,set}$
Magnitude (zero active power P_0, zero reactive power Q_0) for 0.939 ≥ (cos/sin φ) ≥ 0.766	at $P_{0,set}$; $Q_{0,set}$: 1% … 30% P_{0n}**; Q_{0n}** at $P_{0,set}$; $Q_{0,set}$: 30% … 100% P_{0n}**; Q_{0n}** at $P_{0,set}$; $Q_{0,set}$: 100% … 200% P_{0n}**; Q_{0n}**	≤ 2% P_{0n}**; Q_{0n}** ≤ 5% $P_{0,set}$; $Q_{0,set}$ ≤ 6% $P_{0,set}$; $Q_{0,set}$
Magnitude (zero active power P_0, zero reactive power Q_0) for 0.766 ≥ (cos/sin φ) ≥ 0.5	at $P_{0,set}$; $Q_{0,set}$: 1% … 30% P_{0n}**; Q_{0n}** at $P_{0,set}$; $Q_{0,set}$: 30% … 100% P_{0n}**; Q_{0n}** at $P_{0,set}$; $Q_{0,set}$: 100% … 200% P_{0n}**; Q_{0n}**	≤ 5.5% P_{0n}**; Q_{0n}** ≤ 12% $P_{0,set}$; $Q_{0,set}$ ≤ 13% $P_{0,set}$; $Q_{0,set}$
Trip time: Definite time (DT)	See test CT1: 1A	See test CT1: 1A
Reset time: Definite time (DT)	See test CT1: 1A	See test CT1: 1A

CT-GND1: 2 – 3000mA (test: up to 3000mA); PT-GND1: 100V***		
Operate quantity	**Set range**	**Deviation**
Magnitude (zero apparent power S_0)	at $S_{0,set}$: 1% … 30% S_{0n}* at $S_{0,set}$: 30% … 100% S_{0n}* at $S_{0,set}$: 100% … 150% S_{0n}*	≤ 0.5% S_{0n}* ≤ 1% $P_{0,set}$; $Q_{0,set}$ ≤ 2% $P_{0,set}$; $Q_{0,set}$
Magnitude (zero active power P_0, zero reactive power Q_0) for 1 ≥ (cos/sin φ) ≥ 0.939	at $P_{0,set}$; $Q_{0,set}$: 1% … 30% P_{0n}*; Q_{0n}* at $P_{0,set}$; $Q_{0,set}$: 30% … 100% P_{0n}*; Q_{0n}* at $P_{0,set}$; $Q_{0,set}$: 100% … 150% P_{0n}*; Q_{0n}*	≤ 1% P_{0n}*; Q_{0n}* ≤ 3% $P_{0,set}$; $Q_{0,set}$ ≤ 3.5% $P_{0,set}$; $Q_{0,set}$
Magnitude (zero active power P_0, zero reactive power Q_0) for 0.939 ≥ (cos/sin φ) ≥ 0.766	at $P_{0,set}$; $Q_{0,set}$: 1% … 30% P_{0n}*; Q_{0n}* at $P_{0,set}$; $Q_{0,set}$: 30% … 150% P_{0n}*; Q_{0n}*	≤ 2.5% P_{0n}*; Q_{0n}* ≤ 6% $P_{0,set}$; $Q_{0,set}$
Magnitude (zero active power P_0, zero reactive power Q_0) for 0.766 ≥ (cos/sin φ) ≥ 0.5	at $P_{0,set}$; $Q_{0,set}$: 1% … 30% P_{0n}*; Q_{0n}* at $P_{0,set}$; $Q_{0,set}$: 30% … 100% P_{0n}*; Q_{0n}* at $P_{0,set}$; $Q_{0,set}$: 100% … 150% P_{0n}*; Q_{0n}*	≤ 6% P_{0n}*; Q_{0n}* ≤ 12% $P_{0,set}$; $Q_{0,set}$ ≤ 35% $P_{0,set}$; $Q_{0,set}$
Trip time: Definite time (DT)	See test CT1: 1A	See test CT1: 1A
Reset time: Definite time (DT)	See test CT1: 1A	See test CT1: 1A

* S_{0n}, P_{0n}, Q_{0n} = 100 [VA, W, VAR]
** S_{0n}, P_{0n}, Q_{0n} = 500 [VA, W, VAR]
*** f_n = 50Hz

ANSI 27Q – Reactive Power / Undervoltage protection

ANSI 27Q		
CT1: 1A*, PT1: 100V***/400V*** **		
Operate quantity	**Set range**	**Deviation**
Magnitude (voltages U_{L-L})	See test ANSI 27	See test ANSI 27
Magnitude (positive sequence current I_1)	at I_{1set}: 1% … 100% I_n*	1% I_n*
Magnitude (frequency)	see test ANSI 81 O/U	see test ANSI 81 O/U
Magnitude (positive sequence reactive power Q_1) for 1 ≥ (sin φ) ≥ 0.766	at Q_{1set}: 1% … 75% Q_n* at Q_{1set}: 75% … 100% Q_n*	≤ 1% Q_n* ≤ 1.5% Q_n*
Magnitude (positive sequence reactive power Q_1) for 0.766 ≥ (sin φ) ≥ 0.5	at Q_{1set}: 1% … 40% Q_n* at Q_{1set}: 40% … 50% Q_n*	≤ 1% Q_n* ≤ 1.5% Q_n*

	at Q_{1set}: 50% … 100% Q_n*	≤ 5% Q_n*
Trip time: Definite time (DT)	at t_{set}: 0s … 10s	≤ 35ms or 5% of t_{set}
Reset time: Definite time (DT)	at t_{set}: 0s … 10s	≤ 20ms or 5% of t_{set}
CT1: 5A*, PT1: 100V***/400V*****		
Operate quantity	**Set range**	**Deviation**
Magnitude (voltages U_{L-L})	See test ANSI 27	See test ANSI 27
Magnitude (positive sequence current I_1)	at I_{1set}: 1% … 100% I_n**	1% I_n**
Magnitude (frequency)	See test ANSI 81 O/U	See test ANSI 81 O/U
Magnitude (positive sequence reactive power Q_1) for 1 ≥ (sin φ) ≥ 0.766	at Q_{1set}: 1% … 50% Q_n** at Q_{1set}: 50% … 100% Q_n**	≤ 1% Q_n** ≤ 1.5% Q_n**
Magnitude (positive sequence reactive power Q_1) for 0.766 ≥ (sin φ) ≥ 0.5	at Q_{1set}: 1% … 50% Q_n** at Q_{1set}: 50% … 100% Q_n**	≤ 1% Q_n** ≤ 5% Q_n**
Trip time: Definite time (DT)	See test CT1: 1A	See test CT1: 1A
Reset time: Definite time (DT)	See test CT1: 1A	See test CT1: 1A

* Q_n = 173 [VAR] at 100V and S_n, P_n, Q_n = 693 [VAR] at 400V
** Q_n = 866 [VAR] at 100V and S_n, P_n, Q_n = 3464 [VAR] at 400V
* I_n = 1A;
** I_n = 5A;
*** f_n = 50Hz

ANSI 46 – Negative phase sequence current (NPS) protection

ANSI 46		
CT1: 1A; PT1: 100V***		
Operate quantity	**Set range**	**Deviation**
Magnitude (negative phase sequence current I_2)	at I_{set}: 1% … 100% I_n* at I_{set}: 200% … 300% I_n* at I_{set}: 300% … 3000% I_n*	0.5% I_n* 1% I_n* 1% I_{set}
Trip time: Definite time (DT)	Instantaneous operation at t_{set}: 0.1s … 60s	≤ 45ms ≤ 50ms or 5% of t_{set}
Reset time: Definite time (DT)	Instantaneous operation at t_{set}: 0.3s … 30s	≤ 45ms ≤ 45ms or 5% of t_{set}
Trip time: IDMT	IDMT curve (IEC, ANSI) at TMS: 0.05 … 10	≤ 45ms or 5% of t_{calc}
Reset time: IDMT	IDMT curve (IEC, ANSI) at TMS: 0.05 … 10	≤ 45ms or 5% of t_{calc}
Trip time: IDMT curve (Thermal)	IDMT curve (Thermal) at TMS: 0.05 … 10	≤ 55ms or 5% of t_{calc}
Reset time: IDMT curve (Thermal)	IDMT curve (Thermal) at TMS: 0.05 … 10	≤ 45ms or 5% of t_{calc}

CT1: 5A		
Operate quantity	**Set range**	**Deviation**
Magnitude (negative phase sequence current: I_2/I_n; I_2/I_1)	at I_{set}: 1% … 100% I_n** at I_{set}: 200% … 600% I_n**	0.5% I_n** 1% I_{set}
Trip time: IDMT	IDMT curve (IEC, ANSI) at TMS: 0.05 … 10	≤ 45ms or 5% of t_{calc}
Reset time: IDMT	IDMT curve (IEC, ANSI) at TMS: 0.05 … 10	≤ 45ms or 5% of t_{calc}
Trip time: IDMT curve (Thermal)	IDMT curve (Thermal) at TMS: 0.05 … 10	≤ 55ms or 5% of t_{calc}
Reset time: IDMT curve (Thermal)	IDMT curve (Thermal) at TMS: 0.05 … 10	≤ 45ms or 5% of t_{calc}

* In = 1A
** In = 5A
*** f_n = 50Hz

ANSI 49 – Thermal replica

ANSI 49		
CT1: 1A		
Operate quantity	**Set range**	**Deviation**
Trip time calculation accuracy $t_{(Ieq)}$ *** (I_{eq}: 120% I_B … 500% I_B)	at I_B: 10%I_n* … 100% I_n*; τ: 10s … 3000s	5% I_{calc} or 1s
Trip time delay: Warning limit	at t_{set}: 0s … 60s	≤ 10ms
Trip time delay: Trip limit	at t_{set}: 0s … 60s	≤ 10ms
CT1: 5A		
Operate quantity	**Set range**	**Deviation**
Trip time calculation accuracy $t_{(Ieq)}$ *** (I_{eq}: 120% I_B … 500% I_B)	at I_B: 10%I_n** … 100% I_n**; τ: 10s … 3000s	5% I_{calc} or 1s
Trip time delay: Warning limit	at t_{set}: 0s … 60s	≤ 10ms
Trip time delay: Trip limit	at t_{set}: 0s … 60s	≤ 10ms
Functional test	**Activation criterion**	**Test result**
Warning limit	See test: CT1 = 1A	See test: CT1 = 1A
Trip limit	See test: CT1 = 1A	See test: CT1 = 1A
Basic current factor k	See test: CT1 = 1A	See test: CT1 = 1A
Store thermal limit	See test: CT1 = 1A	See test: CT1 = 1A
Current heating threshold	See test: CT1 = 1A	See test: CT1 = 1A

* I_n = 1A
** I_n = 5A
*** Trip time depends on equivalent heating current I_{eq}

ANSI 64REF – Restricted earth fault protection

ANSI 64REF		
CT1: 1A; CT-GND1: 1A		
Operate quantity	**Set range**	**Deviation**
Magnitude (differential ground current I_d)	at I_d: 1% … 300 I_n* at I_d: 300% … 2000 I_n*	1% I_n* 1%I_{set}
Magnitude (stabilisation current I_{stab})	at I_{stab}: 4% … 200% I_n* at I_{stab}: 200% … 1000% I_n*	2% I_n* 1%I_{set}
Trip time: Step 1	at t_{set}: 0s … 60s	≤ 35ms
Trip time: Step 2	at t_{set}: 0s … 60s	≤ 35ms
CT1: 5A; CT-GND1: 5A		
Operate quantity	**Set range**	**Deviation**
Magnitude (differential ground current I_d)	at I_d: 1% … 100 I_n** at I_d: 100% … 1000 I_n**	1% I_n** 1%I_{set}
Magnitude (stabilisation current I_{stab})	at I_{stab}: 4% … 200% I_n** at I_{stab}: 200% … 1000% I_n**	1% I_n** 1%I_{set}
Trip time: Step 1	See test: CT1: 1A; CT-GND1: 1A	See test: CT1: 1A; CT-GND1: 1A
Trip time: Step 2	See test: CT1: 1A; CT-GND1: 1A	See test: CT1: 1A; CT-GND1: 1A
CT1: 1A; CT-GND1: 2mA-3000mA		
Operate quantity	**Set range**	**Deviation**
Magnitude (differential ground current I_d)	at I_d: 1% … 100 I_n* at I_d: 100% … 500 I_n* at I_d: 500% … 600 I_n*	1% I_n* 1%I_{set} 4%I_{set}
Magnitude (stabilisation current I_{stab})	at I_{stab}: 4% … 200% I_n* at I_{stab}: 200% … 1000% I_n*	1% I_n** 1%I_{set}
Trip time: Step 1	See test: CT1: 1A; CT-GND1: 1A	See test: CT1: 1A; CT-GND1: 1A
Trip time: Step 2	See test: CT1: 1A; CT-GND1: 1A	See test: CT1: 1A; CT-GND1: 1A

*: I_n = 1A
**: I_n = 5A

ANSI 78 – Vector surge protection

ANSI 78		
PT1: 100V* (tested at nominal voltage and nominal frequency)		
Operate quantity	**Set range**	**Deviation**
Magnitude (voltage angle difference $\Delta\theta$)	at $\Delta\theta_{set}$: 1° … 25°	≤ 0.5°
Reset delay time trip (test only for PT1: 100V)	at t_{set}: 0.25s … 60s	≤ 5ms or 5% of t_{set}
Minimum start voltage delay time (test only for PT1: 100V)	at t_{set}: 0.5s … 60s	≤ 20ms or 5% of t_{set}
Current increase time (test only for PT1: 100V)	at t_{set}: 0.05s … 60s	≤ 5ms or 5% of t_{set}
PT2: 100V/400V (tested at nominal voltage and nominal frequency)		
Operate quantity	**Set range**	**Deviation**
Magnitude (voltage angle difference $\Delta\theta$)	at $\Delta\theta_{set}$: 1° … 20° at $\Delta\theta_{set}$: 20° … 25°	≤ 0.5° ≤ 1°

PT3: 100V/400V (tested at nominal voltage and nominal frequency)		
Operate quantity	**Set range**	**Deviation**
Magnitude (voltage angle difference $\Delta\theta$)	at $\Delta\theta_{set}$: 1° … 25°	≤ 0.5°

*: f_n = 50Hz

ANSI 25 – Synchrocheck

ANSI 25 Synchrocheck		
PT1, PT2: 100V*		
Operate quantity	**Set range**	**Deviation**
Magnitude min/max dU (voltage difference)	at dU: +/-1% … +/-10% U_n**	1.5%U_n**
Magnitude min/max df (frequency difference)	at df: +/-0.05Hz … +/-0.5Hz	10mHz
Magnitude min/max dPHI (angle difference)	at dPHI: +/-0.5° … +/-10°	2°
Magnitude min/ max voltage limit	See test ANSI 27 and ANSI 59	See test ANSI 27 and ANSI 59
Magnitude min/max frequency limit	See test ANSI 27 and ANSI 59	See test ANSI 27 and ANSI 59
Delay time (Synchrocheck)	at t_{set}: 0s … 60s	≤ 5ms
Delay time (Voltage check)	at t_{set}: 0s … 60s	≤ 5ms
PT1, PT2: 400V*		
Operate quantity	**Set range**	**Deviation**
Magnitude min/max dU (voltage difference)	at dU: +/-1% … +/-10% U_n***	1.5%U_n***
Magnitude min/max df (frequency difference)	at df: +/-0.05Hz … +/-0.5Hz	10mHz
Magnitude min/max dPHI (angle difference)	at dPHI: +/-0.5° … +/-10°	0.5°
Magnitude min/ max voltage limit	See test ANSI 27 and ANSI 59	See test ANSI 27 and ANSI 59
Magnitude min/max frequency limit	See test ANSI 27 and ANSI 59	See test ANSI 27 and ANSI 59
Delay time (Synchrocheck)	See test: PT1, PT2 100V	See test: PT1, PT2 100V
Delay time (Voltage check)	See test: PT1, PT2 100V	See test: PT1, PT2 100V

*: f_n = 50Hz
**: U_n = 100V
***: U_n = 400V

ANSI 47 – Negative phase sequence overvoltage protection

ANSI 47		
PT1,PT2,PT3: 100V*		
Operate quantity	**Set range**	**Deviation**
Magnitude (negative phase sequence voltage U2)	at U_{set}: 2% … 200% U_n**	1,2% U_n**
Trip time: Definite time (DT)	Instantaneous operation at t_{set}: 0s … 60s	≤ 45ms ≤ 50ms or 5% of t_{set}
Reset time: Definite time (DT)	Instantaneous operation at t_{set}: 0s … 60s	≤ 50ms ≤ 50ms or 5% of t_{set}
PT1,PT2,PT3: 400V*		
Operate quantity	**Set range**	**Deviation**
Magnitude (negative phase sequence voltage U2)	at U_{set}: 2% … 100% U_n***	1% U_n***
Trip time: Definite time (DT)	Instantaneous operation at t_{set}: 0s … 60s	≤ 45ms ≤ 50ms or 5% of t_{set}
Reset time: Definite time (DT)	Instantaneous operation at t_{set}: 0s … 60s	≤ 50ms ≤ 50ms or 5% of t_{set}

*: f_n = 50Hz

**: U_n = 100V

***: U_n = 400V

ANSI 79 – Automatic reclosing (AR)

ANSI 79		
Operate quantity	**Set range**	**Deviation**
Timer: Pause time	at t_{set}: 0s … 60s	≤ 15ms or 5% of t_{set}

ANSI 37 – Undercurrent protection

ANSI 37		
CT1: 1A		
Operate quantity	**Set range**	**Deviation**
Magnitude (phase currents: I_{L1}, I_{L2}, I_{L3})	at I_{set}: 1% … 100% I_n*	1% In*
Trip time: Definite time (DT)	Instantaneous operation at t_{set}: 0.1s … 60s	≤ 35ms ≤ 35ms or 5% of t_{set}
Reset time: Definite time (DT)	Instantaneous operation at t_{set}: 0.3s … 30s	≤ 40ms ≤ 40ms or 5% of t_{set}
CT1: 5A		
Operate quantity	**Set range**	**Deviation**
Magnitude (phase currents: I_{L1}, I_{L2}, I_{L3})	at I_{set}: 1% … 100% I_n**	1% In**
Trip time: Definite time (DT)	See test CT1: 1A	See test CT1: 1A
Reset time: Definite time (DT)	See test CT1: 1A	See test CT1: 1A

*: In = 1A

**: In = 5A

LVM – Limit value monitoring

LVM		
CT1: 5A; PT1,PT2,PT3,PT-GND1: 100V*; Analog Input 1-4		
Operate quantity	**Set range**	**Deviation**
Trip time: Definite time (DT)	Instantaneous operation at t_{set}: 0s … 60s	≤ 45ms ≤ 45ms or 5% of t_{set}

*: fn = 50Hz

ANSI 52 – Pole discordance protection

ANSI 52		
CT1: 1A		
Operate quantity	**Set range**	**Deviation**
Magnitude (phase currents: I_{L1}, I_{L2}, I_{L3})	See test ANSI 37	See test ANSI 37
Trip time: Definite time (DT)	Instantaneous operation at t_{set}: 0.1s … 60s	≤ 35ms ≤ 35ms or 5% of t_{set}
CT1: 5A		
Operate quantity	**Set range**	**Deviation**
Magnitude (phase currents: I_{L1}, I_{L2}, I_{L3})	See test ANSI 37	See test ANSI 37
Trip time: Definite time (DT)	Instantaneous operation at t_{set}: 0.1s … 60s	≤ 35ms ≤ 35ms or 5% of t_{set}

2.4 Binary inputs and outputs

2.4.1 Binary inputs

Specifications of binary inputs (BI) of the P60 Agile device variants

Description	Specification			
General	Number	18 BIs (Standard)		
	Voltage	24/48/60/220V DC, 110V AC/DC, 230V AC (parameterizable) NOTE: Maximum permitted voltage for all BIs = 270V AC/DC		
24V DC	Max. turn-on delay	BIs “Fct.10” to “Fct 25“:	X2.3:34 to 45 and X2.5:66 to 70	13 ms
		BIs “Fct.26 and “Fct 27“:	X2.3:30 to X2.3:33	40 ms
	Max. turn-off delay	BIs “Fct.10” to “Fct 25“:	X2.3:34 to 45 and X2.5:66 to 70	15 ms
		BIs “Fct.26 and “Fct 27“:	X2.3:30 to X2.3:33	30 ms
	Power consumption	BIs “Fct.10” to “Fct 25“:	X2.3:34 to 45 and X2.5:66 to 70	8,16 mW
		BIs “Fct.26 and “Fct 27“:	X2.3:30 to X2.3:33	4,32 mW
	Current	BIs “Fct.10” to “Fct 25“:	X2.3:34 to 45 and X2.5:66 to 70	0,34 mA
		BIs “Fct.26 and “Fct 27“:	X2.3:30 to X2.3:33	0,18 mA
	HIGH level	BIs “Fct.10” to “Fct 25“:	X2.3:34 to 45 and X2.5:66 to 70	18 V
		BIs “Fct.26 and “Fct 27“:	X2.3:30 to X2.3:33	19 V
	LOW level	BIs “Fct.10” to “Fct 25“:	X2.3:34 to 45 and X2.5:66 to 70	7 V
		BIs “Fct.26 and “Fct 27“:	X2.3:30 to X2.3:33	8 V
48V DC	Max. turn-on delay	BIs “Fct.10” to “Fct 25“:	X2.3:34 to 45 and X2.5:66 to 70	13 ms
		BIs “Fct.26 and “Fct 27“:	X2.3:30 to X2.3:33	40 ms

Description	Specification			
	Max. turn-off delay	BIs "Fct.10" to "Fct 25":	X2.3:34 to 45 and X2.5:66 to 70	12 ms
		BIs "Fct.26 and "Fct 27":	X2.3:30 to X2.3:33	30 ms
	Power consumption	BIs "Fct.10" to "Fct 25":	X2.3:34 to 45 and X2.5:66 to 70	33,12 mW
		BIs "Fct.26 and "Fct 27":	X2.3:30 to X2.3:33	16,80 mW
	Current	BIs "Fct.10" to "Fct 25":	X2.3:34 to 45 and X2.5:66 to 70	0,69 mA
		BIs "Fct.26 and "Fct 27":	X2.3:30 to X2.3:33	0,35 mA
	HIGH level	BIs "Fct.10" to "Fct 25":	X2.3:34 to 45 and X2.5:66 to 70	35 V
		BIs "Fct.26 and "Fct 27":	X2.3:30 to X2.3:33	39 V
	LOW level	BIs "Fct.10" to "Fct 25":	X2.3:34 to 45 and X2.5:66 to 70	18 V
		BIs "Fct.26 and "Fct 27":	X2.3:30 to X2.3:33	18 V
60V DC	Max. turn-on delay	BIs "Fct.10" to "Fct 25":	X2.3:34 to 45 and X2.5:66 to 70	12 ms
		BIs "Fct.26 and "Fct 27":	X2.3:30 to X2.3:33	40 ms
	Max. turn-off delay	BIs "Fct.10" to "Fct 25":	X2.3:34 to 45 and X2.5:66 to 70	11 ms
		BIs "Fct.26 and "Fct 27":	X2.3:30 to X2.3:33	25 ms
	Power consumption	BIs "Fct.10" to "Fct 25":	X2.3:34 to 45 and X2.5:66 to 70	51,60 mW
		BIs "Fct.26 and "Fct 27":	X2.3:30 to X2.3:33	26,40 mW
	Current	BIs "Fct.10" to "Fct 25":	X2.3:34 to 45 and X2.5:66 to 70	0,86 mA
		BIs "Fct.26 and "Fct 27":	X2.3:30 to X2.3:33	0,44 mA
	HIGH level	BIs "Fct.10" to "Fct 25":	X2.3:34 to 45 and X2.5:66 to 70	44 V
		BIs "Fct.26 and "Fct 27":	X2.3:30 to X2.3:33	49 V
	LOW level	BIs "Fct.10" to "Fct 25":	X2.3:34 to 45 and X2.5:66 to 70	24 V
		BIs "Fct.26 and "Fct 27":	X2.3:30 to X2.3:33	23 V
110V DC	Max. turn-on delay	BIs "Fct.10" to "Fct 25":	X2.3:34 to 45 and X2.5:66 to 70	12 ms
		BIs "Fct.26 and "Fct 27":	X2.3:30 to X2.3:33	45 ms
	Max. turn-off delay	BIs "Fct.10" to "Fct 25":	X2.3:34 to 45 and X2.5:66 to 70	11 ms
		BIs "Fct.26 and "Fct 27":	X2.3:30 to X2.3:33	25 ms
	Power consumption	BIs "Fct.10" to "Fct 25":	X2.3:34 to 45 and X2.5:66 to 70	174 mW
		BIs "Fct.26 and "Fct 27":	X2.3:30 to X2.3:33	88 mW
	Current	BIs "Fct.10" to "Fct 25":	X2.3:34 to 45 and X2.5:66 to 70	1,58 mA
		BIs "Fct.26 and "Fct 27":	X2.3:30 to X2.3:33	0,80 mA
	HIGH level	BIs "Fct.10" to "Fct 25":	X2.3:34 to 45 and X2.5:66 to 70	78 V
		BIs "Fct.26 and "Fct 27":	X2.3:30 to X2.3:33	91 V
	LOW level	BIs "Fct.10" to "Fct 25":	X2.3:34 to 45 and X2.5:66 to 70	38 V
		BIs "Fct.26 and "Fct 27":	X2.3:30 to X2.3:33	45 V
220V DC	Max. turn-on delay	BIs "Fct.10" to "Fct 25":	X2.3:34 to 45 and X2.5:66 to 70	12 ms
		BIs "Fct.26 and "Fct 27":	X2.3:30 to X2.3:33	50 ms
	Max. turn-off delay	BIs "Fct.10" to "Fct 25":	X2.3:34 to 45 and X2.5:66 to 70	12 ms
		BIs "Fct.26 and "Fct 27":	X2.3:30 to X2.3:33	25 ms
	Power consumption	BIs "Fct.10" to "Fct 25":	X2.3:34 to 45 and X2.5:66 to 70	695 mW
		BIs "Fct.26 and "Fct 27":	X2.3:30 to X2.3:33	352 mW
	Current	BIs "Fct.10" to "Fct 25":	X2.3:34 to 45 and X2.5:66 to 70	3,16 mA
		BIs "Fct.26 and "Fct 27":	X2.3:30 to X2.3:33	1,6 mA
	HIGH level	BIs "Fct.10" to "Fct 25":	X2.3:34 to 45 and X2.5:66 to 70	157 V

Description	Specification			
		BIs "Fct.26 and "Fct 27":	X2.3:30 to X2.3:33	183 V
	LOW level	BIs "Fct.10" to "Fct 25":	X2.3:34 to 45 and X2.5:66 to 70	76 V
		BIs "Fct.26 and "Fct 27":	X2.3:30 to X2.3:33	90 V
110V AC	Max. turn-on delay	BIs "Fct.10" to "Fct 25":	X2.3:34 to 45 and X2.5:66 to 70	120 ms
		BIs "Fct.26 and "Fct 27":	X2.3:30 to X2.3:33	40 ms
	Max. turn-off delay	BIs "Fct.10" to "Fct 25":	X2.3:34 to 45 and X2.5:66 to 70	100 ms
		BIs "Fct.26 and "Fct 27":	X2.3:30 to X2.3:33	20 ms
	Power consumption	BIs "Fct.10" to "Fct 25":	X2.3:34 to 45 and X2.5:66 to 70	95,7 mW
		BIs "Fct.26 and "Fct 27":	X2.3:30 to X2.3:33	49,5 mW
	Current	BIs "Fct.10" to "Fct 25":	X2.3:34 to 45 and X2.5:66 to 70	0,87 mA
		BIs "Fct.26 and "Fct 27":	X2.3:30 to X2.3:33	0,45 mA
	HIGH level	BIs "Fct.10" to "Fct 25":	X2.3:34 to 45 and X2.5:66 to 70	60 V
		BIs "Fct.26 and "Fct 27":	X2.3:30 to X2.3:33	77 V
	LOW level	BIs "Fct.10" to "Fct 25":	X2.3:34 to 45 and X2.5:66 to 70	53 V
		BIs "Fct.26 and "Fct 27":	X2.3:30 to X2.3:33	55 V
230V AC	Max. turn-on delay	BIs "Fct.10" to "Fct 25":	X2.3:34 to 45 and X2.5:66 to 70	200 ms
		BIs "Fct.26 and "Fct 27":	X2.3:30 to X2.3:33	30 ms
	Max. turn-off delay	BIs "Fct.10" to "Fct 25":	X2.3:34 to 45 and X2.5:66 to 70	60 ms
		BIs "Fct.26 and "Fct 27":	X2.3:30 to X2.3:33	30 ms
	Power consumption	BIs "Fct.10" to "Fct 25":	X2.3:34 to 45 and X2.5:66 to 70	420 mW
		BIs "Fct.26 and "Fct 27":	X2.3:30 to X2.3:33	215 mW
	Current	BIs "Fct.10" to "Fct 25":	X2.3:34 to 45 and X2.5:66 to 70	1,83 mA
		BIs "Fct.26 and "Fct 27":	X2.3:30 to X2.3:33	0,93 mA
	HIGH level	BIs "Fct.10" to "Fct 25":	X2.3:34 to 45 and X2.5:66 to 70	180 V
		BIs "Fct.26 and "Fct 27":	X2.3:30 to X2.3:33	170 V
	LOW level	BIs "Fct.10" to "Fct 25":	X2.3:34 to 45 and X2.5:66 to 70	90 V
		BIs "Fct.26 and "Fct 27":	X2.3:30 to X2.3:33	115 V

2.4.2 Binary outputs

Specifications of binary outputs of the P60 Agile device variants

Designation Binary outputs	Description	Specification
	General Number:	12 pcs (Standard) NOTE: For switching of inductive loads by DC voltage: Protective circuit with flywheel diode for output contacts is required! For switching of inductive loads by AC voltage: Protective circuit with varistor for output contacts is required!

Sync. 1 ON (2 normally open contacts in series)	Contact load Rated voltage (AC) Max. Switching voltage Continuous current Max. making current Max. breaking capacity (AC) Max. breaking capacity (DC) 24V 48V 60V 110V 220V Contact switching times Max. turn-on delay Max. turn-off delay Mechanical contact life-cycle	 250V (AC*) 300V DC; 400V AC 6A (AC/DC) 10A (AC/DC) for 4s 1500VA 144W 19.2W 18W 22W 33W 12ms 5ms > 10 x 10^6 Operating cycles (ON->OFF->ON, or OFF->ON->OFF)
Shunt Trip 1 (change-over contact) NOTE: The normally open (NO) contact is designated for tripping the connected circuit breaker.	Contact load Rated voltage (AC) Max. Switching voltage Continuous current Max. making current Max. breaking capacity (AC) Max. breaking capacity (DC) 24V 48V 60V 110V 220V Contact switching times Max. turn-on delay Max. turn-off delay Mechanical contact life-cycle	 250V (AC*) 300V DC; 400V AC 16A (AC/DC) 30A (AC/DC) for 4s 4000VA 288W 63W 48W 44W 66W 8ms 6ms > 30 x 10^6 Operating cycles (ON->OFF->ON, or OFF->ON->OFF)

Shunt Trip 2 (normally open contact) NOTE: The normally open (NO) contact is designated for tripping the connected circuit breaker.	Contact load Rated voltage (AC) Max. Switching voltage Continuous current Max. making current Max. breaking capacity (AC) Max. breaking capacity (DC) 24V 48V 60V 110V 220V Contact switching times Max. turn-on delay Max. turn-off delay Mechanical contact life-cycle	 250V (AC*) 300V DC; 400V AC 16A (AC/DC) 30A (AC/DC) for 4s 4000VA 288W 53W 48W 44W 66W 8ms 6ms > 30 x 10^6 Operating cycles (ON->OFF->ON, or OFF->ON->OFF)
LOCKOUT (normally open contact)	Contact load Rated voltage (AC) Max. Switching voltage Continuous current Max. making current Max. breaking capacity (AC) Max. breaking capacity (DC) 24V 48V 60V 110V 220V Contact switching times Max. turn-on delay Max. turn-off delay Mechanical contact life-cycle	 250V (AC*) 300V DC; 400 VAC 8A (AC/DC) 15A (AC/DC) for 4s 2000VA 192W 100W 60W 33W 55W 10ms 5ms > 2 x 10^6 Operating cycles (ON->OFF->ON, or OFF->ON->OFF)

Function 1 Function 2 Function 3 Function 4 Function 5 Function 6 (normally open contacts)	Contact load	
	Rated voltage (AC)	250V (AC*)
	Max. Switching voltage	300V DC; 400V AC
	Continuous current	6A (AC/DC)
	Max. making current	10A (AC/DC) for 4s
	Max. breaking capacity (AC)	1500VA
	Max. breaking capacity (DC)	
	24V	144W
	48V	19.2W
	60V	18W
	110V	22W
	220V	33W
	Contact switching times	
	Max. turn-on delay	12ms
	Max. turn-off delay	5ms
	Mechanical contact life-cycle	10 x 10^6 Operating cycles (ON->OFF->ON, or OFF->ON->OFF)
		Note: “Function 1” and Function 2” relay contacts are connected to the same common (rooted contact). Thus, total continuous current for the rooted contact of “Function 1” and “Function 2” contacts must not exceed 6A. Function 3 to Function 6 relay contacts are connected to the same common. Thus, total current for Function 3 to Function 6 contacts must not exceed 16A.
Function 7 Function 8 (Watchdog) (normally open contacts)	Contact load	
	Rated voltage (AC)	240V (AC*)
	Max. Switching voltage	300V DC; 400V AC
	Continuous current	8A (AC/DC)
	Max. making current	10A (AC/DC) for 4s
	Max. breaking capacity (AC)	2000VA
	Max. breaking capacity (DC)	
	24V	192W
	48V	96W
	60V	60W
	110V	55W
	220V	66W
	Contact switching times	
	Max. turn-on delay	7ms
	Max. turn-off delay	3ms
	Mechanical contact life-cycle	30 x 10^6 Operating cycles (ON->OFF->ON, or OFF->ON->OFF)

* U=Urms

2.5 Measuring inputs – voltage and current

Specifications of the P60 Agile current measuring inputs (CT: conventional current transformers)

Description	Specification		
CT1**, CT-GND1	The following specifications of measuring accuracy are only valid for the set nominal frequency: 50Hz/60Hz		
	DEVIATION (MAGNITUDE)		
	Secondary nominal current In:	1A	
	Measuring ranges*:	0,02 ...1 x In,	deviation: ≤ 0,5% In
		1 ... 10 x In,	deviation: ≤ 0,5% of meas. value
		10 ... 20 x In,	deviation: ≤ 1% of meas. value
		20 ... 32 x In	deviation: ≤ 3% of meas. value
	Temperature influence:	0 ... 60°C:	deviation: 1% In
	Harmonics influence:	20% of 3^{rd} or 5^{th} harmonic	deviation: ≤ 1% In
	Secondary nominal current In:	5A	
	Measuring ranges*:	0,02 ...1 x In,	deviation: ≤ 0,5% In
		1 ... 2 x In,	deviation: ≤ 0,5% of meas. value
		2 ... 20 x In,	deviation: ≤ 1% of meas. value
		20 ... 32 x In,	deviation: ≤ 3% of meas. value
	Temperature influence:	0 ... 60°C:	deviation: ≤ 1% In
	Harmonics influence:	20% of 3^{rd} or 5^{th} harmonic	deviation: ≤ 1% In
CT-GND1(sensitive input)	*DEVIATION (MAGNITUDE)*		
	Total measuring range:	2 ... 3000mA	
	Measuring ranges*:	2 ... 100mA,	deviation: ≤ 1mA
		100 ... 2500mA,	deviation: ≤ 1% of meas. value
		2500 ... 2800mA,	deviation: ≤ 3% of meas. value
	Temperature influence:	0 ... 60°C:	deviation: ≤ 1% In
	Harmonics influence:	20% of 3^{rd} or 5^{th} harmonic	deviation: ≤ 1% In
CT1, CT-GND1	*POWER CONSUMPTION*		
	1A inputs*:	at 1 x In:	approx. 0,007VA
		at 20 x In:	approx. 2,8VA
		at 100 x In:	approx. 1,5kVA
	5A inputs*:	at 1 x In:	approx. 0,13VA
		at 20 x In:	approx. 45VA
		at 100 x In:	approx. 15kVA
	NOTE: With a connecting cable (4 mm^2; length:2,5 m) and a 5A current transformer, the total load at 20 x In (5A) amounts to 227VA		
CT-GND1 (sensitive input)	*POWER CONSUMPTION*		
	2 ... 3000mA*:	at 100mA:	approx. 0,007VA
		at 3000mA:	approx. 2,8VA
CT1, CT-GND1	*AC OVERCURRENT PROOF*		
	1A inputs*:	at 250 x In:	for 10ms (half oscillation)
		at 100 x In:	up to 1s
		at 45 x In:	up to 10s
		at 32 x In:	up to 30s
		at 5 x In:	continuous
	5A inputs*:	at 50 x In:	for 10ms (half oscillation)
		at 32 x In:	for 0,5s
		at 20 x In:	up to 1s
		at 10 x In:	up to 10s
		at 7 x In:	up to 30s
		at 5 x In:	continuous
CT-GND1(sensitive input)	*AC OVERCURRENT PROOF*		
	2 ... 3000mA*:	at 50A:	for 10ms (half oscillation)
		at 30A:	up to 1s
		at 15A:	up to 10s
		at 3A:	continuous

For current measurement, a distortion factor k < 5% is assumed.
* Environmental temperature: 20°C; humidity: non-condensing; protection relay at steady operation at nominal values
** Information about deviation refers to both, CT1-M/P and CT1-M

Specifications of the P60 Agile voltage measurement inputs (PT: conventional potential transformers)

Description	Specification
PT1, PT-GND1	Typical nominal voltages Un(AC): 100 V/110V/400V/690 V
	MEASURING RANGES (parameterizable PT input modes) Low range: 0 ... 200V AC High range: 0 ... 690V AC CAUTION: Product design accords to pollution degree 2, overvoltage category 3, for measurement phase-to-neutral voltages up to 300V RMS
	DEVIATION (MAGNITUDE) Measuring ranges*: 0,05 ... 1,0 x Un: deviation: ≤ 0,9% of Un 1,0 ... 2,0 x Un: deviation: ≤ 0,4% of Un
	POWER CONSUMPTION Load per phase: at Un=100 V: approx. 0,1VA at Un=200 V: approx. 0,2VA at Un=400 V: approx. 0,4VA at Un=700 V: approx. 1VA
	AC OVERVOLTAGE PROOF 2000 V up to 1s 2x Un: continuous

For voltage measurement, a distortion factor k < 5% is assumed.
* Environmental temperature: 20°C; humidity: non-condensing; protection relay at steady operation at nominal values

2.6 Communication interfaces

Specification of P60 Agile communication interfaces

Data protocol	Designation phys. interface	Specification	
USB protocol	X2.8	Interface: Location:	mini USB (standard equipment); service interface for parameter setting side of housing
USB protocol	X2.9	Interface: Location:	USB-A (standard equipment); service interface for parameter setting and selection of user levels (ordering option) front panel
Modbus RTU	X2.6	Interface: Terminal connection: Location: Signal transmission type: Terminals, half duplex: Selectable symbol rates (Baud rate): Transmission distance, max.: Network topology: Selectable ID addresses: Signal wiring:	RS485, serial port 1 (standard equipment); electrical; galv. isolated terminal screws back panel differential / half duplex X2.6: 26, 27 9600Bd, 19200Bd, 38400Bd and 57600Bd 1km bus system 0 – 255 (parameterizable) shielded, twisted-pair
		NOTE: Termination of 120 Ω on both ends of the bus system is required!	
IEC 61850	X4.3 (star) / X4.4 (double star, star redundancy, ring or ring redundancy)	Interface: Location: Terminals:	fibre optics (FO) (ordering option); multimode back panel star: TxD 1, RxD 1

Data protocol	Designation phys. interface	Specification	
			star redundancy: TxD 1, RxD 1; TxD 2, RxD 2 double star: TxD 1, RxD 1; TxD 2, RxD 2 ring: TxD 1, RxD 1; TxD 2, RxD 2 ring redundancy: TxD 1, RxD 1; TxD 2, RxD 2
		Fibre type:	glass fibre
		Diameter sleeve:	125µm
		Diameter core:	50µm or 62,5µm
		Connection type:	ST®
		Wavelength:	1300 nm
		Transmission distance:	max. 2km
		Selectable source subscriber IDs:	0 – 128 (parameterizable)
		Laser class:	1
	X4.3 (star) / X4.4 (double star, star redundancy, ring or ring redundancy)	Interface:	RJ45 (ordering option), electrical, galv. isolated
		Location:	back panel
		Terminals:	star: Port 1 star redundancy: Port 1; Port 2 double star: Port 1; Port 2 ring: Port 1; Port 2 ring redundancy: Port 1; Port 2
		Transmission distance:	max.100m
		Selectable source subscriber IDs:	0 – 128 (parameterizable)
IEC 60870-5-103	X4.5	Interface:	fibre optics (FO) (ordering option); multimode
		Location:	back panel
		Terminals:	TxD, RxD
		Fibre type:	glass fibre
		Diameter sleeve:	125µm
		Diameter core:	50µm or 62,5µm
		Connection type:	ST®
		Wavelength:	820 nm (Multimode)
		Transmission distance:	max. 2km
		Network topology:	star
		Selectable ID addresses:	0 – 255 (parameterizable)
		Laser class:	1
	X4.6	Interface:	RS485; serial port 2 (ordering option); electrical; galv. isolated
		Connection type:	2-pole connector
		Location:	back panel
		Signal transmission type:	differential / half duplex
		Terminals, half duplex:	A1(+), B1(-)
		Selectable symbol rates (Baud rate):	9600Bd, 19200Bd, 38400Bd and 57600Bd
		Transmission distance:	max.1 km
		Network topology:	bus system
		Bus load: master connected to the bus system; e.g.	1/4 UL (unit load) => max. number of users depends on bus load of the Master: 1/4 UL => max. 128 P60 Agile
		Selectable ID addresses:	0 – 255 (parameterizable)
		Signal wiring:	shielded, twisted-pair
		NOTE: Termination of 120 Ω on both ends of the bus system is required!	

ORDERING OPTIONS

CHAPTER 10

1 CHAPTER OVERVIEW

This chapter consists of the following sections:

2 P161 – NON DIRECTIONAL ‘PROTECTION AND CONTROL SYSTEM’

Information required with order

Variants	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
P161 P60 Agile Non-directional overcurrent & Earth fault	P161																									
Phase current transformer CT1																										
CT1: 1 A secondary, rated current		A																								
CT1: 5 A secondary, rated current		B																								
CT1-MP: 1 A secondary, rated current (M: 0.02-2×In, P: 0.02-32×In)		C																								
CT1-MP: 5 A secondary, rated current (M: 0.02-2×In, P: 0.02-32×In)		D																								
Phase current transformer CT2																										
Without			0																							
Phase current transformer CT3																										
Without				A																						
Earth current transformer CT-GND1																										
CT-GND1: 1 A secondary, rated current					0																					
CT-GND1: 5 A secondary, rated current					1																					
CT-GND1: 2 - 3000mA, secondary rated current					2																					
Earth current transformer CT-GND2																										
Without						A																				
Power supply -device																										
24V DC							0																			
48VDC							1																			
60V DC							2																			
110-220V DC; 110-230V AC							3																			
Binary inputs																										
18 (Ur: 24/48/60/110/220V DC; 110V/230V AC: Parametrizable)								A																		
Binary outputs																										
12 (potential-free contacts)									0																	
Analog Inputs and Outputs																										
Without										A																
Communication - SCADA Port-1																										
Modbus RTU; RS485; half-duplex											0															
Communication - SCADA Port-2																										
Without												A														
IEC 61850 (single), FO & RJ45												B														
IEC 61850 (single), RJ45												C														
IEC 61850 (single), FO												D														
IEC 61850 (redundancy), RJ45												E														
IEC 61850 (redundancy), FO												F														
Communication - SCADA Port-3																										
Without													0													
IEC 60870-5-103; RS485													1													
IEC 60870-5-103; Fiber optic													2													
Communication - Interfaces																										
1 x USB interface (front plate; parameter setting)														A												
Reserved															0	A	0	A	0	A	0					
Connectors U/I-measuring																										
I-measuring connector without integrated short-circuiters																						A				
Reserved																							0			
Firmware version (FW)																										
Latest version																								A		
Hardware version (HW)																										
Latest version: v1-2.x																									0	
Menu language																										
English, German, Polish																										A

3 P162 – NON DIRECTIONAL ‘PROTECTION AND CONTROL SYSTEM’ (WITH DIRECTIONAL E/F)

Information required with order

Variants	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
P162 P60 Agile Non-directional overcurrent & directional Earth	**P162**																									
Phase current transformer CT1																										
CT1: 1 A secondary, rated current		A																								
CT1: 5 A secondary, rated current		B																								
CT1-MP: 1 A secondary, rated current (M: 0.02-2×In, P: 0.02-32×In)		C																								
CT1-MP: 5 A secondary, rated current (M: 0.02-2×In, P: 0.02-32×In)		D																								
Phase current transformer CT2																										
Without			0																							
Phase current transformer CT3																										
Without				A																						
Earth current transformer CT-GND1																										
CT-GND1: 1 A secondary, rated current					0																					
CT-GND1: 5 A secondary, rated current					1																					
CT-GND1: 2 - 3000mA, secondary rated current					2																					
Earth current transformer CT-GND2																										
Without						A																				
Power supply -device																										
24V DC							0																			
48VDC							1																			
60V DC							2																			
110-220V DC; 110-230V AC							3																			
Binary inputs																										
18 (Ur: 24/48/60/110/220V DC; 110V/230V AC: Parametrizable)								A																		
Binary outputs																										
12 (potential-free contacts)									0																	
Analog Inputs and Outputs																										
Without										A																
Communication - SCADA Port-1																										
Modbus RTU; RS485; half-duplex											0															
Communication - SCADA Port-2																										
Without												A														
IEC 61850 (single), FO & RJ45												B														
IEC 61850 (single), RJ45												C														
IEC 61850 (single), FO												D														
IEC 61850 (redundancy), RJ45												E														
IEC 61850 (redundancy), FO												F														
Communication - SCADA Port-3																										
Without													0													
IEC 60870-5-103; RS485													1													
IEC 60870-5-103; Fiber optic													2													
Communication - Interfaces																										
1 x USB interface (front plate; parameter setting)														A												
Reserved															0	A	0	A	0	A	0					
Connectors U/I-measuring																										
I-measuring connector without integrated short-circuiters																						A				
Reserved																							0			
Firmware version (FW)																										
Latest version																								A		
Hardware version (HW)																										
Latest version: v1-2.x																									0	
Menu language																										
English, German, Polish																										A

4 P163 – DIRECTIONAL ‘PROTECTION AND CONTROL SYSTEM’

Information required with order

Variants	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
P163 P60 Agile Directional Overcurrent & Directional Earth Fault	P163																									
Phase current transformer CT1																										
CT1: 1 A secondary, rated current		A																								
CT1: 5 A secondary, rated current		B																								
CT1-MP: 1 A secondary, rated current (M: 0.02-2×In, P: 0.02-32×In)		C																								
CT1-MP: 5 A secondary, rated current (M: 0.02-2×In, P: 0.02-32×In)		D																								
Phase current transformer CT2																										
Without			0																							
Phase current transformer CT3																										
Without				A																						
Earth current transformer CT-GND1																										
CT-GND1: 1 A secondary, rated current					0																					
CT-GND1: 5 A secondary, rated current					1																					
CT-GND1: 2 - 3000mA, secondary rated current					2																					
Earth current transformer CT-GND2																										
Without						A																				
Power supply -device																										
24V DC							0																			
48VDC							1																			
60V DC							2																			
110-220V DC; 110-230V AC							3																			
Binary inputs																										
18 (Ur: 24/48/60/110/220V DC; 110V/230V AC: Parametrizable)								A																		
Binary outputs																										
12 (potential-free contacts)									0																	
Analog Inputs and Outputs																										
Without										A																
Communication - SCADA Port-1																										
Modbus RTU; RS485; half-duplex											0															
Communication - SCADA Port-2																										
Without												A														
IEC 61850 (single), FO & RJ45												B														
IEC 61850 (single), RJ45												C														
IEC 61850 (single), FO												D														
IEC 61850 (redundancy), RJ45												E														
IEC 61850 (redundancy), FO												F														
Communication - SCADA Port-3																										
Without													0													
IEC 60870-5-103; RS485													1													
IEC 60870-5-103; Fiber optic													2													
Communication - Interfaces																										
1 x USB interface (front plate; parameter setting)														A												
Reserved															0	A	0	A	0	A	0					
Connectors U/I-measuring																										
I-measuring connector without integrated short-circuiters																						A				
Reserved																							0			
Firmware version (FW)																										
Latest version																								A		
Hardware version (HW)																										
Latest version: v1-2.x																									0	
Menu language																										
English, German, Polish																										A

Imagination at work

Grid Solutions
St Leonards Building
Redhill Business Park
Stafford, ST16 1WT, UK
+44 (0) 1785 250 070
www.gegridsolutions.com/contact

P16x/EN M/F