# NPS3_
# Negative-Phase-Sequence Protection
# Low-Set Stage (NPS3Low)
# High-Set Stage (NPS3High)

## Contents

# 1. Introduction

## 1.1 Features

- Negative-phase-sequence protection
- Definite-time (DT) or inverse-time (IDMT) operation
- Definite minimum time for high-level negative-sequence currents in inverse-time operation
- Limited maximum operate time for long-time low-level negative-sequence currents in inverse-time operation
- Adjustable start delay in inverse-time operation
- Backwards counting when overload disappears in inverse-time mode
- Current measurement with conventional current transformers or Rogowski coils
- Two- or three-phase negative-sequence current measurement
- Input signal for selecting the direction of rotation
- Delayed trip output for the circuit-breaker failure protection (CBFP) function
- Output for blocking the reconnection of an overheated machine
- Wide setting ranges

## 1.2 Application

This document specifies the functions of the negative-phase-sequence function blocks NPS3Low and NPS3High used in products based on the RED 500 Platform. The low-set stage and the high-set stage are identical in operation.

The function blocks NPS3Low and NPS3High are designed for negative-phase-sequence protection whenever the operating characteristic is appropriate. They are applied for the protection of power generators or synchronous motors against thermal stress and damage.
(See Figure 5).

I2>

I2>>

*Figure 1. Protection diagram symbols of NPS3Low and NPS3High (For IEC symbols used in single line diagrams, refer to the manual "Technical Descriptions of Functions, Introduction", 1MRS750528-MUM)*

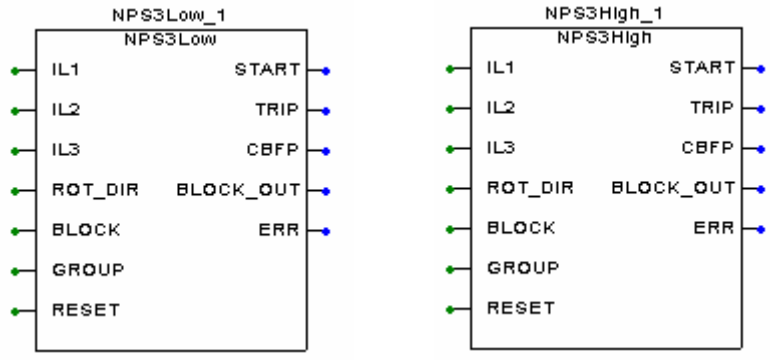


*Figure 2. Function block symbols of NPS3Low and NPS3High*

## 1.3 Input description

| Name | Type | Description |
|---|---|---|
| IL1 | Analogue signal (SINT) | Input for measuring phase current $I_{L1}$ |
| IL2 | Analogue signal (SINT) | Input for measuring phase current $I_{L2}$ |
| IL3 | Analogue signal (SINT) | Input for measuring phase current $I_{L3}$ |
| ROT_DIR | Digital signal (BOOL, active high) | Input signal for selecting rotation direction of the machine |
| GROUP | Digital signal (BOOL, active high) | Control input for switching between the setting groups 1 and 2 |
| BLOCK | Digital signal (BOOL, active high) | Input for blocking the function |
| RESET | Reset signal (BOOL, pos. edge) | Input signal for resetting the trip signal and registers of NPS3Low or NPS3High |

## 1.4 Output description

| Name | Type | Description |
|---|---|---|
| START | Digital signal (BOOL, active high) | Start signal |
| TRIP | Digital signal (BOOL, active high) | Trip signal |
| CBFP | Digital signal (BOOL, active high) | Delayed trip signal for circuit-breaker failure protection (CBFP) |
| BLOCK_OUT | Digital signal (BOOL, active high) | Signal for blocking the reconnection of an overheated machine |
| ERR | Digital signal (BOOL, active high) | Signal for indicating a configuration error |

# 2. Description of Operation

## 2.1 Configuration

Phase currents can be measured via conventional current transformers or Rogowski coils. The measuring devices and signal types for the analogue channels are selected and configured in a special dialogue box of the Relay Configuration Tool included in the CAP 505 Tool Box. Digital inputs are configured in the same programming environment (the number of selectable analogue inputs, digital inputs and digital outputs depends on the hardware used).

When the analogue channels and digital inputs have been selected and configured in the dialogue box, the inputs and outputs of the function block can be configured on a graphic worksheet of the configuration tool.

In case of three phase currents (Figure 3), the phase currents $I_{L1}$, $I_{L2}$ and $I_{L3}$ are connected to the corresponding IL1, IL2 and IL3 inputs of the function block, whereas in case of two phase currents (Figure 4), the phase currents are connected to the first two phase current inputs and the third analogue input is left unconnected.

Digital inputs are connected to the boolean inputs of the function block and in the same way, the outputs of the function block are connected to the output signals.

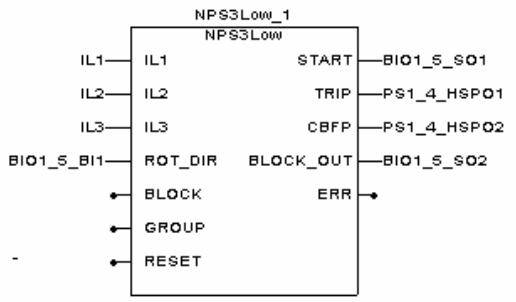


*Figure 3. Configuration example in case of three phase currents*

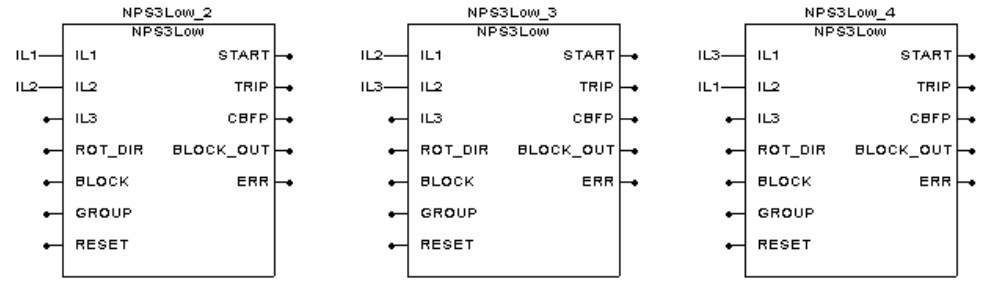


*Figure 4. Analogue channel connections in case of two phase currents*

In the input data and recorded data fields, the monitored phase currents are those actually connected to the corresponding inputs. For example, if the analogue channel IL3 is connected to the input IL1, the value of the “Current IL1” parameter is actually the value of phase current IL3.

The ROT_DIR input is used for motor protection. If status information about the motor rotation direction is available, it can be connected to the ROT_DIR input of the function block. In this case the control setting parameter “Dir. selection” must be set to value “Input rot.dir.”, which means the measured negative-sequence current and the operation of the function block are independent of the motor rotation direction.

## 2.2 Configuration error checking

When the relay is started, the function block checks that at least two phase currents are connected to the first two analogue inputs. If two currents are not connected, the ERR output is activated and the error event E13 is sent.

If the phase currents are connected in a different order compared to the configuration examples, the error event is not sent and the ERR output is not activated. In these cases, however, the control setting parameter “Dir. selection” must be set to “Reverse” value to achieve correct operation.

## 2.3 Measuring mode

Negative phase-sequence current can be calculated from two- or three-phase currents. The number of phase currents is set via the control setting parameter ”Num. of phases”. If only two phase currents are connected, the value of “Num. of phases” parameter is always two and cannot be changed. The negative-sequence current calculation is based on fundamental-frequency phase currents.

When three-phase currents are used, the negative-sequence current is calculated as follows:

$$I_2 = \tfrac{1}{3}\left|\underline{I}_R + \underline{I}_S \angle 240° + \underline{I}_T \angle 120°\right|$$

where $I_R$, $I_S$ and $I_T$ are phase currents.

In case of two-phase currents, the value of the neutral current is assumed to be 0, that is, $I_R+I_S+I_T=0$. Thus, the negative-sequence current is calculated as follows:

$$I_2 = \frac{\sqrt{3}}{3}\left|\underline{I}_R + \underline{I}_T \angle 60°\right|$$

where $I_R$ and $I_T$ are phase currents.

## 2.4 Operation criteria

The function block has the two operation modes “Definite time” and “Inverse time”. The type of operation is selected via the setting parameter ”Operation mode”.

In both operation modes the function block starts if the calculated negative phase-sequence exceeds the set start current, which is set via the “Start value” parameter. The parameter is common to the two operation modes.

Note! The default value of the “Start value” parameter is 20% of nominal, which is usual for motor protection. Generators are more sensitive to current unbalance and the negative sequence current value that a generator can stand continuously is usually between 5% and 10%. Therefore in case of generator protection a safer value for the “Start value” parameter is 5%.

### 2.4.1 Definite-time operation

The function block trips when the measured negative phase-sequence has remained over the set limit for the time set via the “Operate time” parameter. The “Operate time” parameter is used only in the definite-time operation.

When the function block trips, the BLOCK_OUT output is activated and will remain active for the set time. The cooling time is set via the “Cooling time” parameter. The same parameter is also used in the inverse-time operation. The BLOCK_OUT signal is used to prevent the auto-reclosing of an overheated generator.

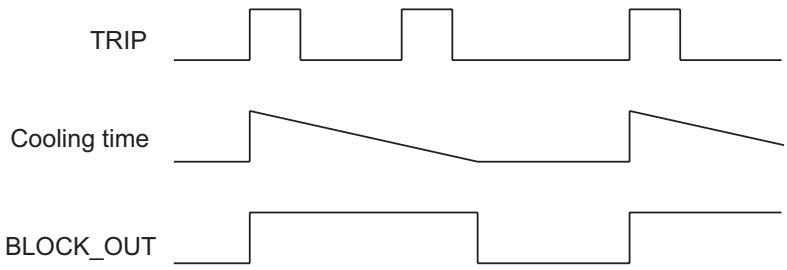


*Figure 5. Use of the “Cooling time” parameter*

For intermittent faults, the definite-time operation includes the delayed reset function. Without the delayed reset function the DT timer would reset once the negative-sequence current drops off.

When the DT timer has started, it goes on running normally even if the current drops off, provided the drop-off period is shorter than the set drop-off time. If the drop-off period is longer than the set drop-off time, the DT timer will reset when the drop-off time elapses (Figure 6).

In Figures 6 and 7 the input signal IN of the DT timer is TRUE when the current is above the set start value and FALSE when the current is below the set start value.

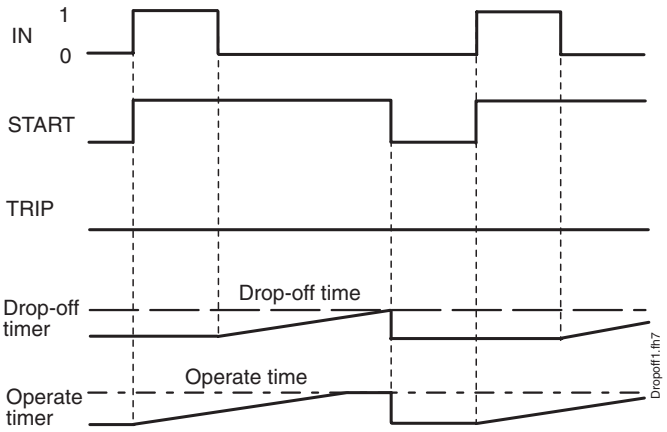


*Figure 6. The drop-off period is longer than the set drop-off time*

If the drop-off period is shorter than the set drop-off time and the DT timer time has elapsed during the drop-off period, the function block will trip once the current exceeds the set value again (Figure 7).

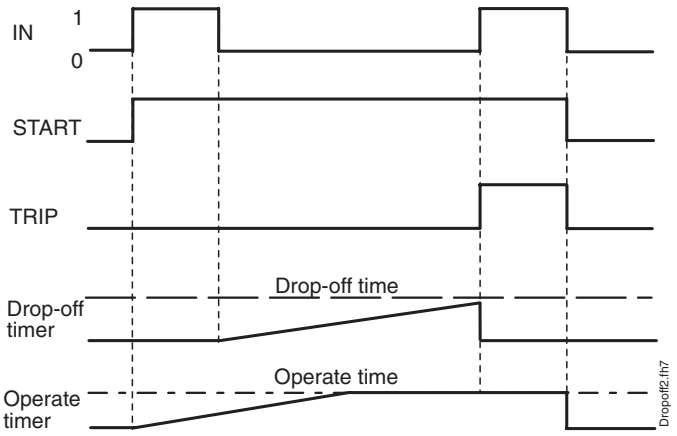


*Figure 7. The drop-off period is shorter than the set drop-off time*

## 2.4.2 Inverse-time operation

The operate time of the function block in the inverse-time mode is expressed mathematically as follows :

$$t = \frac{K}{\left(\frac{I_2}{I_N}\right)^2 - StartValue^2}$$

where

| | |
|---|---|
| t | relay operate time in seconds |
| $I_2$ | negative-sequence current |
| $I_N$ | rated current of the machine |
| Start value | Setting parameter that corresponds to the continuous negative-sequence current withstand of the machine, the $I_2$ current expressed in $xI_N$ (rated current of the machine) |
| K | Setting parameter that corresponds to the machine constant, equal to the $I_2^2t$ constant of the machine, as stated by the machine manufacturer |

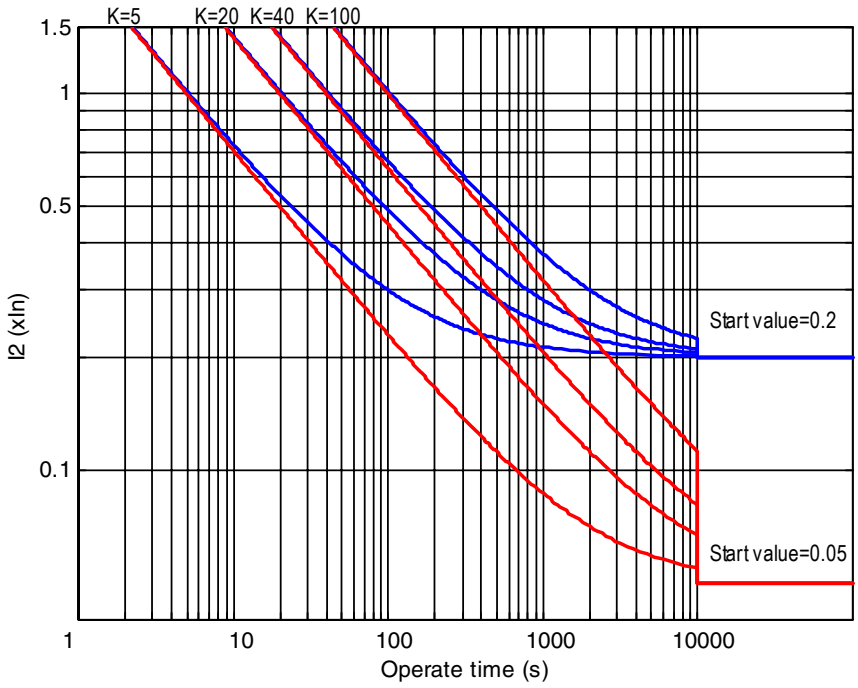


*Figure 8. The time/negative sequence current characteristics of NPS3Low and NPS3High*

When the measured negative-sequence current exceeds the set start current $I_2$, the function block starts accumulating a sum, the accumulate rate being proportional to the subtraction of the squared value of the actual negative-sequence current and the

squared value of the “Start value” parameter. When the sum exceeds the level corresponding to the setting parameter K, the function block operates. The higher the degree of current unbalance, the faster the sum increases, and as the operate level of the sum is defined only by the constant K, the negative-sequence relay will have an inverse-time operating characteristic which conforms to the thermal load characteristic of a rotating machine. When the overload disappears, the subtraction ($I_2^2$ - StartValue$^2$) becomes negative and the sum decreases. Thus, decrease of the sum indicates cooling of the machine, and the cooling speed depends on the value of the $I_2$ current. When the sum reaches 0, the accumulation is stopped.

The accumulation is also stopped and the sum is set to 0 if the negative-sequence current remains below the set limit for the set cooling time. Another purpose of the “Cooling time” parameter is to keep the BLOCK_OUT signal active after tripping for the set time. The BLOCK_OUT signal is used to prevent the auto-reclosing of the overheated generator.

In inverse-time operation, the delay of the START output can be set via the parameter “Start delay”. The start delay can be used for definite-time alarming when the START output is used as an alarm output. The set start delay does not affect the operate time of the function block.

The maximum operate time is limited for long-time low-level negative-sequence currents. The maximum operate time can be set via the “Maximum time” parameter and the minimum operate time via the “Minimum time” parameter. The meaning of the minimum and maximum time settings is illustrated in the figure below.

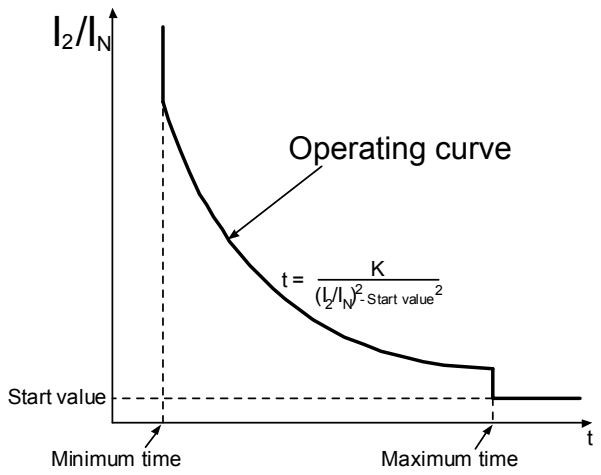


*Figure 9. Operating characteristic*

The setting parameters “K”, “Start delay”, “Minimum time” and “Maximum time” do not affect the definite-time mode.

## 2.5 Setting groups

Two different groups of setting values, group 1 and group 2, are available for each function block. Switching between the two groups can be done in the following three ways:

1 Locally via the control parameter “Group selection”[1)] of the MMI

2 Over the communication bus by writing the parameter V2[1)]

3 By means of the input signal GROUP when allowed via the parameter “Group selection” (i.e. when V2 = 2[1)])

[1)] Group selection (V2): 0 = Group 1; 1 = Group 2; 2 = GROUP input

The control parameter “Active group” indicates the setting group valid at a given time.

## 2.6 Test mode

The digital outputs of the function block can be activated with separate control parameters for each output either locally via the MMI or externally via the serial communication. When an output is activated with the test parameter, an event indicating the test is generated.

The protection functions operate normally while the outputs are tested.

## 2.7 START, TRIP and CBFP outputs

The output signal START is always pulse-shaped. The minimum pulse width of the corresponding output signal is set via a separate parameter on the MMI or on serial communication. If the start situation is longer than the set pulse width, the START signal remains active until the start situation is over.

The output signal TRIP may have a non-latching or latching feature. When the latching mode has been selected, the TRIP signal remains active until the output is reset even if the operation criteria have reset.

Each function block provides a delayed trip signal CBFP after the TRIP signal unless the fault has disappeared during the set CBFP time delay. In circuit-breaker failure protection, the CBFP output can be used to operate a circuit breaker in front of the circuit breaker of the machine. The control parameter “Trip pulse” also sets the width of the CBFP output signal.

## 2.8 Resetting

The TRIP output signal and the registers can be reset either via the RESET input, or over the serial bus or the local MMI.

The operation indicators, latched trip signal and recorded data can be reset as follows:

| | Operation indicators | Latched trip signal | Recorded data |
|---|---|---|---|
| RESET input of the function block [1] | | X | X |
| Parameter F077V013 for NPS3Low [1] | | X | X |
| Parameter F078V013 for NPS3High [1] | | X | X |
| General parameter F001V011 [2] | X | | |
| General parameter F001V012 [2] | X | X | |
| General parameter F001V013 [2] | X | X | X |
| Push-button C [2] | X | | |
| Push-buttons C + E (2 s) [2] | X | X | |
| Push-buttons C + E (5 s) [2] | X | X | X |

[1] Resets the latched trip signal and recorded data of this particular function block.
[2] Affects all function blocks.

# 3. Parameters and Events

## 3.1 General

- Each function block has a specific channel number for serial communication parameters and events. The channel for NPS3Low is 77 and that for NPS3High 78.
- The data direction of the parameters defines the use of each parameter as follows:

| Data direction | Description |
|---|---|
| R, R/M | Read only |
| W | Write only |
| R/W | Read and write |

- The different event mask parameters (see section “Control settings”) affect the visibility of events on the MMI or on serial communication (LON or SPA) as follows:

| | |
|---|---|
| Event mask 1 (FxxxV101/102) | SPA / MMI (LON) |
| Event mask 2 (FxxxV103/104) | LON |
| Event mask 3 (FxxxV105/106) | LON |
| Event mask 4 (FxxxV107/108) | LON |

For example, if only the events E3, E4 and E5 are to be seen on the MMI of the relay terminal, the event mask value 56 (8 + 16 + 32) is written to the “Event mask 1” parameter (FxxxV101).

In case a function block includes more than 32 events, there are two parameters instead of e.g. the “Event mask 1” parameter: the parameter “Event mask 1A” (FxxxV101) covers the events 0...31 and “Event mask 1B”(FxxxV102) the events 32...63.

## 3.2 Setting values

### 3.2.1 Actual settings

| Parameter | Code | Values | Unit | Default | Data direction | Explanation |
|---|---|---|---|---|---|---|
| Operation mode | S1 | 0...2 [1] | - | 1 | R/M | Selection of operation mode (definite- or inverse-time mode) |
| Start value | S2 | 0.01...0.50 | x $I_n$ | 0.20 | R/M | Start value of negative-sequence current $I_2$ |
| Operate time | S3 | 0.1...120.0 | s | 1.0 | R/M | Operate time in definite-time mode |
| K | S4 | 5.0...100.0 | - | 5.0 | R/M | Operating characteristic constant |
| Start delay | S5 | 0.1...60.0 | s | 1.0 | R/M | Definite start time in inverse-time mode |
| Minimum time | S6 | 0.1...120.0 | s | 0.1 | R/M | Definite minimum operate time |
| Maximum time | S7 | 500...10000 | s | 1000 | R/M | Maximum operate time regardless of the inverse characteristic |
| Cooling time | S8 | 5...10000 | s | 50 | R/M | Time required to cool the machine |

[1] Operation mode 0 = Not in use; 1 = Definite time; 2 = Inverse time

### 3.2.2 Setting group 1

| Parameter | Code | Values | Unit | Default | Data direction | Explanation |
|---|---|---|---|---|---|---|
| Operation mode | S41 | 0...2 [1] | - | 1 | R/W | Selection of operation mode (definite- or inverse-time mode) |
| Start value | S42 | 0.01...0.50 | x $I_n$ | 0.20 | R/W | Start value of negative-sequence current $I_2$ |
| Operate time | S43 | 0.1...120.0 | s | 1.0 | R/W | Operate time in definite-time mode |
| K | S44 | 5.0...100.0 | - | 5.0 | R/W | Operating characteristic constant |
| Start delay | S45 | 0.1...60.0 | s | 1.0 | R/W | Definite start time in inverse-time mode |
| Minimum time | S46 | 0.1...120.0 | s | 0.1 | R/W | Definite minimum operate time |
| Maximum time | S47 | 500...10000 | s | 1000 | R/W | Maximum operate time regardless of the inverse characteristic |
| Cooling time | S48 | 5...10000 | s | 50 | R/W | Time required to cool the machine |

[1] Operation mode 0 = Not in use; 1 = Definite time; 2 = Inverse time

### 3.2.3 Setting group 2

| Parameter | Code | Values | Unit | Default | Data direction | Explanation |
|---|---|---|---|---|---|---|
| Operation mode | S71 | 0...2 [1] | - | 1 | R/W | Selection of operation mode (definite- or inverse-time mode) |
| Start value | S72 | 0.01...0.50 | x $I_n$ | 0.20 | R/W | Start value of negative-sequence current $I_2$ |
| Operate time | S73 | 0.1...120.0 | s | 1.0 | R/W | Operate time in definite-time mode |
| K | S74 | 5.0...100.0 | - | 5.0 | R/W | Operating characteristic constant |
| Start delay | S75 | 0.1...60.0 | s | 1.0 | R/W | Definite start time in inverse-time mode |
| Minimum time | S76 | 0.1...120.0 | s | 0.1 | R/W | Definite minimum operate time |
| Maximum time | S77 | 500...10000 | s | 1000 | R/W | Maximum operate time regardless of the inverse characteristic |
| Cooling time | S78 | 5...10000 | s | 50 | R/W | Time required to cool the machine |

[1] Operation mode 0 = Not in use; 1 = Definite time; 2 = Inverse time

### 3.2.4 Control settings

| Parameter | Code | Values | Unit | Default | Data direction | Explanation |
|---|---|---|---|---|---|---|
| Num. of phases | V1 | 2...3 | - | 3 | R/W | Selection of two-phase or three-phase measurement |
| Group selection | V2 | 0...2 [1)] | - | 0 | R/W | Selection of the active setting group |
| Active group | V3 | 0 or 1 [2)] | - | 0 | R/M | Active setting group |
| Dir. selection | V4 | 0...2 [3)] | - | 0 | R/W | Selection of rotation direction |
| Rotation dir. | V5 | 0 or 1 [4)] | - | 0 | R/M | Rotation direction |
| Drop-off time | V6 | 0...1000 | ms | 0 | R/W | Resetting time of the operate time counter in DT mode |
| Start pulse | V7 | 0...1000 | ms | 0 | R/W | Minimum pulse width of START signal |
| Trip signal | V8 | 0 or 1 [5)] | - | 0 | R/W | Selection of latching feature for TRIP output |
| Trip pulse | V9 | 40...1000 | ms | 40 | R/W | Minimum pulse width of TRIP and CBFP |
| CBFP time | V10 | 100...1000 | ms | 100 | R/W | Operate time of the delayed trip CBFP |
| Reset registers | V13 | 1=Reset | - | 0 | W | Resetting of latched trip signal and registers |
| Test START | V31 | 0 or 1 [6)] | - | 0 | R/W | Testing of START |
| Test TRIP | V32 | 0 or 1 [6)] | - | 0 | R/W | Testing of TRIP |
| Test CBFP | V33 | 0 or 1 [6)] | - | 0 | R/W | Testing of CBFP |
| Event mask 1 | V101 | 0...4095 | - | 63 | R/W | Event mask 1 for event transmission (E0... E11) |
| Event mask 2 | V103 | 0... 4095 | - | 63 | R/W | Event mask 2 for event transmission (E0... E11) |
| Event mask 3 | V105 | 0... 4095 | - | 63 | R/W | Event mask 3 for event transmission (E0... E11) |
| Event mask 4 | V107 | 0... 4095 | - | 63 | R/W | Event mask 4 for event transmission (E0... E11) |

[1)] Group selection 0 = Group 1; 1 = Group 2; 2 = GROUP input
[2)] Active group 0 = Group 1; 1 = Group 2
[3)] Dir. selection 0 = Forward; 1 = Reverse; 2 = Input rot.dir.
[4)] Rotation dir. 0 = Forward; 1 = Reverse
[5)] Trip signal 0 = Non-latching; 1 = Latching
[6)] Test 0 = Do not activate; 1 = Activate

## 3.3 Measurement values

### 3.3.1 Input data

| Parameter | Code | Values | Unit | Default | Data direction | Explanation |
|---|---|---|---|---|---|---|
| Neg. seq. cur. | I1 | 0.00...60.00 | x In | 0.00 | R/M | Negative-sequence current I2 |
| Current IL1 | I2 | 0.00...60.00 | x In | 0.00 | R/M | Phase current IL1 |
| Current IL2 | I3 | 0.00...60.00 | x In | 0.00 | R/M | Phase current IL2 |
| Current IL3 | I4 | 0.00...60.00 | x In | 0.00 | R/M | Phase current IL3 |
| Input Rot. dir. | I5 | 0 or 1 [1] | - | 0 | R/M | Input signal for selecting rotation direction for the generator |
| Input BLOCK | I6 | 0 or 1 [2] | - | 0 | R/M | Input signal for blocking the function block |
| Input GROUP | I7 | 0 or 1 [2] | - | 0 | R/M | Signal for switching between groups 1 and 2 |
| Input RESET | I8 | 0 or 1 [2] | - | 0 | R/M | Signal for resetting the output signals and registers of NPS3Low or NPS3High |

[1] Rot. dir. 0 = forward; 1 = reverse
[2] Input 0 = Not active; 1 = Active

### 3.3.2 Output data

| Parameter | Code | Values | Unit | Default | Data direction | Explanation |
|---|---|---|---|---|---|---|
| Output START | O1 | 0 or 1 [1] | - | 0 | R/M | Status of start signal |
| Output TRIP | O2 | 0 or 1 [1] | - | 0 | R/M | Status of trip signal |
| Output BLOCK | O3 | 0 or 1 [1] | - | 0 | R/M | Status of BLOCK_OUT signal (signal for keeping the machine separated from the power system) |
| Output CBFP | O4 | 0 or 1 [1] | - | 0 | R/M | Status of CBFP signal |

[1] Output 0 = Not active; 1 = Active

### 3.3.3 Recorded data

#### 3.3.3.1 General

The information required for later fault analysis is recorded when the function block starts or trips.

The data of three last operations (operation 1...3) are recorded and the values of the most recent operation always replace the data of the oldest operation. The registers are updated in the following order: Operation 1, Operation 2, Operation 3, Operation 1, Operation 2,...

#### 3.3.3.2 Date and time

The time stamp indicates the rising edge of the START or TRIP signal.

#### 3.3.3.3 Duration

The duration of the start situation is recorded as a percentage of the calculated operate time.

#### 3.3.3.4 Currents

If the function block trips or starts, the negative-sequence current is updated at the moment of tripping or starting i.e. on the rising edge of the TRIP or START signal. The negative-sequence current is recorded as a multiple of the rated current $I_n$.

#### 3.3.3.5 Status data

The status data of the input signal BLOCK (Active or Not active) and the parameters “Rotation dir.” and “Active group” are recorded at the moment of triggering.The “Rotation dir.” parameter indicates the rotation direction of the machine and the “Active group” parameter the setting group valid for the recorded data.

### 3.3.3.6 Priority

The priority of the recording function is the following:

1 Tripping
2 Starting

### 3.3.3.7 Recorded data 1

| Parameter | Code | Values | Unit | Default | Data direction | Explanation |
|---|---|---|---|---|---|---|
| Date | V201 | YYYY-MM-DD | - | - | R/M | Recording date |
| Time | V202 | hh:mm:ss.mss | - | - | R/M | Recording time |
| Duration | V203 | 0.0...100.0 | % | 0.0 | R/M | Duration of start situation |
| Neg. seq. cur. | V204 | 0.00...60.00 | x In | 0.00 | R/M | Negative-sequence current |
| Current IL1 | V205 | 0.00...60.00 | x In | 0.00 | R/M | Filtered value of IL1 |
| Current IL2 | V206 | 0.00...60.00 | x In | 0.00 | R/M | Filtered value of IL2 |
| Current IL3 | V207 | 0.00...60.00 | x In | 0.00 | R/M | Filtered value of IL3 |
| Rotation dir. | V208 | 0 or 1 [1] | - | 0 | R/M | Status of rotation direction |
| BLOCK | V209 | 0 or 1 [2] | - | 0 | R/M | Status of BLOCK input |
| Active group | V210 | 0 or 1 [3] | - | 0 | R/M | Active setting group |

[1] Rotation dir. 0 = Forward; 1 = Reverse
[2] BLOCK 0 = Not active; 1 = Active
[3] Active group 0 = Group 1; 1 = Group 2

### 3.3.3.8 Recorded data 2

| Parameter | Code | Values | Unit | Default | Data direction | Explanation |
|---|---|---|---|---|---|---|
| Date | V301 | YYYY-MM-DD | - | - | R/M | Recording date |
| Time | V302 | hh:mm:ss.mss | - | - | R/M | Recording time |
| Duration | V303 | 0.0...100.0 | % | 0.0 | R/M | Duration of start situation |
| Neg. seq. cur. | V304 | 0.00...60.00 | x In | 0.00 | R/M | Negative-sequence current |
| Current IL1 | V305 | 0.00...60.00 | x In | 0.00 | R/M | Filtered value of IL1 |
| Current IL2 | V306 | 0.00...60.00 | x In | 0.00 | R/M | Filtered value of IL2 |
| Current IL3 | V307 | 0.00...60.00 | x In | 0.00 | R/M | Filtered value of IL3 |
| Rotation dir. | V308 | 0 or 1 [1] | - | 0 | R/M | Status of rotation direction |
| BLOCK | V309 | 0 or 1 [2] | - | 0 | R/M | Status of BLOCK input |
| Active group | V310 | 0 or 1 [3] | - | 0 | R/M | Active setting group |

[1] Rotation dir. 0 = Forward; 1 = Reverse
[2] BLOCK 0 = Not active; 1 = Active
[3] Active group 0 = Group 1; 1 = Group 2

### 3.3.3.9 Recorded data 3

| Parameter | Code | Values | Unit | Default | Data direction | Explanation |
|---|---|---|---|---|---|---|
| Date | V401 | YYYY-MM-DD | - | - | R/M | Recording date |
| Time | V402 | hh:mm:ss.mss | - | - | R/M | Recording time |
| Duration | V403 | 0.0...100.0 | % | 0.0 | R/M | Duration of start situation |
| Neg. seq. cur. | V404 | 0.00...60.00 | x In | 0.00 | R/M | Negative-sequence current |
| Current IL1 | V405 | 0.00...60.00 | x In | 0.00 | R/M | Filtered value of IL1 |
| Current IL2 | V406 | 0.00...60.00 | x In | 0.00 | R/M | Filtered value of IL2 |
| Current IL3 | V407 | 0.00...60.00 | x In | 0.00 | R/M | Filtered value of IL3 |
| Rotation dir. | V408 | 0 or 1 [1] | - | 0 | R/M | Status of rotation direction |
| BLOCK | V409 | 0 or 1 [2] | - | 0 | R/M | Status of BLOCK input |
| Active group | V410 | 0 or 1 [3] | - | 0 | R/M | Active setting group |

[1] Rotation dir. 0 = Forward; 1 = Reverse
[2] BLOCK 0 = Not active; 1 = Active
[3] Active group 0 = Group 1; 1 = Group 2

## 3.3.4 Events

| Code | Weighting coefficient | Default mask | Event reason | Event state |
|---|---|---|---|---|
| E0 | 1 | 1 | START signal from I2> or I2>> stage | Reset |
| E1 | 2 | 1 | START signal from I2> or I2>> stage | Activated |
| E2 | 4 | 1 | TRIP signal from I2> or I2>> stage | Reset |
| E3 | 8 | 1 | TRIP signal from I2> or I2>> stage | Activated |
| E4 | 16 | 1 | CBFP signal from I2> or I2>> stage | Reset |
| E5 | 32 | 1 | CBFP signal from I2> or I2>> stage | Activated |
| E6 | 64 | 0 | BLOCK_OUT signal from I2> or I2>> stage | Reset |
| E7 | 128 | 0 | BLOCK_OUT signal from I2> or I2>> stage | Activated |
| E8 | 256 | 0 | BLOCK signal of I2> or I2>> stage | Reset |
| E9 | 512 | 0 | BLOCK signal of I2> or I2>> stage | Activated |
| E10 | 1024 | 0 | Test mode of I2> or I2>> stage | Off |
| E11 | 2048 | 0 | Test mode of I2> or I2>> stage | On |

# 4. Technical Data

| | |
|---|---|
| **Operation accuracies** | Depends on the frequency of the current measured:<br>$f/f_n$ = 0.95...1.05: ± 2.5% of set value or ± 0.01 x $I_n$. |
| **Start time** | Injected negative-seq. current = 2.00 x start value:<br>$f/f_n$ = 0.95...1.05 internal time < 32 ms<br>total time[1] < 40 ms |
| **Reset time** | 40...1000 ms<br>(depends on the minimum pulse width set for the TRIP output) |
| **Reset ratio** | Typ. 0.96 (range 0.95...0.98) in definite-time mode |
| **Retardation time** | Total retardation time when the negative-sequence current drops below the start value[2] < 45 ms |
| **Operate time accuracy in definite-time mode** | Depends on the frequency of the current measured:<br>$f/f_n$ = 0.95...1.05: ± 2% of set value or ± 20 ms[2] |
| **Accuracy class index E in inverse-time mode** | Depends on the frequency of the current measured:<br>$f/f_n$ = 0.95...1.05: ± 2% of the calculated ideal operate time or ± 20 ms[2] |
| **Configuration data** | Task execution interval (Relay Configuration Tool):10 ms<br>at the rated frequency $f_n$ = 50 Hz |

[1] Includes the delay of the signal relay
[2] Includes the delay of the heavy-duty output relay

| **Technical revision history** | |
|---|---|
| **Technical revision** | **Change** |
| E | - |
| F | - |
| G | Events E12 and E13 removed.<br>Parameter Output ERR changed to Output CBFP. |