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NOC3_
Three-Phase Non-Directional Overcurrent Protection Low-Set Stage (NOC3Low) Low-Set Stage (NOC3LowB) High-Set Stage (NOC3High) Instantaneous Stage (NOC3Inst)

Contents

1. Introduction

1.1 Features

- Non-directional overcurrent protection
- Definite-time (DT) operation
- NOC3Low and NOC3LowB: fourteen inverse-time (IDMT) characteristics
- Current measurement with conventional current transformers or Rogowski coils
- Two alternative measuring principles: the average value of consecutive instantaneous peak-to-peak values or the numerically calculated fundamental frequency component of the short-circuit current
- NOC3High and NOC3Inst: Fast blocking output to be used in blocking-based busbar protection
- Delayed trip output for the circuit-breaker failure protection (CBFP) function

1.2 Application

This document specifies the functions of the three-phase non-directional overcurrent function blocks NOC3Low, NOC3LowB, NOC3High and NOC3Inst used in products based on the RED 500 Platform. The inverse-time operation is only included in the NOC3Low and NOC3LowB function blocks.

The three-phase non-directional overcurrent function blocks are designed for non-directional two-phase and three-phase overcurrent and short-circuit protection whenever the DT characteristic or, as concerns NOC3Low and NOC3LowB, the IDMT (Inverse Definite Minimum Time) characteristic is appropriate. Suppression of harmonics is possible.

Table 1 . Protection diagram symbols used in the relay terminal

ABB	IEC	ANSI
NOC3Low	**3I>**	**51-1**
NOC3LowB	**3I>_B**	**51-4**
NOC3High	**3I>>**	**51-2**
NOC3Inst	**3I>>>**	**51-3**

For IEC symbols used in single line diagrams, refer to the manual “Technical Descriptions of Functions, Introduction”, 1MRS750528-MUM.

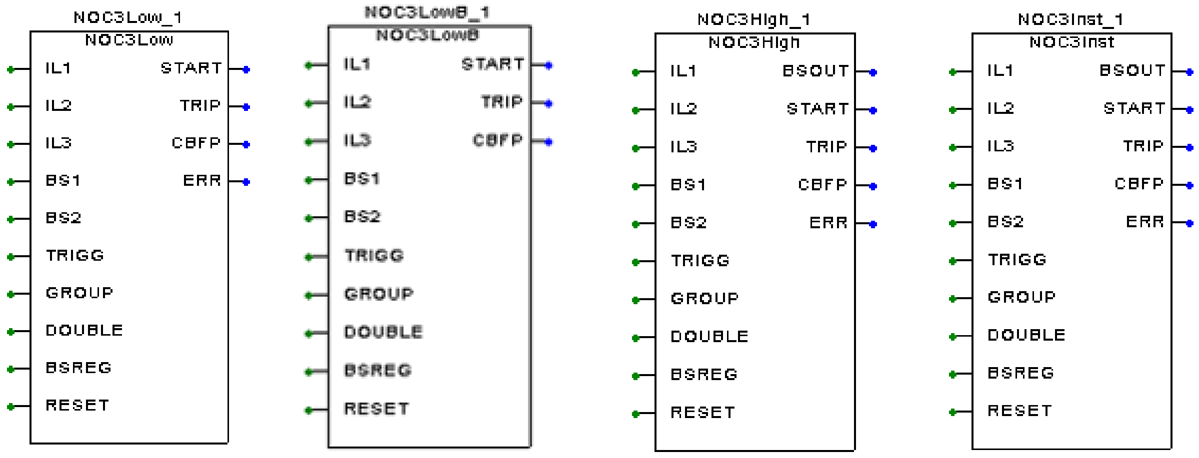

Figure 1.2.-1 Function block symbols of NOC3Low, NOC3LowB, NOC3High and NOC3Inst

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}
BS1	Digital signal (BOOL, active high)	Blocking signal 1
BS2	Digital signal (BOOL, active high)	Blocking signal 2
TRIGG	Digital signal (BOOL, pos. edge)	Control signal for triggering the registers
GROUP	Digital signal (BOOL, active high)	Control input for switching between the setting groups 1 and 2. When GROUP is FALSE, group 1 is active. When GROUP is TRUE, group 2 is active.
DOUBLE	Digital signal (BOOL, active high)	Input signal for doubling the set start current value temporarily at magnetizing inrush or start-up
BSREG	Digital signal (BOOL, active high)	Input for blocking the recording function
RESET	Reset signal (BOOL, pos. edge)	Input signal for resetting the trip signal and registers of NOC3Low, NOC3LowB, NOC3High and NOC3Inst

1.4 Output description

NOC3Low and NOC3LowB

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)
ERR	Digital signal (BOOL, active high)	Signal for indicating a configuration error

NOC3High and NOC3Inst

Name	Type	Description
BSOUT	Digital signal (BOOL, active high)	Blocking signal for blocking-based busbar protection
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)
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 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. The phase currents I_{L1}, I_{L2} and I_{L3} are connected to the corresponding IL1, IL2 and IL3 inputs of the function block. At least one phase current is required to be connected. Furthermore, 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.

2.2 Measuring mode

The function block operates on two alternative measuring principles: the average value of consecutive instantaneous peak-to-peak values or the numerically calculated fundamental frequency component of the short-circuit current. The measuring mode is selected by means of either an HMI parameter or a serial communication parameter.

With both the measuring principles, the operation is insensitive to the DC component and the operation accuracy is defined in the frequency range f/f_n=0.95...1.05. In peak-to-peak measurement, the harmonics of the phase currents are not suppressed, whereas in fundamental frequency measurement the harmonics suppression is at least -50 dB at f = n x f_n, where n = 2, 3, 4, 5,...

2.3 Operation criteria

The function starts if the current in one or more phases exceeds the set start current. The set start current is automatically doubled when the signal connected to the input DOUBLE is active. The function block Inrush3 can be used for doubling, e.g. during a magnetizing inrush or at start-up.

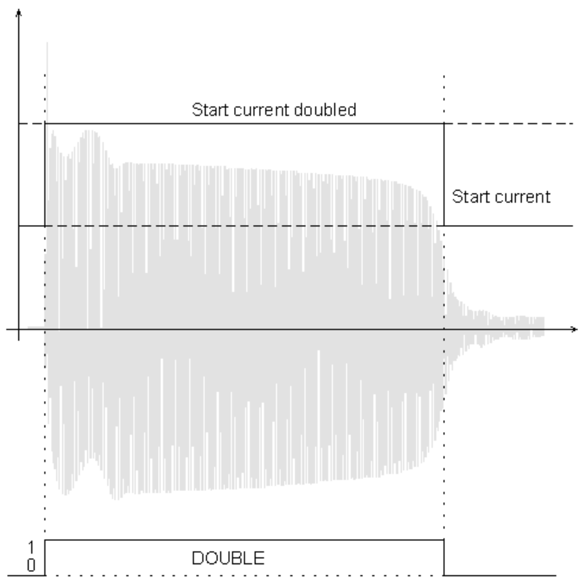

Figure 2.3.-1 Function of NOC3Low, NOC3LowB, NOC3High and NOC3Inst when the DOUBLE input is activated by the Inrush3 function block

When the function block starts, the START signal is set to TRUE. Should the overcurrent situation exceed the set definite operate time or, at the inverse-time operation, the time determined by the level of the measured current, the function block operates. The internal delay of the heavy-duty output relay is included in the total operate time. When the function block operates, the TRIP signal is set to TRUE. Operation mode instantaneous is selectable in the function blocks NOC3High and NOC3Inst. In instantaneous mode the TRIP signal is set active immediately.

Additionally, the function blocks NOC3High and NOC3Inst have a fast blocking output to be used in interlocking-based busbar protection. Once a phase current exceeds the set start current, the BSOUT signal is set to TRUE. The BSOUT signal remains active for at least 20 ms. The START output is set to TRUE if at least one digitally filtered phase current exceeds the start current. If the START signal is not activated within the 20 ms, the signal BSOUT will reset.

The DT or IDMT timer is allowed to run only if the blocking signal BS1 is inactive, i.e. its value is FALSE. When the signal becomes active, i.e. its value turns to TRUE, the timer will be stopped (frozen).

When the blocking signal BS2 is active, the TRIP signal cannot be activated. The TRIP signal can be blocked by activating the signal BS2 until the function block drops off.

2.4 Delayed reset facility and drop-off time in DT and IDMT modes

The purpose of the delayed reset function is to enable fast clearance of intermittent faults, e.g. self-sealing insulation faults, and severe faults which may produce high asymmetrical fault currents that partially saturate the current transformers. It is typical for an intermittent fault that the fault current contains so called drop-off periods during which the fault current is below the set start current. Without the delayed reset function the DT or the IDMT timer would reset once the current drops off. In the same way, an apparent drop-off period of the secondary current of the saturated current transformer might reset the DT or the IDMT timer. The adjustable delayed reset function also enables closer co-ordination with electromechanical induction disc relays.

When the DT timer has started, it goes on running as normally even if the current drops off, provided the drop-off period is shorter than the set drop-off time. In the same situation, the IDMT timer is frozen. If the drop-off period is longer than the set drop-off time, the DT or the IDMT timer will be reset when the drop-off time elapses. The situation in the case of the DT timer is described in Figure 2.4.-1.

In Figures 2.4.-1 and 2.4.-2 the input signal IN of the DT or the IDMT timer is TRUE when the current is above the set start value and FALSE when the current is below the set start value.

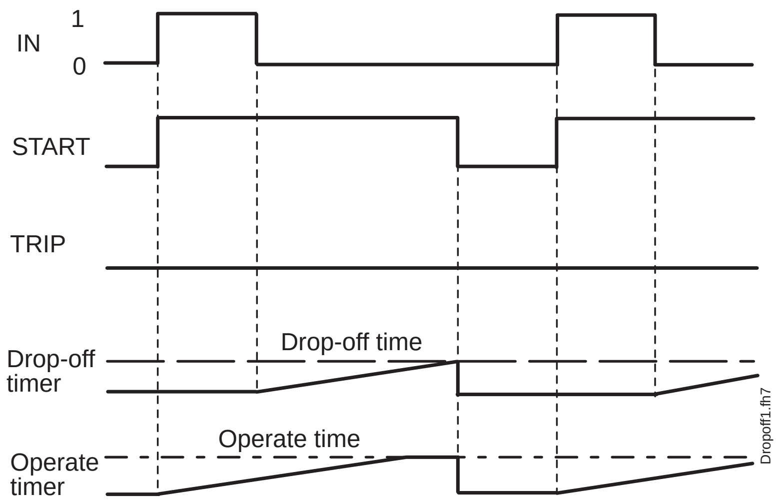

Figure 2.4.-1 The drop-off period is longer than the set drop-off time

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 2.4.-2).

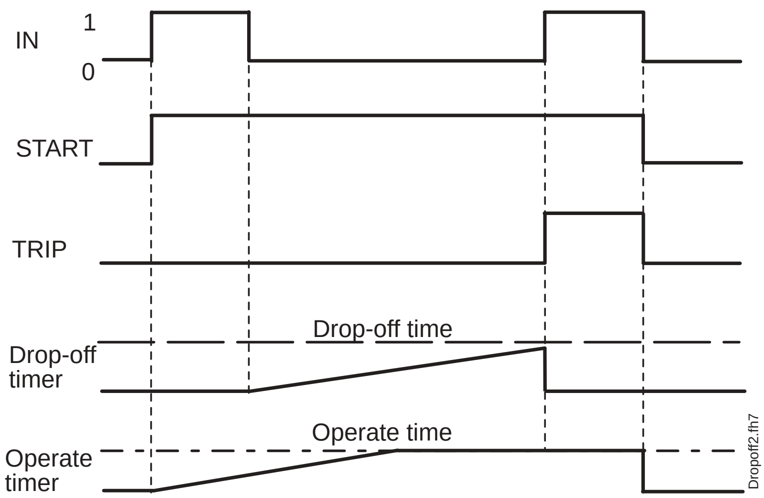

Figure 2.4.-2 The drop-off period is shorter than the set drop-off time

2.5 IDMT type operation of NOC3Low and NOC3LowB

In the inverse-time mode the operate time of the stage is a function of the current; the higher the current, the shorter is the operate time. Fourteen time/current curve groups are available. Four of the groups comply with the BS 142 and IEC 60255 standards, whereas the two curve groups RI and RD (RXIDG) are special type of curve groups corresponding to the ABB praxis. Eight IEEE curves comply with the IEEE C37.112 standard. The setting "Operation mode" is used for selecting the desired operate time characteristic.

The shortest operate time at the inverse-time operation is limited by a special adjustable minimum time located in control settings. The definite minimum time will not allow operate times shorter than the set minimum time, which is why the inverse-time mode is called the IDMT mode (Inverse Definite Minimum Time).

2.5.1 Standard curve groups

The four internationally standardized inverse-time characteristics incorporated in the inverse-time operation of the function are:

- Normal inverse (NI)
- Very inverse (VI)
- Extremely inverse (EI)
- Long-time inverse (LI)

(For a graphical presentation of the curves, refer to the manual Technical Descriptions of Functions, Introduction.)

The relationship between time and current is in accordance with the standard IEC 60255-4 and can be expressed as follows

$$t[s] = \frac{k \times \beta}{(\frac{I}{I>})^{\alpha} - 1}$$

where

t	operate time in seconds
k	adjustable time multiplier, parameters S4, S44 and S74
I	phase current
I>	adjustable start current, parameters S2, S42 and S72
α, β	constants to provide selected curve characteristics

The values of the constants a and b determine the slope as follows

Inverse-time characteristic	α	β
Normal inverse	0.02	0.14
Very inverse	1.0	13.5
Extremely inverse	2.0	80.0
Long-time inverse	1.0	120

According to the standard BS 142: 1966 the effective current range is defined as 2...20 times the set start current. If the time/current characteristic is normal inverse, very inverse or extremely inverse, the function has to start at the latest when the current exceeds the set start current by 1.3 times. For the long-time inverse characteristic, the effective current range is specified to be 2...7 times the set start current and the relay is to start at the latest when the current exceeds the setting value by 1.1 times. The three-phase non-directional overcurrent function blocks NOC3Low and NOC3LowB will start and the IDMT integration will begin once the current exceeds the set start value.

The operate time tolerances specified by the standard BS 142 : 1966 are the following (E denotes the accuracy in percent):

I/I >	Normal	Very	Extremely	Long time
2	2.22E	2.34E	2.44E	2.34E
5	1.13E	1.26E	1.48E	1.26E
7	-	-	-	1.00E
10	1.01E	1.01E	1.02E	-
20	1.00E	1.00E	1.00E	-

The tolerance factors are in accordance to those defined by the standard BS 142: 1966 for currents 2 and 5 times the setting. The function block NOC3Low and NOC3LowB complies with the tolerances of class 5 (E = 5.0%) for all inverse-time curves.

For example:

I/I>= 10, characteristic = Normal
Operate time tolerance = 1.01 x 5.0% = 5.05%

2.5.2 RI curve groups

The RI-type inverse-time characteristic is a special characteristic mainly used to obtain time grading with mechanical relays. The characteristic can be expressed as follows:

$$t[s] = \frac{k}{0.339 - 0.236 \text{ x } \frac{I>}{I}}$$

2.5.3 RD curve groups

The RD-type characteristic is a special characteristic mainly used in earth-fault protection where a high degree of selectivity is required also at high-resistance faults. Mathematically, the characteristic can be expressed as follows:

$$t[s] = 5.8 - 1.35 \text{ x } \ln \frac{I}{k \text{ x } I>}$$

The accuracy of the RI- and RD-type characteristics is 5%. Also with the RI- and RD-type characteristics, the function block will start and the IDMT integration will begin once the current exceeds the set start current.

2.5.4 IEEE curve groups

IEEE time overcurrent curve equation according to the standard IEEE C37.112:

$$t[s] = \left(\frac{A}{\left(\frac{I}{I>}\right)^p - 1} + B \right) \times n$$

where	I>	adjustable start current, parameters S2, S42 and S72
	n	adjustable IEEE time dial setting, parameters S5, S45 and S75
	A, B, p	constants to provide selected curve characteristics

Curve	A	B	p
IEEE Extremely Inverse	6.407	0.025	2.0
IEEE Very Inverse	2.855	0.0712	2.0
IEEE Inverse	0.0086	0.0185	0.02
IEEE Short Time Inverse	0.00172	0.0037	0.02
IEEE Short Time Ext. Inverse	1.281	0.005	2.0
IEEE Long Time Ext. Inv.	64.07	0.250	2.0
IEEE Long Time Very Inv.	28.55	0.712	2.0
IEEE Long Time Inverse	0.086	0.185	0.02

2.6 Setting groups

Two different groups of setting values, group 1 and group 2, are available for the 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 HMI

2 Over the communication bus by writing the parameter V3[1)]

3 By means of the input signal GROUP when allowed via the parameter “Group selection” (i.e. when V3 = 2[1)]).

[1)] Group selection (V3): 0 = Group 1; 1 = Group 2; 2 = GROUP input

The group settings come into effect immediately after the selection. The control parameter "Active group" indicates the setting group, which is valid at a given time.

2.7 Test mode

The digital outputs of the function block can be activated with separate control settings for each output either locally via the HMI 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.

2.8 START, TRIP, BSOUT and CBFP outputs

The output signal START is always pulse-shaped. The minimum pulse width of the START and TRIP output signals is set via a separate parameter on the HMI or on the 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. If the start situation is longer than the set pulse width and the non-latching mode has been selected, the TRIP signal remains active until the start situation is over. When the latching mode has been selected, the TRIP signal remains active until the output is reset even if the operation criteria have reset.

The output signal BSOUT of NOC3High and NOC3Inst is always pulse-shaped with the minimum width of 20 ms.

The circuit-breaker failure protection function provides a delayed trip signal, CBFP, after the TRIP signal unless the fault has disappeared during the set CBFP time delay. The CBFP output can be used to operate a circuit breaker in front of the circuit breaker of the feeder.

Note! The control parameter "Trip pulse" also sets the pulse width of the CBFP output signal. The CBFP signal resets when the set pulse width elapses, even if the start situation is still active. Therefore, if the CBFP function is used, a setting value of 200ms or longer for the control parameter "Trip pulse" is recommended.

2.9 Resetting

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

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 F031V013 for NOC3Low[1]		X	X
Parameter F053V013 for NOC3LowB[1]		X	X
Parameter F032V013 for NOC3High[1]		X	X
Parameter F033V013 for NOC3Inst[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 the 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 NOC3Low is 31, that for NOC3LowB 53, that for NOC3High 32 and that for NOC3Inst 33.
- 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 HMI or on serial communication (LON or SPA) as follows:

Event mask 1 (FxxxV101/102)	SPA / HMI (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 HMI 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

NOC3Low and NOC3LowB

Parameter	Code	Values	Unit	Default	Data direction	Explanation
Operation mode	S1	0 ... 15 [1)]	-	1	R	Selection of operation mode and inverse-time characteristic
Start current	S2	0.10...5.00	x In	0.10	R	Start current
Operate time	S3	0.05...300.00	s	0.05	R	Operate time in DT mode
Time multiplier	S4	0.05...1.00	-	0.05	R	Time multiplier ‘k’ in IDMT mode
IEEE time dial	S5	0.5...15.0	-	0.5	R	IEEE time dial ‘n’ in IDMT mode

[1)] Operation mode 0 = Not in use; 1 = Definite time; 2 = Extremely inv.; 3 = Very inv.; 4 = Normal inv.; 5 = Long-time inv.; 6 = RI-type inv.; 7 = RD-type inv. .; 8 = IEEE Ext.; 9 = IEEE Very inv.; 10 = IEEE Inverse; 11 = IEEE S.T. inv.; 12 = IEEE S.T.E. inv; 13 = IEEE L.T.E. inv.; 14 = IEEE L.T.V. inv.; 15 = IEEE L.T. inv.

NOC3High and NOC3Inst

Parameter	Code	Values	Unit	Default	Data direction	Explanation
Operation mode	S1	0 ... 2 [1)]	-	1	R	Selection of operation mode
Start current	S2	0.10...40.00	x In	0.10	R	Start current
Operate time	S3	0.05...300.00	s	0.05	R	Operate time in DT mode

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

3.2.2 Setting group 1

NOC3Low and NOC3LowB

Parameter	Code	Values	Unit	Default	Data direction	Explanation
Operation mode	S41	0 ... 15 [1)]	-	1	R/W	Selection of operation mode and inverse-time characteristic
Start current	S42	0.10...5.00	x In	0.10	R/W	Start current
Operate time	S43	0.05...300.00	s	0.05	R/W	Operate time in DT mode
Time multiplier	S44	0.05...1.00	-	0.05	R/W	Time multiplier ‘k’ in IDMT mode
IEEE time dial	S45	0.5...15.0	-	0.5	R/W	IEEE time dial ‘n’ in IDMT mode

[1)] Operation mode 0 = Not in use; 1 = Definite time; 2 = Extremely inv.; 3 = Very inv.; 4 = Normal inv.; 5 = Long time inv.; 6 = RI-type inv.; 7 = RD-type inv. .; 8 = IEEE Ext.; 9 = IEEE Very inv.; 10 = IEEE Inverse; 11 = IEEE S.T. inv.; 12 = IEEE S.T.E. inv; 13 = IEEE L.T.E. inv.; 14 = IEEE L.T.V. inv.; 15 = IEEE L.T. inv.

NOC3High and NOC3Inst

Parameter	Code	Values	Unit	Default	Data direction	Explanation
Operation mode	S41	0 ... 2 [1)]	-	1	R/W	Selection of operation mode
Start current	S42	0.10...40.00	x In	0.10	R/W	Start current
Operate time	S43	0.05...300.00	s	0.05	R/W	Operate time in DT mode

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

3.2.3 Setting group 2

NOC3Low and NOC3LowB

Parameter	Code	Values	Unit	Default	Data direction	Explanation
Operation mode	S71	0 ... 15 [1)]	-	1	R/W	Selection of operation mode and inverse-time characteristic
Start current	S72	0.10...5.00	x In	0.10	R/W	Start current
Operate time	S73	0.05...300.00	s	0.05	R/W	Operate time in DT mode
Time multiplier	S74	0.05...1.00	-	0.05	R/W	Time multiplier ‘k’ in IDMT mode
IEEE time dial	S75	0.5...15.0	-	0.5	R/W	IEEE time dial ‘n’ in IDMT mode

[1)] Operation mode 0 = Not in use; 1 = Definite time; 2 = Extremely inv.; 3 = Very inv.; 4 = Normal inv.; 5 = Long time inv.; 6 = RI-type inv.; 7 = RD-type inv. .; 8 = IEEE Ext.; 9 = IEEE Very inv.; 10 = IEEE Inverse; 11 = IEEE S.T. inv.; 12 = IEEE S.T.E. inv; 13 = IEEE L.T.E. inv.; 14 = IEEE L.T.V. inv.; 15 = IEEE L.T. inv.

NOC3High and NOC3Inst

Parameter	Code	Values	Unit	Default	Data direction	Explanation
Operation mode	S71	0 ... 2 [1)]	-	1	R/W	Selection of operation mode
Start current	S72	0.10...40.00	x In	0.10	R/W	Start current
Operate time	S73	0.05...300.00	s	0.05	R/W	Operate time in DT mode

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

3.2.4 Control settings

NOC3Low and NOC3LowB

Parameter	Code	Values	Unit	Default	Data direction	Explanation
Measuring mode	V1	0 or 1 [1)]	-	0	R/W	Selection of measuring mode
Drop-off time	V2	0...1000	ms	0	R/W	Resetting time of the operate time counter
Group selection	V3	0 ... 2 [2)]	-	0	R/W	Selection of the active setting group
Active group	V4	0 or 1 [3)]	-	0	R/M	Active setting group
Start pulse	V5	0...1000	ms	0	R/W	Minimum pulse width of START signal
Trip signal	V6	0 or 1 [4)]	-	0	R/W	Selection of latching feature for TRIP output
Trip pulse	V7	40...1000	ms	40	R/W	Minimum pulse width of TRIP and CBFP
Minimum time	V8	0.03...10.00	s	0.03	R/W	Minimum operate time in IDMT mode
CBFP time	V9	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 [5)]	-	0	R/W	Testing of START
Test TRIP	V32	0 or 1 [5)]	-	0	R/W	Testing of TRIP
Test CBFP	V33	0 or 1 [5)]	-	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)] Measuring mode 0 = Peak-to-peak; 1 = Fundam.freq.
[2)] Group selection 0 = Group 1; 1 = Group 2; 2 = GROUP input
[3)] Active group 0 = Group 1; 1 = Group 2
[4)] Trip signal 0 = Non-latching; 1 = Latching
[5)] Test 0 = Do not activate; 1 = Activate

NOC3High and NOC3Inst

Parameter	Code	Values	Unit	Default	Data direction	Explanation
Measuring mode	V1	0 or 1 [1]	-	0	R/W	Selection of measuring mode
Drop-off time	V2	0...1000	ms	0	R/W	Resetting time of the operate time counter
Group selection	V3	0 ... 2 [2]	-	0	R/W	Selection of the active setting group
Active group	V4	0 or 1 [3]	-	0	R/M	Active setting group
Start pulse	V5	0...1000	ms	0	R/W	Minimum pulse width of START signal
Trip signal	V6	0 or 1 [4]	-	0	R/W	Selection of latching feature for TRIP output
Trip pulse	V7	40...1000	ms	40	R/W	Minimum pulse width of TRIP and CBFP
CBFP time	V8	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 [5]	-	0	R/W	Testing of START
Test TRIP	V32	0 or 1 [5]	-	0	R/W	Testing of TRIP
Test CBFP	V33	0 or 1 [5]	-	0	R/W	Testing of CBFP
Event mask 1	V101	0...16383	-	63	R/W	Event mask 1 for event transmission (E0 ... E13)
Event mask 2	V103	0...16383	-	63	R/W	Event mask 2 for event transmission (E0 ... E13)
Event mask 3	V105	0...16383	-	63	R/W	Event mask 3 for event transmission (E0 ... E13)
Event mask 4	V107	0...16383	-	63	R/W	Event mask 4 for event transmission (E0 ... E13)

[1] Measuring mode 0 = Peak-to-peak; 1 = Fundam.freq.
[2] Group selection 0 = Group 1; 1 = Group 2; 2 = GROUP input
[3] Active group 0 = Group 1; 1 = Group 2
[4] Trip signal 0 = Non-latching; 1 = Latching
[5] Test 0 = Do not activate; 1 = Activate

3.3 Measurement values

3.3.1 Input data

Parameter	Code	Values	Unit	Default	Data direction	Explanation
Current IL1	I1	0.00...60.00	x In	0.00	R/M	Phase current I_{L1}
Current IL2	I2	0.00...60.00	x In	0.00	R/M	Phase current I_{L2}
Current IL3	I3	0.00...60.00	x In	0.00	R/M	Phase current I_{L3}
Input BS1	I4	0 or 1 [1)]	-	0	R/M	Block signal BS1
Input BS2	I5	0 or 1 [1)]	-	0	R/M	Block signal BS2
Input TRIGG	I6	0 or 1 [1)]	-	0	R/M	Signal for triggering the registers
Input GROUP	I7	0 or 1 [1)]	-	0	R/M	Signal for switching between the groups 1 and 2
Input DOUBLE	I8	0 or 1 [1)]	-	0	R/M	Signal for doubling the set start current
Input BSREG	I9	0 or 1 [1)]	-	0	R/M	Signal for blocking the recording function
Input RESET	I10	0 or 1 [1)]	-	0	R/M	Signal for resetting the output signals and registers of NOC3Low, NOC3LowB, NOC3High or NOC3Inst

[1)] Input 0 = Not active; 1 = Active

3.3.2 Output data

NOC3Low and NOC3LowB

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 CBFP	O3	0 or 1 [1)]	-	0	R/M	Status of CBFP signal

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

NOC3High and NOC3Inst

Parameter	Code	Values	Unit	Default	Data direction	Explanation
Output BSOUT	O1	0 or 1 [1)]	-	0	R/M	Status of BSOUT signal
Output START	O2	0 or 1 [1)]	-	0	R/M	Status of start signal
Output TRIP	O3	0 or 1 [1)]	-	0	R/M	Status of trip signal
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, or when the recording function is triggered via an external triggering input.

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,...

The recording function can be blocked via the BSREG input. For example, if an auto-reclose sequence is initiated by the trip signal of the function block, the values most reliable for later fault analysis are those recorded just before Shot 1. When the auto-reclose sequence has started, no recordings are needed at the moment of tripping. The output signal ACTIVE in AR5Func indicating AR in progress is connected to the BSREG input to prevent useless recording.

3.3.3.2 Date and time

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

3.3.3.3 Duration

In the DT mode of operation the duration of the start situation is recorded as a percentage of the set operate time and, as concerns NOC3Low and NOC3LowB, in the IDMT mode of operation as a percentage of the calculated operate time.

3.3.3.4 Currents

If the function block trips, the current values are updated at the moment of tripping i.e. on the rising edge of the TRIP signal. For external triggering, the current values are updated at the moment of triggering i.e. on the rising edge of the input signal TRIGG. If the function block starts but does not trip, the current values captured one fundamental cycle (20 ms at rated frequency 50 Hz) after the beginning of the start situation are recorded. So the values of the phase currents I_{L1}, I_{L2} and I_{L3} always originate from the same moment and are recorded as multiples of the rated current I_n.

3.3.3.5 Status data

The status data of the input signals BS1, BS2 and DOUBLE as well as the “Active group” parameter are recorded at the moment of recording. The “Active group” parameter indicates 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. External triggering,

which means that if the function block has started, it will neglect an external triggering request.

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
IL1 mean	V204	0.00...60.00	x In	0.00	R/M	Filtered value of I_{L1}
IL2 mean	V205	0.00...60.00	x In	0.00	R/M	Filtered value of I_{L2}
IL3 mean	V206	0.00...60.00	x In	0.00	R/M	Filtered value of I_{L3}
IL1 peak	V207	0.00...60.00	x In	0.00	R/M	Momentary peak of I_{L1}
IL2 peak	V208	0.00...60.00	x In	0.00	R/M	Momentary peak of I_{L2}
IL3 peak	V209	0.00...60.00	x In	0.00	R/M	Momentary peak of I_{L3}
BS1	V210	0 or 1 [1)]	-	0	R/M	Status of BS1 input
BS2	V211	0 or 1 [1)]	-	0	R/M	Status of BS2 input
DOUBLE	V212	0 or 1 [1)]	-	0	R/M	Status of DOUBLE input
Active group	V213	0 or 1 [2)]	-	0	R/M	Active setting group

[1)] Status 0 = Not active; 1 = Active
[2)] 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
IL1 mean	V304	0.00...60.00	x In	0.00	R/M	Filtered value of I_{L1}
IL2 mean	V305	0.00...60.00	x In	0.00	R/M	Filtered value of I_{L2}
IL3 mean	V306	0.00...60.00	x In	0.00	R/M	Filtered value of I_{L3}
IL1 peak	V307	0.00...60.00	x In	0.00	R/M	Momentary peak of I_{L1}
IL2 peak	V308	0.00...60.00	x In	0.00	R/M	Momentary peak of I_{L2}
IL3 peak	V309	0.00...60.00	x In	0.00	R/M	Momentary peak of I_{L3}
BS1	V310	0 or 1 [1)]	-	0	R/M	Status of BS1 input
BS2	V311	0 or 1 [1)]	-	0	R/M	Status of BS2 input
DOUBLE	V312	0 or 1 [1)]	-	0	R/M	Status of DOUBLE input
Active group	V313	0 or 1 [2)]	-	0	R/M	Active setting group

[1)] Status 0 = Not active; 1 = Active
[2)] 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
IL1 mean	V404	0.00...60.00	x In	0.00	R/M	Filtered value of I_{L1}
IL2 mean	V405	0.00...60.00	x In	0.00	R/M	Filtered value of I_{L2}
IL3 mean	V406	0.00...60.00	x In	0.00	R/M	Filtered value of I_{L3}
IL1 peak	V407	0.00...60.00	x In	0.00	R/M	Momentary peak of I_{L1}
IL2 peak	V408	0.00...60.00	x In	0.00	R/M	Momentary peak of I_{L2}
IL3 peak	V409	0.00...60.00	x In	0.00	R/M	Momentary peak of I_{L3}
BS1	V410	0 or 1 [1)]	-	0	R/M	Status of BS1 input
BS2	V411	0 or 1 [1)]	-	0	R/M	Status of BS2 input
DOUBLE	V412	0 or 1 [1)]	-	0	R/M	Status of DOUBLE input
Active group	V413	0 or 1 [2)]	-	0	R/M	Active setting group

[1)] Status 0 = Not active; 1 = Active
[2)] Active group 0 = Group 1; 1 = Group 2

3.3.4 Events

NOC3Low and NOC3LowB

Code	Weighting coefficient	Default mask	Event reason	Event state
E0	1	1	START signal from 3I> stage	Reset
E1	2	1	START signal from 3I> stage	Activated
E2	4	1	TRIP signal from 3I> stage	Reset
E3	8	1	TRIP signal from 3I> stage	Activated
E4	16	1	CBFP signal from 3I> stage	Reset
E5	32	1	CBFP signal from 3I> stage	Activated
E6	64	0	BS1 signal of 3I> stage	Reset
E7	128	0	BS1 signal of 3I> stage	Activated
E8	256	0	BS2 signal of 3I> stage	Reset
E9	512	0	BS2 signal of 3I> stage	Activated
E10	1024	0	Test mode of 3I> stage	Off
E11	2048	0	Test mode of 3I> stage	On

NOC3High and NOC3Inst

Code	Weighting coefficient	Default mask	Event reason	Event state
E0	1	1	START signal from 3I>> or 3I>>> stage	Reset
E1	2	1	START signal from 3I>> or 3I>>> stage	Activated
E2	4	1	TRIP signal from 3I>> or 3I>>> stage	Reset
E3	8	1	TRIP signal from 3I>> or 3I>>> stage	Activated
E4	16	1	CBFP signal from 3I>> or 3I>>> stage	Reset
E5	32	1	CBFP signal from 3I>> or 3I>>> stage	Activated
E6	64	0	BSOUT signal from 3I>> or 3I>>> stage	Reset
E7	128	0	BSOUT signal from 3I>> or 3I>>> stage	Activated
E8	256	0	BS1 signal of 3I>> or 3I>>> stage	Reset
E9	512	0	BS1 signal of 3I>> or 3I>>> stage	Activated
E10	1024	0	BS2 signal of 3I>> or 3I>>> stage	Reset
E11	2048	0	BS2 signal of 3I>> or 3I>>> stage	Activated
E12	4096	0	Test mode of 3I>> or 3I>>> stage	Off
E13	8192	0	Test mode of 3I>> or 3I>>> stage	On

4. Technical data

Operation accuracies	Depends on the frequency of the current measured: f/f_n = 0.95...1.05 NOC3Low and NOC3LowB: ± 2.5% of set value or ± 0.01 x I_n NOC3High and NOC3Inst: at currents in the range 0.1...10 x I_n ± 2.5% of set value or ± 0.01 x I_n at currents in the range 10...40 x I_n ± 5.0% of set value
Start time	Injected currents > 2.0 x start current: f/f_n = 0.95...1.05 internal time < 32 ms total time[1)] < 40 ms
Reset time	40...1000 ms (depends on the minimum pulse width set for the TRIP output)
Reset ratio	Typ. 0.95 (range 0.95...0.98)
Retardation time	Total retardation time when the current drops below the start value[2)] < 45 ms
Operate time accuracy in definite-time mode	Depends on the frequency of the current measured: f/f_n = 0.95...1.05: ± 2% of set value or ± 20 ms[2)]
Accuracy class index E in inverse-time mode (NOC3Low and NOC3LowB)	Depends on the frequency of the current measured: f/f_n = 0.95...1.05: Class index E = 5.0 or ± 20 ms[2)]
Suppression of harmonics	Measuring mode 0 No suppression 1 -50 dB at f = n x f_n, where n = 2, 3, 4, 5,...
Configuration data	Task execution interval (Relay Configuration Tool): 10 ms 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		
Function block	**Technical revision**	**Change**
NOC3Low	D	- IEEE IDMT curves added
NOC3LowB	A	
NOC3High	C	
NOC3Inst	C	