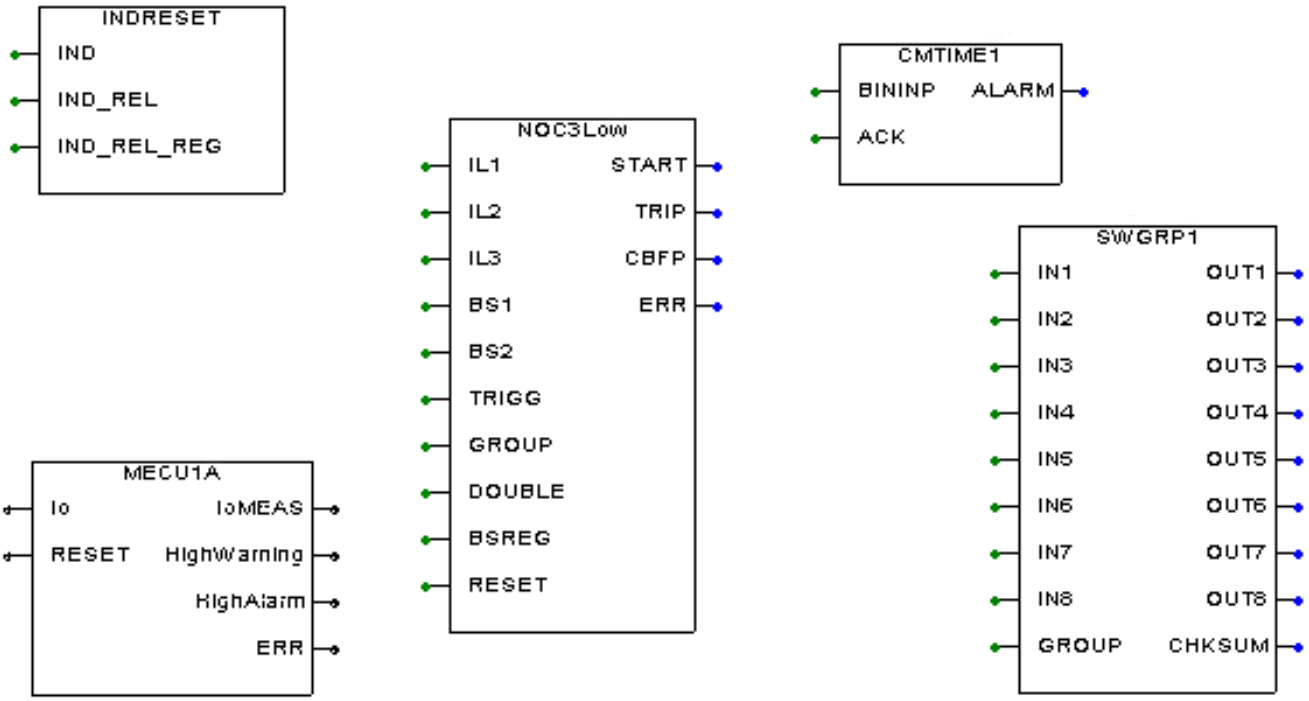
INDRESET
IND
IND_REL
IND_REL_REG
NOC3Low
IL1
IL2
IL3
BS1
BS2
TRIGG
GROUP
DOUBLE
BSREG
RESET
START
TRIP
CBFP
ERR
CMTIME1
BININP
ACK
ALARM
SWGRP1
IN1
IN2
IN3
IN4
IN5
IN6
IN7
IN8
GROUP
OUT1
OUT2
OUT3
OUT4
OUT5
OUT6
OUT7
OUT8
CHKSUM
MECU1A
Io
RESET
IoMEAS
HighWarning
HighAlarm
ERR

Contents

1. Introduction

1.1 About this document

This document is a guide to the actual technical descriptions of functions that can be found as separate documents divided into the following categories:

- protection
- measurement
- power quality
- control
- condition monitoring
- communication
- general
- standard

In this document, the functions available are listed both divided under the above mentioned categories in chapters 2.1 to 2.8 and in alphabetical order in the end of the document. Some information on the function blocks belonging to each category is given in this document, whereas the detailed descriptions of functions can be found as separate documents.

1.2 Technical descriptions of functions

Each description of a function, i.e. a function block manual, covers either one specific function block or several function blocks representing the stages of a protection, measurement or other function. For example, the non-directional overcurrent function blocks NOC3Low, NOC3High and NOC3Inst are described in one manual (NOC3_). The manuals provide information on the operation and features of function blocks as well as on their inputs and outputs, a list of HMI parameters (if existing) and technical data.

The version letter, e.g. A, on the cover of a function block manual indicates the document version, i.e. corrections to language, layout etc., whereas the technical revision of the function block in question is given in section “Technical Data” in the end of each manual.

1.3 Function blocks

The functionality of RED 500 based products is tied to the hardware configuration and also depends on the selected functionality level (refer to the technical reference manual of the product). The desired functions can be activated from a wide range of protection, measurement, power quality, control, condition monitoring, general and communication functions within the scope of the I/O connections and analogue channels available and considering the total CPU load.

The functionality is programmed by means of function blocks (FBs) and other programmable logic controller (PLC) elements. Interconnections between FBs and other elements accomplish the relay configuration according to the requirements of the customer application. The relay configuration is carried out with the Relay Configuration Tool and downloaded into the target device.

The function blocks and elements are seen as graphical symbols on the worksheets of the Relay Configuration Tool. The name of the element is written under the upper edge of the block, see Figure 1.3.-1 below. The name of the instance is written above the upper edge. The direction of processing through the block is from left to right, input parameters are on the left and output parameters on the right.

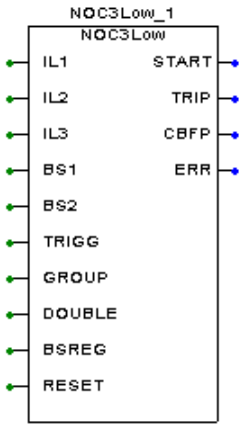

Figure 1.3.-1 Graphical symbol for the non-directional overcurrent protection stage I> (NOC3Low)

Typically, a function block or an element contains inputs and outputs that can be interconnected with other elements or signals, see Figure 1.3.-2 below. Only the inputs, outputs and signals with the same data type can be interconnected. For example, if an output with the data type Boolean (BOOL) is to be connected to an input of the type Real (REAL), the data type conversion element has to be used.

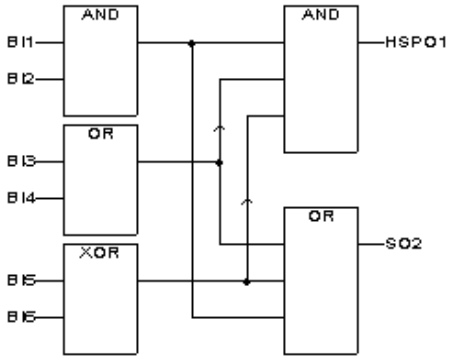

Figure 1.3.-2 Example of the Boolean logic

2. Functions

All the function blocks supported in the RED 500 series are divided into groups according to the application area and listed in the following tables. Each product of the RED 500 series supports a subset of the complete function block list. Product-specific function block lists can be found in the technical reference manual of the product in question.

Each function block is given a processing load (in percent) from the processing capacity reserved for the function blocks. The processing loads are directive and they can vary from product to product. The relay calculates and checks the actual processing load in connection to the downloading of the configuration. For more details, please refer to “Configuration Guideline” (1MRS750745-MUM) chapter 3.4.

Also, information about the task intervals of the function blocks is given in the tables below. This information can contain a minimum, a maximum and a recommended task interval of a function block. Some function blocks allow only one option to a task interval. Because a task interval is always a multiple of a one-fourth of the network frequency period, it depends on the network frequency. In the lists, task intervals are given in milliseconds when the frequency of the network is 50 Hz. Intervals are transformed for the 60 Hz network by multiplying them by 50/60,
e.g. (50/60) * 10 ms = 8.33 ms.

2.1 Protection functions

Descriptions of the protection function blocks listed below can be found as separate documents, except for protection functions consisting of two or three stages. For example, the descriptions of the function blocks NOC3Low, NOC3High and NOC3Inst have been compiled into one document.

The maximum number of instances for protection functions is 1.

ANSI Device no.	IEC symbol	Task interval/ms [1]	Load % [2]	Description	RE_ 5__ function	Displayed IEC symbol	Displayed ANSI device no.	1MRS
Short circuits								
51	3I>	5, 10	3	Three-phase non-directional overcurrent function, low-set stage	NOC3Low	3I>	51-1	100031
51	3I>	5, 10	3	Three-phase non-directional overcurrent function, low-set stage	NOC3LowB	3I>_B	51-4	100053
50/51/51B	3I>>	5, 10	2	Three-phase non-directional overcurrent function, high-set stage	NOC3High	3I>>	51-2	100032
50/51B	3I>>>	5, 10	2	Three-phase non-directional overcurrent protection function, instantaneous stage	NOC3Inst	3I>>>	51-3	100033
67	3I>→	5, 10	7	Three-phase directional overcurrent protection, low-set stage	DOC6Low	3I>-->	67-1	100035
67	3I>>→	5, 10	7	Three-phase directional overcurrent protection, high-set stage	DOC6High	3I>>-->	67-2	100036
67	3I>>>→	5, 10	7	Three-phase directional overcurrent protection, instantaneous stage	DOC6Inst	3I>>>-->	67-3	100037
51V	I(U)>	5, 10	3	Voltage-dependent overcurrent protection, low-set stage	VOC6Low	I(U)>	51V-1	100091
51V	I(U)>>	5, 10	3	Voltage-dependent overcurrent protection, high-set stage	VOC6High	I(U)>>	51V-2	100107
21G	Z<	5, 10	2	Three-phase underimpedance protection, low-set stage	UI6Low	Z<	21-1	100110
21G	Z<<	5, 10	2	Three-phase underimpedance protection, high-set stage	UI6High	Z<<	21-2	100111
87T	3 Δ I> 3 Δ I>>	5	35	Stabilized three-phase differential protection for transformers	Diff6T	3dI>T	87T	100106
87G/87M	3 Δ I>	5	2	High-impedance or flux-balance based differential protection for generators and motors	Diff3	3dI>	87	100100
87G	3 Δ I> 3 Δ I>>	5	10	Stabilized three-phase differential protection for generators	Diff6G	3dI>G	87G	100099

[1] Applies when the nominal network frequency is 50 Hz. The underlined task interval is recommended.

[2] a) Loads are subject to change.
b) Applies when the POU is executed at its recommended task interval (underlined) and the nominal frequency is 50 Hz.

Table continued on the next page.

ANSI Device no.	IEC symbol	Task interval/ms [1]	Load % [2]	Description	RE_ 5__ function	Displayed IEC symbol	Displayed ANSI device no.	1MRS
Earth faults								
51N	I_0>/SEF	5, 10	2	Non-directional earth-fault protection function, low-set stage (or SEF=sensitive earth-fault protection)	NEF1Low	Io>	51N-1	100038
50N/51N	I_0>>	5, 10	2	Non-directional earth-fault protection function, high-set stage	NEF1High	Io>>	51N-2	100039
50N	I_0>>>	5, 10	2	Non-directional earth-fault protection function, instantaneous stage	NEF1Inst	Io>>>	51N-3	100090
67N/51N	I_0>→/SEF	5, 10	3	Directional earth-fault protection function, low-set stage (or SEF =sensitive earth-fault protection)	DEF2Low	Io>-->	67N-1	100040
67N	I_0>>→	5, 10	3	Directional earth-fault protection function, high-set stage	DEF2High	Io>>-->	67N-2	100041
67N	I_0>>>→	5, 10	3	Directional earth-fault protection function, instantaneous stage	DEF2Inst	Io>>>-->	67N-3	100042
87N	ΔI_0>, REF	5	2	High-impedance based restricted earth-fault protection	REF1A	dIo>	87N	100102
59N	U_0>	5, 10	2	Residual overvoltage protection, low-set stage	ROV1Low	Uo>	59N-1	100044
59N	U_0>>	5, 10	2	Residual overvoltage protection, high-set stage	ROV1High	Uo>>	59N-2	100045
59N	U_0>>>	5, 10	2	Residual overvoltage protection, instantaneous stage	ROV1Inst	Uo>>>	59N-3	100046
87N	Δ Io>	5	4	Stabilized restricted earth-fault protection, high voltage side	REF4A	dIo3dI>	87N-1	100101
87N	Δ Io>	5	4	Stabilized restricted earth-fault protection, low voltage side	REF4B	dIo3dI>B	87N-2	100119

[1] Applies when the nominal network frequency is 50 Hz. The underlined task interval is recommended.

[2] a) Loads are subject to change.
b) Applies when the POU is executed at its recommended task interval (underlined) and the nominal frequency is 50 Hz.

Table continued on the next page.

ANSI Device no.	IEC symbol	Task interval/ms [1]	Load % [2]	Description	RE_ 5__ function	Displayed IEC symbol	Displayed ANSI device no.	1MRS
Overload/ unbalanced load								
49F	3	40…<u>100</u>	1	Three-phase thermal protection for cables	TOL3Cab	3Ith>	49F	100047
49M/49G/ 49T	3	40…<u>60</u>	3	Three-phase thermal protection for devices (motors, generators and transformers)	TOL3Dev	3Ithdev>	49M/G/T	100048
46	I_2>	5, <u>10</u>	2	Negative-phase-sequence (NPS) protection, low-set stage	NPS3Low	I2>	46-1	100077
46	I_2>>	5, <u>10</u>	2	Negative-phase-sequence (NPS) protection, high-set stage	NPS3High	I2>>	46-2	100078
Overvoltage/ undervoltage								
59	3U>	5, <u>10</u>	2	Three-phase overvoltage protection, low-set stage	OV3Low	3U>	59-1	100062
59	3U>>	5, <u>10</u>	2	Three-phase overvoltage protection, high-set stage	OV3High	3U>>	59-2	100063
27	3U<	5, <u>10</u>	3	Three-phase undervoltage protection, low-set stage	UV3Low	3U<	27-1	100064
27	3U<<	5, <u>10</u>	2	Three-phase undervoltage protection, high-set stage	UV3High	3U<<	27-2	100065
27, 47, 59	U_1< U_2> U_1>	5, <u>10</u>	3	Phase-sequence voltage protection, stage 1	PSV3St1	U1U2<>_1	47-1	100112
27, 47, 59	U_1< U_2> U_1>	5, <u>10</u>	3	Phase-sequence voltage protection, stage 2	PSV3St2	U1U2<>_2	47-2	100113
Overfrequency/ underfrequency								
81U/81O	f</f>, df/dt	<u>5</u>	6	Underfrequency or overfrequency protection, stage 1 (incl. rate of change)	Freq1St1	f1	81-1	100072
81U/81O	f</f>, df/dt	<u>5</u>	6	Underfrequency or overfrequency protection, stage 2 (incl. rate of change)	Freq1St2	f2	81-2	100073
81U/81O	f</f>, df/dt	<u>5</u>	6	Underfrequency or overfrequency protection, stage 3 (incl. rate of change)	Freq1St3	f3	81-3	100074
81U/81O	f</f>, df/dt	<u>5</u>	6	Underfrequency or overfrequency protection, stage 4 (incl. rate of change)	Freq1St4	f4	81-4	100075
81U/81O	f</f>, df/dt	<u>5</u>	6	Underfrequency or overfrequency protection, stage 5 (incl. rate of change)	Freq1St5	f5	81-5	100076

[1] Applies when the nominal network frequency is 50 Hz. The underlined task interval is recommended.

[2] a) Loads are subject to change.
b) Applies when the POU is executed at its recommended task interval (underlined) and the nominal frequency is 50 Hz.

Table continued on the next page.

ANSI Device no.	IEC symbol	Task interval/ms [1]	Load % [2]	Description	RE_ 5__ function	Displayed IEC symbol	Displayed ANSI device no.	1MRS
Underexcitation/ overexcitation								
40	X<	5…20	2	Three-phase underexcitation protection, low-set stage	UE6Low	X<	40-1	100066
40	X<<	5…20	2	Three-phase underexcitation protection, high-set stage	UE6High	X<<	40-2	100067
24	U/f>	10	3	Overexcitation protection, low-set stage	OE1Low	U/f>	24-1	100068
24	U/f>>	10	3	Overexcitation protection, high-set stage	OE1High	U/f>>	24-2	100069
Overpower/ underpower								
32P/32Q	P>→ Q>→	5, 10	2	Three-phase directional overpower protection, stage 1	OPOW6St1	POW>_1	32P-1	100092
32P/32Q	P>→ Q>→	5, 10	2	Three-phase directional overpower protection, stage 2	OPOW6St2	POW>_2	32P-2	100093
32P/32Q	P>→ Q>→	5, 10	2	Three-phase directional overpower protection, stage 3	OPOW6St3	POW>_3	32P-3	100094
32	P< P>←	5, 10	2	Three-phase underpower or reverse power protection, stage 1	UPOW6St1	POW<_1	32-1	100095
32	P< P>←	5, 10	2	Three-phase underpower or reverse power protection, stage 2	UPOW6St2	POW<_2	32-2	100096
32	P< P>←	5, 10	2	Three-phase underpower or reverse power protection, stage 3	UPOW6St3	POW<_3	32-3	100097
Motor protection								
48, 14, 66	I_S^2t, n<	5, 10	2	Three-phase start-up supervision for motors (incl. I^2t and speed device modes, and start-up counter)	MotStart	Is2t n<	48	100054
37	3I<	5, 10	2	Three-phase non-directional undercurrent protection, stage 1	NUC3St1	3I<	37-1	100088
37	3I<	5, 10	2	Three-phase non-directional undercurrent protection, stage 2	NUC3St2	3I<_2	37-2	100089
46R	3I↶ 3I↷	5, 10	2	Phase reversal protection	PREV3	3I()	46R	100055

[1] Applies when the nominal network frequency is 50 Hz. The underlined task interval is recommended.

[2] a) Loads are subject to change.
b) Applies when the POU is executed at its recommended task interval (underlined) and the nominal frequency is 50 Hz.

Table continued on the next page.

ANSI Device no.	IEC symbol	Task interval/ms [1]	Load % [2]	Description	RE_ 5__ function	Displayed IEC symbol	Displayed ANSI device no.	1MRS
Capacitor bank protection								
51C, 37C, 68C	3I> 3I<	5	13	Three-phase overload protection for shunt capacitor banks	OL3Cap	3I>3I<	51C	100116
51NC	Δ I>	5, 10	4	Current unbalance protection for shunt capacitor banks	CUB1Cap	dI>C	51NC-1	100117
51NC	3 Δ I>	5, 10	3	Three-phase current unbalance protection for H-bridge connected shunt capacitor banks	CUB3Cap	3dI>C	51NC-2	100052
Additional functions								
79	O $\rightarrow$ I	5, 10	3	Auto-reclosure function	AR5Func	O-->I	79	100080
25	SYNC	5, 10	3	Synchro-check / voltage-check function, stage 1	SCVCSt1	SYNC1	25-1	100070
25	SYNC	5, 10	3	Synchro-check / voltage-check function, stage 2	SCVCSt2	SYNC2	25-2	100071
68	$3I_{2f}$>	5, 10	1	Three-phase transformer inrush and motor start-up current detector	Inrush3	3I2f>	68	100034
46	Δ I>	5…20...40	1	Phase discontinuity protection	CUB3Low	Iub>	46	100051
60	FUSEF	5…10...20	2	Fuse failure supervision	FuseFail	FUSEF	60	100118
21FL	FLOC	5, 10	12	Fault locator	FLOC	FLOC	21FL	100058

[1] Applies when the nominal network frequency is 50 Hz. The underlined task interval is recommended.

[2] a) Loads are subject to change.
b) Applies when the POU is executed at its recommended task interval (underlined) and the nominal frequency is 50 Hz.

2.2 Measurement functions

Descriptions of the measurement function blocks listed below can be found as separate documents.

The maximum number of instances for measurement functions is 1.

IEC symbol	Task interval/ms [1]	Load % [2]	Description	RE_ 5__ function	Displayed IEC symbol	Displayed ANSI device no.	1MRS
mA/V/°C/Ω	20...40…100	1	General measurement / Analogue input on RTD/analogue module	MEAI1…8	AI1...8	AI1...8	100213 … 100220
mA	20...40…100	1	Analogue output on RTD/analogue module	MEAO1…4	AO1...4	AO1...4	100456 … 100459
Io	20...40…100	1	Neutral current measurement, stage A	MECU1A	Io	Io	100201
Io	20...40…100	1	Neutral current measurement, stage B	MECU1B	Io_B	Io_B	100203
3I	20...40…100	2	Three-phase current measurement, stage A	MECU3A	3I	3I	100200
3I	20...40…100	2	Three-phase current measurement, stage B	MECU3B	3I_B	3I_B	100202
	10	7	Transient disturbance recorder	MEDREC16	DREC	DREC	100225
f	20...40	1	System frequency measurement	MEFR1	f	f	100208
E, P, Q, pf	20...40	1	Three-phase power and energy meas.	MEPE7	PQE	PQE	100207
Uo	20...40…100	1	Residual voltage measurement, stage A	MEVO1A	Uo	Uo	100205
Uo	20...40…100	1	Residual voltage measurement, stage B	MEVO1B	Uo_B	Uo_B	100226
3U	20...40…100	2	Three-phase voltage measurement, stage A	MEVO3A	3U	3U	100204
3U	20...40…100	2	Three-phase voltage measurement, stage B	MEVO3B	3U_B	3U_B	100206

[1] Applies when the nominal network frequency is 50 Hz. The underlined task interval is recommended.

[2] a) Loads are subject to change.
b) Applies when the POU is executed at its recommended task interval (underlined) and the nominal frequency is 50 Hz.

2.3 Power quality functions

Descriptions of the power quality function blocks listed below can be found as separate documents.

The maximum number of instances for power quality functions is 1.

IEC symbol	Task interval/ms [1]	Load % [2]	Description	RE_ 5__ function	Displayed IEC symbol	Displayed ANSI device no.	1MRS
3I~harm	10	5	Current waveform distortion measurement	PQCU3H	PQ 3Inf	PQ 3Inf	100512
3U~harm	10	5	Voltage waveform distortion measurement	PQVO3H	PQ 3Unf	PQ 3Unf	100513
PQ 3U<>	10	2	Short duration voltage variations	PQVO3Sd	PQ 3U<>	PQ 3U<>	100514

[1] Apply when the nominal network frequency is 50 Hz. The underlined task interval is recommended.
[2] a) Loads are subject to change.
b) Apply when the POU is executed at its recommended task interval (underlined) and the nominal frequency is 50 Hz.

2.4 Control functions

Descriptions of the control function blocks listed below can be found as separate documents.

The maximum number of instances for control functions is 1.

Description	Task interval/ms [1]	Load % [2]	RE_ 5__ function	Displayed IEC symbol	Displayed ANSI device no.	1MRS
Circuit breaker 1 (2 state inputs / 2 control outputs)	5…20...40	2	COCB1	I<->O CB1	COCB1	100120
Circuit breaker 2 (2 state inputs / 2 control outputs)	5…20...40	2	COCB2	I<->O CB2	COCB2	100121
Direct open for CBs via HMI	5…20...100	1	COCBDIR	CBDIR	COCBDIR	100141
Disconnector 1 (2 state inputs / 2 control outputs)	5…20...40	2	CODC1	I<->O DC1	CODC1	100122
Disconnector 2 (2 state inputs / 2 control outputs)	5…20...40	2	CODC2	I<->O DC2	CODC2	100123
Disconnector 3 (2 state inputs / 2 control outputs)	5…20...40	2	CODC3	I<->O DC3	CODC3	100124
Disconnector 4 (2 state inputs / 2 control outputs)	5…20...40	2	CODC4	I<->O DC4	CODC4	100125
Disconnector 5 (2 state inputs / 2 control outputs)	5…20...40	2	CODC5	I<->O DC5	CODC5	100126
Three state disconnector 1 (3 state inputs / 4 control outputs)	5…20...40	2	CO3DC1	I<->O 3DC1	CO3DC1	100139
Three state disconnector 2 (3 state inputs / 4 control outputs)	5…20...40	2	CO3DC2	I<->O 3DC2	CO3DC2	100140

[1] Applies when the nominal network frequency is 50 Hz. The underlined task interval is recommended.
[2] a) Loads are subject to change.
b) Applies when the POU is executed at its recommended task interval (underlined) and the nominal frequency is 50 Hz.

Table continued on the next page.

Description	Task interval/ms [1]	Load % [2]	RE_ 5__ function	Displayed IEC symbol	Displayed ANSI device no.	1MRS
Object indication 1 (2 state inputs)	5…20...100	1	COIND1	I<->O IND1	COIND1	100127
Object indication 2 (2 state inputs)	5…20...100	1	COIND2	I<->O IND2	COIND2	100128
Object indication 3 (2 state inputs)	5…20...100	1	COIND3	I<->O IND3	COIND3	100129
Object indication 4 (2 state inputs)	5…20...100	1	COIND4	I<->O IND4	COIND4	100130
Object indication 5 (2 state inputs)	5…20...100	1	COIND5	I<->O IND5	COIND5	100131
Object indication 6 (2 state inputs)	5…20...100	1	COIND6	I<->O IND6	COIND6	100132
Object indication 7 (2 state inputs)	5…20...100	1	COIND7	I<->O IND7	COIND7	100133
Object indication 8 (2 state inputs)	5…20...100	1	COIND8	I<->O IND8	COIND8	100134
Logic control position selector	5…20...100	1	COLOCAT	I<->O POS	COLOCAT	100142
On/off switch 1 (1 output)	5…20...100	1	COSW1	SW1	COSW1	100135
On/off switch 2 (1 output)	5…20...100	1	COSW2	SW2	COSW2	100136
On/off switch 3 (1 output)	5…20...100	1	COSW3	SW3	COSW3	100137
On/off switch 4 (1 output)	5…20...100	1	COSW4	SW4	COSW4	100138
Power factor controller	20…40	3	COPFC	COPFC	55	100143
On-load tap changer controller (voltage regulator)	5…20…100	3	COLTC	COLTC	COLTC	100144
Alarm 1 (HMI, remote)	-	1	MMIALAR1	ALARM1	ALARM1	100162
Alarm 2 (HMI, remote)	-	1	MMIALAR2	ALARM2	ALARM2	100163
Alarm 3 (HMI, remote)	-	1	MMIALAR3	ALARM3	ALARM3	100164
Alarm 4 (HMI, remote)	-	1	MMIALAR4	ALARM4	ALARM4	100165
Alarm 5 (HMI, remote)	-	1	MMIALAR5	ALARM5	ALARM5	100166
Alarm 6 (HMI, remote)	-	1	MMIALAR6	ALARM6	ALARM6	100167
Alarm 7 (HMI, remote)	-	1	MMIALAR7	ALARM7	ALARM7	100168
Alarm 8 (HMI, remote)	-	1	MMIALAR8	ALARM8	ALARM8	100169
MIMIC dynamic data point 1	-	1	MMIDATA1	MMIDATA1	MMIDATA1	100157
MIMIC dynamic data point 2	-	1	MMIDATA2	MMIDATA2	MMIDATA2	100158
MIMIC dynamic data point 3	-	1	MMIDATA3	MMIDATA3	MMIDATA3	100159
MIMIC dynamic data point 4	-	1	MMIDATA4	MMIDATA4	MMIDATA4	100160
MIMIC dynamic data point 5	-	1	MMIDATA5	MMIDATA5	MMIDATA5	100161

[1] Applies when the nominal network frequency is 50 Hz. The underlined task interval is recommended.

[2] a) Loads are subject to change.
b) Applies when the POU is executed at its recommended task interval (underlined) and the nominal frequency is 50 Hz.
c) Load of the MMIDATA and MMIALAR function blocks is <1% at any task.

2.5 Condition monitoring functions

Descriptions of the condition monitoring function blocks listed below can be found as separate documents.

The maximum number of instances for condition monitoring functions is 1.

Description	Task interval/ms [1]	Load % [2]	RE_ 5__ function	Displayed IEC symbol	Displayed ANSI device no.	1MRS
CB electric wear 1	5, 10	1	CMBWEAR1	CB wear1	CB wear1	100187
CB electric wear 2	5, 10	1	CMBWEAR2	CB wear2	CB wear2	100188
Supervision function of the energizing current input circuit	20...100	1	CMCU3	MCS 3I	MCS 3I	100181
Gas pressure monitoring	20...100	1	CMGAS1	GAS1	CMGAS1	100186
Three-pole gas pressure monitoring	20...100	1	CMGAS3	GAS3	CMGAS3	100194
Scheduled maintenance	20...100	1	CMSCHED	SCHED	CMSCHED	100189
Spring charging control 1	20...100	1	CMSPRC1	SPRC1	CMSPRC1	100190
Trip Circuit Supervision 1	20...100	1	CMTCS1	TCS1	TCS1	100191
Trip Circuit Supervision 2	20...100	1	CMTCS2	TCS2	TCS2	100192
Operate time counter 1 for used operate time (motors)	20...100	1	CMTIME1	TIME1	TIME1	100184
Operate time counter 2 for used operate time (motors)	20...100	1	CMTIME2	TIME2	TIME2	100185
Breaker travel time 1	5, 10	1	CMTRAV1	TRAV1	CMTRAV1	100193
Supervision function of the energizing voltage input circuit	20...100	1	CMVO3	MCS 3U	MCS 3U	100182

[1] Applies when the nominal network frequency is 50 Hz. The underlined task interval is recommended.

[2] a) Loads are subject to change.
b) Applies when the POU is executed at its recommended task interval (underlined) and the nominal frequency is 50 Hz.

2.6 Communication functions

Description of the function block below can be found as a separate document.

The maximum number of instances for communication functions is 32.

Description	Load % [1]	RE_ 5__ function	Displayed IEC symbol	Displayed ANSI device no.	1MRS
Event to be defined by the customer, E0...E63	2	EVENT230	EVENT230	EVENT230	100230

[1] a) Loads are subject to change.
b) Load corresponds to a situation where all 32 instances are associated to a 5 ms task interval.

2.7 General functions

Descriptions of the function blocks listed below can be found as separate documents except for the 20 switchgroups, SWGRP1 to SWGRP 20, that have been compiled into one document.

The maximum number of instances for system functions is 1.

Description	RE_ 5__ function	Displayed IEC symbol	Displayed ANSI device no.	1MRS
Activation of HMI backlight	MMIWAKE	MMIWAKE	MMIWAKE	100028
Resetting of operation indicators, latched output signals, registers and waveforms i.e. the disturbance recorder	INDRESET	INDRESET	INDRESET	100029
Switchgroups SWGRP1...SWGRP20	SWGRP1…20	SWGRP1…20	SWGRP1…20	100030

2.8 Standard functions

Descriptions of the standard function blocks below can be found compiled into one document with the name “Generic”.

The number of instances in generic functions is unlimited.

The symbol “X” in the “Extensible inputs” column means that the function supports adding the number of inputs. For example, in figure 1.3.-2 an AND port is used with both two and three inputs.

2.8.1 Arithmetic

Function	Description	Extensible inputs
ADD	Adder	X
DIV	Divider	-
EXPT	Exponentiation	-
MOD	Modulo	-
MOVE	Move, out := in	-
MUL	Multiplier	X
SUB	Subtractor	-

2.8.2 Bistable

Function	Description
RS	Reset dominant bistable function block
RS_D	Reset dominant bistable function block with data input
SR	Set dominant bistable function block

2.8.3 Bit-shift

Function	Description
ROL	Rotate to left
ROR	Rotate to right
SHL	Bit-shift to left
SHR	Bit-shift to right

2.8.4 Bitwise operation

Function	Description	Extensible inputs
AND	Bitwise Boolean AND connection	X
BITGET	Get one bit	-
BITSET	Set one bit	-
NOT	Bitwise Boolean NOT connection	-
OR	Bitwise Boolean OR connection	X
XOR	Bitwise Boolean exclusive OR connection	X

2.8.5 Comparison

Function	Description	Extensible inputs
COMH	Hysteresis comparator	-
EQ	Equal	X
GE	Greater than or equal	X
GT	Greater than	X
LE	Less than or equal	X
LT	Less than	X
NE	Not equal	-

2.8.6 Counter

Function	Description
CTD	Down-counter
CTU	Up-counter
CTUD	Up-down counter

2.8.7 Edge detection

Function	Description
F_TRIG	Falling edge detector
R_TRIG	Rising edge detector

2.8.8 Numeric

Function	Description
ABS	Absolute value
ACOS	Principal arc cosine
ASIN	Principal arc sine
ATAN	Principal arc tangent
COS	Cosine in radians
EXP	Natural exponential
LN	Natural logarithm
LOG	Logarithm base 10
SIN	Sine in radians
SQRT	Square root
TAN	Tangent in radians

2.8.9 Selection

Function	Description	Extensible inputs
LIMIT	Limiter	-
MAX	Maximum	X
MIN	Minimum	X
MUX	Multiplexer	X
SEL	Binary selection	-

2.8.10 Timer

Function	Description
TOF	Time delay OFF
TON	Time delay ON
TP	Pulse

2.8.11 Type conversion

Function	Description
BCD2INT	BCD coded BOOL inputs to SINT (Transformer Tap Changer)
BOOL2INT	BOOL inputs to INT output
BOOL_TO_BYTE	Type conversion BOOL to BYTE
BOOL_TO_DINT	Type conversion BOOL to DINT
BOOL_TO_DWORD	Type conversion BOOL to DWORD
BOOL_TO_INT	Type conversion BOOL to INT
BOOL_TO_REAL	Type conversion BOOL to REAL
BOOL_TO_SINT	Type conversion BOOL to SINT
BOOL_TO_UDINT	Type conversion BOOL to UDINT
BOOL_TO_UINT	Type conversion BOOL to UINT
BOOL_TO_USINT	Type conversion BOOL to USINT
BOOL_TO_WORD	Type conversion BOOL to WORD
BYTE_TO_DWORD	Type conversion BYTE to DWORD
BYTE_TO_WORD	Type conversion BYTE to WORD
DATE_TO_UDINT	Type conversion DATE to UDINT
DINT_TO_INT	Type conversion DINT to INT
DINT_TO_REAL	Type conversion DINT to REAL
DINT_TO_SINT	Type conversion DINT to SINT
DWORD_TO_BYTE	Type conversion DWORD to BYTE
DWORD_TO_WORD	Type conversion DWORD to WORD
INT2BOOL	INT input to BOOL outputs
INT_TO_DINT	Type conversion INT to DINT
INT_TO_REAL	Type conversion INT to REAL
GRAY2INT	GRAY coded BOOL inputs to SINT (Transformer Tap Changer)
NAT2INT	Natural binary coded BOOL inputs to SINT (Transformer Tap Changer)
REAL_TO_DINT	Type conversion REAL to DINT
REAL_TO_INT	Type conversion REAL to INT
REAL_TO_SINT	Type conversion REAL to SINT
REAL_TO_UDINT	Type conversion REAL to UDINT
REAL_TO_UINT	Type conversion REAL to UINT
REAL_TO_USINT	Type conversion REAL to USINT
SINT_TO_DINT	Type conversion SINT to DINT
SINT_TO_INT	Type conversion SINT to INT
SINT_TO_REAL	Type conversion SINT to REAL

Table continued on the next page.

Function	Description
TIME_TO_REAL	Type conversion TIME to REAL
TIME_TO_TOD	Type conversion TIME to TOD
TIME_TO_UDINT	Type conversion TIME to UDINT
TOD_TO_REAL	Type conversion TOD to REAL
TOD_TO_TIME	Type conversion TOD to TIME
TOD_TO_UDINT	Type conversion TOD to UDINT
UDINT_TO_REAL	Type conversion UDINT to REAL
UDINT_TO_UINT	Type conversion UDINT to UINT
UDINT_TO_USINT	Type conversion UDINT to USINT
UINT_TO_BOOL	Type conversion UINT to BOOL
UINT_TO_REAL	Type conversion UINT to REAL
UINT_TO_UDINT	Type conversion UINT to UDINT
UINT_TO_USINT	Type conversion UINT to USINT
USINT_TO_REAL	Type conversion USINT to REAL
USINT_TO_UDINT	Type conversion USINT to UDINT
USINT_TO_UINT	Type conversion USINT to UINT
WORD_TO_BYTE	Type conversion WORD to BYTE
WORD_TO_DWORD	Type conversion WORD to DWORD

2.8.12 Truncation toward zero

Function	Description
TRUNC_REAL_TO_DINT	Truncation toward zero
TRUNC_REAL_TO_INT	Truncation toward zero
TRUNC_REAL_TO_SINT	Truncation toward zero
TRUNC_REAL_TO_UDINT	Truncation toward zero
TRUNC_REAL_TO_UINT	Truncation toward zero
TRUNC_REAL_TO_USINT	Truncation toward zero

3. Inverse-time characteristics

The inverse-time characteristics available in the current and voltage protection function blocks of RE_ 5_ _ are illustrated below. For more information about the inverse-time operation of a specific function block, refer to the corresponding function block manual.

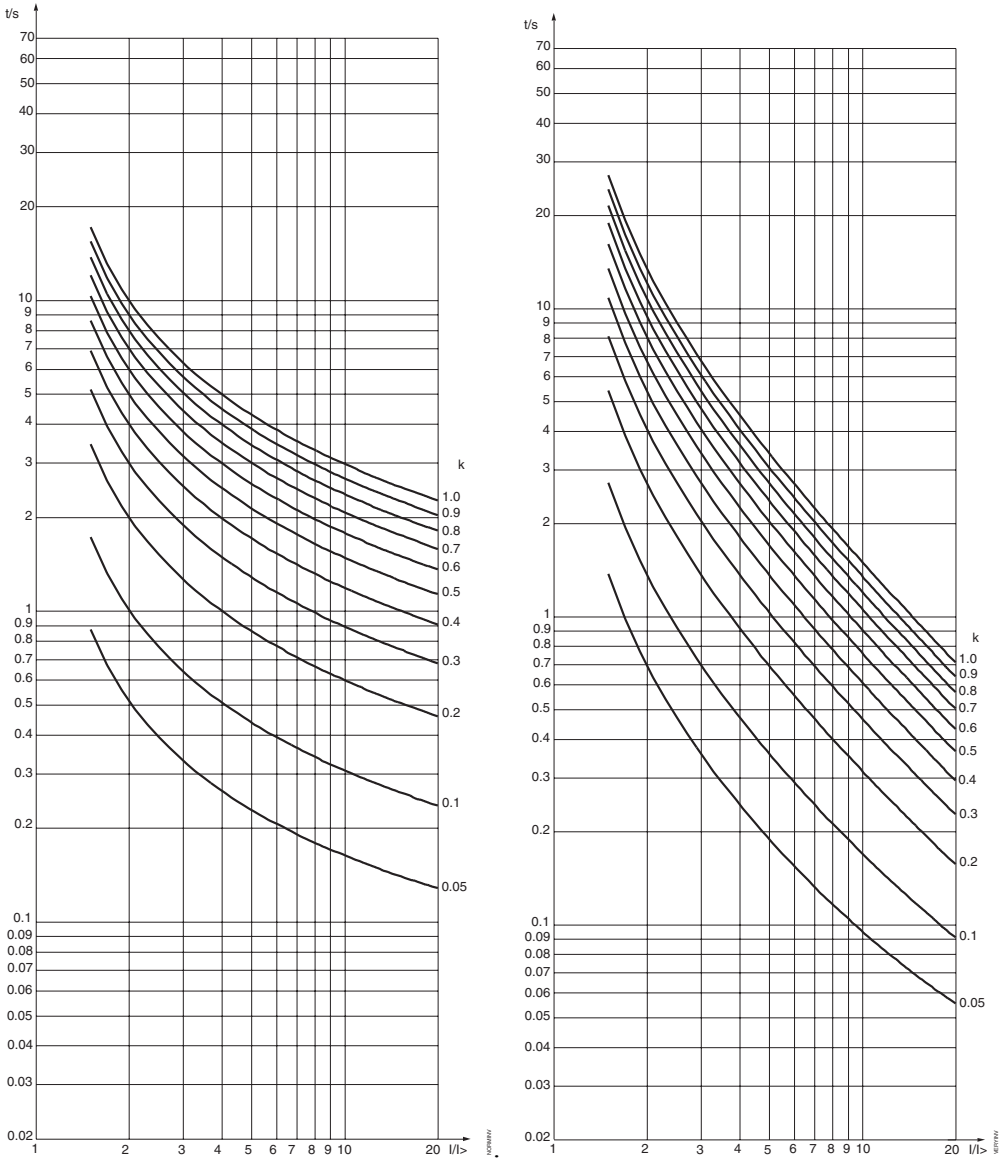

Figure 3-1 IEC inverse-time characteristic curve sets "Normal inverse" (left) and "Very inverse" (right) for current protection

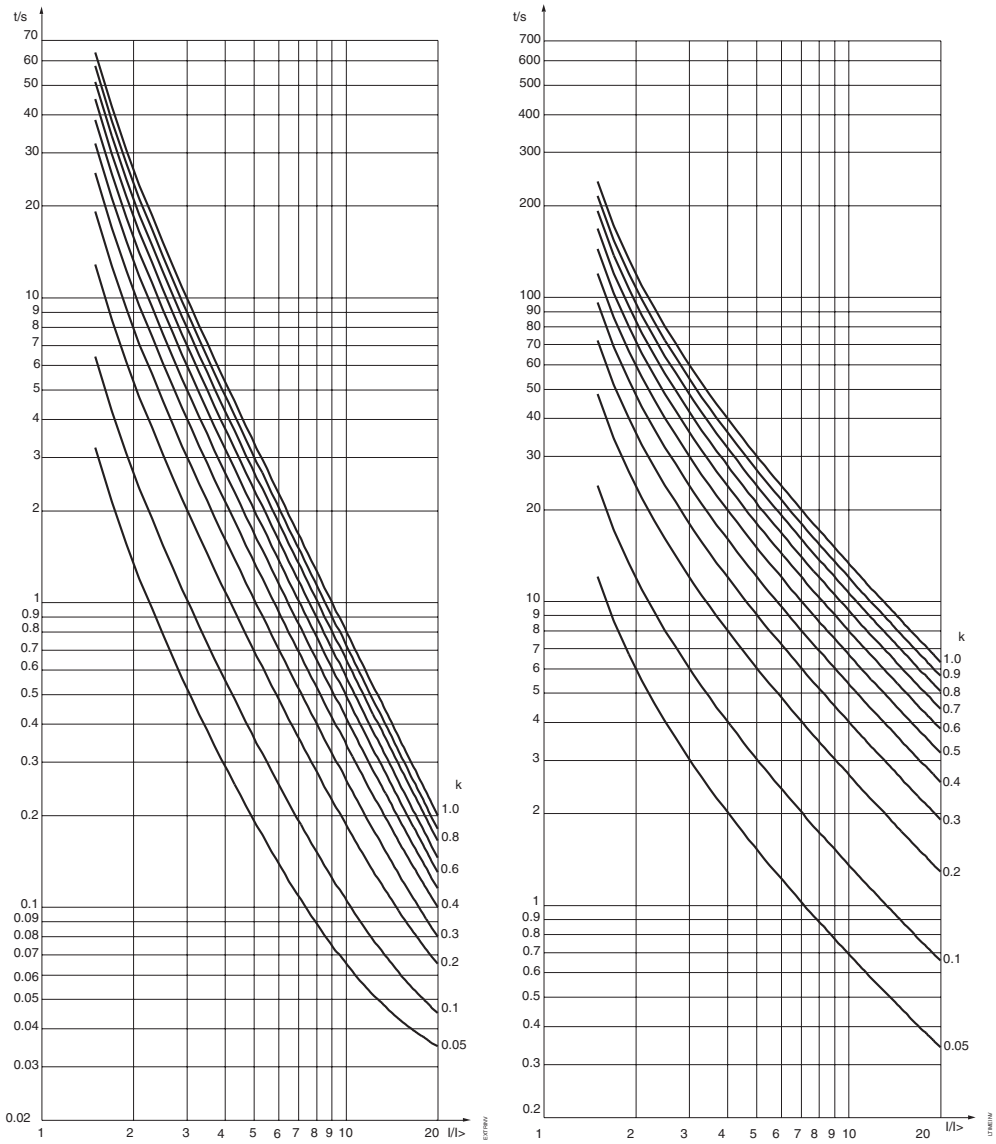

Figure 3-2 IEC inverse-time characteristic curve sets "Extremely inverse" (left) and "Long time inverse" (right) for current protection

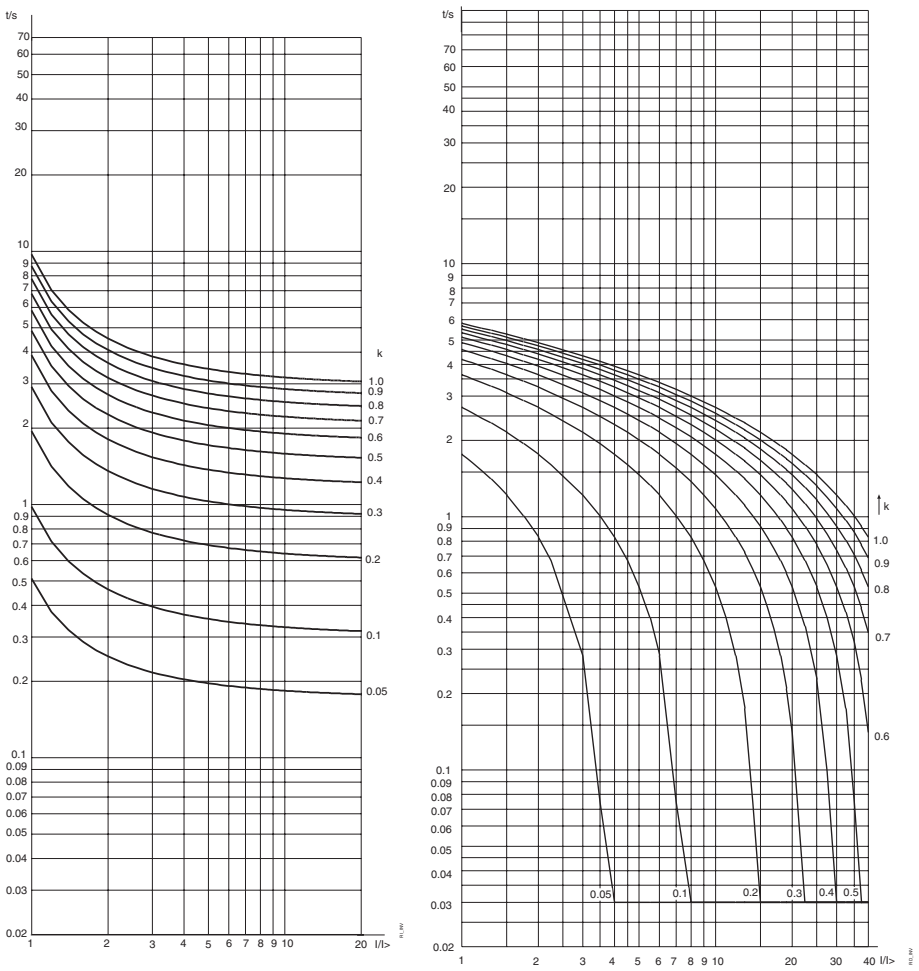

Figure 3-3 Special inverse-time characteristic curve sets "RI-type inverse" (left) and "RD-type inverse" (right) for current protection

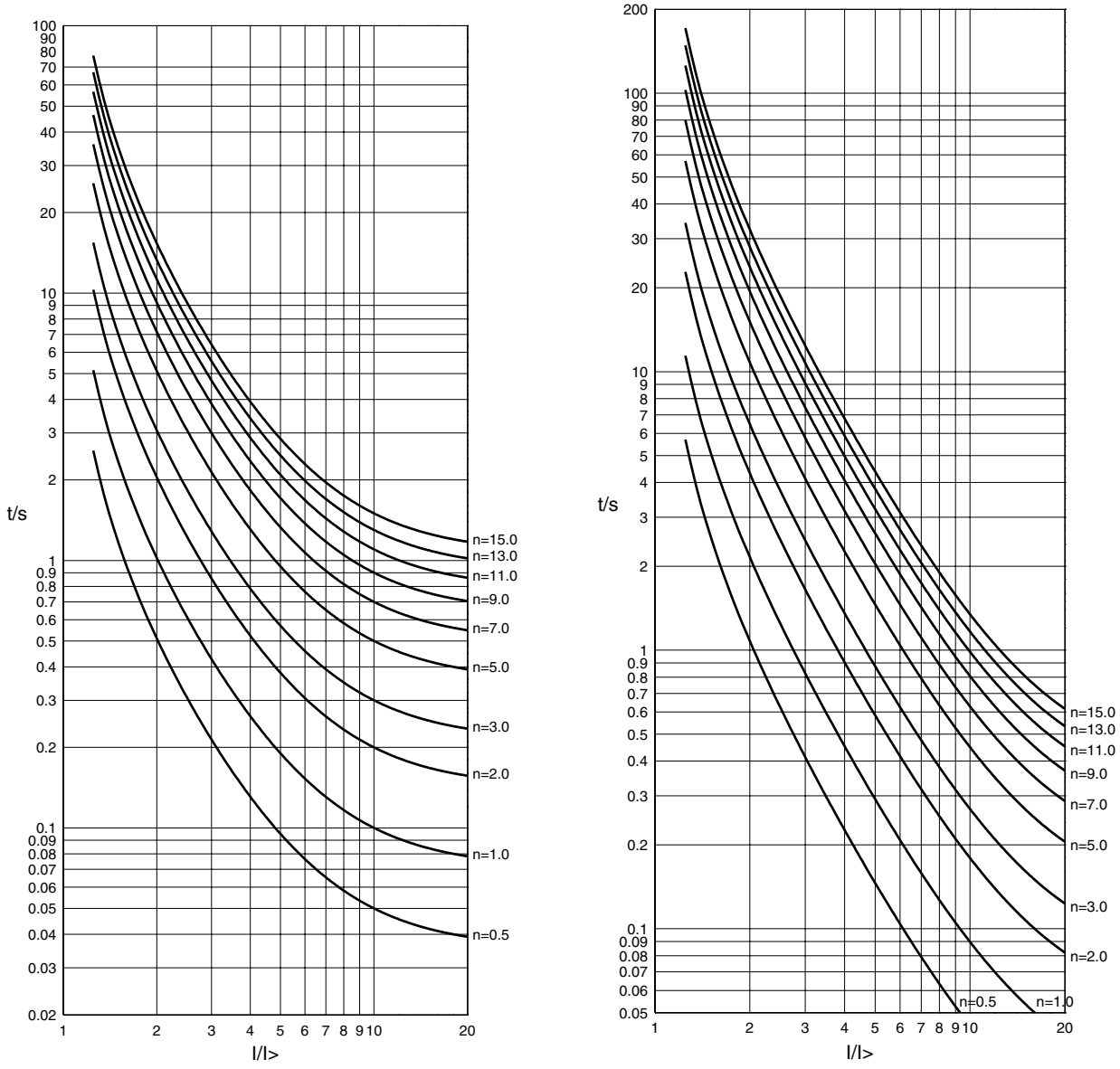

Figure 3-4 ANSI inverse-time characteristic curve sets "Extremely inverse" (left) and "Very inverse" (right) for current protection

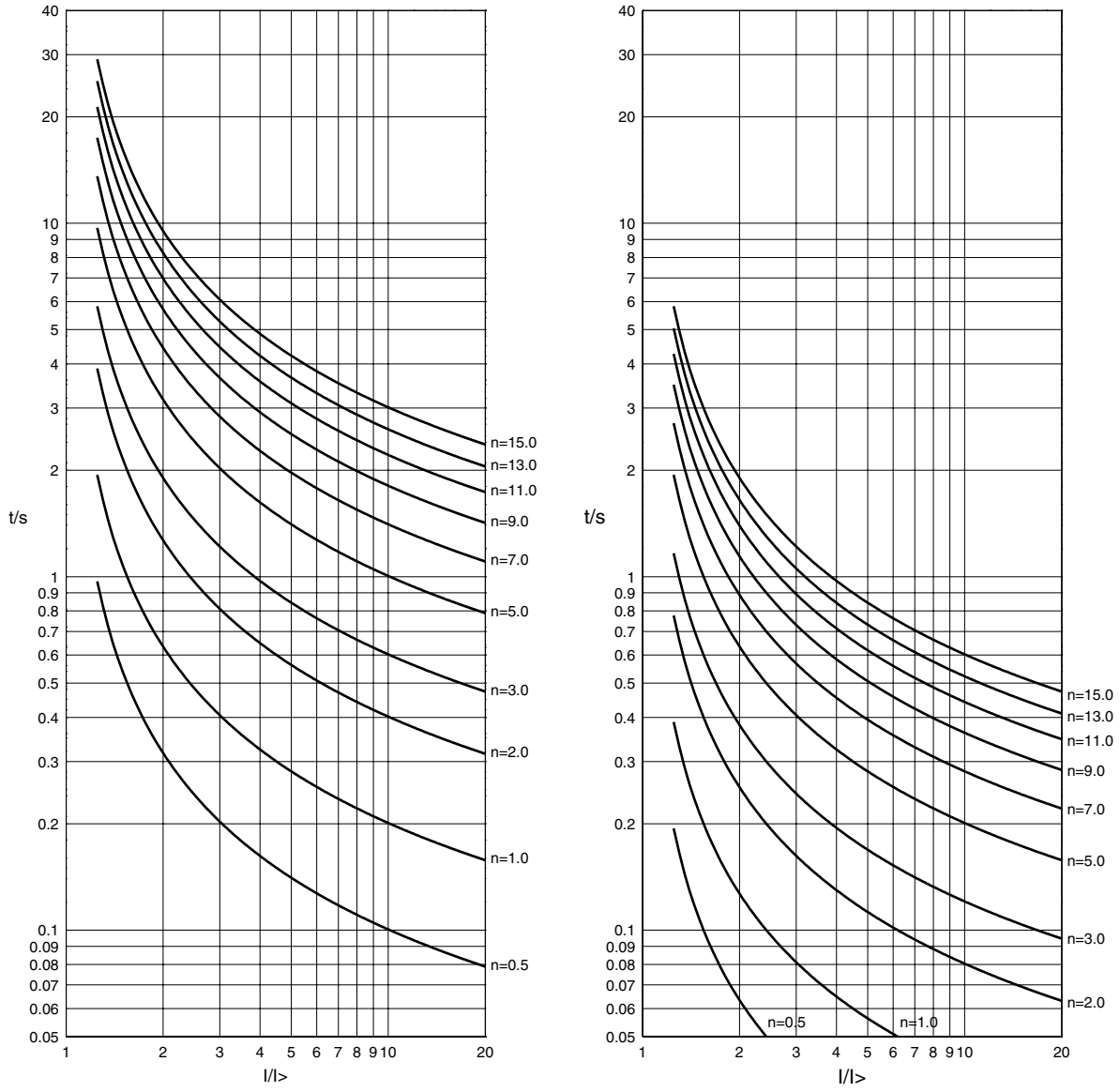

Figure 3-5 ANSI inverse-time characteristic curve sets "Inverse" (left) and "Short time inverse" (right) for current protection

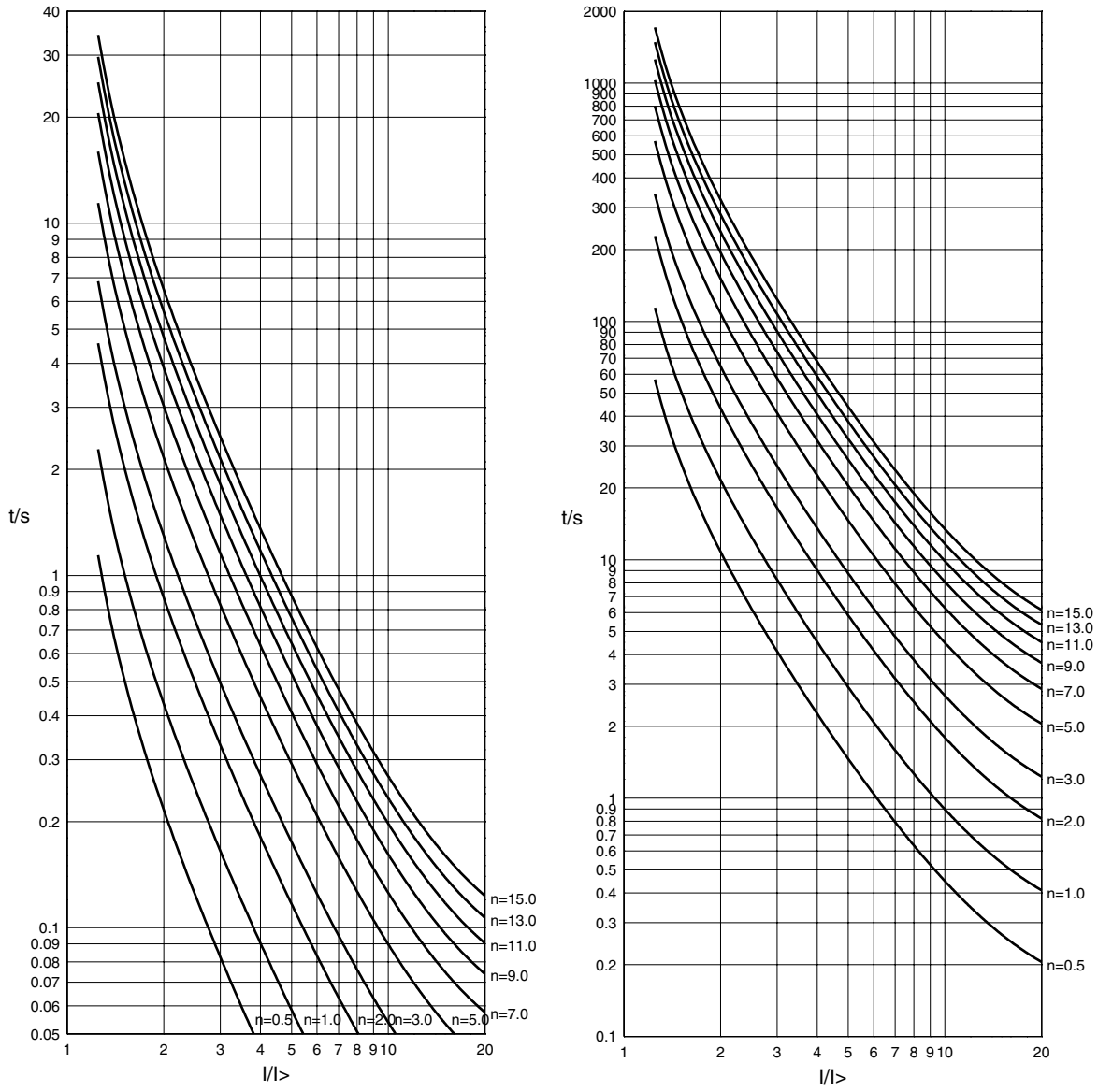

Figure 3-6 ANSI inverse-time characteristic curve sets "Short Time Extremely Inverse" (left) and "Long Time Extremely Inverse" (right) for current protection

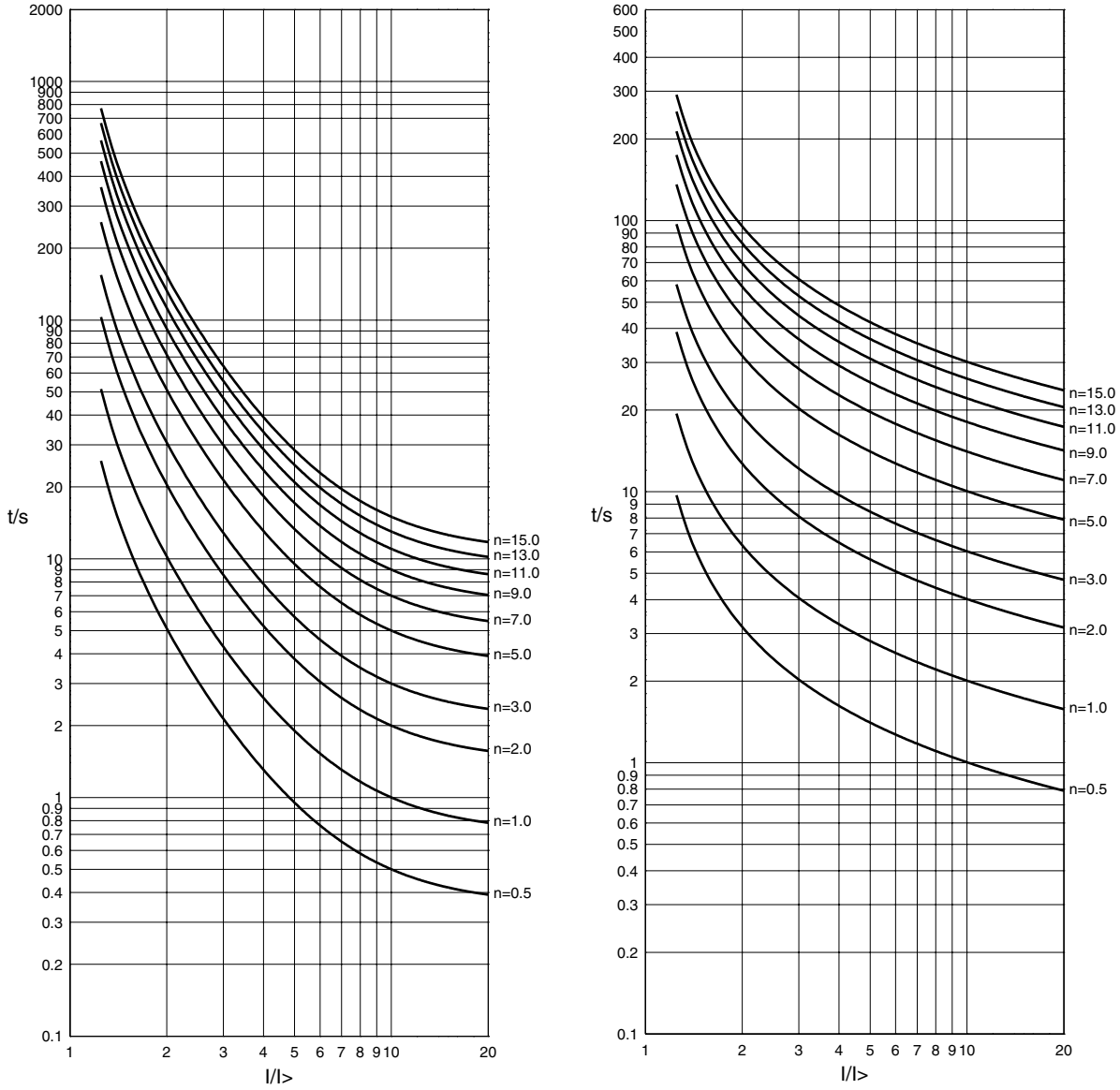

Figure 3-7 ANSI inverse-time characteristic curve sets "Long Time Very Inverse" (left) and "Long Time Inverse" (right) for current protection

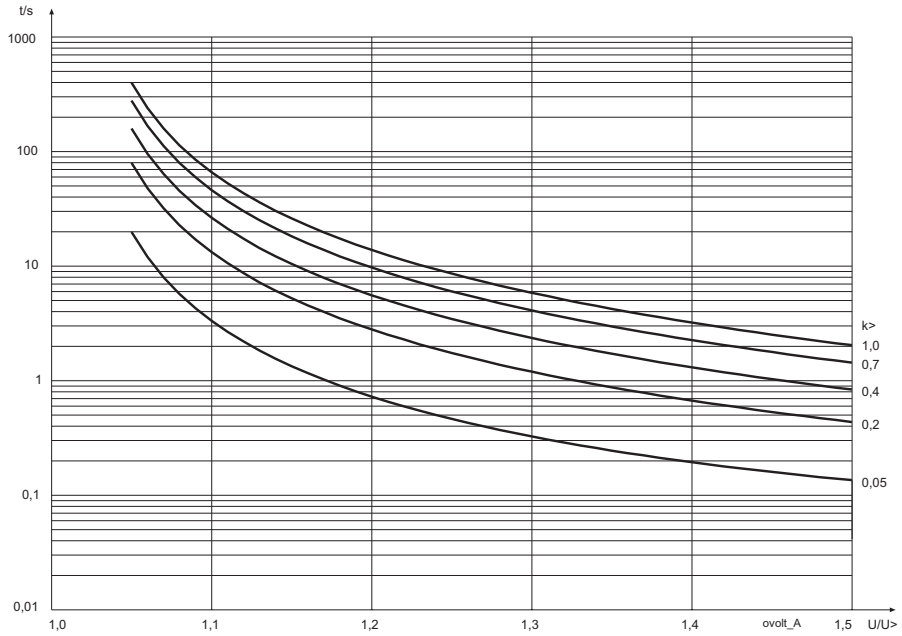

Figure 3-8 Inverse-time characteristic curve set A for overvoltage protection

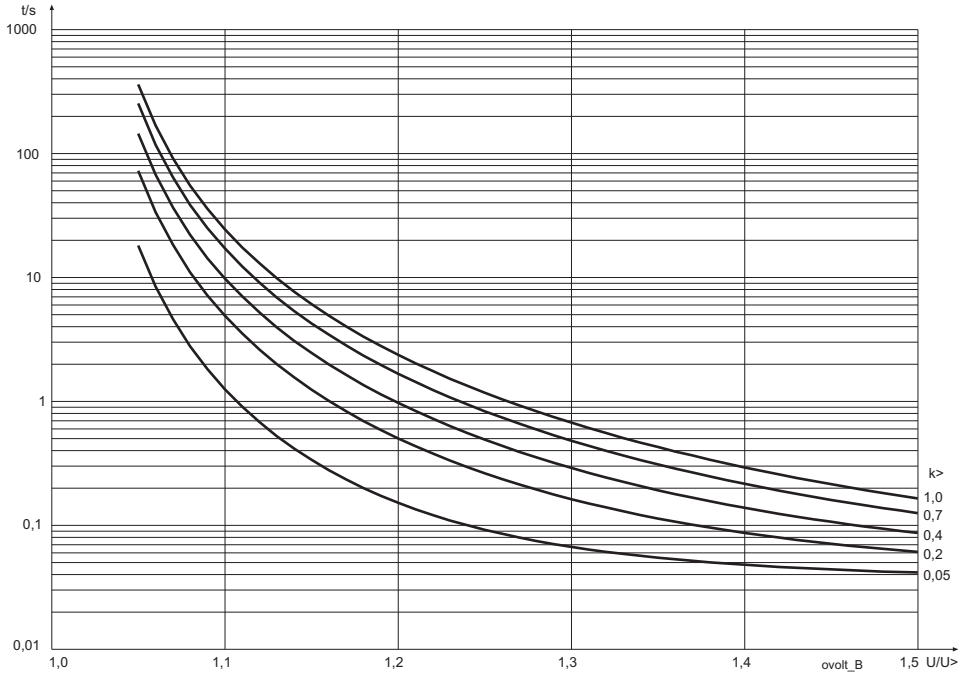

Figure 3-9 Inverse-time characteristic curve set B for overvoltage protection

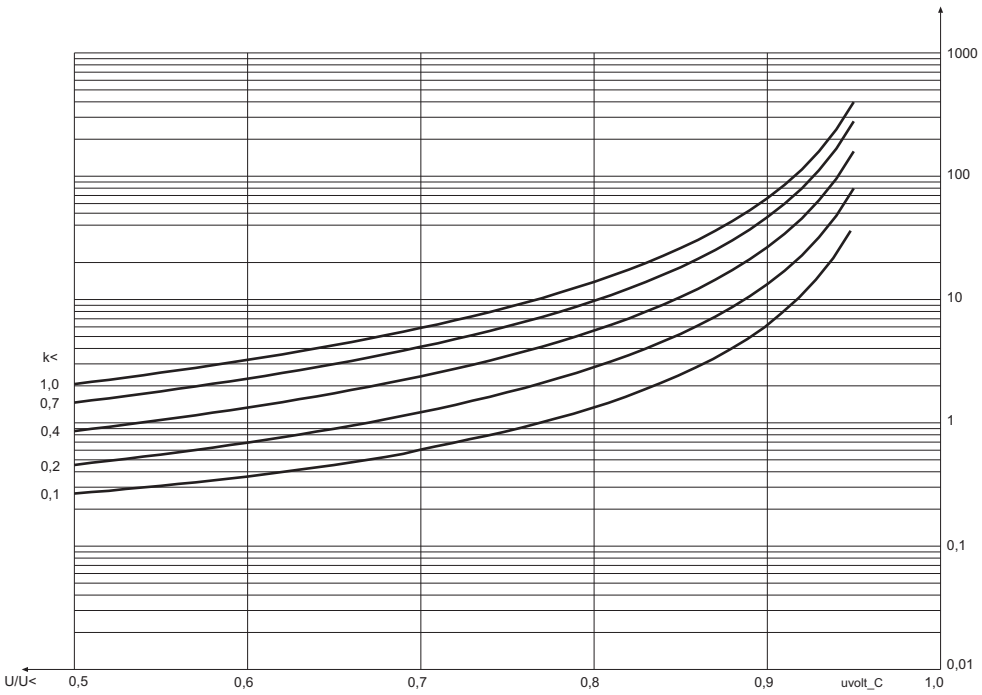

Figure 3-10 Inverse-time characteristic curve set C for undervoltage protection

4. Function block names and categories in alphabetical order

ABS	Standard; numeric
ADD	Standard; arithmetic
AND	Standard; bitwise operation
AR5Func	Protection
BITGET	Standard; bitwise operation
BITSET	Standard; bitwise operation
BCD2INT	Standard; type conversion
BOOL_TO_BYTE	Standard; type conversion
BOOL_TO_DINT	Standard; type conversion
BOOL_TO_DWORD	Standard; type conversion
BOOL_TO_INT	Standard; type conversion
BOOL_TO_REAL	Standard; type conversion
BOOL_TO_SINT	Standard; type conversion
BOOL_TO_UDINT	Standard; type conversion
BOOL_TO_UINT	Standard; type conversion
BOOL_TO_USINT	Standard; type conversion
BOOL_TO_WORD	Standard; type conversion
BOOL2INT	Standard; type conversion
BYTE_TO_DWORD	Standard; type conversion
BYTE_TO_WORD	Standard; type conversion
CMBWEAR1	Condition monitoring
CMBWEAR2	Condition monitoring
CMCU3	Condition monitoring
CMGAS1	Condition monitoring
CMGAS3	Condition monitoring
CMSCHED	Condition monitoring
CMSPRC1	Condition monitoring
CMTCS1	Condition monitoring
CMTCS2	Condition monitoring
CMTIME1	Condition monitoring
CMTIME2	Condition monitoring
CMTRAV1	Condition monitoring
CMVO3	Condition monitoring
CO3DC1	Control

CO3DC2	Control
COCB1	Control
COCB2	Control
COCBDIR	Control
CODC1	Control
CODC2	Control
CODC3	Control
CODC4	Control
CODC5	Control
COIND1	Control
COIND2	Control
COIND3	Control
COIND4	Control
COIND5	Control
COIND6	Control
COIND7	Control
COIND8	Control
COLOCAT	Control
COLTC	Control
COMH	Standard; comparison
COPFC	Control
COSW1	Control
COSW2	Control
COSW3	Control
COSW4	Control
CTD	Standard; counter
CTU	Standard; counter
CTUD	Standard; counter
CUB1Cap	Protection
CUB3Cap	Protection
CUB3Low	Protection
DATE_TO_UDINT	Standard; type conversion
DEF2High	Protection
DEF2Inst	Protection
DEF2Low	Protection
Diff3	Protection
Diff6G	Protection
Diff6T	Protection

DINT_TO_INT	Standard; type conversion
DINT_TO_REAL	Standard; type conversion
DINT_TO_SINT	Standard; type conversion
DIV	Standard; arithmetic
DOC6High	Protection
DOC6Inst	Protection
DOC6Low	Protection
DWORD_TO_BYTE	Standard; type conversion
DWORD_TO_WORD	Standard; type conversion
EQ	Standard; comparison
F_TRIG	Standard; edge detection
FLOC	Protection
Freq1St_	Protection
FuseFail	Protection
GE	Standard; comparison
GRAY2INT	Standard; type conversion
GT	Standard; comparison
INDRESET	General
Inrush3	Protection
INT_TO_DINT	Standard; type conversion
INT_TO_REAL	Standard; type conversion
INT2BOOL	Standard; type conversion
LE	Standard; comparison
LIMIT	Standard; selection
LT	Standard; comparison
MAX	Standard; selection
MEAI1…8	Measurement
MEAO1…4	Measurement
MECU1A	Measurement
MECU1B	Measurement
MECU3A	Measurement
MECU3B	Measurement
MEDREC16	Measurement
MEFR1	Measurement
MEPE7	Measurement
MEVO1A	Measurement
MEVO1B	Measurement
MEVO3A	Measurement

MEVO3B	Measurement
MIN	Standard; selection
MMIALAR1	Control
MMIALAR2	Control
MMIALAR3	Control
MMIALAR4	Control
MMIALAR5	Control
MMIALAR6	Control
MMIALAR7	Control
MMIALAR8	Control
MMIDATA1	Control
MMIDATA2	Control
MMIDATA3	Control
MMIDATA4	Control
MMIDATA5	Control
MMIWAKE	General
MotStart	Protection
MOVE	Standard; arithmetic
MUL	Standard; arithmetic
MUX	Standard; selection
NAT2INT	Standard; type conversion
NE	Standard; comparison
NEF1High	Protection
NEF1Inst	Protection
NEF1Low	Protection
NOC3High	Protection
NOC3Inst	Protection
NOC3Low	Protection
NOT	Standard; bitwise operation
NPS3High	Protection
NPS3Low	Protection
NUC3St1	Protection
NUC3St2	Protection
OE1Low	Protection
OE1High	Protection
OL3Cap	Protection
OPOW6St1	Protection
OPOW6St2	Protection

OPOW6St3	Protection
OR	Standard; bitwise operation
OV3High	Protection
OV3Low	Protection
PQCU3H	Power quality
PQVO3H	Power quality
PQVO3Sd	Power quality
PREV3	Protection
PSV3St1	Protection
PSV3St2	Protection
R_TRIG	Standard; edge detection
REAL_TO_DINT	Standard; type conversion
REAL_TO_INT	Standard; type conversion
REAL_TO_SINT	Standard; type conversion
REAL_TO_UDINT	Standard; type conversion
REAL_TO_UINT	Standard; type conversion
REAL_TO_USINT	Standard; type conversion
REF1A	Protection
REF4A	Protection
REF4B	Protection
ROV1High	Protection
ROV1Inst	Protection
ROV1Low	Protection
RS	Standard; bistable
RS_D	Standard; bistable
SCVCSt1	Protection
SCVCSt2	Protection
SEL	Standard; selection
SINT_TO_DINT	Standard; type conversion
SINT_TO_INT	Standard; type conversion
SINT_TO_REAL	Standard; type conversion
SR	Standard; bistable
SUB	Standard; arithmetic
SWGRP1…20	General
TIME_TO_REAL	Standard; type conversion
TIME_TO_TOD	Standard; type conversion
TIME_TO_UDINT	Standard; type conversion
TOD_TO_REAL	Standard; type conversion

TOD_TO_TIME	Standard; type conversion
TOD_TO_UDINT	Standard; type conversion
TOF	Standard; timer
TOL3Cab	Protection
TOL3Dev	Protection
TON	Standard; timer
TP	Standard; timer
TRUNC_REAL_TO_DINT	Standard; type conversion
TRUNC_REAL_TO_INT	Standard; type conversion
TRUNC_REAL_TO_SINT	Standard; type conversion
TRUNC_REAL_TO_UDINT	Standard; type conversion
TRUNC_REAL_TO_UINT	Standard; type conversion
TRUNC_REAL_TO_USINT	Standard; type conversion
UDINT_TO_REAL	Standard; type conversion
UDINT_TO_UINT	Standard; type conversion
UDINT_TO_USINT	Standard; type conversion
UE6High	Protection
UE6Low	Protection
UI6Low	Protection
UI6High	Protection
UINT_TO_BOOL	Standard; type conversion
UINT_TO_REAL	Standard; type conversion
UINT_TO_UDINT	Standard; type conversion
UINT_TO_USINT	Standard; type conversion
UPOW6St1	Protection
UPOW6St2	Protection
UPOW6St3	Protection
USINT_TO_REAL	Standard; type conversion
USINT_TO_UDINT	Standard; type conversion
USINT_TO_UINT	Standard; type conversion
UV3High	Protection
UV3Low	Protection
VOC6High	Protection
VOC6Low	Protection
WORD_TO_BYTE	Standard; type conversion
WORD_TO_DWORD	Standard; type conversion
XOR	Standard; bitwise operation